



E210 Engineering Cyber-Physical Systems

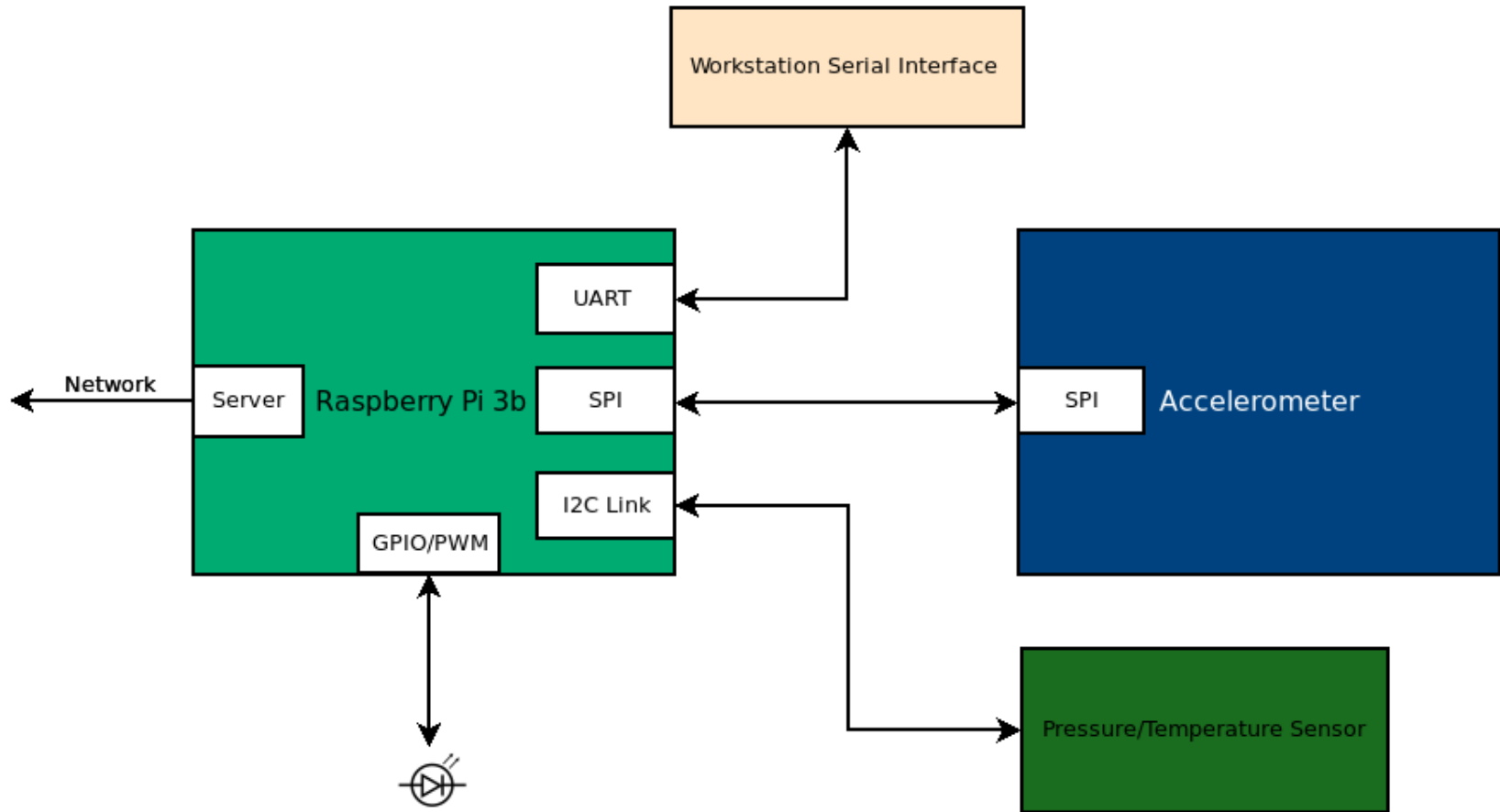
Flask

Bryce Himebaugh

Weekly Focus	Reading	Monday	Wed	Lab
CPS Intro/UART		1/10: CPS Introduction	1/12: Pi Intro/UART Bus	Project 0 Raspberry PI Setup
I2C Bus		1/17: MLK Day	1/19: I2C Bus Overview	Project 1 I2C Pressure/Temperature Sensor
I2C and SPI Bus		1/24: Pressure Sensor	1/26: SPI Bus Overview	Project 2 SPI Accelerometer
SPI/Networking		1/31: Accelerometer	2/2: MQTT	Project 3 MQTT Sensor Data Server
Networking		2/7: GPIO/LED	2/9: Flask	Project 4 Sensor LED Output
Web Server		2/14: No Class	2/16: CPS Wrapup, Exam Review	P5 Demultiplexer
Evaluation		2/21: Exam 1	2/23: CE Intro/ Logic	P6 ALU

