Fundamental of Cognitive Interaction with Robots

Lecture 1

Assessment

Total: 100 marks

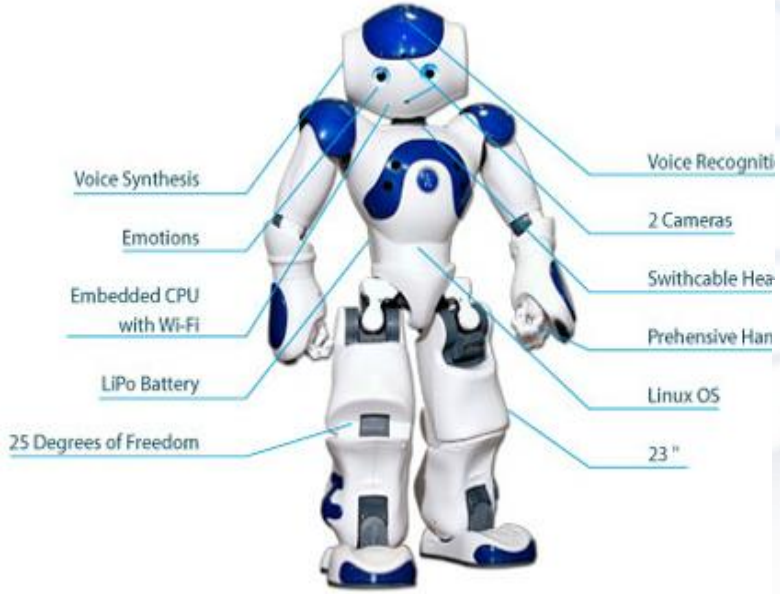
- Final Exam: 60 marks
- Mid-term: 20 marks
- Project+Oral : 20 marks

Contents

1- Raspberry Pi

- Components
- Programming
- Some applications

2- Robots



- Physical part
- Control part
- Motors
- Sensors
- Vision part
- Auditory part
- Navigation part

Contents

Raspberry Pi

Raspberry Pi Foundation

- The Raspberry Pi Foundation is a UK-based charity that works to put the power of computing and digital making into the hands of people all over the world.

https://www.raspberrypi.org

- The foundation cooperates with other organizations to develop a cheap single-board computers (Raspberry Pi products).

https://www.raspberrypi.com

Most Pis are made in a Sony factory in Wales, while others are made in China and Japan.

Raspberry Pi

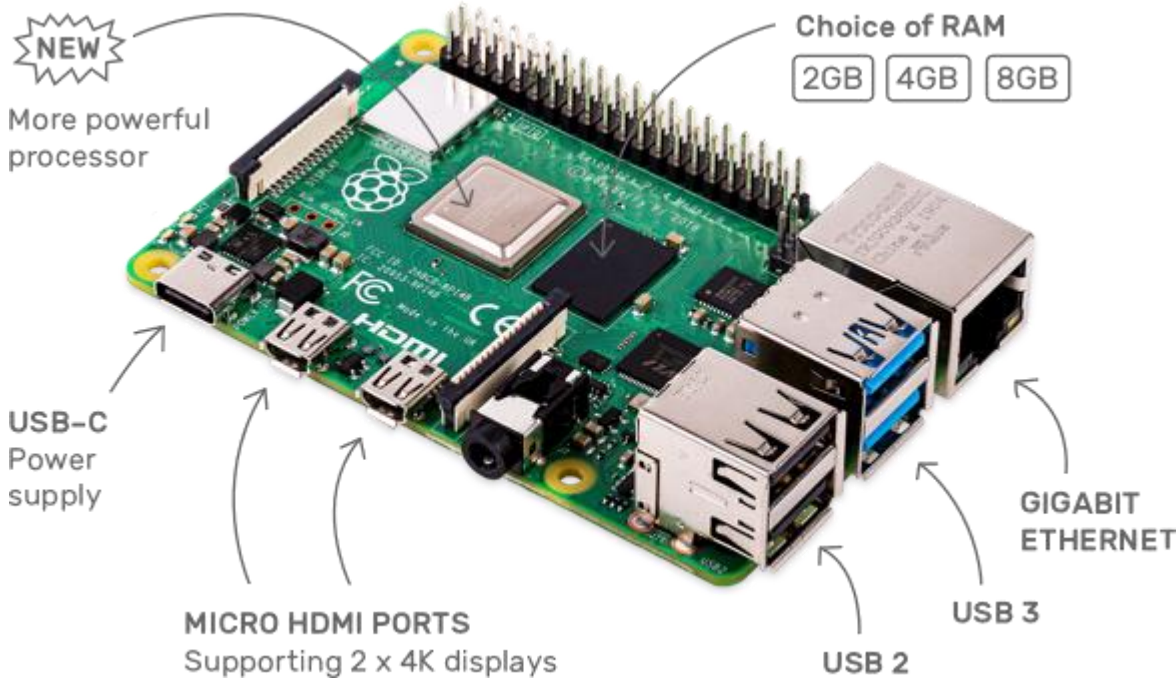
What is a Raspberry Pi?

