An Introduction to Single-Board Microcomputers

A microcomputer is a small, relatively inexpensive computer consisting of a central processing unit that executes program instructions, memory that stores the instructions, and input/output circuitry that allows the computer to communicate with other devices. Many laptops and personal computers are microcomputers equipped with a display and keyboard. In 1982, Commodore International released the Commodore 64, one of the first commercially successful microcomputers designed for personal use. It measured 3 inches by 16 inches by 8 inches in size and weighed four pounds. In contrast, one of today's most popular microcomputers, the Raspberry Pi, measures 2.5 inches by 2.2 inches, by .5 inches and weighs only 1.4 ounces, or .09 pounds. The small size of the Raspberry Pi makes it ideal for programming compact projects like robots, smart devices, and digital kiosks.

Raspberry Pi 4 Microcomputer

Computer systems are divided into two categories: hardware and software. Hardware refers to the physical components of the system, such as a microcomputer, a keyboard, or a monitor. Software refers to programs and applications that use the hardware to perform different tasks. Common examples are operating systems (e.g., Windows or MacOS) and web browsers (e.g., Chrome or Firefox).

Installing an Operating System

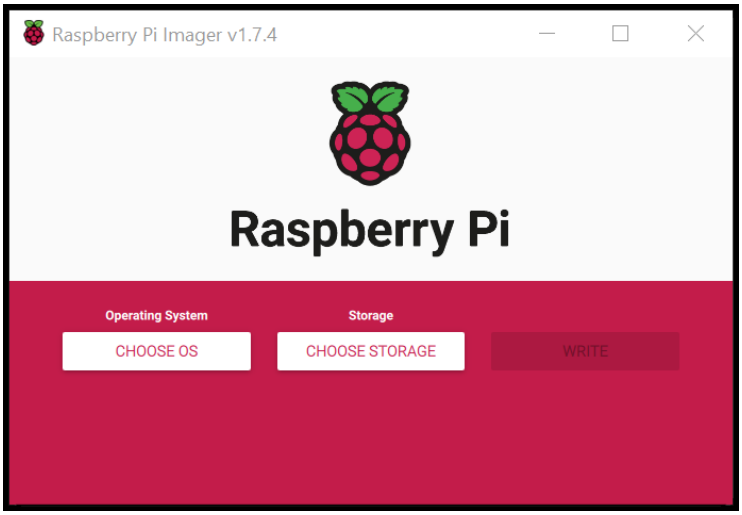
To install an operating system on Raspberry Pi, you will need a computer with internet access, a microSD card, a microSD card reader, and the microcomputer.

First, download the Raspberry Pi Disk Imager install file using the link below. Be sure to select the appropriate operating system for your computer.

https://www.raspberrypi.com/software/

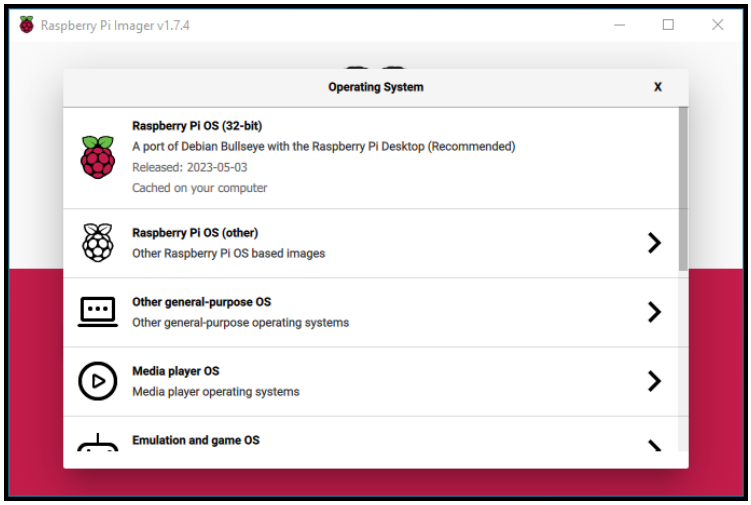
Disk imagers are programs used to copy an Operating System (OS) from the memory of one computer and distribute it to a different computer.

