Welcome to COMPSCI111/111G

Today's class

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

Lecturers

- See Canvas or course website
  - Andrew Luxton-Reilly
  - Damir Azhar
  - Katerina Taskova

Course coordinator & lab supervisor

- Ann Cameron
  - 303, Level 4, room 413
  - a.cameron@auckland.ac.nz
  - Open door policy, visit anytime or email for an appointment
- Contact Ann if you have questions about the course or labs

Computer Science Support Network

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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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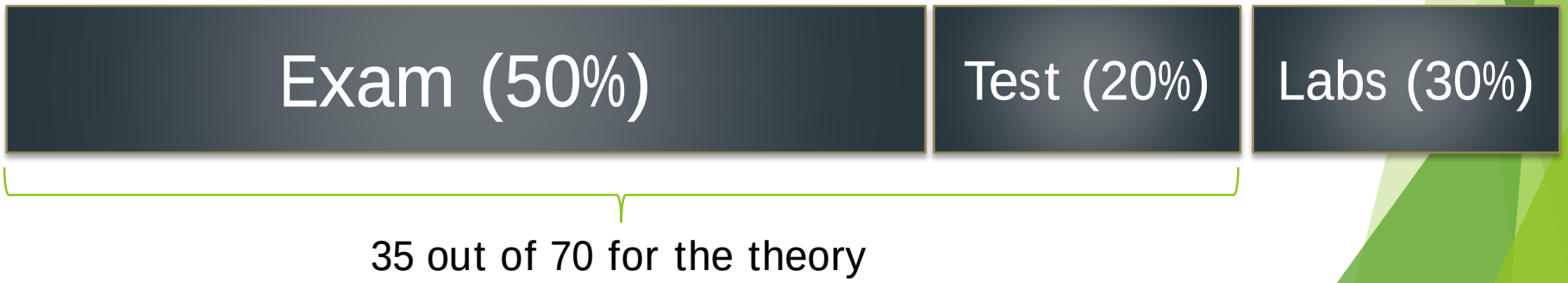
Marks for COMPSCI111/111G

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



Test

- For date, time and venue see Canvas
- Test is worth 20% of your final grade

Labs

- An opportunity to practise what you learn in lectures
  - 2 compulsory 3-hour labs 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 please:
  - Find the First Floor Teaching Lab (FTL - 303S-175)
  - Make sure you have a USB drive
  - NOTE: Labs start this week on Thursday!

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/compsci111ssc/
- Online course reference manual, available on the home page of the course website
- Piazza
- Any of the COMPSCI111/111G teaching staff ☺
  - Please use your University email account when emailing us
  - Please include CS.111 in the subject