- RPi is a low-cost, small size (about 9x6 cm) single-board computer that supports embedded Linux operating systems.

Raspberry Pi

What is a Raspberry Pi?

- Affordable credit-card sized computer
- Plugs into a computer monitor or TV
- Uses standard keyboard and mouse
- Can browse the internet (Ethernet or WiFi)
- Can play audio and HD video
- Can also interact with the outside world through GPIO pins



Raspberry Pi

Raspberry Pi OS

- The recommended Operating System is called Raspberry Pi OS (previously called Raspbian)
- Raspberry Pi OS is a Debian-based OS (a version of Linux) for Raspberry Pi.
- The OS installer is called Raspberry Pi Imager (previously called NOOBS)
- To install the necessary OS, you need a microSD card.
- Then you use the “Raspberry Pi Imager“ in order to download the OS to the microSD card.

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

Raspberry Pi

Other operating systems you can use with Raspberry Pi

LibreElec

Ubuntu Desktop

Ubuntu Server

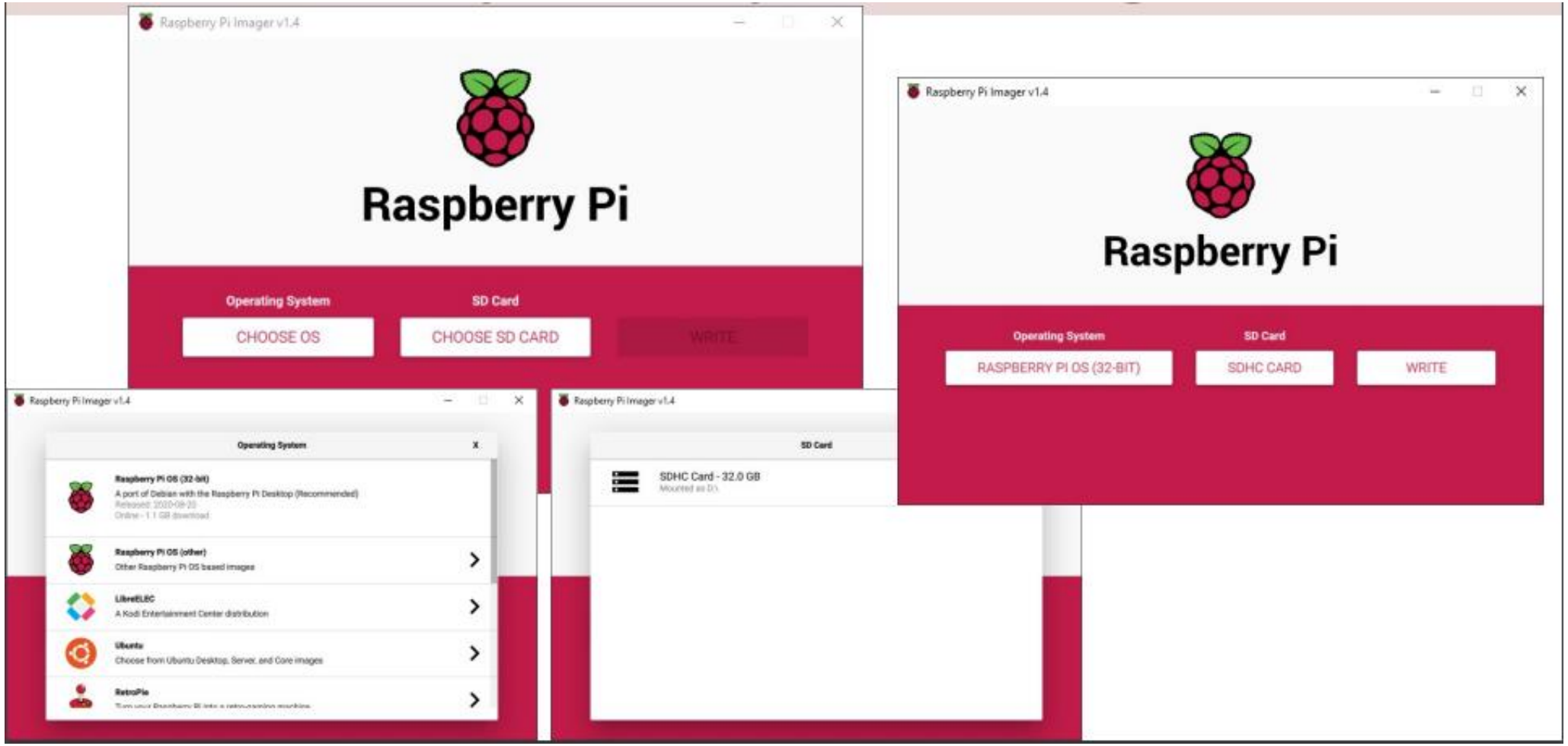
Ubuntu Core

RetroPie

TLXOS

Raspberry Pi

Raspberry Pi Imager

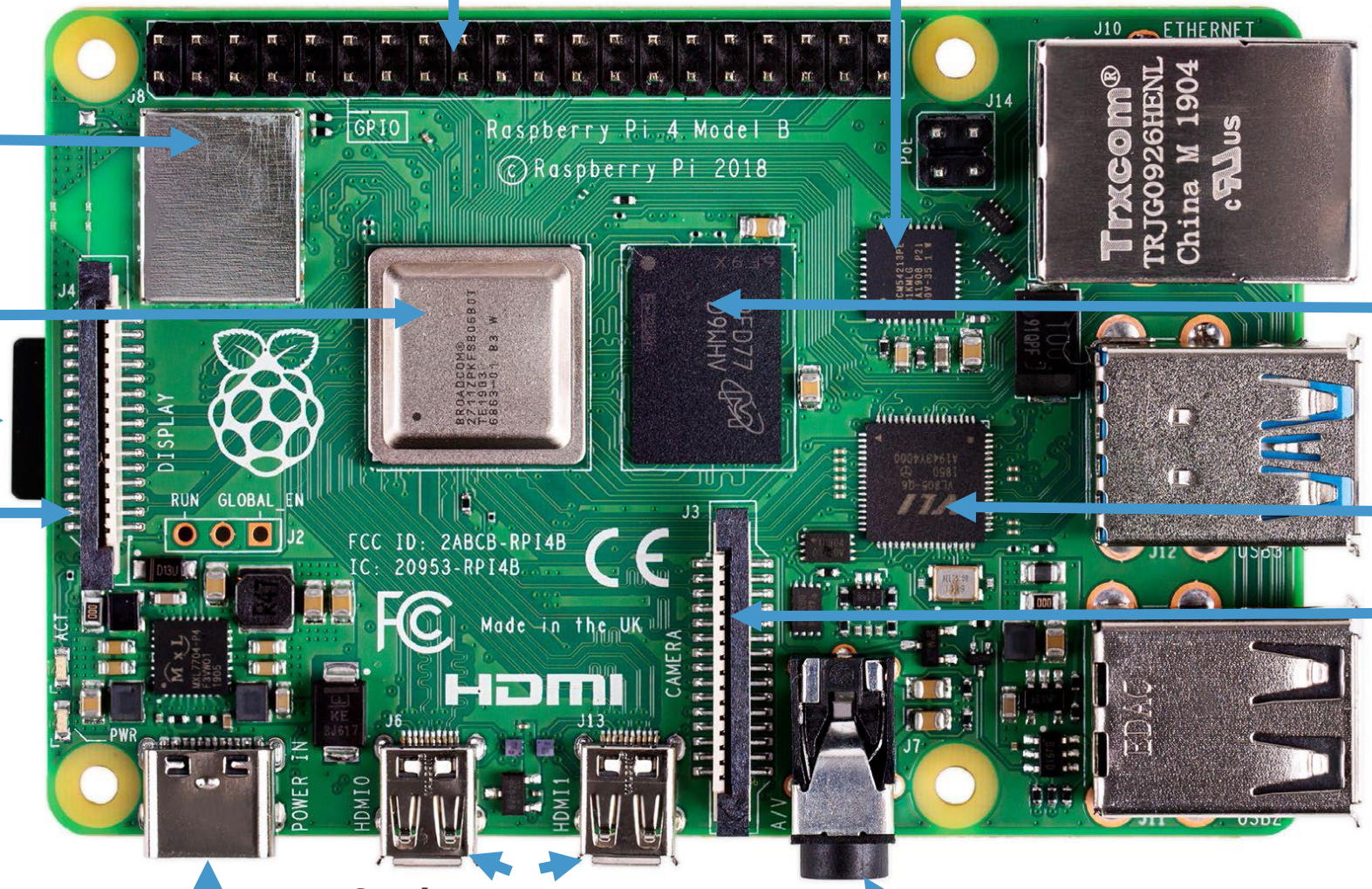


Raspberry Pi

Is the Raspberry Pi open source?

- The Raspberry Pi operates in the open source ecosystem: it runs Linux, and its main supported operating system, Pi OS, is open source and runs a suite of open source software.
- The Raspberry Pi's schematics are regularly released as documentation, but the board is not open hardware.
- The Raspberry Pi Foundation relies on income from the sale of Raspberry Pi units to do its charitable work in the education sector.