Once the disk imager installer has finished downloading, run the file and click **Install**. Once the disk imager has finished installing, run the program.



Raspberry Pi Disk Imager

From the top of the menu that opens when you click **Choose OS,** select **Raspberry Pi OS (32-bit)**.



Operating System Selection

Insert the microSD card into the microSD card reader and plug the card reader into your computer. In the Raspberry Pi Imager, click **Choose Storage**, navigate to the microSD card, and select it.

Once the OS and storage device have been selected, click **Write** to install the operating system on the SD card.

Setting up the Microcomputer

1. Micro SD Card Slot	4. USB 2.0 Ports
2. USB-C Power Port	5. USB 3.0 Ports
3. Micro HDMI Ports	6. Ethernet Port

Under the Raspberry Pi and on the end opposite the USB ports is a microSD port. Turn the microSD card so that the gold contacts are facing the board and insert it into the port.

Next, you will need to connect a display to the one of the HDMI port using an HDMI cable.

To interact with the microcomputer, plug a keyboard and a mouse into the Raspberry Pi's USB 2.0 ports.

Finally, connect your power supply to the microcomputer using the USB-C port and plug it into an outlet. This will immediately power the device. After a short delay, the operating system will launch.

Follow the initial setup instructions that appear on your screen. Install any updates (if prompted) and remember to make note of the username and password you selected in the setup process. For this project, you do not need an internet connection. To perform updates and synchronize its clock, the Raspberry Pi will need an internet connection. The microcomputer is WiFi compatible, but you may need the help of your school's IT department to set it up.

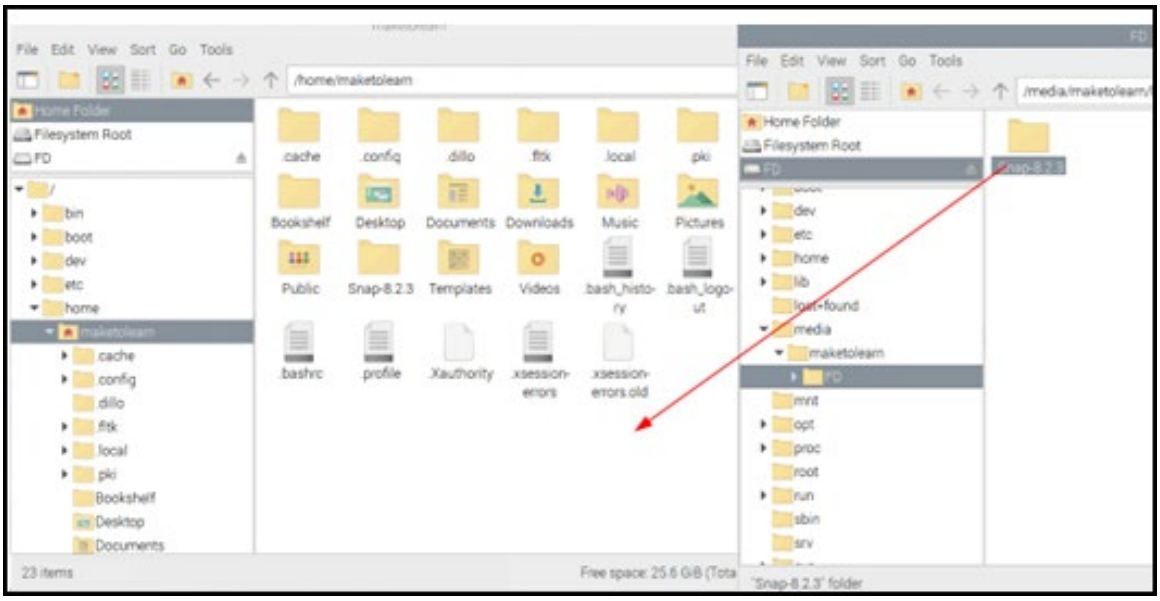
If you want to change the orientation of your screen, this can be done using the **Screen Configuration Tool** which can be found under the **Preferences** menu.