Class representative

AUSA REPRESENTATION

CLASS REP

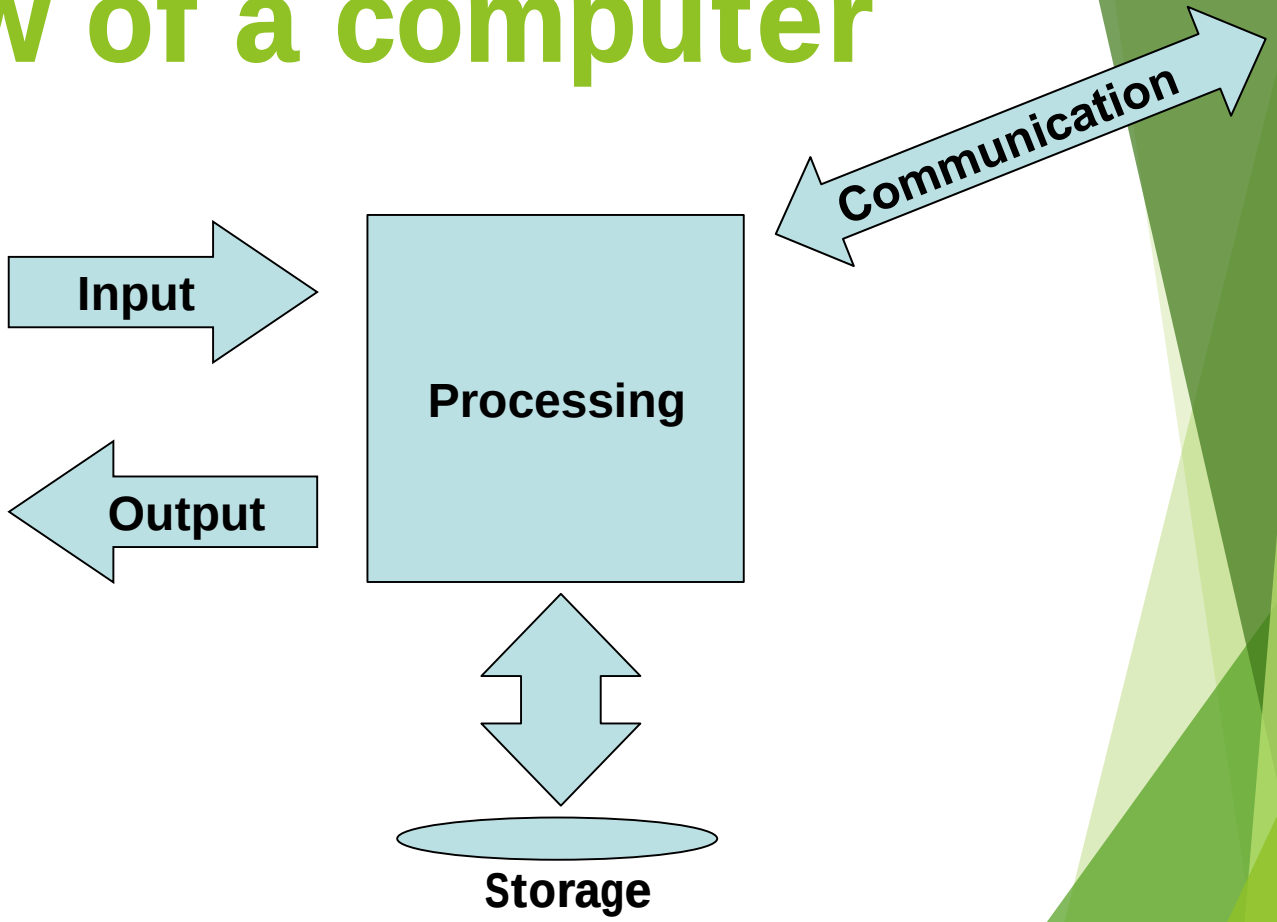
Computer Hardware

Lecture 1 – COMPSCI111/111G

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



Computer hardware

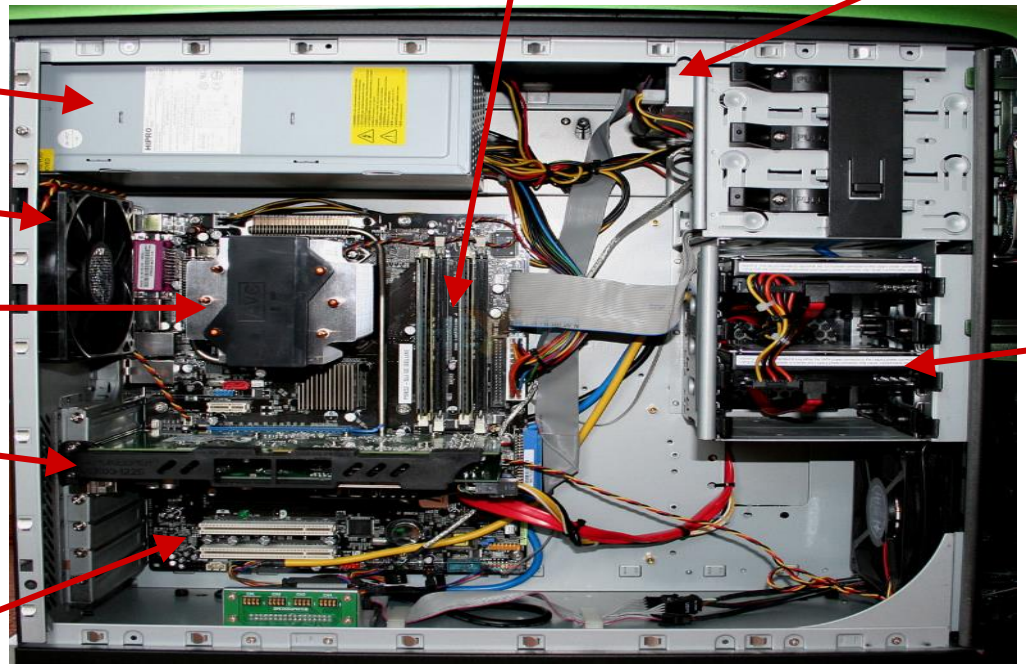
- “Those parts of the system that you can hit with a hammer (not advised) are called hardware”
- Key design principle of **modularity**

