

Welcome to COMPSCI.111

Today's class

- ▶ Introduction to COMPSCI111/111G
 - ▶ People
 - ▶ Assessment
 - ▶ Labs
 - ▶ Test and exam
- ▶ Introduction to computer hardware

Staff Contact Information

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Staff Contact Information

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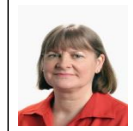
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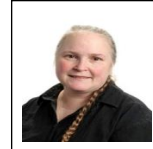
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**Need to talk to someone?
We are here to
listen and help!
Come and talk to us!**



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Marks for COMPSCI111

- Theory: exam and test
- Practical: labs
- **Need to pass half of the theory and half of the practical in order to pass the course**

Exam (50%)

Test
(20%)

Labs
(30%)

Test

- ▶ Wednesday 8th April at 6:25pm.
- ▶ Test is worth 20% of your final grade

Labs

- ▶ An opportunity to practise what you learn in lectures
 - ▶ 1 compulsory 3-hour lab each week
 - ▶ 9 labs together worth 30% of final mark
 - ▶ 10% of each lab's mark is given for arriving on time and completing a certain portion of the lab
 - ▶ Hand in lab assignment before start of next lab
 - ▶ Definitely worth staying for the full 3 hours
- ▶ Before labs start next Monday please:
 - ▶ Find the First Floor Teaching Lab (FTL - 303S-175)
 - ▶ Make sure you have a USB drive

Exam

- ▶ Date and location will be announced by the Examinations Office

Places to find information

- ▶ Canvas announcements
- ▶ The course website:
www.cs.auckland.ac.nz/courses/compsci111s1c
- ▶ Online course reference manual, available on the home page of the course website
- ▶ Piazza
- ▶ Any of the COMPSCI.111 teaching staff
 - ▶ Please use your University email account when emailing us
 - ▶ Please include CS.111 in the subject

Class representative



CLASS REP

Computer Hardware

Lecture 1 - COMPSCI111

Today's lecture

- ▶ Identifying the key components in a computer
- ▶ Understanding how these components work
- ▶ Using this knowledge to understand computer specifications

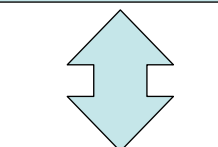
Overview of a computer



Input

Output

Processing



Storage

Communication

Computer hardware

- ▶ “Those parts of the system that you can hit with a hammer (not advised) are called hardware”
- ▶ Key design principle of **modularity**

