Developing WiFi IoT ESP8266-Arduino Based Devices

DAY 1 : ESP8266 Introduction: WiFi Hello World

Webinar Logistics

- Turn on your system sound to hear the streaming presentation.

- If you have technical problems, click "Help" or submit a question asking for assistance.

- Participate in 'Attendee Chat' by maximizing the chat widget in your dock.
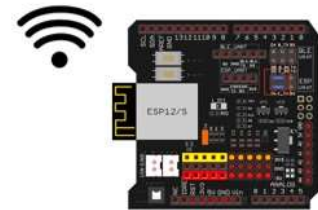
Don Wilcher

Visit 'Lecturer Profile' in your console for more details.

Course Kit:
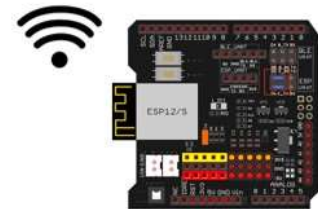### Osoyoo ESP8266 Arduino IoT Kit

Agenda:

- IoT Research Perspectives
- What is the ESP8266 microcontroller?
- Developing an IoT Prototyping Concepts Lab
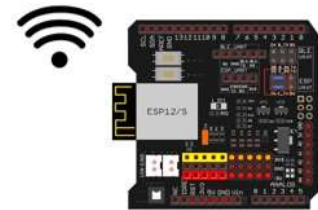- Osoyoo ESP8266 Arduino Kit Overview
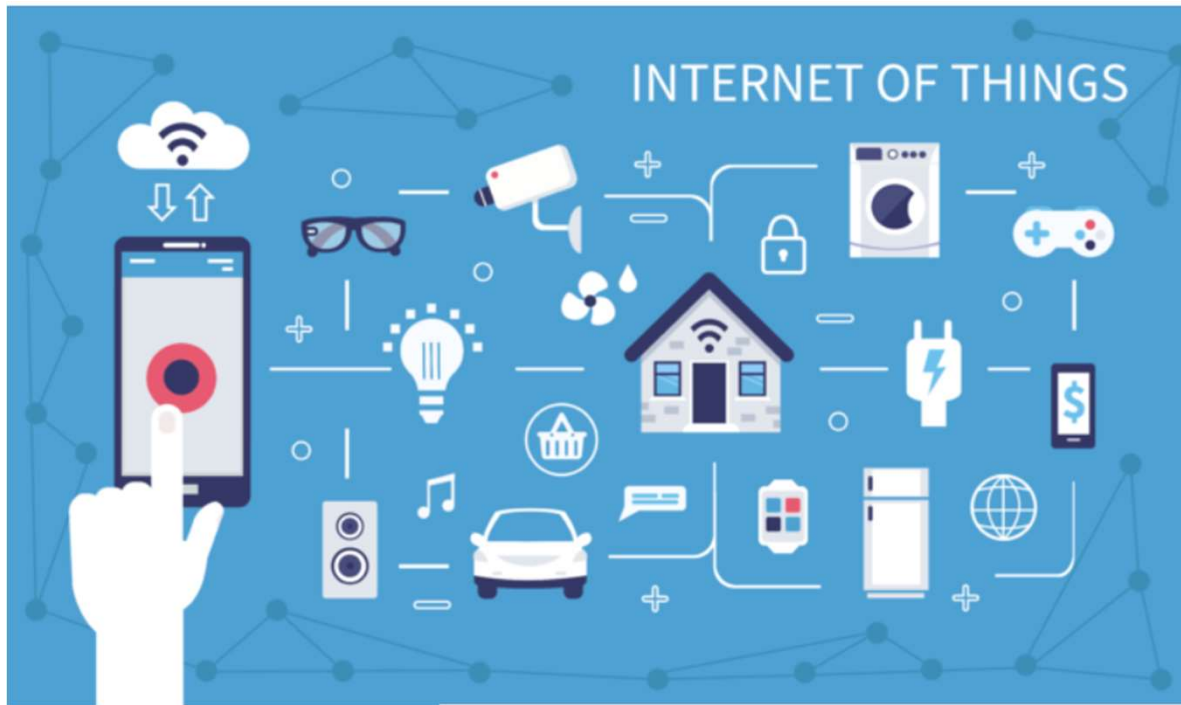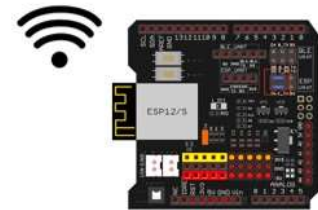- Lab: WiFi Marquee - Hello World

Internet of Things :

" The Internet of Things (IoT) is a concept in which the virtual world of information technology integrates seamlessly with the real world of thing." (Uckelman, Harnson & Michahelles, 2011, p.2).

