1977
First Modern PC – Apple II

Learning Outcomes addressed in this section are listed below.

1.7 develop algorithms to implement chosen solutions

1.11 discuss the complex relationship between computing technologies and society including issues of ethics

1.13 identify important computing developments that have taken place in the last 100 years and consider emerging trends that could shape future computing technologies

1.15 consider the quality of the user experience when interacting with computers and list the principles of universal design, including the role of a user interface and the factors that contribute to its usability

1.18 recognise the diverse roles and careers that use computing technologies

2.1 use abstraction to describe systems and to explain the relationship between wholes and parts

2.4 illustrate examples of abstract models

2.11 describe the different components within a computer and the function of those components

2.12 describe the different types of logic gates **and explain how they can be arranged into larger units to perform more complex tasks**

When other Learning Outcomes are addressed, for instance in classroom activities or through related online resources, the LO is numbered.

A brief review

The first electronic computers, Colossus and ENIAC, weighed tons and occupied large rooms. The invention of solid state transistors and integrated circuits placed computer hardware on the exponential curve now known as Moore's Law. The reality from 1958 was that every 2 years or so, IC manufacturers could squeeze twice as many components into the same space, at reduced cost and operating at faster speeds. In addition software and UI design were accelerating at a phenomenal rate. For example, Hopper's invention of high level programming languages in 1953 or Engelbart's 1968 demo of windows on a screen, word processing and a mouse. By the 1970s, the microcomputer kit which the user assembled into their own casing, became very popular. One of the early examples of a microcomputer kit was the Altair 8080. In 1975 they teamed up with 2 software developers, Paul Allen and Bill Gates. That April, the two friends formed Microsoft.

What made the Apple II different

All of these hardware and software ingredients needed a visionary to bring them together for a mass market. In fact 2 visionaries were required. Steve Wozniak and Steve Jobs.

The Apple 1 was the first computer assembled on a single circuit board. However it was still a microcomputer kit, which the user housed in their own casing. Apple II revolutionised the concept of a computer through a mixture of innovative hardware design and a focus on user-centred design.

The first Apple was completed in 1976. It sold 175 units. Users had to build their own casing around it, like this wooden casing in the photo. Wozniak used 1970s state of the art Intel processors. Software (written by him in BASIC) was still quite limited as it had to be customised to the hardware.

The second Apple was completed in 1977. Inspired by modern electronic commodities such as TV and stereos, the modern PC had truly arrived. Apple produced a million units. Major corporations, such as IBM, were now being disrupted for the first time by small start-ups like Apple.

Watch a short video on the evolution of computing devices.

Some video prompt questions:

- What 4 features of the Babbage machine made it revolutionary?
- Name components that act as switches?
- What was the first microprocessor used for?

Explore the Human Brain Project website to see the latest advances in how our brains could be simulated.

LO 1.13
LO 2.1, 2.11

Wozniak and Jobs, April 1, 1976

One of the biggest differences in the development of the first PC, compared to previous computing technology, was that it started up from the garages and homes of computer enthusiasts. Wozniak, seen on the left of this photo with Jobs, was a highly gifted engineer, but computer engineering was a pastime he pursued on his own and through his computer club. In many ways he was the original hacker. When he teamed up with Steve Jobs, the concept of a start-up company in a garage or a bedroom was born.

Steve Wozniak himself looks back at his invention of the PC.

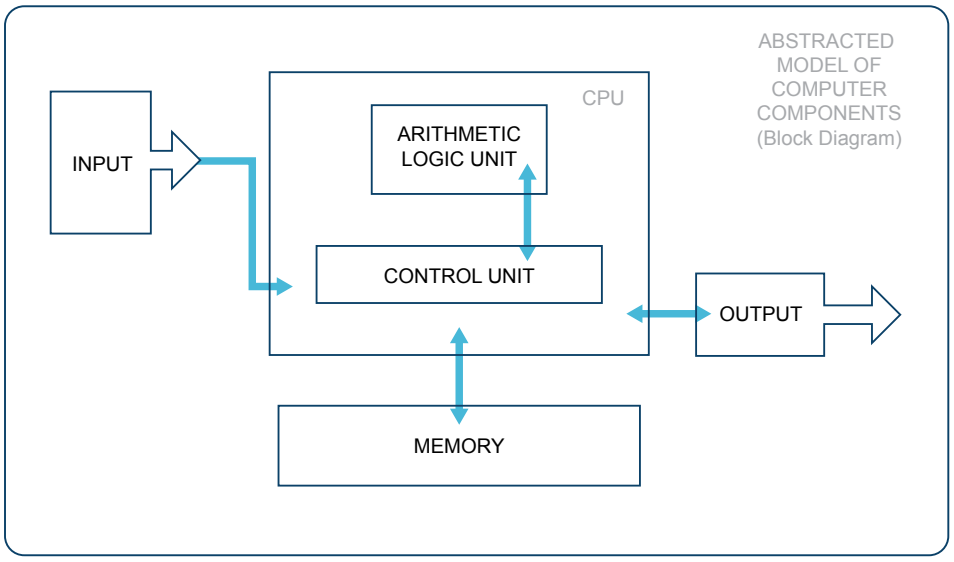
In this intriguing 5 minute tour, from 1984, he explains his concept of a "portable computer" and how 1984 would be the year of the mouse!

Later, in 2014, he explains his innovations as part of a series on hi-tech companies disrupting the business world.

LO 1.13, 1.15
LO 2.11

Inside the computer

At an abstracted level, the modern computer has four components. Input, Output, Memory and Processing. For the modern computer, processing is done in the Central Processing Unit (CPU). It makes sense when describing CPU to describe the Arithmetic Logic Unit (ALU) and the Control Unit. The schematic diagram shows the five components.



