MRCET

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(AUTONOMOUSINSTITUTION –UGC,GOVT.OFINDIA)

Department of CSE

(EmergingTechnologies)

(CYBER SECURITY)

B.TECH(R-20Regulation)

(IV YEAR – I SEM)

(2023-24)

CYBER FORENSICS

(R20A06210)

MALLAREDDYCOLLEGEOFENGINEERING&TECHNOLOGY

(AutonomousInstitution–UGC,Govt.ofIndia)

Recognizedunder2(f)and12(B)ofUGCACT1956

(AffiliatedtoJNTUH,Hyderabad,ApprovedbyAICTE-AccreditedbyNBA&NAAC–'A'Grade-ISO9001:2015Certified)

Maisammaguda,Dhulapally(PostVia.Hakimpet),Secunderabad–500100,TelanganaState,India

DepartmentofComputerScienceandEngineering

EMERGINGTECHNOLOGIES

CYBER FORENSICS

(R20A06210)

LECTURENOTES

Preparedby

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On

04.08.2023

DepartmentofComputerScienceandEngineering

EMERGINGTECHNOLOGIES

Vision

- "To be at the forefront of Emerging Technologies and to evolve as a Centre of Excellence in Research, Learning and Consultancy to foster the students into globally competent professionals useful to the Society."

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IV Year B.Tech. CSE (CYS)- I Sem **L/T/P/C 3/-/-/3**

PROFESSIONAL ELECTIVE – V

(R20A06210) DIGITAL FORENSICS

OBJECTIVES:

1. Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
2. Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
3. Understand how to manage Evidence & Presentation
4. Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics.
5. To gain knowledge on Mobile Forensics.

UNIT - I

Digital Forensics Science: Forensics science, computer forensics, and digital forensics. Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics.

UNIT - II

Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT - III

Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, define and apply probable cause.

UNIT - IV

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case. Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data

UNIT - V

Mobile Forensics: mobile forensics techniques, mobile forensics tools. Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008. Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

TEXT BOOKS:

1. B. Nelson, A. Phillips, and C. Steuart, Guide to Computer Forensics and Investigations, 4th Edition, Course Technology, 2010

REFERENCE BOOKS:

1. John Sammons, The Basics of Digital Forensics, 2nd Edition, Elsevier, 2014
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, Laxmi Publications, 2005.

COURSE OUTCOMES:

1. Understand relevant legislation and codes of ethics.
2. Investigate computer forensics and digital detective and various processes, policies and procedures data acquisition and validation, e-discovery tools.
3. Analyze E-discovery, guidelines and standards, E-evidence, tools and environment.
4. Apply the underlying principles of Email, web and network forensics to handle real life problems
5. Use IT Acts and apply mobile forensics techniques.

INDEX

UNIT-1

DIGITALFORENSICSSCIENCE

FORENSICSCIENCE:

Definition

Forensic science involves the application ofthenatural,physical,andsocialsciencestomatters oflaw. Forensic science refers to the applicationofnatural,physical,andsocialsciencestomattersof thelaw.Mostforensicscientistsholdthatinvestigationbeginsatthescene,regardlessoftheirassociatedfield. The proper investigation, collection, and preservation of evidence are essential forfact-finding andforensuringproperevaluationandinterpretationoftheevidence,whethertheevidenceisbloodstains, human remains, hard drives, ledgers, and files or medical records. Sceneinvestigations are concerned with the documentation, preservation, and evaluation of a location inwhich a criminal actmayhaveoccurredandanyassociatedevidencewithinthelocationforthepurposeof reconstructingeventsusingthescientificmethod.Theproperdocumentationofasceneandthe subsequentcollection,packaging,andstorageofevidenceareparamount.Evidencemustbecollectedinsuch amannertomaintainitsintegrityandpreventloss,contamination,or deleteriouschange.Maintenanceofthechainofcustodyoftheevidencefromthescenetothe laboratoryorastoragefacilityiscritical.Achainofcustodyreferstotheprocesswhereby investigators preserveevidence throughout the life of a case.

It includes information about: who collected the evidence, themannerinwhichtheevidencewascollected,andallindividualswhotookpossessionoftheevidence after itscollection and thedateand timewhich suchpossession took place. Significantattentionhasbeenbroughttothejointscientificandinvestigativenatureofsceneinvestigations.P ropercrimesceneinvestigationrequiresmorethanexperience;itmandatesanalyticalandcreativethinking as well as the correct application of science and the scientificmethod.Thereisagrowingmovementtowardashiftfromsolelyexperiential basedinvestigation stoinvestigationsthatincludescientificmethodologyandthinking.Onecriticoftheexpe riencebased approach lists the following pitfalls of limiting scene investigations to lay individuals and lawenforcement personnel: lack of scientific supervision and oversight, lack of understanding of thescientifictoolsemployedandtechnologiesbeingusedatthescene,andanoverallllackofunderstanding of theapplicationofthescientificmethodtodevelophypothesessupportedbytheevidence(Schaler 2012).Anothercriticismisthatsomeinvestigators(aswellasattorneys)willdrawconclusionsand

then obtain (or present) evidence to support their version of events DepartmentofEmergingTechnologies CyberForensics 2 whileignoringothertypesofevidencethatdonotsupporttheirversionorseemtocontradicttheirversion (i.e.,confirmationbias).Manyadvocatesofthescientificbasedapproachbelievethathavingscientistsatth escenewillminimizebiasandallowformoreobjectiveinter pretationsandreconstructionsoftheevents under investigation.

HISTORYOFFORENSIC

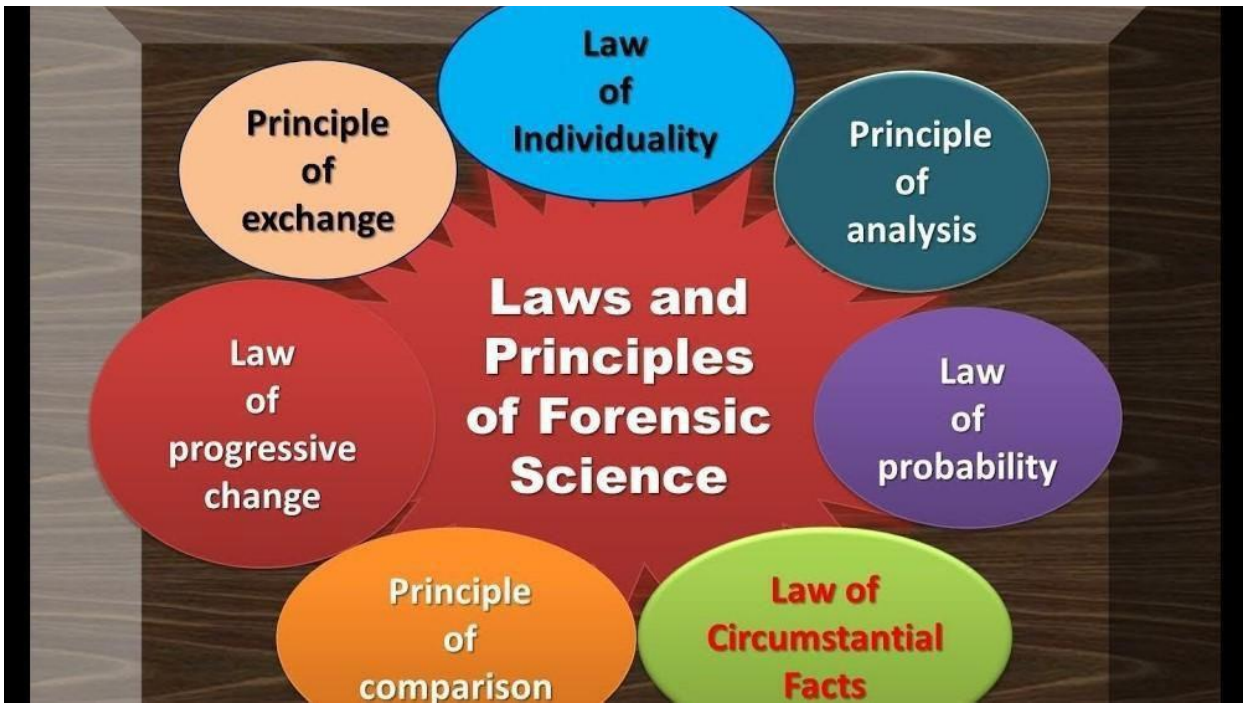
Date	Event
44BC	**Deathofanemperor** JuliusCaesarisassassinated.Followingthisevent,aphysicianperformedanautopsy,and determined that of the23 wounds found on thebody, onlyonewas fatal.
400	**Whodeterminescauseofdeath(400s)** GermanicandSlavicsocietiesmadelawthatmedicalexpertsmustbetheonestodeterminecause of deathin crimes.
600	**Useoffingerprintsforthefirsttime(600s)** Fingerprintsfirstusedtodetermineidentity.Arabicmerchantswouldtakea debtor'sfingerprintand attach it to thebill.
1248	**Firstforensicsciencebook** FirstforensicsciencemanualpublishedbytheChinese.Thiswasthefirstknown recordofmedical knowledgebeingusedto solve criminalcases.
1600	**Reportingcases(1600s)** Firstpathologyreports published.
1784	**Physicalevidenceusedincriminalcase** Firstrecordedinstanceofphysicalmatchingofevidenceleadingtoamurderconviction(John Toms, England). Evidence was a torn edge of newspaper in a pistol that matchednewspaperin his pocket.
1806	**Investigatingpoisoning** GermanchemistValentin Rossdeveloped amethod ofdetectingarsenicinavictim'sstomach,thusadvancingtheinvestigation ofpoisondeaths.
1816	**Morephysicalevidencediscoveredtoworkinforensics** Clothingandshoes ofa farmlaborer wereexamined andfound tomatchevidenceofanearbymurderscene,whereayoungwomanwasfounddrownedina shallowpool.
1836	**Chemicaltestingutilized**

	JamesMarsh,anEnglishchemist,useschemicalprocessestodeterminearsenicasthe causeof death in amurder trial.
1854	**Firstusesofphotosinidentification(1854-59)** SanFranciscousesphotographyforcriminalidentification,thefirstcityintheUSto doso.
1880	**Fingerprintsfoundtobeunique** HenryFauldsandWilliamJamesHerschelpublish apaperdescribingthe uniquenessoffingerprints.FrancisGalton,ascientist,adaptedtheirfindingsfor the court. Galton'ssystem identified the following patterns: plain arch, tented arch, simple loop, centralpocketloop, double loop,lateral pocket loop, plainwhorl,andaccidental.
1887	**SherlockHolmesandthecoroner** Coroner'sactestablishedthatcoroners'weretodeterminethecausesofsudden, violent,andunnaturaldeaths.ArthurConanDoylealso publishesthefirstSherlockHolmesstory.
1892	**FingerprintIDusedincrime** JuanVucetich,anArgentineanpoliceofficer,is thefirsttousefingerprints asevidenceinamurderinvestigation.Hecreatedasystemof fingerprintidentification,whichhetermeddactyloscopy.
1888	**Criminalfeaturesreducedtonumericalmeasurements** Anthropometry,asystemusingvariousmeasurementsofphysicalfeaturesand bones,used throughout the US and Europe. Using the system, a criminal's information could bereducedtoaset ofnumbers.
1901	**Investigationsintobloodmarkers** Humanbloodgrouping, ABO,discoveredbyKarlLandsteinerandadaptedforuseonbloodstains byDieterMaxRichter.
1901	**FingerprintIDmorecommon** Galton-Henrysystemoffingerprintidentificationofficiallyusedby ScotlandYard, and isthemost widelyused fingerprintingmethod to date.
1903	**FirstfingerprintprisonerIDused** NYstateprisonsystemimplementedfingerprintidentification.
1909	**Learningaboutforensics** FirstschoolofforensicsciencefoundedbyRodolpheArchibaldReiss,inSwitzerland.

1910	**Hairnowusedinforensics** Victor Balthazard and Marcelle Lambert publish first study on hair, includingmicroscopicstudiesfrommostanimals.Firstlegalcaseeverinvolvinghair alsotookplacefollowingthis study.
1912	**Gunsareunique** Victor Balthazard realizes that tools used to make gun barrels never leave the samemarkings, and individual gun barrels leave identifying grooves on each bullet firedthroughit.Hedevelopedseveralmethodsofmatchingbulletstogunsviaphotography.
1923	**Crimelabsbuilt** FirstpolicecrimelabestablishedinLosAngeles.
1930	**Liedetection** Prototypepolygraph,whichwasinventedbyJohnLarsonin1921,developedforuseinpolicestations.
1932	**Crimeexpertsbuildlab** FBIestablishesitsowncrimelaboratory,nowoneoftheforemostcrimelabsin theworld.Thissameyear,achair oflegalmedicineatHarvardwasestablished.
1960	**Voicerecording,usedasevidence(1960s)** Asoundspectrographdiscoveredtobeabletorecordvoices.Voiceprintsbegantobeusedin investigations and as court evidence from recordings of phones, answeringmachines,ortaperecorders.
1967	**Firstnationalcrimesystem** FBIestablishedtheNationalCrime InformationCenter,a computerizednationalfilingsystemonwantedpeople,stolenvehicles,weapons,etc.
1974	**Advancesin residuedetection** TechnologydevelopedatAerospaceCorporationintheUStodetectgunshot residue,whichcanlinkasuspecttoacrimescene,andcan showhowclosethatsuspectwastothegun.
1975	**Advancedmanualfingerprints** FirstfingerprintreaderinstalledattheFBI
1979	**Autofingerprintsystemfirstused** RoyalCanadianMountedPoliceimplementfirstautomaticfingerprintidentification

	system.
1984	**DNAtechniqueforuniqueID** DNAfingerprintingtechniquesdevelopedbySirAlecJeffreys.
1983	**AdvancesinDNAleadtoconviction(1983-86)** DNA fingerprinting led to conviction of Colin Pitchfork in the murder of two teenagegirls. This evidence cleared the main suspect in the case, who likely would have beenconvictedwithout it.
1987	**DNAcatchesthecriminal** TommyLeeAndrewsconvictedofaseriesofsexualassaults, usingDNAprofiling.
1996	**DNAevidencecertified** NationalAcademyofSciencesannouncesDNAevidenceisreliable.
1999	**FasterfingerprintIDs** FBIestablishestheintegratedautomatedfingerprintidentificationsystem,cuttingdownfingerprintinquiryresponse from two weeks to two hours.
2001	**FasterDNAIDs** TechnologyspeedsupDNAprofilingtime,from6-8weekstobetween1-2days.
2007	**Footweardetectionsystem** Britain'sForensicScienceServicedevelopsonlinefootwearcodinganddetectionsystem.Thishelps policeto identifyfootwear marks quickly.
2008	**Detectionaftercleaning** Awayforscientiststovisualizefingerprintsevenaftertheprinthasbeenremoved isdeveloped,relatingto how fingerprints cancorrodemetal surfaces.
2011	**Facialsketchesmatchedtophotos** Michiganstateuniversitydevelopssoftwarethatautomaticallymatcheshand-drawnfacialsketches to mugshots stored in databases.
2011	**4seconddentalmatch** Japanese researchers develop a dental x-ray matching system. This system canautomaticallymatchdentalx-raysinadatabase,andmakesapositivematchinless than4seconds.

LAWSANDPRINCIPLESOFFORENSIC SCIENCE



Lawsand PrinciplesofForensicScience

Forensic Science is the scientific discipline which is engaged to the recognition, identification,individualization and evaluation of physical evidence by using the laws and principles of naturalscience forthepurposeof administrationto terminate doubtfulquestions in thecourt oflaw.

The term "forensics" taken from latin word "forensic" which mean 'the forum'. Forensic scientistalso play an active role in civil proceedings (such as violate of agreement and negligence) and inregulatoryissues.Theprinciplesof forensicsciencehave astraight impactoncriminalproceedings.

LawsandPrinciplesofForensicScience-

LawofIndividuality

LawofProgressive

changePrincipleof

Comparison

PrincipleofAnalysis

PrincipleofExchange(Locard'sprincipleof Exchange)LawofProbability

LawofCircumstantialfacts.

1) ***Law ofIndividuality***-

Thislawstatesthat,"Everyobjectwhethernaturalorman-madehasadistinctivequalityorcharacteristicinit which is not duplicated in any other object," in other words, no two things in thisuniversearealike.Mostcommonexampleisthehumanfingerprints;theyareunique,permanentandprov eindividualityof aperson. Even the twins did not havethesame fingerprints.

Consider grains of sand, salt, seeds or man-made objects such as currency notes, laptop, typewriter,etc.theymaylook similar but aunique characteristicis always present between them.

Thisprinciple consideredasthe mostbasicelementary unitof Forensic Science.Fingerprints,footprints, tool marks, obtained from the crime scene are studied and analyzed on the principle ofindividuality.

2) Law ofProgressiveChange

This principle emphasizes that, "Everything changes with the passage of time and nothing remainsconstant."Thechangingfrequencyvariesfromsampletosampleand ondifferent objects.

The crime scene must be secured in time otherwise a change in weather (rain, heat, wind), presenceof animals/humans, etc. affects the crime scene. For example, a road accident on a busy highwaymayloseall essential evidenceif not properlysecured on time.

A bullet fragments may grow rust, firearm barrels loosen, shoes suffer wear and tear marks, woodenobjectsmaysufferduetopresenceoftermite, etc. Longer thedelay,greater thechanges.

When samples are not much durable, several complications occur in an investigation as the processof identification is affected due to the variations in the main features of identification. Without anappropriatepreservative,tissuesamplesstartdegradingimmediately& theyneedimmediate

analysis.

Thecriminalsundergoprogressivechangeswithtime.Ifheisnotapprehendedintimehebecomesunrecognizableexcept hisfingerprints or other characteristics of permanentnature.

3) Locard'sprincipleofExchange(Lawofexchange)

ThisprinciplewasstatedbyFrenchscientist-EdmondLocard(apioneerincriminologyandforensicscience). Law of exchange states that, "As soon as two things come in connection with eachother,theymutuallyinterchangethe tracesbetween them."

Whenevercriminalorhisweapon/instrumentmadeconnectionwiththevictimorthethingssurroundinghim he left some traces at crime scene and also picked up the traces from the area orperson he hasbeen in contacted with (mutual exchange of matter). These traces are very helpful forinvestigationpurposes as these traces are identified by the expert and linked to its original sourceresulted in thedecisivelinkageofthecriminalwiththecrimesceneandthevictim.Thislawformsthebasisof scientificcrime investigation.

Thisprincipleisvalidatedinallcaseswherethereisacontactsuchasfingerprints,tyremarks,bullet residues, footmarks,hairsample,skin,muscles,bodilyfluids,blood,piecesofclothingetc.DNAanalysisisa straight application of this principle, where any such items are under analysiswhichwas believed to beheld bythe perpetrator.

Basicrequirementofthislawisthecorrectlocationofthephysicalevidence-

i) What are the areas and things with which the perpetrator or tool actually came in contact duringthecrime?

ii) Investigating officer should establish the correct points of contact, its lead the investigation incorrectdirection.

4) ***PrincipleofComparison***–ForlaboratoryInvestigationthislawisveryimportant.Thelaw statethat "Only the likes can be compared". It highlights the requirement of providing like samples andspecimensfor evaluationwiththequestioned items'.

Forexample,ifthemurderisdonebyafirearmweaponthenitisuselesstosendaknifeforcomparison.

So,theimportantconditionofthisprincipleistosupplyspecimen/samplesoflikenatureforproperassessmen twith the questioned samplediscoveredfrom the crimescene.

5) ***PrincipleofAnalysis***

This principle states that, "The quality of any analysis would be better by collection ofcorrectsample and its correct preservation in the prescribed manner". This leads to better result and avoidtampering,contamination and destruction ofasample.

If you collect a hard disk in a paper bag, it can be damaged when it falls within the range of a strongelectromagnetic field resulted in poor results. Hence, always appropriate and effective collection andpackagingtechniques must beused.

6) ***Law ofProbability***

This law states that, "All identifications (definite or indefinite), made consciously or unconsciouslyonthe basis of probability."

The perpetrator blood group is also the blood group of various people is high, but the probability ofthesame occurringin thecaseis low.

A woman with a tattoo bear on its right hand and an old injury mark on head is reported missing, anunknown woman is found murdered with these characteristics then the probability for cops that theunknown corpse is of that missing woman is high. The probability that the dead body is of anotherwomanwill be1 in millions.

7) ***LawofCircumstantialfacts***

According to this law, “Facts cannot be wrong, they cannot lie not wholly absent but men can anddo.” This law emphasizes the significance of circumstantial facts and supports that a statement givenby a human may or may not be accurate. In an investigation identified and discovered facts are moreaccurateandreliable than anyeyewitness.

Conclusion

Forensicscienceby theseprinciplesisusedforrecognition,identification;individualizationofpieces of evidence collectedfromthesceneofcrime andguidesthecriminalproceedingsfromthediscoveryof a crimeto theconviction of theaccused, helpingthe process of investigation.

COMPUTERFORENSIC

WHATISCOMPUTERFORENSICS?

Computerforensicsistheprocessofmethodicallyexaminingcomputermedia(hard¬disks,diskettes,tapes, etc.) for evidence. In other words, computer forensics is the collection, preservation,analysis, andpresentationofcomputer-relatedevidence.Computerforensicsalsoreferredtoascomputerforensicanalysis,electronicdiscovery,¬electronicevidencediscovery,digitaldiscovery,data recovery, data discovery, computer analysis, and computer examination.Computer evidencecanbeuseful incriminalcases, civildisputes, andhumanresources/¬employmentproceedings.