IoT Research Perspectives

- Today, the IoT is a foundation for
  - a) connecting things like
    - i. sensors
    - ii. actuators
    - iii. other smart technologies
  - b) enabling person to object –to-object communications
- The IoT will bridge the gap between information and objects
- Currently, the IoT is all about information visibility.
- The advantages of the IoT are obvious.
  - a) Improve data communication efficiency
  - b) Data communication effectiveness
  - c) New business opportunities maybe achieved.

Source: Uckelman, D.,Harnson, M., & Michahelles, F (Eds). (2011). *Architecting the internet of things*. Springer.

IoT Research Perspectives

Source: Partida, D. (2022, January 31). *8. top internet of things (iot) certifications*. https://www.datamation.com/careers/iot-certifications/
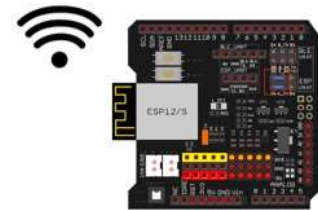
Question 1

Currently, the IoT is all about information
   a) visibility
   b) invisibility
   c) connectivity

9

IoT Research Perspectives...

Learning and instructing thoughts
- Technologies, technology knowledge, and personal experiences must be included when teaching IoT to learners (Willner-Giwerc, Rogers, & Wendell, 2020).
- The IoT instructional material must be created to allow interaction between the learners and their created system (Willner-Giwerc, Rogers, & Wendell, 2020).

Source: Willner-Giwerc, S., Rogers, C., & Wendell, K. (2020).The symbiotics system: Designing an internet of things platform for elementary school students. *International Journal of Designs for Learning ,11*(2), 64-79. https//doi.org/10.14434/ijdl.v11i2.26719

What is the ESP8266 microcontroller?

ESP8266 is a
- WiFi system on chip (SoC) microcontroller.
- Tensilica L106 Diamond 32bit microprocessor-based microcontroller.
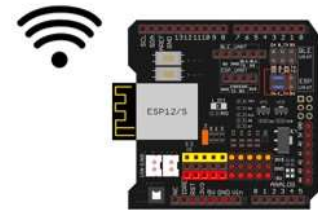
Manufactured by Expressif:
ESP8266 module

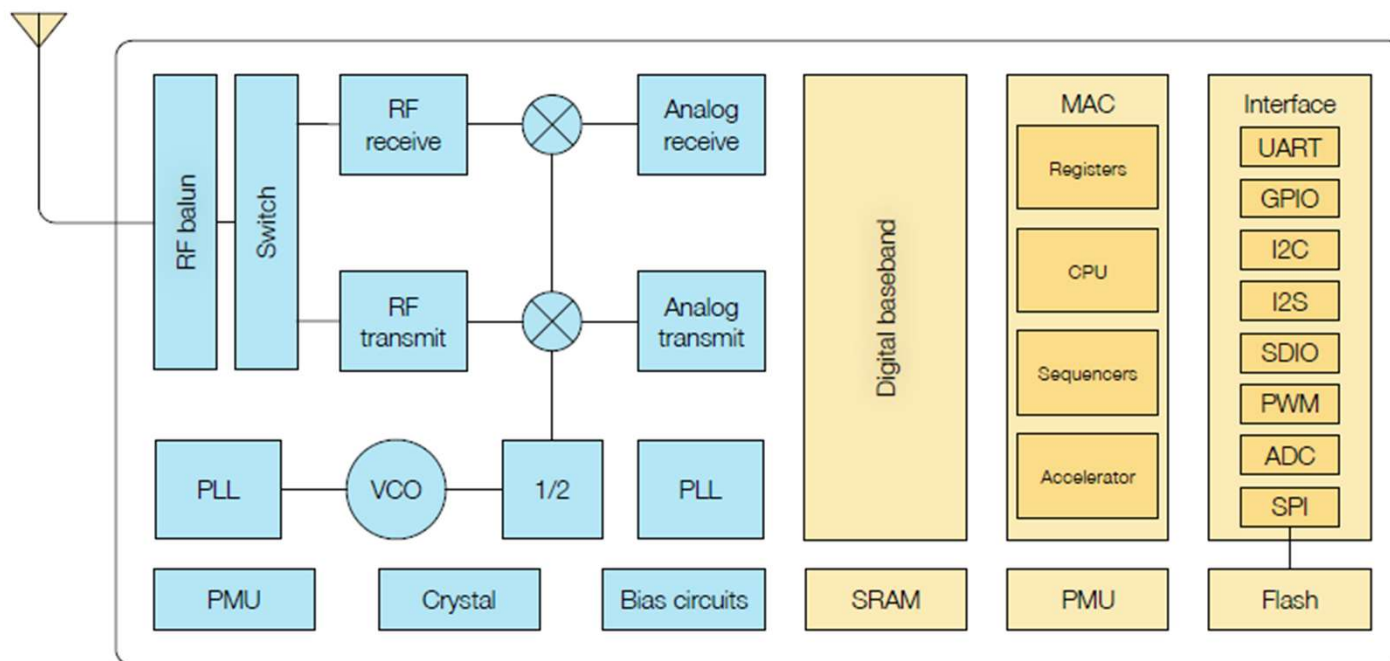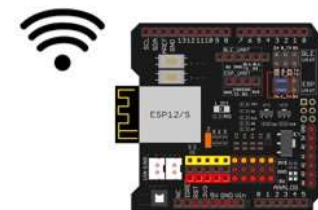Image Source: ESP8266 Hardware Design Guidelines (www.expressif.com)

