Computer Science

Notes

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typeset with LaTeX

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Todo list

The notes give the three figures without a source. They look like the statistics quoted in a Microsoft enterprise-mobility presentation, so treat them as claims to be referenced. 1

The last item on the page reads "> 75% → stolen credentials" and is marked with two asterisks. It is read here as the share of cloud breaches that involve stolen credentials. 1

In Windows the system folders are `System32` and `SysWOW64` (the 32-bit components on 64-bit Windows). There is no standard `System64` folder. 1

"Only vendor" is a marketing claim from the course material. Other vendors also provide mobile device management. 2

The ticks and crosses on the arrows of the drawing are hard to read. The dashed arrow from Intune to Office 365 is read as the policy-verification result. 2

.NET Core 2.1 was current when the notes were written. It is long out of support; current releases are ".NET" (without "Core") with a number such as 8. 5

The sentence ".NET Conf 2017 is a wrap" is read as written. 5

On the page "`new`" is overwritten with "(app)" ahead of "`web`". The command is read as `dotnet new web -o mywebapp`, which creates an empty web project in the folder `mywebapp`. 5

The surnames of the speakers are hard to read, and three of them are given only by first name. 7

No source or year is given for the 20 billion figure. 7

This comparison is a short note in the margin. Its meaning (the cost of data use against how many people can use the service) is read from the arrows and may not be what was said in the talk. 8

The word "Instructor" in front of each post may be a note on who teaches that stage. It is kept as on the page. 8

The wording of these licensing answers comes from a Microsoft training quiz for System Center 2012 and follows its licensing terms (ML = management licence, OSE = operating system environment). The product and its licensing model are no longer sold; check the current Microsoft licensing documents before relying on them. 10

The wording of question 3 is partly hard to read ("license quality for"), and "SMSE" is marked in yellow. 10

The chain from "Something wrong" to "Problem with barcode" is hard to read; the last words after the sad-face symbol are kept as written. . 12

In the original diagram the control step sits between the risk statement and the learn step, with an arrow from “Learn” and a note “Master Risk”. I have drawn it as a side branch from “Learn”; the exact arrows should be checked against the scan. 14

The four small lists written vertically beside the nested boxes (“locks”, “docking stations”, “laptop security”, “laptop safes”, “theft recovery”, “alarms”) are hard to read in the scan; I have placed them under *Servers*. 15

The last answer looks wrong. Microsoft’s technology for centrally managing users and information about them is *Active Directory* (which uses LDAP, Kerberos and DNS, as noted below); the Point-to-Point Tunnelling Protocol (PPTP) is a VPN protocol. The answer is kept as written. 15

Question 3 is correct as written: PGP is used for signing and encrypting email and files, while SSL/TLS secures websites. 15

“Leg angles” is written at the bottom of the behavioural list; it may mean gait analysis. 16

PKI and CRL are written together under “Encryption” with a bracket pointing to the list of forms. I have kept them as related infrastructure rather than as forms of encryption. 16

In question 3 the answer is written as “Network access translation”; the technique is *network address translation* (NAT). In question 5 the answer (False) is right: a firewall works at the network and transport layers (layers 3 and 4), and some work up to layer 7, but not specifically layer 6. 18

The question written over *predictive* analytics is “Why?”, the same as for diagnostic analytics. The usual formulation is: descriptive, “what happened?”; diagnostic, “why did it happen?”; predictive, “what will happen?”; prescriptive, “how can we make it happen?” The wording is kept as written. 21

The lab architecture is drawn vertically, with the labels rotated; the order of the boxes and the direction of the arrow between the Power BI report and the flight-booking apps are my best reading of the scan. . . 23

The grade bands overlap at their edges (85%, 64%); the boundaries are kept as written. 24

TaihuLight is a Chinese machine; the 122.3 PFLOPS score is that of the US supercomputer Summit (2018). The two entries appear to have been joined; the lines are kept as written. 25

A short note “#1 … YouTube” beside the ROM list refers to the source of the lecture (partly struck out in the scan). 25

Several dates and names in this list differ from the usual accounts. The slide rule is credited to William Oughtred, in England, around 1622 (the notes say Germany, 1620, "William Artet"). The Harvard Mark I was completed in 1944, not 1930. Hollerith's tabulating machine was used for the 1890 US census. The notes are kept as written. 26

The notes write "dots per minute (dpi)"; the unit is dots per *inch*. . . . 28

The last two names ("Bronto byte" and "Geop byte (Geb)") are informal; they are kept as written. 29

An earlier page of the notes gives 101 keys for a standard keyboard; 101 and 104 are both common standard layouts. 29

"Virtual memory... if memory full of ROM" in the original probably means RAM; virtual memory uses disk space when RAM is full. . . . 29

This method treats 35 as a decimal number, and the remainders are also off (the decimal number 35 is 100011_2). The usual method for octal to binary is to write each octal digit in three bits: $3 \to 011$ and $5 \to 101$, so $(35)_8 = (011101)_2 = (11101)_2$, which equals the 29_{10} found in the previous step. The notes are kept as written. 30

The notes give the answer as $(01111)_2$. The remainders written down (1, 1, 1, 1, and then 0 for the last step) would give 01111_2, but the last step 1/2 leaves remainder 1, so the correct answer is $(11111)_2 = 31$. . . 31

DNG is Adobe's *Digital Negative* raw-image format; the notes write "Digital network format". JPG is the same format as JPEG with a shorter file extension. For PDF the notes write "(Permanent) document format" and strike out "Permanent", correcting it to *Portable*. 32

The embedded OS entry has empty brackets in the notes, and the examples for the distributed OS ("Rover, AI") are partly cut off. . . . 33

Unix was not originally released under an open-source licence (it was proprietary to AT&T Bell Labs; later free variants appeared). The notes write "Duglus" for Douglas McIlroy. DOS 8.0 does not exist as a standalone release: MS-DOS reached version 6.22 in 1994, and the DOS inside Windows Me is sometimes labelled 8.0. The notes are kept as written. 33

The notes place the router's description as "Processor/Memory/I/O Interface $\ni$ Router"; this is kept out of the summary above because its meaning is unclear. A gateway can work at any layer, including the application layer; the transport layer is what the notes say. 37

The shortcut for a new worksheet and the "Value choose forecasting" item are written as short phrases in the notes; the answers are kept as written. The Freeze Panes command is on the View tab in recent versions of Excel (on the Window menu in older ones). 38

1 Enterprise Mobility and Microsoft Azure

Contents of the notebook

The notebook lists the following topics: increase productivity and security with enterprise mobility; ASP.NET Core; an IT-expert roundtable on the cloud at Microsoft; System Center 2012 licensing overview; Windows 10 IT Pro essentials and support secrets; security fundamentals; the Cortana Intelligence Suite end to end; CCC (Concepts of Computer Course); CCC exam questions.

1.1 Increase productivity and security with enterprise mobility

1.1.1 Trends and security

Area	Figure	Finding
Mobiles	61%	work happens on personal phones and computers
Computers	> 80%	of employees use non-approved software
Cloud	> 75%	of breaches involve stolen credentials

The notes give the three figures without a source. They look like the statistics quoted in a Microsoft enterprise-mobility presentation, so treat them as claims to be referenced.

Security has four parts: users, devices, apps and data. Other points noted: use false identification generally, and key travel with data.

1.1.2 Identity

The last item on the page reads "> 75% → stolen credentials" and is marked with two asterisks. It is read here as the share of cloud breaches that involve stolen credentials.

95% of organisations use Windows Server with an identity service (Active Directory). Data security must cover *employees, business partners and customers*, and gives them *access to applications*.

Today a computer has millions of files in directories such as

```
\PerfLogs
\Program Files
\Program Files (x86)
\ProgramData
\Users\Public
\Users\[UserName]\AppData
\Windows\System
\Windows\System32
\Windows\System64
\Windows\WinSxS
```

In Windows the system folders are `System32` and `SysWOW64` (the 32-bit components on 64-bit Windows). There is no standard `System64` folder.

1.2 Microsoft Azure

Microsoft Azure is a cloud computing service created by Microsoft for building, testing, deploying and managing applications and services through a global network of Microsoft-managed data centres. It provides software as a service (SaaS), platform as a service (PaaS) and infrastructure as a service (IaaS), and supports many different programming languages.

- Project *Red Dog* was the code name. Azure was released on 1 February 2010.