USEOFCOMPUTERFORENSICSINLAW

ENFORCEMENTComputerforensicsassistsinLawEnforcement.

Recoveringdeletedfilessuchasdocuments,graphics,andphotos.

Searchingunallocatedspaceontheharddrive,places whereanabundanceofdataoftenresides.

Tracing artifacts, those tidbits of data left behind by the operating system. Our expert know how tofind these artifacts and, more importantly, they know how to evaluate the value of the informationtheyfind.

Processing hidden files— files that are not visible or accessible to the user that contain past usageinformation. Often, this process requires reconstructing and analyzing the date codes for each fileanddeterminingwheneachfilewascreated,lastmodified,last accessedandwhendeleted.

Runningastring-searchfore-mail,whennoe-mailclientis obvious.

COMPUTERFORENSICSASSISTANCETOHUMANRESOURCES/EMPLOYMENTPROCEEDINGS

Computers can contain evidence in many types of human resources proceedings, including sexualharassment suits, allegations of discrimination, and wrongful termination claims. Evidence can befoundinelectronicmailsystems,on networkservers,and onindividualemployee's computers.

EMPLOYERSAFEGUARDPROGRAM

Employersmustsafeguardcriticalbusinessinformation.Anunfortunateconcerntodayisthepossibilitythat data could be damaged, destroyed, or misappropriated by a discontented individual.Before an individual is informed of their termination, a computer forensic specialist should comeon-siteandcreateanexactduplicateofthedataontheindividual'scomputer.Inthisway,shouldthe employee choose to do anything to that data before leaving, the employer is protected. Damagedor deleteddata can be re-placed, and evidence can be recovered to show what occurred. This methodcan alsobe used to bolster an employer's case by showing the removal of proprietary information ortoprotect the employer from false charges made by the employee. You should be equipped to findand interpret the clues that have been left behind. This includes situations where files have beendeleted, disks have been reformatted, or other steps have been taken to conceal or destroy theevidence.Forexample, didyou know?

What Web sites have been visited?What files have been downloaded?Whenfiles werelastaccessed?

Ofattemptstoconcealordestroyevidence?Ofattempts tofabricateevidence?

Thattheelectroniccopyofadocumentcancontaintextthatwasremovedfromthefinalprintedversion?

Thatsomefaxmachines cancontainexactduplicatesofthelastseveralhundredpages received?

That faxes sent or received via computer may remain on the computer indefinitely?Thatemailisrapidlybecomingthecommunicationsmedium ofchoiceforbusinesses?
Thatpeopletendtowritethingsinemailthattheywouldneverconsiderwritinginamemorandumorletter?
Thatemailhas beenused successfullyin criminalcases aswell asin civillitigation?Thatemailisoftenbackedupontapesthataregenerallykeptformonths oryears?
Thatmanypeoplekeeptheirfinancialrecords,includinginvestments,oncomputers?

COMPUTERFORENSICSSERVICES

Computer forensics professionals should be able to successfully perform complex evidence recoveryprocedureswiththeskillandexpertisethatlendscredibilitytoyourcase. Forexample,they shouldbeable to perform thefollowingservices:

1. **DATASEIZURE**

Following federal guidelines, computer forensics experts should act as the representative, usingtheirknowledgeof data storagetechnologies to track downevidence.
Theexpertsshouldalsobeabletoassistofficialsduringtheequipmentseizure process.

2. **DATADUPLICATION/PRESERVATION**

Whenonepartymustseizedatafromanother,twoconcernsmustbeaddressed;thedatamustnotbealtered inanywaytheseizuremust not put an undueburdenon therespondingparty
Thecomputerforensicsexpertsshouldacknowledgebothoftheseconcernsbymakingan exact duplicateoftheneeded data.'
Whenexpertsworksontheduplicatedata,theintegrityoftheoriginal ismaintained.

3. RECOVERY

Usingproprietarytools,yourcomputerforensicsexpertsshouldbeabletosafely recoverandanalyzeotherwiseinaccessible evidence.
Theabilitytorecoverlostevidenceismadepossiblebytheexpert'sadvanced understandingofstoragetechn ologies

4. DOCUMENTSEARCHES

Computerforensicsexpertsshouldalsobeabletosearchover200,000electronicdocuments in

secondsratherthanhours.

Thespeedandefficiencyofthesesearchesmakethediscoveryprocesslesscomplicatedand lessintrusiveto all parties involved.

5. MEDIACONVERSION

Computer forensics experts should extract the relevant data from old and un-readable devices,convertit into readable formats,and placeit ontonewstoragemedia for analysis.

6. EXPERTWITNESSSERVICES

Computer forensics experts should be able to explain complex technical processes in an easy-to-understand fashion.This should help judges and juries comprehend how computer evidence isfound,what it consists of,and how it is relevantto a specific situation.

7. COMPUTEREVIDENCESERVICEOPTIONS

Computerforensicsexpertsshouldoffervariouslevelsofservice,eachdesignedtosuityourindividual investigative needs. For example, they should be able to offer the following services:**Standardservice**:Computerforensicsexpertsshouldbeabletoworkonyourcaseduringnor-malbusinesshours untilyourcritical electronicevidenceisfound.

On-siteservice: Computerforensicsexpertsshouldbeabletotraveltoyourlocationto per-form complete computer evidence services. While on-site, the experts should quickly be able toproduceexact duplicatesofthe data storagemediain question.

Emergency service: Your computer forensics experts should be able to give your case the highestpriority in their laboratories. They should be able to work on it without interruption until yourevidenceobjectives aremet.

Priority service: Dedicated computer forensics experts should be able to work on your caseduringnormalbusinesshours(8:00A.M.to5:00P.M.,MondaythroughFriday)untiltheevidencei sfound. Priorityservicetypicallycutsyour turnaround time in half.

Weekend service: Computerforensics experts should beableto workfrom 8:00 A.M. to 5:00P.M., Saturday and Sunday, to locate the needed electronic evidence and will continue 14 ComputerForensics,Second Editionworkingonyour caseuntilyourevidenceobjectivesaremet.

8. OTHERMISCELLANEOUSSERVICES

Computerforensicsexpertsshouldalsobeabletoprovideextendedservices.Theseservices

include:

Analysis of computers and data in criminal investigationsOn-siteseizureofcomputerdataincriminalinvestigationsAnalysisof computers anddata incivil litigation.
On-siteseizureof computerdatain civillitigationAnalysisofcompanycomputerstodetermineemployee activityAssistanceinpreparingelectronicdiscoveryrequests
Reportingina comprehensiveandreadilyunderstandablemannerCourt-recognizedcomputerexpert witness testimony
ComputerforensicsonbothPCandMac platformsFastturnaroundtime.

BENEFITSOFPROFESSIONALFORENSICMETHODOLOGY

Aknowledgeablecomputerforensicsprofessionalshouldensurethatasubjectcomputersystemiscarefully handled to ensurethat:

1. Nopossibleevidenceisdamaged,destroyed,orotherwisecompromisedbytheproceduresusedtoinvestigate thecomputer.
2. Nopossiblecomputervirusisintroducedtoasubject computerduringtheanalysisprocess.
3. Extractedandpossiblyrelevantevidenceisproperlyhandledandprotectedfromlater mechanicalorelectromagneticdamage.
4. Acontinuingchainofcustodyis establishedandmaintained.
5. Businessoperationsareaffectedforalimitedamountoftime,ifatall.
6. Anyclient-attorneyinformationthatisinadvertentlyacquiredduringaforensicexplorationisethicallyand legallyrespected and not divulged.

DIGITALFORENSIC

WhatisthePurposeofDigitalForensics?

The most common use of digital forensics is to support or refute a hypothesis in a criminal or civilcourt:

- **Criminal cases:** Involve the alleged breaking of laws and law enforcement agencies andtheirdigital forensic examiners.
- **Civilcases:** Involvetheprotectionofrightsandpropertyofindividualsorcontractualdisputes between commercial entities where a form of digital forensics called electronicdiscovery(eDiscovery)maybeinvolved.

Digitalforensicsexpertsarealsohiredbytheprivatesectoraspartofcybersecurityand informationsecurityteamstoidentifythecauseofdatabreaches,dataleaks,cyberattacksandothercyberthreats.Digitalforensicanalysismayalsobepartofincidentresponsetohelprecoveroridentifyany sensitivedata or personallyidentifiableinformation(PII) thatwaslostorstoleninacybercrime.

WhatisDigitalForensicsUsedFor?

WhatistheDigitalForensicsInvestigationProcess?

There are a number of process models for digital forensics, which define how forensic examinersshould gather, process and analyze data. That said, digital forensics investigations commonly consistoffour stages:

1. **Seizure:**Priortoactualexaminationdigitalmediaisseized.Incriminalcases,thiswill beperformedbylaw enforcement personnel to preservethe chainof custody.
2. **Acquisition:**Onceexhibitsareseized,aforensicduplicateofthedataiscreated.Oncecreatedusinga hard drive duplicator or software imagingtoolthen the originaldrive isreturnedtoasecurestoragetopreventtampering.Theacquiredimageisverifiedwith SHA-1orMD5hashfunctionsandwillbeverifiedagainthroughoutanalysistoverifytheevidenceisstillin its original state.
3. **Analysis:** After acquisition, files are analyzed to identify evidence to support or contradictahypothesis.Theforensicanalystusuallyrecoversevidencematerialusinganumberofmethods(andtools),oftenbeginningwiththerecoveryofdeletedinformation.Thetypeofdataanalyzedvariesbutwillgenerallyincludeemail,chatlogs,images,internethistory anddocuments. The data can be recovered from accessible disk space, deleted space or from theoperatingsystem cache.

Reporting: Oncetheinvestigationiscomplete,theinformationiscollatedintoareportthatisaccessibletonon-technical individuals. It may include audit information or other meta-documentation.

WhatistheHistoryofDigitalForensics?

Beforethe1970s,cybercrimesweredealt withexistinglaws.

The first cyber crimes were recognized in the 1978 Florida Computer Crimes Act. The 1978 FloridaComputer Crimes Actincluded legislation againstthe unauthorized modification or deletion ofdata.

As the range of computer crimes increased, state laws were passed to deal with copyright, privacy,harassmentandchild pornography.

In the 1980s, federal laws began to incorporate computer offences. Canada was the first country topass legislation in 1983, with the United States following in 1986, Australia in 1989 and Britain'sComputerMisuse Act in 1990.

1980s-1990s

The growth in cyber crime in the 1980s and 1990s force law enforcement agencies to establishspecializedgroups at a nationallevelto handle technical investigations.

In1984,theFBIlauncheda *ComputerAnalysisandResponseTeam* andin1985,theBritishMetropolitanPolicefraudsquatlaunchedacomputercrimedepartment.

One of the first practical examples of digital forensics was Cliff Stoll's pursuit of Markus Hess in1986. Hess is best known for hacking networks of military and industrial computers based in theUnitedStates,EuropeandEastAsia.HethensoldtheinformationtotheSovietKGBfor $54,000.Stollwasnotadigitalforensicexpertbutusedcomputerandnetworkforensictechniquesto identifyHess.

Inthe1990stherewasahighdemandfordigitalforensicresourcesandthestrainonthecentralunits led to regional oreven localgroups to handle the load. This ledto the scienceofdigitalforensicmaturingfrom an ad-hocset of tools and techniques to a moredeveloped discipline.

By 1992, "computer forensics" was used in academic literature in a paper by Collier and Spaul thatattempted to justify digital forensics as a new discipline. That said, digital forensic remained ahaphazarddiscipline due to a lack ofstandardization and training.

Bythelate1990s,mobilephonesweremorewidelyavailableandadvancingbeyondsimplecommunication devices.Despitethis,digitalanalysisofcellphoneshaslaggedbehindtraditionalcomputermedia dueto theproprietarynatureof devices.

2000s

Since 2000, various bodies and agencies have published guidelines for digital forensics in responsetotheneedforstandardization.Standardizationbecamemoreimportantas lawenforcement agencies moved away from central units to regional or even local units to try keep upwith demand.

For example, the British National Hi-Tech Crime Unit was set up in 2001 to provide nationalinfrastructure for computer crime, with personnel located centrally in London and with the variousregionalpoliceforces.

In2002,theScientificWorkingGrouponDigitalEvidence(SWGDE)produced*BestpracticesforComputerForensics.*

A European lead international treaty, theConvention of Cybercrimecame into force in 2004 withthe aim of reconciling national computer crime laws, investigation techniques and internationalcooperation. The treaty has been signed by 43 nations (including the United States, Canada, Japan,SouthAfrica, United Kingdom and other Europeannations) and ratified by16.

In2005,anISOstandardfordigitalforensicswasreleasedinISO17025,*Generalrequirements forthecompetenceof testingand calibration laboratories.*
Thiswaswhendigitalforensicstrainingbegantoreceivemoreattentionwithcommercialcompaniesbeginni ngto offercertifiedforensictrainingprograms.

Thefieldofdigitalforensicsstillfacesissues.A2009paper,*DigitalForensicResearch:TheGood,theBadandtheUnaddres sed* identifiedabiastowardsWindowsoperatingsystemsindigitalforensicsresearchdespitewidespreaduseofs martphones,unixandlinuxbasedoperatingsystems.

In 2010, Simson Garfinkel pointed out the increasing size of digital media, widespread encryption,growing variety of operating systemsand file formats,more individualsowning multiple devicesandlegallimitationsaskeyriskstodigitalforensics investigations.Thepaperalsoidentifiedtraining issues and the high cost of entering the field as key issues. Other key issues include the shifttoward Internet crime,cyber warfareandcyber terrorism.

WhatToolsDoDigitalForensicExaminersUse?

Inthe1980s,veryfewdigitalforensictoolsexistedforcingforensicinvestigatorstoperformliveanalysis,usi ngexistingsysadmintoolstoextractevidence.Thiscarriedtheriskofmodifyingdataonthe disk which led to claims of evidencetampering.

The need for software to address this problem was first recognized in 1989 at the Federal LawEnforcement Training Center and resulted in the creation of IMDUMP and SafeBack. DIBS, ahardwareand softwaresolution, was releasedcommerciallyin 1991.

Thesetoolscreateanexactcopyofapieceofdigitalmediatoworkonwhileleavingthe originaldiskintact forverification.

Bytheendofthe1990s,thedemandfordigitalevidencemeantmoreadvancedtoolssuchasEnCaseandFTK weredeveloped, allowing analyststoexamine copiesof media withoutliveforensics.

ThereisnowatrendtowardslivememoryforensicsusingtoolssuchasWindowsSCOPEand toolsformobile devices.

Today, there are single-purpose open-source tools like Wireshark, a packet sniffer, and HashKeeper,a tool to speed up examination of database files. As well as commercial platforms with multiplefunctions and reporting capabilities like Encase or CAINE, an entire Linux distribution designed forforensicsprograms.

Ingeneraltoolscanbebrokendownintothefollowingten categories:

1. Diskand datacapturetools
2. Fileviewers

3. Fileanalysistools
4. Registryanalysistools
5. Internetanalysistools
6. Emailanalysistools
7. Mobiledevicesanalysistools
8. MacOS analysistools
9. Networkforensicstools
10. Databaseforensicstools

WhataretheLegalConsiderationsofDigital Forensics?

The examination of digital media is covered by national and international legislation. For civilinvestigations, laws may restrict what can be examined. Restrictions against networkmonitoring orreadingpersonal communications are common.

Likewise,criminalinvestigationsmayberestrictedbynationallawsthatdictatehowmuchinformation can be seized. As an example, seizure of evidence by law enforcement is governed bythe PACE act in the United Kingdom. The 1990 computer misuse act legislates against unauthorizedaccessto computermaterial which makes ithard forcivil investigators in theUK.

Oneofthecommonconsiderationswhichislargelyundecidedisanindividual'srightto privacy.TheUSElectronicCommunicationsPrivacyActplaceslimitationsontheabilityforlawenforcement andcivil investigators tointercept and access evidence.

The act makes a distinction between stored communication (e.g. email archives) and transmittedcommunication(e.g.VOIP).Transmittedcommunicationisconsideredmoreofaprivacy invasionandis harder to obtainawarrant for.

Digitalevidencefallsintothesamelegalguidelinesasotherevidence.Ingen

eral,lawsdealingwithdigitalevidenceare concernedwith:

- **Integrity:** Ensuring theactof seizing andacquiring digitalmedia doesnotmodify theevidence (either theoriginal orthe copy).
- **Authenticity:** The ability to confirm the integrity of information. The chain of custody fromcrime scene through analysis and ultimately to the court, in the form of an audit trail, is animportantpart of establishingthe authenticityofevidence.

Each of the branches of digital forensics have their own guidelines on how to conduct investigationsandhandle data.

WhataretheDifferentBranchesofDigitalForensics?

Digital forensics is no longer synonymous with computer forensics.It is increasingly concernedwith data from other digital devices such as tablets, smart phones, flash drives and even cloudcomputing.

Ingeneral,wecanbreakdigitalforensicsintofivebranches:

1. Computerforensics
2. Mobiledeviceforensics
3. Networkforensics
4. Forensicdataanalysis
5. Databaseforensics

WhatisComputerForensics?

Computerforensicsorcomputerforensicscienceisabranchofdigitalforensicsconcerned withevidencefoundincomputersanddigitalstoragemedia.Thegoalofcomputerforensicsistoexamine digitaldatawiththeaimofidentifying,preserving,recovering,analyzingandpresentingfactsand opinions aboutthe digital information.

It is used in both computer crime and civil proceedings. The discipline has similar techniques andprinciples to data recovery, with additional guidelines and practices designed to create a legal audittrailwith a clearchain ofcustody.

Evidence from computer forensics investigations is subjected to the same guidelines and practicesofotherdigital evidence.

WhatisMobileDeviceForensics?

Mobiledeviceforensicsisabranchofdigitalforensicsfocusedontherecoveryofdigital evidencefrom mobiledevices usingforensicallysound methods.

Whilethephrasemobiledevicegenerallyreferstomobilephones,itcanrelatetoanydevicethathasinternal memoryandcommunication abilityincludingPDAdevices, GPS devices andtablets.

While theuse of mobilephones incrimehasbeen widelyrecognizedfor years, theforensic study ofmobilephones is anew field, beginningin thelate1990s.

Thegrowingneedformobiledeviceforensicsisdrivenby:

- Useofmobilephonestostoreandtransmitpersonalandcorporate information
- Useofmobilephonesinonlinetransactions

Thatsaid,mobiledeviceforensicsisparticularlychallengingdueto:

- Evidential and technical challenges such as cell site analysis which makes it possible todetermine roughly the cell site zone from which a call was made or received but not aspecificlocation such asan address
- Changes in mobile phone form factors, operating systems, data storage, services, peripheralsandeven pin connectorsand cables
- Storagecapacitygrowth
- Theirproprietarynature
- Hibernationbehaviorwhereprocessesaresuspended whenthedeviceisofforidle

As a result of these challenges, many tools exist to extract evidence from mobile devices.Butnoone tool or method can acquire all evidence from all devices. This has forced forensic examiners,especially those who wish to be expert witnesses, to undergo extensive training to understand howeach tool and method acquires evidence, how it maintains forensic soundness and how it meets legalrequirements.

WhatisNetworkForensics?

Network forensics is a branch of digital forensics focused on monitoring and analyzing computernetworktrafficfor information gathering, legal evidenceor intrusion detection.

Unlike other branches of digital forensics, network data is volatile and dynamic. Once transmitted, itisgoneso network forensics is often aproactiveinvestigation.

Networkforensicshastwogeneraluses:

1. Monitoringanetworkforanomaloustrafficandidentifyingintrusions.

2. Lawenforcementmayanalyzecapturenetworktrafficaspartofcriminalinvestigations.

WhatisForensicDataAnalysis?

Forensic data analysis (FDA) is a branch of digital forensics that examines structured data in regardsto incidents of financial crime. The aim is to discover and analyze patterns of fraudulent activities.Structureddata is datafromapplication systems or their databases.

This can be contrasted to unstructured data that is taken from communication, officeapplicationsand mobile devices. Unstructured data has no overarching structure and analysis therefore meansapplying keywords or mapping patterns. Analysis of unstructured data is usually done by computerforensicsormobile deviceforensicsexperts.

WhatisDatabase Forensics?

Database forensics is a branch of digital forensics related to databases and their related metadata.Cachedinformation mayalso existin a server's RAM requiringliveanalysis techniques.

A forensic examination of a database may relate to timestamps that apply to the update time ofarow inarelationaldatabasethatisbeinginspectedandtestedforvaliditytoverifytheactionsofadatabaseuser.Alternatively,itmayfocusonidentifyingtransactionswithinadatabaseorapplicationthat indicateevidenceof wrongdoing,suchas fraud.

COMPUTERCRIME

Alternativelyreferredtoas **cybercrime**, **e-crime**, **electroniccrime**,**hi-techcrime**. **Computer crime** is anactperformedbyaknowledgeablecomputeruser,sometimesreferredtoasahackerthatillegally

browsesorstealsacompany'sorindividual'sprivateinformation.Insomecases,thispersonorgroup of individualsmaybemalicious and destroyor otherwisecorrupt thecomputer ordatafiles.

Whydopeoplecommitcomputercrimes?

