Welcome to COMPSCI111/111G!
Today’s class

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

- Introduction to computer hardware

https://www.cs.auckland.ac.nz/courses/compsci111s1c/
Lecturers

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- **Ian Watson**
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https://www.cs.auckland.ac.nz/courses/compsci111s1c/people/
Course coordinator and lab supervisor

- Ann Cameron
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  - Open door policy, visit anytime or email for an appointment

- Contact Ann if you have questions about the course or labs

https://www.cs.auckland.ac.nz/courses/compsci111s1c/people/
Computer Science Support Network

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Marks for COMPSCI111/111G

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

https://www.cs.auckland.ac.nz/courses/compsci111s1c/exams/
Test

- Thursday, 11th April, 2019, 6:30pm - 7:30pm.
- Location: TBA
- Test is worth 20% of your final grade
- The entire test is Multi-Choice and you will be answering the questions on a teleform sheet.

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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
  - Hand in lab assignment sometime before start of next lab
  - Definitely worth staying for the full 3 hours

- Before labs start on March 11 please:
  - Find the First Floor Teaching Lab (FTL - 303S-175)
  - Make sure you have a USB drive
  - There is no lab manual
  - Lab assignments are handed out at the lab sessions
  - No required textbook

https://www.cs.auckland.ac.nz/courses/compsci111s1c/labs/
Exam

- Date and location will be announced by the Examinations Office
Places to find information

- Canvas announcements
- The course website: https://www.cs.auckland.ac.nz/courses/compsci111s1c/
- Online course reference manual; available on the homepage of the course website
- Piazza (click on Piazza link on Canvas)
- Any of the COMPSCI111/111G teaching staff 😊
  - Please use your University email account when emailing us
Class representative
Computer Hardware

Lecture 1 - COMPSCI111/111G

“Yes, I did say I wanted to change the wallpaper on my desktop. But not that type. You don’t know much about computers, do you?”
Today’s lecture

- Identifying the key components in a computer
- Understanding how these components work
- Using this knowledge to understand computer specs
Overview of a computer

- Input
- Processing
- Output
- 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

All-in-one PC

Tower

Desktop

SFF
Small Form Factor

USFF
Ultra Small Form Factor
Inside the system unit

- Power supply
- Fans
- CPU
- Expansion cards
- RAM
- Optical drive
- Hard disk drive
- Motherboard
Inside a laptop

- RAM
- CPU
- Fans
- Motherboard
- Power supply (batteries)
- Optical drive
- Hard disk drive
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)

- Performance measured in instructions per second.
- Clock speed (measured in Hertz [Hz]) measures the speed at which electrical signals pass through the processor.
- 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 embedded devices
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

- CPU caches
- Primary memory (RAM)
- Secondary memory (HDD, SSD)

Faster access time
Lower cost and higher capacity
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

- 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
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?
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

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
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