Raspberry Pi 4 Tech Specs



40 GPIO pins

Ethernet Controller

WiFi
Bluetooth

Gigabit
Ethernet

Processor
Broadcom,
quad-core
1.5 GHz

DDR4 RAM
2, 4, 8 GB

Micro SD

2 USB3

LCD
Display Port

USB Controller

Camera Port

2 USB2

USB-C Power Input
5V 3A

2 Micro HDMI ports
Supporting two 4K displays

3.5 mm Audio

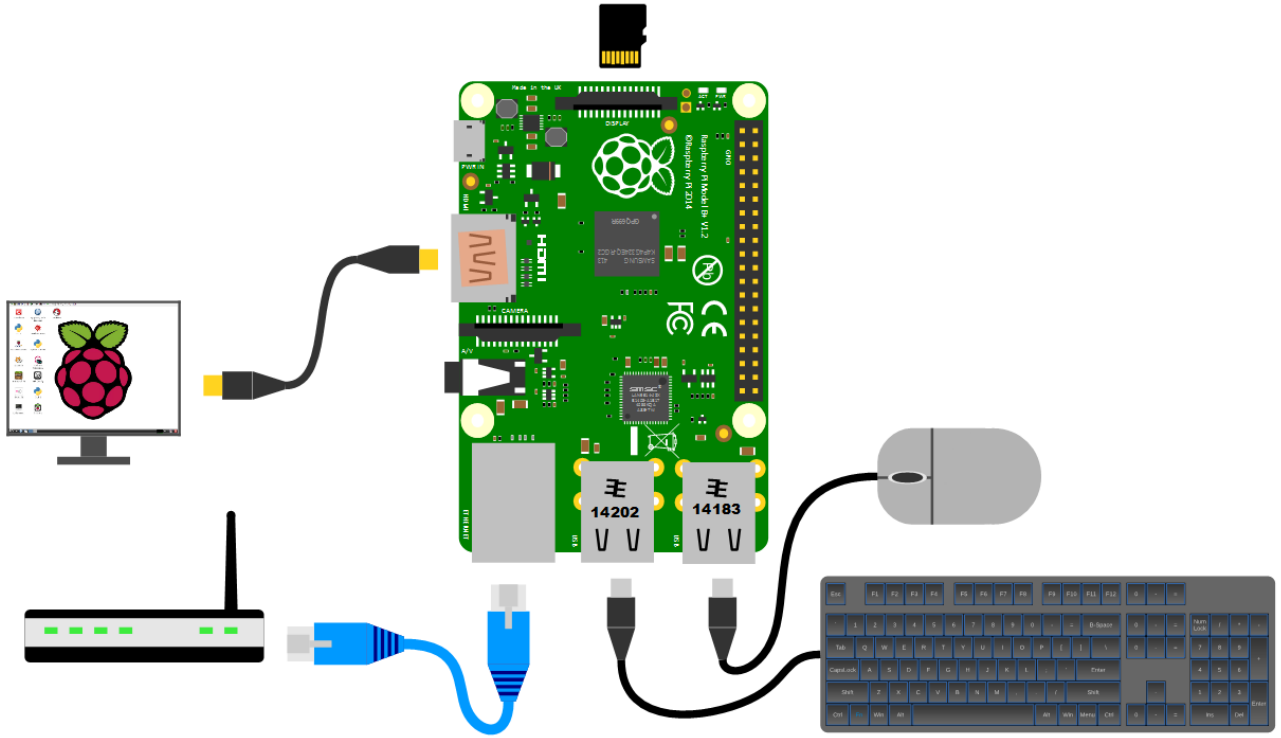
Raspberry Pi 4 Tech Specs

Processor:	Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
Memory:	2GB, 4GB or 8GB LPDDR4 (depending on model)
Connectivity:	2.4 GHz and 5.0 GHz IEEE 802.11b/g/n/ac WiFi Bluetooth 5.0, BLE Gigabit Ethernet 2 × USB 3.0 ports 2 × USB 2.0 ports.
GPIO:	40-pin GPIO header
Video & sound:	2 × micro HDMI ports (up to 4Kp60 supported) Display port Camera port 4-pole stereo audio and composite video port
Input power:	5V DC via USB-C connector (minimum 3A) 5V DC via GPIO header (minimum 3A) Power over Ethernet (PoE)–enabled
SD card support:	Micro-SD card slot for loading operating system and data storage

Raspberry Pi

What Do you Need?

- Raspberry Pi
- microSD Card (+ Adapter)
- Power Supply (5V, 3A min.)
- microHDMI to HDMI Cable
- Monitor
- Mouse
- Keyboard



History

- The first Official launch of Raspberry Pi boards was in 2012.
- There have been several iterations and variations released since then.
- The original Pi (version 1) had a single-core 700MHz CPU and just 256MB RAM.
- The latest model (version 4) has a quad-core CPU clocking in at over 1.5GHz, and 8GB RAM.
- The price point for Raspberry Pi has always been under $100 (starting from $35 USD), most notably the Pi Zero, which costs just $10.

History

- Pi 1 Model B (2012)
- Pi 1 Model A (2013)
- Pi 1 Model B+ (2014)
- Pi 1 Model A+ (2014)
- Pi 2 Model B (2015)
- Pi Zero (2015)
- Pi 3 Model B (2016)
- Pi Zero W (2017)
- Pi 3 Model B+ (2018)
- Pi 3 Model A+ (2019)
- Pi 4 Model A (2019)
- Pi 4 Model B (2020)
- Pi 400 (2021)

Raspberry Pi 400 (US$80)

