MAE 6291
Internet of Things for Engineers

Prof. Kartik Bulusu, MAE Dept.

Week 6 [02/26/2025]	• Localhost • Tunnel – Exposing your localhost • Analog-Digital conversion • Perceiving the IoT Architecture using a 5-layer model	• In-class: run the Flask API code and create a localhost • Install Cloudflare localhost tunnelling software • Expose localhost to the internet by a tunnel

```
git clone https://github.com/gwu-mae6291-iot/spring2025_codes.git
```

GW School of Engineering & Applied Science

THE GEORGE WASHINGTON UNIVERSITY

Spring 2025

Photo: Kartik Bulusu

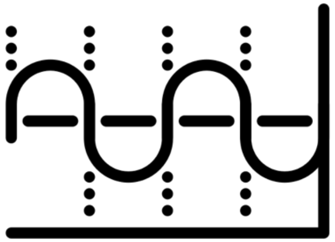
Midterm projects

Midterm Project Status – Spring 2025

Name	Project title	Hardware requirements	Status
Alexandra Trotter	Inconvenience in Animal Welfare	VIbration sensor – Recommended PIR sensor & Buzzer	**Approved.** **Needs to collect sensors**
Ben Sirota	Baja Car Speedometer	Hall effect Sensors, Photointerruptors - Recommndation: Pi Camera	**Approved.** **Needs to collect sensors** **Need more information**
Dominic Savarino	*EyePi: Intelligent Object Detection with Email Alerts*	Pi Camera	**Approved.** **Needs to collect sensors**
Elliot Hunter	*Smart Seat Occupancy and Safety System (Grad Student Perfector)*	Vibration Switch, Pi Camera, Relay, MQ2 Gas sensor, LED	**Approved.** **Needs to collect sensors**
Alex Vasilev	*Real-time battery display*	Voltage detector, A/D converter	**Approved.** **Needs to collect sensors**
Puchen Wang	*Infrared Sensor-Based Automatic Pet Door*	LEDs, IR transceivers – Recommendation: PIR sensors	**Approved.** **Needs to collect sensors**
Miya Liu	*iSwipe: connecting hungry students to meal swipes*	GPS module	**Approved.** **Needs to collect sensors** **Need more information**
Nick Neirotti	*Shade Runner 2025*	DC Motors, Motor Drivers, ESP32, Battery holder	**Approved.** **Needs to collect sensors**
Nathan Janssen	*Project Saver*	Recommendation: Servo motors	**Approved.** **Needs to collect actuators**
Omar Nayfeh	*REEFLEX Water Leak Detection System*	Sound sensor	**Conditionally Approved.** **Need make and model numbers of the sensors**
Shota Kakiuichi	*Smart Refill Monitoring System for Waste Management*	Ultrasonic sensor, LCD module, Active Buzzer, LED, button	**Approved.** **Needs to collect sensors**
William Lynam	PlantPal	Hiumiture sensors	**Approved.** **Need make and model numbers of the sensors**
Yazan Sawalhi	*Candle Monitor and Extinguisher*	Flame sensor, Ultrasound sensor., Motorized Fan	**Approved.** **Needs to collect sensors**
Aly Nguyen	*Extreme Study Buddy*	Servo Motors, LEDs, Sound sesnors, ultrasound sensor, LCD Module	**Approved.** **Need make and model numbers of the sensors**
Sumner Gubisch	*Print Schedular, Live Updates, Time-lapse and Controls for Vat Photopolymerization (VPP) Printers*	Pi Camera	**Approved.** **Need make and model numbers of the sensors**
Kartik Bulusu	*Translator-at-ease*	Microphone	**Need more information; Unclear how he's going to pull this off!!**

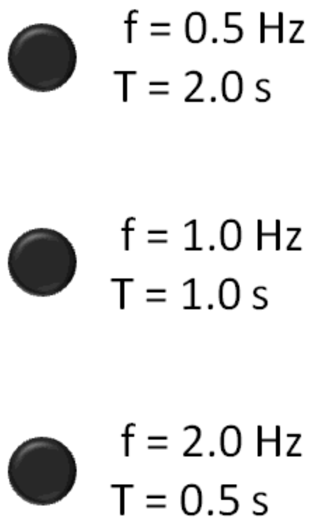
Icon Sources:
analog by I Putu Dicky Adi : https://thenounproject.com/browse/icons/term/analog/
Digital signal by Arthur Shlain: https://thenounproject.com/browse/icons/term/digital-signal

Digitization of Sensor Measurands



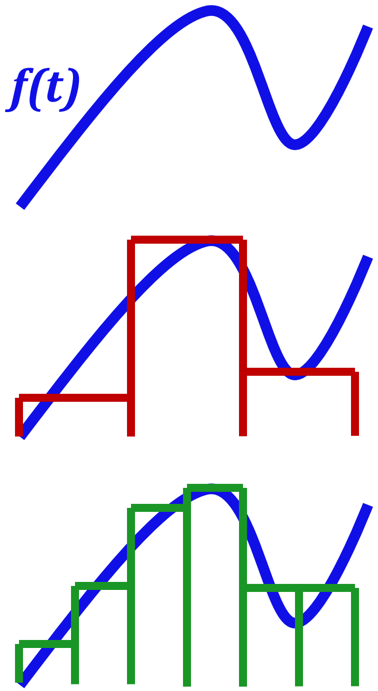
Frequency of signals and measurements

Frequency is the number of occurrences of a repeating event per unit **time**.



Wikimedia Commons

The **sampling frequency** or **sampling rate, f_s,** is the average number of samples obtained in one second (*samples per second*), thus **$f_s = 1/T$**.



The general range of hearing for young people is 20 Hz to 20000 Hz.

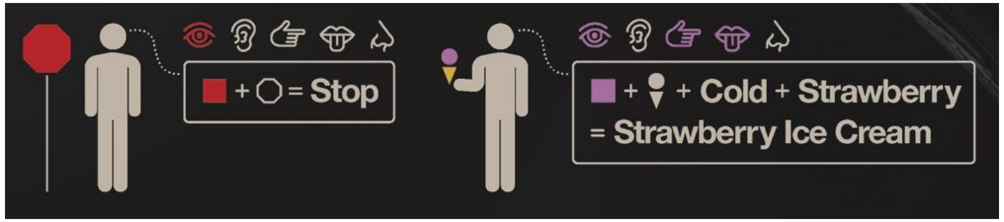
Audio CD, most commonly used with MPEG-1 audio is sampled at 44100 Hz

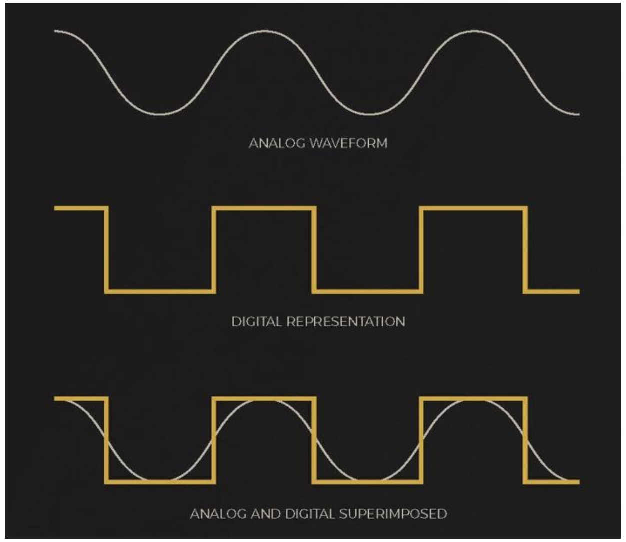
HD DVD (High-Definition DVD) audio tracks are sampled at 98000 Hz

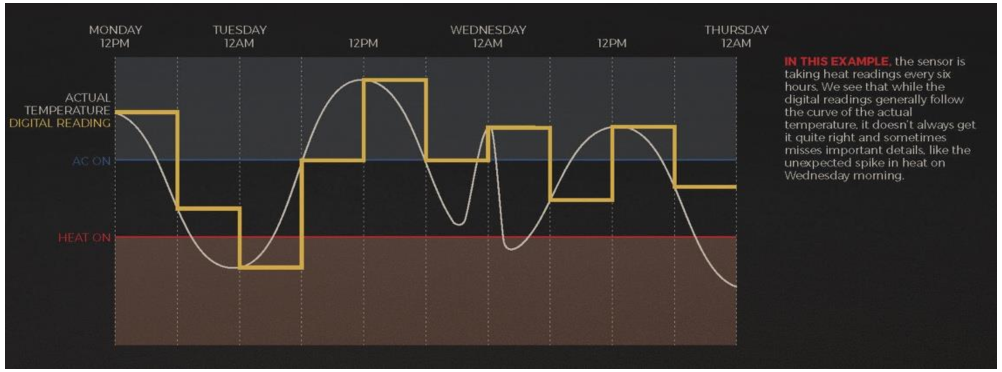
The approximately double-rate requirement is a consequence of the Nyquist theorem.

Source:
SparkFun: https://learn.sparkfun.com/

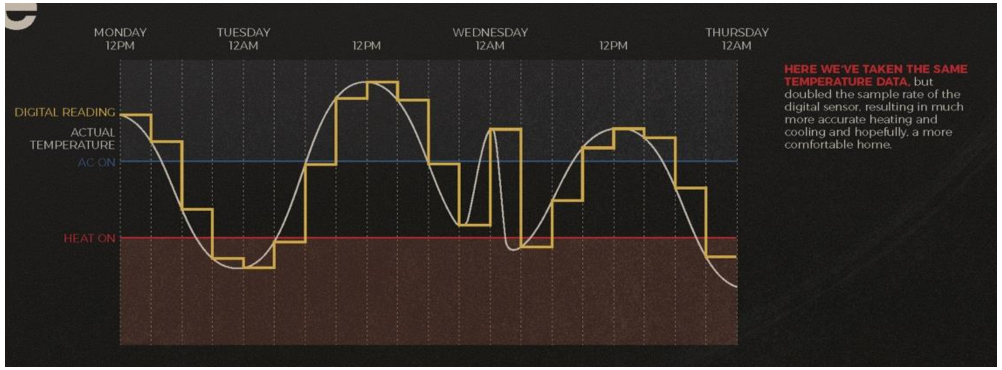
From Analog to the Digital World







IN THIS EXAMPLE, the sensor is taking heat readings every six hours. We see that while the digital readings generally follow the curve of the actual temperature, it doesn't always get it quite right and sometimes misses important details, like the unexpected spike in heat on Wednesday morning.



