
Welcome!
Android Things
Spring 2024

Lecture #1
Introduction to IoT

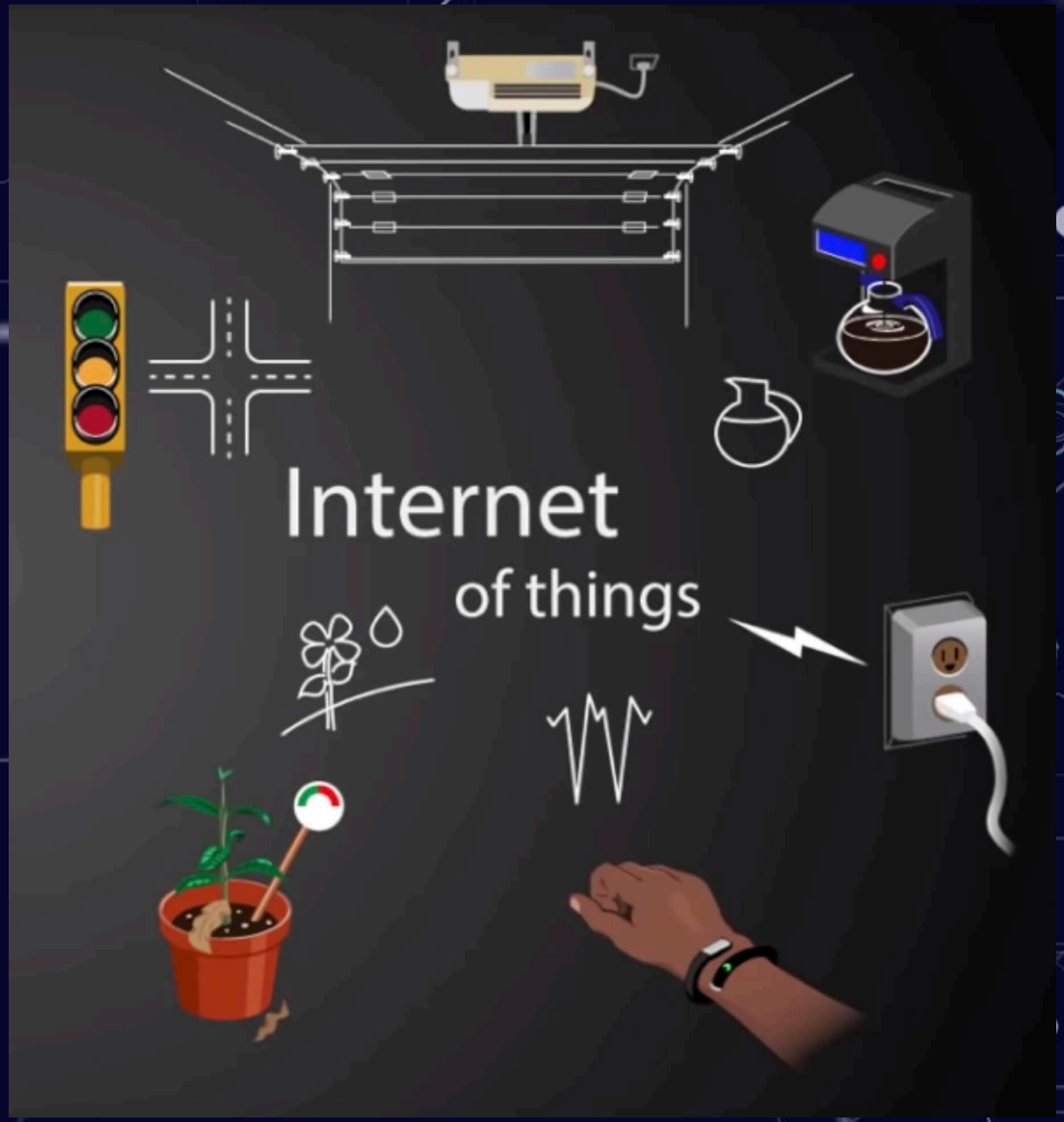
Prerequisites

- Modern programming language
- Object oriented
- Statically types
- IDE - IntelliJ/Android Studio

What you should know...

- Basics:
  - Object-oriented programming
  - Classes, methods
  - Exception handling


Internet
of people


Internet
of things

Why

- Collect and aggregate data.
- Remote control devices.
- Automate certain tasks.

Image source: https://newsignature.com/articles/iot-now-eric-stein-new-signature-solutions-architect/

What

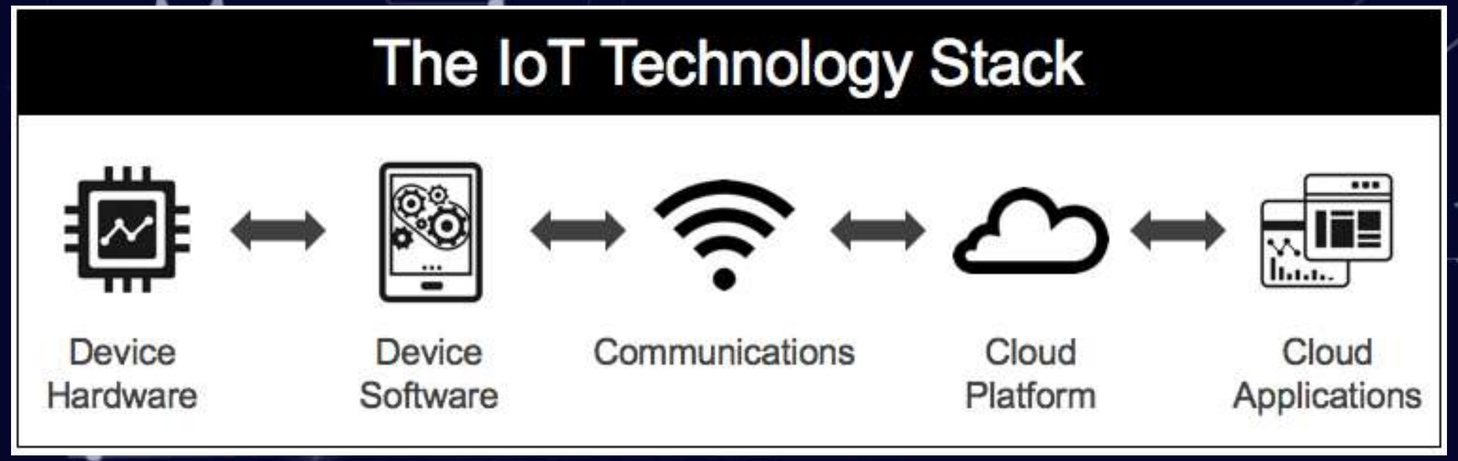
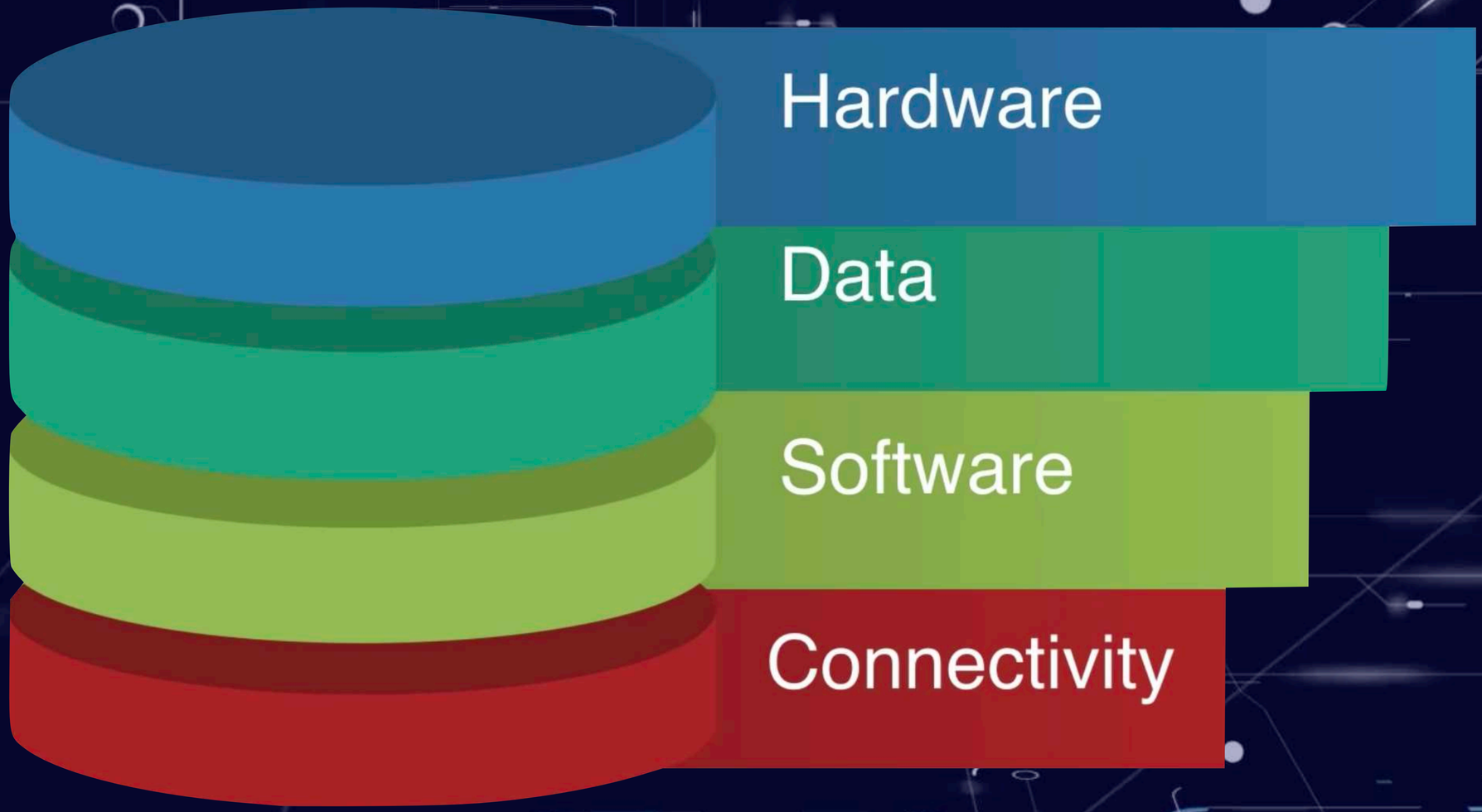


Image source: https://www.iotforall.com/iot-product-managers-guide-iot-technology-stack/