Form factors

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

All-in-one PC

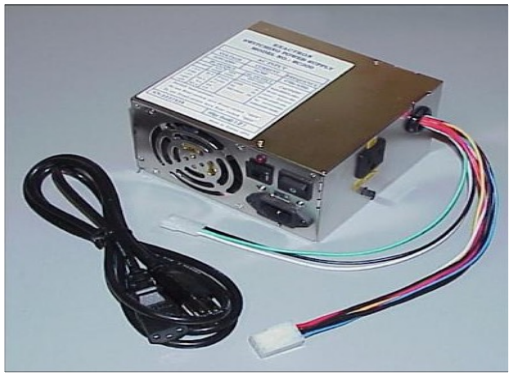
Inside the system unit



Inside a laptop

Power supply unit

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

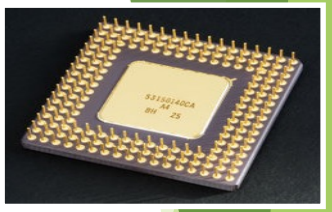


Motherboard

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

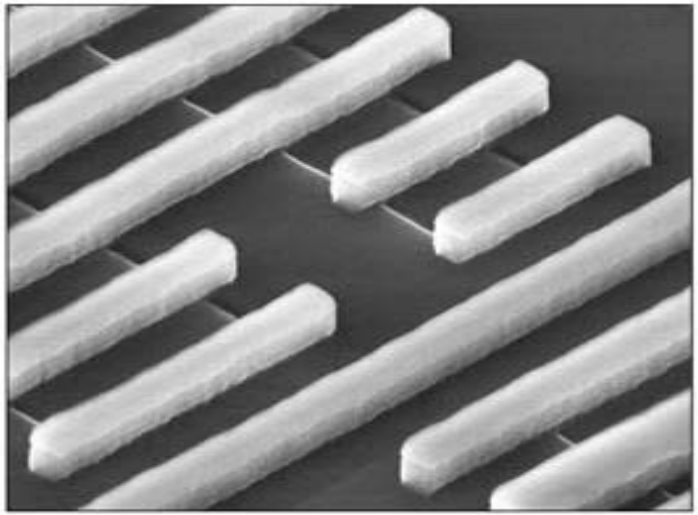
Central processing unit (CPU)