Why it is cost effective:

- Microsoft uses a single-person access platform to serve services;
- remote desktop service can be accessed easily;
- it is always up to date;
- it is simple to set up and connect;
- cloud and hybrid service;
- access to all products and apps with a single identity credential.

1.2.1 Example: IIT Roorkee

The Indian Institute of Technology Roorkee has thousands of students, departments, deans and faculties. Its webmail now has permanent accounts, which are secure and updated.

1.2.2 Identification of the sender

Before	Now
No identification of the sender	identification of the user, the device, the application and the data

Microsoft is the only vendor that provides deep management of Android, iOS and other information, and copy and paste of work data can also be identified.

"Only vendor" is a marketing claim from the course material. Other vendors also provide mobile device management.

1.3 Conditional access

Users on Windows 10 reach Office 365 only after policy verification. Microsoft Intune checks the device, using the Windows "Provable PC Health" (PPCH) service.

The ticks and crosses on the arrows of the drawing are hard to read. The dashed arrow from Intune to Office 365 is read as the policy-verification result.

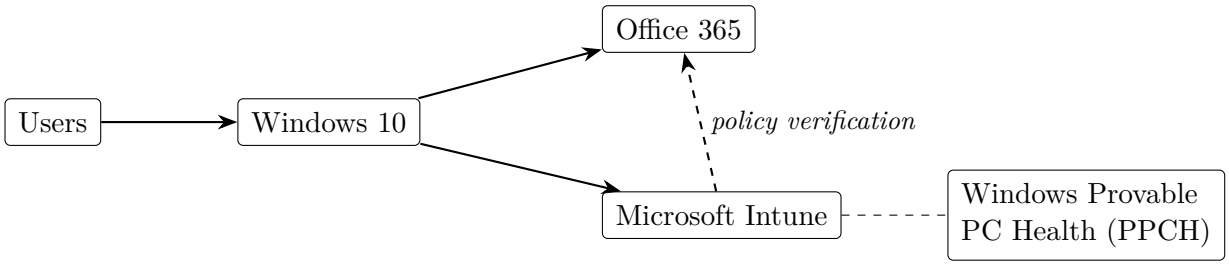


Figure 1.1: A user on Windows 10 is allowed into Office 365 after Intune verifies the policy.

1.3.1 Policy compliance verification

- device management;
- device compliance;
- measured boot integrity status;
- advanced device compliance (antivirus, firewall, patch state, etc.).

1.3.2 Multi-identity policy

Corporate data and personal data are kept apart. From email, corporate data is allowed to go to OneDrive (saved) but not to personal storage or to a personal app by paste; personal data may go to personal storage.

1.3.3 Encrypt files and data

Protect any file and share it with any person, and know: who opened the data, who placed the data, and who tried to open the data.

1.4 Managing access to applications

- single sign-on to SaaS apps;
- access to line-of-business (LOB) applications;
- access to your Windows apps.

1.4.1 Identity-driven security

Machine learning, security reports, privileged identity management, conditional access, multi-factor authentication, cloud app discovery, user behaviour analysis, and a simple attack timeline.

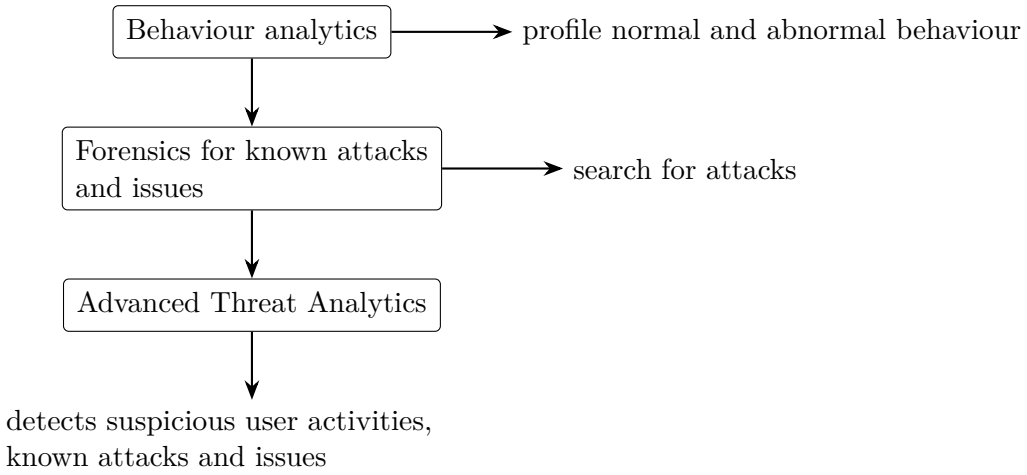


Figure 1.2: The components of Advanced Threat Analytics as listed in the notes.

1.4.2 Microsoft Advanced Threat Analytics

1.4.3 Enterprise Mobility Suite

- identity and access management;
- mobile and app management;
- information protection;
- behaviour-based threats analytics.

2 ASP.NET Core

2.1 Introduction

Download the `.exe` installer of the .NET software from dot.net: it is called *.NET Core 2.1*.

.NET Core 2.1 was current when the notes were written. It is long out of support; current releases are ".NET" (without "Core") with a number such as 8.

2.2 .NET CLI and templating

ASP.NET Core has its own templates, as usual for every app. Keep them.

```
dotnet new console --help
dotnet new
dotnet new --help
code .
```

`dotnet new` lists the templates, `-help` shows the options of one, and `code .` opens the current folder in Visual Studio Code.

2.3 Documentation and community

Use the .NET documentation. .NET Conf 2017 is a wrap!

The sentence ".NET Conf 2017 is a wrap" is read as written.

2.4 From a console to a web application

```
dotnet new web -o mywebapp
```

On the page "`new`" is overwritten with "(app)" ahead of "`web`". The command is read as `dotnet new web -o mywebapp`, which creates an empty web project in the folder `mywebapp`.

2.5 Dynamically rendered HTML

Use HTML code for .NET.

2.6 Configuration

Check faults at the terminal first.

2.7 Razor pages

A Razor page layout calls

```
@RenderBody()
<hr />
<footer> ... </footer>
```

`@RenderBody()` inserts the content of each page into the layout, followed by a horizontal rule and the footer.

2.8 CRUD

Create a web application (CRUD stands for create, read, update, delete).

3 IT Expert Roundtable: Cloud at Microsoft

These notes follow an *IT Showcase* roundtable on the cloud at Microsoft. The speakers noted are Sheri Bettine, Rob Beddart, Lyle Dodge, Joe, Robert and Mark.

The surnames of the speakers are hard to read, and three of them are given only by first name.

3.1 Cloud as a business

Cloud is a business of about 20 billion dollars, led by Amazon and Microsoft.

No source or year is given for the 20 billion figure.

3.2 Cultural changes at Microsoft

To achieve digital transformation Microsoft made cultural changes:

- upskills of employees;
- reducing the friction of processes;
- modern processes.

3.3 With Azure only

Managing, with Azure, covers security, privacy, software, infrastructure and connectivity.

3.3.1 Business process

Benefits; hard work; architecture; an example process; patience.

3.4 Scale, techniques and migration

- Scale reading and study for more benefits, and save the industry.
- Different business techniques.
- Employ a migration and security approach: it should be easy to work with via one security access.

A comparison of Google and Microsoft is drawn under “good technology”:

	Plan	Result
Google	plan with low data consumption	high peoples' access
Microsoft	high data consumption	low peoples' access

This comparison is a short note in the margin. Its meaning (the cost of data use against how many people can use the service) is read from the arrows and may not be what was said in the talk.

3.5 Security and controls

Security needs to be highlighted and needs guidance. Core controls are important.