Copying Snap Files to the Microcomputer

To run Snap*!* files without an internet connection, you will need to install Snap*!* on the microcomputer. Download the local version of the software using the link below and save the folder to a USB drive.

https://www.dropbox.com/sh/21rsicj0qy550uv/AACRUE_3Vv_KQs9vKCzlXemoa?dl=0

Next, plug the USB drive into the microcomputer. Copy the files from the USB drive and navigate to your username's folder in the file explorer. This can be done by using the menu on the left side of the window. Underneath the top folder is a folder named "home". Inside of that folder, is another folder with a name that matches your username. Paste the Snap*!* files into this folder.



Copying Files from a USB Drive

This is also the location where you should save any Snap*!* programs you want to run.

Once the files have finished copying, you may remove the USB drive from the microcomputer.

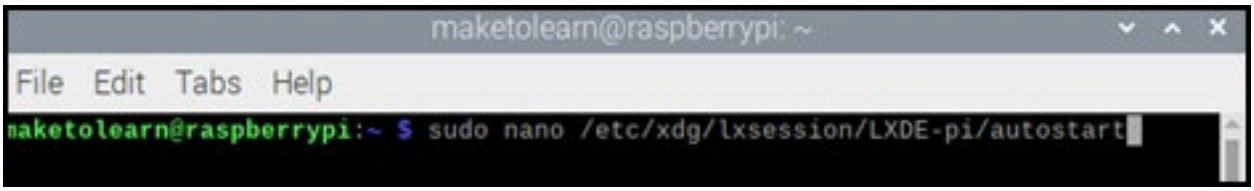
To run Snap*!* without an internet connection, open the *Snap* folder and double-click the *snap.html* file. Once Snap*!* is open, you can load programs from the file menu.

Running Snap*!* on Startup

One of the advantages of using a microcomputer for a project is that it can launch directly into a program. This is done by editing the microcomputer's autostart file. To edit the file, first open the **Terminal**. \

Into the terminal, type the following: *sudo nano /etc/xdg/lxsession/LXDE-pi/autostart*

As mentioned earlier, the "sudo" command lets the microcomputer know that you are about to run a command as the system administrator. The "nano" portion of the command calls a text editing program named "Nano", and the final portion of the command provides the file name and address of the file to be edited.



If entered correctly, this should open the autostart file and allow you to edit it. The file should already contain several lines of text. To run Snap*!* program on start, move the cursor to beneath the other text and enter the commands below:

@chromium-browser --kiosk --disable-web-security --allow-file-access-from-files file:////home/[your username]/Snap/snap.html#run:file:////home/[your username]/Snap/[your program].xml

Substitute your username for "*[your username]"* and your program name for "*[your program name]*". Double check to make sure you have four slashes after each "*file:*" and double hyphens in front of each command.

The "@chromium-browser" portion of the command tells the microcomputer to start the chromium browser when it powers on.

"--kiosk" tells it to start in kiosk mode, which will make the program run full screen.

"--disable-web-security" does exactly what it says and is necessary to open Snap*!* files.

"--allow-files-access-from-files" allows the Chromium browser to access files stored locally.

file:////home/[your username]/Snap/snap.html tells the Chromium browser which file to open.

"#run:file:////home/[your username]/Snap/[your program].xml" tells the Snap*!* program which file to load.

Once you have typed in the whole command, press **Ctrl+O** to save the file. Press **Enter,** and then press **Ctrl+X** to exit the Nano text editor.

To reboot the device, type *sudo reboot* into the terminal and press enter. When the device restarts, it should open your program in kiosk mode. If it does not, double check the autostart file for typing errors and try again. When using the terminal, you can use the up and down arrows to cycle through recently used commands.