HERE WE'VE TAKEN THE SAME TEMPERATURE DATA, but doubled the sample rate of the digital sensor, resulting in much more accurate heating and cooling and hopefully, a more comfortable home.

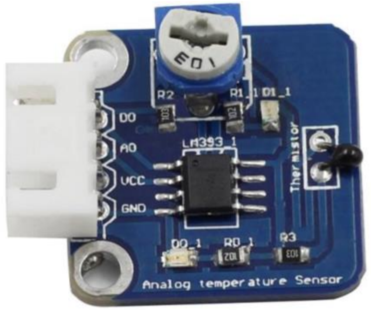
Sources:

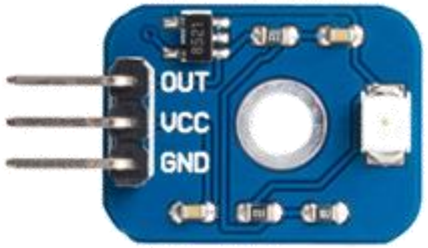
McGrath, M. J. and Scanaill, C. N., Sensor Technologies - Healthcare, Wellness and Environmental Applications, Apress Open
Misra, S., Mukherjee, A and Roy, A, Introduction to IoT, Cambridge University Press (2021)
analog by I Putu Dicky Adi : https://thenounproject.com/browse/icons/term/analog/
Digital signal by Arthur Shlain: https://thenounproject.com/browse/icons/term/digital-signal
Sunfounder: http://wiki.sunfounder.cc/index.php?title=Analog_Temperature_Sensor_Module
Sunfounder: https://www.sunfounder.com/products/analog-200nm-370nm-uv-detection-sensor-module

Sensor classification-based on output

Analog sensors

- Output signals are proportional (linearly or non-linearly) to the quantity being measured
- continuous in time and amplitude

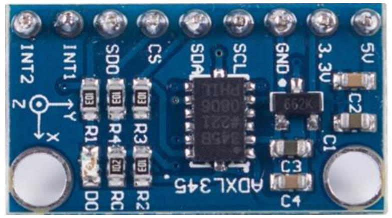




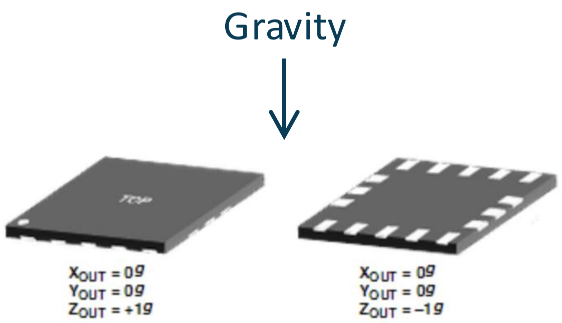
UV detection sensor module

Digital sensors

- Discrete time representation of the quantity being measured
- Binary signals in the form of logic-1 and logic-0
- Output as a single bit (serial transmission) or eight-bit (byte, parallel transmission)

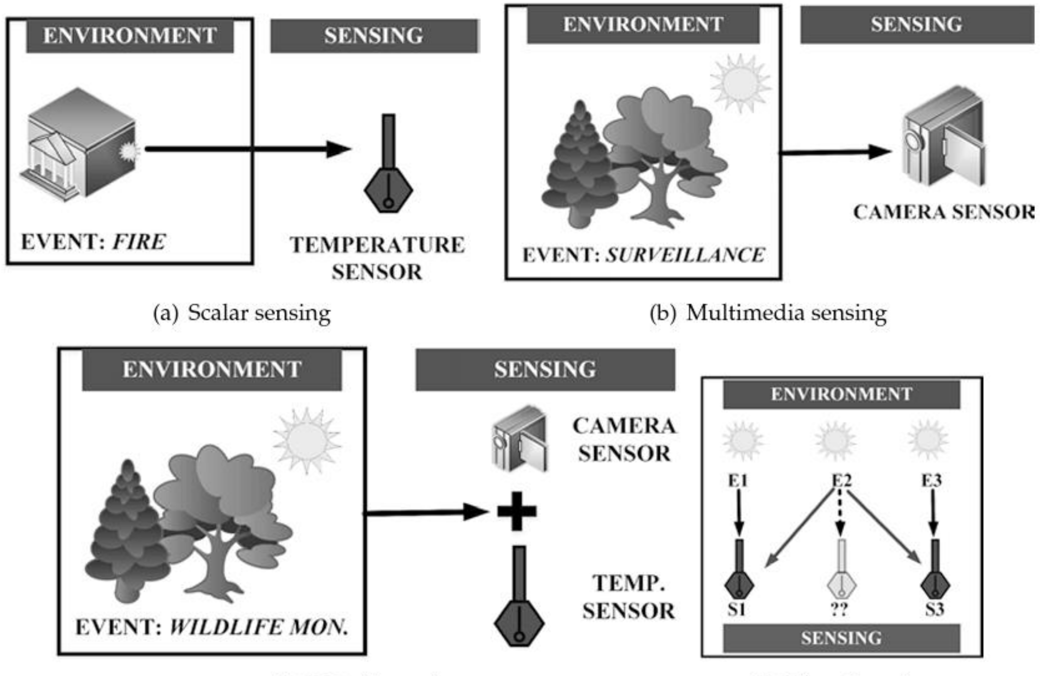


Digital Accelerometer module



Sources:
Misra, S., Mukherjee, A and Roy, A, Introduction to IoT, Cambridge University Press (2021)