- 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

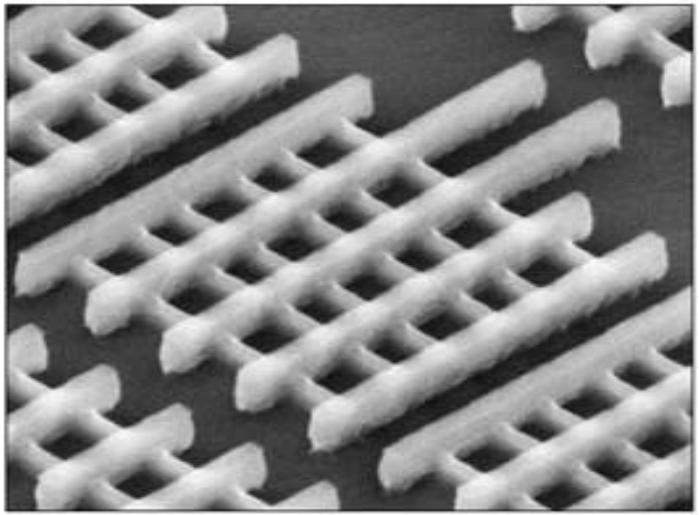


CPUs - transistors

32 nm Planar Transistors



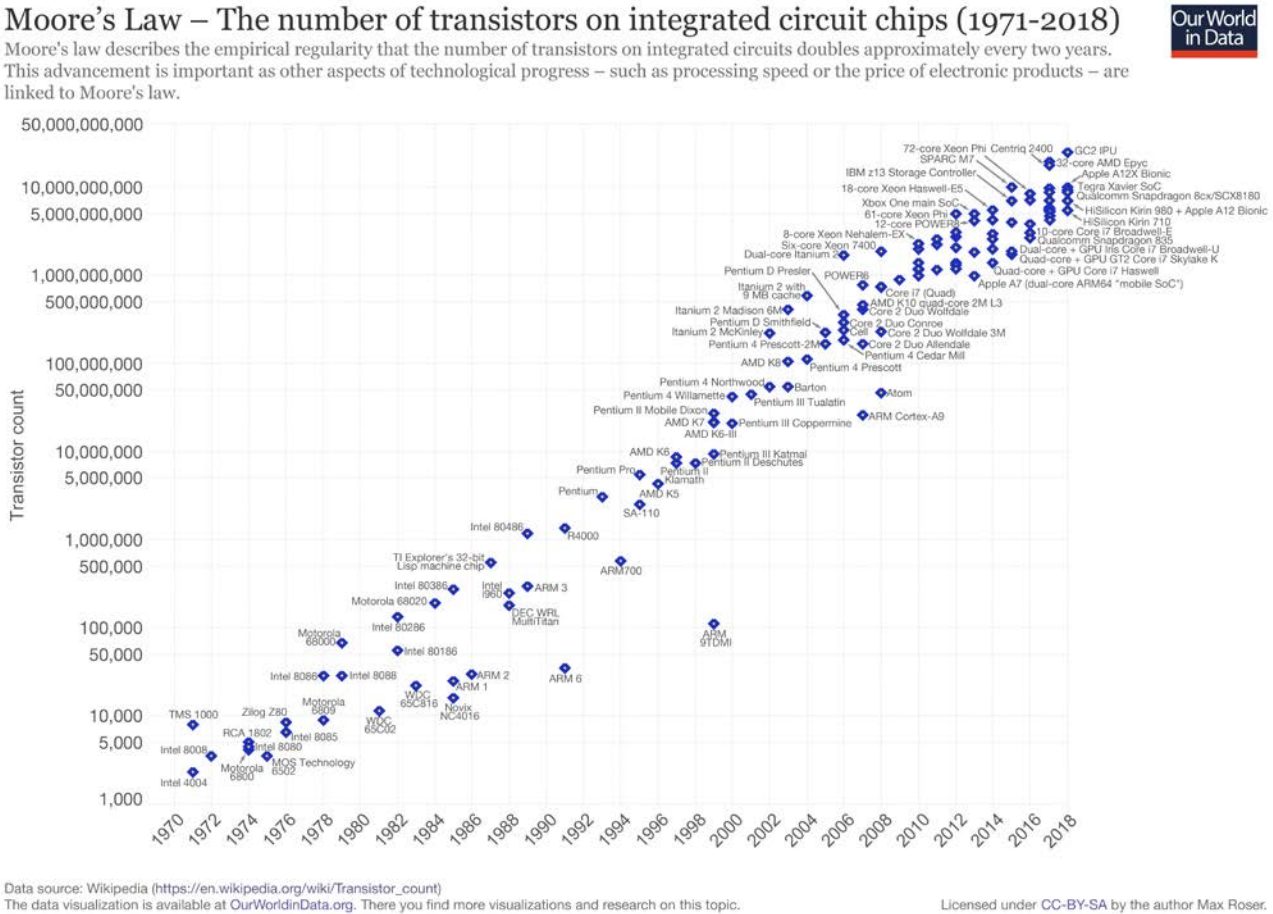
22 nm Tri-Gate Transistors



CPUs – Moore's Law

- Gordon Moore (Intel co-founder) observed that the number of transistors in a circuit doubles about every two years. This became known as "Moore's Law".
- A colleague at Intel estimated computing "power" increased even more rapidly, approximately doubling every 18 months.
- So…
  - In 3 years, CPUs will be 4 times more powerful
  - In 15 years, CPUs will be 1000 times more powerful