Model Comparison

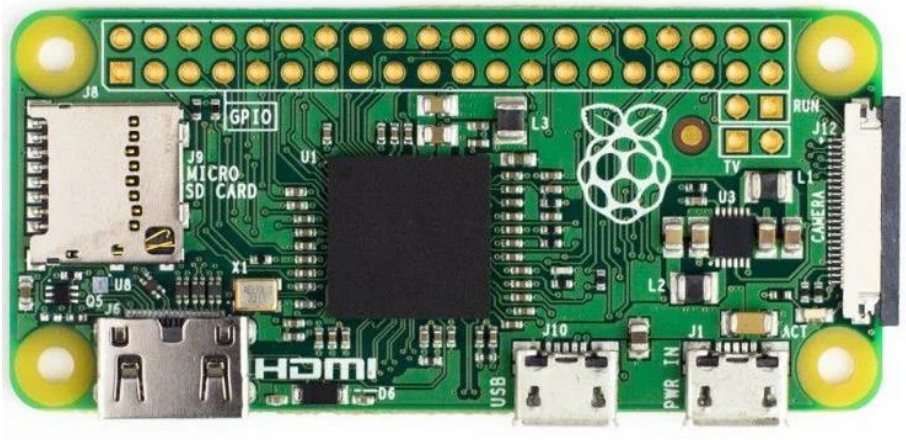
Family	Model	Memory	Processor	Ethernet	USB	Wireless	GPIO	Released
Raspberry Pi 1	B	256 MB	700 MHz single-core	Yes	2 × USB 2.0	No	26-pin	February 2012
		512 MB						October 2012
	A	256 MB		No	1 × USB 2.0			2013
	B+	512 MB		Yes	4 × USB 2.0		40-pin	2014
	A+			No	1 × USB 2.0			
Raspberry Pi 2	B	1 GB	900 MHz quad-core	Yes	4 × USB 2.0	No		2015
Raspberry Pi Zero	Zero	512 MB	1GHz single-core	No	No	No		
	W					Yes		2017
	2 W							2021
Raspberry Pi 3	B	1 GB	1.2 GHz quad core	Yes	4 × USB 2.0			2016
	A+	512 MB	1.4GHz quad-core	No	1 × USB 2.0	Yes (dual band)		2018
	B+	1 GB	1.4 GHz quad core	Yes	4 × USB 2.0			2018
Raspberry Pi 4	B	1 GB	1.5 GHz quad core	Yes	2 × USB 3.0 1 × USB 2.0	Yes (dual band)		2019
		2 GB						
		4 GB						