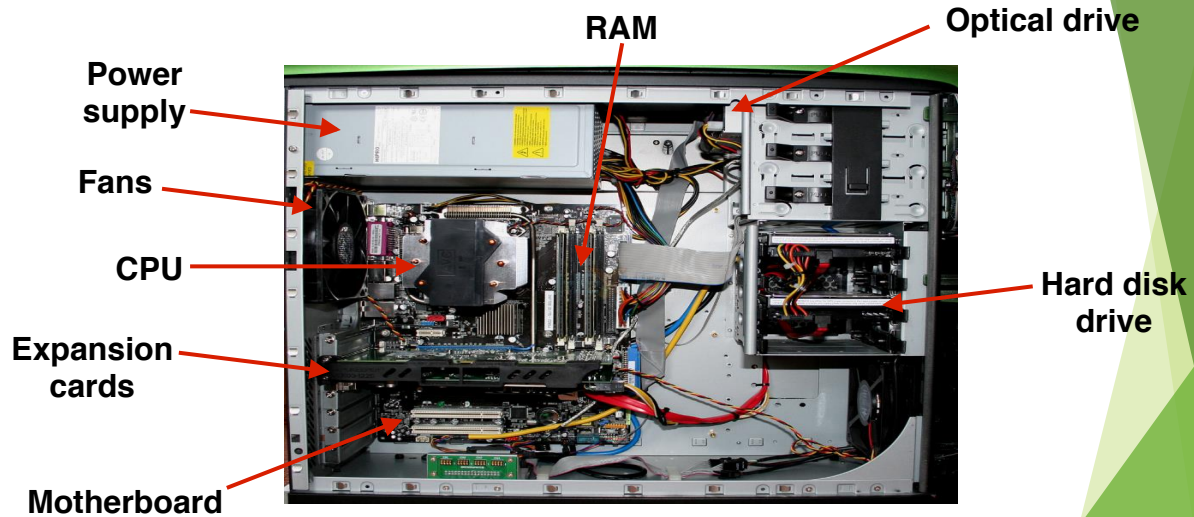


Form factors

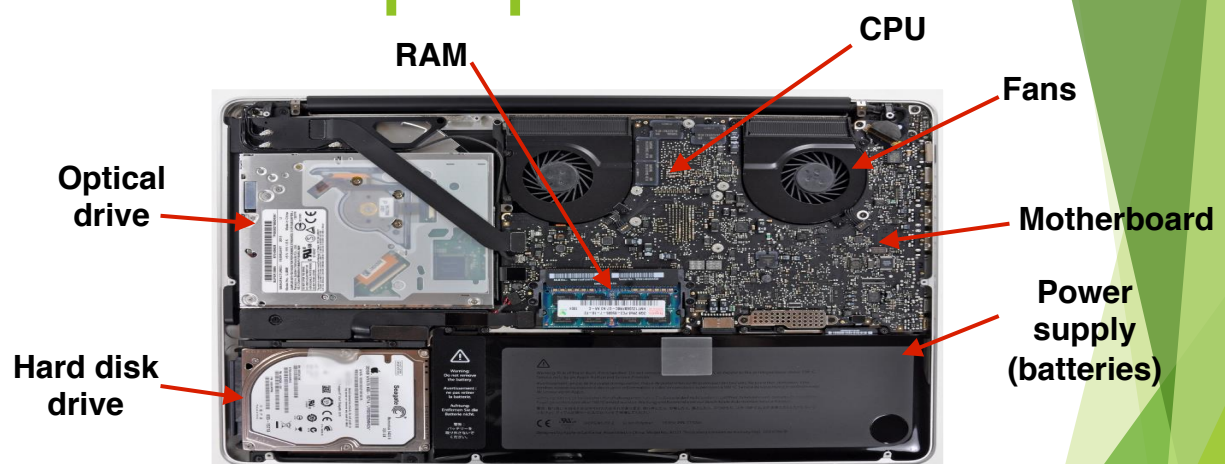
- ▶ System units come in lots of different **form factors**



Inside the system unit



Inside a laptop



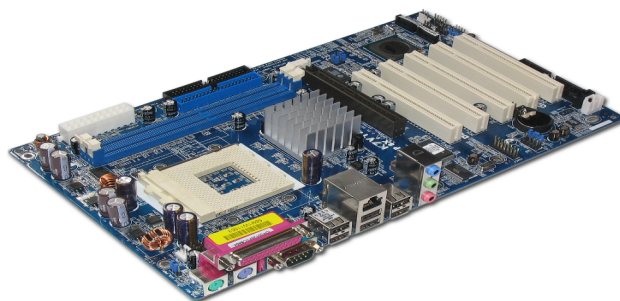
Power supply unit

- Converts AC voltage to DC voltage for use within the computer



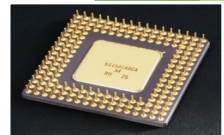
Motherboard

- The main circuit board to which all components are connected, allowing them to communicate with each other



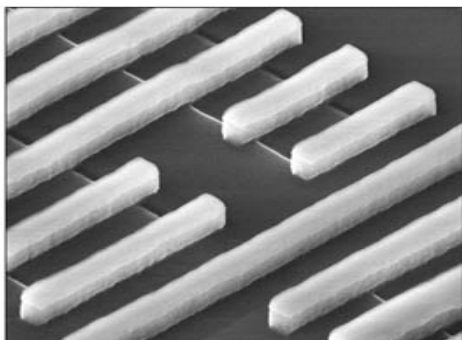
Central processing unit (CPU)

- ▶ The 'brain' of a computer. Processes data in a computer using its **instruction set**
- ▶ Performance can be measured in:
 - ▶ Instructions per second
 - ▶ Clock speed (Hertz - Hz)
- ▶ CPUs must be kept cool, generally using a heatsink and fan

