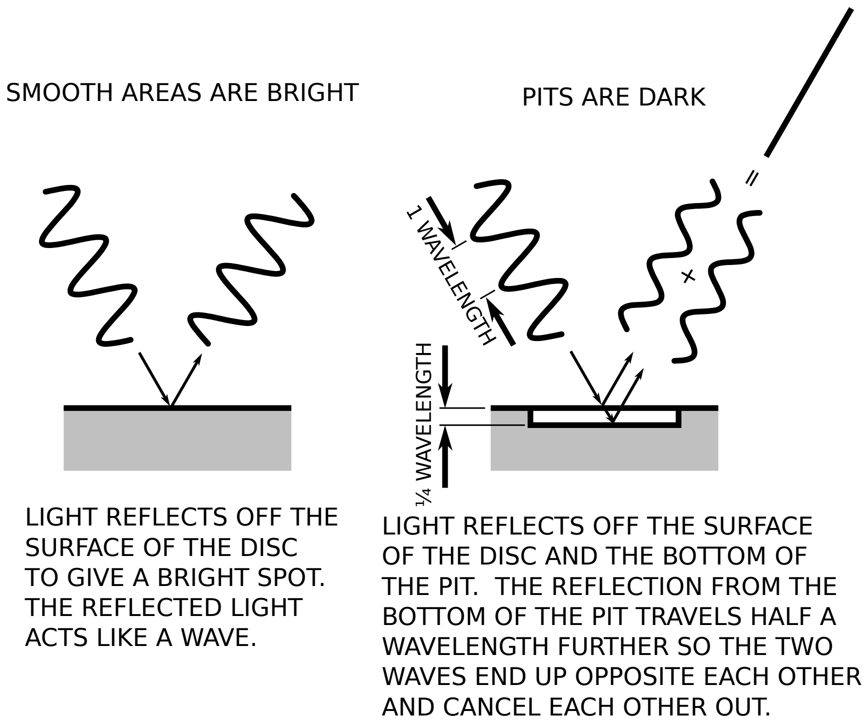
# 29/5/2018 Week 3:

## Installation of an Operating System

Use a CD to install an operating system:

1. Insert CD
2. Explanation of using key combinations on power up to access boot menus and BIOS and how the computer needs to fetch its first program, typically from a hard disk inside the computer. You need to change the boot order, so the computer looks for its first program on the CD rather than the hard disk.
3. Answer the questions asked.
4. Partitioning: Partitioning is the process of setting up the format of the disk. It destroys all information on the disk. This is why the installer asks you to confirm before writing the new partition, as you cannot go back. Partitions are like drawers in a filing cabinet, allowing you to separate information on the hard disk.

How a Compact Disc Stores Information:




Information is stored as a series of pits in the smooth surface of the CD, which causes the reflected laser light to quickly turn on and off as the disc spins, allowing the information to be read.

# A Course in Computers

## Information

What do we mean by information? Ask the class for examples of information. Examples: your name, where something is, what colour something is, ...

Information is how we tell things to other people. It goes deeper than that though, as information is how all parts of the world communicate, not just how people communicate. Information will become central to your lives as you grow up, as the world is increasingly being described in terms of information. Even fundamental physics, like that which goes on in the Large Hadron Collider, is in the process of being redefined in terms of information. You can use physics to describe the world around you, or you can equivalently describe the world around you in terms of information.

Here is an example. Hold up a whiteboard marker. How do you know that I'm holding this marker here? Class answers: we can see it. How can you see it? Answer: light. Yes the light is travelling from the pen you your eye, so you know where the pen is. The light is carrying information about the pen from the pen to your eye.

Think about this: the **only** way that you know about the pen is because of the information in the light that is travelling to your eye. Imagine if I could remove the pen, but there was no change to the light entering your eye. You would have no way of knowing that the pen had been moved. Here is a clearer example: Who knows how long light takes to travel from the Sun to Earth? Class guesses, might or might not get the answer of 8 minutes. Yes, light travels as a finite speed and it takes 8 minutes for the light from the Sun to reach Earth. Now imagine that the sun blows up. It would take 8 minutes from when the Sun blew up until we knew about it. The point is that the only way we know about the Sun is because of the information which is travelling from the Sun to us on the Earth. Information is a fundamental property of our world.

There is a whole branch of mathematics about information and how it behaves. It's called Information Theory.

## The Bit

Who can tell me the smallest amount of information that you can give to someone, excluding giving them no information at all? Class guesses: My name, ...