Inmostcases,someonecommitsacomputercrimetoobtaingoodsormoney.Greedanddesperation are powerful motivators for some people to try stealing by way of computer crimes.Some people mayalso commit a computer crime because they are pressured, or forced, to do so byanotherperson.

Some people also commit a computer crime to prove they can do it. A person who can successfullyexecute a computer crime may find great personal satisfaction in doing so. These types of people,sometimescalled blackhathackers,liketocreatechaos,wreakhavoconotherpeopleandcompanies.

Anotherreasoncomputercrimesaresometimescommittedisbecausepeoplearebored.They wantsomethingto do and don't careif theycommit acrime.

Examplesofcomputercrimes

Below isa list of the differenttypes of computer crimes today.Clicking any of the linksgivesfurtherinformation about eachcrime.

- **Childpornography**-Making,distributing,storing,orviewingchildpornography.
- **Copyrightviolation**-Stealingorusinganotherperson'sCopyrightedmaterialwithoutpermission.
- **Cracking**-Breakingordecipheringcodesdesignedtoprotectdata.
- **Cyberterrorism**-Hacking,threats,andblackmailingtowards abusinessorperson.
- **CyberbullyorCyberstalking**-Harassingorstalkingothersonline.

- **Cybersquatting**-Settingupa domainofanotherpersonorcompanywiththesoleintentionofsellingittothemlaterata premiumprice.
- **CreatingMalware**-Writing,creating,ordistributingmalware(e.g.,virusesandspyware.)
- **Datadiddling**-Computerfraudinvolvingtheintentionalfalsificationofnumbersindataentry.
- **DenialofServiceattack**-Overloadingasystemwithsomanyrequestsitcannotservenormalrequests.
- **Doxing**-Releasinganotherperson'spersonalinformationwithouttheirpermission.
- **Espionage**-Spyingonapersonorbusiness.
- **Fraud**-Manipulatingdata,e.g.,changingbankingrecordstotransfermoneytoanaccountorparticipatingin credit card fraud.
- **GreenGraffiti**-Atypeofgraffitithatusesprojectorsorlaserstoprojectanimageormessageontoa building.
- **Harvesting**-Collectaccountoraccount-relatedinformationonotherpeople.
- **Humantrafficking**-Participatingintheillegalactofbuyingorsellingotherhumans.
- **Identitytheft**-Pretendingtobesomeoneyouarenot.
- **Illegalsales**-Buyingorsellingillicitgoodsonline,includingdrugs,guns,andpsychotropicsubstances.
- **Intellectualpropertytheft**-Stealingpracticalorconceptualinformationdevelopedbyanotherpersonorcompany.
- **IPRviolation**-Anintellectualpropertyrightsviolationisanyinfringementofanother'sCopyright,patent,or trademark.
- **Phishing**or**vishing**-Deceivingindividualstogainprivateorpersonalinformationaboutthat person.
- **Ransomware**-Infectingacomputerornetworkwithransomwarethatholdsdatahostageuntila ransom is paid.
- **Salamislicing**-Stealingtinyamountsofmoneyfromeachtransaction.
- **Scam**-Trickingpeopleintobelievingsomethingthatisnottrue.
- **Slander**-Postinglibelorslanderagainstanotherpersonorcompany.
- **Softwarepiracy**-Copying,distributing,orusingsoftwarethatwasnotpurchasedbytheuserof

thesoftware.

- **Spamming**-Distributedunsolicitede-mailtodozensorhundredsofdifferentaddresses.
- **Spoofing**-Deceivingasystemintothinkingyouaresomeoneyou'renot.
- **Swatting**-Theactofcallinginafalsepolicereporttosomeoneelse'shome.
- **Theft**-
  Stealingortakinganything(e.g.,hardware,software,orinformation)thatdoesn'tbelongtoyou.
- **Typosquatting**-Settingupadomainthatisamisspellingofanotherdomain.
- **Unauthorizedaccess**-Gainingaccesstosystemsyouhavenopermissiontoaccess.
- **Vandalism**-Damaginganyhardware,software,website,orotherobject.
- **Wiretapping**-Connectingadevicetoaphonelinetolistento conversations.

CRIMINALISTICS

The criminal justice system in America is the overarching establishment through which crimes andthose who commit them are discovered, tried, and punished. This includes all of the institutions ofgovernment aimed at upholding social order, deterring and mitigating crime, and sanctioning thosewhoviolatethe law, suchas lawenforcementandthe court and jail systems.

Criminology and criminalisticsare two subsets of the criminal justice system. Criminology relates tostudying and preventing crime—typically with behavioral sciences like sociology, psychology, andanthropology. Criminalistics refers to a type of forensics—the analysis of physical evidencefrom acrimescene.

While criminology has preventative components, criminalistics comes into effect only after a crimehas been committed. A criminalist applies scientific principles to the recognition, documentation,preservation, and analysis of physical evidence from a crime scene. Criminalistics can also includecrime scene investigations. The Bureau of Labor Statistics(BLS) classifies criminalists as forensicsciencetechnicians.Mostprofessionalsregardcriminalisticsasaspecialtywithinthefieldofforensi cscience.

WHATDO CRIMINALISTSDO?

Criminalists use their knowledge of physical and natural science to examine and analyze every pieceof evidence from a crime scene. They prepare written reports of their findings and may have topresent their conclusions in court. A criminalist is not involved in determining the guilt or innocenceofan accusedindividual.Theirjob, rather, isto presentan objective analysis of theevidence.

There are several critical skills that criminalists need to be successful in their work. First, they mustbe detail-oriented and have excellent written and verbal communication skills. Second, they shouldalso have strong critical-thinking and problem-solving skills and a solid background in science,statistics,physics,math,andethics.Finally,criminalistsshouldbecomfortabletestifyingincourt.

Most of a criminalist's work is performed in a laboratory unless they specialize in crime sceneinvestigation. Their job typically includes recognizing what information is important, collectingandanalyzingevidencewithoutcontaminatingit,andorganizingallinformationandevidencecoherently.

Criminalisticshasmanyfieldsofspecialization.Specialtiesinclude,butarenotlimitedto:

- Alcoholanddrugs
- Arson
- Bloodandtissuespatter
- Computerforensics
- DNA
- Explosions
- Serology(examiningandanalyzingbodyfluids)
- Toxicology
- Firearmsandtoolmarks
- Traceevidence
- Wildlife(analyzingevidenceagainstpoachers)

As long as crimes continue to be committed, there will always be work for criminalists. A criminalwill always leave evidence, no matter how minute, according to forensic scientist and "Father ofCriminalistics"Paul L.Kirk:

"Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve assilentevidenceagainsthim.Notonlyhisfingerprintsorhisfootprints,buthishair,thefibersfrom his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood orsemen that he deposits or collects – all these and more bear mute witness against him. This isevidencethatdoesnotforget.Itisnotconfusedbytheexcitementofthemoment.Itisnotabsent

> because human witnesses are. It is factual evidence. Physical evidence cannot be wrong; it cannotperjure itself; it cannot be wholly absent. Only its interpretation can err. Only human failure tofindit, studyand understand it, can diminishits value."

As soon as a crime is reported, an investigation is opened by the police or law enforcement agencywithjurisdiction.

Policedetectivesandinvestigatorsusecriminalisticsincrime-sceneinvestigations.Criminalisticsis"thescientificstudyandevaluationofphysicalevidenceinthecommissionofcrimes."Criminalistics plays a vital role in organizing crime scenes, helping victims, ensuring justice, andservingthepublic.

Criminalistscoverabroadrangeofcriminaljusticejobswithintheforensicsciencefieldthat examine physical evidenceto link crime scenes with victims and offenders. Criminalists aresometimesreferredtoaslabtechniciansorcrimesceneinvestigators,atermmadefamousbytheTVdrama *CSI*.

Thesecriminalistsconsultwithexperts,examineandanalyzeavarietyofevidenceincludingfingerprints,hair, fibers,skin,blood,andmore.The criminaliststhen use their analysistodetermineanswersto howacrimewas committed.

CRIMINALISTICSINPOLICEINVESTIGATIONS

A report from the National Institute of Justiceoutlined the role of criminalistics in police work.Criminalists investigate a variety of crimes, including domestic and aggravated assaults, burglary,robbery,sexual violence,and homicide.

Herearethebasicfunctionscompletedbycriminalists:

Establishinganelementofthecrime

- It's important for criminalists to establish proof that a crime occurred and to determine thecause and manner of death. Autopsies will help confirm the latter, while sending crime scenesamplesof blood,drugs,orsemen,for example, couldhelp determinethecrimeitself.

Identificationofasuspectorvictim

- Fingerprint and DNA testing are two examples of forensic evidence that criminalists use toidentifyan offender.

Associativeevidence

- Thistypeofscientificfindingcanhelplinktheoffendertothevictim.

  Examplesofassociative evidenceinclude hair follicles, blood, semen, fingerprints left on an object, footimpressions,and more.

Reconstruction

- Criminalists try to reconstruct how the crime happened using evidence from the crime scene.For example, certain evidence on a gunshot victim can discern the distance between a victimandthe shooter.

Corroboration

- Physical evidence from a crime scene can corroborate or refute information that investigatorscollectduringinterviewswith witnesses, victims andsuspects.

CRIMINALISTICSINREALTIME

TheFBIandU.S.DepartmentofJusticedistributeaguideforcriminalistprotocolswhen respondingtoa crimescene.

Here'swhattheJusticeDepartmentrecommendstakesplace.

Arrival/InitialResponse

- Uponarrivingonthescene,criminalistsshouldattempttopreservethecrimescenewithminimaldist urbanceof thephysical evidence.
- Criminalistsshouldmakeinitialobservationstoassessthescenewhileensuringofficersafetyand security.
- Theyshouldreactwithcaution.Offenderscouldstillbeatthecrimesceneandcriminalistsshouldrem ain alertandattentiveuntilthecrimesceneis declaredclear ofdanger.

DocumentationandEvaluation

- The investigator(s) in charge should set responsibilities, share preliminary information anddevelop investigative plans in compliance with department policy and local, state and federallaws.
- Criminalists should speak with the first responders regarding observations from the crimescene before evaluating safety issues at the scene, establishing a path of exit and entry, andinitialsceneboundaries.
- If multiple scenesexist, criminalists should establish and maintain communication withpersonnelat those sites.

ProcessingtheScene

- Basedonthetypeofincidentandcomplexityofthecrimescene,criminalistsshouldetermineteamc omposition on site.
- Criminalists will assess the scene to determine which specialized resources are required. Forexample, forensic examiners could be called to the scene, or a coroner to investigate acadaver.

CompletingandRecordingtheCrimeSceneInvestigation

- Criminalistsshouldestablishacrimescenedebriefingteam,whichenablesalllawenforcementbodies to shareinformationabout findings beforethesceneisreleased.
- Criminalists determine what evidence was collected, discuss the preliminary scene findingswith scenepersonnel, discuss potential forensic tests that will takeplace, and initiate anyactionrequired to completethe crimesceneinvestigation.

Theobjectandcategoriesofcriminalistics

The structure of criminalistics in Europe is notuniform. Western European countries tookthe British-American model which describes "criminalistics" as close to equal with "forensicscience".According to this model, forensic science usescriminalistic techniques, employedfor technical solution of judicial problems. Additionally, this model contains crime sceneinvestigationtechniques.SomeofthesetechniquesareusedincentralEuropean modelswithinthefieldofcriminalistictactics.ForanumberofcentralEuropeanlaw practitioners,criminalistics falls within the broad category of legal sciences31.Owing to the legalaspectof the criminalistics, forensic science and the science of criminalistics cannot be linked toeachother.NotbeingidentifiedintheCriminalCode,someoftheforensicsciencetechniques,such aselectro-technicalexamination,examinationofdigitalevidence,ormetallographicexamination,donotbelo ngtolegalmethods,andthereforeforensicscienceisviewedasadifferentdisciplinethan criminalistics.Thelegalaspectplaysacriticalroleinthedifferentiationbetweenthetwo models32. Criminalistics is an independent science that"examines the manifestation of theevent in form of physical and memory characteristics"33.In criminalistics, this manifestation is called trace evidence. Trace evidence is the object ofthescienceofcriminalistics.Criminalisticsdifferentiatestwotypesoftraceevidence:physical (material)andmental(memory).Naturally,criminalinvestigationbasedonmaterialevidence providesahigherlevelofprecisionandcertainty34(Itisnecessarytonotethat incriminalistics, we differentiate between evidence and trace evidence. Evidence is a termforproving something, and is basically regarded as a proof, whereas trace evidence is meant asanimprintusedforidentification).Contemporarycriminalisticsisbrokendowntotwo maingroups, criminalistic techniques and criminalistic tactics. Criminalistic techniques focus onanexaminationofmaterial(physical)traceevidence,whilecriminalistictactics examinemainlymemorytraceevidence.Regardlessofthedifferentcategoriesofevidence,criminal istics is focused on finding, seizing and examining the evidence35. Criminalisticsdistinguishesbetweenthreecategoriesofachievingthisgoal:(a)modus operandi– methodofcommittingacrime,(b)criminalisticstraceevidenceand(c)criminalistics identification.

Modusoperandi/methodofcommittingacrime

Considerableemphasisincriminalinvestigationisplacedonadetaileddescriptionofthemethodofcommittingthecrime,whichisknownasmodusoperandi(orMO).Three majorcomponents of MO play a role in criminal investigation, and they are listed as follows: Thecomponentspertainingtoanactioncharacterizethephysicalandpsychologicalactivityofthe offenderwhile committingacrime.Materialcomponentsconsistoftoolsanditemsnecessary for committing the crime. Finally, multifaceted componentsare a complex groupofactivities and information required for committingthe crime.

Humanbehaviourisdeterminedbynumerousfactors.Similarly,thebehaviouroftheoffenderdependsontheinteractionbetweenthesefactors.Criminalisticsdividesthesefactorsonobjectiveand subjective determinants. Objective determinants do not depend onoffender'schoice.Ingeneral,theyaresocial/culturalconditions,victim(s)/target(s),therelationshipbetweentheoffenderandthevictim/target,thecrimescene,thetime,theaccessibilityoftools(weapon,etc.),andtheexistenceofco-offender(s).Subjectivedeterminants depend onand are connected to the offender(s) specifically. They are thephysical(somatic)characteristicsoftheoffender(ie.his/herstrength,bodybuild),psychological andmotorcharacteristicsoftheoffender(his/herlevelofintelligence,easeofmobility, hobbies, and sexual behaviour), age, gender, criminal experience and educationallevel(qualification,skills)36.Knowledgeofthemethodofcommittingacrimeoffersadditionalimportantinformation.Itenablesinvestigatorstocreatecriminalisticversions,andprovides data for criminal profiling37 .

Analysisofcyber-criminalisticsarea: Criminalistictraceevidence

In criminal investigation, trace evidence gives investigators a picture of the criminal actalong with the indications about behaviour of the perpetrator and his/her victim(s) at thescene. The knowledge of the trace evidence mechanism and its creation lays the foundationfor criminal investigation methods and techniques. The essence of trace evidence is themutual association of two objects that provide information about criminal act. When twoobjects have an effect on one another, they create changes. These changes illustrate andreproduce characteristics of affected objects. Each change in a physical environment or ahumanmindthatisinfluencedbyacriminalactisconsideredtobetraceevidence.As aresultofthis,criminalisticsdistinguishesbetweenmaterial(physical)traceevidenceand

memory trace evidence. Three major changes must come into effect in order to produce traceevidence: change that is generated by the criminal act, change that exists until the time of itsseizing, and change that can be assessed by criminalistics methods and techniques38. Traceevidenceis widelyrecognized as oneof thesubjects of scientificexamination39 .

Material(physical)traceevidenceisdividedintofivecategories:Traceevidencethat givesinformation about (a) the structure of outer surface of the objects, such as finger-prints orballisticsevidence,(b)thestructureoftheinnersurfaceoftheobjects,suchas biological,chemical orpyrotechnical evidence, (c)the functional and dynamicfeatures ofthe objects,suchasvoice,posturewhilewalking,orhand-writing,(d)characteristicsofthe objects thatcreated the trace evidence, such as finger-prints created by blood, foot-prints that provideinsight into walking patterns, and (e) features of the objects created by change, such asperipheraltraceevidence,(movinganobjectfromoneplacetoanother),slitsor bruises40.Althoughmemorytraceevidencehasphysicalfeatures(likechangesinbraincells) methodsoftheirexaminationarequitecomplex.Memorytraceevidenceisformedbythe five humansenses(sight,hearing,touch,smellandtaste),butitisverydifficulttoexaminetheexactwayin which it is created. Additionally, it is influenced by the personality of the person whocreated it(theperson'sshortand longtermmemoryaswellashis/heremotionalstate,etc.)andisnot accessible immediately. Once the person dies or if he/she is not willing to sharehis/hermemory,thetraceevidenceislost.Allmemory traceevidenceisformedasareflection of the human mind, which is influenced by the organic or inorganic environment.The basic impulsethatcreatesthememorytraceevidenceisaperceptionthatisgenerated bythepressureof theenvironment on the humansenses41 .

The examination of memory trace evidence is achievable merely by methods which allow aperson to interpret his/her own experience through recollection of a specific event. This canbe done using legalmethods of psychologicalmanipulation.Asa resultof this,memorytrace evidence is examined using a combination of methods of criminalistic tactics, such ascriminalistic versions, interrogation, confrontation, verification of the statement on the scene,recognition,andinsome cases,criminalisticexperimentandcriminalisticreconstruction42.

Criminalisticidentification

Oncetraceevidenceisformedduringacriminalact,theinvestigatorsstrivetofindout whocreatedtheevidenceandwhatobjectwereused.Criminalisticidentificationincludesexamining objects(livingandnon-living)whichmayhavecontributedtotheformationoftrace evidence. During the process of criminalistic identification, the object is not onlyidentified, but also individualized. Individualization of the object is the process by whichinvestigatorsexaminegeneralandspecificfeaturesoftheobject.Criminalisticsidentificationis divided according to four categories. In relation to the subject (person whoperformed the identification),criminalisticsdistinguishesidentificationmadebyanexpertwitnessor recognition by thewitness (lay person). Identification made by scientific methodsofexaminationconsistsoffinger-printexamination,ballistics,biologicalidentificationetc.Inrelationtotheidentifiedobjectscrimina listics differentiates between identification ofpeopleandidentificationofnon-livingobjects.Identificationofpeopleisusuallymadeonthebaseofanatomicandanthropologicalfe aturesofthehumanbody,functionalcharacteristicsofmotorsigns,(humangesticulation,hand-writing),thehumanvoice,biologicaltraces,andtracktraces(foot-print,lip-print,teeth). Identificationofnon-livingobjectsisconductedmoreoftenbyballistics,tracktraces,tool marks and microscopes. Thelast category distinguishes identification on the basis of results; for instance, whether theobject was identified or not. Individual identification is achieved by confirmation (witnesses,DNA, etc).In the caseof the process ofincomplete identification, the identification isfinished, but the object was not identified. Here, examiners conduct partialidentification bygrouping the object into a bigger category (type of vehicle). Identificationaccording toidentifying features is made on the basis of specific characteristics of the object, suchasfunctional,dynamic,structural,etc.Asaresultofitscapabilitytobescientifically examined,criminalisticsidentificationbelongstobothcriminalisticssub-categories:criminalistictactics and criminalistic techniques. Therefore, identification enables the examination ofmaterial and memorytraceevidence43 .

Methodsofcriminalistics

Criminalistic methods developed during the historical progress of criminalistics through itsown scientific growth and through the adaptation and adjustment of methods developed inother sciences. However, criminalistic examination can be done by criminalistic

methodsonly.Thesemethodsmustmeetfourstrictcriteria.Themethodsmust(a)notcontravene

lawfulnorms,(b)bescientificallybased,(c)beverifiedbycriminalisticpracticeand(d) beacceptedbycriminalisticpractice.Satisfactionofthelawful(legal)normisacentralcriterionforthea pplicationofcriminalisticmethods.Itsimportanceliesintheoutcomeofthecriminal investigation.

If the evidence was gathered using an illegal method (for instance,theuseofphysicalorpsychologicalforceduringtheinterrogation),evidenceusuallybeco mes inadmissible in court. Scientific base criterion is determined by the current situationoftheprogressinthescientificworld.Whennewknowledgeisscientificallyrecognized,the method can be changed or altered and the old method is eventually discarded. Verifica-tioncriterionisfulfilledwhenthescientificbasisofthemethodisconfirmedinan existingpracticalsituation.Recognitioncriterionislinkedtotheverificationprinciple, however,thetimethatelapsesfromtheverificationofaparticular methodtothecomplete applicationofthismethodintothepracticeisessentiallylonger44.Poradaetal.45identify threegroupsofcriminalisticcmethods.Thefirstgroupconsistsof"methodsofuniversal perception".

Thesemethodsaregenerallyemployedbyallexaminers,suchasobservation,description,comparis on,measurementandexperiment.Thesecondgroupinvolves"methodstakenfromother sciences".