1. **INPUT** The keyboard and mouse quickly established themselves as the most effective input devices. Increasingly voice and visual images are forming an essential part of interaction with computing technology.
2. **OUTPUT** Computer screens have been the most enduring physical devices associated with computers, with modern screens displaying at very high resolutions. The visual and audio output elements are becoming increasingly important. 3D Games require excellent graphics cards to function on PCs. It was once thought computers would bring in a paperless world. However, printers remain essential for outputting hard copies.

3. **MEMORY** The hard drive of a computer is the name for the permanent (magnetic) long-term storage of vital information. We are now in Terabytes for most hard drives. Random Access Memory (RAM) is temporary short-term storage, while your computer is working. The Apple II had 24 kB of RAM. A good analogy is that RAM is what you need when sorting files on your desk and your hard drive is what you file away in your filing cabinet.
4. **ALU** The Arithmetic Logic Unit is an integrated circuit of logic gates, designed to carry out basic mathematical and logical operations. Most CPU operations are executed in the ALU. The inputs to the ALU are stored in specialised CPU memory called input registers. Once the calculations are performed, the results are stored in memory called output registers.
5. **CONTROL UNIT** The control unit controls the operation of the processor and tells all other components how to respond to the computer's instructions. A program counter is a specialised memory that keeps track of the order of instruction that a computer is executing. The dedicated bit of memory is called a processor register.

Operating System Layers

"The most important and crucial piece of software for a computer is its operating system (OS). The same hardware under a different OS is literally a different computer."[12] An OS is software that manages all other programs on a computer. The other programs are called application programs (apps). The OS handles the operation of the 4 abstracted components of a computer system: Input, Output, Processing and Memory. The interface between the application programs and the OS is called the Application Program Interface (API). The user can interact directly with the OS through the Graphical User Interface (GUI) or sometimes through the command line. An even more fundamental piece of software is the Basic Input Output System (BIOS). This acts as the interface between IO devices and the main OS. Because it is particular to the hardware of the machine, and comes pre-installed, it is often called firmware. Examine another way of looking at OS layers.

The most common operating system on home PCs are Microsoft Windows and Mac OS. Corporate firms also commonly use Linux and UNIX OS.

Read the section on the five components of a computer. Then address the following.

INPUT Will the physical keyboard and mouse become obsolete?

Memory What is the RAM on the device you are using to read this?

Check out this site explaining units of memory.

Is lots of memory on your PC so important, or even necessary, with the dominance of cloud computing?

> **ALU** Review the operation of logic gates and how to build more complex arithmetic blocks.

LO 1.7
LO 2.4, 2.11, 2.12

A brief history of computers provides more detail on how

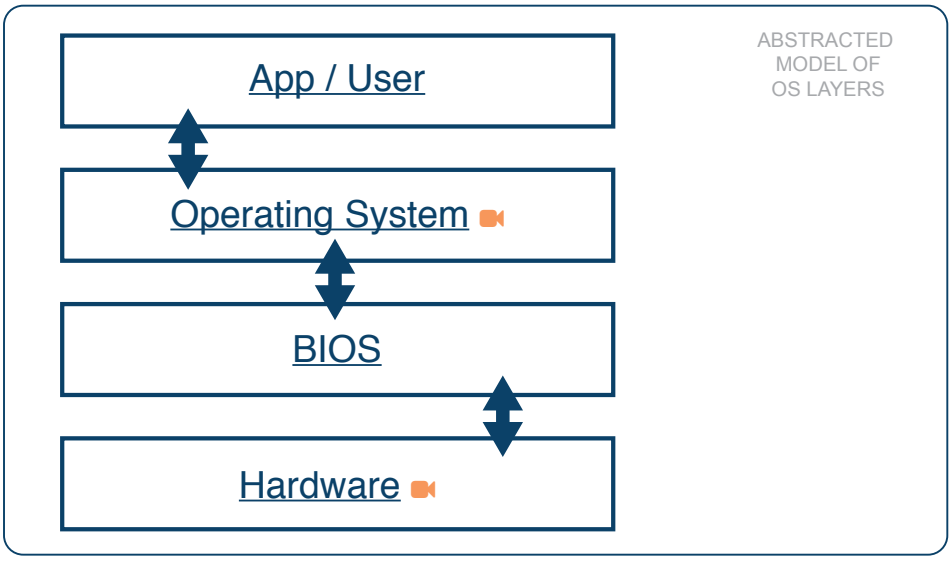
- Apple II evolved
- Intel and Microsoft established dominance in the market (and Kildall didn't!)
- Steve Jobs started a user revolution in the late 1980s, starting with the Mac OS GUI.

LO 1.11, 1.15
LO 2.11

12 Wang (2016) *From Computing to Computational Thinking*. CRC Press (p 69–77).

Why have an OS?

Computers simply cannot function without the coordination and resource management offered by an OS. The software in the first PCs had to be customised to the specific hardware design. This meant that a user's programs could not operate on a different computer. In 1976 Gary Kildall, from the same computer club as Wozniak, had an idea to put a system between the user and hardware. This Operating System could run the user's programs and also communicate with the hardware design. Because the OS can communicate with the hardware design of any machine of similar make, then the user can run their programs on any machine. This is crucial for programmers, business and general home users.



Click the links on each OS layer to watch a *video* (OS and Hardware) or *read some more* (App/User and BIOS)

Videos are from techquickie and code.org.

The *read some more* articles are from the CS Field Guide and Wikipedia.

LO 1.15
LO 2.1, 2.4, 2.11