Welcome to COMPSCI111/111G!

SEMESTER 1, 2017
Today’s class

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

Introduction to computer hardware
Lecturers

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

Exam (60%)   Test (20%)   Labs (20%)
Test

Tuesday 11th April from 6:30pm–7:30pm
Location TBA
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 20% 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 next Monday (13th March) please:

◦ Buy this semester’s lab manual from UBS
◦ 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
Class representative
Places to find information

Canvas announcements

The course website:
www.cs.auckland.ac.nz/courses/compsci111s1c

You need to purchase a 2017 Semester 1 lab manual from UBS

Online course reference manual; available on the home page of the course website

The Computer Science student forum:
http://forums.cs.auckland.ac.nz

Any of the COMPSCI111/111G teaching staff 😊
  • Please use your University email account when emailing us
Computer Hardware

“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
- Motherboard
- RAM
- Optical drive
- Hard disk drive
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)

The ‘brain’ of a computer. Processes data in a computer using its **instruction set**

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
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
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

Data → RAID Controller → Hard Disk 01
Data → RAID Controller → Hard Disk 02
Data → RAID Controller → Hard Disk 03
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
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?

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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Supercomputer

A computer at the frontline of contemporary processing capacity – particularly the number of calculations.

Supercomputers play an important role in the field of computational science. They are used for a wide range of computationally intensive tasks.

They use many microprocessors in parallel.

Performance of a supercomputer is measured in floating-point operations per second (FLOPS).
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