11

Question 2

SoC is the abbreviation for
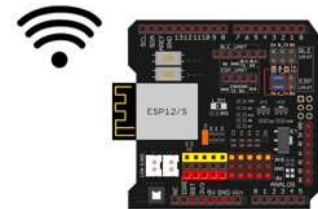**a) System on Communication**
b) System on Chips
c) System on Chip

What is the ESP8266 microcontroller? . . .

Note:
MAC(media or medium access control) sublayer is the layer that controls the hardware responsible for interaction with the wired, optical or wireless transmission medium.

ESP8266 Block Diagram

What is the ESP8266 microcontroller? . . .

MAC

Registers

CPU

← Tensilica L106 Diamond
32bit microprocessor

Sequencers

Accelerator

PMU

14

What is the ESP8266 microcontroller? . . .

ESP8266 Core Circuit
Schematic Diagram
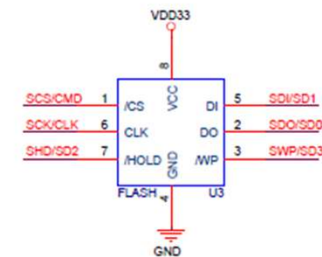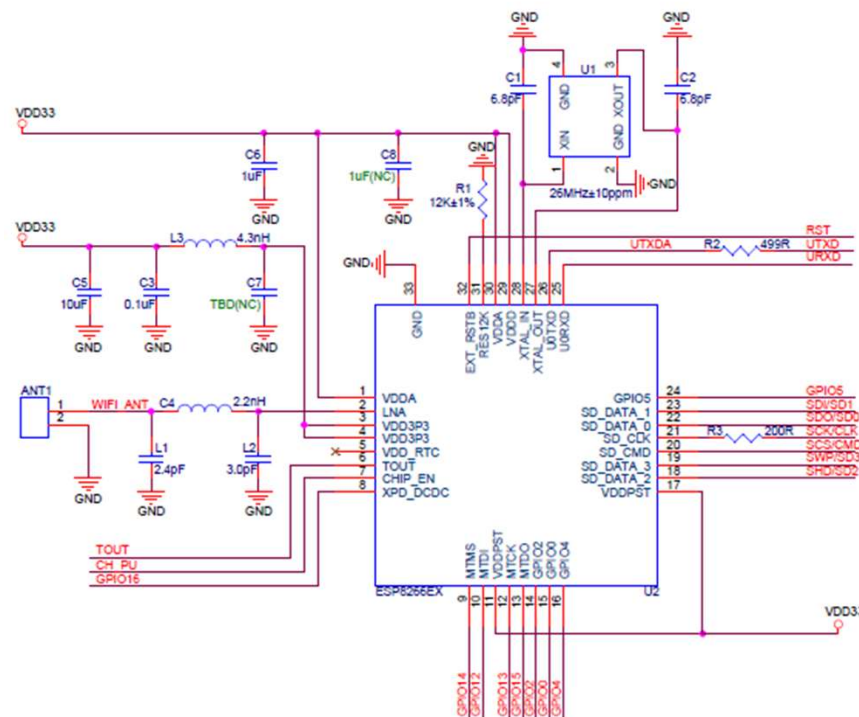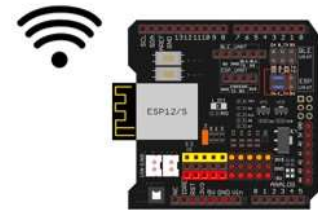
Question 3