Sensing strategies leading into IoT

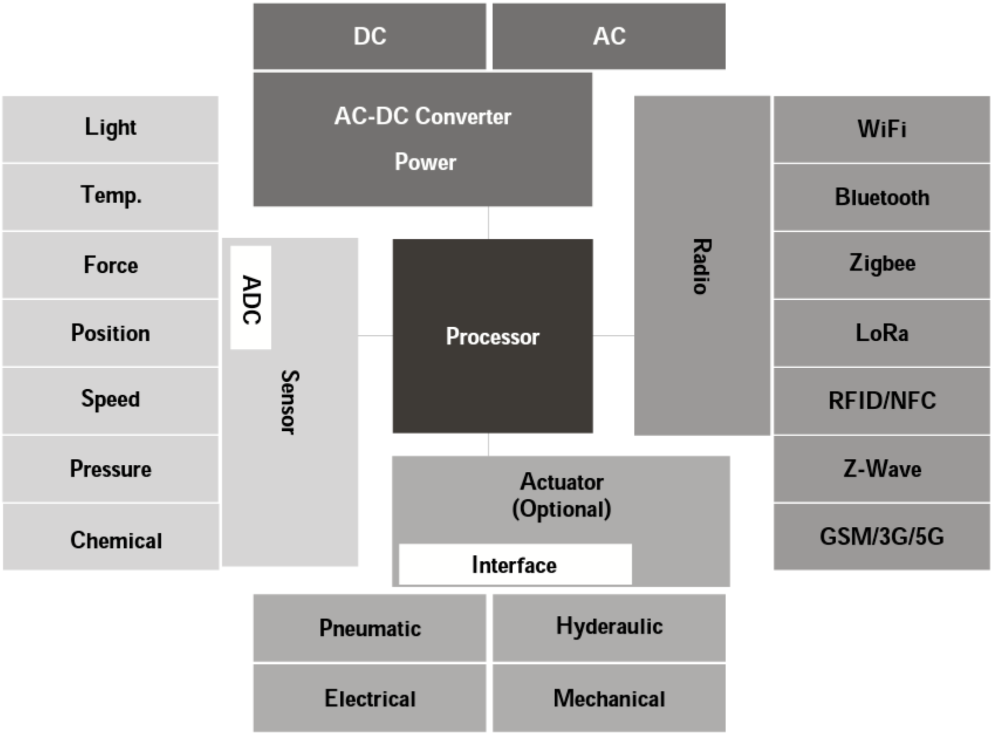


(a) Scalar sensing

(b) Multimedia sensing

(c) Hybrid sensing

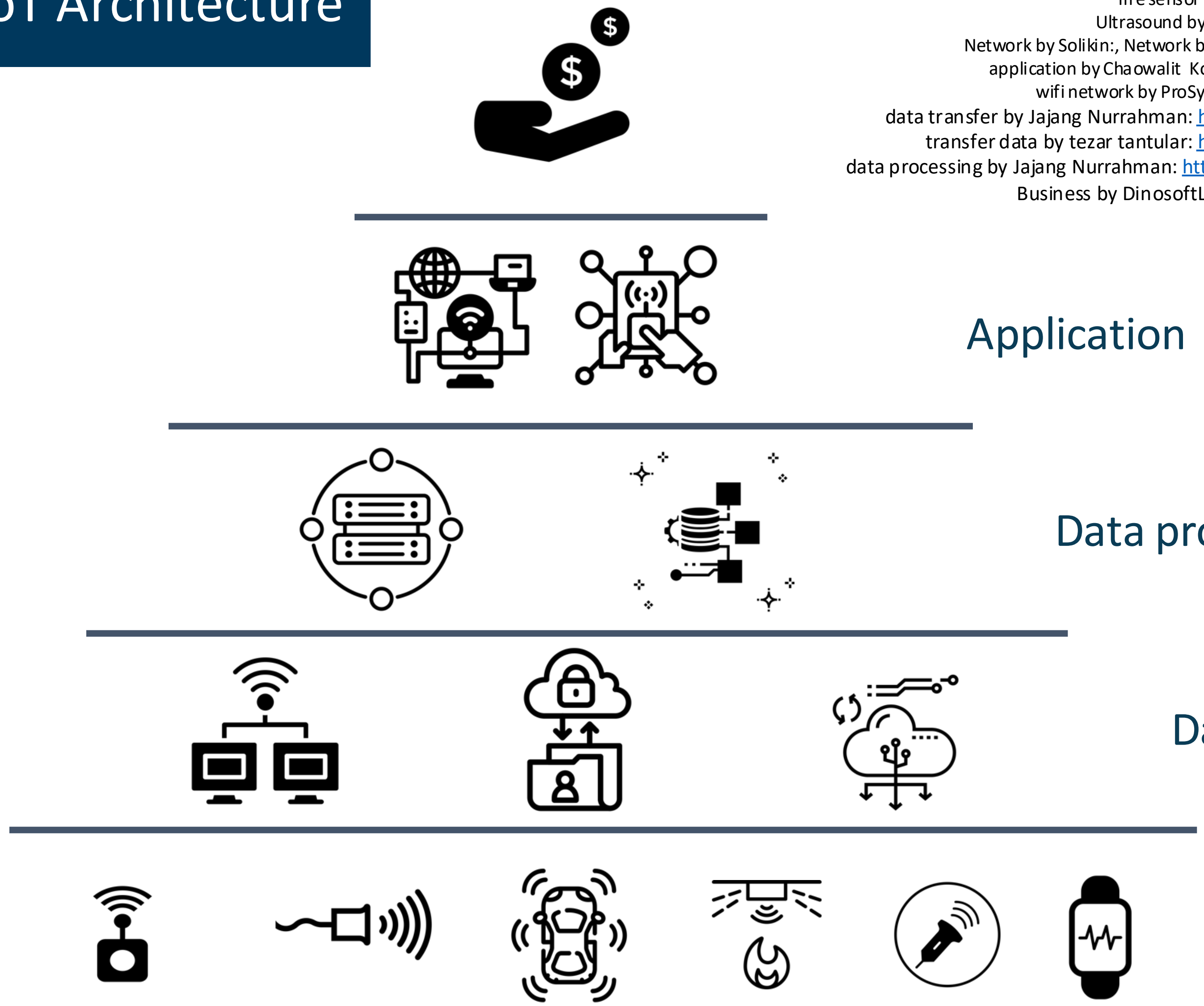
(d) Virtual sensing



DC
AC
AC-DC Converter
Power
Light
Temp.
Force
Position
Speed
Pressure
Chemical
ADC
Sensor
Processor
Radio
WiFi
Bluetooth
Zigbee
LoRa
RFID/NFC
Z-Wave
GSM/3G/5G
Actuator (Optional)
Interface
Pneumatic
Hyderaulic
Electrical
Mechanical

Building the next IoT Architecture

Icon Sources:
sensor by Carolina Cani:, sensor by Pham Duy Phuong Hung, sensor by Tippawan Sookruay, sensor by Lorenzo:
https://thenounproject.com/browse/icons/term/sensor
fire sensor by LAFS : https://thenounproject.com/browse/icons/term/fire-sensor/
Ultrasound by Shocho: https://thenounproject.com/browse/icons/term/ultrasound/
Network by Solikin:, Network by Tippawan: https://thenounproject.com/browse/icons/term/network
application by Chaowalit Koetchuea: https://thenounproject.com/browse/icons/term/application
wifi network by ProSymbols: https://thenounproject.com/browse/icons/term/wifi-network/
data transfer by Jajang Nurrahman: https://thenounproject.com/browse/icons/term/data-transfer/
transfer data by tezar tantular: https://thenounproject.com/browse/icons/term/transfer-data/
data processing by Jajang Nurrahman: https://thenounproject.com/browse/icons/term/data-processing
Business by DinosoftLab: https://thenounproject.com/browse/icons/term/business/



Business-layer

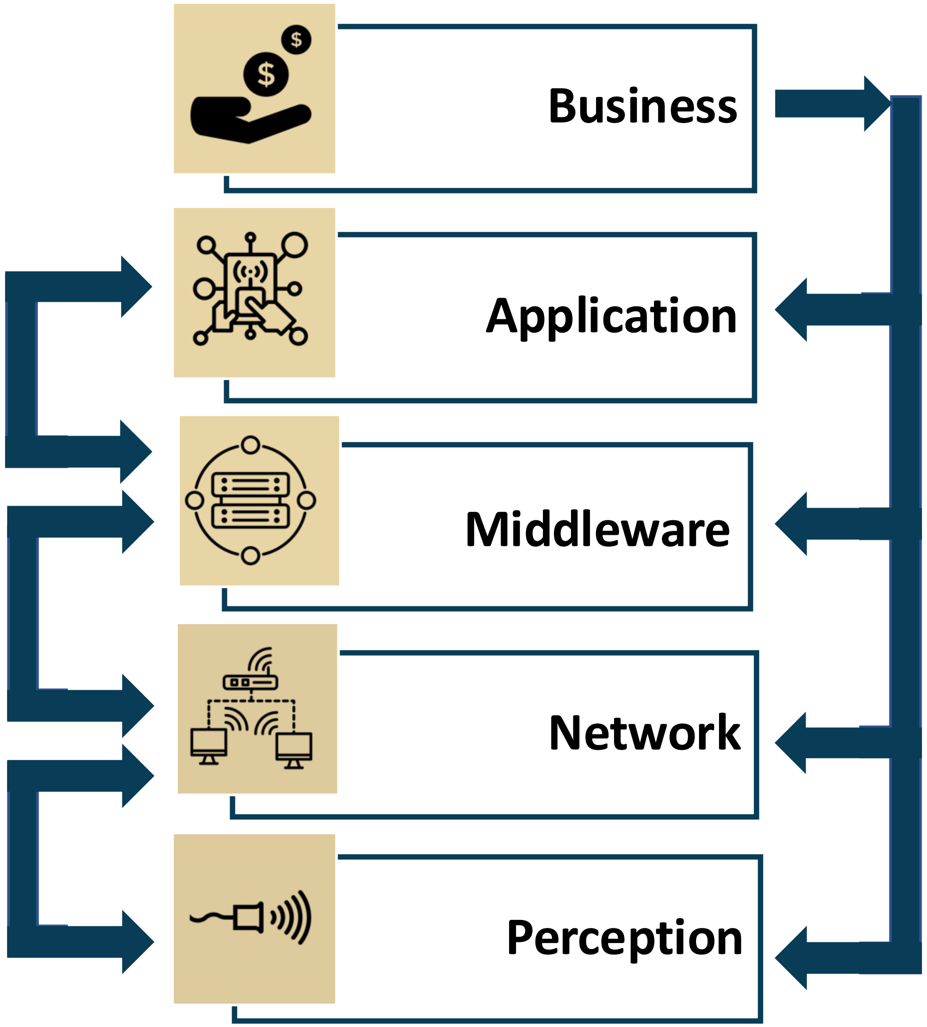
Information-layer — Application

Processing- or Middleware-layer — Data processing

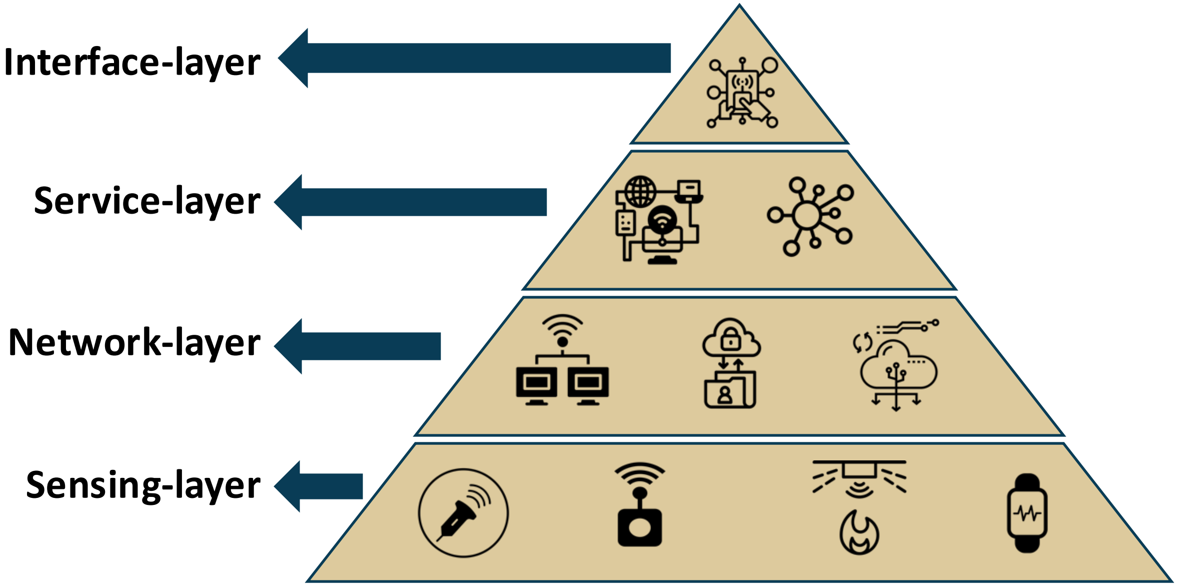
Communication-layer — Data transfer

Sensor-layer — Things

The 5-Layer IoT Architecture



Service-oriented IoT Architecture



Sources:
sensor by Carolina Cani:, sensor by Pham Duy Phuong Hung, sensor by Tippawan Sookruay, sensor by Lorenzo: https://thenounproject.com/browse/icons/term/sensor
wifi network by Matthias Hartmann:: https://thenounproject.com/browse/icons/term/wifi-network/
application by Chaowalit Koetchuea: https://thenounproject.com/browse/icons/term/application/
IoT Architecture layers: https://www.startertutorials.com/blog/iot-architecture-layers.html

localhost

Sources:
Medium: https://medium.com/devgorilla/exploring-localhost-and-127-0-0-1-what-is-the-difference-c109ffce7f29
jocalhost: https://todaybestreports.com/127-0-0-162893-localhost-port-usage-explain/
IP address :https://www.geeksforgeeks.org/what-is-local-host/
https://www.geeksforgeeks.org/open-systems-interconnection-model-osi/
https://www.avast.com/c-what-is-an-ip-address#:~:text=An%20IP%20address%20has%20two,number%20is%20the%20host%20ID.

