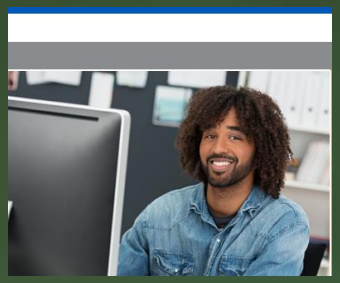
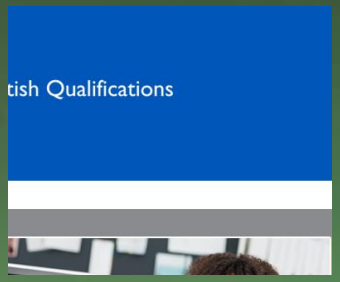
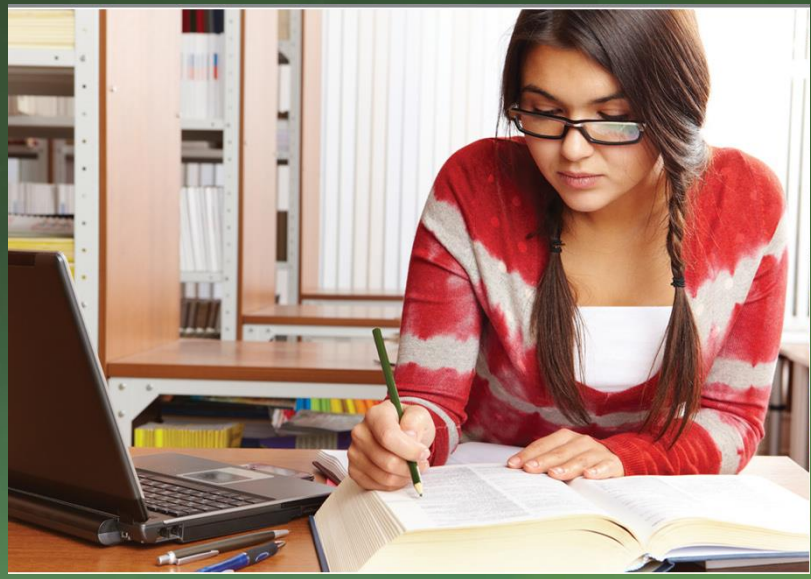
Awarding Great British Qualifications







Computer Systems

Topic 1A:

Introduction to Computer Systems

Scope and Coverage

This topic will cover:

- Module Overview & Syllabus Introduction
- Computer Types & Classifications
- Computing – Historical Evolution & Key Landmarks
- Computing – The Situation Today
- Computing – Being a Futurologist

Learning Outcomes

By the end of this topic, you will be able to:

- Describe the module syllabus
- Understand the assessment profile
- Compare different types of computer system
- Understand the historical evolution of computing
- Appreciate the current state of computing
- Predict the future of computing paradigms

Learning Outcomes

Learning Outcomes; The Learner will:	**Assessment Criteria;** The Learner can:
1. Understand the function of computer systems	1.1 Explain the role of computer systems in different environments 1.2 Explain the hardware, software and peripheral components of a computer system 1.3 Compare different types of computer systems
2. Be able to design computer systems	2.1 Produce a system design specification to meet a client's needs 2.2 Evaluate the suitability of a system design specification
3. Be able to build and configure computer systems	3.1 Build and configure a computer system to meet a design specification 3.2 Test and document a computer system
4. Be able to undertake routine maintenance on computer systems	4.1 Perform routine maintenance tasks on a computer system 4.2 Upgrade the hardware and software on a computer system

Module Syllabus (Weeks 1 – 6)

1. Introduction to Computer Systems
2. Computers & Their Environments
3. Computer Hardware & Components
4. Computer Peripherals & Accessories
5. Computer Software & Languages
6. Operating Systems & Interfaces

Module Syllabus (Weeks 7 – 12)

7. Software & System Testing
8. Maintenance - Software
9. Maintenance - Hardware
10. File & Data Management
11. Systems Development – Lifecycles & Methodologies
12. Future Trends in Computing & Communication

Module Delivery - 1

Lectures:

- The lecturer will present information with the aid of PowerPoint slides - just like this one.
- You will need to take notes during the lecture
- Bring a pen and paper.
- Mostly, this work will be assessed in the examination.