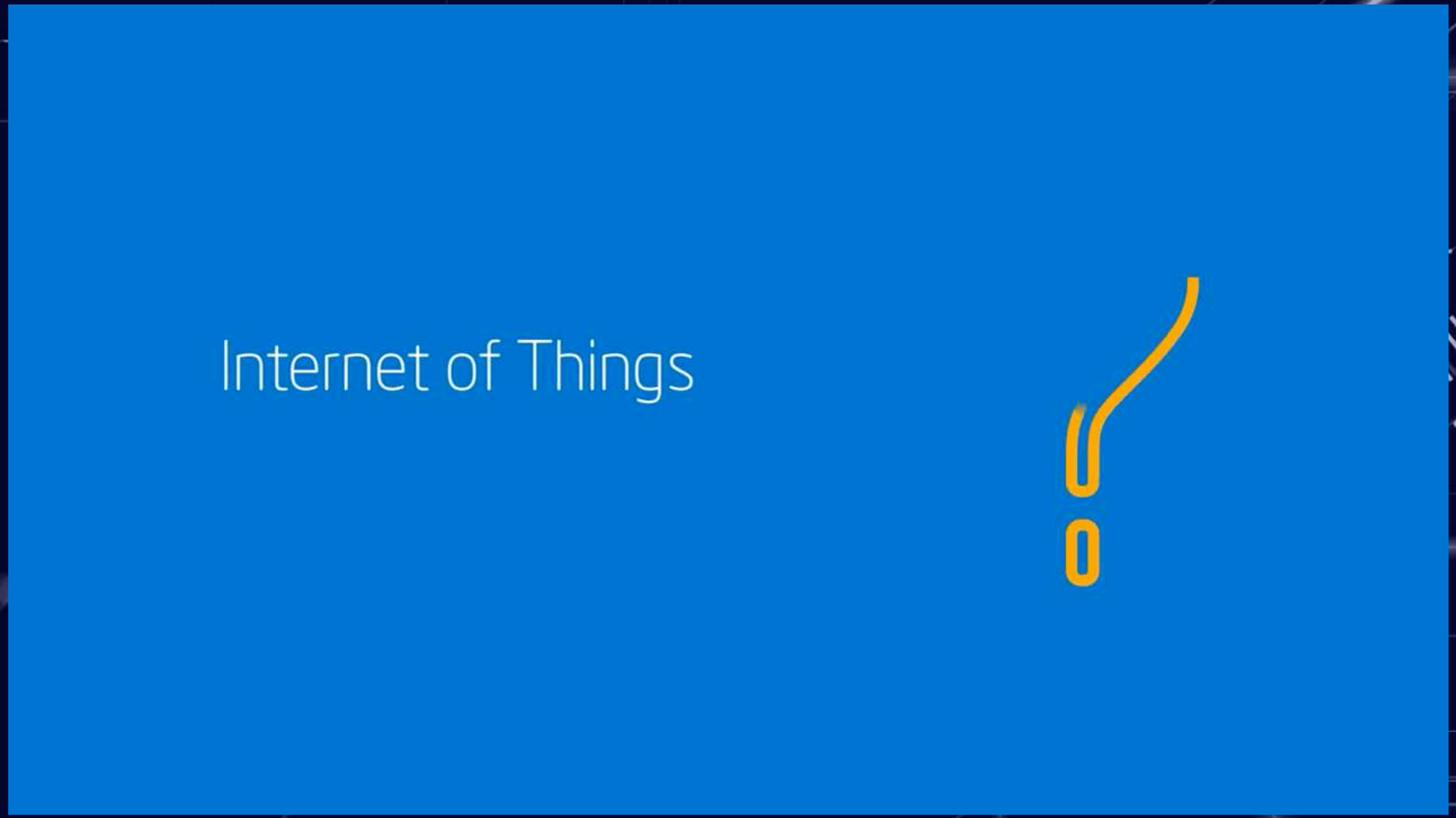
What



What

Image from http://www.cchc.cl/informacion-a-la-comunidad/industria-de-la-construccion/personaje/

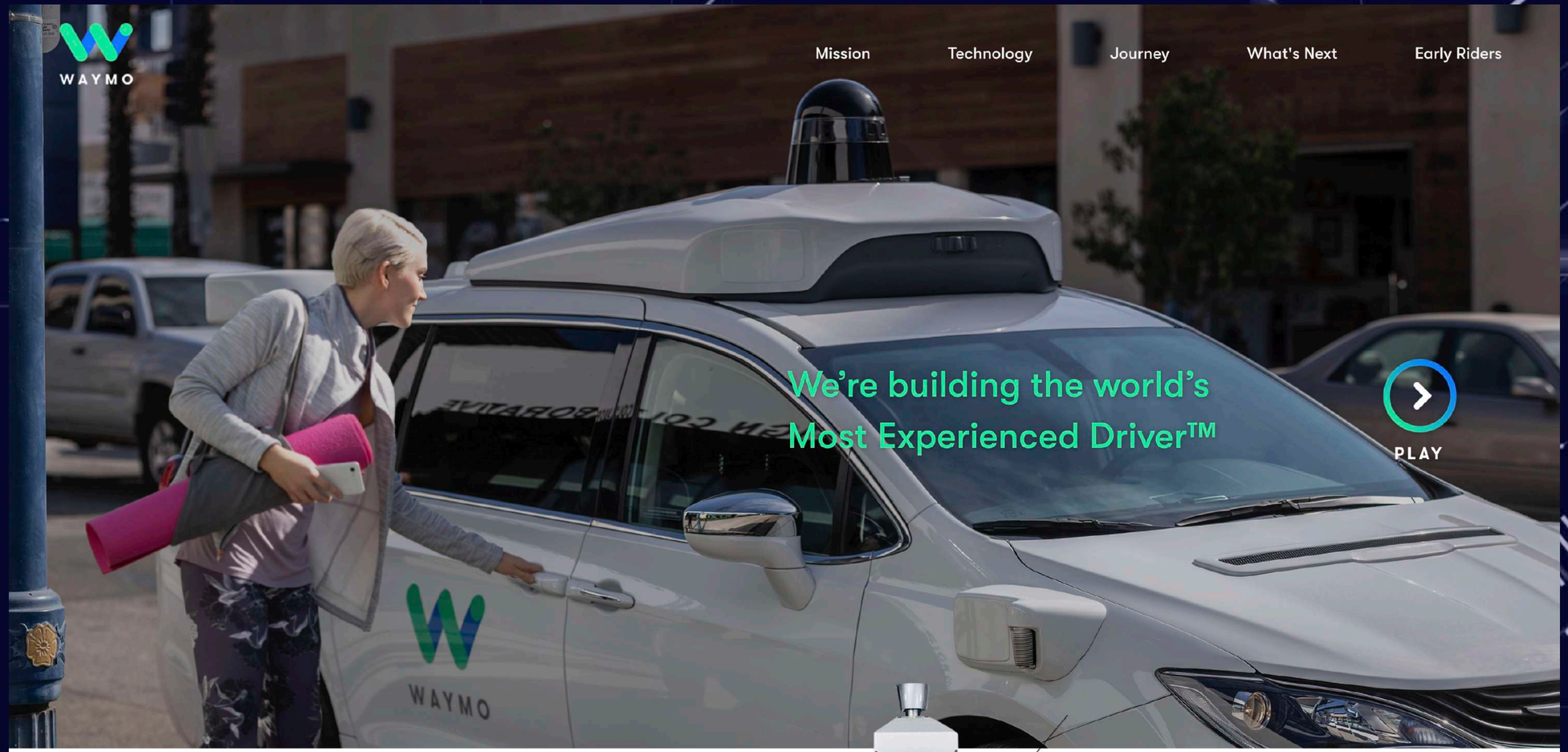
What



https://www.youtube.com/watch?v=Q3ur8wzzhBU

https://www.youtube.com/watch?v=KECfgrw02fU

https://www.ratp.fr/en/groupe-ratp/engineering/fully-automated-century-old-metro-lines



https://waymo.com/

"The Internet of everything will have five to 10 times the impact on society as the Internet itself"

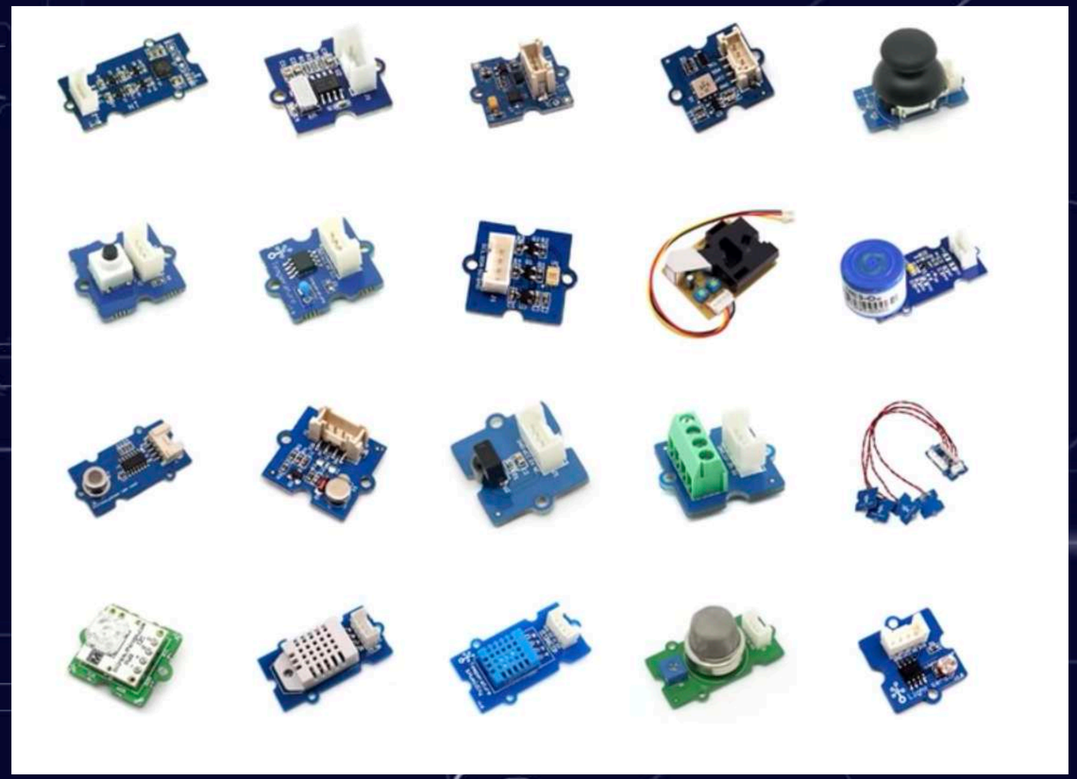
Cisco CEO John Chambers

$19 trillion in economic benefit and value over the next decade.