3.6 Careers: from algorithms to production

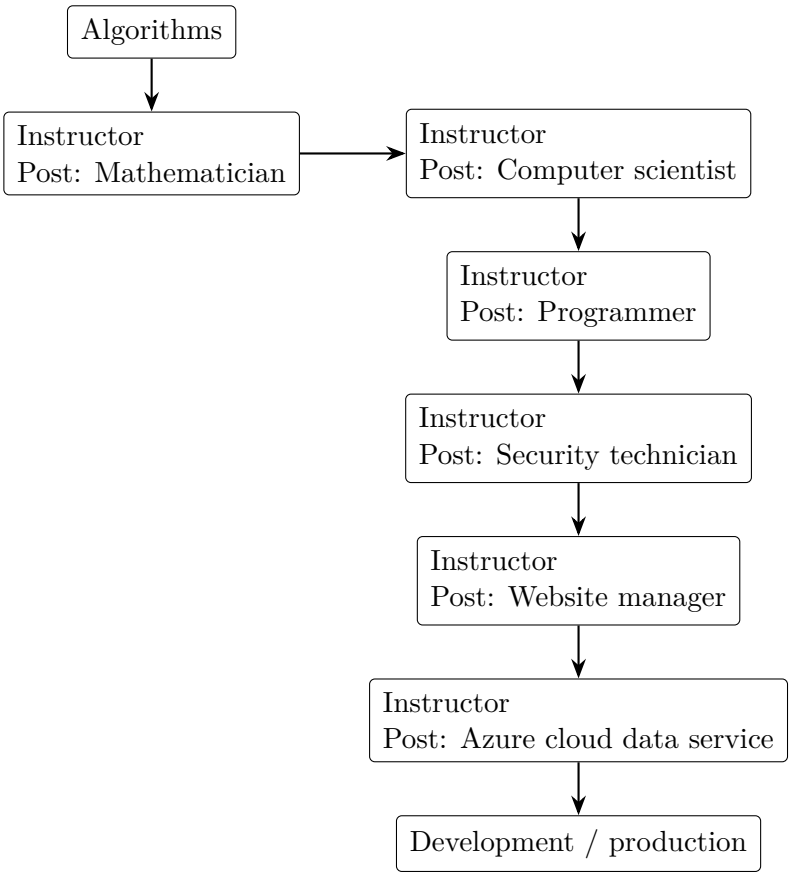


Figure 3.1: The chain of roles from algorithms to development and production.

The word "Instructor" in front of each post may be a note on who teaches that stage. It is kept as on the page.

3.7 Benefits of cloud computing

Hardware support is also needed. Managing the cost by industry employees. The benefits of cloud computing are:

- infrastructure mobility without a real workplace;
- cost saving;

- efficiency more than others;
- disaster management and data security;
- recovering the economy;
- application monetisation;
- secure and reliable (good in quality);
- historical changes.

3.7.1 Engineering

The advantages in engineering are: efficient at work, fast working, security, network, reliability and connectivity.

4 System Center 2012: Licensing Overview

The notes are a set of questions with their answers on the licensing of Microsoft System Center 2012. A question is marked **T/F** if it is true or false.

1. **T/F.** With the System Center 2012 licensing overview model, you need to track the basic and advanced workload that you will be managing.
   Answer: False.

2. With the processor-based licensing model, each server ML for both editions of System Center 2012 will cover up to how many physical processors per licence?
   Answer: 2.

3. What will customers with one Server Management Suite Enterprise (SMSE) licence and with existing Software Assurance coverage on current System Center licence quality for, when System Center 2012 becomes generally available?
   Answer: 2 System Center 2012 Standard licences.

4. **T/F.** The SQL Server Standard edition runtime is included in the server MLs.
   Answer: True.

5. **T/F.** You can extend a server ML to manage applications running on the public cloud.
   Answer: True.

6. **T/F.** With the System Center 2012 licensing model, you need the basic and advanced workload.
   Answer: False.

7. How many Standard server MLs are required for a single four-processor, non-virtualised server?
   Answer: 2.

8. **T/F.** The System Center 2012 Standard edition provides management of unlimited operating system environments (OSEs).
   Answer: False.

9. **T/F.** You can use Microsoft System Center 2012 Operations Manager to monitor your Windows Azure applications.
   Answer: True.

10. What is included in the System Center 2012 Client Management Suite ML?
    Answer: Operations Manager, Service Manager, Data Protection Manager and Orchestrator.

The wording of these licensing answers comes from a Microsoft training quiz for System Center 2012 and follows its licensing terms (ML = management licence, OSE = operating system environment). The product and its licensing model are no longer sold; check the

5 Windows 10 IT Pro Essentials: Support Secrets

These notes follow a talk by Ed Bott. Themes: troubleshooting and recovery; putting people at ease (and making them more productive); mobile devices and the cloud; security and privacy, replacing fear with fact.

5.1 Troubleshooting

Something goes wrong because of *hardware failure, malware, user error or a driver* (a driver fault gives the "screen of death"). The solution is to be prepared:

- Windows Defender (a third-party tool can be used instead);
- File History backup (requires an external drive);
- system image backup (a system image for Windows, or recover Windows 7): choose the external drive, click Next, create the drive;
- a recovery drive.

For help from a friend, use *Quick Assist*: remote access to give or get assistance, protected by a security passcode, with sharing of data.

Other tools: uninstall device drivers, hide an unwanted driver update, and reset Windows 10.

5.2 Ease

Hardware fine-tuning; Cortana; Start and taskbar; Action Center; making things personal (background, lock screen, sign-in screen); adjusting the display, volume control, managing storage and setting up a printer; pinning shortcuts.

5.3 Mobile devices

Network 101; OneDrive (sync, backup, folders); power options (status, sleep); things you never knew your device can do. "Networking is magic": hit the reset button, use the network troubleshooter or network reset, and run a speed test in Task Manager.

5.4 Security

Secure data with BitLocker/encryption. Sign in with a password, PIN, fingerprint, image or two-factor authentication, and keep Windows up to date.

The chain from “Something wrong” to “Problem with barcode” is hard to read; the last words after the sad-face symbol are kept as written.

6 Security Fundamentals

These notes follow an introductory course on security fundamentals (a Microsoft Technology Associate topic), together with the assessment questions and answers that go with it. Themes: core security principles, authentication, accounting and authorisation, security policies, network security, and protecting the server and client.

6.1 Assessment: introduction

1. Minimising the attack surface is an example of which risk management response?
   Answer: avoidance.

2. **T/F.** Biometrics are a good way to secure certain areas of a building.
   Answer: True.

3. **T/F.** Microsoft offers other courses in the Microsoft Technology Associate track which would be beneficial either before or after watching the Security Fundamentals video.
   Answer: True.

4. Which of the following methods, used to gain access to data, systems or networks, relies primarily on misrepresentation and on the trusting nature of the person being attacked?
   Answer: social engineering.

5. What are the presenters' names?
   Answer: Christopher Chapman and Thompson Willingham.

6.2 Core security principles

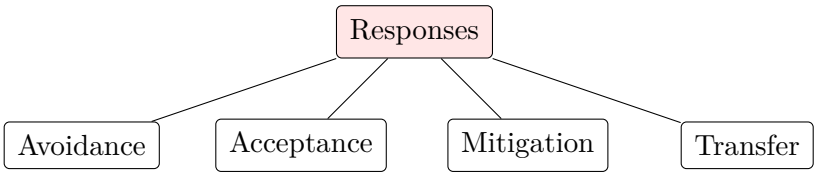
Which of the following are ways to secure an external perimeter? *Answer: multi-factor authentication, a guard gate and security cameras.*

The three core principles are

> **Confidentiality**, **Integrity**, **Availability** (the CIA triad).

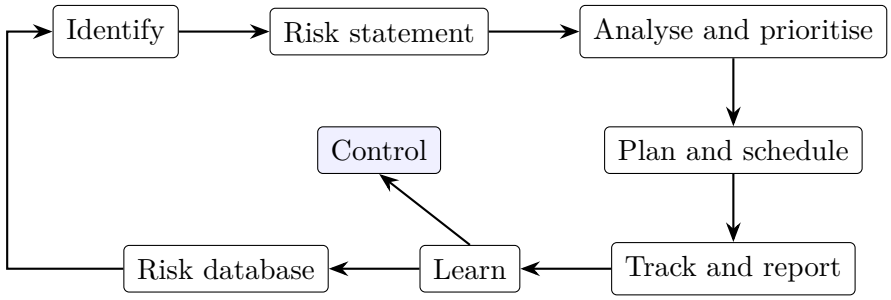
6.2.1 Risk responses

There are four responses to a risk: avoidance, acceptance, mitigation and transfer.