These methods of examination were created by other sciences, such asphysics,chemistry,andbiology,andcriminalisticsincludestheminitsmethodofexamination. Thelastgroupiscomposedof"specificmethodsofcriminalisticsscience"andtheseare applied exclusively in the field of criminalistics, such as knowledge gathered fromcriminalinvestigation, law enforcement or judicial practice46 . Criminalistic methods aredivided into

twomajorgroups.Thefirst,methodsofcriminalisticstechniques,examinesmaterial (substantive)

trace evidence (finger-print analysis, DNA, etc.), while the second,methodsofcriminalisticstactics,usuallystudiesmemorytraceevidence(crimesceneexami nation, interrogation, search, etc.)47 . Methods of criminalistic techniques The rapiddevelopment of scientific disciplines and the colossal growth of modern technologieshasimproved the methods and techniques of criminal investigation, along with the process of

theidentificationofmaterialtraceevidence.Therefore,criminalistictechniquesfocuson theidentificationofpeople,items,andoccasionallyanimals.Withrespecttothescientificprocedure used for the examination of trace evidence, criminalistics techniques are dividedinto

morecategories.Thefirst, methodsthat useproceduresbasedonoptical principles,takesadvantageof the miniature structureof trace evidence and the possibility of

examiningitwithoutcausinganyfurtherdamage.Magnifyingglassesandmicroscopesaretoolswidely

usedbyforensicspecialists.Theapplicationofmicroscopes(binocular,comparing,biological, metallographic,andelectronicscanning)isexclusivelyachievableatforensiclaboratories. Magnifying glasses can be used both at the crime scene and forensic laboratory.The second category, methods of criminalistics techniques that use procedures based onelectromagnetic light,employsX-rays,ultra-violet,infraredandnucleuslightforfurtheridentificationof materialtraceevidence.Lastly,methodsthatusechemicalandphysicalprocedures,areusedinanalysesofdrugs,blood,toxins,fuels,emissions,plastics,etc.andarecommonlyapplied48.Theapplicationofknowledgeincorporatedfromvariousscientificdisciplinesintoforensicscience is thekey factorthat helps link theoffenderto thecrimeby means ofmaterial traceevidence. Forensicspecialistsemploynumeroustechniquesappropriatetothecharacteristicsofthe crime.

Frequently used techniques are finger-printanalysis,(daktyloscopy),DNAanalysis,forensicpathology,forensicbiology,forensicanthropology, ballistics, forensic audio-expertise, firearm and tool mark examination, digitalimagingenhancement, forensic datarecovery,andaccounting.

Methodsofcriminalistictactics

The significance of criminalistic tactics as a method of collection, examination, explorationand application of evidence lies in its contribution to the process of criminal investigation. Inthe 1950s, Bohuslav Nemec defined criminalistic tactics as (a) a science about crime andcriminalacts,(b)studyaboutmethodsofoffenders'activities,(c)generalizationofcriminalistic knowledgeanditspracticalapplication,(d)activesummaryandstatistics,(e)effectivefunctioningoflawenforcement,and(f)investigativeprocess"49.Lateroninthe60s,the objectsofcriminalistictacticsshiftedtoinvestigativemethodsandtechniquesofcriminal investigation. Additionally, characteristics of the offender, methods of committingcrimes,andtheirclassificationwereadded.Duringthe70s,academicsagreedthatcriminalistic tactics should focus on the issues of examination and application of methodsrelated to the investigation and prevention of dangerous activities. Criminalistic tactics assistin finding the facts in issue, and therefore they have to satisfy numerous requirements. Aspecific tactic mustbelegallyapproved,scientificallyverifiable,appropriate,andaccessible;finally,their

application is required to be ethical. At present, methods of criminalistics tacticsfocus on the examination of memory trace evidence. Each method examines evidence from aspecificpointofview.However,thistypeofevidencedoesnotexistinavacuum;memory

isfrequently interconnected with material evidence and the material environment. Existingmethodsofcriminalistictacticsinclude(a)crimesceneinvestigation,(b)criminalisticsearch,(c)criminalisticversions,(d)interrogation/interview,(e)confrontation,(f)verificationofthestatementonthescene,(g)recognition,(h)criminalisticexperiment,and
(i) criminalistic reconstruction. In some cases, criminalistic documentation, planning andmanagementofcriminalisticsexaminationareaddedtothemethodsofcriminalistictactics50.

Crimesceneinvestigation

The key role of the crime scene investigation (or CSI) is the comparison between an object'smaterial condition and trace evidence obtained from this object, as well as their mutualrelationship. The core of the CSI lies in direct observation of the scene and the object whilesearching for material changes in the object, which can become evidence. However, thisprocess is not just mere observation. It is also empirical examination, continuous evaluationanddocumentationofacrimescene'sphysicalconditionandobjectsconnectedtoit.Observation can bemadebythe senses orusingelectronic/technical equipment.

ThegoaloftheCSIisto(a)findevidence,(b)discoverrelationshipsandassociations,and
(c) detect other circumstances, such as conditions, motives and hypotheses for the creationofcriminalisticsversions51.ThesignificanceoftheCSIasoneofcriminalisticmethods isremarkable.Itenablesinvestigatorstounderstandthecharacteristicsoftheeventthat tookplaceatthecrimesceneincludingplausiblecausesandconditionsthatgaveriseto thecriminalevent,ortounderstandtheoffenderwhocommittedcrime.Successofa criminalinvestigationoftendependsonthequalityoftheCSI,whichisonecriminalistic tacticthatcannotbereplacedbyanyothermethod.Thelevelofitsqualityessentiallyinfluences thequalityofthegatheredevidence.Insufficientknowledgeandskillsoranirresponsibleapproachoflawenforcementofficersmayleadtoalesserpunishmentorevenacquittalofatrue offender.CSIprovidesinitialinformationaboutevidenceandtheeventitselfwhich tookplaceatthecrimescene.Ashoeprintmightbeanexample,asitmayleadto

knowledgeone'sheight.Factsderivedfrompreliminaryinformationaboutevidencedependconsid erably on experience and knowledge. Thecrime scene investigation isconsidered tobeateameffortmadebythepoliceofficers,investigators,andforensicspecialists52.The

first officers at the crime scene are the members of the "permanent access group". Additionalparticipants of the CSIarewitnesses, any victims or even the accused. It is crucial to usegood judgement in deciding whether the attendance of such people is necessary or notbecause it might put the investigation at risk. A phone call made to 112 initiates four majortasks:(a)completionofinitial,emergencyactivities,(b)preparationforcrimesceneexaminati on, (c) completion of crime scene examination along with proper documentation ofitsresults and(d)evaluation ofaccomplished results andtheirapplication53.

Criminalisticdocumentation

Theaimofcriminalisticdocumentationistosecuretraceevidence(verballyandacoustically)and to takecontrolofthecourseandoutcomeofthecriminalinvestigation.Incriminalistic examination,(investigation),traceevidenceandcomparingmaterialhavethenatureof documentedmarksandseizedobjects54.Documentedmarksare deliveredinwritten form, (transcript), phonogram (audio recording), photographic form (photographs,hologramvideo,film,anddigitalrecording),andtopographicform(sketch,plan,and drawing).Standardcriminalisticdocumentationcomesintheformofatranscript.In otherwords, it describes a situation that was observed by its author. A transcript must consist ofobjectively true statement of facts – the subjective feelings of the author are not allowed.Inaddition to an oral description of the observed situation, investigators can choose the form ofanaudio(phonographic)recording.Furthermore,thisformofdocumentationis frequentlyusedattheinterrogation/interview,wherethestatementsmadebytheaccused, witnesses orthevictimarerecorded.However,photographicformprovidesthemostprecisedocumentation.W ritten,phonographicandphotographicformsaresupplementedbytopographic form, usually consistingofsketches,plans,anddrawings.Seizedobjectsaresubmittedintheirnatural form,andtheexactlocationwheretheywerefoundisdocumentedalongwithallofthe circumstancesandconditionssurroundingtheirdiscovery.Notonlytraceevidencebutalso anymanipulationtoitmustbedocumentedinordertoprotectthechainofevidence.Each andeverypieceofevidence,itsmanipulationandthecircumstancesaround itisimportantfor a criminal investigation, therefore thorough documentation iscrucial.

CHALLENGESFACEDBYDIGITALFORENSIC

Developmentisseverelychallengedbythegrowingpopularityofdigitaldevicesandtheheterogeneoushardwareand softwarebeingutilised.

- TheincreasingvarietyoffileformatsandOSshampersthedevelopmentofstandardizedDFtoolsand processes.
- Theemergenceofsmartphonesthatincreasinglyutilizeencryptionrenderstheacquisitionofdigitalevidence anintricatetask.

Also, advancements in cybercrime have culminated in the substantial challenge, such asCrime as a Service(CaaS),whichprovidestheattackerswith easyaccesstothetools,programmingframeworks, andservices neededto conductcyber attacks.

- Digitalforensicshasbecomeanimportanttoolintheinvestigation/identificationofcomputer- basedand computer-assisted crime.
- EricHolder(DeputyAttorneyGeneraloftheUnitedStatesSubcommitteeonCriminal OversightfortheSenate)hasclassifiedthe challengesintothreecategories
  - Technicalchallenges
  - Legalchallenges
  - Resourcechallenge

1. Technical challenges:

Findingtheforensicsevidenceshavebeenhinderedby:

- DifferentMediaformat
- Encryption
- Anti-forensics
- Steganography.
- Liveacquisitionandanalysis

2. Legalchallenges:

- Jurisdictionalissue.
- Lackofstandardlegislationcreatesthelegalchallenges.
- Statusasscientificevidence.
- Whatistheknownorpotentialrateoferrorofthemethodused.
- whetherthetheoryormethodhasbeengenerallyacceptedbythescientificcommunity.

3. Resourcechallenges:

Itisseverelychallengedbythegrowingpopularityofdigitaldevicesandtheheterogeneoushardwareand softwareplatforms beingutilized.

- Volumeofdata&timetakentoacquireandanalyzeforensic media.
- Toensuretosatisfiedcriticalinvestigativeandprosecutorialneedsatalllevelsofgovernment.

UNIT-2

CYBERCRIMESCENEANALYSIS:

Cybercrime scene analysis, also known as digital forensics or cyber forensics, is the process of investigating and analyzing digital evidence related to a cybercrime. Cybercrimes can include hacking, data breaches, identity theft, online fraud, and other illegal activities that occur in the digital realm. The goal of cybercrime scene analysis is to collect, preserve, and analyze digital evidence to identify the perpetrators, understand the scope and impact of the crime, and support potential legal actions.

Theprocessofcybercrimescene analysistypicallyinvolvesthefollowingsteps:

- **Identification:** The first step is to identify that a cybercrime has occurred or is suspected to have occurred. This could be through various means such as detecting unauthorized access, data breaches, or unusual activities on a network or system.
- **Preservation:**Onceapotentialcybercrimeisidentified,itiscrucialtopreservethedigital evidence to ensure its integrity and admissibility in court, if necessary. This involves creating a forensic image of affected systems or devices, which is an exact copy of the data at that point in time.
- **Collection:**Digitalevidencemaybespreadacrossvariousdevicesandlocations,suchas computers, servers, mobile phones, and cloud services. Skilled investigators use specialized tools and techniques to collect relevant data without altering the original evidence.
- **Examination:**Thecollecteddigitalevidenceisthenexaminedandanalyzedtouncoverpotential clues,tracetheactivities oftheattacker,and determinethe extentofthe cybercrime.
- **Analysis:** Investigators use their expertise to analyze the data and reconstruct the events that occurred during the cyber attack. This may involve examining network logs, email exchanges, systemfiles,andanyotherrelevantdatatounderstandtheattackvectorandthetacticsusedbythe perpetrator.
- **Documentation:**Throughouttheprocess,investigatorsmeticulouslydocumenttheirfindings, methodologies, and the chain of custody for the digital evidence. This documentation is essential for legal purposes and to maintain the integrity of the evidence.
- **Reporting:**Acomprehensivereportisprepared,detailingtheinvestigation'sfindings, conclusions, and any potential recommendations for strengthening the organization's

cybersecurity.

- **Legalproceedings:**If required, the digital evidence collected duringthe cybercrime scene analysis can be presented in a court of law to support the prosecution of the individuals responsible for the cybercrime.
- Cybercrimesceneanalysisrequiresspecializedskillsandknowledgeinbothdigitalforensicsand cybersecurity. It is a constantly evolving field, as cybercriminals develop new techniques, and technology advances. Therefore, cyber forensics experts need to stay up-to-date with the latest trends and tools to effectively combat cyber,suchassystemthreats.

DISCUSSTHEVARIOUS COURTORDERS:

- One order sheet (may contain numerous pages) per case ismaintained bythe court in each casefiled before it.
- Acourtmaypass orders at any stageofthesuit, likeat thetimeof admissibility ofthesuit, during hearings, at the evidence stage, etc.
- All final orders are decree. Orderis defined in section 2(14)of theCode of Civil Procedure, 1908, which states that it is the formal expression of any civil court's decision and not a decree.
- Someoftheordersmentionedbelowaremuchneededindailylifeandforjudicialservices examinations conducted by various states.

1. **InterlocutoryOrders**
2. **PermanentOrders**
3. **MandatoryOrders**
4. **Final Order**
5. **SpeakingOrder**
6. **Non-SpeakingOrder**
7. **Anton Pillar Orders**
8. **RemandOrder**
9. **Stay Order**
10. **Garnishee Order**
11. **RestrainingOrder**
12. **ProtectionOrder**
13. **RejectionOrder**

1. InterlocutoryOrders:

Theseorders arealso calledinterimorders.The purposeof aninterlocutory orderisto resolve any issuesthatarisethroughoutthecase.Suchordersaremadetoachievesomeaimorpurpose

required and vital to the case's development. They are generallyincidental to the issues that thecourt will resolve in the ultimate decision. These are not final orders.

2. PermanentOrders

If the parties cannot reach an agreement before their hearing date, they will be required to attenda hearing known as a permanent order hearing. These orders will be in effect indefinitely and willnot be changedfor theremainingof theparties' lives.

3. MandatoryOrders

Aprivilegeorderdirecting an inferiorcourt,tribunal, orotherpublicbody to undertakeadefined public duty relating to its obligations, which can be obtained through a judicial reviewapplication to the High Court. It is also known as the Writ of Mandamus.

4. Final Order

It disposes of all the claims and adjudicates rights and liabilities of parties in a suit. It terminates the proceeding of a court, or in other words, it terminates the litigation. It also refers to an order that has not stayed, appealed, reviewed, amended or recalled.

5. SpeakingOrder

Such orders speak for themselves. If the order can be brief, explains why it was passed, it is a speaking order. All of the questions specifics, unambiguous results and a justification should be included in the order.

6. Non-SpeakingOrder

An order that is not speaking is called a non-speaking order. It is order without reasoning and findings. The impugned order is a non-speaking order. Such orders subvert judicial integrity.

7. Anton Pillar Orders

An order which requires one party (the respondent) to allow the other party (the applicant) to inspect, remove or make copies of documents or other items which might provide evidence in an action or action against the respondent. The order of Anton Piller is also known as a **searchorder**. Such orders are granted in copyright infringements, trademarks, patents etc.

8. RemandOrder

It isan order to sendthe accused back tocustody. Insuch casesaccused is denied bailand should remain in custody till the date mentioned in the order.

9. Stay Order

The act of a higher court ordering a temporary halt to a legal proceeding. It is generally opted to secure the rights of one party over the other. Taking note of its misuse, the Supreme Court said:

Allstayordershaveatimelimitofsixmonthsinthelatestlandmarkjudgement– Asian

ResurfacingRoad AgencyvsCentralBureauof Investigation.

10. Garnishee Order

A court order allowing you to retrieve judgement debt from the bank account of the other partyor from someone else who is owing money to the other party. It is used more in recovering debts from salary or wage, bank accounts etc.

11. RestrainingOrder

Arestraining order is called an orderissued by thecourt,preventing aperson from harassing and contacting someone. It is provided in principle to safeguard the life of the individual from danger or danger anticipation. A person may not perform something for a permanent duration or for a temporary amount of time. It is an order issued in future to prevent assault or harassment of the accused. If the abuser continues to breach the orders, the police can arrest him and punish him by the courts.

12. ProtectionOrder

A court order designed to enable protection to one party against the other party's harassment or abuse. In this order, the partner's behaviour can be limited by a judge.

13. RejectionOrder

Itisanorderofthecourtrejectingtheplaintbecauseithasnotmetcertain standardslikeabaron limitation, non-disclosure of a cause of action etc. Rejection of an order is also called a deemed decree. In other words, it is called a dismissal order or order of dismissal.

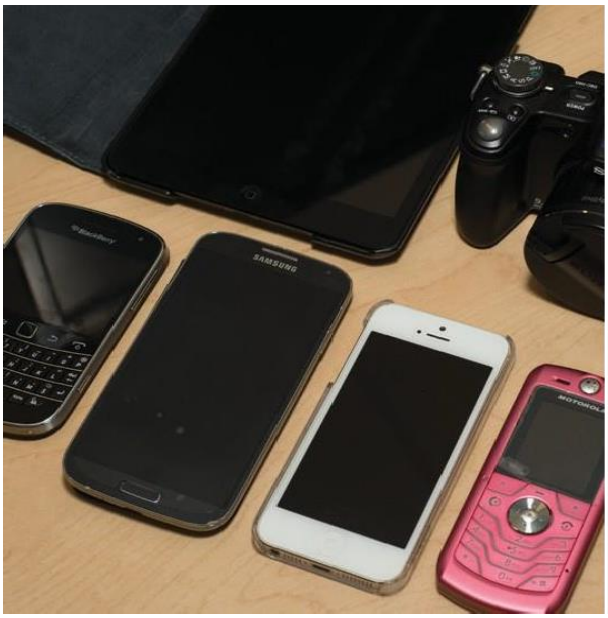
METHODSTOSEARCHANDSEIZUREELECTRONICEVIDENCE:

- Intoday'ssociety,peopleutilizevariouscomputers,electronicdevices,andotherelectronicmedia in numerous aspects of their lives.
- Criminalsalsousethesesamedevicesinthe facilitationoftheirunlawful activities.
- Currenttechnologypermitscriminalstocommitcrimesinternationallyandremotelywithnear anonymity.
- Instantcommunicationandelectronicmailprovidesavenueforcommunicationbetween criminals as well as victims.
- As such, computers andother electronic media can be used to commit crimes, store evidence ofcrimes, and provide information on suspects and victims.

This field guide is designed to assist the patrol officer, detective, and investigator in recognizing how computers and electronic devices may be used as an instrument of a crime or as a storage device for evidence in a host of federal and state crimes.

- It will also assist these individuals in properly securing evidence and transporting it for examination at a later time by a Computer Forensic Examiner/Analyst.

We recommend that the patrol officer, detective, and investigator consult and seek assistance from theiragency'sresources orotheragenciesthat seizeelectronicmedia.This mayincludeyour local District Attorney, State Prosecutor.



METHODSFORSEIZINGEVIDENCE

- The methods for searching and seizing electronic evidence are generally conducted by law enforcement agencies and follow established legal procedures.
- Thepatrolofficer,detectiveorinvestigatorislegallypresentat acrimesceneorother location and has the legal authority to seize the computer, hardware, software or electronic media.
- If you have a reason to believe that you are not legally present at the location or the individual (suspect or victim) does not have the legal ability to grant consent, then immediately contact the appropriate legal counsel in your jurisdiction.
- Keepinmindthatlawsandpracticesmayvary bycountry andregion,soit'scrucialtoconsultup-to-datelegalresourcesinyourjurisdiction.

Herearesome commonmethodsused tosearchandseizeelectronicevidence:

1. PLAINVIEW

- The plain view exception to the warrant requirement only gives the legal authority to **SEIZE** a computer, hardware, software and electronic media, but does **NOT** give the legal authority to conduct a **SEARCH** of this same listed electronic media.

2. CONSENT

- Ifan individualvoluntarilygivesinformedconsent,lawenforcement can conductasearchwithout a warrant. However, the consent must be freely given, and the person must be aware of their right to refuse consent.

3. SEARCHWARRANT

- Searchwarrantsallow for the search andseizure ofelectronic evidenceaspredefinedunderthe warrant.
- Obtaining a search warrant from a court is one of the most common methods for law enforcement to search and seize electronic evidence.
- A warrant typically requires probable cause and specific details about the evidence sought and the location to be searched.

4. Incident to Arrest: If an individual is lawfully arrested, law enforcement may search the person and the immediate area around them, including electronic devices, to ensure officer safety and prevent the destruction of evidence.

5. Exigent Circumstances: In emergency situations where there is a risk of immediate harm or the loss of evidence, law enforcement may be able to search and seize electronic devices without a warrant.

6. Border Searches: Customs and border protection agents may conduct searches of electronic devices at border crossings without a warrant or suspicion. This is a sensitive area where different rules may apply compared to searches within a country.

7. Subpoenas: Some cases may involve the issuance of subpoenas, court orders that require individuals or organizations to produce specific electronic evidence relevant to an investigation.

8.Digital Forensics: Law enforcement agencies use digital forensic techniques and tools to analyze electronic devices and recover relevant evidence. This can include data extraction, data recovery, and analysis of electronic information.

9.Surveillance: In certain cases, law enforcement may use electronic surveillance methods, such as wiretaps or tracking devices, to gather evidence. However, these methods typically require specific legal authorization.

- Itisimportanttonotethatthemethodsemployedtosearchandseizeelectronicevidencemust complywithrelevantlawsandregulations,includingthoseprotectingindividuals'privacyand constitutional rights.
- Ifyouareinvolvedinasituationconcerningthesearchandseizureofelectronicevidence,itis essentialtoseek legaladviceto understandyour rights andobligations fully.

- Lawsandpractices inthisareacanbecomplex andsubjectto change.