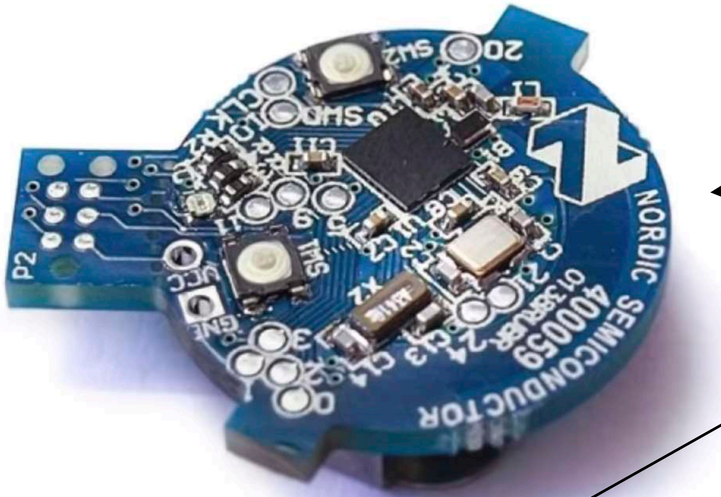
https://www.cnet.com/news/how-much-is-the-internet-of-everything-worth-cisco-says-19-trillion/

Sensors

- Measure values.
- Send raw data.
- Low power.
- Almost no maintenance needed.

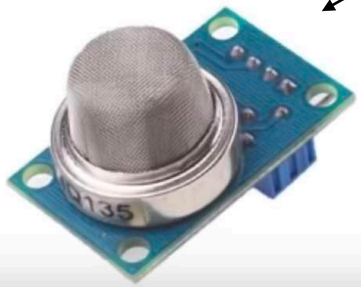


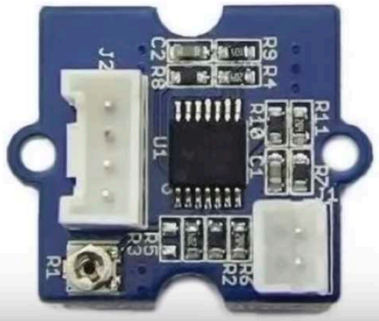
Sensors



Galvanic Skin Response Sensor

Consumer Products





Local Processing Persistence

- Collects sensor data.
- Light processing.
- Uploads data to the cloud.

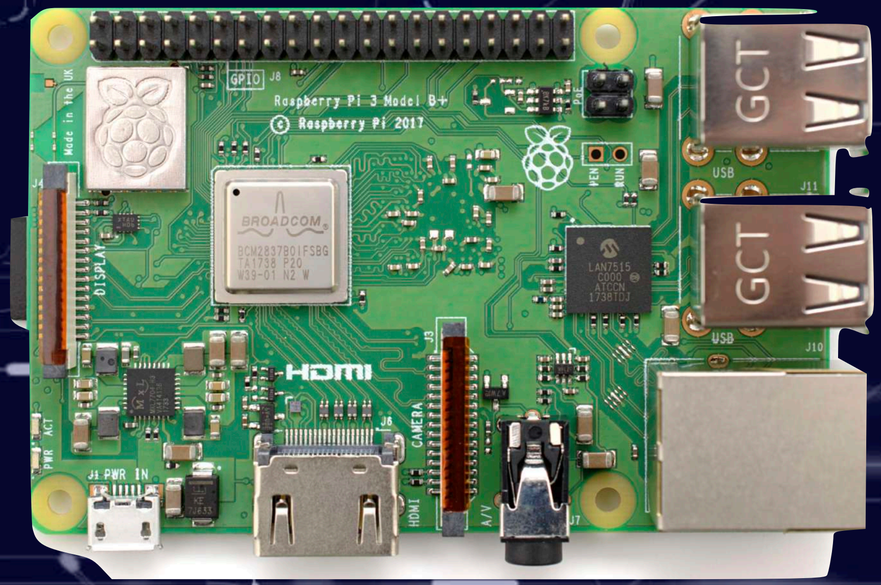


Image source: https://www.flickr.com/photos/120586634@N05/39906369025/

Edge/Fog Computing

intel

CISCO

Network & Internet

- IoT Gateways.
- Connects multiple sensors and local processing units.
- Protocols:
  - CoAP http://coap.technology/
  - MQTT http://mqtt.org/
  - HTTP https://www.w3.org/Protocols/
  - XMPP https://xmpp.org

Image source: https://commons.wikimedia.org/wiki/File:Linksys-Wireless-G-Router.jpg

Cloud Processing & Storage

- Aggregate.
- Store.
- Analyze.
- Predict.

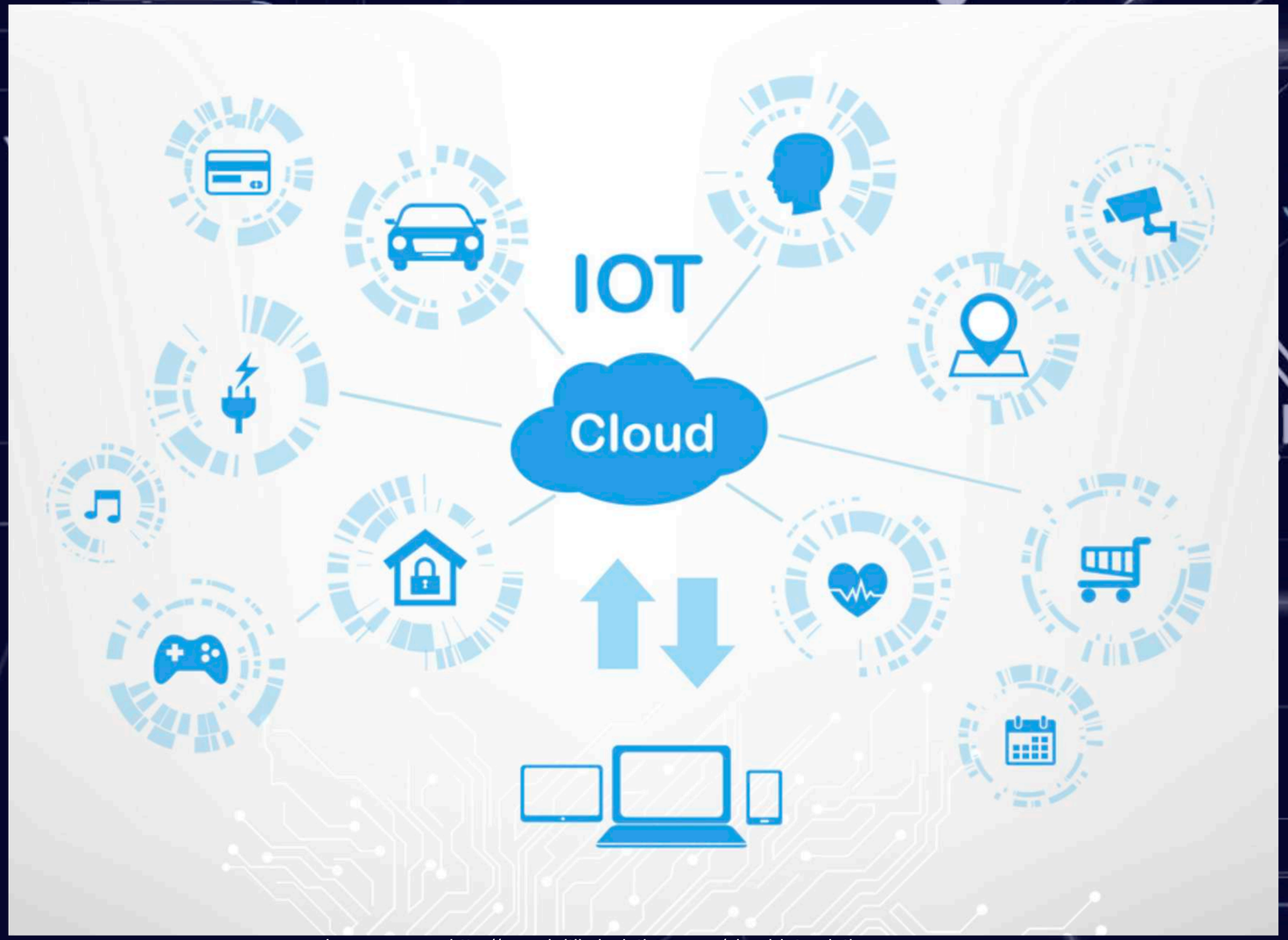


Image source: http://www.kritikalsolutions.com/cloud-iot-solutions

How it started

- August 26th, 1997
  - Bruce Perens
  - https://lists.debian.org/debian-announce/1997/msg00026.html