6.2.2 The risk management cycle

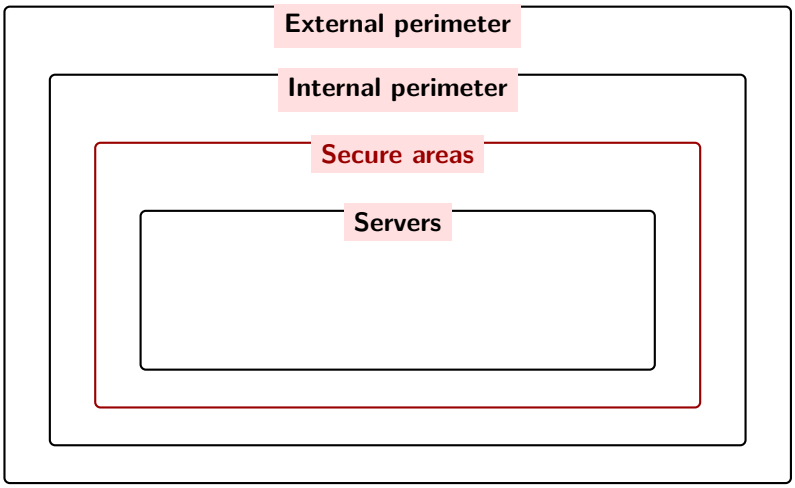
The risk process is a loop. A risk is identified and written as a risk statement; it is analysed and prioritised; a plan and schedule are made; progress is tracked and reported; the team learns from the result and feeds the lesson into a risk database, which informs the next identification. The control step sits in the middle of the loop (the *master risk* is written beside it in the notes).



In the original diagram the control step sits between the risk statement and the learn step, with an arrow from "Learn" and a note "Master Risk". I have drawn it as a side branch from "Learn"; the exact arrows should be checked against the scan.

6.2.3 Layered physical security

Security is built in layers, from the outside in.



External perimeter

- security camera
- parking lot lights
- perimeter fence
- gate with guards
- gate with access badge reader
- guard patrols

Internal perimeter

- locks

- security cameras
- guard desk and patrols
- smoke detectors
- turnstiles
- mantraps

Secure areas

- badge reader
- biometric access
- security doors
- X-ray detector
- metal detector and intrusion detection
- cameras

Servers

- locks
- docking stations
- laptop security
- laptop safes
- theft recovery
- alarms

The four small lists written vertically beside the nested boxes ("locks", "docking stations", "laptop security", "laptop safes", "theft recovery", "alarms") are hard to read in the scan; I have placed them under *Servers*.

6.3 Authentication, accounting and authorisation

6.3.1 Assessments

1. **T/F.** NTFS is a default file system for a Windows Server 2012 installation.
   Answer: True.

2. A small key-ring device displaying a changing code (an RSA token) is an example of a...
   Answer: security token.

3. **T/F.** PGP is the encryption technology used to secure websites on the internet.
   Answer: False.

4. What is the process of identifying an individual, usually based on a username and password?
   Answer: authentication.

5. Which of the following are examples of forms of encryption?
   Answer: SSL, EFS, PGP. (SSL = Secure Sockets Layer; EFS = Encrypting File System; PGP = Pretty Good Privacy.)

6. What is Microsoft's technology for centrally tracking and managing users and information about them?
   Answer as written: Point to Point Tunneling Protocol.

The last answer looks wrong. Microsoft's technology for centrally managing users and information about them is *Active Directory* (which uses LDAP, Kerberos and DNS, as noted below); the Point-to-Point Tunnelling Protocol (PPTP) is a VPN protocol. The answer is kept as written.

Question 3 is correct as written: PGP is used for signing and encrypting email and files, while

6.3.2 Authentication

Authentication is the process of identification. Methods:

- password or PIN;
- smart card or ID card;
- biometrics (retina scans, voice input).

Biometric methods split into two groups:

Physiological	Behavioural
face	keystrokes
fingerprint	signature
hand	voice
iris	leg angles
DNA	

"Leg angles" is written at the bottom of the behavioural list; it may mean gait analysis.

6.3.3 Active Directory

Active Directory uses `LDAP` (the Lightweight Directory Access Protocol), `Kerberos` and `DNS`.

6.3.4 Authorisation

Authorisation concerns the permission of access, for example NTFS permissions.

6.3.5 Auditing (accounting)

Auditing is tracking what users do. For remote systems, the protocols `RADIUS` and `TACACS+` are used.

6.3.6 Encryption

> Encryption is the process of converting data into a format that cannot be read.

Related infrastructure: `PKI` (public key infrastructure) and `CRL` (certificate revocation list). Forms of encryption:

- Secure Sockets Layer (SSL);
- Secure/Multipurpose Internet Mail Extensions (S/MIME);
- Pretty Good Privacy (PGP);
- Encrypting File System (EFS);
- BitLocker;
- Virtual Private Network (VPN).

PKI and CRL are written together under "Encryption" with a bracket pointing to the list of forms. I have kept them as related infrastructure rather than as forms of encryption.

6.4 Understanding security policies

There are two linked topics: common password attacks and password policies.

Common password attacks.

- A *dictionary attack* uses an extensive list of passwords; the attacker tracks a user ID and guesses the appropriate password (a *brute-force attack*).
- An attacker with physical access to data can crack passwords.
- *Sniffers* capture network packets and traverse the network.

Password policies. A policy can require

- upper case (A to Z);
- lower case (a to z);
- numerals (0 to 9);
- non-alphanumeric characters (`! , @ # $ % ^ & ;`);
- a minimum password length;
- a password age: a *minimum password age* and a *maximum password age*.

6.4.1 Assessments

1. What is a very effective method for any user to adopt to make a password attack more difficult to succeed?
   Answer: create complex passwords.

2. Which of the following is a crude type of attack that attempts to compromise a password by trying all possible combinations of permitted character types?
   Answer: brute-force attack.

3. The shortest possible amount of time that a user is required to use the same password under a password policy is known as...
   Answer: minimum password age.

4. **T/F.** "This Is My1st Password!" is an example of a complex password.
   Answer: True.

5. Microsoft provides which of the following as a password policy option to prevent password attacks from being effective?
   Answer: account lockout.

6. Which of the following is a valid network troubleshooter tool that can be used by someone trying to steal data or logon credentials from a network?
   Answer: network sniffers.

6.5 Understanding network security

6.5.1 Assessments

1. Which of the following is a method used to analyse the health of computers attempting to connect to the network, and allows or denies access to the network based on the results?
   Answer: Network Access Protection (NAP).

2. What can be used to serve as a buffer between two networks and provide isolation to certain network services?
   Answer: a perimeter network.

3. Which of the following is a technique used to modify the network address information of a host while traffic is traversing a router or firewall?
   Answer: network address translation.

4. Which of the following are ways for NAP to be enforced?
   Answer: IPsec, VPN, DHCP.

5. **T/F.** Firewalls operate at layer 6 of the OSI model.
   Answer: False.

In question 3 the answer is written as "Network access translation"; the technique is *network address translation* (NAT). In question 5 the answer (False) is right: a firewall works at the network and transport layers (layers 3 and 4), and some work up to layer 7, but not specifically layer 6.

6.5.2 The OSI model

The Open Systems Interconnection (OSI) model is a conceptual model created to standardise communication between systems on a network. Its seven layers, from the top down, are:

1. Application
2. Presentation
3. Session
4. Transport
5. Network
6. Data link
7. Physical

6.5.3 NAP enforcement

Network Access Protection (NAP) can be enforced with

- IPsec enforcement;
- 802.1x enforcement;
- VPN enforcement;
- DHCP enforcement.

VPN stands for Virtual Private Network.

6.6 Protecting the server and client

6.6.1 Assessments

1. Which of the following are examples of malware? (multiple answers)
   Answer: virus, rootkits, adware.

2. **T/F.** The Windows Firewall can be centrally managed using Group Policy.
   Answer: True.

3. **T/F.** Malware is software designed to infiltrate or affect a computer system without the owner's informed consent.
   Answer: True.

4. **T/F.** Microsoft provides an anti-malware/anti-virus package for Windows.
   Answer: True.

5. What is a way for a spammer to exploit a vulnerable email server to send email that appears to come from your email server instead of theirs?
   Answer: SMTP relay.

6. When a user receives an email or sees a pop-up window warning them of a virus infection, and either asks them to forward the warning on or provides a link to download software to remove the threat, it is known as a...
   Answer: social engineering attack; virus hoax.

7. **T/F.** Malware is a software.
   Answer: True.

6.6.2 Malicious software (malware)

> Malware is software designed to infiltrate or affect a computer system without the computer owner's informed consent.

Kinds of malware: viruses, worms, Trojan horses, spyware, rootkits and adware.

- A **computer virus** is a programme that can copy itself and infect a computer without the user's consent or knowledge.
- A **worm** is a self-replicating programme that replicates to other computers over the network without any user intervention.
- A **Trojan horse** is an executable programme that appears as a desirable or useful programme.
- A **rootkit** is a software or hardware device designed to gain administrator-level control over a computer system without detection.
- A **virus hoax** is a message warning of a virus that does not exist.