Module Delivery - 2

- Laboratory
  - Practical sessions during which you will work with relevant computer equipment and software
  - May also involve some demonstrations by lecturers or students
  - Mostly, the work covered in lab sessions will be assessed in your coursework assignment
- Private Study
  - Additional work that you do on your own:
    - Completing and writing up work started in labs
    - Researching topics covered in previous lectures
    - Preparing for future classes

Assessment

- Assignment
  - 50% of your final grade
  - Practical work to be completed in laboratory sessions.
  - Written-up as lab reports
  - Details of the tasks and what to put in the reports are covered on each lab sheet
  - Deadlines

- Examination
  - 50% of your final grade

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Topic 1A – Introduction to Computer Systems

Any Questions?

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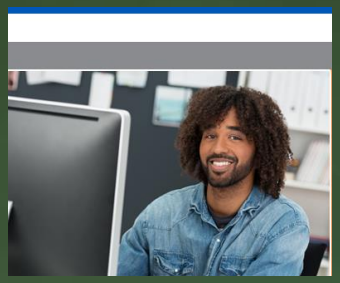
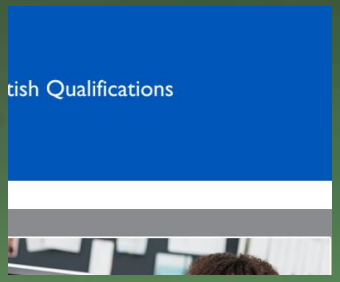
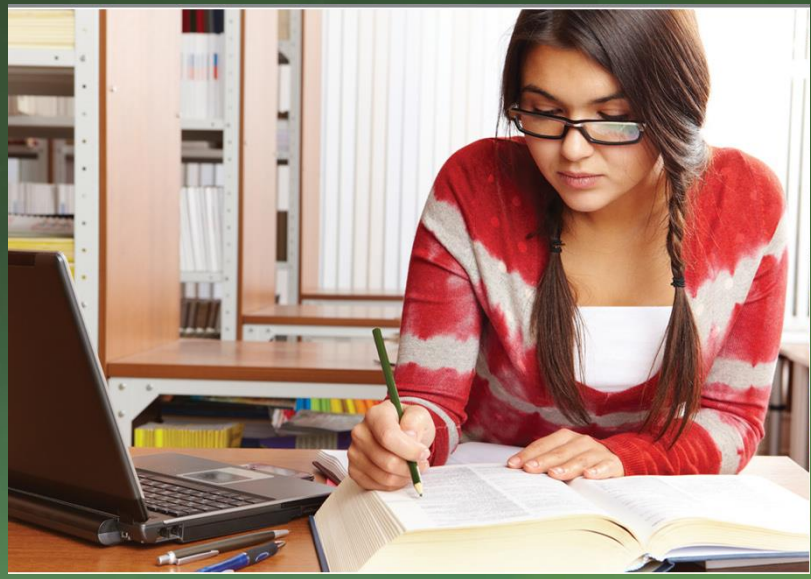






Computer Systems

Topic 1B:

Introduction to Computer Systems

What is a ‘Computer’?

- A ‘computer’ is anything – human or machine – that ‘computes’, ‘calculates’ or performs ‘computations’
- ‘Human computers’ have been around as long as the concepts of numbers, measurement and calculations
- The first recorded use of the word ‘computer’ was in 1613 by Richard Braithwaite...

http://www.computinghistory.org.uk/cgi/computing-timeline.pl

Human Computing

Not a machine in sight!

Human Computing

- During the industrial revolution of the Late 18th century through to the middle of the 20th century most ‘computing’ was done manually by humans
- Gradually, quill, pencil and pen was joined in the human computer’s toolkit by:
- Slide rules
- Punched cards
- Tabulating machines

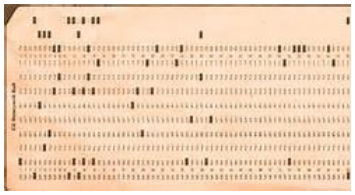
http://www.computinghistory.org.uk/cgi/computing-timeline.pl

Human Computing Toolkit

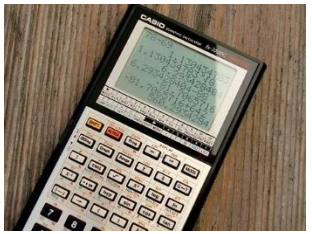
- Abacus

- Slide Rule

- Punched cards



- Calculating Machines



All these devices *assist* a human to 'compute' - they do not *replace* the human. As such, they are not true 'computers' in the sense that we use the phrase now.