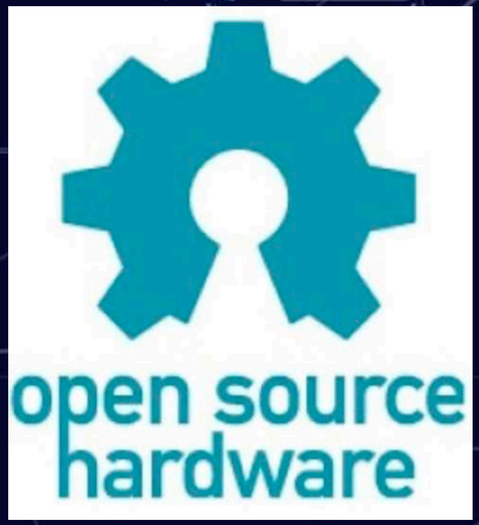


Image source: https://www.oshwa.org/open-source-hardware-logo/

1972

Microcontroller

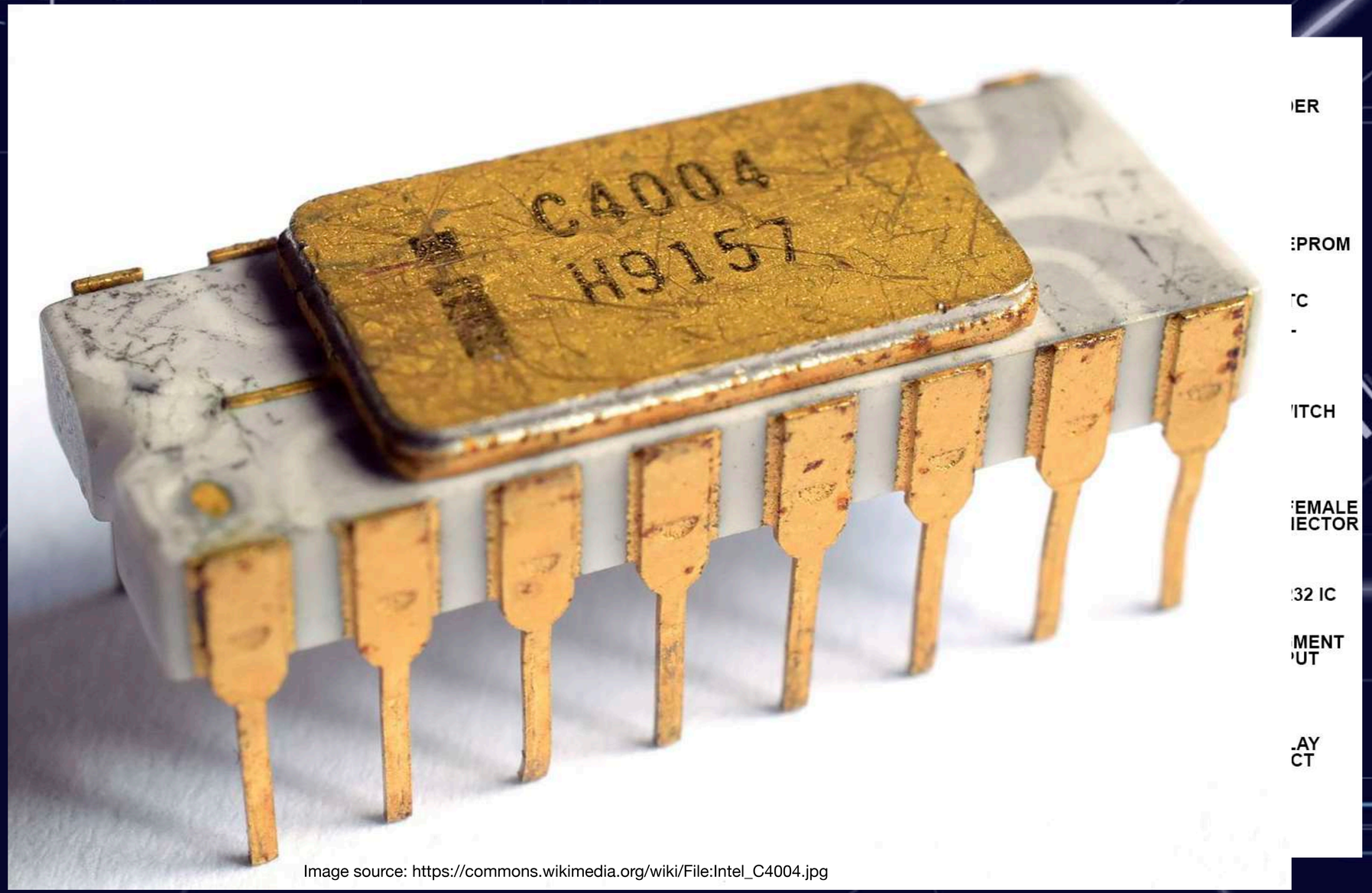


Image source: https://commons.wikimedia.org/wiki/File:Intel_C4004.jpg

1972 1982

First Internet Connected Device

CMU’s connected Coke machine

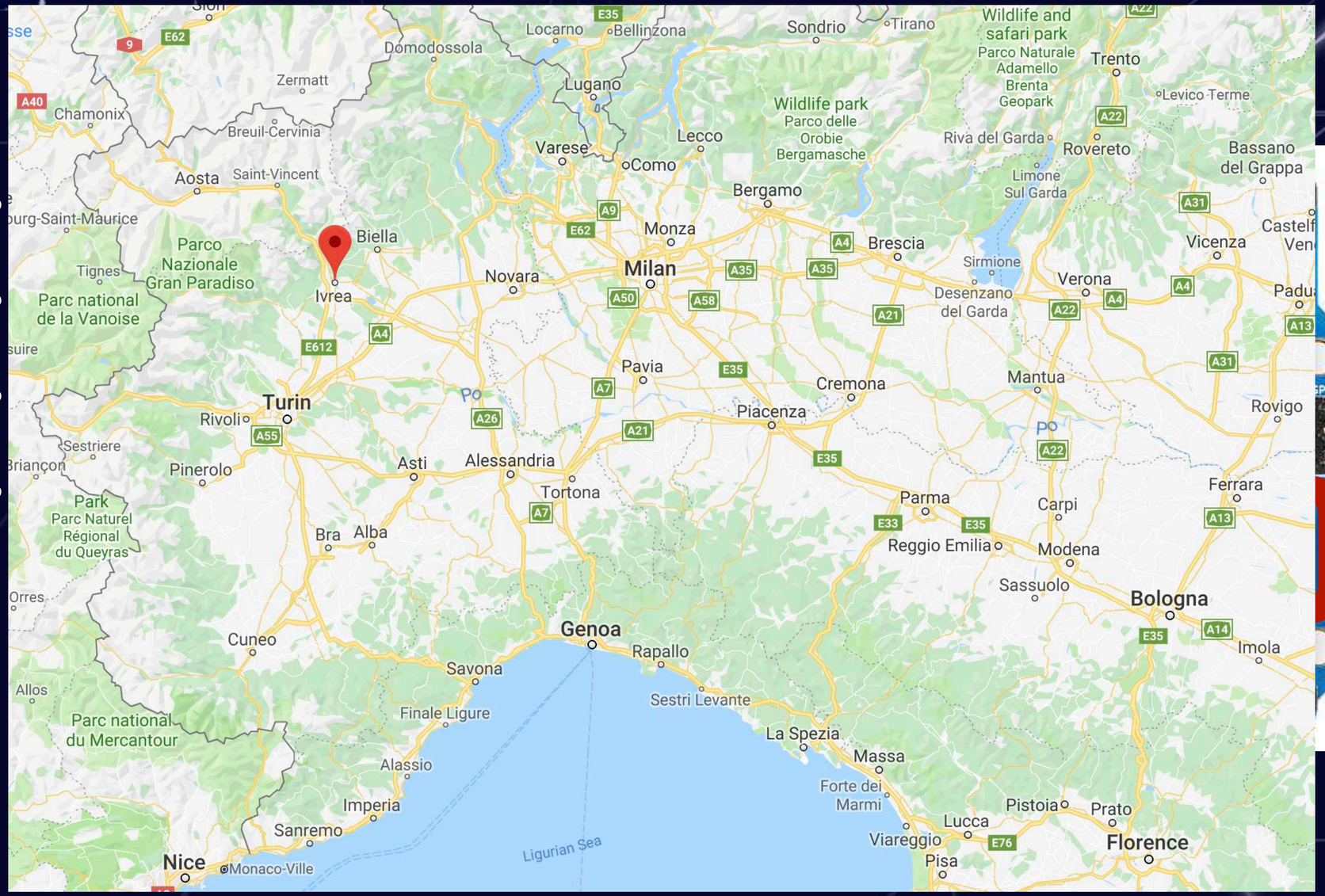
https://www.cs.cmu.edu/~coke/history_long.txt

1972 1982 1999

Internet of Things

1972 1982 1999 2003

Arduino



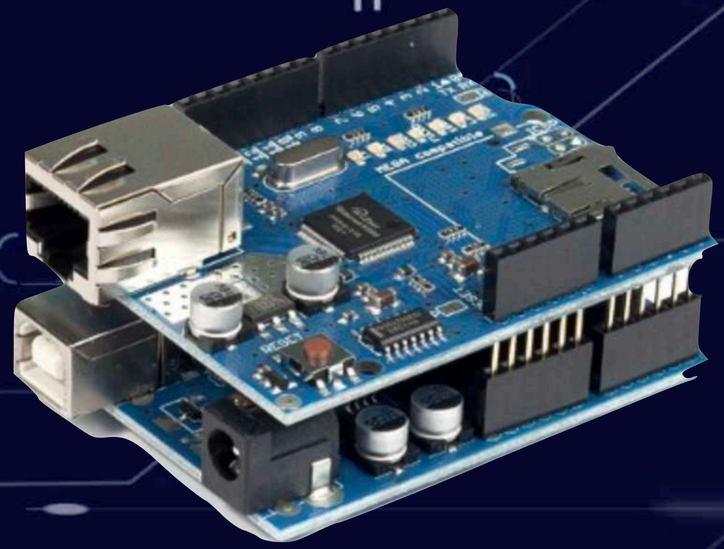
1972 1982 1999 2003

Arduino

Image source: https://learn.sparkfun.com/tutorials/what-is-an-arduino/all

Arduino Ethernet

- Programmable device.
- Easily connectable.
- Open source.
- Simple to use software.
- Has network connectivity.



1972 1982 1999 2003 2012

Raspberry Pi

February 29th, 2012

- Computer.
- Linux inside.
- Programming oriented.
- Full network stack.