6.6.3 Protection layers

- Keep your software up to date.
- Use an up-to-date anti-virus protection package.
- Update Windows, and the server settings:
  - WSUS: Windows Server Update Services;
  - SCCM: System Center Configuration Manager;
  - UAC: User Account Control.
- Update and turn on the firewall.
- Spam filtering and the Sender Policy Framework; SMTP relay control.
- `MBSA`: Microsoft Baseline Security Analyzer.
- Secure dynamic updates in DNS.
- Use a secure browser, with cookies on.

6.6.4 Firewall

A firewall protects a computer or network from network-based attacks. It performs filtering of data packets traversing the network: internet traffic reaches the firewall, and only the traffic permitted after the filters are applied passes to the corporate network.

6.6.5 Common attacks

- password cracking;
- dictionary attack;
- brute-force attack;
- software vulnerability attack;
- buffer overflow attack;
- remote code execution attack;
- SQL injection;
- cross-site scripting attack.

7 Cortana Intelligence Suite End-to-End

These notes follow an overview of the Cortana Intelligence Suite, Microsoft's set of cloud services for big data and analytics. Themes: from data to intelligence to action, the stages of an analytics pipeline, the four kinds of analytics, and a lab architecture that ends in a Power BI report.

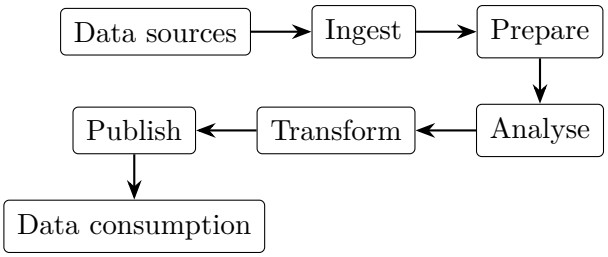
7.1 Big data, cloud and intelligence

Three ideas come together: *big data*, the *cloud* and *intelligence*. Hardware, software and data together form analytics. The aim is to move from data, to intelligence, to action:



7.2 The analytics pipeline

Information management (*Data Factory*, *Data Catalog*, *Event Hubs*) connects the data sources to a pipeline of stages:



7.3 Kinds of analytics

The four kinds of analytics climb from information to optimisation.

Kind	Question in the notes	Stage
Descriptive analytics	What?	information
Diagnostic analytics	Why?	information
Predictive analytics	Why?	optimisation
Prescriptive analytics	How?	optimisation

The question written over *predictive* analytics is "Why?", the same as for diagnostic analytics. The usual formulation is: descriptive, "what happened?"; diagnostic, "why did it happen?"; predictive, "what will happen?"; prescriptive, "how can we make it happen?" The wording is kept as written.

Examples.

- Fixing problems proactively, before they start, with predictive maintenance.
- Getting the right products to the right places with inventory management.

7.4 Cortana Intelligence

Cortana Intelligence takes inputs from business apps, custom apps, and sensors and devices, and delivers its results to people, apps and automated systems.



7.5 Big data analytics made easy

Data Lake Analytics can query data held in several stores: SQL Data Warehouse, SQL Database, the Data Lake Store, storage blobs, and SQL Database in a virtual machine.

Intelligence services (the cognitive APIs).

Vision

- computer vision
- face
- emotion
- video

Speech

- speaker recognition
- speech
- CRIS

Language

- text analytics
- Bing Spell Check
- Web Language Model
- linguistic analysis
- Language Understanding Intelligent Service

Knowledge

- academic
- entity linking service
- knowledge exploration
- recommendations

Search (the heading is written as "... {}")

- Bing
- Bing Image Search API
- Bing Video Search API
- Bing News Search API
- Bing Autosuggest API

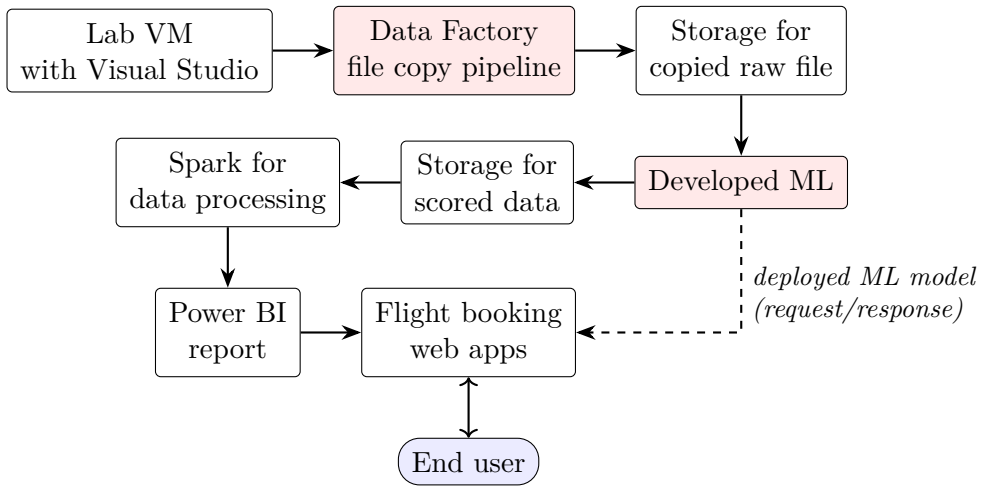
7.6 Dashboards and visualisations

Power BI is the dashboard layer. It can draw on HDInsight, Event Hubs, Machine Learning, storage and SQL Database.

7.7 Lab architecture

A lab virtual machine with Visual Studio runs a Data Factory file-copy pipeline; the raw file is stored; a developed machine learning model scores the data; the

scored data are stored and processed with Spark; and the result feeds a Power BI report. A deployed ML predictive model answers requests from flight-booking web apps used by the end user.



The lab architecture is drawn vertically, with the labels rotated; the order of the boxes and the direction of the arrow between the Power BI report and the flight-booking apps are my best reading of the scan.

8 Course on Computer Concepts (CCC)

These notes follow the Course on Computer Concepts (CCC), a basic computer-literacy course with an objective examination. The notes are numbered by lecture (#1 to #33). Some words are glossed in Hindi in the original; they are given here in transliteration.

8.1 The examination

Duration	90 minutes
Questions	100 objective-type questions
Syllabus	computer related
Marking	+1 for a correct answer, 0 for a wrong answer
Maximum marks	100

Grades by percentage.

Grade	Percentage
S	85% and over
A	75–85%
B	74–64%
C	64–55%
D	54–50%
F (fail)	below 50%

The grade bands overlap at their edges (85%, 64%); the boundaries are kept as written.

Syllabus tree. Computer basics (history, hardware, software, programming languages); operating systems (Windows, Linux, Ubuntu); word processing; spreadsheet; internet and the World Wide Web; presentation; graphical user interface (GUI); application of digital financial services.

8.2 Lecture 1: introduction to computers

8.2.1 History of computers

A computer performs calculation: arithmetic and logical. Other uses: music, graphics, internet, storage and analysis.

8.2.2 Characteristics

Speed, accuracy, diligence, storage capacity. The notes also list: versatile (*bahuuddeshiya*), secrecy (*gopaniyata*), diligence (*sakshamata*) and automatic (*svachalit*).

8.2.3 Types of computers

1. microcomputer;
2. minicomputer;
3. mainframe;
4. supercomputer.

In the notes the supercomputer entry is "US: Sunway's TaihuLight (name)", with a score of 122.3 PFLOPS.

TaihuLight is a Chinese machine; the 122.3 PFLOPS score is that of the US supercomputer Summit (2018). The two entries appear to have been joined; the lines are kept as written.

8.2.4 Abbreviations

CRT	Cathode Ray Tube
CPU	Central Processing Unit
ALU	Arithmetic Logical Unit
CU	Control Unit
LCD	Liquid Crystal Display
UPS	Uninterruptible Power Supply
DDR	Double Data Rate
SIMM	Single Inline Memory Module
DIMM	Dual Inline Memory Module
DRAM	Dynamic Random Access Memory

A computer has two parts: **hardware** and **software**. The Hindi word for computer, written at this point in the notes, is *sanganak*.

8.2.5 Computer memory

RAM (Random Access Memory) comes in many forms: SRAM, cache memory, DRAM, SDRAM, DDR SDRAM, DDR2 SDRAM, DDR3 SDRAM, RIMM, RDRAM, SIMM and DIMM.