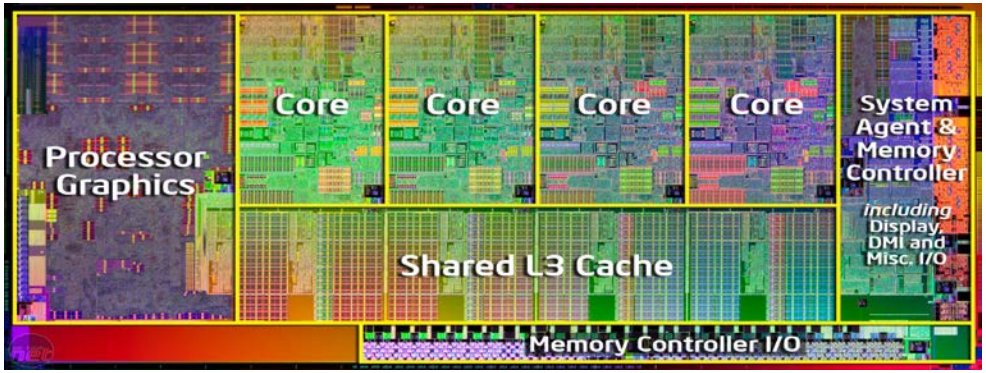
CPUs - Moore's Law



Data source: Wikipedia (https://en.wikipedia.org/wiki/Transistor_count)
The data visualization is available at OurWorldinData.org. There you find more visualizations and research on this topic.

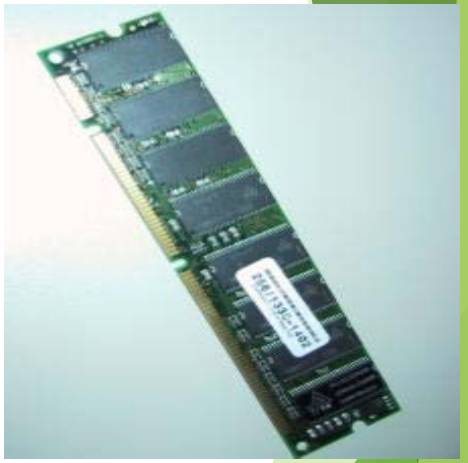
CPUs – other measures

- 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)

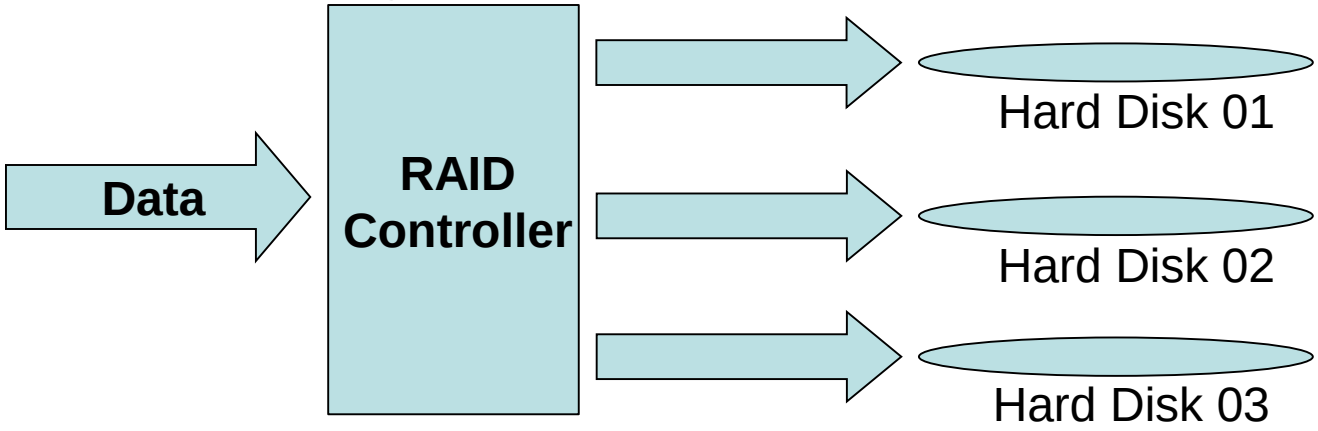
- Stores data on flash memory, the same technology used by USB drives