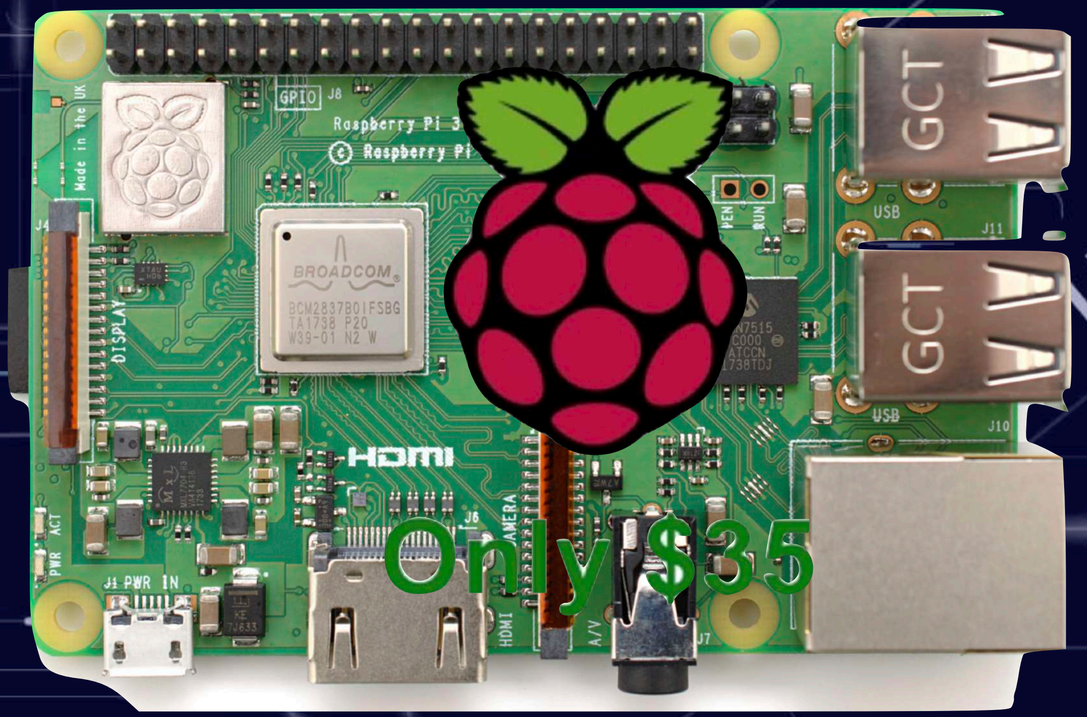
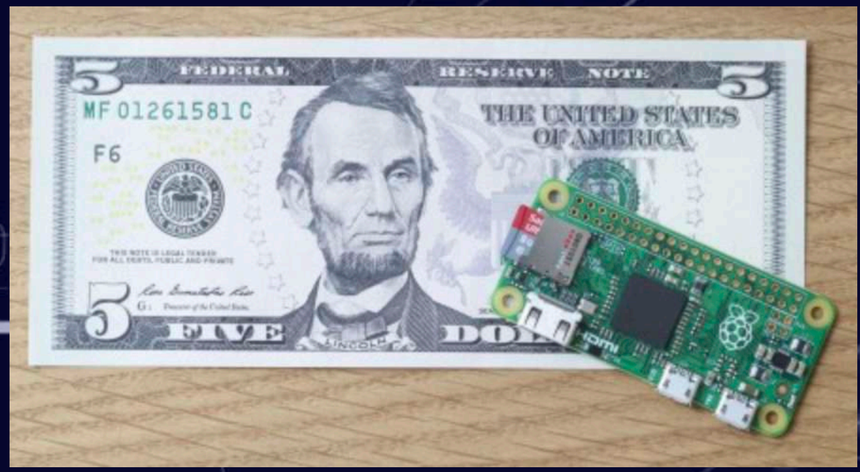


Image source: https://www.flickr.com/photos/120586634@N05/39906369025/

Raspberry Pi Zero

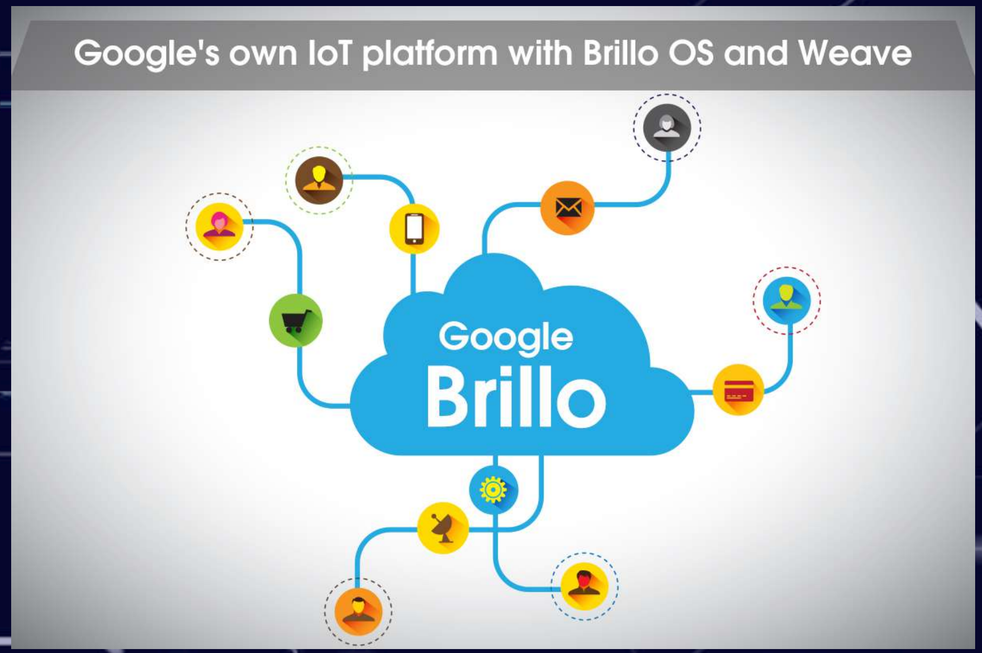
- A Broadcom BCM2835 application processor
- 1GHz ARM11 core
  - 40% faster than Raspberry Pi 1
- 512MB of LPDDR2 SDRAM
- A micro-SD card slot
- A mini-HDMI socket for 1080p60 video output
- Micro-USB sockets for data and power
- An unpopulated 40-pin GPIO header
- Small form factor, at 65mm x 30mm x 5mm



https://www.raspberrypi.org/blog/raspberry-pi-zero/

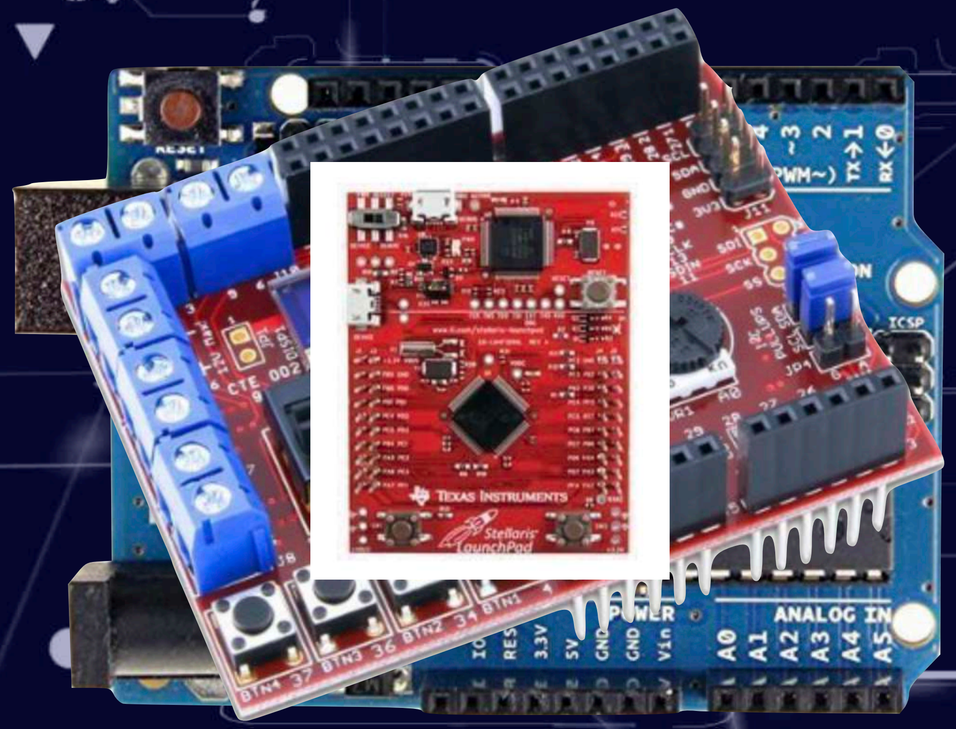
Android Things

- Android Things lets you experiment with building devices on a trusted platform, without previous knowledge of embedded system design:
  - Develop using the Android SDK and Android Studio.
  - Access hardware such as displays and cameras natively through the Android framework.
  - Connect your apps with Google services.
  - Integrate additional peripherals through the Peripheral I/O APIs.
  - Use the Android Things Console to push over-the-air feature and security updates.