The answer is: "The answer to a yes/no question". For example: hold up a (purple) whiteboard marker and ask the question "Is this pen purple?" The class answers "Yes". You have just sent the smallest possible amount of information to me: the answer to a yes/no question. We call this amount of information a "bit". Further examples of yes no answers: Is your name Michael, is the light on, ... If anyone doubts, ask them to think of a simpler answer than yes/no.

We can represent a bit, or a yes/no answer, in many different ways. Give the class one example then ask them for more. At the end add the following examples if not already given. If they have trouble getting the examples flowing, grease the wheel with a few more until examples start to flow from them:

- yes/no
- 1/0
- on/off
- black/white
- ...

The idea is that we have the abstract notion of a bit as a yes/no decision, but we can represent that bit or decision in many different ways.

Two of the most important representations are 1/0 and on/off. We can use 1/0 to write down bits and do mathematics with them. We can use on/off to represent bits with electrical circuits. For example, we may turn the lights on to signal yes, or turn them off to signal no.

On/off is the representation used by the computers in front of you. They contain electrical circuits which switch on and off very quickly, billions of times per second, but don't let the large numbers make it seem complicated. They are just using on and off to represent yes and no.

## Multiple Bits

You've seen how a bit is an answer to a yes/no question. How might we use bits to answer a more complicated question? Class guesses answers. The answer is: “we use more than one bit”.

Here is an example. I have three pens here, red, black and purple (hold them up). Now I am going to put them behind my back and transfer one of them to my left hand. Using only yes/no questions. you need to find out the colour of the pen in my left hand. Class asks questions along the lines of “Is it red?” and I answer “yes/no” until they get it right. See how you had to use more than one yes/no answer to know the colour of the pen? (If they get it on the first guess, repeat until they need more than one guess.)

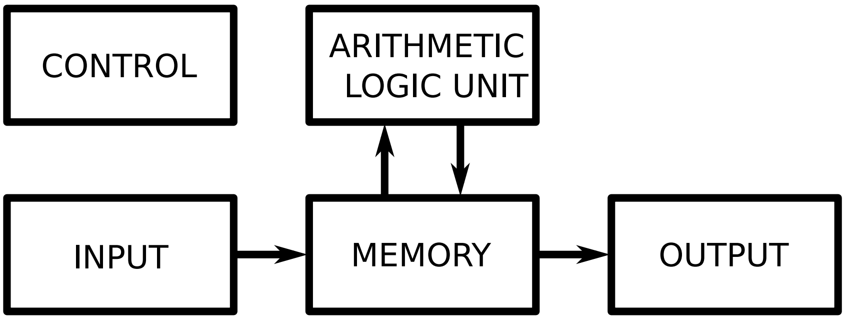
Hold the pens up. Notice how you need to ask two questions to always know which pen I was holding. For example, you could ask the questions “Is it red?” and “Is it purple?” and if the answer to both is “no” then you know it must be the last colour which is black. In this case, you need two bits to represent the colours of the three pens.

In fact we can show mathematically that we need two bits to represent the colours of three pens.

Now think of the information in a computer. The computer in front of you has 4 Gigabytes of memory in it, that is 32 billion bits, or the answers to 32 billion yes/no questions. That's a huge number of questions and it's why computers can do such complicated things. Don't let the large numbers confuse you though. The computer is still just representing information with yes/no answers, exactly as we did with three pens.

## Computer Architecture

Here is a picture of what's inside a traditional computer: (draw on board)




We've already covered the memory. It is a circuit that contains information. Billions of bits that we have just described.

Input is the way we get information from the outside world into the memory. Output is how we get information from the computer to the outside world. Can you given me some examples of input and output? Class: mouse, keyboard, speakers, screen, headphones, Ethernet, Bluetooth, USB, ... Classify each as input/output/both as they say them and write under the block in the digram.

So we have a memory and a way to get information in and out of it. The last main block is the Arithmetic and Logic Unit (ALU). This is the circuit that changes the information in the memory. It can do sums, such as adding numbers, subtracting numbers, multiplying or dividing. For example, we might have the numbers “1” and “2” in memory. The ALU can take these two numbers and add them together to get the answer “3”, which it puts back in memory. Alternatively it might multiply them to get the answer “2”. Note that if you can do addition then you can also do multiplication by adding over and over again. The ALU can also do logical operations. This means it can combine existing answers to get new answers. For example, it might use the answers to the questions “Is it raining? and “Do I have a rain coat?” to tell you whether you should take your umbrella.

The last circuit is the control circuit. This is the circuit that tells each part of the computer what to do and when. It coordinates the other parts of the computer.