True Computers

- If we rule out ‘calculating machines’, the first true computers appeared during World War 2
- Driven by urgent need for military calculations and decoding secret messages:
  - Bletchley Park (UK) – ‘Colossus’
  - http://www.tnmoc.org/explore/colossus-gallery
  - University of Pennsylvania (America) – ‘ENIAC’
  - https://www.britannica.com/technology/ENIAC

True Computers

- Even then, they were not ‘stored program’ computers – they fed data and instructions in by punched card or tape
- World’s first ‘stored program’ computer was the ‘Manchester Baby’ in 1948
- http://www.computinghistory.org.uk/det/6013/the-manchester-baby-the-world-s-first-stored-program-computer-ran-its-first-program

Computers go Mainstream

- Since the late 1940s up to 1970's computers gradually got more powerful, had more memory and storage and were more common
- Started out for secret intelligence and military work, then used by large corporations and universities, then finally smaller organizations
- Still not meant for private or home use – yet!
- http://www.computinghistory.org.uk/cgi/computing-timeline.pl

Computers get Personal

- During 1970s, many huge developments in miniaturizing components & getting costs down.
- Start of the ‘personal computing’ revolution
- Commodore, Apple, Acorn Computers etc
  - Massive step was IBM ‘PC’ in 1981
  - https://www-03.ibm.com/ibm/history/exhibits/pc25/pc25_birth.html
  - Spawned a new generation of ‘PC clones’ – Dell, Compaq etc

Computers become Ubiquitous

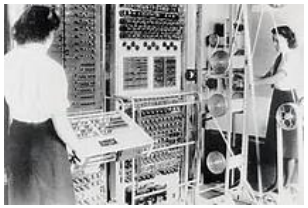
- From the mid-1980s onwards, the ‘desktop’ PC starts to appear everywhere – IBM or IBM clone
- Used professionally in the office for word processing, spreadsheets, databases & email
- Used at home for playing games, budgets etc
- By the 1990s, the ‘laptop’ computer arrives – offering portability and decreased size & weight but at a substantial price-hike over the desktop

Computers become Flexible

- Once the computer was freed from the desktop, mobility was further enhanced by the ‘netbook’ and ‘PDA’
- This trend continues today with ‘smart’ phones and tablets which offer high-performance, low cost computing and communications on-the-go
- Computing also makes huge in-roads on the gaming scene with specialized games consoles

Computers in Pictures

- Colossus
- Manchester Baby
- IBM PC
- Laptop & Netbook
- PDA
- Smartphone
- Tablet
- Gaming Console



1940s

1980s

Smaller, faster, more powerful, more portable and cheaper.

2010s

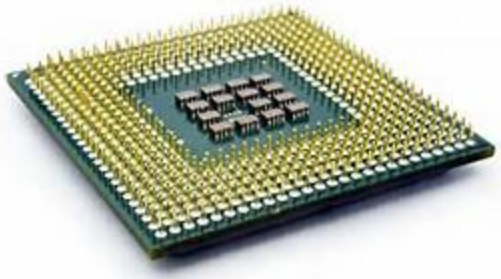
Classifying Computers – Unseen Brains

- Some ‘computers’ don’t look like computers
- They may be ‘embedded’ inside another device – other than a traditional PC, laptop or server
- Could be inside washing machines, smart meters, satellite TV boxes, engine-management in cars, Satnav systems, digital cameras etc
- Micro-Processors: The hidden ‘brain’ inside
- Micro-Controllers: Hidden brain with peripherals

Classifying Computers – Unseen Brains

- See:

http://www.microcontrollertips.com/the-basics-what-is-an-embedded-processor/
http://www.futureelectronics.com/en/Microprocessors/embedded-processors.aspx
https://www.britannica.com/technology/embedded-processor



Classifying Computers – Unseen Sensors

- Some micro-processors are about ‘sensing’ the environment, not just controlling a device:
  - RFID (Radio Frequency Identification)
  - WSN (Wireless Sensor Network)
  - Home Automation & ‘Smart Buildings’
  - http://www.zigbee.org/
  - https://nest.com/uk/
  - https://www.hivehome.com/

Classifying Computers – The ‘IoT’