https://developer.android.com/things

Good with Sensors



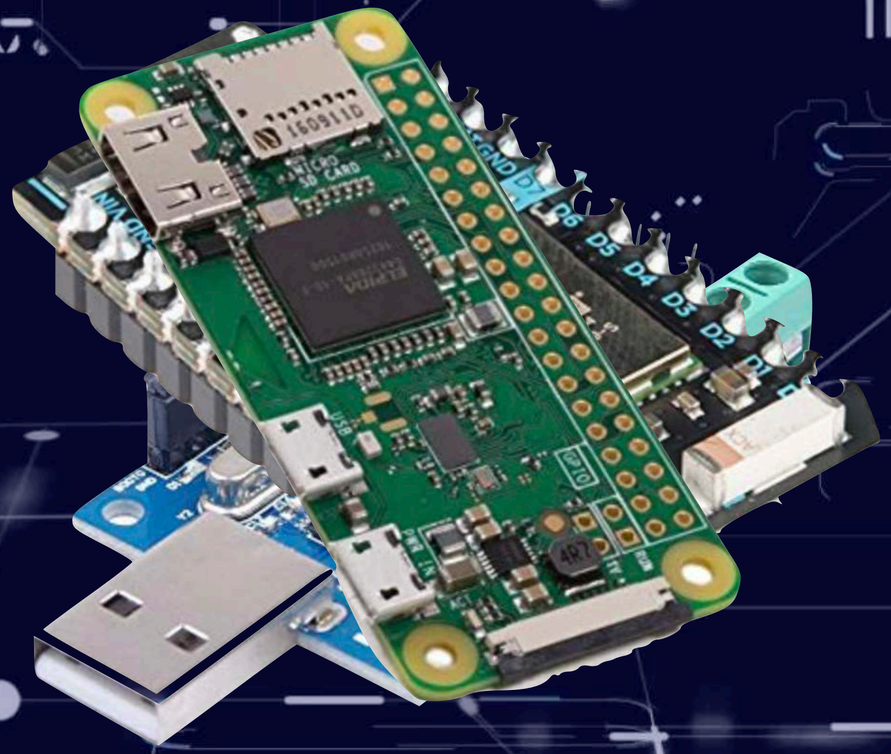
chip

Shield

$

ATmega328P

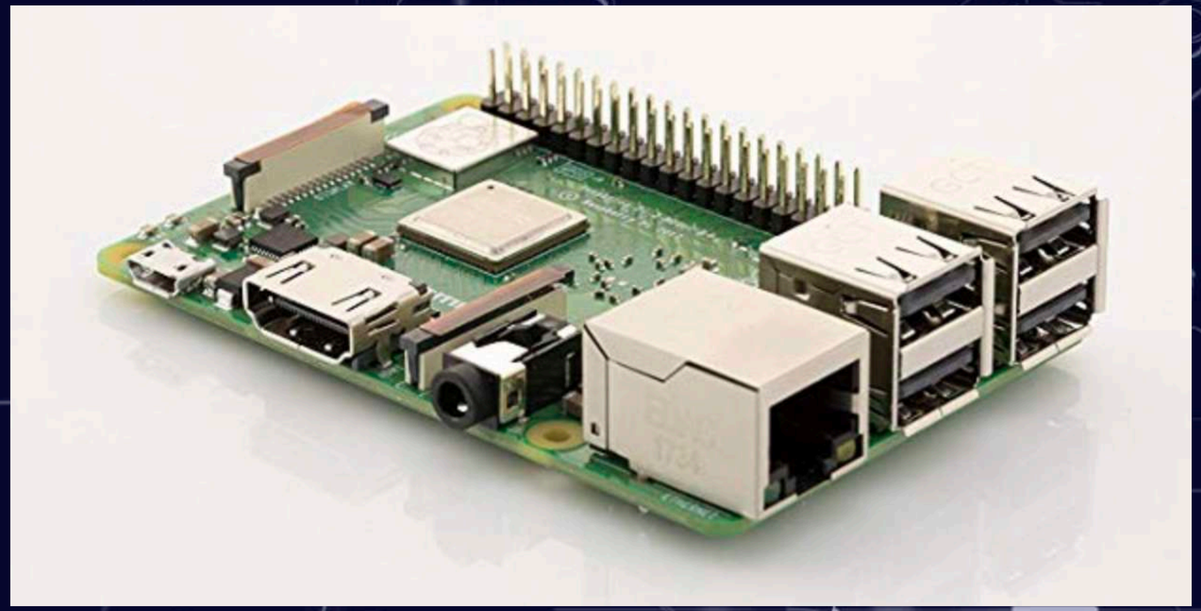
Good with Sensors and for Processing



Raspberry Pi Zero

CH340 ARM Module

Good for Processing and Network

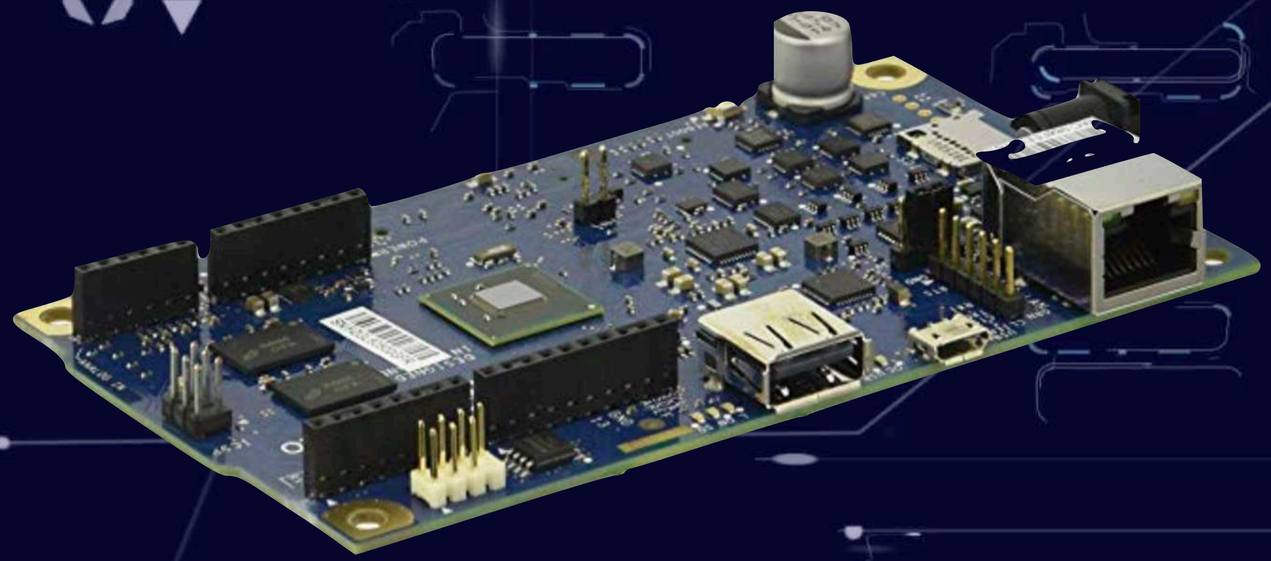


Raspberry Pi 3 B+

35$

ARM - 1GB RAM

Good for Processing and Network

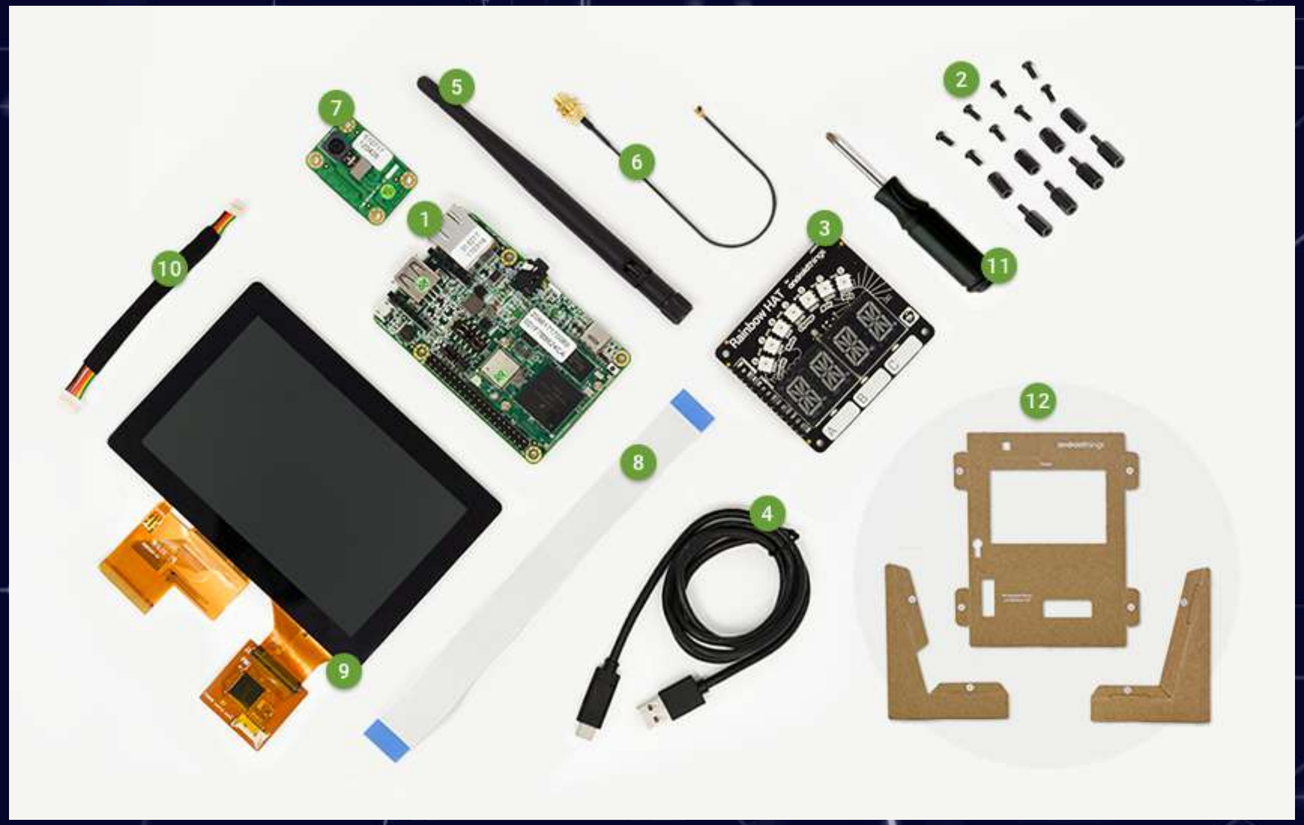