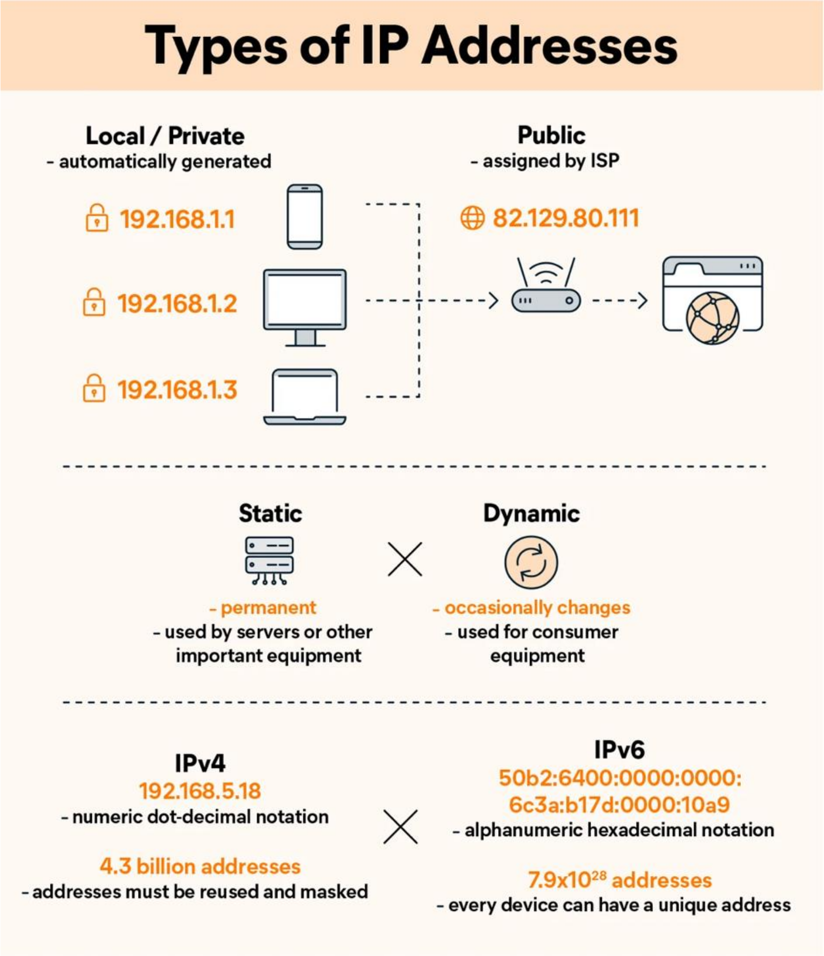
What is an IP address ?

An **IP address** is a unique number that identifies a device on the internet or a local network.

- **A home address** but for computers, helping them find and communicate with each other.
- **A numerical label** assigned to the devices that are connected to the networks, based on the Internet Protocol.

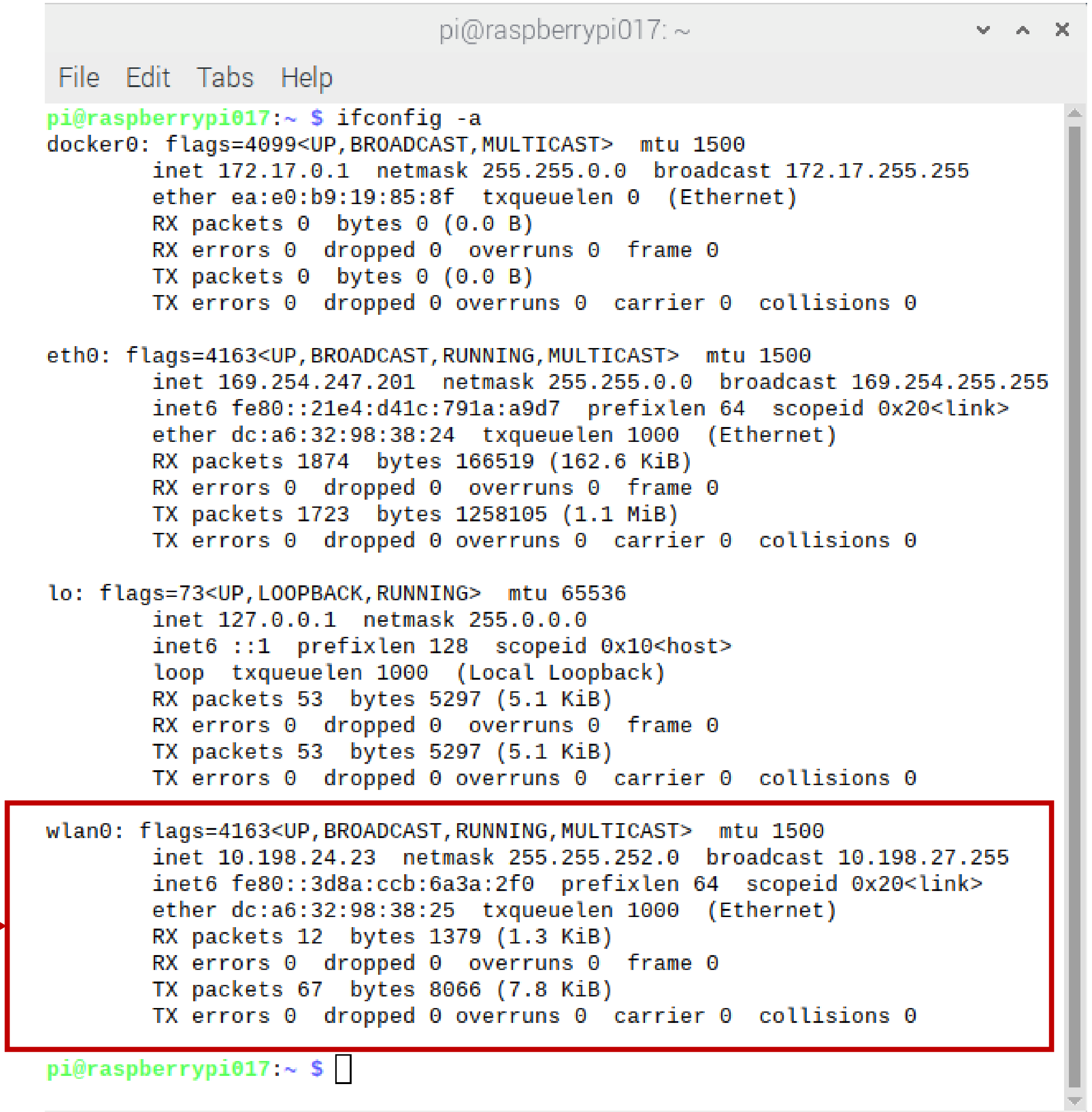
IP addresses come in two versions:

- **IPv4** consists of a string of four 32-bit characters separated by a dot, like **192.168.0.1**; a series of four numbers, ranging from 0 (except the first one) to 255, each separated from the next by a period
- **IPv6** addresses are represented as eight groups of four hexadecimal digits, with the groups separated by colons. A typical IPv6 address might look like this: **2620:0aba2:0d01:2042:0100:8c4d:d370:72b4.**


Types of IP Addresses
Local / Private
- automatically generated
192.168.1.1
192.168.1.2
192.168.1.3
Public
- assigned by ISP
82.129.80.111
Static
- permanent
- used by servers or other important equipment
Dynamic
- occasionally changes
- used for consumer equipment
IPv4
192.168.5.18
- numeric dot-decimal notation
4.3 billion addresses
- addresses must be reused and masked
IPv6
50b2:6400:0000:0000:6c3a:b17d:0000:10a9
- alphanumeric hexadecimal notation
7.9x10^28 addresses
- every device can have a unique address

IP address of your RPi connected to the GWdevice network using WiFi

ifconfig -a



```
pi@raspberrypi017:~ $ ifconfig -a
docker0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        inet 172.17.0.1  netmask 255.255.0.0  broadcast 172.17.255.255
        ether ea:e0:b9:19:85:8f  txqueuelen 0  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 169.254.247.201  netmask 255.255.0.0  broadcast 169.254.255.255
        inet6 fe80::21e4:d41c:791a:a9d7  prefixlen 64  scopeid 0x20<link>
        ether dc:a6:32:98:38:24  txqueuelen 1000  (Ethernet)
        RX packets 1874  bytes 166519 (162.6 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1723  bytes 1258105 (1.1 MiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 53  bytes 5297 (5.1 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 53  bytes 5297 (5.1 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.198.24.23  netmask 255.255.252.0  broadcast 10.198.27.255
        inet6 fe80::3d8a:ccb:6a3a:2f0  prefixlen 64  scopeid 0x20<link>
        ether dc:a6:32:98:38:25  txqueuelen 1000  (Ethernet)
        RX packets 12  bytes 1379 (1.3 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 67  bytes 8066 (7.8 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

pi@raspberrypi017:~ $ 
```

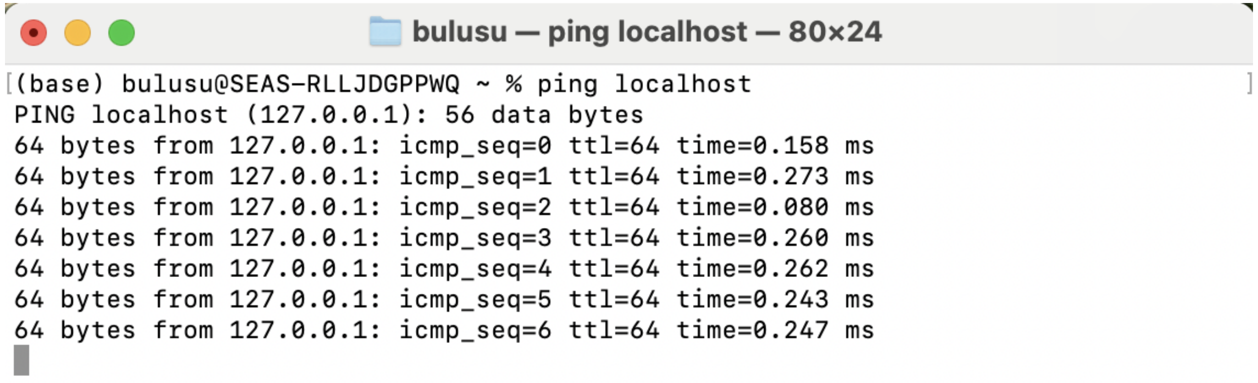
Understanding 127.0.0.1:

The localhost Address

Sources:
Medium: https://medium.com/devgorilla/exploring-localhost-and-127-0-0-1-what-is-the-difference-c109ffce7f29
jocalhost: https://todaybestreports.com/127-0-0-162893-localhost-port-usage-explain/
IP address :https://www.geeksforgeeks.org/what-is-local-host/

The IP address 127.0.0.1 is commonly known as **localhost**.

- It is a special IP address used by a computer to refer to itself.
- Instead of connecting to an external network or the internet, this address is used for loopback communication within the same machine.



```
(base) bulusu@SEAS-RLLJDGPPWQ ~ % ping localhost
PING localhost (127.0.0.1): 56 data bytes
64 bytes from 127.0.0.1: icmp_seq=0 ttl=64 time=0.158 ms
64 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.273 ms
64 bytes from 127.0.0.1: icmp_seq=2 ttl=64 time=0.080 ms
64 bytes from 127.0.0.1: icmp_seq=3 ttl=64 time=0.260 ms
64 bytes from 127.0.0.1: icmp_seq=4 ttl=64 time=0.262 ms
64 bytes from 127.0.0.1: icmp_seq=5 ttl=64 time=0.243 ms
64 bytes from 127.0.0.1: icmp_seq=6 ttl=64 time=0.247 ms
```

On your web browser:
http://localhost
or
http://127.0.0.1

Network Configuration:
A server or program that you are running locally will frequently give you instructions on how to access it via localhost, along with the necessary ports and extra paths.