		8 GB						2020
	400	4 GB	1.8 GHz quad core		2 × USB 3.0 1 × USB 2.0			
Raspberry Pi Pico	N/A	264 KB	133 MHz dual core	No	No	No	26-pin	2021

Prices

Raspberry Pi Pico

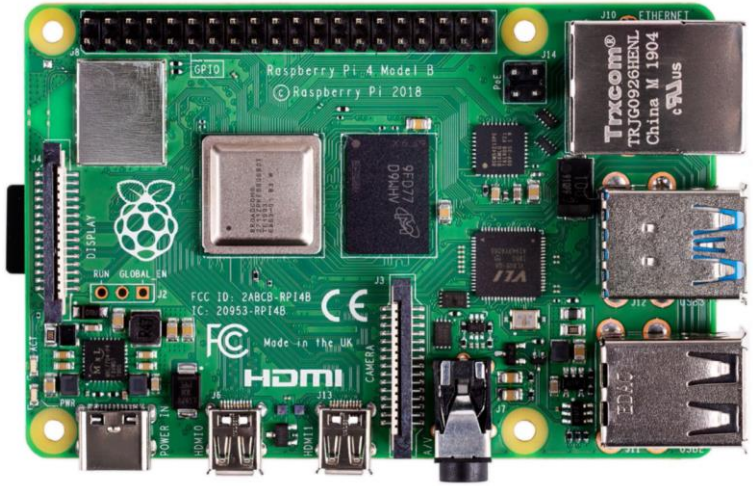
$4.0

Raspberry Pi Zero



$10.0

Raspberry Pi 4 (4 GB)



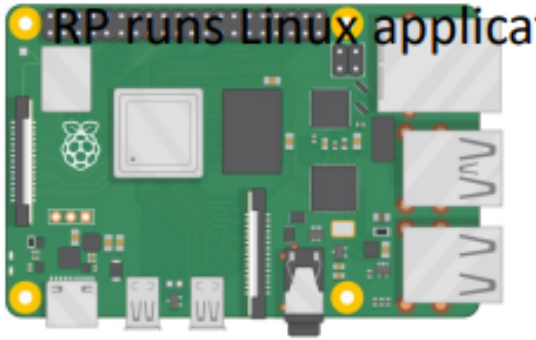
$60.0

Raspberry Pi 400

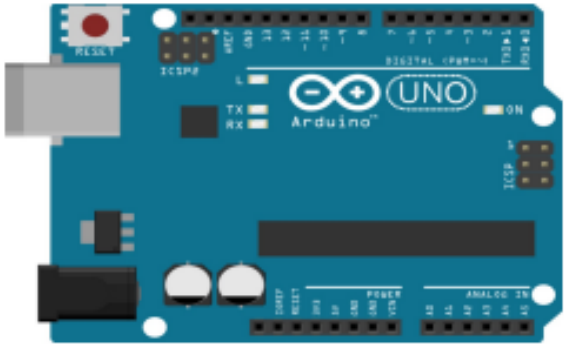
$80.0

Raspberry Pi vs. Arduino

- Raspberry PI is a Microcomputer
- It has an ordinary Operating System (OS)
- You can connect USB devices, Keyboard, Mouse, Monitors, etc.
- It has a “hard-drive“ in form of a microSD card
- RP has Bluetooth, Wi-Fi, and Ethernet connection
- RP has basically all the features an ordinary computer has but in a much smaller package
- Uptill 8 Gb RAM
- RP runs Linux applications