Intel Galileo Gen 2P

50$

Quark SoC - 400MHz - 256MB RAM

Android Things
NXP i.MX7D Starter Kit



ARM Cortex-A7 + M4

200$

https://shop.technexion.com/pico-pi-imx7-startkit-rainbow-hat.html

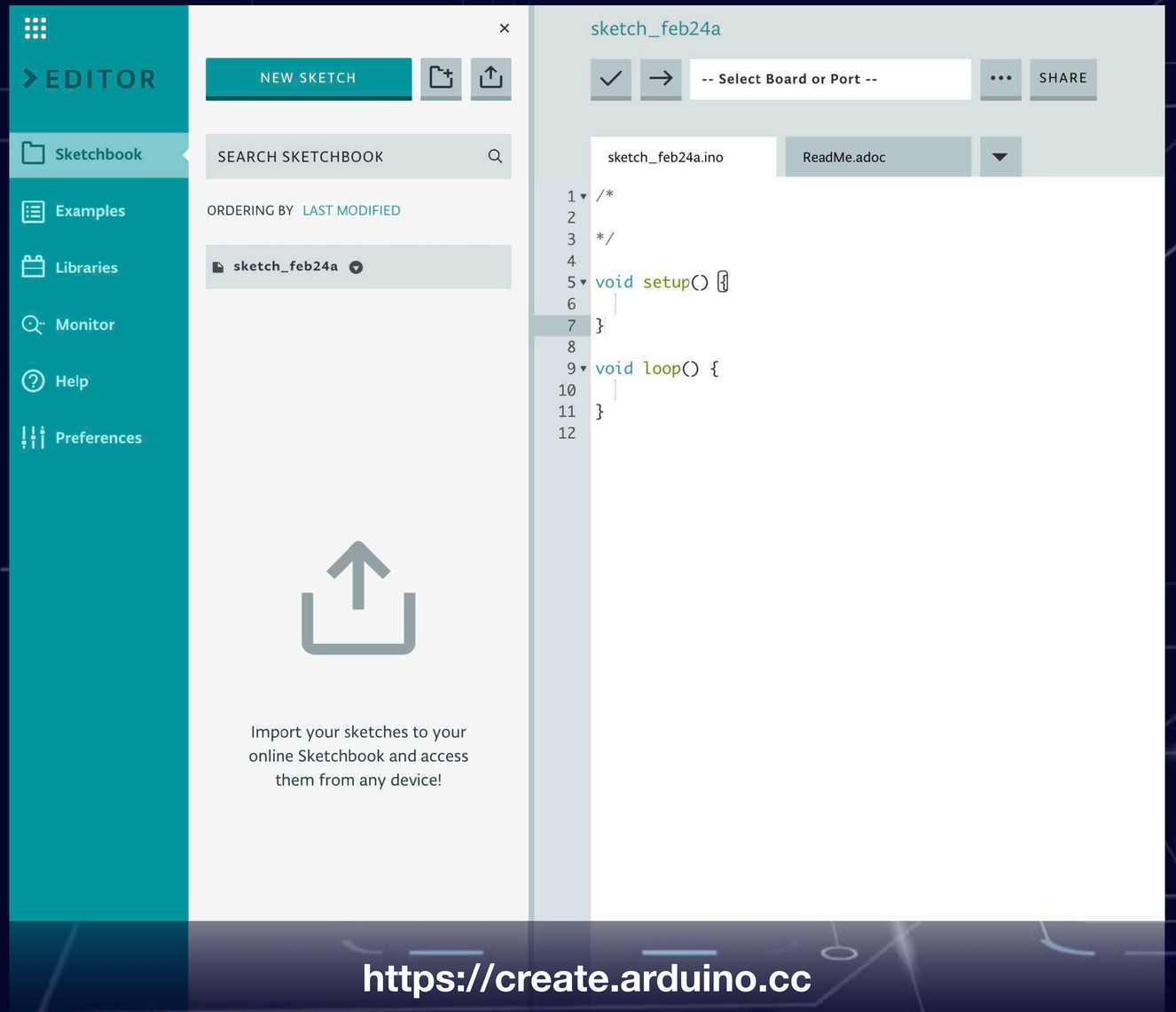
Android Things Raspberry Pi Kit

ARM Cortex A53

100$

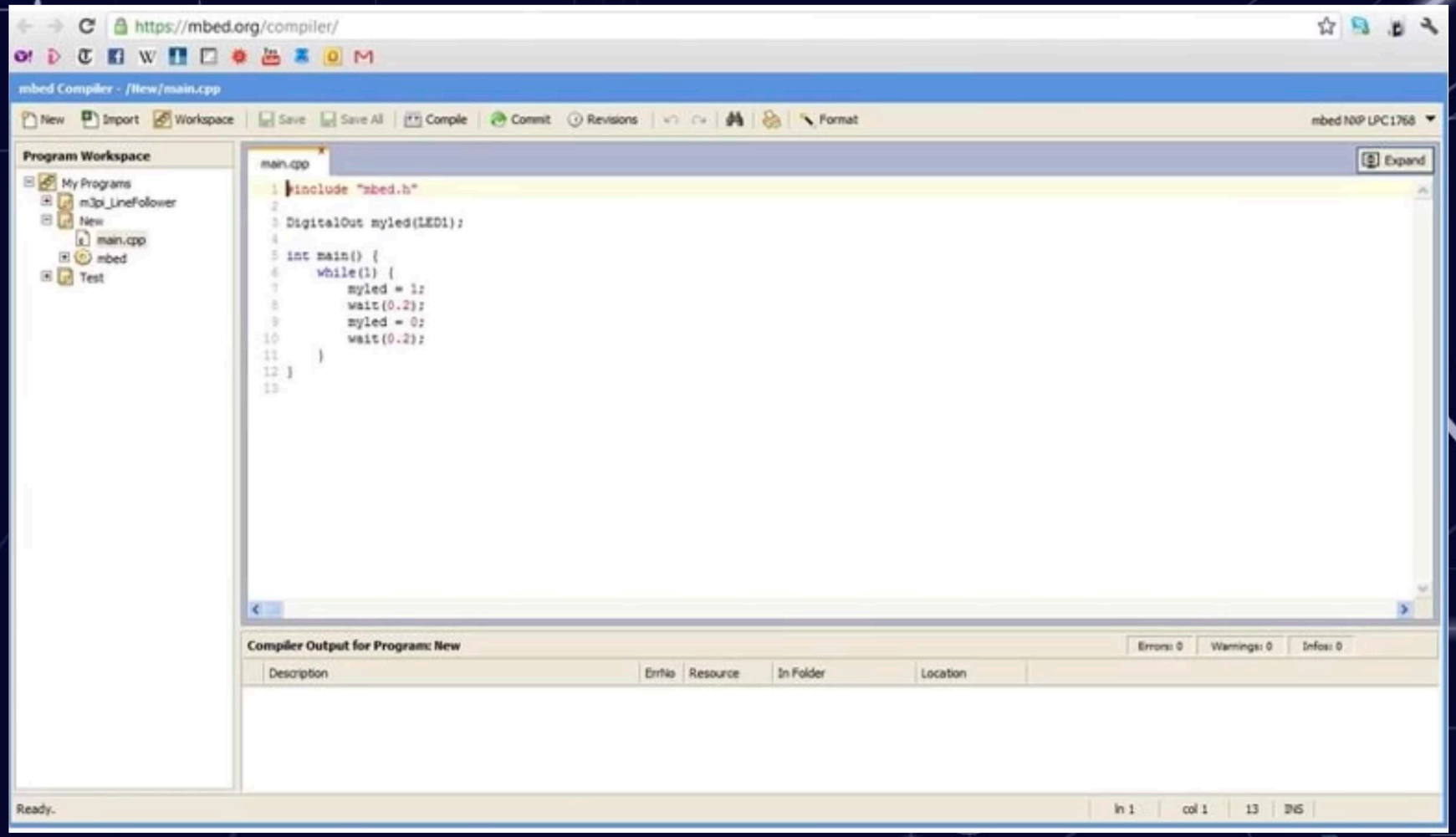
https://androidthings.withgoogle.com/#!/kits/raspberry-pi-3-starter-kit