In reviewing the ESP8266 microcontroller circuit schematic diagram on slide 15, what is the operating frequency for the crystal?
  a) 35MHz
  b) 50MHz
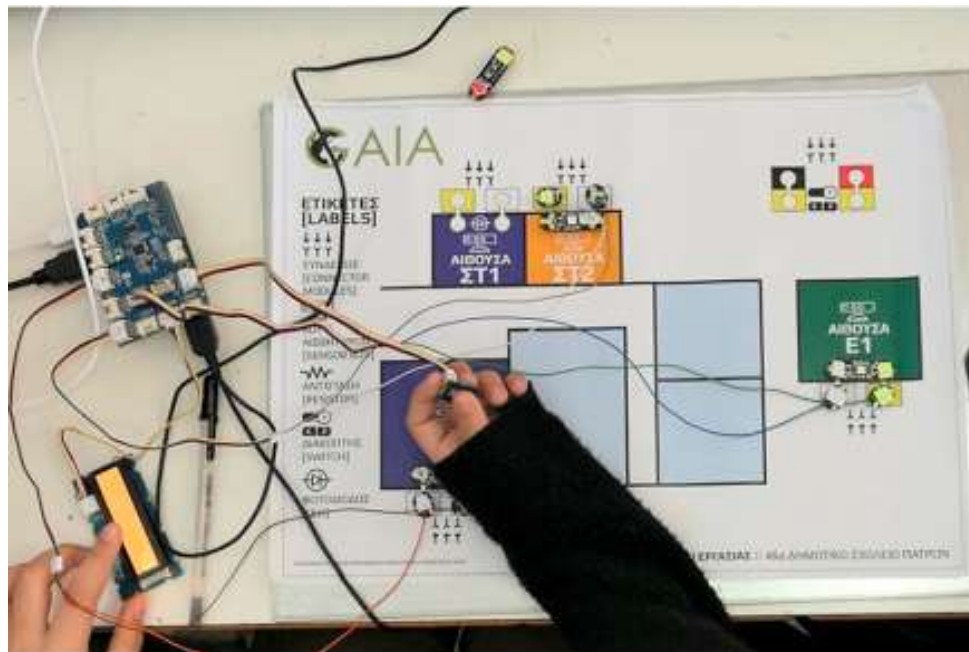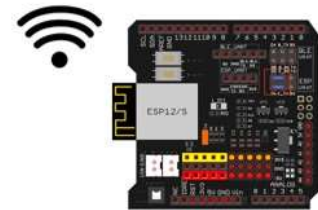 **c) 25MHz**

16

What is the ESP8266 microcontroller? . . .

ESP8266 Module PCB Layout

A

ESP8266 Microcontroller
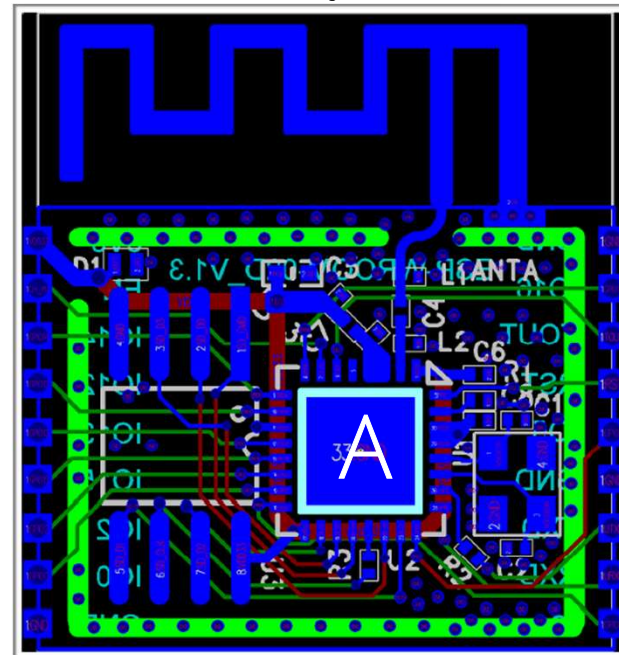
Developing an IoT Prototyping Concepts Lab:
The Effective Toolkit

Developing an IoT Prototyping Concepts Lab:
The Effective Toolkit...