- These technologies can be used to build the ‘Internet of Things’ (IoT)
- Combine WSN and ‘big data’ analytics to capture and process vast amounts of environmental data – remotely
- ‘Smart Buildings’ & ‘Smart Cities’ concept
- Monitor pollution, traffic flows, temperatures etc

http://www.iec.ch/whitepaper/pdf/iecWP-internetofthings-LR-en.pdf

Classifying Computers – The ‘IoT’

- The ‘Internet’ is about data and communication
- The ‘Web’ is about information and sharing
- Both about connecting people with knowledge
- The ‘Internet of Things’ (IoT) connects **physical** devices – to allow remote sensing and control
- Connects: buildings, vehicles, domestic appliances, health monitoring systems etc

Classifying Computers – The ‘IoT’

- The precise technologies will differ
- But ultimately will use TCP/IP Internet protocol
- The Internet connected humans with knowledge
- The Internet of Things connects humans with physical objects and objects to each other

Classifying Computers – Virtual Clouds

- Another major trend is ‘cloud computing’
- Rather than buy and maintain local ‘on-premise’ IT platforms (hardware + software + staff) – replace with ‘off-premise’ facilities from specialist vendors
- Easier, quicker & cheaper to ‘buy-in’ resources
- The ‘utility’ or ‘pay-as-you-go’ model of computing – like gas, electricity, water etc

Classifying Computers – Virtual Clouds

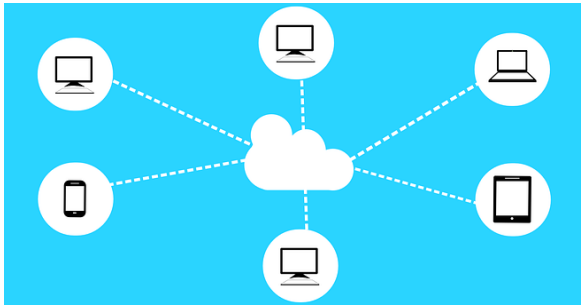
- The ‘XaaS’ (Anything as a Service) model:
  - IaaS (Infrastructure as a Service)
  - PaaS (Platform as a Service)
  - SaaS (Software as a Service)
  - DaaS (Database as a Service)
  - DRaaS (Disaster Recovery as a Service)
  - GaaS (Gaming as a Service)

Classifying Computers – Virtual Clouds

- Cloud based on ‘virtualization’ concept
- Many **physical assets** can be made to appear as a single **logical (virtual) resource**
- One ‘cloud database’ will in reality comprise 100s or 1000s of individual computers
- One ‘cloud storage unit’ may be multiple hard disks OR one massive hard disk may be virtually broken down into many ‘cloud storage units’

Classifying Computers – Virtual Clouds

- Hides all messy technical details from end users
- Provides a ‘virtualized & commoditized’ package that is easily understood and monitored
- But ultimately, it is underpinned by physical computers and infrastructure…



End-users see logical view

Cloud vendors see physical view

Classifying Computers – Virtual Clouds

- Key cloud vendors:
- Microsoft Azure
  - https://azure.microsoft.com/en-gb/overview/what-is-cloud-computing/
- Amazon Web Services
  - https://aws.amazon.com/what-is-cloud-computing/
- Google Cloud
  - https://cloud.google.com/
- Dropbox
  - https://www.dropbox.com/?landing=dbv2
- IBM
  - https://www.ibm.com/cloud-computing/uk/en/
- There are many others – just search online…

Classifying Computers – A Summary

- So far, we have examined the two extremes of computing platforms
  - The very small (embedded processors and sensors)
  - The very large (Internet of Things and Cloud Computing)
- In the middle are human-scale computing devices…
  - Server
  - Desktop
  - Laptop
  - Netbook
  - Tablet
  - Smartphone
  - Games Consoles




Classifying Computers – A Comparison

- Each device has different characteristics, strengths, weaknesses, features, functions and applications…