<https://engr210.github.io/>







Flask Overview

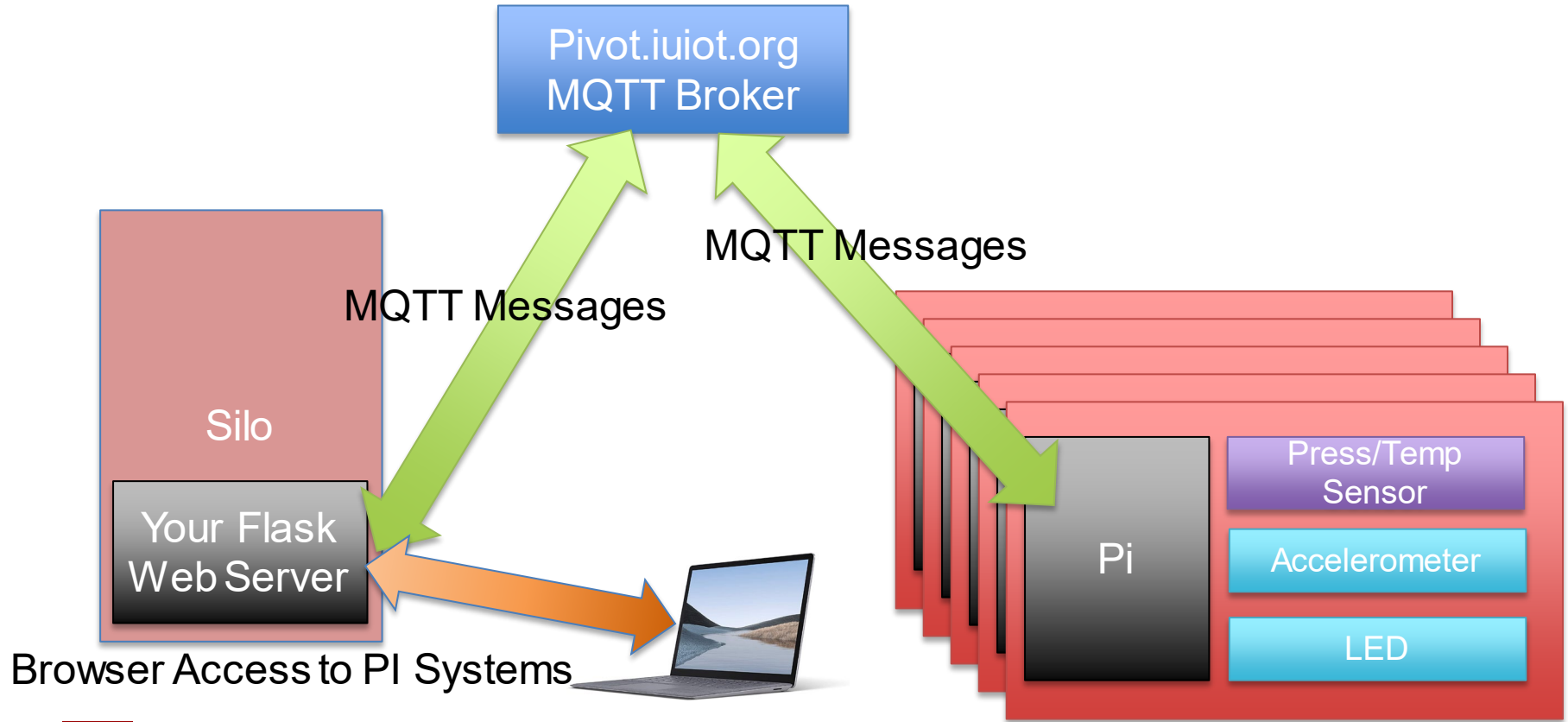
Flask



1. Python Micro Web Framework
 - Minimalist compared to Django Framework
2. First Release in 2010
3. Hammer vs toolbox
4. Used in projects as the API ...



System Architecture





Minimal Example

```
from flask import Flask
app = Flask(__name__)
@app.route('/')
def index():
    return 'Hello world'
if __name__ == '__main__':
    app.run(debug=True, port=55346, host='0.0.0.0')
```




```
from flask import Flask
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def index():
    return 'Hello world'
if __name__ == '__main__':
    app.run(debug=True, port=55346, host='0.0.0.0')
```



Python Function Decorators

Functions

Python

>>>

```
>>> def add_one(number):  
...     return number + 1  
  
>>> add_one(2)  
3
```

<https://realpython.com/primer-on-python-decorators/#functions>



Functions can be Passed as Arguments

Python

```
def say_hello(name):  
    return f"Hello {name}"  
  
def be_awesome(name):  
    return f"Yo {name}, together we are the awesomest!"  
  
def greet_bob(greeter_func):  
    return greeter_func("Bob")
```

Python

>>>

```
>>> greet_bob(say_hello)  
'Hello Bob'  
  
>>> greet_bob(be_awesome)  
'Yo Bob, together we are the awesomest!'
```