AUTHORITYFORSEIZINGEVIDENCE:CONSIDERATIONS

- **Roleof thecomputer**

  Thesearchwarrant shouldstatethecomputer'srole inthecrimeandwhy it willcontain evidence.

- **Nexus**

  Establishwhyyouexpecttofindelectronicevidenceatthesearchlocation.

- **Specifyevidencesought**

  Specifically describe the evidence you have probable cause to search for and any evidence of ownership of the computer.

- **Boilerplate language**

  Adaptallsearchlanguagetothespecific factsofyourcase.Avoidusingboilerplatelanguage.

- **Location of search**

  Is it practical or safe to conduct a search of the computers and electronic media on site? Consider the vast storage capacities of consumer hard disk drives that were only available commercially not too long ago. It is not uncommon for computer forensic examinations to take many hours, or insome cases days.

- **Non-Disclosure**

  May be necessary to protect informants or to prevent the disclosure of trade secrets/intellectual property.

- **Special Master**

  Special legal considerations should be given to investigations involving doctors, attorneys, spouses, publishers, clergy, etc.

CONSENTTO SEARCHELECTRONIC MEDIA

The following is a general reference guideline for consent forms pertaining to computers and electronic media. Consult your District Attorney *regarding consent language applicable to yourjurisdiction.*

I,, havebeen asked to give my consent to thesearch ofmy computer/electronicequipment. I have also been informed of my right to refuse to consent to such a search.

Iherebyauthorizetoconducta complete search of allcomputer/electronic equipmentlocated at

_____. These officers/agents (and any other person(s) designated to assist, including but notlimited to computer forensic examiners/analysts) are authorized by me to take from the above location(s), any computers, including internal/external hard disk drives, compact discs (CDs), digital video discs (DVDs), USB drives, scanners, printers, other computer/electronic hardware or software and related manuals, and any other electronic storage devices, including but not limited to, cellular/mobile telephones and electronic pagers, and any other electronic equipment capableof storing, retrieving, and/or accessing data. I hereby consent to a complete search of those items by these personnel for any data or material that is contraband or evidence of any crime. I understand that this contraband or evidence may be used against me in a court of law.

I give this written permission voluntarily. I have not been threatened, placed under duress or promisedanything in exchangeformy consent. Ihaveread this form orithas been read to meand I understand it. I understand the

_____ languageand havebeenableto communicatewith the agents/officers.

IunderstandthatImaywithdrawmyconsentatanytimeforanyreason.Imayalsoaskfora receipt for all things taken.

Signed:_____ Signature of Witnesses: _____

Date and Time: _____

GOLDEN RULES

There are general principles to follow when responding to any crime scene in which computers and electronic technology may be involved. Several of those principles and considerations are as follows:

- Wheneverpossible,itisbesttohaveatrainedComputerForensicExaminer/Analystcollect electronic evidence.
- Doyouhavealegal basistoseizethecomputer(plainview,search warrant,consent, etc.)?
- Ifyou have reason to believethat thecomputeris involved in thecrimeyou areinvestigating, take immediate steps to preserve the evidence.
- IfthecomputerisOFF,leaveitOFF.DoNOTpoweritontobeginsearchingthroughthe computer.
- IfthecomputerisON,andaproperlytrainedComputerForensicExaminer/Analystisnot

available, go to the appropriate section in this guide on how to properly secure the computer and preserve evidence.

- Ifyoureasonablybelievethatthecomputerisdestroyingevidence,immediatelyshutdownthe computerbypulling thepower cordfrom theback ofthe computer.
- In all instances, document the location and state of the computer to include attached electronic media.
- Inallinstances,takephotographsofthecomputer,thelocationofthecomputer,andany electronic media attached. If the computer is onand the screen is blank, move the mouse or press the space bar (this will display the active image on the screen), then photograph the screen.
- Dospeciallegalconsiderationsapply(doctor,attorney,clergy,psychiatrist,newspapers, publishers,etc.)?

RETRIEVED&UNRETRIEVEDCOMMUNICATION

- In the context of digital forensics, "retrieved communications" and "unretrieved communications" take on a slightly different meaning. Digital forensics involves the collection, preservation, analysis, and presentation of digital evidence for legal or investigative purposes. Let's delve into how these terms apply in this field:

RetrievedCommunications(Digital Forensics):

- In digital forensics,"retrieved communications" refer to electronic messages or data that investigators have successfully recovered and accessed from digital devices or communication platforms.
- Thesecommunicationscanincludeemails,textmessages,instantmessages,socialmedia messages, and any other digital conversations that have been obtained from devices or data sources during a forensic investigation.

UnretrievedCommunications(Digital Forensics):

- Conversely,"unretrieved communications"indigitalforensicsareelectronicmessagesordatathat have not yet been accessed or recovered from the digital devices or communication platforms under investigation.
- Thesecouldbemessagesthatweredeletedorotherwiseinaccessibleatthetimeofdata acquisition.
- It is the forensic investigator's task to employ various techniques and tools to attempt to recoversuch data if possible.
- Digitalforensicexpertsusespecializedsoftwareandmethodstoacquire,preserve,andanalyze

digitalcommunicationsaspartofaninvestigation.

- The goal is to reconstruct the digital trail and gather relevant evidence that may be useful in legal proceedings or for investigative purposes.
- It is important to note that digital forensics is a complex and evolving field, and the success of retrieving communications depends on various factors such as the type of device, the data storage methods, encryption, and the expertise of the forensic examiner.
- Insomecases,retrievedcommunicationsmaybeinstrumentalinbuildingacase,whilethe absence of certain communications might also be significant in drawing conclusions during an investigation.

DISCUSS THE IMPORTANCE OF UNDERSTANDING WHAT COURT DOCUMENTS WOULD BE REQUIRED FOR A CRIMINAL INVESTIGATION:

- Courtdocumentsplayacrucialroleinthecriminaljusticesystem,andobtainingtheright documentsisessential forafairandeffectiveinvestigation.
- Understandingwhatcourtdocumentswouldberequiredforacriminalinvestigationisof paramount importance for law enforcement agencies, investigators, and legal professionals. Herearesomekeyreasonswhyitiscrucialtoknowwhatcourtdocumentsareneededfora criminal investigation:
- **LegalBasisandJurisdiction:**Courtdocumentsestablishthelegalbasisandjurisdictionunder whicha criminalinvestigationisconducted. Theyprovide informationonthe chargesfiled,the alleged offenses, and the relevant court where the case is being prosecuted.
- **EvidenceCollection:**Courtdocumentsoftencontainvaluableinformationaboutthealleged crime,thevictim,andthesuspects.Thisinformationcanguideinvestigatorsincollecting evidence, conducting interviews, and building a case.
- **SearchandArrestWarrants:**Courtdocumentsmayincludesearchandarrestwarrantsissued by a judge. These documents authorize law enforcement to search specific locations for evidence or arrest individuals suspected of involvement in the crime.
- **AffidavitsandStatements:**Affidavitsandstatementssubmittedtothecourtaspartofthe investigation can provide critical leads and insights into the case. These documents may containinformation from witnesses, victims, or informants.
- **CourtOrders:**Courtordersrelatedtotheinvestigation,suchasordersforwiretapsor surveillance,canbevitalinunderstandingthelegalscopeandlimitationsofinvestigative techniques used.

- **Case History and Prior Rulings:** Previous court decisions and rulings related to the case or similar cases can provide valuable legal precedent and guidance in shaping the investigation and building the case.
- **ChainofCustody:**Courtdocumentscanalsoserveaspartofthechainofcustodyforevidence, ensuringthattheintegrityandadmissibilityofthe evidence are maintained.
- **Due Process and Fair Trial:**Understanding the required court documents ensures that investigators follow due process and respect the rights of the accused, which is essential for maintaining the integrity of the criminal justice system and ensuring a fair trial.
- **CollaborationwithLegalProfessionals:**Forasuccessfulcriminalinvestigation,cooperation between law enforcement and legal professionals is vital. Understanding the necessary court documents enables effective communication and collaboration between these entities.
- **AdmissibilityofEvidence:**Ensuringthatallrequiredcourtdocumentsareproperlyobtainedand submitted is critical for the admissibility of evidence in court. Improperly obtained evidence may be challenged and deemed inadmissible.
- Insummary,knowingwhatcourtdocumentsarerequiredforacriminalinvestigationisessential for a well-organized, lawful, and successful investigative process. These documents provide the legal framework, evidence, and guidance necessary to conduct an objective and thorough investigationwhileupholdingtheprinciplesofjusticeandfairness.

UNIT-3

EVIDENCEMANAGEMENT&PRESENTATION:

Evidence management and presentation are critical aspects of the legal process, ensuring that relevant evidenceisproperlycollected,preserved,andpresentedinaclearandorganizedmannerduringatrialor legal proceeding.

Here'sanoverviewofbothaspects:

Evidence Management:

1. **Collection:** The process of gathering evidence involves identifying, locating, and securing relevant items,documents,orinformation.Thiscanincludephysicalevidence(e.g.,weapons,fingerprints)or digital evidence (e.g., emails, computer files).
2. **Chain ofCustody:** Maintaining a clear and documented chain of custody is crucial to preserve the integrityofevidence.Thisinvolvestrackingthemovementofevidencefromthetimeitiscollectedto its presentation in court, ensuring it remains unaltered and admissible.
3. **Preservation:** Proper storage and handling of evidence are essential to prevent contamination, damage,orloss.Physicalevidencemustbestoredinasecureandclimate-controlledenvironment, while digital evidence may require specialized tools and techniques for preservation.
4. **CatalogingandDocumentation:**Eachpieceofevidenceshouldbecarefullydocumented,includingrelevant details like date, time, location of collection, individuals involved, and a description of the evidence. Digital evidence may require additional metadata to be recorded.
5. **Authentication:**Ensuringtheauthenticityofevidenceisessential.Authenticationinvolvesverifyingthatthe evidence is what it purports to be and has not been tampered with or altered.
6. **Admissibility:** Evidence must meet specific legal criteria to be admissible in court. It should be relevant, materialtothecase,andcollectedthroughlegalmeans.Thechainofcustodyandproperdocumentationalso play a role in determining admissibility.

EvidencePresentation

1. **OpeningStatements:**Duringtrial,eachsidemayprovideanopeningstatementtooutlinetheircaseandthe evidence they intend to present.
2. **DirectExamination:** Thisistheprocessofquestioningwitnessesbythepartythatcalledthemtotestify.The goal is to elicit relevant information and evidence to support their case.
3. **Cross-Examination:**Afterdirectexamination,theopposingpartyhastheopportunitytocross-examinethe witness. This aims to challenge the witness's credibility or the reliability of their testimony.

4. **Exhibits:**Physicalevidenceordocumentsmaybepresentedasexhibitsduringwitnesstestimony.Eachexhibit should be marked for identification and shown to the court and opposing counsel.
5. **Expert Witnesses:** Expert witnesses may provide specialized knowledge or opinions in areas that require expertisebeyondthatoftheaverageperson.Theycanpresentevidenceandprovideexplanationstohelpthe court understand complex matters.
6. **ClosingArguments:**Attheconclusionofthetrial,eachsidepresentsclosingargumentssummarizingthe evidence and reiterating their key points.

- Effectiveevidencemanagementandpresentationarecrucialtoensuringafairandjustlegal process.
- Attorneys,investigators,andotherlegalprofessionalsworktogethertogather,organize,andpresentevidence that supports their respective cases while adhering to the rules of evidence and legal procedures.

CREATEANDMANAGESHAREDFOLDERSUSINGOPERATINGSYSTEM

Creating and managing shared folders can vary depending on the operating system you are using. Below,I'lloutlinethestepsforcreatingandmanagingsharedfoldersontwocommonoperating systems: Windows and Linux.

CreateandmanagesharedfoldersonWINDOWS

CreatingaSharedFolder:

1. Right-clickonthefolderyouwanttoshareandselect "Properties."
2. Inthe folderpropertieswindow, gotothe"Sharing"tab.
3. Clickonthe"AdvancedSharing"button.
4. Checkthe box thatsays "Sharethis folder."
5. Optionally,you canmodifythesharename.By default,it willusethefolder's name.
6. Click"Apply"and then"OK" toconfirm thesharing settings.

ManagingSharedFolders:

1. Toviewallsharedfoldersonyoursystem,open"FileExplorer."
2. Intheleft-handpane,clickon"Network."
3. Youshouldseealistofallsharedfoldersonyour network.

CreatingandmanagingsharedfoldersonLINUX(UBUNTU)

Creating a Shared Folder:

1. InstallSamba,asoftwaresuitethatenablesfileandprintsharingbetweenLinuxandWindowssystems: ‘sudo’ apt install samba
2. Createafolderthatyouwanttoshare:mkdir/path/to/sharedfolder
3. OpentheSambaconfigurationfile for editing:sudonano /etc/samba/smb.conf
4. Addthefollowing linesto theconfiguration file:

- [SharedFolderName]
- path= /path/to/shared_folder
- readonly=no
- browsable=yes

Replace“SharedFolderName”withthedesirednamefortheshared folder.

- Savethe changesand exitthetext editor.
- RestarttheSambaservice: ‘sudo servicesmbd restart’

ManagingSharedFolders:

1. Toviewallshared foldersontheLinuxsystem,usethe‘smbstatus’commandintheterminal.
2. ToaccesssharedfoldersfromanotherWindowsorLinuxmachine,youcanusethefilemanagerand navigate to the network section, where the shared folder should be visible.
   Keepinmindthatsharingfoldersonanetworkcanintroducesecurityrisks,soit'sessentialtoconfigure proper access controls and permissions to ensure that only authorized users have access to the shared data.

IMPORTANCEOFFORENSICMINDSET:

⦿ The forensic mindset is a critical aspect of forensic science and investigation, encompassing a set of principles, attitudes, and approaches that guide forensic professionals in their work. It plays a vital role in the accurate and objective analysis of evidence, ensuring the integrity of the investigative process and the validity of findings. Here are some reasons highlighting the importance of the forensic mindset:

1. **Objectivity:** Forensic professionals must maintain an objective and unbiased approach to their work. The forensic mindset emphasizes the need to avoid personal biases and preconceptions, ensuring that evidenceis analyzed without undue influence, leading to more reliable and impartial conclusions.
2. **Scientific Rigor:** Forensic science relies on the application of scientific principles and methodologies. The forensic mindset emphasizes the use of robust scientific methods, adherence to established protocols, and the documentation of procedures, enhancing the credibility of forensic findings in court.
3. **Attention to Detail:** The forensic mindset emphasizes the significance of paying attention to even the smallest details. Forensic professionals are trained to observe, document, and interpret evidence meticulously, as seemingly insignificant details can have a substantial impact on the investigation.
4. **Ethical Conduct:** Ethical considerations are essential in forensic work, as it involves sensitive information and often affects people's lives and liberties. The forensic mindset encourages adherence to ethical guidelines and respect for the rights of individuals involved in the investigation.
5. **Impartiality:** Forensic professionals should remain neutral and independent from the parties involved in a case. The forensic mindset ensures that investigators are not influenced by external factors, maintaining the credibility and integrity of their findings.
6. **Continuous Learning and Improvement:** The forensic field is constantly evolving with newtechnologies, techniques, and best practices. The forensic mindset fosters a commitment to continuous learning and professional development, enabling forensic professionals to stay up-to-date with the latest advancements in the field.
7. **Collaboration:** Forensic investigations often involve interdisciplinary collaboration. The forensic mindset promotes effective teamwork among forensic experts, law enforcement, legal professionals, and other stakeholders, facilitating a more comprehensive and accurate analysis of evidence.
8. **Uncovering the Truth:** The ultimate goal of forensic science is to uncover the truth and provide a reliable and evidence-based account of events. The forensic mindset ensures that investigators remain focused on the objective pursuit of truth, regardless of the implications or outcomes.
9. **Adherence to Legal Standards:** Forensic professionals must follow legal standards and guidelines when handling evidence and presenting their findings in court. The forensic mindset stresses the importance of understanding and complying with these legal requirements to ensure the admissibility of evidence.

⊙ Insummary,theforensicmindsetisessentialformaintainingthecredibility,reliability,andintegrityof forensic science and investigations. It ensures that forensic professionals approach their work with objectivity, scientific rigor, and ethical considerations, ultimately contributing to the pursuit of justice and the resolution of complex cases.

DEFINETHE WORKLOADOF LAW ENFORCEMENT:

- The workload of law enforcement refers to the range and volume of tasks, responsibilities, and duties that law enforcement officers and agencies are required to handle on a regular basis.
- The workload can vary significantly depending on the size of the agency, the jurisdiction they cover, the type of crimes prevalent in the area, and the available resources.

Herearesomekey componentsthat contributetotheworkloadoflaw enforcement:

1. **Patrolling and Crime Prevention:** Law enforcement officers often spend a significant portion of theirtimepatrollingdesignatedareastodetercriminalactivity,respondtoemergencycalls,andprovideavisible presence in the community.
2. **Investigations:** Law enforcement agencies are responsible for investigating crimes, which may range from minor offenses to serious felonies. This involves collecting evidence, conducting interviews, analyzingdata, and building a case to identify and apprehend suspects.
3. **Traffic Enforcement:** Officers enforce traffic laws, issue citations, investigate traffic accidents, and work to improve road safety.
4. **Community Engagement:** Building positive relationships with the community is crucial for law enforcement. Officers may participate in community events, engage with citizens, and collaborate withlocal organizations to address community concerns.
5. **Emergency Response:** Law enforcement is often the first to respond to emergency situations, including incidents like shootings, robberies, domestic disputes, and natural disasters.
6. **Arrests and Apprehensions:** Officers may be involved in apprehending suspects, making arrests, and transporting individuals to detention facilities.
7. **Court Appearances:** Law enforcement officers may be required to testify in court as witnesses in criminal cases they have investigated or been involved in.
8. **Paperwork and Documentation:** Law enforcement work involves extensive paperwork, includingincident reports, arrest records, evidence logs, and administrative documentation.
9. **Specialized Units:** Some officers may be part of specialized units such as SWAT teams, K-9 units, narcotics teams, or cybercrime units, adding specific responsibilities to their workload.
10. **Training and Professional Development:** Law enforcement officers participate in ongoing training and professional development to stay updated on new laws, investigative techniques, and technological advancements.

11. **Public Safety Initiatives:** Law enforcement agencies may be involved in various public safety initiatives, such as drug prevention programs, community outreach events, and educational campaigns.

- It'simportanttonotethattheworkloadoflawenforcementcanbedemandingandmayvaryfromdayto day.
- Officersmusteffectivelymanagetheirworkloadwhileprioritizingpublicsafety,followinglegal procedures, and upholding ethical standards in their actions.
- Additionally, law enforcement agencies must continuously assess their workload and resource allocation to ensure efficiency and effectiveness in fulfilling their responsibilities.

EXPLAINWHATTHENORMALCASEWOULDLOOKLIKE

SamplesThatMayBeCollectedAtACrimeScene:

Awidevarietyofphysicalevidencecanbecollectedatascenethatisdeemedvaluable("probative")forcollectionandi nvestigation:

- biologicalevidence(e.g.,blood,bodyfluids,hairandothertissues)
- latentprintevidence(e.g.,fingerprints,palmprints,footprints)
- footwearandtiretrackevidence
- traceevidence(e.g.,fibers,soil,vegetation,glassfragments)
- digitalevidence(e.g.,cellphonerecords,Internetlogs,emailmessages)
- toolandtoolmarkevidence
- drugevidence
- firearmevidence

Thetypeofevidencecollectedwillvarywiththetypeofcrime.Inthecaseofaburglary,forexample,itwouldbecommon to perform tasks in the order listed below. This will help ensure that evidence isn't inadvertentlydamagedordestroyed:

1. Photographanddocumentthescene
2. Collecttracematerials(especiallyfromprobablepointsofentry)
3. Collectlow-levelDNAevidencebyswabbingareasoflikelycontact
4. Collectotheritemsthatmaycontainbiologicalevidence
5. Locateandcollectlatentfingerprints

WhoExaminesCrimeScenes

The number and type of professional(s) responsible for investigating a scene and collecting evidence largelydepends on the type of crime and the resources of the law enforcement agency. Larger agencies often havededicated, highly trained crime scene specialists, while smaller agencies may require that first responders ordetectives process the scene in addition to their otherduties.In many instances, a case will be investigated by adetective who is responsible for interviewing persons of interest and victims, pursuing leads and piecingtogethertheinformationthatisdevelopedfromthematerialscollectedatthescene.Thedetectiveworks intandem with a team of crime scene personnel who search the scene and collect the evidence. The crime sceneinvestigation team may consist of crime scene photographers and evidence collection personnel specializing ingathering specific evidence such as latent prints, DNA, trace evidence and the like.In the United States,
therearenonationalrequirementsthatmustbemettoserveasacrimesceneinvestigator;however,investigatorscanachieve four levels of certification through the International Association for Identification (IAI) thatdemonstratetheirproficiency:

- CertifiedCrimeSceneInvestigator
- CertifiedCrimeSceneAnalyst
- CertifiedCrimeSceneReconstructionist
- CertifiedSeniorCrimeSceneAnalyst

Other certifications commonly achieved include the Evidence Photographer Certification from the EvidencePhotographersInternationalCouncil,Inc.andBoardCertifiedMedicolegalDeathInvestigatoroftheAmericanBoardofMedicolegalDeathInvestigators(ABMDI).