When you access 127.0.0.1, you're telling your machine to communicate internally rather than looking for an external IP address.

Why do we need a localhost?

Purpose:

The primary purpose of **localhost** is to enable developers

- **To run services locally** for testing without exposing the application to the wider network and
- **To facilitate debugging**, testing web applications, and running local servers.

Universality:

127.0.0.1 is configured as the **localhost** address across all systems.

Loopback Address:

The 127.0.0.1 address belongs to the **loopback network**, a reserved IP range used for network diagnostics and testing purposes.

- It allows the machine to send and receive data packets to itself without going through the network interface.

Development Servers

Flask web development, one drop at a time

node JS

RAILS

Database Connections

MySQL

MongoDB

API testing

Browser Debugging

Application Logs

Sources:

Medium: https://medium.com/devgorilla/exploring-localhost-and-127-0-0-1-what-is-the-difference-c109ffce7f29

jocalhost: https://todaybestreports.com/127-0-0-162893-localhost-port-usage-explain/

IP address :https://www.geeksforgeeks.org/what-is-local-host/

NodeJs: By Ryan Dahl, MIT, https://commons.wikimedia.org/w/index.php?curid=26936716

PostgreSQL: By Daniel Lundin - https://wiki.postgresql.org/images/a/a4/PostgreSQL_logo.3colors.svg

By Vectorised from https://labs.mysql.com/common/logos/mysql-logo.svg, Fair use, https://en.wikipedia.org/w/index.php?curid=67634535

By Jamie Dihiansan http://weblog.rubyonrails.org/2016/1/19/new-rails-identity/2 - http://rubyonrails.org/, CC0, https://commons.wikimedia.org/w/index.php?curid=55052527

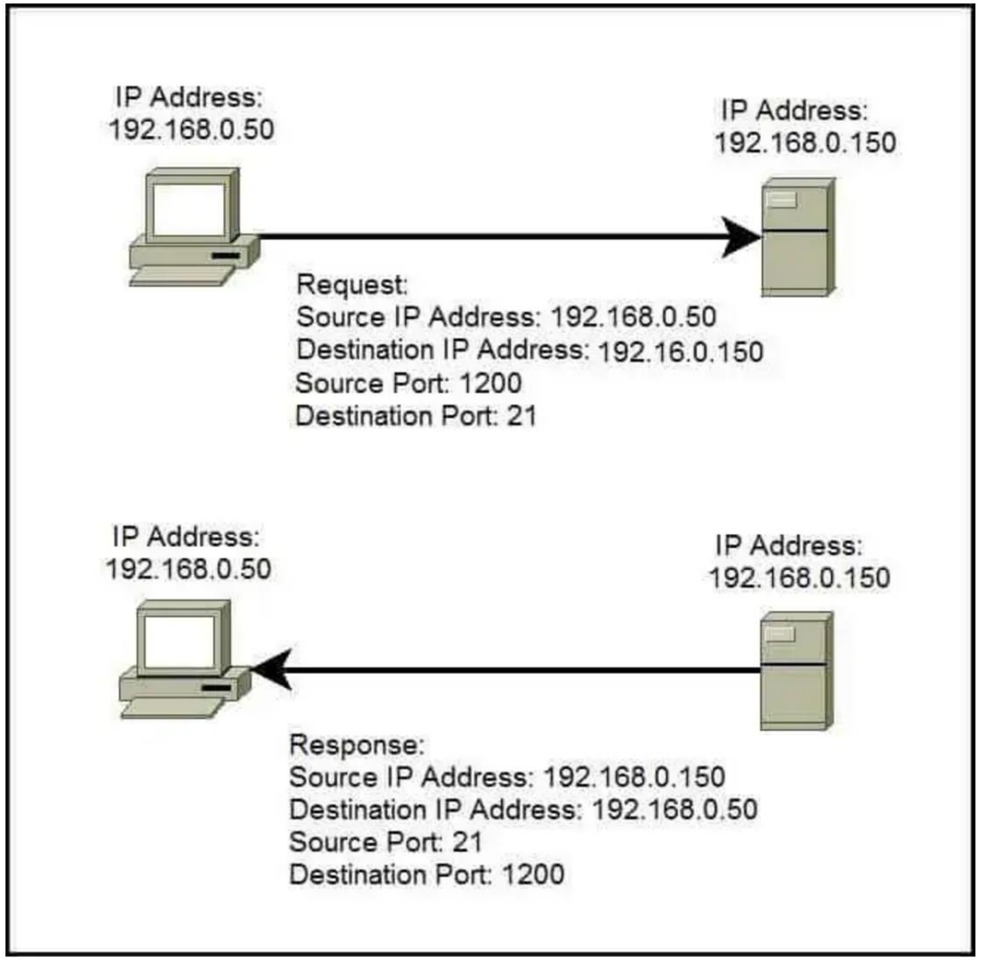
By The logo is from the following website: www.mongodb.com/brand-resources, Fair use, https://en.wikipedia.org/w/index.php?curid=74919610

What is a port in network communication ?

Sources:
Medium: https://medium.com/devgorilla/exploring-localhost-and-127-0-0-1-what-is-the-difference-c109ffce7f29
jocalhost: https://todaybestreports.com/127-0-0-162893-localhost-port-usage-explain/
IP address :https://www.geeksforgeeks.org/what-is-local-host/
https://study-ccna.com/ports-explained/

Definition:
A **port** is a communication endpoint used by software applications to send and receive data over a network.

- Ports serve as endpoints for communication, allowing multiple network applications to coexist on a single device.
- Ports are identified by numbers, ranging from 0 to 65535.



Request:
Source IP Address: 192.168.0.50
Destination IP Address: 192.16.0.150
Source Port: 1200
Destination Port: 21

Response:
Source IP Address: 192.168.0.150
Destination IP Address: 192.168.0.50
Source Port: 21
Destination Port: 1200

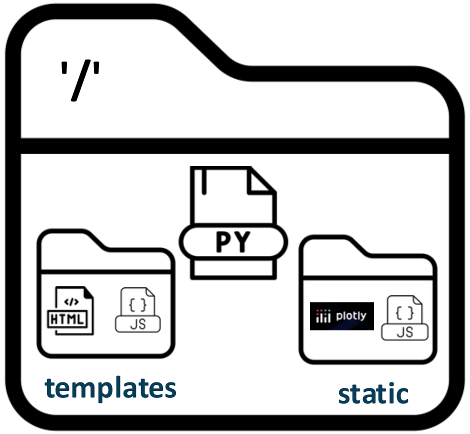
Usage:
Different applications use different ports.

- For example, web servers typically use **port 80** for **HTTP** traffic and **port 443** for **HTTPS**.
- In the case of **127.0.0.1:62893**, the number **62893** is likely dynamically assigned by the operating system for a temporary service or local development task.

Sources:
https://plotly.com
API by Vectors Point from https://thenounproject.com/browse/icons/term/api/
json by ME from https://thenounproject.com/browse/icons/term/json/
javascript file by SAM Designs from https://thenounproject.com/browse/icons/term/javascript-file/
html by tezar tantular from https://thenounproject.com/browse/icons/term/html/
Folder by Colourcreatype from https://thenounproject.com/browse/icons/term/folder/

Graded homework due on February 26, 2025

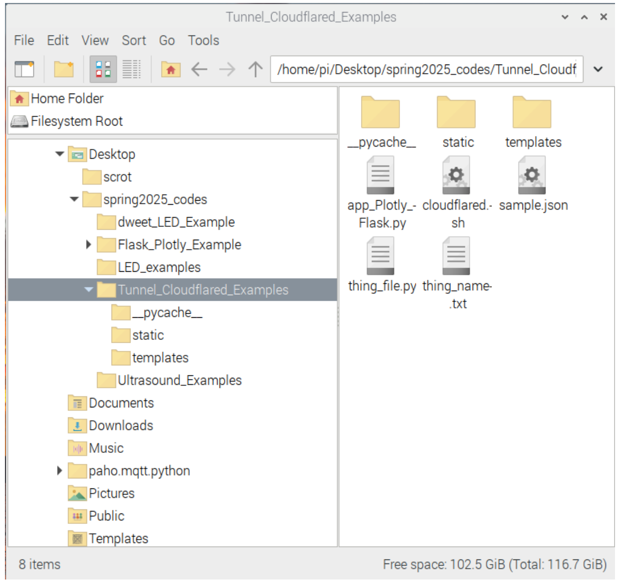
1. Live stream data from your Raspberry Pi 4B
2. Upload your unique *thing_name.txt* associated with your IoT device



Create a localhost webserver using Flask

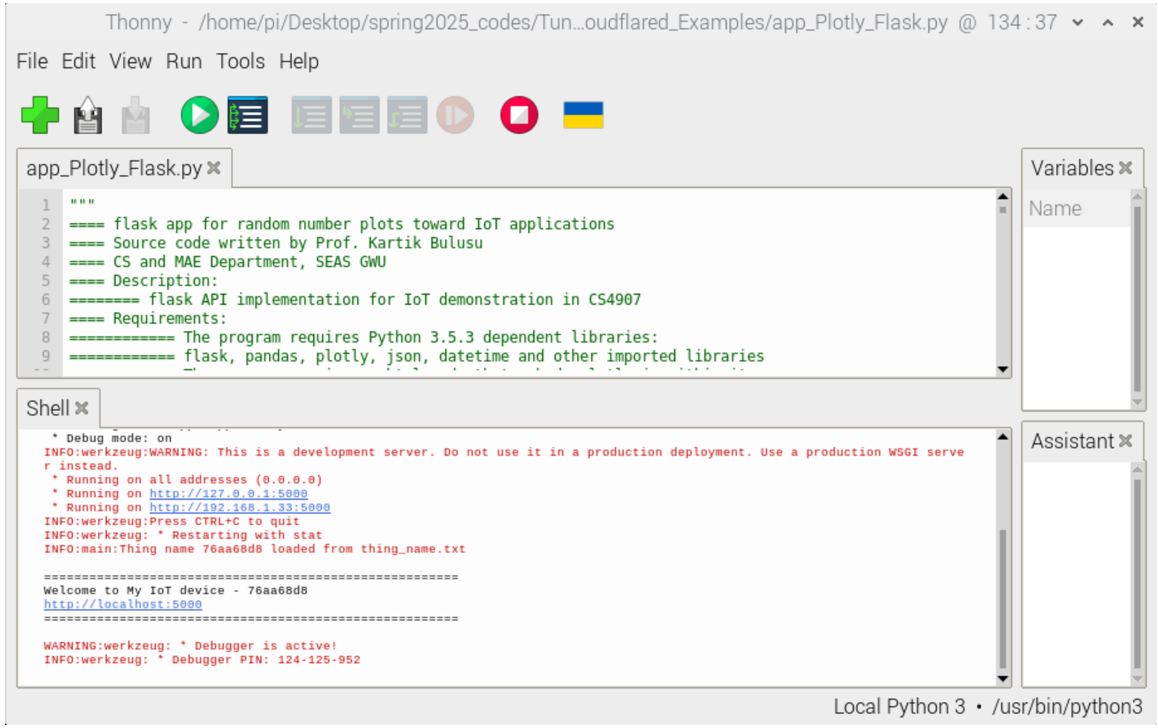
Step-0: git clone https://github.com/gwu-mae6291-iot/spring2025_codes.git