- Arduino is a Microcontroller
- Arduino has a Bootloader and not an ordinary operating system
- Arduino is NOT a computer, only a small controller, whose purpose is to control things
- No Bluetooth, Wi-Fi (some models have), and Ethernet (but can be provided as so-called Shields)
- Very little RAM (32 Kb)
- Inexpensive



Both have Digital Pins

Both have SPI and I2C

Arduino (UNO) has also Analog Input Pins

Other Development Boards

- Nvidia Jetson Nano Developer Kit
- UDOO BOLT
- Odroid
- ASUS Tinker Board
- Orange Pi
- Banana Pi

Other Development Boards

Nvidia Jetson Nano Developer Kit

- it is a single-board computer that allows you to work with applications like image classification, object detection, segmentation, and speech processing.
- It also comes with support for many popular AI frameworks, like TensorFlow, PyTorch, Caffe, and MXNet.

Other Development Boards

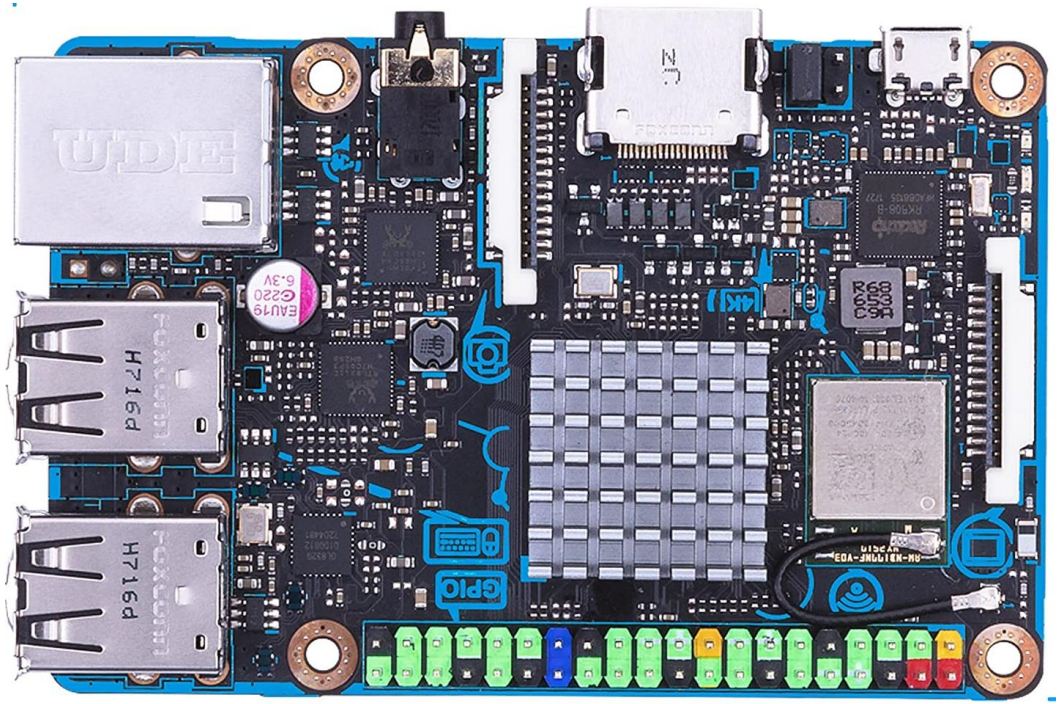
UDOO BOLT

- It can handle VR, AR, games, cryptocurrency mining, AI, IoT, edge computing, and much more.
- But at $500, this is a very expensive board.

Other Development Boards

ASUS Tinker Board

- Rockchip Quad-Core RK3288 processor
- Arm Mali-T764 GPU
- 2GB Dual-Channel DDR3
- 802.11 b/g/n, Bluetooth V4.0




Any Questions