- Advantages:
  - Silent operation
  - Higher read/write speeds when compared to HDDs
  - Low power usage
  - More durable
  - Use less space

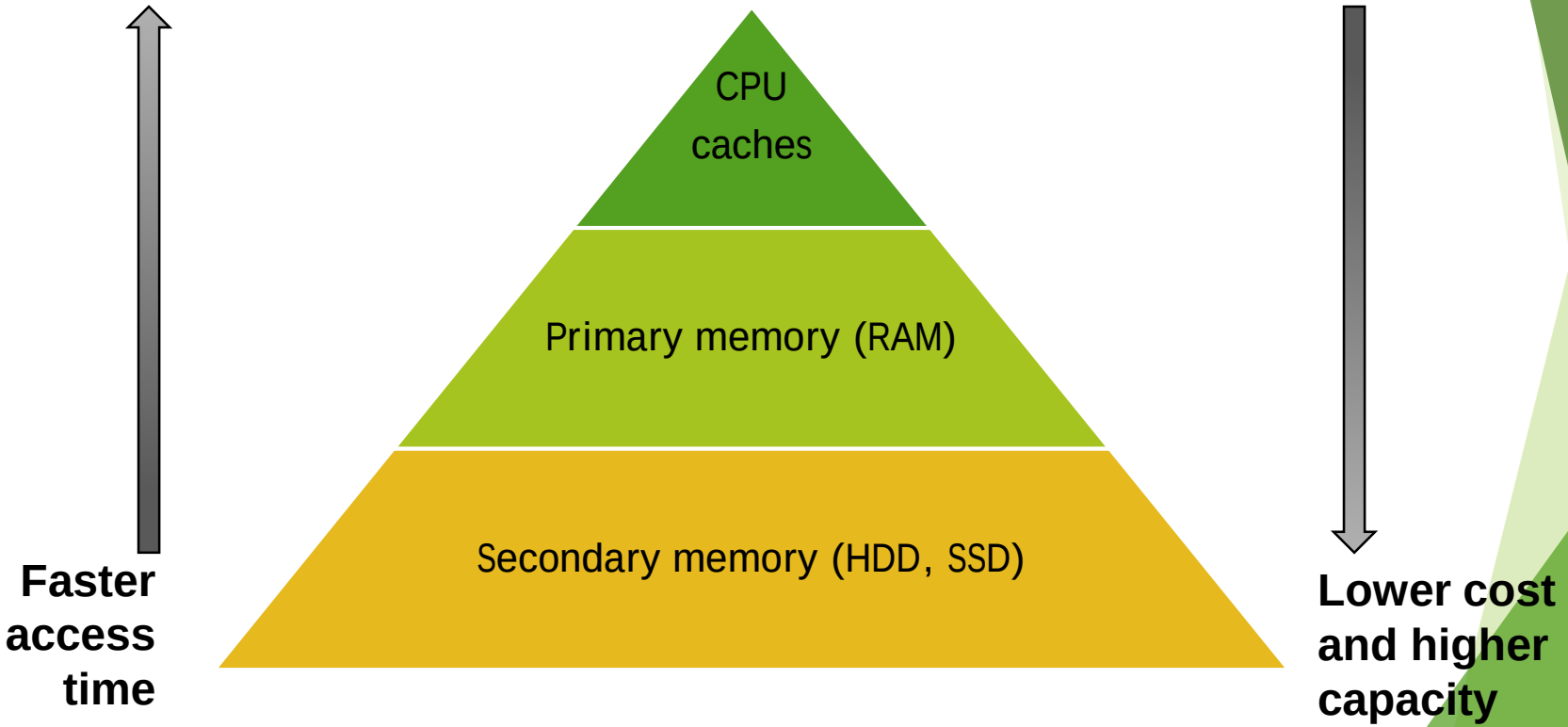
- Disadvantages:
  - Costlier than HDDs
  - Can wear out faster than HDDs

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



Memory hierarchy



Memory capacity

Measured in bytes

Plain Text (approx.)

– 1 byte	1 character - using ASCII standard for encoding
– 1 KB	13 lines/1000 characters in our course notes
– 1 MB	300 pages
– 1 GB	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

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