Von Hippel (Von Hippel 2001) argues that an effective toolkit for user innovation
should enable five objectives.
- First, toolkits should enable users to carry out complete cycle of trial- and- error learning
- Second, they will offer a well- defined solution space that encompasses the specific designs
- Third requirement is that well designed toolkits must be user-friendly (will not require much trainer to use them)
- Fourth, they will contain libraries of commonly used modules- allows focus on product concept development
- Fifth and finally, properly designed toolkits will allow custom products and services created by the user can be manufactured using production equipment.

Developing an IoT Prototyping Concepts Lab: The Effective Toolkit . . .

Electronic Test Instrumentation
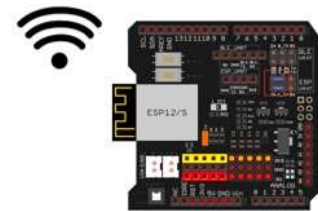
Example: Function Generator

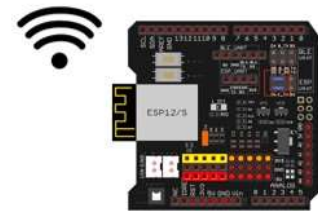A variety of basic controls signals can be emulated and used to test prototype embedded IoT devices.

Developing an IoT Prototyping Concepts Lab: The Effective Toolkit . . .

Electronic Test Instrumentation

Example: Oscilloscope

An oscilloscope will allow visualization of control signals from prototype embedded IoT devices.

Developing an IoT Prototyping Concepts Lab: The Effective Toolkit . . .

Electronic Tool Kit

Example: PLUSIVO toolkit

The kit comes with a wealth of soldering and electronic tools to aid in building and repairing prototype IoT projects.

Question 4

Who is the MIT professor that argued an effective toolkit for user innovation enables five objectives?
   a) Neil Gernshenfeld
   b) Mitchel Resnick
   c) Eric von Hippel
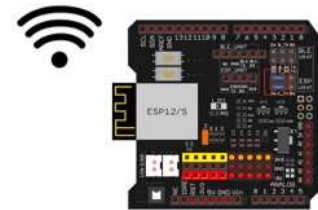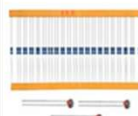
Osoyoo ESP8266 Arduino Kit Overview

Osoyoo ESP8266 Arduino Kit Overview

https://osoyoo.com/2020/05/30/wifi-iot-learning-kit-for-arduino/

Lab: WiFi Marquee – Hello World!

Lab: WiFi Marquee – Hello World! . . .

Learning Objectives:
- You will learn how to use a WiFi Shield with an Arduino Compatible.
- You will learn how to use an Arduino Compatible as a Web Server to display the "Hello World" message.
- You will learn how to modify C++ and HTML code to:
    a) display a new message
    b) blink a LED