Step-1: Navigate to **Tunnel_Cloudflare_Examples** folder and run the python program **app_Plotly_Flask.py**



Step-2:

Click on http://localhost:5000 to observe your data


Thonny - /home/pi/Desktop/spring2025_codes/Tun...oudflared_Examples/app_Plotly_Flask.py @ 134 : 37
File Edit View Run Tools Help
app_Plotly_Flask.py
Variables
Name
Shell
Assistant
Local Python 3 • /usr/bin/python3

```
"""
==== flask app for random number plots toward IoT applications
==== Source code written by Prof. Kartik Bulusu
==== CS and MAE Department, SEAS GWU
==== Description:
======== flask API implementation for IoT demonstration in CS4907
==== Requirements:
============ The program requires Python 3.5.3 dependent libraries:
============ flask, pandas, plotly, json, datetime and other imported libraries
```

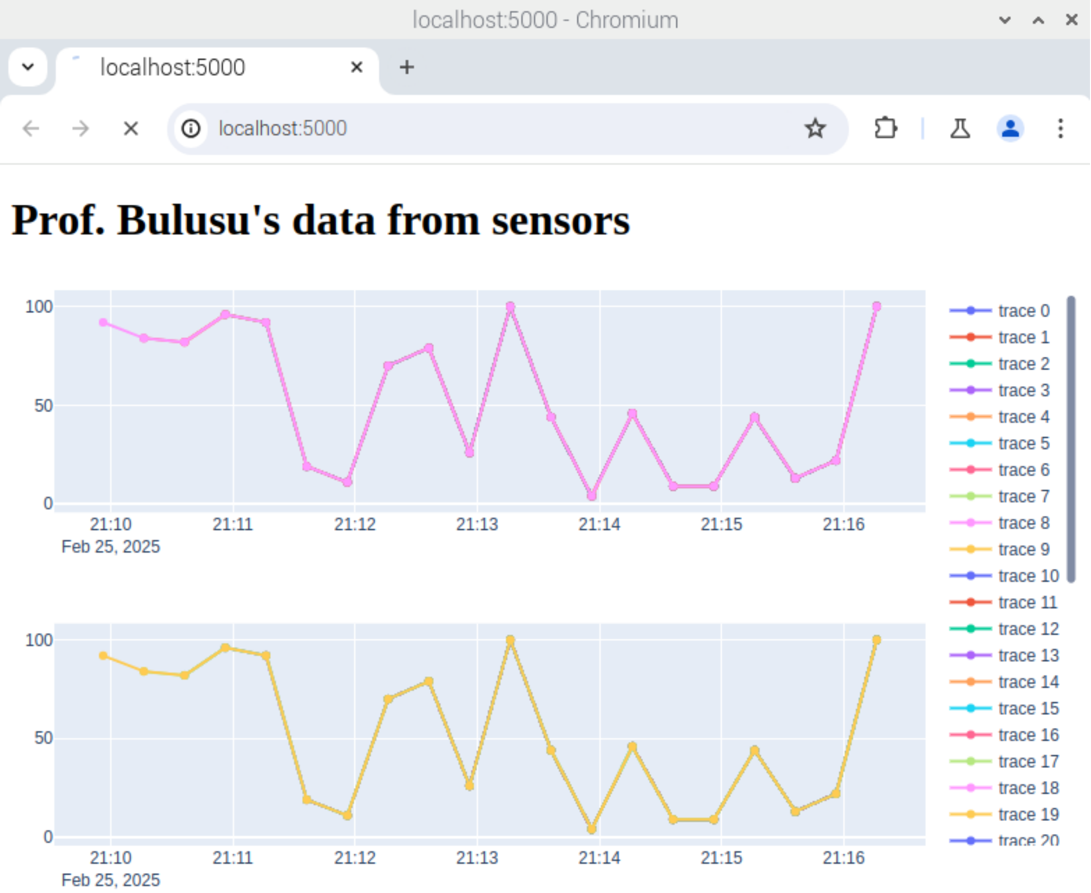
```
 * Debug mode: on
INFO:werkzeug:WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI serve
r instead.
 * Running on all addresses (0.0.0.0)
 * Running on http://127.0.0.1:5000
 * Running on http://192.168.1.33:5000
INFO:werkzeug:Press CTRL+C to quit
INFO:werkzeug: * Restarting with stat
INFO:main:Thing name 76aa68d8 loaded from thing_name.txt

=======================================================
Welcome to My IoT device - 76aa68d8
http://localhost:5000
=======================================================

WARNING:werkzeug: * Debugger is active!
INFO:werkzeug: * Debugger PIN: 124-125-952
```

Your output on http://localhost:5000

From Step-2:

The data you should see will look like the image presented here.

- Can you identity the port used in this python program ?
- Is it a default port ?
- Can you change it ?



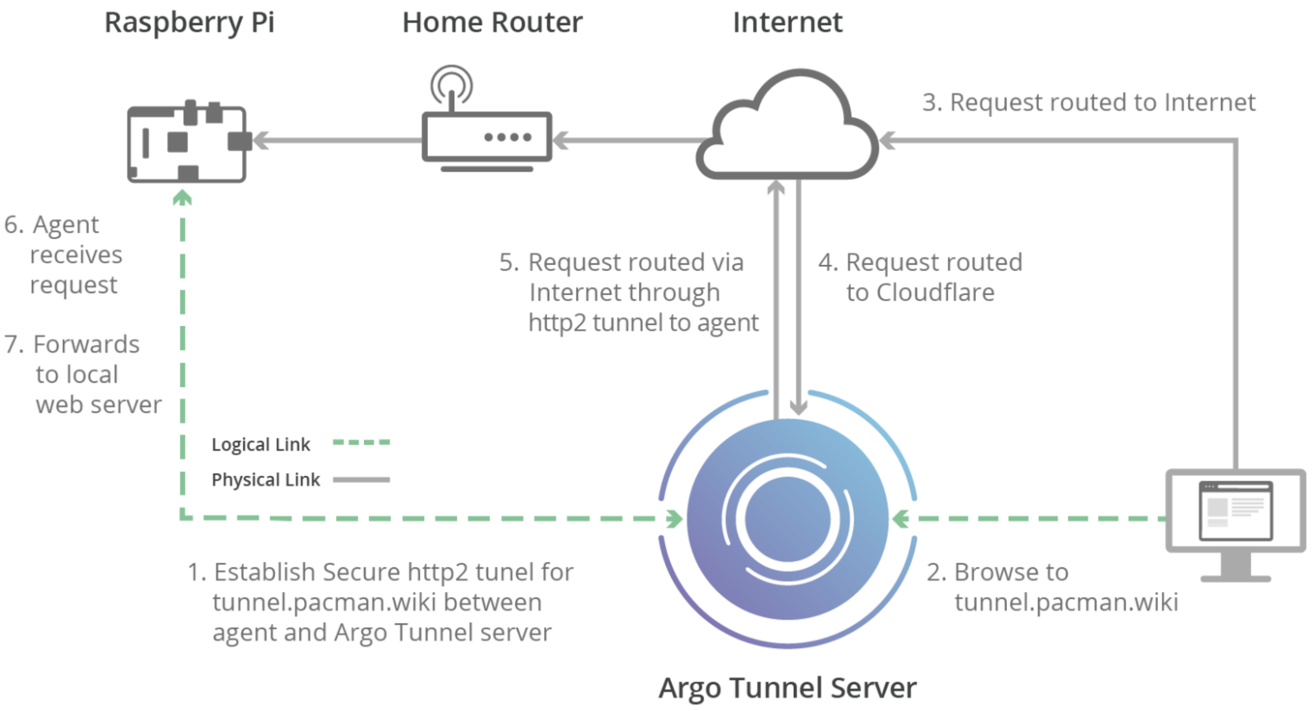
Prof. Bulusu's data from sensors

Expose the localhost by creating a tunnel: Cloudflare

Localhost tunnels

A localhost tunnel establishes a connection between your local machine and a remote connection.

- The connection is intended to proxy traffic from a publicly-addressable IP address and URL to your local machine.
- Localhost tunnels are most useful for allowing a tester to connect to a server running on your local development system so they can try out an in-development application you are building but have not yet deployed.