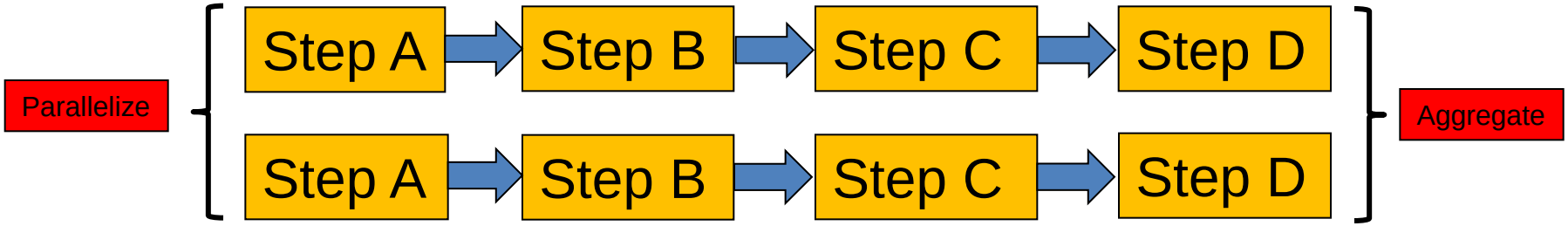
Device	Price	Power	Strengths	Weaknesses	Usage
Server	HIGH	HIGH	RELIABILITY POWER	COST NOT PORTABLE	HOSTING WEB & DATABASE S/W
Desktop	MEDIUM	HIGH-MEDIUM	GENERAL PURPOSE EASY TO USE	LACK OF PORTABILITY	ANYTHING DONE AT A DESK
Laptop	MEDIUM	MEDIUM	PORTABILITY GENERAL PURPOSE	LESS POWER THAN DESKTOP	ANYTHING DONE ON THE MOVE
Netbook	LOW	LOW	PORTABILITY GENERAL PURPOSE	LESS POWER THAN DESKTOP	ANYTHING DONE ON THE MOVE
Tablet	LOW	LOW	PORTABILITY GENERAL PURPOSE	LESS POWER THAN DESKTOP	ANYTHING DONE ON THE MOVE
Smartphone	LOW-MEDIUM	LOW	PORTABILITY EVERYTHING IN ONE	BATTERY LIFE SIGNAL STRENGTH	ANYTHING DONE ON THE MOVE
Games Console	LOW-MEDIUM	MEDIUM-HIGH	OPTIMIZED FOR GRAPHICS	NOT GENERAL PURPOSE	PLAYING GAMES INTERNET ACCESS

Classifying Computers – HPC

- HPC stands for High Performance Computing - often known as ‘super computing’ - the elite, specialized end of the computing spectrum
- Normally used in scientific applications like genetics, astronomy or meteorology where massive data sets and complex operations need to be performed
- It can involve a single, ultra-powerful machine or a cluster of lesser machines acting together
- The key principles used are **pipelining**, **parallelization & aggregation**

Classifying Computers – HPC

- In **pipelining**, the task to be performed is broken down into a series of sequential steps, with the output of one stage feeding into the input of the next stage – like a car production line
- In **parallelization**, the data and code acting on that data are decomposed into ‘streams’ or ‘threads’ or activity, each running in isolation concurrently to the others
- In **aggregation**, the various results from different streams or threads are then merged into a single final result



Classifying Computers – HPC

- Cray Research
  - http://www.cray.com/
- Fujitsu
  - http://www.fujitsu.com/global/products/computing/servers/supercomputer/primehpc-fx100/
- IBM
  - https://www.ibm.com/it-infrastructure/us-en/hpc/
- HP & Intel
  - http://www8.hp.com/uk/en/hp-intel-computing-center/overview.html
- Silicon Graphics
  - http://www.sgi.com/products/servers/

Computers – The Future?

We have already seen some of the trends that will dominate the future:

1. Remote sensing and control (CCTV, home automation, IoT etc.)
2. Big Data by Machines – all that sensing captures a lot of data
3. Big Data by Humans – all those social media uploads and tweets
4. Nanotechnology – smaller is often better – it gets you into more places
5. Data Analytics – all the above Big Data has to be processed & analyzed
6. Always On – users demand 24x7 access – anywhere (cloud computing)
7. Novel interfaces – we can do better than a keyboard and screen!
8. Biometric security – hard to hack a (living) thumb or iris scan!
9. Mobility – 5G and other technologies for enhanced on-the-go computing

References

- http://www.computerhistory.org/
- http://www.tnmoc.org/
- https://www.bletchleypark.org.uk/
- http://www.computinghistory.org.uk/
- http://www.computinghistory.org.uk/cgi/computing-timeline.pl
- http://www.computerhistory.org/timeline/

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Topic 1B – Introduction to Computer Systems

Any Questions?