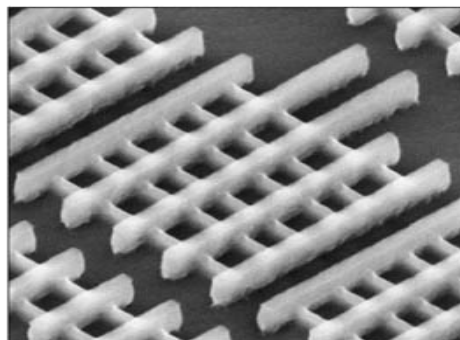


CPUs - transistors

32 nm Planar Transistors



22 nm Tri-Gate Transistors

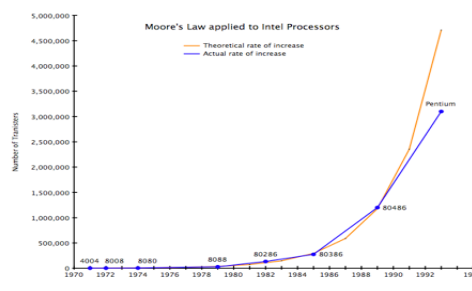


CPUs - Moore's Law

- ▶ Gordon Moore (Intel co-founder) stated in a 1965 paper:
'The number of transistors on a single integrated circuit doubles approximately every 18 months, while the price remains the same.'
- ▶ So...
 - ▶ In 3 years, CPUs will be 4 times faster
 - ▶ In 15 years, CPUs will be 1000 times faster

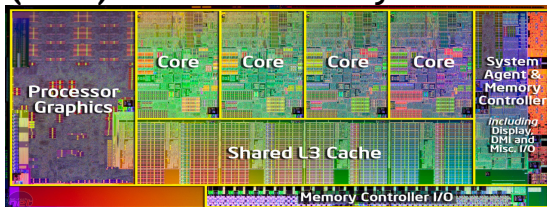
CPUs - Moore's Law

- ▶ Moore's Law has been an important guide for many parts of the tech industry, especially in CPU manufacturing
- ▶ More difficult to keep up with Moore's Law as we reach the limits of CPU fabrication technology



CPUs - other measures

- ▶ Power efficiency and heat are just as important as clock speed
- ▶ Modern CPUs have multiple cores, increasing their processing capacity
- ▶ New kinds of processors, such as **system on chip (SoC)** are commonly used in mobile and



Primary memory

- ▶ Used to store data for quick access by CPU
- ▶ Main form of primary memory is **Random Access Memory (RAM)**
- ▶ RAM is **volatile memory**
- ▶ More RAM improves a computer's speed by providing more quick access memory
- ▶ Capacity is measured in bytes, clock speed measured in Hz
- ▶ Many types of RAM; common type is DDR3 SDRAM



Secondary memory

- ▶ Used to store files for repeated access over time
- ▶ Also known as **non-volatile storage**; the storage medium retains its contents without needing a supply of electricity
- ▶ Many forms of secondary storage:
 - ▶ Hard disk drive (HDD)
 - ▶ Solid state drive (SSD)
 - ▶ CDs, DVDs, Blu-ray
 - ▶ USB drives, external HDDs

Hard Disk Drive (HDD)

- ▶ Stores data on spinning magnetic disks. Data is read and written by moving heads
- ▶ Advantages:
 - ▶ Cheap storage medium
 - ▶ Widely used and supported
 - ▶ Can have very large capacity drives
 - ▶ Long operating life
- ▶ Disadvantages:
 - ▶ Noisy operation
 - ▶ Can consume more power than SSDs
 - ▶ Fragile, needs to be handled carefully



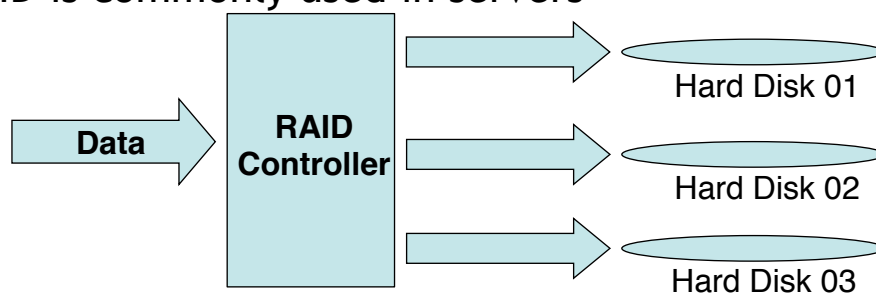
Solid State Drive (SSD)