Raspberry Pi
Home Router
Internet
3. Request routed to Internet
6. Agent receives request
7. Forwards to local web server
5. Request routed via Internet through http2 tunnel to agent
4. Request routed to Cloudflare
Logical Link
Physical Link
1. Establish Secure http2 tunel for tunnel.pacman.wiki between agent and Argo Tunnel server
2. Browse to tunnel.pacman.wiki
Argo Tunnel Server

Sources:
https://www.fullstackpython.com/localhost-tunnels.html
https://dev.to/omarcloud20/a-free-cloudflare-tunnel-running-on-a-raspberry-pi-1jid
https://blog.cloudflare.com/cloudflare-argo-tunnel-with-rust-and-raspberry-pi/

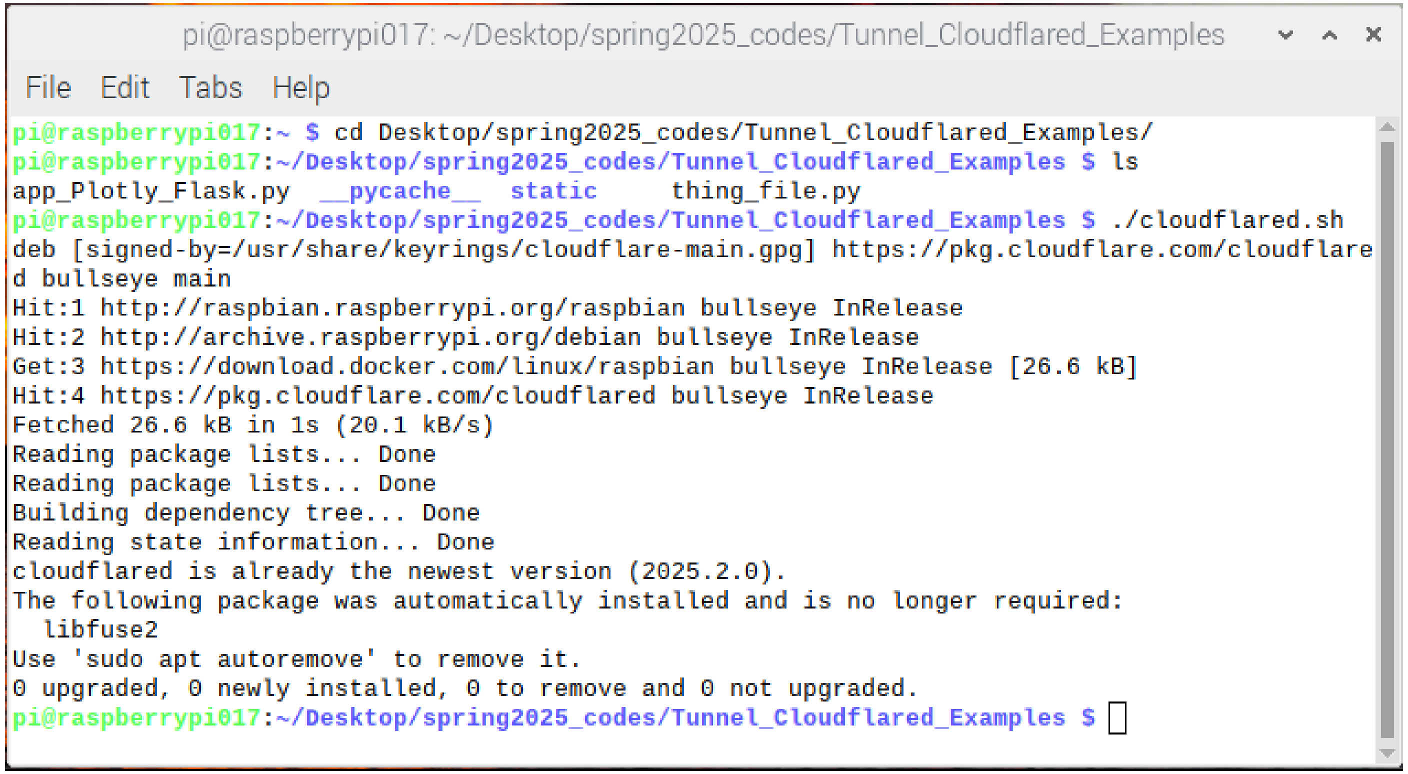
Install Cloudflare client on your Raspberry Pi

Step-3:

Make sure you are connected to a network (GWdevice or other)

Step-4:

Run the bash-script **cloudflared.sh** provided to you


pi@raspberrypi017: ~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples
File Edit Tabs Help

```
pi@raspberrypi017:~ $ cd Desktop/spring2025_codes/Tunnel_Cloudflared_Examples/
pi@raspberrypi017:~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples $ ls
app_Plotly_Flask.py  __pycache__  static     thing_file.py
pi@raspberrypi017:~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples $ ./cloudflared.sh
deb [signed-by=/usr/share/keyrings/cloudflare-main.gpg] https://pkg.cloudflare.com/cloudflare
d bullseye main
Hit:1 http://raspbian.raspberrypi.org/raspbian bullseye InRelease
Hit:2 http://archive.raspberrypi.org/debian bullseye InRelease
Get:3 https://download.docker.com/linux/raspbian bullseye InRelease [26.6 kB]
Hit:4 https://pkg.cloudflare.com/cloudflared bullseye InRelease
Fetched 26.6 kB in 1s (20.1 kB/s)
Reading package lists... Done
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
cloudflared is already the newest version (2025.2.0).
The following package was automatically installed and is no longer required:
  libfuse2
Use 'sudo apt autoremove' to remove it.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
pi@raspberrypi017:~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples $ 
```

Check Cloudflare client version and Run the Flask Program

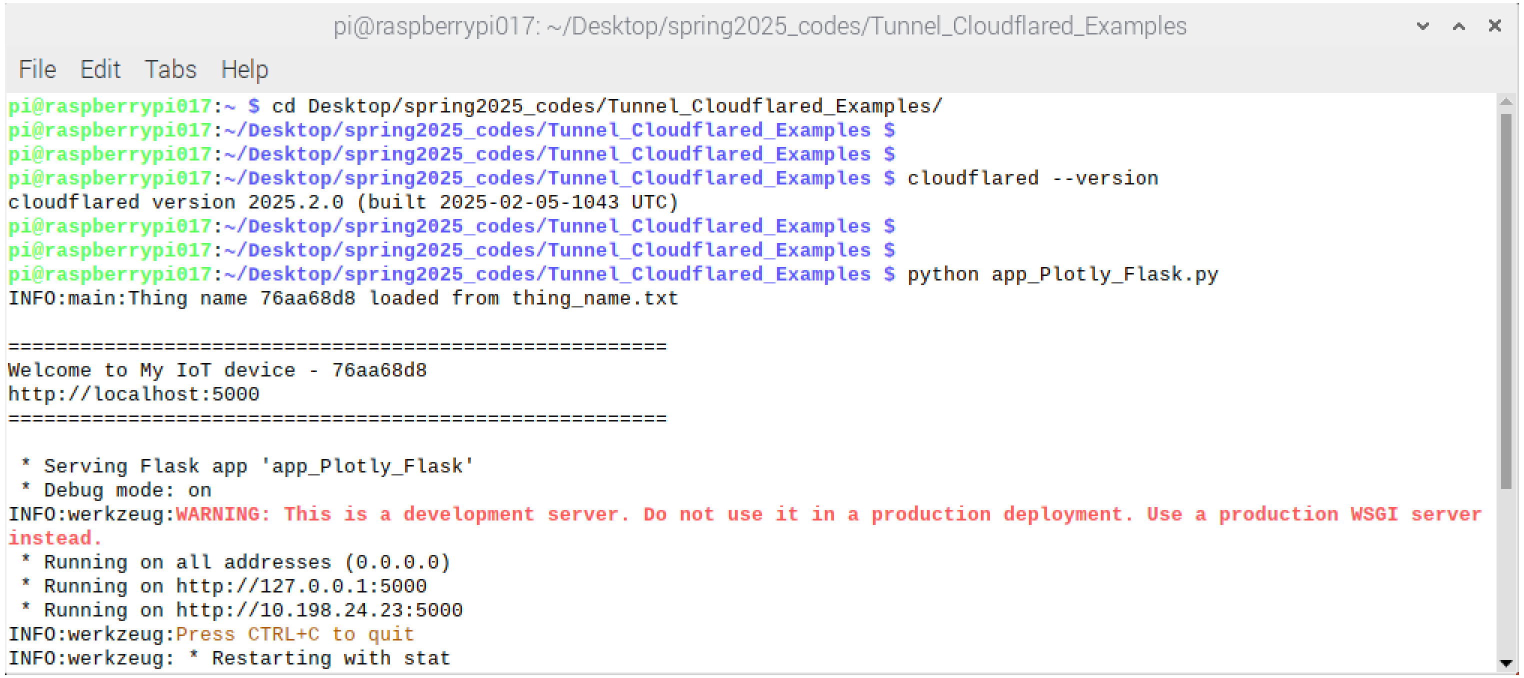
Step-5:

Check **cloudflare** version on your Raspberry Pi

Step-6:

Run app_Plotly_Flask.py

The data will be displayed as seen in Step-2 on http://localhost:5000


pi@raspberrypi017: ~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples
File
Edit
Tabs
Help

```
pi@raspberrypi017:~ $ cd Desktop/spring2025_codes/Tunnel_Cloudflared_Examples/
pi@raspberrypi017:~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples $
pi@raspberrypi017:~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples $
pi@raspberrypi017:~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples $ cloudflared --version
cloudflared version 2025.2.0 (built 2025-02-05-1043 UTC)
pi@raspberrypi017:~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples $
pi@raspberrypi017:~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples $
pi@raspberrypi017:~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples $ python app_Plotly_Flask.py
INFO:main:Thing name 76aa68d8 loaded from thing_name.txt

=======================================================
Welcome to My IoT device - 76aa68d8
http://localhost:5000
=======================================================

 * Serving Flask app 'app_Plotly_Flask'
 * Debug mode: on
INFO:werkzeug:WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server
instead.
 * Running on all addresses (0.0.0.0)
 * Running on http://127.0.0.1:5000
 * Running on http://10.198.24.23:5000
INFO:werkzeug:Press CTRL+C to quit
INFO:werkzeug: * Restarting with stat
```