IDE Options



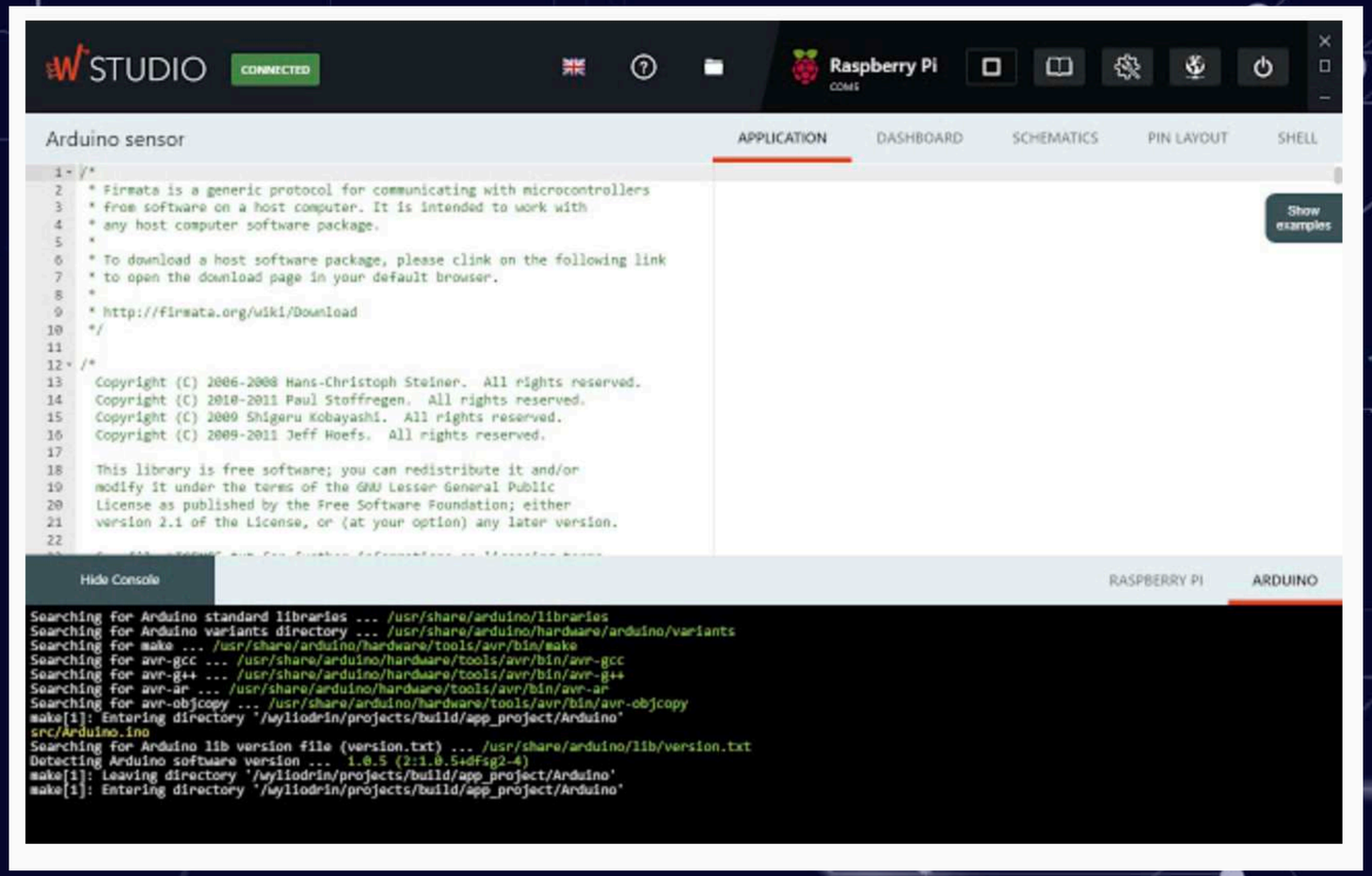
https://create.arduino.cc

IDE Options



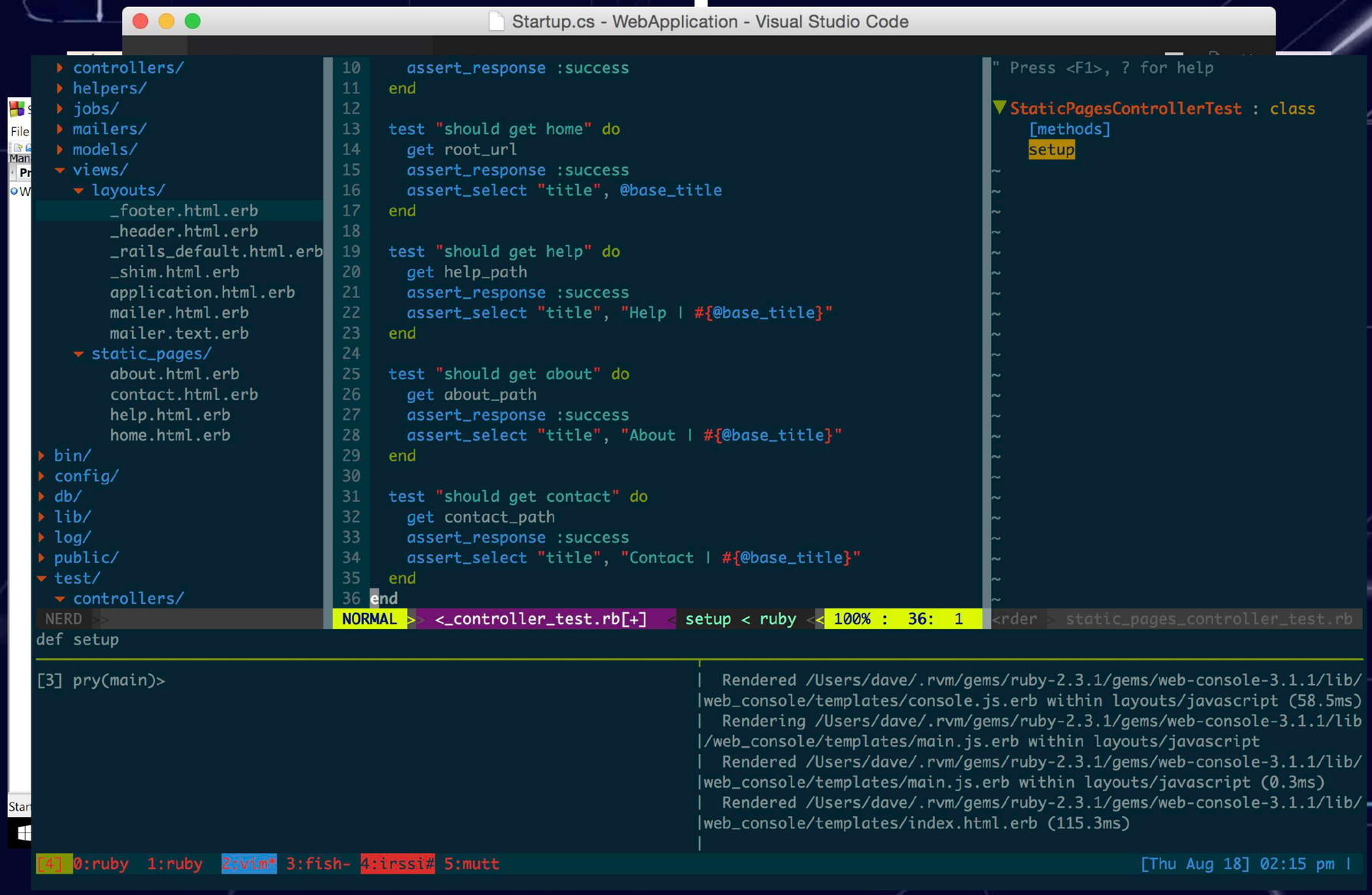
https://os.mbed.com/

IDE Options

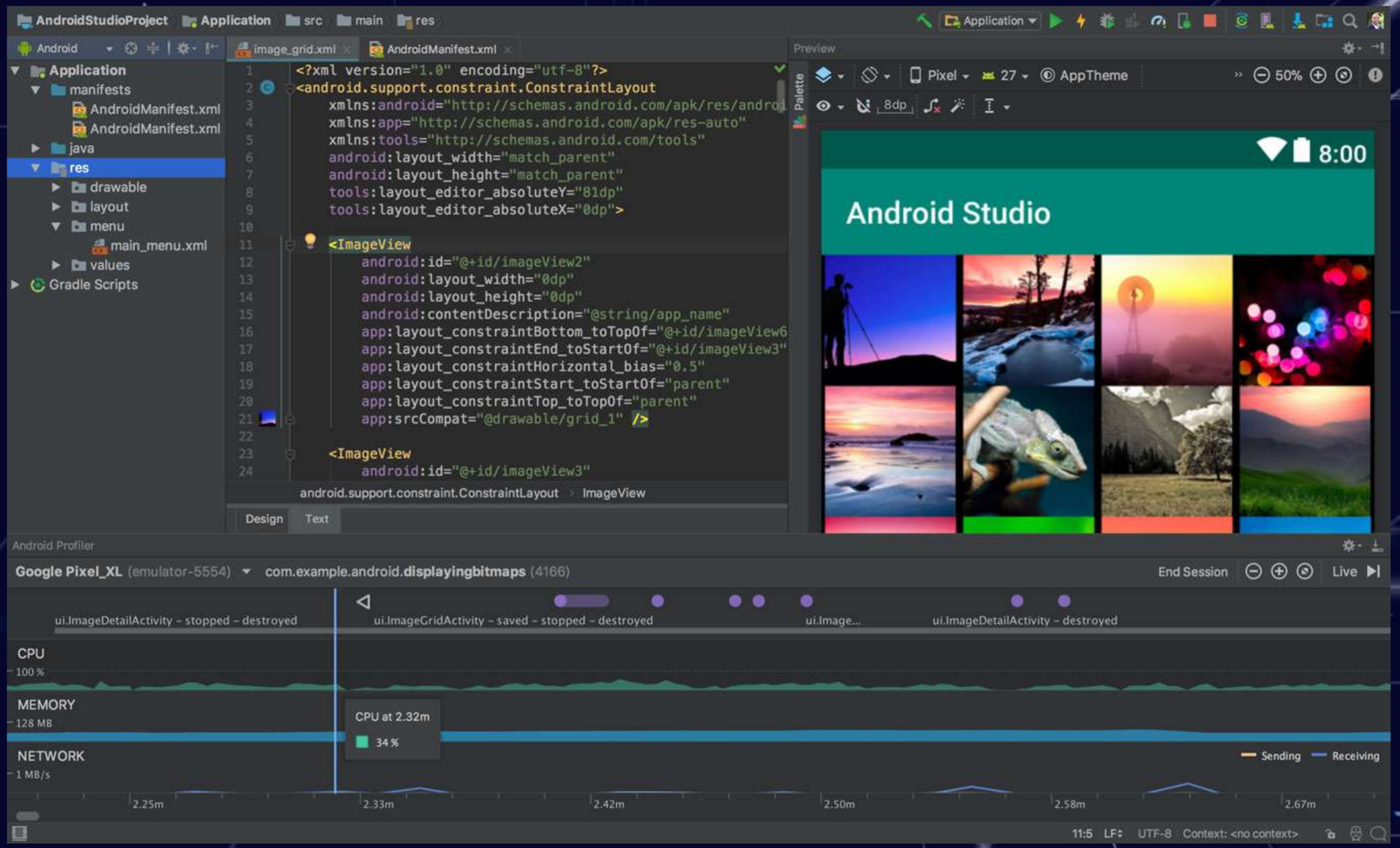


https://wyliodrin.com/

IDE Options


Startup.cs - WebApplication - Visual Studio Code
controllers/
helpers/
jobs/
mailers/
models/
views/
layouts/
_footer.html.erb
_header.html.erb
_rails_default.html.erb
_shim.html.erb
application.html.erb
mailer.html.erb
mailer.text.erb
static_pages/
about.html.erb
contact.html.erb
help.html.erb
home.html.erb
bin/
config/
db/
lib/
log/
public/
test/
controllers/
NERD
10 assert_response :success
11 end
12
13 test "should get home" do
14 get root_url
15 assert_response :success
16 assert_select "title", @base_title
17 end
18
19 test "should get help" do
20 get help_path
21 assert_response :success
22 assert_select "title", "Help | #{@base_title}"
23 end
24
25 test "should get about" do
26 get about_path
27 assert_response :success
28 assert_select "title", "About | #{@base_title}"
29 end
30
31 test "should get contact" do
32 get contact_path
33 assert_response :success
34 assert_select "title", "Contact | #{@base_title}"
35 end
36 end
NORMAL <_controller_test.rb[+] setup < ruby < 100% : 36: 1
" Press <F1>, ? for help
StaticPagesControllerTest : class
[methods]
setup
<rder static_pages_controller_test.rb
def setup
[3] pry(main)>
Rendered /Users/dave/.rvm/gems/ruby-2.3.1/gems/web-console-3.1.1/lib/web_console/templates/console.js.erb within layouts/javascript (58.5ms)
Rendering /Users/dave/.rvm/gems/ruby-2.3.1/gems/web-console-3.1.1/lib/web_console/templates/main.js.erb within layouts/javascript
Rendered /Users/dave/.rvm/gems/ruby-2.3.1/gems/web-console-3.1.1/lib/web_console/templates/main.js.erb within layouts/javascript (0.3ms)
Rendered /Users/dave/.rvm/gems/ruby-2.3.1/gems/web-console-3.1.1/lib/web_console/templates/index.html.erb (115.3ms)
[4] 0:ruby 1:ruby 2:vim* 3:fish- 4:irssi# 5:mutt
[Thu Aug 18] 02:15 pm

IDE Options



https://developer.android.com/studio

Laboratory Projects

- Two projects:
  - Individual project - 60% of the final grade.
  - Team project - 40% of the final grade.

Image source:
http://inkawall.com

Individual Project

Image source:
http://ceelo.org/individual-leader/

- A project similar to the samples available here:
  - https://github.com/androidthings/doorbell/
- Or enhance an existing sample.

Individual Project

- A project similar to the samples available here:
  - https://github.com/androidthings/doorbell/
  - Or enhance an existing sample.
- Due: **April 15th**.
- Deliverables:
  - The source code should be hosted in a github classroom repository.
  - A webpage presenting the project results, similar to:
    - https://github.com/androidthings/doorbell/
  - A short video presenting the results.

Image source:
http://ceelo.org/individual-leader/

Team Project

Image source:
https://www.contractingbusiness.com

- A team of 3 students to tackle a real-world problem.
- Either:
  - Choose an existing project proposed by the lab instructor.
  - Define a new one, together with the lab instructor.

Team Project

Image source:
https://www.contractingbusiness.com

- A team of 3 students to tackle a real-world problem.
- Either:
  - Choose an existing project proposed by the lab instructor.
  - Define a new one, together with the lab instructor.
- Due: **May 15th**.
- Deliverables:
  - The source code should be hosted in a github classroom team repository.
  - A webpage presenting the project results, similar to:
    - https://github.com/androidthings/doorbell/
  - A short video presenting the results.
  - A companion mobile app to manage the IoT app.

Lecture outcomes

- Understand the available hardware and software options.
- IDE options.
- Project details.