

# Introduction to the Raspberry Pi

---

## Introduction

Understanding the basics of computer hardware is key to writing good software. In this lab, the Raspberry Pi 2 is used to take a closer look at a simple computer.

The Stored-Program Concept, in which the data and instructions to manipulate that data are stored on the same machine, is a key component of modern computer design. This architecture, commonly referred to as the von Neumann architecture, consists of the following five components:

1. A separate memory unit that holds the data and instructions. Memory is a collection physical cells that can be individually addressed. The Raspberry Pi 2 has 1025MB of SDRAM.
2. An arithmetic/logic unit (ALU) that performs arithmetic and logic operations on data. This component is part of the central processing unit (CPU). The Raspberry Pi 2 is built with a 900MHz quad-core ARM Cortex-A7 processor. This processor can be used for various purposes, such as smartphone and mobile computing, digital home entertainment, or home and web 2.0 servers.
3. An input unit to receive information from outside the computer.
4. An output unit to communicate information to the outside world.
5. A control unit that manages and coordinates the other four components. It is located in the CPU along with the ALU and registers.

These components work together so a computer can store, retrieve, and process data when executing a program. As previously stated, program's instructions and data are both stored in addressable memory. To begin execution, the address of the first instruction is loaded into memory (specifically, the program counter register) and a process known as the Fetch-Execute Cycle begins. This cycle continues with the following steps:

- Fetch the next instruction from memory and update the program counter.
- Decode the instruction.
- Get any data that is required by the instruction.
- Execute the instruction.

These steps repeat until the program terminates.

To get a quick overview of the Raspberry Pi 2, watch this video, <https://youtu.be/uXUjwk2-qx4>

## Learning Goals and Objectives

- Know the basic architectures of a computing device.
- Understand the difference between hardware and software.
- Be able to set up a Raspberry Pi, turn it on, and access the command line interface.

At the conclusion of this lab students are able to:

- Identify and understand the basic architecture of a computer: processor, storage, and input/output.
- Connect components of a Raspberry Pi together using the peripheral device in the computer lab.
- Power up a Raspberry Pi, log in using the command line interface.

## Getting Started

Gather the materials needed:

- Raspberry Pi 2 Starter kit (including the Pi and power supply).
- Micro SD card preloaded with the operating system
- HDMI adapter cable
- Computer lab keyboard, mouse, and monitor
- Digital camera

## Tasks

1. Working with your partner, identify each the following components of the Raspberry Pi on the attached image and specify which component of the von Neumann architecture it corresponds.
  - Central Processing Unit (CPU)
  - Status light-emitting diodes (LEDs)
  - External Universal Serial Bus (USB) ports
  - Ethernet port
  - High-Definition Multimedia Interface (HDMI) connector
  - Power input
  - Secure Digital (SD) Card slot
2. Connect the keyboard and mouse using two of the USB ports.
3. Using the HDMI adapter cable, connect the monitor to the HDMI connector port.
4. Install the SD card by carefully inserting it into the SD card slot.
5. Verify that all peripheral devices and the SD card are properly connected, then connect the power adapter and plug it into a power outlet.
6. Observe the LEDs flashing as the Raspberry Pi boots for the first time and when it finishes the opening screen allows you to select a few options before installing the operating system. Click in the checkbox for **Raspian [RECOMMENDED]** in the center of the window and select **English (US)** as the language and **US** as the keyboard configuration. Click the Install button located in the upper left area of the display to begin the installation process. This will take about 10 minutes, so now is a good time to complete the diagram from step 1.
7. Once the **OS(es) Installed Successfully** display appears, click **OK** or press **Enter** on the keyboard. Text will scroll on the screen and then the **Raspberry Pi Software Configuration Tool (raspi-config)** will open.
8. Using the arrow keys, move to option 3 and Chose boot option to be “Console Text console” and click **OK**. This will return to the configuration screen; tab twice to highlight **<Finish>** and press the Enter key. Respond **<Yes>** to the reboot screen to allow the new configurations to be set.
9. After rebooting, log into the computer with the following information: Login: pi and password: raspberry

## Deliverables

Using a digital camera, take a photograph of you, your partner, and your connected Raspberry Pi. Insert the images into a Microsoft Word document and write a paragraph describing your first impressions of the Raspberry Pi along with the joys and heartaches of putting together the components of this computer. Include in the paragraph at least one piece of advice for the next pair of Pi Pastry Chefs to tackle this task. Verify that both of your names are on the document and upload it to the assignment link in Blackboard.

To properly shut down the Raspberry Pi, type this command, **sudo shutdown -h now**. Disconnect all peripheral devices and reconnect them to the computer lab machine. Verify that the mouse, keyboard, and monitor all work properly. Return the Raspberry Pi and submit the labeled image of the Raspberry Pi to your instructor in class before you leave.

## Resources

Cortex-A15 Processor - ARM. 17 June 2015 <<http://www.arm.com/products/processors/cortex-a/cortex-a15.php>>.

Lewis, Nell Dale and John. Computer Science Illuminated, Sixth Edition. Sixth Edition. Burlington: Jones & Bartlett Learning, 2016.

RASPBERRY PI FOUNDATION. Raspberry Pi Learning Resources. 17 June 2015  
<<https://www.raspberrypi.org/learning/getting-started-with-raspberry-pi-lesson/lessons/>>.

RPi Hardware. 30 March 2015. Bill Traynor. 17 June 2015 <[http://elinux.org/RPi\\_Hardware](http://elinux.org/RPi_Hardware)>.

Wallace, Matt Richardson & Shawn. Getting Started with Raspberry Pi. Sebastopol: Maker Media, 2013.

Name: \_\_\_\_\_

Name: \_\_\_\_\_

## Raspberry Pi Components