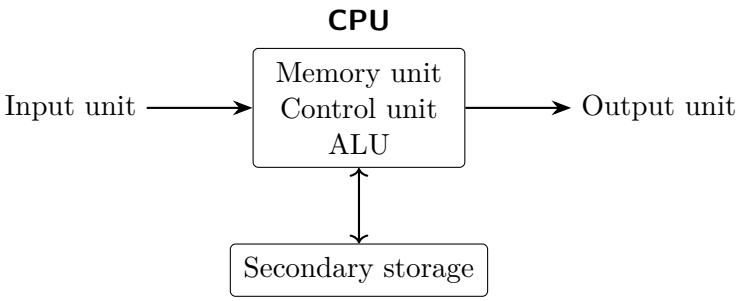
ROM (Read Only Memory) has three types:

1. MROM, mask read only memory;
2. PROM, programmable read only memory;
3. EPROM, erasable programmable read only memory.

A short note "#1 ... YouTube" beside the ROM list refers to the source of the lecture (partly struck out in the scan).

8.2.6 The central processing unit

The CPU contains the memory unit, the control unit and the ALU. An input unit feeds the CPU and an output unit receives from it; secondary storage exchanges data with it.



- A **peripheral device** receives or sends data.
- The **control unit** reads an instruction, turns it into a signal and decodes it; the ALU then does the work.
- 1 ns $= 10^{-9}$ s.
- Clock speed is measured in MHz or GHz.
- A standard keyboard has 101 keys.

8.3 Lecture 2: history of computing

1. **Abacus.** China, 16th century (attributed in the notes to "Li Kai Chen").
2. **Napier's bones.** Scotland, 1617, John Napier.
3. **Slide rule.** Germany, 1620, "William Artet".
4. **Pascaline.** France, 1642, Blaise Pascal.
5. **Mechanical calculator.** Germany, 1671, Leibniz (also the origin of speedometers, as noted).
6. **Difference engine.** British, 1822; the *analytical engine* followed (1833). Charles Babbage, the father of the computer.
7. **Tabulating machine.** 1880, Herman Hollerith; in 1896 he founded the Tabulating Machine Company, later renamed IBM (International Business Machines).
8. **Mark 1.** 1930, Harvard; the first electromechanical calculating machine.
9. **ENIAC** (Electronic Numerical Integrator and Calculator). 1946, J. P. Eckert and John Mauchly; the first electronic computer.
10. **EDSAC** (Electronic Delay Storage Automatic Calculator). 1949, Maurice Wilkes.

Several dates and names in this list differ from the usual accounts. The slide rule is credited to William Oughtred, in England, around 1622 (the notes say Germany, 1620, "William Artet"). The Harvard Mark I was completed in 1944, not 1930. Hollerith's tabulating machine was used for the 1890 US census. The notes are kept as written.

8.4 Lecture 3: generations of computers

First generation (1946–1954): vacuum tubes.
The vacuum tube was developed by Lee de Forest (1908 in the notes). Examples: ENIAC, EDVAC, UNIVAC, IBM-701. Drawbacks: large size, high cost, heat and low speed.

Second generation (1956–1963): transistors.
Transistors replaced vacuum tubes; William Shockley's group invented the transistor in 1947. High-level languages were used: FORTRAN, ALGOL, COBOL. Examples: IBM 1620, IBM 7094, UNIVAC 1108.

Third generation (1964–1971): integrated circuits.
An IC (silicon chip, integrated circuit) replaced the transistor; it was developed by Jack Kilby in 1959. Keyboard and mouse were used, with display on a monitor. Examples: Honeywell-6000, PDP, IBM-370/168, TDC-316. IC chips are difficult to maintain.

Fourth generation (1971–1980): LSI and VLSI.
Large Scale Integration and Very Large Scale Integration. MS-DOS and MS Windows were developed, with the graphical user interface (GUI), and C, C++ and others. Example: PDP-11.

Fifth generation (1981 onwards): artificial intelligence.
AI, ULSI (Ultra Large Scale Integration), 64-bit microprocessors and natural language processing. Examples: desktop, laptop, notebook, ultrabook, Chromebook.

8.5 Lecture 4: classification of computers

Computers are classified by application, purpose and size.

- **By application:** analogue (thermometer), digital (mobile phone), hybrid (ECG, dialysis).
- **By purpose:** general or special.
- **By size:** micro (PC), mini (about 250 users), mainframe, server, supercomputer (research).

Supercomputers are very costly and are used for scientific simulation, graphics, nuclear energy research and geographical data. The first supercomputer was the Cray (1976).

India. PARAM 8000 and 10000; ADITYA; ANUPAM; PARAM YUVA; EKA, the fastest in India (at the time of the notes). The fastest Indian supercomputer is Pratyush (January 2018, IITM); the first Indian supercomputer, from C-DAC, was PARAM-8000; the first Indian computer was Siddharth.

8.6 Lecture 5: applications and input–output

Applications: education, banking, communication, medical, airlines and railway reservation, recreation, administration, security, commerce, e-commerce, research, science and engineering.

8.6.1 Input devices

Keyboard; mouse; digitising tablet; trackball; joystick; touch screen; light pen; speech recognition system; digital camera; scanner; Magnetic Ink Character Recognition (MICR); Optical Character Recognition (OCR); Optical Mark Recognition (OMR); barcode reader; webcam.

8.6.2 Output devices

Monitor; printer; plotter; speaker; headphones; projector. Display technologies:

- CRT: cathode ray tube;
- LED: light-emitting diode;
- LCD: liquid crystal display;
- TFT: thin film transistor.

8.6.3 Printers

Output is either a soft copy or a hard copy.

- **Impact printers:** dot matrix, daisy wheel, line, chain, drum.
- **Non-impact printers:** inkjet, thermal, laser, electromagnetic, electrostatic.

Printer speed: characters per minute (CPM), lines per minute (LPM) and pages per minute (PPM). **Quality:** dots per inch (dpi).

The notes write "dots per minute (dpi)"; the unit is dots per *inch*.

8.7 Lecture 6: computer memory

Memory is either *main memory* or *auxiliary (secondary) memory*.

8.7.1 Memory hierarchy

From the fastest, smallest and most expensive to the slowest, largest and cheapest: registers; cache memory (by the CPU); main memory (RAM, ROM); secondary memory. Speed and cost rise towards the registers; size rises towards secondary memory.

8.7.2 Units of memory

1 nibble = 4 bits; 1 byte = 8 bits. Each unit below is 1024 times the previous one: bit, byte, KB (kilobyte), MB (megabyte), GB (gigabyte), TB (terabyte), PB (petabyte), EB (exabyte), ZB (zettabyte), YB (yottabyte), BB ("brontobyte") and "geopbyte".

The last two names ("Bronto byte" and "Geop byte (Geb)") are informal; they are kept as written.

8.7.3 Primary memory

1. **RAM** (random access memory) is volatile. In dynamic RAM each bit is held by a transistor (the switch) and a capacitor (the data store). Types: DRAM, RDRAM, SDRAM; dynamic, static, non-volatile, special, asynchronous and synchronous SRAM.
2. **ROM** (read only memory) is non-volatile. Types of ROM: PROM (one-time writing), EPROM, EEPROM.

Keyboards have 104 keys; other keyboards have 108 or 110.

An earlier page of the notes gives 101 keys for a standard keyboard; 101 and 104 are both common standard layouts.

8.8 Lecture 7: virtual, cache and secondary memory

- **Virtual memory** is temporary storage used when memory is full.
- **Cache memory** sits between the CPU and RAM (it is SRAM): it increases the speed of the CPU and gives fast data search.
- **Secondary (auxiliary) memory** is the cheapest and slowest memory. Examples: magnetic (hard drive, floppy disk), optical (CD, DVD, Blu-ray disc) and SSD (pen drive).

"Virtual memory... if memory full of ROM" in the original probably means RAM; virtual memory uses disk space when RAM is full.

Floppy disk. Tracks and sectors. 8 inch (80 KB); 5½ inch (1.2 MB); 3½ inch (1.44 MB).

Hard disk. Plates, sectors and tracks.

CD. Compact disc; one-time writing; capacity 700 MB.

DVD. Digital Versatile Disc; invented by Philips and Sony in 1995; capacity 4.7 GB (single layer).