- ▶ Stores data on flash memory, the same technology used by USB drives
- ▶ Advantages:
 - ▶ Silent operation
 - ▶ Higher read/write speeds when compared to HDDs
 - ▶ Low power usage
 - ▶ More durable
 - ▶ Use less space
- ▶ Disadvantages:
 - ▶ Costlier than HDDs
 - ▶ Can wear out faster than HDDs



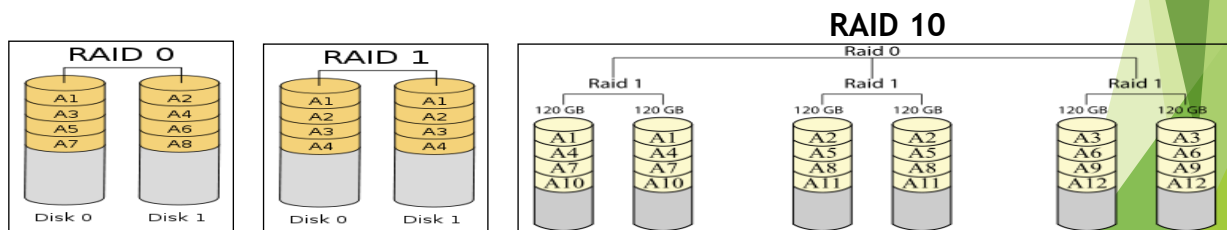
Redundant Array of Independent Disks (RAID)

- ▶ RAID pools HDDs/SSDs together to form a larger, more reliable data storage mechanism
- ▶ Each RAID configuration has its own strengths and drawbacks
- ▶ RAID is commonly used in servers

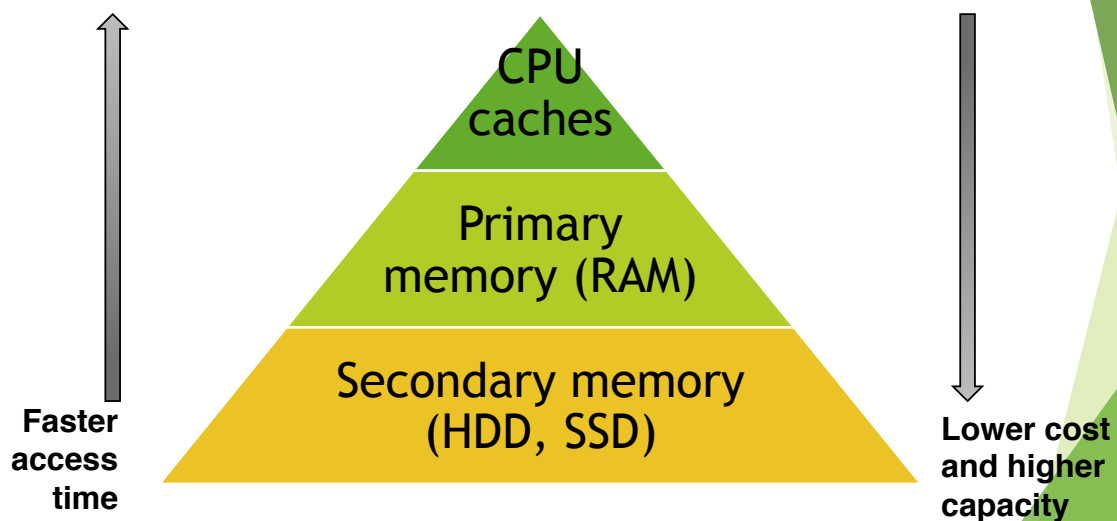


RAID configurations

- ▶ Numerous configurations, we're focusing on two:
 - ▶ RAID 0 - data stripes used to increase speed
 - ▶ RAID 1 - data redundancy used to increase reliability
- ▶ RAID 10 combines RAID 0 and RAID 1 together



Memory hierarchy



Memory capacity

Measured in bytes

Plain Text (approx.)

- 1 byte
- 1 KB
- 1 MB
- 1 GB

1 character - using ASCII standard for encoding

13 lines/1000 characters in our course notes

300 pages

175 phone books

Music (approx.)