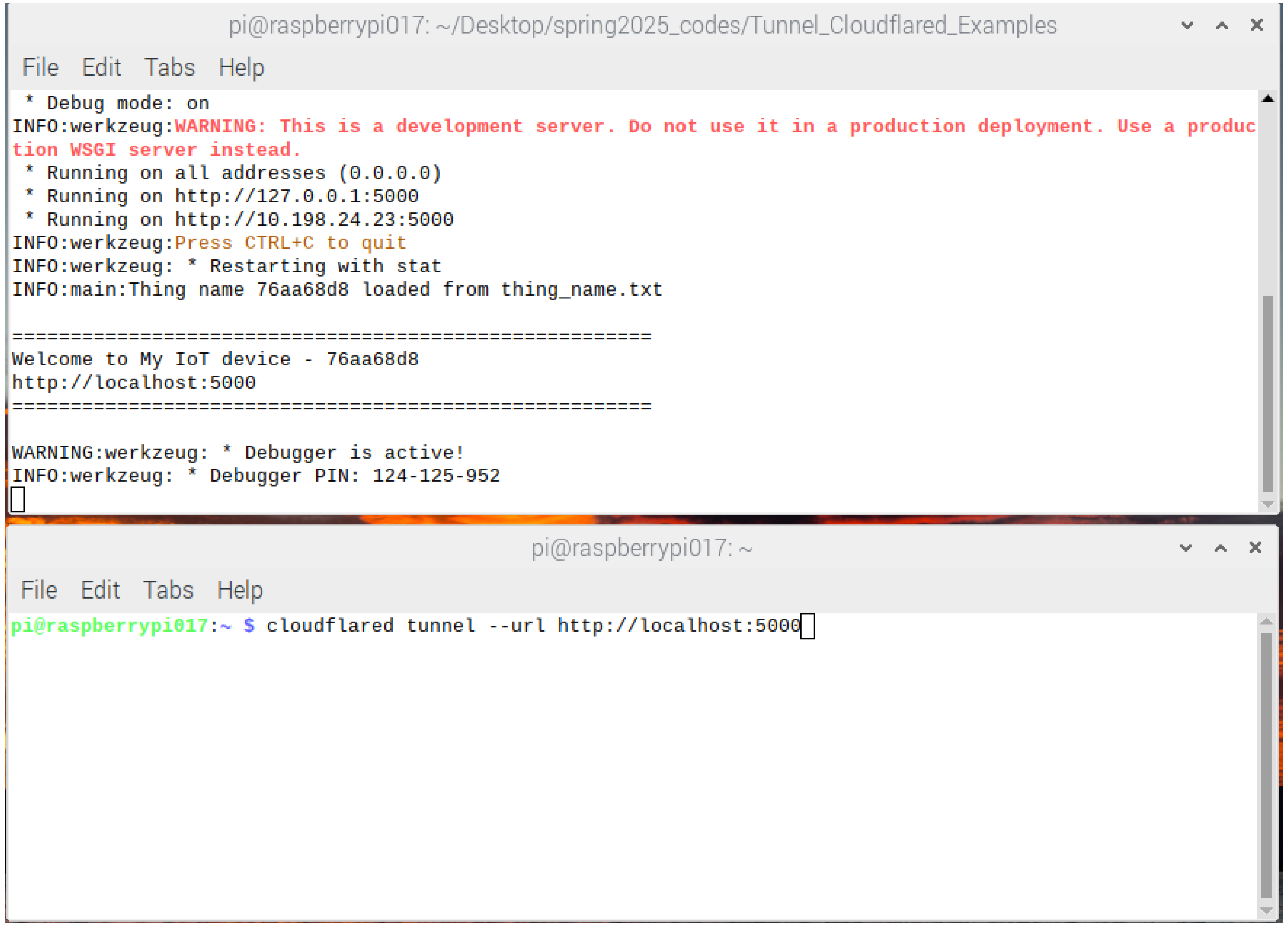
Create a localhost Cloudflare tunnel

Step-7:

Open a new Terminal

Step-8:

Create a cloudflared tunnel as shown


pi@raspberrypi017: ~/Desktop/spring2025_codes/Tunnel_Cloudflared_Examples
File Edit Tabs Help

```
 * Debug mode: on
INFO:werkzeug:WARNING: This is a development server. Do not use it in a production deployment. Use a produc
tion WSGI server instead.
 * Running on all addresses (0.0.0.0)
 * Running on http://127.0.0.1:5000
 * Running on http://10.198.24.23:5000
INFO:werkzeug:Press CTRL+C to quit
INFO:werkzeug: * Restarting with stat
INFO:main:Thing name 76aa68d8 loaded from thing_name.txt

=======================================================
Welcome to My IoT device - 76aa68d8
http://localhost:5000
=======================================================

WARNING:werkzeug: * Debugger is active!
INFO:werkzeug: * Debugger PIN: 124-125-952
```

```
pi@raspberrypi017:~ $ cloudflared tunnel --url http://localhost:5000
```

You successfully exposed your localhost using a tunnel

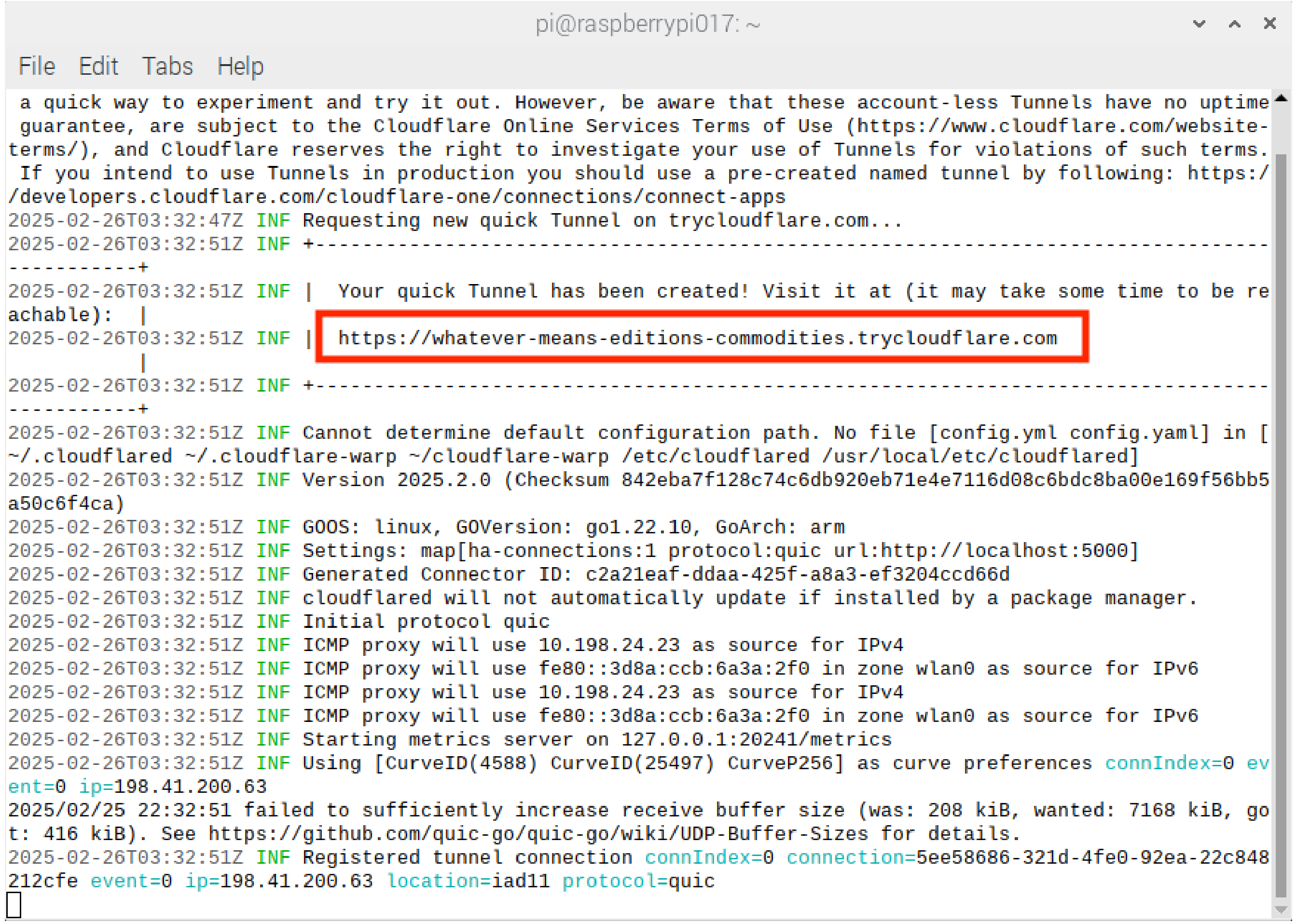
Step-8:

Look for the funny looking URL on your terminal

Done:

Your **localhost is now live using a cloudflared tunnel.**

Type in your URL on your phones or other media to see the data from the localhost.



```
 a quick way to experiment and try it out. However, be aware that these account-less Tunnels have no uptime
 guarantee, are subject to the Cloudflare Online Services Terms of Use (https://www.cloudflare.com/website-
terms/), and Cloudflare reserves the right to investigate your use of Tunnels for violations of such terms.
 If you intend to use Tunnels in production you should use a pre-created named tunnel by following: https:/
/developers.cloudflare.com/cloudflare-one/connections/connect-apps
2025-02-26T03:32:47Z INF Requesting new quick Tunnel on trycloudflare.com...
2025-02-26T03:32:51Z INF +--------------------------------------------------------------------------------
-----------+
2025-02-26T03:32:51Z INF |  Your quick Tunnel has been created! Visit it at (it may take some time to be re
achable):  |
2025-02-26T03:32:51Z INF |  https://whatever-means-editions-commodities.trycloudflare.com
           |
2025-02-26T03:32:51Z INF +--------------------------------------------------------------------------------
-----------+
2025-02-26T03:32:51Z INF Cannot determine default configuration path. No file [config.yml config.yaml] in [
~/.cloudflared ~/.cloudflare-warp ~/cloudflare-warp /etc/cloudflared /usr/local/etc/cloudflared]
2025-02-26T03:32:51Z INF Version 2025.2.0 (Checksum 842eba7f128c74c6db920eb71e4e7116d08c6bdc8ba00e169f56bb5
a50c6f4ca)
2025-02-26T03:32:51Z INF GOOS: linux, GOVersion: go1.22.10, GoArch: arm
2025-02-26T03:32:51Z INF Settings: map[ha-connections:1 protocol:quic url:http://localhost:5000]
2025-02-26T03:32:51Z INF Generated Connector ID: c2a21eaf-ddaa-425f-a8a3-ef3204ccd66d
2025-02-26T03:32:51Z INF cloudflared will not automatically update if installed by a package manager.
2025-02-26T03:32:51Z INF Initial protocol quic
2025-02-26T03:32:51Z INF ICMP proxy will use 10.198.24.23 as source for IPv4
2025-02-26T03:32:51Z INF ICMP proxy will use fe80::3d8a:ccb:6a3a:2f0 in zone wlan0 as source for IPv6
2025-02-26T03:32:51Z INF ICMP proxy will use 10.198.24.23 as source for IPv4
2025-02-26T03:32:51Z INF ICMP proxy will use fe80::3d8a:ccb:6a3a:2f0 in zone wlan0 as source for IPv6
2025-02-26T03:32:51Z INF Starting metrics server on 127.0.0.1:20241/metrics
2025-02-26T03:32:51Z INF Using [CurveID(4588) CurveID(25497) CurveP256] as curve preferences connIndex=0 ev
ent=0 ip=198.41.200.63
2025/02/25 22:32:51 failed to sufficiently increase receive buffer size (was: 208 kiB, wanted: 7168 kiB, go
t: 416 kiB). See https://github.com/quic-go/quic-go/wiki/UDP-Buffer-Sizes for details.
2025-02-26T03:32:51Z INF Registered tunnel connection connIndex=0 connection=5ee58686-321d-4fe0-92ea-22c848
212cfe event=0 ip=198.41.200.63 location=iad11 protocol=quic
```

Photo: Kartik Bulusu

Someone should summarize what we learned today