HowaCrimeSceneInvestigationisConducted

The circumstances that investigators encounter at the scene will largely dictate the approach used to process thescene. A homicide will likely require different treatment and processing than a burglary. However, to ensure athoroughprocess,thesevenstepsoutlinedbelowareoftenfollowed.Thesestepscanbeconductedinadifferentorder,com

binedorevenskippedaltogethertomeettheneedsofthesituation.

1. **Establish the scene dimensions and identify potential safety and health hazards** - Investigators initiallylocatethe“focalpoint”ofthescene,themainareaofdisturbance. Thiscouldbearansackedbedroom, the areawhere an attack occurred, or the room in which a victim was found. Radiating out from that point, investigatorsestablishanareathatissizeableenoughtolikelycontainallrelevantphysicalevidencethatmaybepresent. Itiseasier for investigators to condense the size of a scene at a later point than to discover that sensitive evidenceoutsidethescenehasbeendamagedordestroyedbyotherresponders, mediaoronlookers.Inaddition, potentialpaths of perpetrator entry/exit are identified. Safety is of paramount importance during the initial approach tothe scene. Weapons, biohazards, chemical hazards and even intentional traps could be waiting for responders.Ifmedical,fireorcoronerswillbeonscene,theywillneedtobeadvisedregardingevidentiaryissuesaswell.

2. **Establish security** - According to Locard’s Exchange Principle, every person who enters or exits the scenewilladdorsubtractmaterialfromthecrimescene,soit’scrucialtoquicklysecurethearea.Tocontrolaccess,the scene may be cordoned off with yellow crime scene tape, cones or by other means. In addition, a commonentrywayisoftenestablishedthatallcrimescenepersonnelwillusetoenterandexitthesceneand all peopleentering or leaving the scene are documented once the boundaries have been established. Additional areas forconsultationandevidencestorage mayalsobe establishedifnecessary.

3. **Plan,communicateandcoordinate**-Beforecollectingevidence,investigatorsmust firstdevelop atheoryregarding the type of offense that occurred. Knowing the type of crime will help investigators anticipate theevidence that could be present. This may requiregathering information from witnesses or personsofinterest.Basedonthisinformation,thecrimesceneteamwilldevelopanevidence-collection strategy taking intoconsideration weather conditions, time ofday and other factors. Additional forensic resources may also berequestedtohandlespecialsituations.

4. **Conduct a primary survey/walkthrough** - An initial survey of the scene is then conducted to prioritizeevidencecollection.Duringthiswalkthrough,theleadinvestigatorwillidentifypotentiallyvaluable evidence,take notes and capture initial photographs of the scene and the evidence. The crime scene is documented torecord conditions such as whether lights were on or off, the position of shades and doors, position of movablefurniture,

anysmellspresent,thetemperatureofthescene,etc.Tofacilitatethisprocess,crimescenespecialists maycreateanevidence-freepathwayleading totheprimaryareaofinterestbyconducting athoroughsweepforevidenceinthatarea.

5. **Document and process the scene** - With a plan in place, the crime scene team conducts a thorough,coordinated investigation of the scene, collecting all probative evidence. This entails detailed documentationwith digital and video cameras or, if available, a 3-D scanner.

For some situations, sketches and diagrams arealso created.Duringtheevidence-collectionprocess,itiscrucialthatthecrime scene investigatorfollowproperprocedures for collecting, packagingandpreservingtheevidence,especiallyifitisofabiologicalnature.Biologicalevidencecan be destroyed or damaged by weather conditions, individuals can inadvertentlycontaminateit,oritcanbeoverlooked entirelyifalternatelightsourcesarenotusedto inspect thescene.

6. **Conductasecondarysurvey/review** -
Toensurethatthescenehasbeenthoroughlysearched,asecondsurveyoftheareaisconductedas aqualitycontrolstep.

7. **Recordandpreserveevidence**-Tomakecertainthatallevidenceisaccountedfor,aninventory log iscreated.Thedescriptionsrecorded intothelogmustmatchthephotooftheevidencetakenatthesceneandthedescriptionincludedinthecrime scene report. For instance, if a gun is collected, the serial number of thefirearm in the evidence log must match the serial number shown in the photo that was taken at the scene. Thispaper trail establishes the chain of custody that will follow the evidence throughout the lifecycle of the case.

HowandWhereTests ontheEvidenceareConducted

The most probative evidence will be sent to either a forensic laboratory or, if the laboratory does not have anexpert in that forensic discipline, to an outside analyst for examination. To help identify the evidence that ismost valuable, the crime scene personnel may conduct initial screening tests, called presumptivetests,atthescene.Thesetestscanbeusefulindeterminingthetypeofsubstancepresent— whether it's a toxin or a drug, astainthatcontainsbodyfluids,orevenwhether adriedredsubstancefoundinthekitchenisbloodorketchup.

Presumptivetestsallowinvestigatorstonarrowthefieldofpossibilitiestoacertainclassofsubstance, but theyare not specific enough to confirm the presence of specific compounds. In addition to helping provide clues toindicate how the crime occurred and who may have been involved, presumptive tests can also help reduce

thequantityofevidencethatissubmittedtothelabtoincludeonlythemostimportantitems.Thishelpstoexpedite processingatthelaboratory.

Astechnologyadvancesanddevicesbecomemoreportableandaffordable,additionaltestingofevidencewilllike lybeconductedatthescene.

DEFINEWHOSHOULDBENOTIFIEDOFACRIME

The parties who should be notified of a crime can vary depending on the nature and severity of the crime, aswell as the jurisdiction in which it occurs. Generally, the following entities or individuals should be notified when a crime is committed:

- **LawEnforcement**:Thelocallawenforcementagency,suchasthepolicedepartmentorsheriff'soffice, should be notified immediately when a crime occurs. They are responsible for investigating the crime, collecting evidence, and taking appropriate action based on the circumstances.
- **EmergencyServices**:Ifthecrimeinvolvesanimmediatethreattolifeorproperty,emergencyservicessuch asparamedics,firefighters,orotherfirstrespondersshouldbenotifiedas well.
- **VictimServices**:Organizationsthatprovidesupportandassistancetovictimsofcrime,suchasvictimadvocacy groups or crisis centers, can be contacted to offer help to those affected by the crime.
- **LegalAuthorities**:Ifacrimehasbeencommitted,legalauthoritiessuchasprosecutorsordistrictattorneysmay need to be notified to initiate legal proceedings against the alleged perpetrator.
- **SchoolsorInstitutions**:Incasesinvolvingminorsorcrimesthatoccurwithineducationalinstitutions,school authorities or relevant institutions should be notified as appropriate.
- **Government Agencies**: Certaincrimes,especiallythose involvingspecific regulationsor sensitiveinformation,may require notification of relevant government agencies or regulatory bodies.
- **Neighborhood Watch**: In communities with neighborhood watch programs, the local group might appreciate being informed of criminal activity to enhance community safety and awareness.
- **Security Personnel**: If a crime occurs within a facility or premises with private security personnel, they should benotified to take appropriate security measures and cooperate with law enforcement.
- **InsuranceCompanies**:Forcertaintypesofcrimes,suchastheftorpropertydamage,notifyinginsurancecompanies might be necessary to initiate claims for compensation.
- **ChildProtectiveServices**:Ifacrime involves child abuseorneglect,ChildProtectiveServicesortheequivalent agency in your jurisdiction should be notified.
- **Human Rights Organizations**: In cases involving human rights violations, discrimination, or hate crimes, relevant human rights organizations or advocacy groups may need to be informed.
- It'simportanttonotethattheexactproceduresandpartiestobenotifiedcanvarybasedonyourlocationandthe specific circumstances of the crime. If you are unsure about who should be notified, you can contact your local law enforcementagencyoralegalprofessionalfor guidance.

PARTSOFGATHERINGEVIDENCE:

- Gatheringevidenceisacrucialaspectoflawenforcementinvestigationsandlegalproceedings.Itinvolvesthe collection of relevant information, facts, and materials to establish the truth or support a claim. Here aresome key parts of gathering evidence:

1. Witness Statements: Statements from individuals who have firsthand knowledge of the events or circumstancesbeinginvestigatedcanprovidevaluableinformation.Lawenforcementofficersofteninterview witnesses to gather their accounts of what they saw or experienced.

2. Physical Evidence: Physical items such as documents, photographs, videos, weapons, drugs, fingerprints, clothing,andmorecanserveas evidence.Properlycollecting,preserving,anddocumentingphysicalevidence is essential to maintain its integrity for legal proceedings.

3. Surveillance: Surveillancetechniques,suchassecuritycamerafootageorundercoveroperations,canyield visual evidence of activities relevant to an investigation.

4. ExpertOpinions:Incaseswherespecializedknowledgeisrequired,expertsinvariousfieldsmaybecalled upon to provide opinions or analyses. For example, a forensic expert might analyze DNA evidence, and a financial expert might testify about complex financial transactions.

5. DigitalEvidence:Withtheincreasingrelianceontechnology,digitalevidencelikeemails,textmessages, computer files, and social media posts can play a significant role in investigations.

6. ForensicEvidence:Forensicevidenceincludesawiderangeofscientificanalyses,suchasDNAtesting, ballistics, toxicology, and more. This type of evidence can be crucial in establishing connections between individuals, objects, or locations.

7. Documentation:Writtenrecords,suchasincidentreports,officialrecords,medicalreports,and communication logs, can provide a chronological account of events and actions taken.

8. Search Warrants: When law enforcement officers need to search a specific location or seize certain items, theyobtainasearchwarrantfromajudge.Thewarrantoutlineswhatcanbesearchedandseized,andit'sbased on probable cause.

9. Informant Information: Information from confidential informants can sometimes provide leads or insight intocriminalactivities.However,lawenforcementagenciesmustcarefullyassessthecredibilityandreliability of informants.

10. ChainofCustody:Maintainingaclearandunbrokenchainofcustody forevidenceisessentialtoensureits admissibility in court. This involves documenting who had control of the evidence from its collection to presentationin court.

11. **Interviews and Interrogations**: Conducting interviews and interrogations with suspects, victims, and witnessescanyieldinformationthathelpsshapetheinvestigation.Propertechniquesandlegalprotocolsmust be followed.
12. **LegalConsiderations**:Allevidencegatheringmustbeconductedincompliancewithlegalstandardsand the rights of individuals, as outlined in the constitution and relevant laws.

- Gatheringevidence requirescareful attentiontodetail,ethicalconsiderations,andadherencetolegal procedures. Itplays acritical roleinensuringfair andjustlegalprocessesandoutcomes.

DEFINEANDAPPLYPROBABLECAUSE:

- **Probable cause:**

Probable cause is a legal standard used in criminal law to establish that there is a reasonable belief that a crime hasbeen orisbeingcommitted.Itisthelevel of justificationorevidencerequiredby lawenforcementofficers before they can make an arrest, conduct a search, or obtain a search warrant. In simpler terms, probable cause means that there is enough factual information to support the belief that a crime has occurred or is about to occur.

Toapplyprobablecause, lawenforcementofficersneedtogatherenoughfacts,information,orevidencethat would lead a reasonable person to conclude that a crime is likely taking place. This evidence can include witness statements, physical evidence, surveillance, information from informants, and other relevant factors. It'simportanttonotethatprobablecauseisahigherstandardthanmeresuspicionbutlowerthanthestandard required for a conviction, which is proof beyond a reasonable doubt.

- Here'sanexampleofhowprobablecausemightbeapplied:
- Let's say that a police officer receives a report about a person acting suspiciously around a parked car in a dimly lit parking lot. The officer arrives at the scene and observes the individual looking around nervously, repeatedlyglancingtowardsthecar,andfidgeting.Theofficeralsonoticesthatthecar'swindowissmashed, and there are tools commonly used for breaking into cars lying on the ground nearby.
- Inthis scenario:

1. **Observations**:Theofficerobserves the suspiciousbehavior ofthe individual andthetoolsnear thecar.
2. **Factsand Evidence**:Thesmashedwindowandthepresenceofburglary toolsprovidefactual information.
3. **ReasonableConclusion**:Basedontheseobservationsandevidence,areasonablepersonmightconcludethat a car burglary is likely taking place.

4. **ProbableCause**:Theofficernowhasprobablecausetodetaintheindividual,questionthemabouttheir activities, and potentially search them for stolen property or further evidence of the crime.

- It'simportanttonotethattheapplicationofprobablecauseissubjecttolegalscrutiny.Ifevidenceor informationsupportingprobablecauseisfoundtobeinsufficientorimproperlyobtained,anysubsequent arrest, search, or seizure could be challenged in court as a violation of Fourth Amendment rights against unreasonable searches and seizures.

UNIT–IV

COMPUTER FORENSICS

Computer forensics, also known as digital forensics, is a specialized field within forensics that involves the collection, analysis, preservation, and presentation of electronic evidence in legal proceedings. It focuses on investigating digital devices such as computers, smart phones, servers, and other electronic storage media to uncover information relevant to criminal investigations or civil litigation. Computer forensics experts use a variety of techniques to extract, analyze, and interpret digital data to support legal cases.

Keyaspectsofcomputerforensicsinclude:

- **Data Recovery and Preservation**: Computer forensics experts use specialized tools and methods to recover and preserve digital evidence without altering or damaging the original data. This involves creating a forensic copy (bit-by-bit image) of the original storage media to ensure the integrity of the evidence.
- **Investigating Cybercrimes**: Computer forensics plays a crucial role in investigating cybercrimes such as hacking, data breaches, identity theft, and online fraud. Investigators analyze digital trails to identify the methods and perpetrators behind these activities.
- **Digital Evidence Analysis**: Investigators examine various types of digital evidence, including files,emails,documents,images,videos,logs,andmetadata.Theyanalyzethecontentandcontext of the data to establish timelines, connections, and patterns.
- **Malware Analysis**: Computer forensics experts may analyze malicious software (malware) to understand its behavior, origins, and potential impact. This helps in attributing cyberattacks and developing countermeasures.
- **Network Forensics**: Network forensics involves investigating network traffic, logs, and communication patterns to trace the path of data, identify unauthorized access, and reconstruct digital events.
- **Mobile Device Forensics**: With the widespread use of smartphones and tablets, mobile device forensics has become essential. Investigators extract data from mobile devices to find evidence of communication, location, and user activities.

- **Expert Testimony**: Computer forensics experts often testify as expert witnesses in court to explaintheirfindings,methodologies,andthesignificanceofdigitalevidencetojudgesandjuries.
- **Data Encryption and Decryption**: In cases involving encrypted data, computer forensics experts may work to decrypt and access the protected information while adhering to legal and ethical standards.
- **Chain of Custody**: Like other types of forensics, maintaining a clear chain of custody for digital evidence is critical to ensure its admissibility in court.
- **Compliance and Regulations**: Computer forensics experts often work in compliance with legal regulations and industry standards to ensure the admissibility and integrity of the evidence.
- Computer forensics plays a pivotal role in modern law enforcement, cybersecurity, corporate investigations, and civil litigation. It helps uncover hidden information, resolve disputes, and ensure the integrity of the legal process in the digital age.

PREPAREACASE:

Let'screateafictionalcriminalcaseinvolvingaburglary.Pleasenotethatthisisasimplified example, and real cases would involve more intricate details, legal research, and documentation.

- CaseTitle: TheStatevs. John Doe
- FactsoftheCase:
- Date and Location: On July 15, 2023, at approximately 9:00 PM, a burglary occurred at a residential property located at 123 Main Street.
- IncidentDescription:Thehomeownerreportedthatuponreturninghome,theydiscoveredsignsof forced entry, including a shattered rear window. Several valuable items were missing, including electronics, jewelry, and personal documents.
- **Eyewitness Testimony**: A neighbor reported seeing a suspicious individual near the property aroundthetimeoftheincident.Theneighbornoticedtheindividualactingnervouslyandglancing around.
- **Physical Evidence**: Law enforcement collected fingerprints from the shattered window and severalsurfacesinsidethehouse.DNAsampleswerealsotakenfromaglovefoundnearthe broken window.

INVESTIGATION

- Police Response: Officers from the local police department responded to the scene, secured the area, and began gathering evidence. They interviewed the homeowner and the neighbor who provided the eyewitness account.
- Evidence Collection: Crime scene technicians collected fingerprints from various surfaces, including the shattered window and items likely touched by the intruder. DNA samples were also collected from the glove.
- Forensic Analysis: The collected evidence was sent to the crime lab for analysis. Fingerprintswere compared to known records, and DNA samples were analyzed for possible matches.

SUSPECT IDENTIFICATION

- Criminal Record Check: Investigators ran a criminal record check and found that John Doe, a resident with a history of property-related offenses, lived nearby.
- SurveillanceFootage:SecuritycamerasintheareacapturedafigureresemblingJohnDoenearthe property around the time of the burglary.

ARREST&CHARGES

- Probable Cause: Based on the evidence collected, including the fingerprints, DNA samples, eyewitness testimony, and surveillance footage, law enforcement believed they had probablecause to arrest John Doe.
- Arrest: John Doe was apprehended and taken into custody. He was read his Miranda rights and questioned about his involvement.
- Charges:JohnDoewaschargedwithburglary,breakingandentering,andtheft.

LEGAL PROCEEDINGS

- Initial Appearance: John Doe was brought before a judge for his initial appearance. The charges were read, and bail was set.
- Preliminary Hearing: A preliminary hearing was scheduled to determine if there was enough evidence to proceed to trial.

- Possible Defense: John Doe's defense attorney might argue that the surveillance footage is inconclusive and does not definitively identify him as the person near the property. They could also question the reliability of the eyewitness account.

CONCLUSION:

- This hypothetical case involves the burglary of a residential property, with evidence including eyewitness testimony, physical evidence (fingerprints and DNA), and surveillance footage. The case would proceed through legal proceedings, with the prosecution presenting evidence to prove John Doe's guilt beyond a reasonable doubt, and the defense challenging the evidence and presenting counterarguments. Remember, real legal cases are much more complex and involve extensive legal research, courtroom procedures, and adherence to due process.

BEGIN ANINVESTIGATION:

Certainly, let's outline the steps involved in beginning a fictional investigation into a burglary case. Remember that investigations are complex processes that require careful planning, adherence to legal procedures, and attention to detail. This is a simplified example for illustration purposes:

CASE:ResidentialBurglaryat123MainStreet

Step 1: Report and Initial Response

- ReceivetheReport:Ahomeownerreportsaburglarythatoccurredattheirresidencelocatedat 123 Main Street. They provide details about the incident, including the date, time, and items stolen.
- Dispatch Officers: Dispatch sends officers from the local police department to the scene to investigate the reported burglary.

Step2: SceneAssessmentand Preservation

- Secure the Area: Officers arrive at the scene and secure the area to prevent tampering with evidence. They establish a perimeter and restrict access.
- Assess the Scene: Officers assess the scene to identify points of entry, exit, and any potential evidence such as broken windows, damaged locks, or signs of forced entry.

- Document the Scene: Crime scene technicians photograph and document the entire scene, capturing details of the damaged property, items missing, and any potential evidence.

Step3: Evidence Collection

- Collect Physical Evidence: Technicians collect physical evidence, including fingerprints from surfaces likely touched by the intruder, DNA samples from potential sources, and any items left behind.
- Eyewitness Interviews: Officers interview the homeowner and any potential witnesses, such as neighbors, who might have seen suspicious activity or individuals around the property.

Step4: ForensicAnalysis

- EvidenceProcessing:Collectedevidenceissenttothecrimelabforanalysis.Fingerprintsare compared to known records, and DNA samples are analyzed for possible matches.
- Surveillance Footage Review: Investigators review surveillance footage from the area to identify individuals near the property at the time of the burglary.

Step5: SuspectIdentification

- Criminal Record Check: Investigators run a criminal record check to identify individuals with ahistory of property-related offenses in the vicinity.
- WitnessCooperation:Ifaneyewitnessdescriptionmatchesapotentialsuspect,investigatorsmight work with the eyewitness to create a composite sketch.

Step6: DevelopingLeads

- CommunityOutreach:Investigatorsmightconductcommunityoutreach,askingneighborsfor information about unusual activities or persons seen in the area.
- Digital Evidence: If applicable, digital evidence from nearby security cameras or digital devicesmight be analyzed to track movements around the time of the burglary.

Step7: CollaboratewithExperts

- Forensic Experts: If needed, forensic experts (e.g., fingerprint analysts, DNA specialists) provide insights into the collected evidence.

Step8: Suspect Interviewand Arrest

- ProbableCause:Basedonevidenceandinformationgathered,investigatorsbuildacasetoestablish probable cause for the arrest of a suspect.
- MirandaRights:Onceasuspectisidentified,theyarereadtheirMirandarightsbeforeanyquestioning.

Step9: LegalProceedings

- Arrest: Ifthereisenough evidence,thesuspectisarrestedandtakenintocustody.
- Charges: The suspect is charged with burglary, breaking and entering, and theft based on the evidence collected during the investigation.

IMPORTANT NOTE: This is a high-level overview of the investigation process. In real cases, each step involves careful documentation, coordination among law enforcement teams, compliance with legal procedures, and consideration of ethical and privacy concerns.