- 1 GB

2 hours

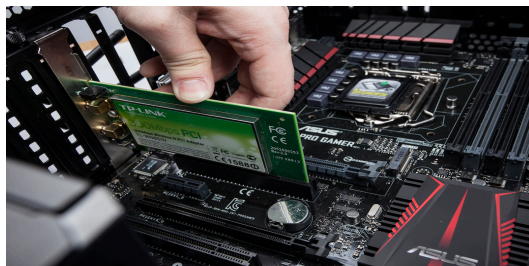
DVD (approx.)

- 1 GB

20 minutes

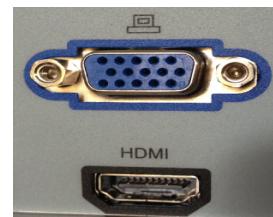
Expansion cards

- ▶ Additional circuit board that provides extra functionality
- ▶ Examples: sound card, graphics card, network card
- ▶ Plugged into motherboard using slots that follow certain standards:
 - ▶ ISA
 - ▶ PCI-E
 - ▶ AGP



Graphics card

- ▶ Used to perform graphics processing and run the computer's monitors (also now used for ML)
- ▶ Consists of:
 - ▶ GPU (either part of CPU or separate graphics card)
 - ▶ Video memory
 - ▶ Heatsink and fan
 - ▶ Ports



Input devices

- ▶ Peripherals that allow the computer to receive input from the outside world, mainly from the user
- ▶ Common input devices:
 - ▶ Keyboard
 - ▶ Mouse
 - ▶ Webcam
- ▶ Other input devices:
 - ▶ Voice recognition
 - ▶ Biometric scanners
 - ▶ RFID tags



Output devices

- ▶ Peripherals that present information processed by the computer to the user
- ▶ Output devices include:
 - ▶ Computer monitor
 - ▶ Printer
 - ▶ Speakers
 - ▶ Touchscreens
- ▶ New forms of output include:
 - ▶ Virtual reality
 - ▶ Augmented reality



Connectors and buses

- ▶ All peripherals are connected to the motherboard via ports
- ▶ Ports form part of a **bus**
- ▶ Wired connections:
 - ▶ USB (Universal Serial Bus)
 - ▶ Thunderbolt high speed connector
 - ▶ Ethernet
 - ▶ VGA, DVI and HDMI for monitors
- ▶ Wireless connections:
 - ▶ Wi-Fi
 - ▶ Bluetooth



Computer specs

- ▶ How much primary memory does this computer have?
- ▶ How many cores does the processor have?
- ▶ Does this computer have a motherboard?
- ▶ What kind of graphics card does this computer have?

ThinkPad T460p 14" High Performance Laptop

This 14" laptop is enhanced with performance-boosting processors, memory, and graphics, to give you superior productivity from a device that's still thin and light enough for travel.

- Up to 6th Generation Intel® Core™ i7 quad-core H processor
- Up to Windows 10 Pro
- **Up to 8 hours battery life with 47.5Wh
- Up to 32GB DDR4 memory
- 14" anti-glare display, up to WQHD (2560x1440) IPS
- Up to 256GB PCIe SSD storage or 512GB SATA SSD storage
- 2x2 802.11 ac WiFi, Bluetooth® 4.1
- Up to NVIDIA GeForce 940MX 2GB discrete graphics
- Starting at 1.81 kg (4 lbs) / 24.4mm
- Ports: 3 USB 3.0 (one powered), HDMI, miniDP, 4-in-1 card reader, optional Smart Card

Computer specs

- ▶ How much primary memory does this computer have?
 - ▶ 32GB of DDR4 RAM
- ▶ How many cores does the processor have?
 - ▶ Quad = 4 cores
- ▶ Does this computer have a motherboard?
 - ▶ Yes, all computers have a motherboard which connects everything together
- ▶ What kind of graphics card does this computer have?
 - ▶ Discrete NVIDIA graphics card

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Summary

- ▶ Computers process input from the user and other sources and provide output
- ▶ Computer systems are designed using the principle of modularity
- ▶ System units are made up of a number of components working together:
 - ▶ Power supply
 - ▶ Motherboard
 - ▶ CPU
 - ▶ Primary and secondary memory
 - ▶ Connectors and buses