Blu-ray disc. 25 GB (single layer); 50 GB (multi-layer).

8.9 Lecture 8: hardware and software

Hardware is the physical body (printer, TFT monitor, CPU, mouse).

Software comprises the programming-language written code, the communication between hardware and system, and the compiler. It is of two kinds:

- **system software** (system management, developing programmes);
- **application software** (Microsoft Office, Photoshop, an internet browser, PageMaker and so on).

Other points: memory that must be refreshed is dynamic RAM; magnetic disks are the most popular medium for direct access and sequential access; the CD was invented by James Russell; a programme used as permanent hardware is called firmware.

8.10 Lecture 9: data representation

An mp3 file, for example, is converted by data representation into a string of ones and zeros.

Types of number system.

System	Digits	Base
Decimal	0 to 9	10
Binary	0, 1	2
Octal	0 to 7	8
Hexadecimal	0 to 9 and A to F	16

8.10.1 Conversion from decimal

Decimal to binary. $(29)_{10} = (\ )_2$: divide repeatedly by 2 and read the remainders upwards.

$$\begin{aligned} 29/2 &= 14 \quad \text{remainder } 1 \\ 14/2 &= 7 \quad \text{remainder } 0 \\ 7/2 &= 3 \quad \text{remainder } 1 \\ 3/2 &= 1 \quad \text{remainder } 1 \\ 1/2 &= 0 \quad \text{remainder } 1 \end{aligned}$$

So $(29)_{10} = (11101)_2$.

Decimal to octal. $(29)_{10}$: $29/8 = 3$ remainder 5; $3/8 = 0$ remainder 3. So $(29)_{10} = (35)_8$. Check: $3 \times 8^1 + 5 \times 8^0 = 24 + 5 = 29$.

Octal to binary. $(35)_8 = (\ )_2$. The notes divide 35 by 2 repeatedly ($35/2 = 17$, $17/2 = 8$, $8/2 = 4$, $4/2 = 2$, $2/2 = 1$, $1/2 = 0$) and read the remainders upwards, giving $(35)_8 = (110011)_2$.

This method treats 35 as a decimal number, and the remainders are also off (the decimal number 35 is 100011_2). The usual method for octal to binary is to write each octal digit in three bits: $3 \to 011$ and $5 \to 101$, so $(35)_8 = (011101)_2 = (11101)_2$, which equals the 29_{10} found in the previous step. The notes are kept as written.

Decimal to hexadecimal. $(45)_{10}$: $45/16 = 2$ remainder $13 = \text{D}$; $2/16 = 0$ remainder 2. So $(45)_{10} = (2\text{D})_{16}$. Check: $2 \times 16^1 + 13 \times 16^0 = 32 + 13 = 45$.

Hexadecimal to binary. $(2\text{D})_{16}$: write each digit in four bits (weights 8, 4, 2, 1): $2 = 0010$ and $\text{D} = 13 = 1101$. So $(2\text{D})_{16} = (101101)_2$.

8.10.2 Codes

BCD (binary coded decimal) is a system of writing numerals that assigns a four-digit binary code to each digit 0 to 9 of a decimal number.

- **ASCII** (American Standard Code for Information Interchange): ASCII-7 is a 7-bit standard code with 128 characters; ASCII-8 is an 8-bit standard code with 256 characters.
- **EBCDIC** (Extended Binary Coded Decimal Interchange Code) represents 256 characters.

8.10.3 Question

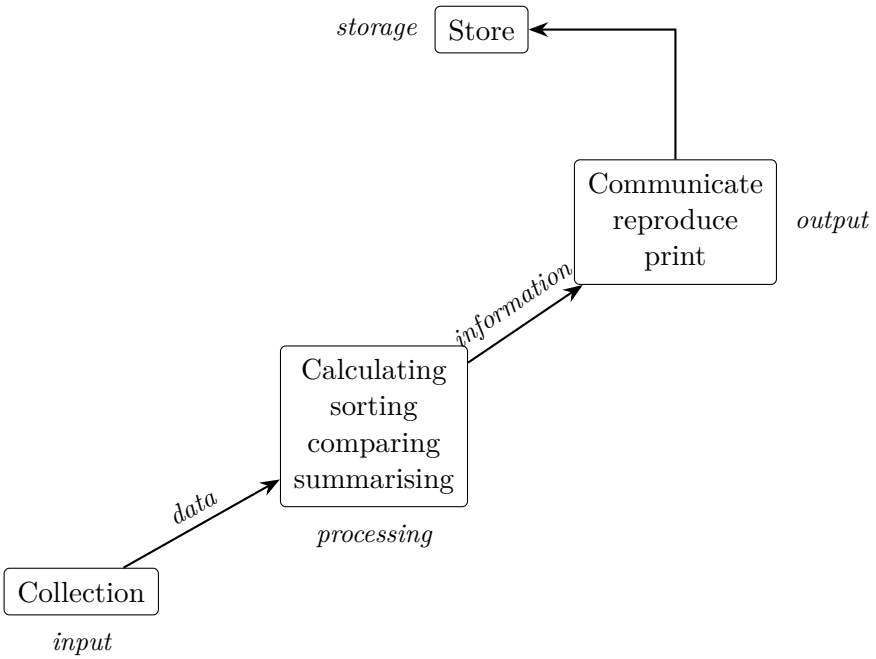
$(31)_{10} = (\ )_2$. Divide by 2: $31/2 = 15$ remainder 1; $15/2 = 7$ remainder 1; $7/2 = 3$ remainder 1; $3/2 = 1$ remainder 1; $1/2 = 0$ remainder 1.

The notes give the answer as $(01111)_2$. The remainders written down (1, 1, 1, 1, and then 0 for the last step) would give 01111_2, but the last step $1/2$ leaves remainder 1, so the correct answer is $(11111)_2 = 31$.

8.11 Lecture 10: data processing and IECT

Concepts of data processing. Storing everything in the mind is replaced by storing virtually: data and information are processed. Saving data in a systematic way is called data processing.

The data processing cycle.



The cycle runs from *collection* (input) through *processing* to *output*, with *storage* holding the data and information.

IECT (Information, Electronics and Communication Technology) applications. First: *e-governance*, which covers communication, information and transactions, in three forms: G2C (government to citizen), G2B (government to business) and G2G (government to government).

8.12 Multimedia

Multimedia carries information as text, video, audio and images, and is used in education, business, simulations and entertainment.

Type	Format	Meaning
Audio	PCM	Pulse Code Modulation
	AIFF	Audio Interchange File Format
	MP3	MPEG-1 Audio Layer 3
	WAV	Waveform Audio
	AAC	Advanced Audio Coding
	WMA	Windows Media Audio
Video	AVI	Audio Video Interleave
	FLV	Flash Video Format
	WMV	Windows Media Video
	3GP	Third Generation Partnership Project
	MP4	Moving Picture Experts Group 4
	MOV	Apple QuickTime Movie
Image	TIFF	Tagged Image File Format
	JPEG	Joint Photographic Experts Group
	JPG	Joint Photographic Group
	GIF	Graphic Interchange Format
	PNG	Portable Network Graphics
	BMP	Bitmap
	DNG	Digital Network Format
Document	PDF	Portable Document Format

DNG is Adobe's *Digital Negative* raw-image format; the notes write "Digital network format". JPG is the same format as JPEG with a shorter file extension. For PDF the notes write "(Permanent) document format" and strike out "Permanent", correcting it to *Portable*.

8.13 Lecture 11: operating systems

An operating system is system software that acts as the system interface between the user and the hardware. Examples: Windows 10, 8, 7, Vista, XP, 2000, NT, ME, 98 SE, 98, 95, DOS; iOS; Chrome OS; Linux; Unix; Fedora; Ubuntu.

Layers. From the bottom: hardware (CPU, memory); operating system (Windows, Linux); utility software (disk defragmenter, virus scanners, encryption utility, backup); application software; user.

Main functions.

1. processing management;
2. memory management;

3. input–output device management;
4. file management;
5. protection and security.

Types of operating system.

1. batch processing OS;
2. single-user OS;
3. multi-user OS;
4. multitasking OS;
5. time-sharing OS;
6. real-time OS (for example an autopilot mode), either hard or soft real time;
7. embedded OS;
8. distributed OS (for example a rover, or AI);
9. network OS.

The embedded OS entry has empty brackets in the notes, and the examples for the distributed OS ("Rover, AI") are partly cut off.

Questions.