UNDERSTANDCOMPUTERFORENSICSWORKSTATIONSANDSOFTWARE:

Computer forensics workstations and software play a crucial role in the field of digital forensics. These specialized tools and systems are designed to help investigators collect, analyze, and preserve digital evidence from various electronic devices. Here's an overview of computer forensics workstations and the software commonly used in the field:

ComputerForensics Workstations:

- Computer forensics workstations are dedicated systems designed to handle the complex tasks of digital evidence analysis.
- These workstations are equipped with hardware and software tailored to the specific needs of investigators. Key features of computer forensics workstations include:
- **High-Performance Hardware**: Workstations are equipped with powerful processors, sufficient RAM, and high-capacity storage to handle the processing and storage demands of large digital evidence datasets.
- **Write-Blocking Technology**: Workstations are equipped with write-blocking hardware or software, ensuring that evidence is not altered during the analysis process.

- **MultipleDriveBays**:Workstationsoftenhavemultipledrivebaystoaccommodatedifferent types of storage media, such as hard drives, SSDs, and USB devices, for evidence acquisition.
- **RemovableDriveCaddies**:Removabledrivecaddiesmakeiteasiertoswapoutdrivesfor analysis without needing to open the workstation's case.
- **MultipleMonitorSetup**:Havingmultiplemonitorscanhelpinvestigators analyzeevidencemore efficiently by allowing them to view multiple sources of data simultaneously.
- **Network Connectivity**: Connectivity options are crucial for accessing networked evidence andfor updating software tools and databases.
- **Secure Operating System**: Some workstations use specialized operating systems or configurations to enhance security and prevent contamination of evidence.

SoftwareUsedinComputer Forensics:

- Varioussoftwaretoolsareusedincomputerforensicstoperformtaskssuchasevidence acquisition, analysis, and reporting. Here are some common types of software used in the field:
- **Forensic Imaging Software**: Tools like "dd,""EnCase,""FTK Imager," and "Forensic Falcon"are used for creating forensic images (bit-by-bit copies) of storage media.
- **Analysis Tools**: These tools help investigators examine and recover data from digital evidence.Examples include "Autopsy,""X-Ways Forensics," and "Forensic Toolkit (FTK)."
- **FileCarvingSoftware**:Thesetoolsareusedtorecoverfilesfromunallocateddiskspaceor fragmented data. Examples include "Scalpel" and "PhotoRec."
- **Registry Analysis Tools**: These tools assist in analyzing Windows registry entries for evidence.Examples include "RegRipper" and "Windows Registry Viewer (RegViewer)."
- **Password Cracking Software**: These tools attempt to recover passwords from encrypted files or user accounts. Examples include "John the Ripper" and "Hashcat."
- **NetworkForensicsTools**:Toolslike"Wireshark"areusedtoanalyzenetworktrafficfor evidence of cyberattacks or unauthorized access.
- **MobileDeviceForensicsSoftware**:Toolslike"CellebriteUFED"and"OxygenForensic Detective" are used to extract data from mobile devices.

- **Data Recovery Software**: These tools help recover deleted or lost data from storage media. Examples include "Recuva" and "TestDisk."
- **Report Generation Tools**: These tools assist investigators in creating detailed and organized reports for legal purposes. They often allow the integration of images, findings, and conclusions. Some analysis tools also have built-in reporting features.
- It's important to note that the specific software used can vary based on the investigator's preferences, the nature of the case, and the jurisdiction's legal requirements. Additionally, computer forensics is a rapidly evolving field, so investigators must stay updated on the latesttools and techniques.

CONDUCTAN INVESTIGATION:

Thegeneralstepsinvolvedinconductingafictionalinvestigation.Let'suseahypotheticalscenarioof a suspected data breach at a company.

Case:SuspectedDataBreachatXYZCorporation

Step1:PreliminaryAssessment

- **Receive Report**: You, as the lead investigator, are informed about a potential data breach at XYZ Corporation. The company suspects that sensitive customer information has been compromised.
- **Gather Initial Information**: Meet with company representatives to get a basic understanding of the incident, including the timeline, possible entry points, and affected systems.

Step2:SecuretheScene

- **IsolateSystems**:Incollaborationwiththecompany'sITteam,isolatetheaffectedsystemsto prevent further compromise.
- **PreserveEvidence**:Ensurethataffectedsystemsarenottamperedwith.Ifnecessary,create forensic images of relevant hard drives for analysis.

Step3:EvidenceCollection

- **IdentifySources**:Determinewhichsystemsandserverswereinvolved.Collectlogs,server configurations, and any physical evidence like USB drives or unauthorized devices.

- **Interview Personnel**: Interview IT staff and anyone who might have noticed suspicious activity. Obtain details about when the breach was discovered and any potential signs.

Step4:Technical Analysis

- **LogAnalysis**:Reviewsystemlogstoidentifyunusualloginactivities,unauthorizedaccessattempts, or any patterns indicative of a breach.
- **Malware Analysis**: If malware is suspected, analyze malware samples to understand its behavior, infection vectors, and potential impact.

Step5:DataReconstruction

- **ReconstructTimeline**:Createatimelineofeventsleadinguptothebreach,includinganypotential entry points and lateral movement within the network.
- **DataRecovery**:Attempt torecoveranydeletedoraltereddatathatmightprovideinsightsintothe breach.

Step6:Identificationof Vulnerabilities

- **VulnerabilityAssessment**:Assessthecompany'ssecuritymeasures,patchmanagement,and network architecture to identify potential vulnerabilities that could have been exploited.
- **External Investigation**: Determine if the breach resulted from external factors, such as hacking, or internal factors, such as insider threats.

Step7:Mitigationand Prevention

- **Containment**: Work with the IT team to implement measures to contain the breach and preventfurther data leakage.
- **Patch and Update**: Ensurethat all systemsarepatched and up to date toprevent similar incidents in the future.

Step8:CommunicationandReporting

- **NotifyAuthorities**:Ifrequiredbylaw,reportthebreachtorelevantauthoritiesandregulatory bodies.

- **Notify Affected Parties**: If customer data was compromised, work with legal counsel and public relations to communicate with affected individuals.
- **Final Report**: Compile all findings into a comprehensive report detailing the breach, its impact,actions taken, and recommendations for strengthening security.

Step9:LegalProceedings

- **Legal Action**: If the breach was a result of criminal activity, work with law enforcement toinitiate legal proceedings against the perpetrators.
- Please note that real investigations are complex and require expertise in various fields, including digital forensics, cybersecurity, and legal matters. Additionally, investigations must be conducted while adhering to legal and ethical standards to ensure the integrity of evidence and compliance with applicable regulations.

COMPLETEA CASE:

Certainly,let'screateafictionalcaseinvolvingasuspectedtheft.Here'sacompleteoverviewofthe case, including theinvestigation, evidence, and legal proceedings:

CaseTitle: TheStatevs.Sarah Smith

FactsoftheCase:

- **Date and Location**: On September 10, 2023, a theft occurred at a local convenience store located at 456 Elm Street.
- **IncidentDescription**:Thestoremanagerreportedthatseveralhigh-valueitems,including electronics and cash from the register, went missing during the evening shift.
- **WitnessAccount**:AnemployeeworkingthelateshiftreportedseeingSarahSmith,another employee, near the cash register just before closing.

Investigation:

- **Police Response**: Officers from the local police department responded to the store andinterviewed the store manager and the employee who witnessed Sarah near the cash register.
- **Surveillance Footage**: The store's security cameras captured Sarah Smith near the cash register around the time of the incident.

- **EvidenceCollection**: Officerscollectedfingerprints from thecashregister andsurrounding areas. They also took statements from employees and reviewed the store's inventory logs.

Suspect Identification:

- **CriminalHistory**:AbackgroundcheckrevealedthatSarahSmithhadapriorcriminalrecord related to theft offenses.
- **Security Footage Analysis**: Investigators reviewed the security footage and observed Sarah near the cash register during closing time.

ArrestandCharges:

- **ProbableCause**:Basedonthesecurityfootage,witnessstatement,andSarah'shistory, investigators believed there was probable cause to arrest Sarah Smith.
- **Arrest**:SarahSmithwasarrestedandreadherMirandarights.Shewasquestionedabouther involvement in the theft.
- **Charges**:SarahSmithwaschargedwiththeft, a misdemeanor, basedonthe evidence collected during the investigation.

Legal Proceedings:

- **InitialAppearance**:SarahSmithwasbroughtbeforeajudgeforherinitialappearance.The charges were read, and bail was set.
- **PreliminaryHearing**:Apreliminaryhearingwasscheduledtodetermineiftherewasenough evidence to proceed to trial.

Trialand Verdict:

- **Trial**:Attrial,theprosecutionpresentedthesecurityfootage,witness testimony,andSarah'sprior record as evidence of her involvement in the theft.
- **DefenseArgument**: Sarah's defenseattorneyargued that the security footage was inconclusiveand that her presence near the cash register did not necessarily imply guilt.
- **Verdict**:Thejurydeliberatedandreturnedaguiltyverdictbasedontheevidencepresentedduring the trial.

Sentencing:

- **Sentencing Hearing**: A sentencing hearing was held to determine Sarah's punishment. The judge considered her criminal history, the nature of the offense, and any mitigating factors.
- **Sentence**:SarahSmithwassentencedtocommunityservice,probation,and restitutiontothestore for the stolen items and cash.

Conclusion:

- This fictional case involved a theft at a convenience store, with evidence including witness statements, security footage, and Sarah Smith's criminal history. The case went through legal proceedings, including trial and sentencing, ultimately resulting in a guilty verdict and a sentence that included community service, probation, and restitution. Keep in mind that real legal cases are more complex and involve numerous details, legal arguments, and considerations.

CRITIQUEA CASE:

Certainly,Icanprovideyouwithafictionalcaseandthenofferacritiqueofit.Let'screatea hypothetical case involving a

suspected arson:

CaseTitle: TheStatevs.Michael Johnson

FactsoftheCase:

- Date and Location: On April 5, 2023, a fire occurred at a commercial building located at 789 Maple Avenue.
- Incident Description: Firefighters responded to a blaze that extensively damaged the building, leading to substantial property loss.
- Witness Account: A bystander reported seeing Michael Johnson near the building shortly before the fire started. The witness stated that they heard an argument between Michael and another individual.

Investigation:

- **Fire Department Response**: Firefighters arrived at the scene to extinguish the fire and secure the area. They preserved any potential evidence during the process.

- **Witness Interviews**: Investigators interviewed the witness who reported seeing Michael Johnson nearthe buildingbeforethefire. Thewitnessdescribedan argumentbetweenMichael andanother person.
- **Fire Origin Analysis**: Arson investigators conducted an analysis of the fire's origin to determineif it was intentionally set.

Suspect Identification:

- **Interview with Michael Johnson**: Investigators questioned Michael Johnson about his presence near the building on the day of the fire. He admitted to being in the area but denied any involvement in starting the fire.
- **Alibi**: Michael provided an alibi, stating that he was at a coffee shop across town during the time of the fire.

ArrestandCharges:

- **Probable Cause**: Based on the witness account, Michael's presence near the building, and the possibility of an argument leading to arson, investigators believed there was probable cause to arrest Michael Johnson.
- **Arrest**: Michael Johnson was arrested and read his Miranda rights. He was questioned about his activities on the day of the fire.
- **Charges**: Michael Johnson was charged with arson, a felony offense, based on the evidence collected during the investigation.

LegalProceedings:

- **Initial Appearance**: Michael Johnson was brought before a judge for his initial appearance. The charges were read, and bail was set.
- **PreliminaryHearing**:Duringthepreliminaryhearing,thedefensearguedthattheevidence presented by the prosecution was circumstantial and did not conclusively prove Michael's guilt.
- **Grand Jury Indictment**: The case proceeded to a grand jury, which reviewed the evidence anddetermined whether there was enough evidence to proceed to trial.

Case Critique:

- **Strengths**:
  - The witness account provides a potential link between Michael Johnson and the buildingaround the time of the fire.
  - Investigatingthefire'soriginisessentialtodetermineifitwasintentional.
  - Michael'salibiprovides anopportunityforthedefensetochallengetheprosecution's case.
- **Weaknesses**:
  - The case reliesheavilyoncircumstantialevidence.While thewitnesssawMichaelnear the building, there is no direct evidence tying him to the fire's ignition.
  - Michael's alibi introduces doubt about his involvement, and the coffee shop's surveillance footage should be reviewed to corroborate his statement.
  - Investigatingpotentialmotivesforarson,suchasinsurancefraudorpersonalconflicts, could strengthen the case.

Recommendations:

- Continue analyzingthefire'soriginandgather anyphysicalevidence thatcouldsupport arson.
- Thoroughly investigate Michael's alibi, including reviewing surveillance footage from the coffee shop.
- Exploreanypotentialmotivesforarson,includingpersonalconflictsorfinancial difficulties.

NOTE: Keep in mind that this critique is based on a fictional case and serves as an example of evaluating the strengths, weaknesses, and potential improvements in an investigation. In real cases, multiple factors, legal standards, and thorough evidence analysis are crucial for a fair and just legal process.

NETWORKFORENSICS:

The word "forensics" means the use of science and technology to investigate and establish facts incriminal or civil courts of law. Forensics is the procedure of applying scientific knowledge for thepurposeofanalyzingtheevidenceandpresenting themincourt.

Networkforensicsisasubcategoryofdigitalforensicsthatessentiallydealswiththeexaminationofthe network and its traffic going across a network that is suspected to be involved in maliciousactivities,anditsinvestigationforexampleanetworkthatisspreadingmalwareforstealingcredent ials or for the purpose analyzing the cyber-attacks. As the internet grew cybercrimes alsogrew along with it and so did the significance of network forensics, with the development andacceptanceofnetwork-basedservicessuchastheWorldWideWeb,e-mails,andothers.

Withthehelpofnetworkforensics,theentiredatacanberetrievedincludingmessages,filetransfers,e-mails,and,webbrowsinghistory,andreconstructedtoexposetheoriginaltransaction.Itisalsopossiblethatt hepayloadintheuppermostlayerpacketmightwinduponthedisc,buttheenvelopesusedfordeliveringitare only capturedinnetworktraffic.Hence,the networkprotocoldatathatencloseeachdialogisoftenvery valuable.

For identifying the attacks investigators must understand the network protocols and applicationssuchaswebprotocols,Emailprotocols,Networkprotocols,filetransferprotocols,etc.

Investigatorsusenetworkforensicstoexaminenetworktrafficdatagatheredfromthenetworksthat are involved or suspected of being involved in cyber-crime or any type of cyber-attack. Afterthat, the experts will look for data that points in the direction of any file manipulation,humancommunication, etc. With the help of network forensics, generally, investigators and cybercrimeexperts cantrack down allthe communications andestablish timelines basedon networkeventslogsloggedbytheNCS.

ProcessesInvolvedinNetworkForensics:

Someprocessesinvolvedinnetworkforensicsaregivenbelow:

- **Identification:**Inthisprocess,investigatorsidentifyandevaluatetheincidentbasedonthenetworkpoin ters.
- **Safeguarding:**Inthisprocess,theinvestigatorspreserveandsecurethedatasothatthetemperingcanbep revented.

- **Accumulation:**Inthisstep,adetailedreportofthecrimesceneisdocumentedandallthecollecteddigital shredsofevidenceareduplicated.
- **Observation:**Inthisprocess,allthevisibledataistrackedalongwiththemetadata.
- **Investigation:**Inthisprocess,afinalconclusionisdrawnfromthecollectedshredsofevidence.
- **Documentation:**Inthisprocess,alltheshredsofevidence,reports,conclusionsaredocumentedandpre sentedincourt.

ChallengesinNetworkForensics:

- Thebiggestchallengeistomanagethedatagenerateddurингtheprocess.
- IntrinsicanonymityoftheIP.
- AddressSpoofing.

OVERVIEWOFNETWORKFORENSICS:

Networkforensicsisthe processofcapturing,recording,andanalyzingnetworktraffictouncoverand investigate security incidents or suspicious activities within a network. It plays a crucial role in identifying and mitigating cyber threats, as well as in gathering evidence for legal proceedings. Hereis an overview ofthekey aspects of networkforensics:

1. Data Capture:

- **PacketSniffing**:Involvesinterceptingandloggingnetworktrafficpassingthroughaspecificinterface or node in a network.
- **NetworkTaps**:Physicaldevicesthatallowforthepassivemonitoringofnetworktrafficbycreatinga copy of the data stream.
- **PortMirroring**:A featureonnetworkswitchesthat allowstrafficto beforwardedto amonitoring port foranalysis.

2. Data Analysis:

- **ProtocolAnalysis**:Examiningthecontentandstructureofdifferentnetworkprotocols(e.g., HTTP, FTP, SMTP) to understand communication patterns.
- **PayloadInspection**:Analyzingtheactualdatatransferredoverthenetwork,whichmayinclude text, files, images, etc.
- **SessionReconstruction**:Reassemblingfragmenteddatapacketstorecreatecompletesessions for analysis.

3. TrafficPatternsandAnomalies:

- **BaselineEstablishment**:Understandingnormalnetworkbehaviortoidentifydeviationsthatmay indicate suspicious activity.
- **IntrusionDetectionSystems(IDS)**:Automatedsystemsthatmonitornetworkorsystemactivitiesfor malicious actions or security policy violations.

4. PacketHeader Analysis:

- **SourceandDestinationIPAddresses**:Identify theoriginanddestinationofnetworktraffic.
- **PortNumbers**:Determinethespecificapplicationorserviceassociatedwithaparticularnetwork connection.
- **ProtocolInformation**:Recognizethenetworkprotocolusedin acommunication (e.g.,TCP, UDP).

5. Timestampsand Logging:

- **TimestampAnalysis**:Analyzingtimestampsinnetworkpacketstoestablishtimelinesofeventsand correlate with other logs.
- **SyslogsandEventLogs**:Examiningsystemlogstoidentifyrelevanteventsonnetworkdevices.

6. MalwareAnalysis:

- **TrafficSignatures**:Identifyingknownpatternsorsignaturesassociatedwithmalware communication.
- **BehavioralAnalysis**:Observingunusualbehaviorpatternsindicativeofmalwareactivity.

7. IncidentResponse:

- **AlertTriage**:Prioritizingandrespondingto securityalertsgeneratedbynetworkmonitoring tools.
- **ContainmentandEradication**:Takingstepstoisolateaffectedsystemsandremovemalicious elements.

8. Legal and Reporting:

- **EvidencePreservation**:Ensuringtheintegrityofcollecteddataforpotentiallegalproceedings.
- **ReportingandDocumentation**:Providingdetailedreportsoffindingsandrecommendationsfor remediation.

OPENSOURCESECURITYTOOLS FORNETWORK FORENSICANALYSIS:

There are several open-source security tools available for network forensic analysis that can help you investigate and analyzenetworktraffic,identifysecurityincidents,andgatherevidenceforpotentialbreaches.Herearesomepopular options:

1. Wireshark:

- Description:Awidely-usedpacketanalyzerfornetworktroubleshooting,analysis,andcommunication protocol development.
- Features:Capturesandanalyzesthedatatravelingbetweendevicesona network.
- Website:Wireshark
- Bro(nowZeek):
  - Description:Apowerfulnetworkanalysisframeworkthatprovidesdetailed logsandmetadata.
  - Features:Analyzesnetworktrafficandgeneratesdetailedlogsaboutit.
  - Website:Zeek
- Security Onion:
  - Description:ALinux distroforintrusion detection,networksecurity monitoring,andlog management.
  - Features:Integratesvariousopen-sourcetoolslikeSnort,Suricata,Bro/Zeek,andmore.
  - Website:Security Onion
- Moloch:
  - Description:Alarge-scale,open-source,indexedpacketcaptureandsearchsystem.
  - Features:Capturesandindexespacket-leveldataforanalysis.
  - Website:Moloch
- NetworkMiner:
  - Description:Anetwork forensicanalysistoolfor Windows.
  - Features:Capturesand analyzestraffic andextractsfilesandmetadata.
  - Website:NetworkMiner

6. Suricata:
   1. Description:Ahigh-performanceNetwork IDS, IPS,andNetworkSecurityMonitoring(NSM)engine.
   2. Features:Analyzesnetworktrafficinreal-timeandcandetectvariousthreats.
   3. Website:Suricata

7. CapTipper:
   1. Description:APythontooltoanalyze,explore,andreviveHTTPmaliciostraffic.
   2. Features:Decodesandanalyzescapturedtraffic,extractsfiles,andmore.
   3. Website:CapTipper
7. YARA:
   7. Description:Apattern-matchingswissknifeformalware researchers.
   8. Features:Helpsinidentifyingandclassifyingmalwaresamplesbasedontextualorbinary patterns.
   9. Website: YARA

8. Volatility:
    7. Description:Anadvancedmemoryforensicsframework.
    8. Features:Analyzesmemorydumpsforextractinginformationaboutrunningprocesses andmore.
    9. Website:Volatility
9. NetworkX:
    1. Description:APythonlibraryforthecreation,manipulation,andstudyofcomplex networks.
    2. Features:Useful foranalyzingandvisualizingnetworkgraphs.
    3. Website:NetworkX

- Remember to always use these tools responsibly and ethically, and ensure that you have the necessary permissionstoperformnetworkforensicanalysisonanynetwork.Additionally,stayingupdatedwiththe latest versions and releases of these tools is important to take advantage of new features and security improvements.

OVERVIEWOFNETWORKFORENSICS

- Network forensics is the process of capturing, recording, and analyzing network traffic to uncover and investigatesecurityincidentsorsuspiciousactivitieswithinanetwork.Itplaysacrucialroleinidentifying and mitigating cyber threats, as well as in gathering evidence for legal proceedings.
- Hereis an overview ofthekey aspects of networkforensics:

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- **AlertTriage**:Prioritizingandrespondingto securityalertsgeneratedbynetworkmonitoring tools.
- **ContainmentandEradication**:Takingstepstoisolateaffectedsystemsandremovemalicious elements.