Lab: WiFi Marquee – Hello World! . . .
Lab Setup Concept
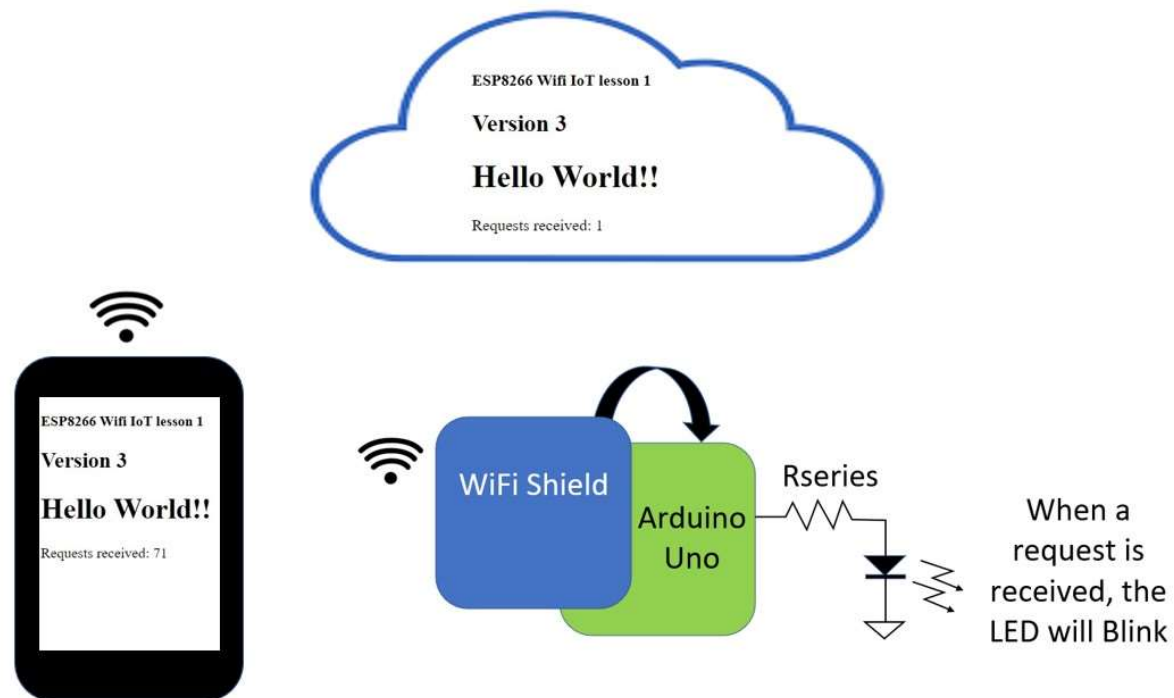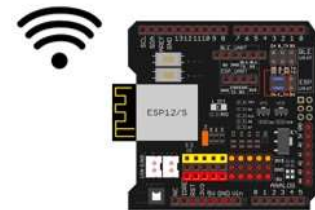
Lab: WiFi Marquee – Hello World! . . .

Lab Setup: Attaching WiFi Shield to the Arduino Compatible
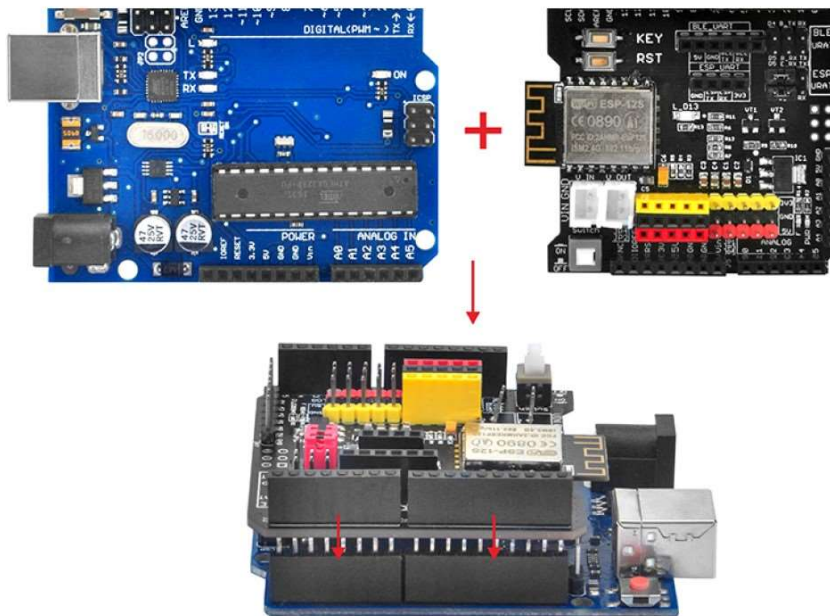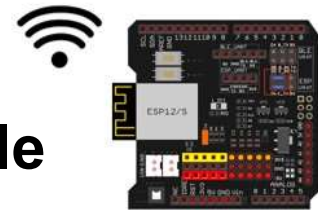
Notes:
a) Attach IoT unit to your development machine
b) Connect your Arduino Compatible to the correct COM port

Lab: WiFi Marquee – Hello World! . . .

Lab Setup: Upload Lesson 1 code to Arduino Compatible
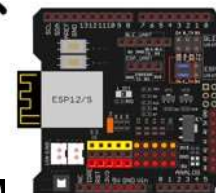
Download the code from here!

