

# Week 1: Computers and the Internet

*How the computer actually works is important to understand at the fundamental level. We will also look at how multiple computers can communicate and form a network we know as the internet.*

## Monday: Computer basics

Your laptop and phone are the result of a rapid evolution, but they still use these very same concepts.

Title	Duration
<a href="#">Boolean Logic &amp; Logic Gates</a>	10:06
<a href="#">Representing Numbers and Letters with Binary</a>	10:45
<a href="#">How Computers Calculate - the ALU</a>	11:09
<a href="#">Registers and RAM</a>	12:16
<a href="#">Using computers</a>	1:34

## Optional

If you got hooked on the series, don't be shy to watch two more videos about the history of computing.

Title	Duration
<a href="#">Early Computing</a>	11:52
<a href="#">Electronic Computing</a>	10:43

# Self Assessment

Write a few sentences about how the following things work or what they are.

- **Boolean operations:**
  - **NOT** Logic gate, it takes the input (true or false) and negates it. True -> False, False -> True
  - **AND** Logic gate, it needs two inputs and it gives true output only when both of the two input are true.
  - **OR** Logic gate, it needs two inputs and it gives true output only when at least one of the two input is true.
  - **XOR** Logic gate, it needs two inputs and it gives true output when only one of the inputs is true.
- **Binary code** The base of the computer science, it represent texts, number, images, basically everything with a pattern of binary digits (1s and 0s)
- **Bit** 1 bit = 1 one or 1 zero.
- **Byte** 1 byte = 8 bits.
- **Character Code (ASCII)** A 7 bit code to represent letters, numbers and other characters, enough to store 128 different values. (enough for english but not for other languages with "national" characters.

## Self Assessment exercises

Input	Operation	Output
TRUE	not	FALSE
FALSE	not	TRUE

Input	Input	Operation	Output
TRUE	TRUE	and	TRUE
TRUE	FALSE	and	FALSE
FALSE	TRUE	and	FALSE
FALSE	FALSE	and	FALSE

Input	Input	Operation	Output
TRUE	TRUE	or	TRUE
TRUE	FALSE	or	TRUE
FALSE	TRUE	or	TRUE
FALSE	FALSE	or	FALSE

Input	Input	Operation	Output
TRUE	TRUE	xor	FALSE
TRUE	FALSE	xor	TRUE
FALSE	TRUE	xor	TRUE
FALSE	FALSE	xor	FALSE

Decimal		Binary
1	=	1
2	=	10
3	=	11
4	=	100
5	=	101

## Tuesday: How does the CPU work?

How exactly does the brain of the computer work?

Title	Duration
<a href="#">In one lesson: How a CPU Works</a>	20:41
<a href="#">Instructions &amp; Programs</a>	10:35
<a href="#">See the 6502 CPU Simulation</a>	-

## Optional

[Play with a virtual CPU](#)

- Click the image to open the simulator
- Copy the program from the end of the page
- Paste it to program code
- Click run
- Try different clock speeds, see 1000Hz for example
- Do you notice where the counting is displayed? **ACC?**

## Self Assessment

Write a few sentences about how the following things work or what they are.

- **CPU** Central Processing Unit - it's responsible for understanding and doing the instructions, given by the running programs. It gives data through the input devices (like a keyboard), then it processes the data and gives back the result on output devices (like a monitor).
- **Control Unit** It directs the operation of the CPU, it tells the RAM, the ALU, and input/output devices how to respond to the instructions that have been sent to the CPU.
- **ALU** Arithmetic and logic unit. Arithmetic: it's responsible for handling all numerical operations (adding, multiplying, dividing, etc. Logic: It's for handling all logic operations (like AND, OR, NOT, XOR, etc).
- **Instruction Set** A list of instructions (like load, add, store, compare, jump if <conditions> stored in the CPU. With these instructions' help, the CPU can understand the programs' instructions, stored in the RAM. So the CPU can 'understand' what to do next.
- **Clock** A particular 'wire' that keeps turning on and off, at a steady rate to help keep everything in sync. Nowadays it's speed is measured in GHz and it shows how many times the wire turns on and off in 1 sec. For example a 4 GHz processor's clock turns on and off 4 billions times per second.
- **RAM** Random access memory, it stores data as long as it gets power. The data it stores is the instructions, datas, and programs waiting for to be processed by the CPU.