8. Legal and Reporting:
- **EvidencePreservation**:Ensuringtheintegrityofcollecteddata forpotentiallegal proceedings.
- **ReportingandDocumentation**:Providingdetailedreportsoffindingsandrecommendationsfor remediation.

9. ForensicToolsandTechnologies:
- **Wireshark**:Awidelyusedopen-sourcepacketanalyzer fornetwork analysis.
- **Snort**:Anopen-sourceintrusiondetectionsystem(IDS)fordetectingandpreventingnetwork intrusions.
- **Bro/Zeek**:Apowerfulnetworksecuritymonitoring framework.
- **ELKStack(Elasticsearch,Logstash,Kibana)**:Usedforlogmanagementand analysis.

10. Continuous Monitoring:
- Implementingongoingnetworkmonitoringandloggingpracticestodetectandrespondtopotentialthreatsin real-time.
- Rememberthatnetworkforensicsisadynamicfield,andit'scrucialforprofessionalstostayupdatedwiththe latest technologies, techniques, and best practices to effectively respond to evolving cyber threats.

OPENSOURCESECURITYTOOLSFORNETWORKFORENSICANALYSIS

- **Thereareseveralopen-sourcesecuritytoolsavailablefornetworkforensicanalysisthatcanhelpyou investigate and analyze network traffic, identify security incidents, and gather evidence for potential breaches. Here are some popular options:**

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UNIT-V

MobileForensics–Definition,Uses,andPrinciples

- Mobileforensicsisabranchofdigitalforensicsthatfocusesonthecollection,preservation, analysis, and presentation of digital evidence from mobile devices such as smartphones, tablets, and sometimes even wearable technology. It plays a critical role in criminal investigations, incident response, and cybersecurity.
- Herearesomekey aspects of mobileforensics:

1. DeviceAcquisition:

- **Logical Acquisition**: Extracting data that is readily accessible without accessing the device's internal storage. This includes call logs, contacts, messages, and some application data.
- **PhysicalAcquisition**:Extractingabit-by-bitcopyoftheentiredevice'sstorage,including deletedandhiddendata.

2. SupportedPlatforms:

- **iOS**:Apple'smobile operatingsystemused oniPhonesand iPads.
- **Android**:Google'smobileoperatingsystem,usedonawiderangeofdevicesfromdifferent manufacturers.
- **Others**:ForensicstoolsmayalsosupportotherplatformslikeWindowsMobileor BlackBerry, though they are less common.

3. Data Categories:

- **CallLogsandMessages**:Informationaboutcallsmade,received, andtextmessages.
- **Contacts**:Informationaboutthecontactsstoredonthedevice.
- **MediaFiles**:Photos,videos,andaudiorecordings.
- **ApplicationData**:Datastoredbythird-partyapplications,suchassocialmediaapps, messaging apps, and email clients.
- **LocationData**:GPScoordinatesandlocationhistory.
- **BrowserHistory**: Informationaboutwebsitesvisited.
- **Emails**:Messagessentand receivedthroughemail clients.
- **AppPermissionsandSettings**:Informationaboutwhichappshaveaccesstocertain features or data.

4. ForensicTools:

- **CellebriteUFED**:Awidelyusedcommercialmobileforensicstool.

- **XRY**:Anotherpopularcommercialmobileforensicssolution.
- **Autopsy**: An open-source digital forensics platform that includes mobile forensics capabilities.

5. FileSystem Analysis:

- **File Carving**: Recovering files from unallocated or unused space, which may have been deleted.
- **SQLite Database Analysis**: Many applications use SQLite databases to store information, and examining these databases can provide valuable insights.

6. PasswordBypass and Decryption:

- Techniques to bypass device passwords or decrypt data, which can be essential in accessing locked devices.

7. Cloud Forensics:

- Investigating data stored in cloud services associated with the device, such as iCloud, Google Drive, or Dropbox.

8. TimelineAnalysis:

- Creating a chronological timeline of events and activities on the device, which can be crucial for reconstructing sequences of events.

9. ReportingandDocumentation:

- Providingdetailedreportsoffindings,includinginformationaboutthemethodologiesused and the evidence collected.

10. LegalConsiderations:

- Ensuring that all forensic procedures adhere to legal and privacy regulations, and that the evidence gathered is admissible in court.

Mobile forensics is a rapidly evolving field due to the continuous development of mobile technologies and the increasing complexity of mobile devices. Professionals in this field need tostay updated with the latest tools and techniques to effectively investigate and respond to incidents involving mobile devices.

MOBILEFORENSICTECHNIQUES

- Mobileforensicsinvolvesvarioustechniquestoextract,analyze,andinterpretdigitalevidence from mobile devices. Here are some common techniques used in mobile forensics:

1. Logical Acquisition:

- Involvesobtainingdatathatisreadilyaccessiblewithoutaccessingthedevice'sinternal storage. This includes call logs, contacts, messages, and some application data.
- Methods:Backupextraction,syncingwithaforensictool,orusingdevice-specific protocols.

2. Physical Acquisition:

- Involvescreatingabit-by-bitcopyoftheentiredevice'sstorage,includingdeletedand hidden data.
- Requiresspecializedtoolsandmay belimitedbydevicemodelsandsoftware versions.

3. FileSystem Analysis:

- Examining the file system of the device to recover and analyze files, including those thathave been deleted.
- Techniqueslikefile carvingcan beusedtorecover datafromunallocatedorunused space.

4. SQLiteDatabase Analysis:

- ManymobileapplicationsuseSQLitedatabasestostoreinformation.Analyzingthese databases can provide valuable insights into the device's activities and user interactions.

5. App DataExtraction:

- Extracting data stored by third-party applications,such associal media apps,messagingapps, and email clients.
- Thismayinvolveaccessingapp-specificdatabasesorextractingdatathroughbackupfiles.

6. CloudForensics:

- Investigatingdatastoredincloudservicesassociatedwiththedevice,suchasiCloud, Google Drive, or Dropbox.
- Requires obtaining access credentials and using appropriate forensic techniques to retrieve cloud-stored data.

7. PasswordBypass and Decryption:

- Techniquestobypassdevicepasswords,unlockpatterns,ordecryptdata,whichcanbe essential in accessing locked devices.

8. TimelineAnalysis:

- Creatingachronologicaltimelineofeventsandactivitiesonthedevice.Thishelpsin reconstructing sequences of events, which can be crucial for investigations.

9. LocationDataAnalysis:

- Extracting and analyzing GPS coordinates, location history, and geotagged information from photos or other files.

10. NetworkTrafficAnalysis:

- Analyzing network traffic generated by the mobile device, which can provide insights into communication patterns, visited websites, and data exchanged over the network.

11. HexadecimalAnalysis:

- Viewing the device's raw data in hexadecimal format to identify patterns, headers, and anomalies.

12. Data Carving:

- Recoveringfilesfromunallocatedorunusedspaceonthedevice'sstorage.Thiscanhelpin retrieving deleted or partially overwritten files.

13. Keyword Searching:

- Using specific keywords or regular expressions to search for relevant information within extracted data.

14. ReportingandDocumentation:

- Providing detailed reports of findings, including information about the methodologiesused, the evidence collected, and the interpretations made.

15. LegalConsiderations:

- Ensuring that all forensic procedures adhere to legal and privacy regulations, and that the evidence gathered is admissible in court.

- It's important to note that the choice of technique depends on factors like the type of device, its operating system, and the specific objectives of the investigation. Additionally, mobile forensics professionals must stay updated with the latest tools and techniques to effectively handle a wide range of devices and operating systems.

MOBILE FORENSICS TOOLS

- There are several specialized tools available for conducting mobile forensics. These tools are designedtohelp investigatorsextract, analyze, andinterpretdigital evidencefrommobiledevices. Here are some commonly used mobile forensics tools:

1. CellebriteUFED:

- Oneofthemostwidelyused commercialmobileforensics tools.
- Supportsawide rangeof devices andoperatingsystems, includingiOSand Android.
- Offersbothlogicalandphysicalacquisitioncapabilities.

2. XRY:

- Anotherpopularcommercialmobileforensicssolution.
- Providessupportforavariety ofdevices andoperating systems.
- Offersfeaturesforbothlogicalandphysicalacquisition,aswellasadvancedanalysis capabilities.

3. OxygenForensicDetective:

- Supportsawiderangeof devicesandoperatingsystems.
- Offersadvancedanalytics,includingsocialmedia,cloud,andapplicationdataextraction.

4. MSABXEC:

- Knownforits comprehensivesupportforvariousmobiledevices andoperating systems.
- Offersbothlogicalandphysicalacquisition,aswellasadvancedanalysiscapabilities.

5. Autopsy:

- Anopen-sourcedigitalforensicsplatformthatincludesmobileforensics capabilities.
- SupportsAndroiddevicesandprovidesfeaturesforlogicalacquisitionandanalysis.

6. Mobilyze:

- Atool designedfor on-scenemobile deviceforensics by Cellebrite.
- Allowsforthequick extractionandanalysisof datafrommobile devices.

7. Magnet AXIOM:

- Adigital forensics tool thatincludes support formobiledevices.
- Offersfeaturesforbothlogicalandphysicalacquisition,aswellasadvancedanalysis capabilities.

8. Paraben'sDeviceSeizure:

- Providessupport forawiderangeof mobiledevices,including iOS, Android, and others.
- Offersfeaturesforbothlogicalandphysicalacquisition.

9. Andriller:

- Anopen-sourceforensictoolforAndroiddevices.
- Allowsfortheextractionofdatafromlockedor encrypted devices.

10. ElcomsoftiOSForensicToolkit:

- SpecializediniOSdeviceforensics.
- Providesadvancedcapabilitiesfor unlockingandextractingdata fromiOSdevices.

11. CelebritePhysicalAnalyzer:

- A component of the Cellebrite UFED suite, focused on the analysis of physically acquired data.

12. SQLiteDB Viewer:

- NotastandaloneforensicTool,butausefulsoftwareformanuallyexaminingSQLite databases extracted from mobile devices.

13. Evimetry:

- Aforensictoolwithmobiledevicesupportknownforitsspeedandscalabilityinevidence acquisition.

- Remember that the choice of tool may depend on various factors, including the type of device, its operating system, and the specific requirements of the investigation. Additionally, it's important for forensic professionals to stay updated with the latest tools and techniques to effectively handle a wide range of devices and operating systems.

LEGALASPECTSOFDIGITAL FORENSICS

- Legal considerations are paramount in digital forensics. When conducting digital investigations, professionals must adhere to legal and ethical guidelines to ensure the admissibilityof evidence in court and protect individuals' rights. Here are some key legal aspects of digital forensics:

1. AuthorizationandConsent:

- Obtaining proper authorization or consent before conducting a digital investigation is crucial. This may come from a court-issued warrant, a company's policies, or an individual's voluntary consent.

2. Chain of Custody:

- Maintaining a detailed record of the custody, control, transfer, and analysis of digital evidence is essential. This helps establish the integrity and authenticity of the evidence in court.

3. Privacy Laws:

- ComplyingwithprivacylawsandregulationsisvitalThisincludeslawslikeGDPR (General Data Protection Regulation) in Europe and HIPAA (Health Insurance Portability and Accountability Act) in the United States.

4. FourthAmendmentRights:

- In the U.S., the Fourth Amendment protects individuals from unreasonable searches and seizures. This means that law enforcement typically requires a search warrant based on probable cause to conduct a digital search.

5. Exigent Circumstances:

- In some situations, such as emergencies or potential destruction of evidence, law enforcement may be allowed to conduct a search without a warrant. However, this should be carefully evaluated and documented.

6. Attorney-ClientPrivilege:

- Communicationsbetweenaclientandtheir attorneyareprivilegedandgenerallycannotbe used as evidence. Digital forensics professionals need to respect this privilege and avoid examining such communications without proper authorization.

7. Expert Testimony:

- Digital forensics experts may be called upon to provide expert testimony in court. They must be prepared to explain their findings, methodologies, and the reliability of the evidence.

8. Spoliation of Evidence:

- Failure to preserve or protect digital evidence can lead to accusations of spoliation, which can result in legal penalties. Proper handling and documentation of evidence are essential to prevent this.

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9. AdmissibilityofEvidence:

- Theevidencecollectedthroughdigitalforensicsmustmeetcertaincriteriatobeadmissible in court. This includes relevance, authenticity, and reliability.

10. Cross-BorderConsiderations:

- When conducting digital investigations that involve data crossing international borders, professionals must be aware of jurisdictional challenges and legal requirements.

11. EthicalHackingandIntrusion:

- Professionals must be aware of the legal implications of their actions. Unauthorizedaccess, even for the purpose of investigation, may be considered hacking and can have serious legal consequences.

12. ReportingandDocumentation:

- Properly documenting all steps taken during the digital investigation is crucial. This includes detailing the tools used, methodologies employed, and findings.

- It's important for digital forensics professionals to work closely with legal experts and law enforcement to ensure that investigations are conducted in compliance with applicable laws and regulations. Staying updated on evolving legal frameworks and precedents is also critical in this field.

ITACT 2000

- The Information Technology Act, 2000 (IT Act 2000) is a significant legislation enacted by the Government of India to govern and regulate various aspects of electronic commerce and digital communication. It addresses legal issues related to electronic transactions, digital signatures, data protection, and cybercrimes. Here is an overview of the key provisions of the IT Act 2000:

1. Digital Signatures:

- The Act provides legal recognition to digital signatures, making them equivalent to handwritten signatures in electronic transactions. This facilitates secure and authenticated online transactions.

2. ElectronicRecordsandDocuments:

- The Act recognizes electronic records as legally valid documents, thereby allowing contracts, notices, and other legal documents to be created and stored electronically.

3. Cybercrimes:

- The Act identifies various cybercrimes such as unauthorized access, hacking, identitytheft, and spreading of computer viruses. It prescribes penalties for these offenses.

4. DataPrivacyand Security:

- The Act includes provisions to protect the privacy and security of electronic data. It mandates that businesses and organizations implement reasonable security practices to safeguard sensitive information.

5. RegulationofCertifyingAuthorities:

- The Act establishes a framework for Certifying Authorities (CAs) that issue digital certificates and authenticate the identity of individuals and entities in electronic transactions.

6. PenaltiesandOffenses:

- The Act outlines penalties for various cyber offenses. These penalties may include imprisonment, fines, or both, depending on the severity of the offense.

7. IntermediaryLiability:

- The Act provides a safe harbor for intermediaries (like internet service providers andsocial media platforms) from legal liability for content posted or transmitted by users, as long as they comply with certain due diligence requirements.

8. Blocking of Information:

- The Act grants authorities the power to issue orders to block public access to certain information or websites in the interest of national security or public order.

9. ExtraterritorialJurisdiction:

- The Act has provisions for dealing with offenses committed outside India, provided they involve a computer or computer system located in India.

10. Appeals andAdjudication:

- The Act establishes an adjudication process for resolving disputes related to electronic transactions, and it allows for appeals against adjudication orders.

11. Amendmentsand Updates:

- The IT Act has been amended several times to address emerging challenges in the digital space, including amendments related to data protection and privacy.

12. PenaltiesforCyberOffenses:

- TheActprescribes penaltiesforvarious cyberoffenses,including imprisonmentand fines.

- It's worth noting that the IT Act has seen significant amendments over the years, and India hasalso introduced additional legislation such as the Information Technology (Intermediaries Guidelines) Rules, 2011, and the Personal Data Protection Bill, 2019, which is underconsideration to become law.
- Giventhedynamicnatureofthedigitallandscape,theITActandrelatedregulationscontinueto evolvetoaddress emergingchallengesandtechnologies.

AMENDMENTOFITACT2008

- The Information Technology Act of 2000 was amended in 2008 to address various emerging issues and to strengthen provisions related to cybercrime and electronic transactions. The amendments were made through the Information Technology (Amendment) Act, 2008. Here are some of the key amendments:

1. IntroductionofNewOffenses:

- The2008amendmentintroduced severalnewoffenses, including:
  - Cyber-terrorism.
  - Publishingortransmittingsexuallyexplicitmaterialinelectronic form.
  - Child pornography.
  - Violation of privacy.
  - Identitytheft.

2. StrengthenedPenalties:

- The amendment increased penalties for various offenses under the IT Act. For example, it increased the maximum imprisonment term for certain offenses.

3. ProvisionsforDataProtectionandPrivacy:

- The amendment included provisions related to data protection and privacy, which were previously not as explicitly addressed. This laid the groundwork for further discussions on comprehensive data protection legislation.

4. BlockingofWebsitesand Content:

- TheamendedActgrantedthegovernmenttheauthoritytoblock websitesoronlinecontent that was deemed to be objectionable or against public interest.

5. IntermediaryLiabilityClarifications:

- The2008amendmentprovidedfurtherclarityontheliabilityofintermediaries. Itspecified that intermediaries would not be held liable for third-party content as long as they act as intermediaries and follow due diligence.

6. PreservationandRetentionofData:

- The amendment strengthened provisions related to the preservation and retention of electronic records by service providers for investigation purposes.

7. StrengtheningofCERT-In:

- The amendment further empowered the Indian Computer Emergency Response Team (CERT-In)tohandlecybersecurityincidentsandprotectcriticalinformationinfrastructure.

8. SearchandSeizurePowers:

- Theamendmentclarifiedandexpandedthepowersoflawenforcementagenciesinrelation to search and seizure of computer systems and electronic evidence.

9. NotificationofData Breaches:

- Theamendmentintroducedprovisionsforthe mandatoryreportingofdatabreaches,which was an important step towards data security and accountability.

10. StrengthenedProvisionsAgainstSpam:

- The amendment included provisions to combat spam and unauthorized electronic communication.

- These amendments were aimed at enhancing the legal framework to address the evolving challenges in the digital space, including cybercrime, privacy, and data protection. They also aimed to align India's legal framework with international best practices in the field of information technology and cybersecurity.

RECENT TRENDS IN MOBILE FORENSIC TECHNIQUEAND METHODS TO SEARCH AND SEIZURE ELECTRONIC EVIDENCE

Somerecenttrendsinmobileforensictechniques:

1. Cloud Forensics:

- With the increasing use of cloud services for data storage and synchronization, forensic experts are focusing on extracting and analyzing data from cloud platforms like iCloud, Google Drive, and Dropbox.

2. SecureEnclaveand Hardware-LevelEncryption:

- The latest mobile devices, particularly iPhones, have advanced security features like Secure Enclave and hardware-level encryption. Forensic experts are exploring techniques to bypass or extract data from these highly secure areas.

3. AdvancedDataExtractionMethods:

- New methods for physical acquisition are being developed to overcome limitations imposed by modern device security features. This includes techniques for bypassing passcodes, screen lock mechanisms, and biometric authentication.

4. AppSecurityandDataProtection:

- As apps implement stronger encryption and security measures, forensic experts are developing methods to bypass or decrypt app-specific protections to access relevant data.

5. ChatandSocialMediaAnalysis:

- Messaging apps and social media platforms continue to be crucial sources of evidence. Forensicexpertsarefocusingontechniquestorecovermessages,media,andotherrelevant data from these platforms.

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6. MachineLearningandAI:

- AI and machine learning algorithms are being employed to analyze large datasets and identify patterns or anomalies. This can aid in automating certain aspects of mobile forensics analysis.

7. BlockchainandCryptocurrencyInvestigations:

- As cryptocurrencies become more prevalent, there is a growing need for forensic techniques to trace and analyze blockchain transactions.

8. IoTDevice Forensics:

- With the proliferation of Internet of Things (IoT) devices, forensic experts are developing methods to extract and analyze data from connected devices like smart home systems, wearables, and IoT sensors.

Methods forsearch and seizureofelectronic evidence, it's importanttonotethatany such activities must be conducted in compliance with legal and ethical standards. Here are some recommended steps:

1. ObtainProper Authorization:

- Ensure that you have the appropriate legal authorization, such as a search warrant issuedby a court, before conducting any search and seizure activities.

2. Documentthe Process:

- Thoroughlydocumenteachstepofthesearchandseizureprocess,includingthedate,time, location, individuals present, and actions taken.

3. Maintain Chain of Custody:

- Keep a detailed record of the custody, control, transfer, and analysis of electronicevidence. This helps establish the integrity and authenticity of the evidence in court.

4. MinimizeData Alteration:

- Take precautions to avoid altering or contaminating the electronic evidence during the search and seizure process.

5. UseProperToolsand Techniques:

- Employ specialized forensic tools and techniques to ensure that electronic evidence is collected in a forensically sound manner.

6. PreserveOriginalEvidence:

- Wheneverpossible,work withcopiesofthedataratherthantheoriginaldevicestoprevent accidental data alteration.

7. NotifyAffected Parties:

- If required by law, inform the affected parties about the search and seizure activities and their rights.

8. AdheretoPrivacyandDataProtectionLaws:

- Comply with relevant privacy and data protection laws, ensuring that the rights of individuals are respected during the process.

9. Consult Legal Experts:

- If in doubt about legal procedures or the interpretation of laws, consult legal experts to ensure compliance.

- It's crucial to stay updated with the latest legal and technological developments in the field of digital forensics to conduct effective and legally compliant investigations. Additionally, always consult with legal experts to ensure that your actions align with current laws and regulations.