https://osoyoo.com/2020/05/30/wifi-shield-iot-learning-kit-for-arduino-lesson-1-arduinoesp8266-wifi-shield-as-web-server/
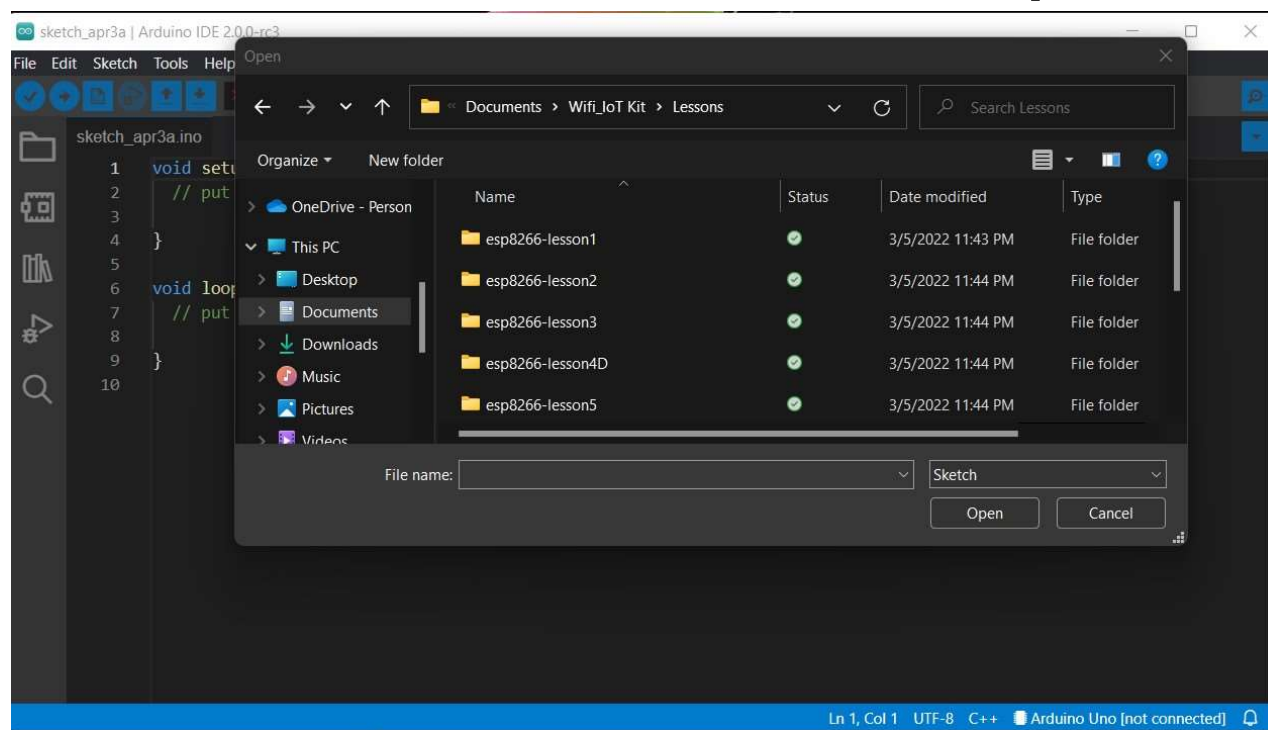
Lab: WiFi Marquee – Hello World! . . .

Lab Setup: Include your WiFi Login Credentials

Code Line Number, code instruction

*28   char ssid[ ] = "******";   // your network SSID (name)*
*29   char pass[ ] = "******"; // your network password*

Notes:
  a) Upload the lesson 1 code to your IoT unit
  b) An IP address based on your SSID will be
     visible within the Arduino IDE's output
     console.
  c) You will type this IP address into your web
     browser to see **Hello World!** Message.
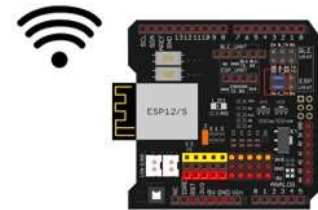
Lab: WiFi Marquee – Hello World! . . .

Let's change the WiFi Marquee message and blink an LED upon receiving requests!

Compile and upload code to the Arduino Compatible

```
Output                                                    ≡  🔓

Sketch uses 14250 bytes (44%) of program storage space. Maximum is 32256 bytes.
Global variables use 1051 bytes (51%) of dynamic memory, leaving 997 bytes for local variables. Maximum is 2048 bytes.

--------------------------
Compilation complete.

--------------------------
upload complete.
```

Lab: WiFi Marquee – Hello World! . . .

Display Message from WiFiESPserver, port 80:

ESP8266 Wifi IoT lesson 1

Hello World! I am connected

Requests received: 1

Lab: WiFi Marquee – Hello World! . . .