## Wednesday: The Internet: under the hood

Learn about how the Internet came to be and how data travels through the network.

Title	Duration
<a href="#">History of the Internet</a>	3:40
<a href="#">What is the Internet?</a>	3:44
<a href="#">Wires, cables, and WiFi &gt; Internet 101</a>	6:40
<a href="#">Packet, routers, and reliability</a>	6:25

## Self Assessment

Write a few sentences about how the following things work or what they are.

- **Memory Address** It's a reference to a specific memory location where the CPU or other PC components and the running programs can store and access to the stored data. Basically it's one bit of information.
- **Bandwidth** Transmission capacity, measured by bitrate
- **Bitrate** The number of bits per second a system can transit
- **Packet** On the internet, the informations (1s and 0s) are sent in piece of packets. Each packet has the internet address where it came from and where it's going.
- **Router** Traffic managing 'computers', they keep the packets moving through the networks smoothly. They keep track of multiple paths for sending packets and they choose the cheapest available path for each piece of data, based on destination IP address for the packet.
- **Internet protocol (IP)** The Internet Protocol is responsible for addressing hosts, encapsulating data into datagrams (including fragmentation and reassembly) and routing datagrams from a source host to a destination host across one or more IP networks. For these purposes, the Internet Protocol defines the format of packets and provides an addressing system.
- **Transmission Control Protocol (TCP)** Transmission Control Protocol - manages the sending and receiving of all my requested data as packets, like a guaranteed mail service. When I request data from a distance server, it comes to my computer in many individual packets. When the packets arrive, TCP makes a full inventory and sends back acknowledgements to the sender server of each packet received. If TCP finds a missing or incomplete packet, it won't sign, so the sender server can resend these packets. After all of the requested packets are successfully delivered, TCP signs.

# Thursday: The Internet: domains and DNS

So how does a random web server know about that you want to see a page stored on it?

Title	Duration
<a href="#">IP addresses and DNS</a>	6:44
<a href="#">How the DNS works</a>	2:26
<a href="#">Inside the Domain Name System</a>	13:28

## Self Assessment

Write a few sentences about how the following things work or what they are.

- Internet Service Provider (isp) is an organization that provides services for accessing, using, or participating in the Internet.
- IP Address In the internet every single devices have their unigue addresses, made of numbers. 32 bits long (8 bits for each part of the address). The parts represent the following informations in this order: Network, Subnetwork, Device, (IPv4). 2 PC can find eachother and communicate through the internet by their IP addresses.
- Domain Name System (DNS) DNS helps translate for example a webpage's URL to the server's IP address which runs the webpage. It's like an address book. DNS servers can communicate with eachother. They are connected in a distributed hierarchy, and are devided into zones.

# Friday: The Internet: how secure are we?

Security should be a major concern when you work with the Internet, let's see some basic concepts.

Title	Duration
<a href="#">Encryption and public keys</a>	6:39
<a href="#">Should all locks have keys? Phones, Castles, Encryption, and You.</a>	5:14
<a href="#">Cybersecurity and crime</a>	5:01
<a href="#">How to avoid social engineering attacks?</a>	2:16
<a href="#">What is Your Password?</a>	2:49
<a href="#">How The Self-Retweeting Tweet Worked: Cross-Site Scripting (XSS) and Twitter</a>	6:16

# Self Assessment

Write a few sentences about how the following things work or what they are.

- **Encryption** 'Scrambling' or changing the information to keep it secret. Nowadays we use 256 bit keys to encrypt information.
- **Security Protocols (https)** For example SSL and TLS, these are security protocols, they protect our information through the internet. Everytime when the communication is secure between my PC and the the server, in the browser's address bar the https indicates it.
- **Virus** Harmful programs that can delete files on the PCs, stole data, or allow someone to remote control my PC. Some viruses can spread themselves to infect another PCs.
- **DDoS** Millions of virus infected PCs which create together a botnet. It can be used to make down websites by overwhelming them with too many requests.
- **Phishing** Cybercriminals send millions of emails in the name of a well known and trusted company for example apple, copying their design, and try to make people to give them private informations like CC numbers, passwords, etc. Usually these emails contain a link to a website which looks like the original company's website and people are asked to log in their account or give their CC informations, which are logged and criminals can use these datas.