- Microsoft's first operating system: DOS.
- The first operating system: punch-card, GM-NAA I/O.

8.14 Lecture 12: Linux, Unix and MS-DOS

Linux.
Multi-user, multiprocessing, multitasking. Open-source licence. Unix based; created in 1991 by Linus Torvalds. Command line interface (CLI) and graphical user interface (GUI). Distributions: Red Hat, Ubuntu, Kubuntu.

Unix.
Uniplexed Information and Computing System. Multi-user, multiprocessing. Developed at Bell Labs (1969) by Ken Thompson, Dennis Ritchie and Douglas (McIlroy); a command-line system, developed in the C language (1972). The notes say "open-source licence (assembly language)".

MS-DOS.
Microsoft Disk Operating System. Single-user, single-tasking. Written by Tim Paterson (1981), and bought by Microsoft. DOS 1.0 (1981) to DOS 8.0 (2000). Commands are internal or external.

Unix was not originally released under an open-source licence (it was proprietary to AT&T Bell Labs; later free variants appeared). The notes write "Duglus" for Douglas McIlroy. DOS 8.0 does not exist as a standalone release: MS-DOS reached version 6.22 in 1994, and the DOS inside Windows Me is sometimes labelled 8.0. The notes are kept as written.

8.14.1 MS-DOS commands

`DIR`	file list
`DATE`	date
`TIME`	time
`CLS`	clear screen
`CD`	current directory (change directory)
`COPY`	copy file
`MD`	create a directory or folder
`REN`	rename a directory or folder
`XCOPY`	copy subfiles (files and subdirectories)

8.15 Lecture 13: computer hardware components

Motherboard; RAM; BIOS; hard drive (HDD); CD/DVD ROM; network interface card (NIC); SMPS (switched-mode power supply); graphics card; ports.

Ports.

- PS/2 (developed by IBM);
- serial and parallel port (modem, mouse; 9 and 25 pins; 115 kbit/s);
- graphics array;
- USB, Universal Serial Bus (1997), 12 Mbit/s;
- LAN or Ethernet port, a network connector (10 to 1000 Mbit/s);
- audio and microphone port;
- DVI port.

Types of hard drive. PATA (Parallel Advanced Technology Attachment), SCSI (Small Computer System Interface), SATA (Serial ATA) and SSD (solid state drive, written as "solid state hard drive").

Display connectors. HDMI is the High Definition Multimedia Interface (audio and video signals). VGA carries video only; DVI is for the monitor screen.

8.16 Lectures 14 to 18: Microsoft Word

The Word file extension is `.docx`.

Mail merge.

- envelope options: the sending address and your return address;
- labels: type the address;
- mail merge: add people;
- finish and merge.

Macros record steps so that they can be used again later.

8.17 Lectures 19 to 29: Microsoft Excel

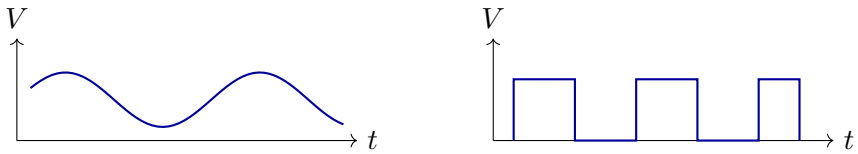
- manages records;
- the address of the first cell is `A1`;
- f_x is the formula bar;
- the last column is `XFD`;
- the last row is 1 048 576;
- the last cell is `XFD1048576`.

8.18 Lecture 30: data communication and networking

Data pass between two stations as a signal.

8.18.1 Signals

An *analogue* signal varies continuously with time, so values near a threshold can be confusing; a *digital* signal takes two levels (1 and 0), so there is no confusion.



analogue signal *digital signal (1 0 1 0 . . .)*

8.18.2 Transmission modes

Simplex. One direction only (for example a transmitter to a receiving television).

Half-duplex. Both directions, but one at a time (for example a walkie-talkie).

Full-duplex. Both directions at the same time.

8.18.3 Communication media

A medium is needed for data transmission (the notes say so in Hindi). There are two kinds: guided and unguided.

Guided media.

- **Twisted pair** (Ethernet): UTP (unshielded twisted pair), STP (shielded), FTP (foiled).
- **Coaxial cable:** centre conductor, dielectric insulator, metallic shield and jacket; data are transferred in the form of current.
- **Fibre-optic cable:** the best data transfer; data are carried in the form of light.

Unguided media.

- **Radio waves:** 3 kHz to 1 GHz; omnidirectional; multicasting (one sender, many receivers).
- **Microwaves:** 1 GHz to 300 GHz; unidirectional (a fixed direction).
- **Infrared:** 300 GHz to 400 THz; used for short-range transmission (a TV remote, a wireless speaker).

8.19 Lecture 31: types of network

LAN	Local Area Network. About 1 km; a private network; faster than MAN and WAN; 10 to 1000 Mbit/s.
MAN	Metropolitan Area Network. Connects cities or towns; uses coaxial or fibre-optic cable; public or private.
WAN	Wide Area Network. Cities, countries and continents (the internet); about 10 times slower than a LAN; microwave stations and satellite connections.
PAN	Personal Area Network. For example mobile to Bluetooth earphones (about 10 m, 33 ft).
SAN	Storage Area Network. For example cloud drive (Google Drive) shared between a computer and a mobile phone.
VAN	Value-Added Network (the notes add: personal network design).

8.20 Lecture 32: network topology

The way nodes and computers are connected is called the network topology. Types: star, ring, bus, mesh, tree and hybrid.

Star.
Every node is connected to a central hub. A fault in one cable does not harm the network, and adding a node does not reduce speed. Low cost. If the hub shuts down, the network closes.

Ring.
The signal travels in one direction around the ring (unidirectional data transmission). A repeater is used if the number of nodes increases. The network closes if a node fails.

Bus.
All nodes hang from a main line, the *backbone*, with a terminator at each end (the notes call it the "signal observer"). Nodes do not affect the system; a fault in the backbone does. A bus is used for small networks only.

Mesh.
Nodes are directly connected to each other. The number of cables for n nodes is $\frac{n(n-1)}{2}$. High cost.

Tree.
Nodes branch from a main root node.

Hybrid.
A combination of ring, star, mesh and tree topologies.

8.21 Lecture 33: networking devices

The devices are the NIC, modem, hub, switch, repeater, router, bridge and gateway.

NIC (network interface card).
Converts parallel data into serial data and vice versa. OSI layer: data link or physical. Also called the network adapter, Ethernet card or LAN card; uses an RJ45 connector.

Modem.
Converts between analogue and digital signals (modulation and demodulation). Internal (for example a USB modem) or external (for example a Wi-Fi modem). The MAC address is the manufacturer-fixed address.

Hub.
4, 8, 16 or 32 ports; connects the computers of a star topology. OSI layer: physical.

Switch.
OSI layer: data link.

Repeater.
OSI layer: physical; used for long-distance connections.

Bridge.
A LAN–LAN connection; used for the same protocol. OSI layer: data link.

Router.
OSI layer: network. Fast data sending; connects several LANs.

Gateway.
Connects two networks that use different protocols (the notes' example translates between Hindi and English personal data). OSI layer: transport. It can be hardware, software or both.

In the OSI model: repeater and hub → physical layer; bridge and switch → data link layer; router → network layer.

The notes place the router's description as "Processor/Memory/I/O Interface ∋ Router"; this is kept out of the summary above because its meaning is unclear. A gateway can work at any layer, including the application layer; the transport layer is what the notes say.

8.22 CCC exam questions

Question	Answer in the notes
New worksheet shortcut	Shift+Alt+F1 or Shift+F11
MS Excel cell address	relative, absolute
Clipboard items	24
Value choose forecasting	Goal Seek
Row maximum height	409 (points)
Protect command	Protect Worksheet; Protect and Share Workbook; Protect Sheet
Freeze Panes option menu	Window (*View* in recent versions)
Task pane shortcut key	Ctrl+F1
Insert a function in MS Excel	Shift+F3 (the notes also write "Fn+?" and strike it out)
Date format in Excel	Ctrl+Shift+#
COS, EVEN, FACT, EXP	mathematics functions
Hide the selected column	Ctrl+0
Current cell address	Name Box
Delete the selected cells	Ctrl+−

The shortcut for a new worksheet and the "Value choose forecasting" item are written as short phrases in the notes; the answers are kept as written. The Freeze Panes command is on the View tab in recent versions of Excel (on the Window menu in older ones).