Let's change the WiFi Marquee message and blink an LED upon receiving requests!

```
20 #include "WiFiEsp.h"
29 int LED = 13; // add this variable to flash the onboard LED
37 void setup( )
38 {
39   //setup LED as an output
40   pinMode(LED, OUTPUT);
```

Lab: WiFi Marquee – Hello World! . . .

Let's change the WiFi Marquee message and blink an LED upon receiving requests!
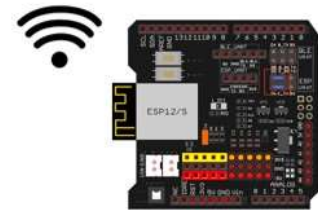
70 // turn on LED for visual connection to network
71 digitalWrite(LED, HIGH);
72 delay(500);
73 digitalWrite(LED, LOW)

Lab: WiFi Marquee – Hello World! . . .

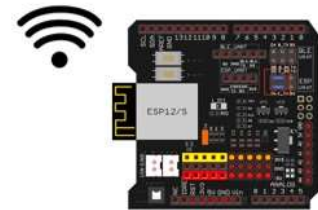**Let's change the WiFi Marquee message and blink an LED upon receiving requests!**

Change the marquee message using these lines of code:

```
110 client.print("<h2>Version 3</h2>\r\n");
111 client.print("<h1>IoT Thing is connected!</h1>\r\n");
```

Lab: WiFi Marquee – Hello World! . . .

Let's change the WiFi Marquee message and blink an LED upon receiving requests!

Compile and upload code to the Arduino Compatible

```
Output                                                        ≡ 🔓

Sketch uses 14250 bytes (44%) of program storage space. Maximum is 32256 bytes.
Global variables use 1051 bytes (51%) of dynamic memory, leaving 997 bytes for local variables. Maximum is 2048 bytes.

--------------------------
Compilation complete.

--------------------------
upload complete.
```

Lab: WiFi Marquee – Hello World! . . .
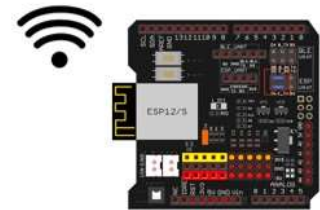
Displayed New Message from WiFiESPserver, port 80:

ESP8266 Wifi IoT lesson 1

Version 3

IoT Thing is connected!

Requests received: 1

Watch IoT Thing YouTube video clip

Click Here ➡ https://youtu.be/Y_Yxw0q25Ck

Question 5

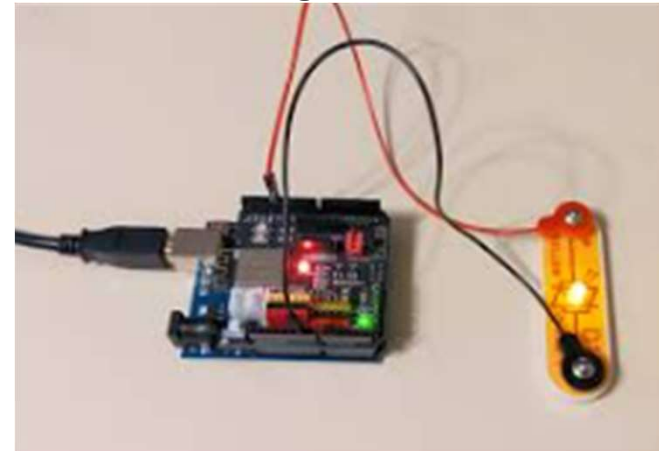**Who is the MIT professor that argued an effective toolkit for user innovation enables five objectives?**
   a) Serial.print( )
   b) LCD.print( )
   c) client.print( )

Thank you for attending

Please consider the resources below:

ESP8266 Hardware Design Guidelines (www.expressif.com)

Osoyoo Website.(2022). WiFi iot learning kit. https://osoyoo.com/2020/05/30/wifi-iot-learning-kit-for-arduino/

Partida, D. (2022, January 31). *8. top internet of things (iot) certifications*. https://www.datamation.com/careers/iot-certifications/

Uckelman, D.,Harnson, M., & Michahelles, F (Eds). (2011). *Architecting the internet of things*. Springer.

von Hippel, E.(2001). Perspective: User toolkits for innovation. *Product Innovation Management 18,* 247-257.

Willner-Giwerc, S., Rogers, C., & Wendell, K. (2020).The symbiotics system: Designing an internet of things platform for elementary school students. *International Journal of Designs for Learning ,11*(2), 64-79. https//doi.org/10.14434/ijdl.v11i2.26719

Thank You