<https://realpython.com/primer-on-python-decorators/#functions>



Functions within Functions (Inner Functions)

Python

```
def parent():  
    print("Printing from the parent() function")  
  
    def first_child():  
        print("Printing from the first_child() function")  
  
    def second_child():  
        print("Printing from the second_child() function")  
  
    second_child()  
    first_child()
```

Python Traceback

```
Traceback (most recent call last):  
  File "<stdin>", line 1, in <module>  
NameError: name 'first_child' is not defined
```

first_child and
second_child only exist
inside of parent >>>

Python

```
>>> parent()  
Printing from the parent() function  
Printing from the second_child() function  
Printing from the first_child() function
```

<https://realpython.com/primer-on-python-decorators/#functions>



Returning Functions

Python

```
def parent(num):
    def first_child():
        return "Hi, I am Emma"

    def second_child():
        return "Call me Liam"

    if num == 1:
        return first_child
    else:
        return second_child
```

Python

```
>>> first()
'Hi, I am Emma'

>>> second()
'Call me Liam'
```

Can call these functions like any other function

Python

```
>>> first = parent(1)
>>> second = parent(2)

>>> first
<function parent.<locals>.first_child at 0x7f599f1e2e18>

>>> second
<function parent.<locals>.second_child at 0x7f599dad5268>
```

Function Reference Returned

<https://realpython.com/primer-on-python-decorators/#functions>



Decorators

Python

```
def my_decorator(func):
    def wrapper():
        print("Something is happening before the function is called.")
        func()
        print("Something is happening after the function is called.")
    return wrapper

def say_whee():
    print("Whee!")

say_whee = my_decorator(say_whee)
```

Python

Decorators wrap the original function

```
>>> say_whee()
Something is happening before the function is called.
Whee!
Something is happening after the function is called.
```

<https://realpython.com/primer-on-python-decorators/#functions>



Dynamic Behavior

Python

```
from datetime import datetime

def not_during_the_night(func):
    def wrapper():
        if 7 <= datetime.now().hour < 22:
            func()
        else:
            pass # Hush, the neighbors are asleep
    return wrapper

def say_whee():
    print("Whee!")

say_whee = not_during_the_night(say_whee)
```

When called after bedtime ...

Python

```
>>> say_whee()
>>>
```

<https://realpython.com/primer-on-python-decorators/#functions>



@ symbol

Python

```
def my_decorator(func):  
    def wrapper():  
        print("Something is happening before the function is called.")  
        func()  
        print("Something is happening after the function is called.")  
    return wrapper
```

```
@my_decorator  
def say_whee():  
    print("Whee!")
```

Same as `say_whee = my_decorator(say_whee)`

<https://realpython.com/primer-on-python-decorators/#functions>



Back to the Example ...

```
from flask import Flask
app = Flask(__name__)
@app.route('/')
def index():
    return 'Hello world'
if __name__ == '__main__':
    app.run(debug=True, port=55346, host='0.0.0.0')
```



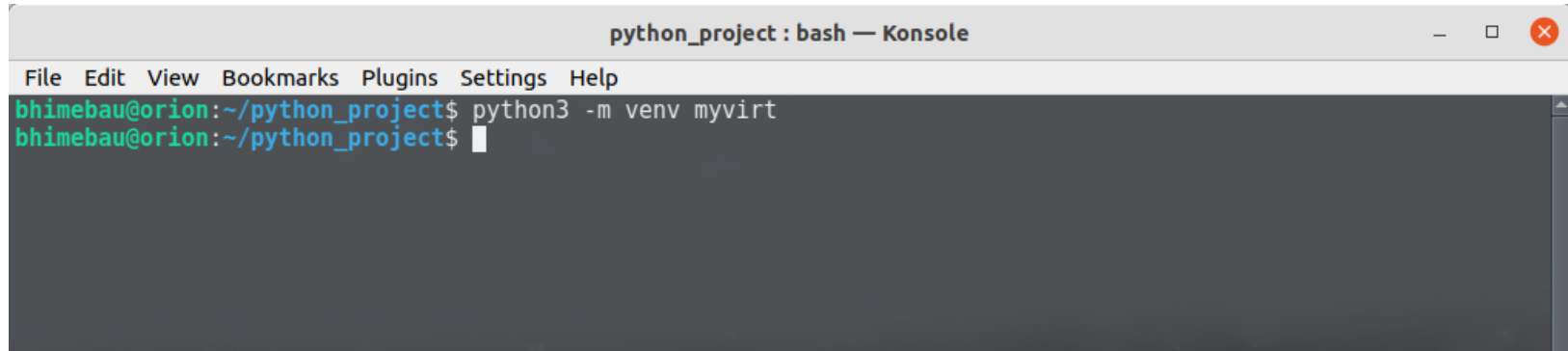
Python Virtual Environment

Python Virtual Environment

1. Used to isolate packages from the larger system
2. Python packages are installed for a given project rather than locally.
3. Uses pip3 to install packages



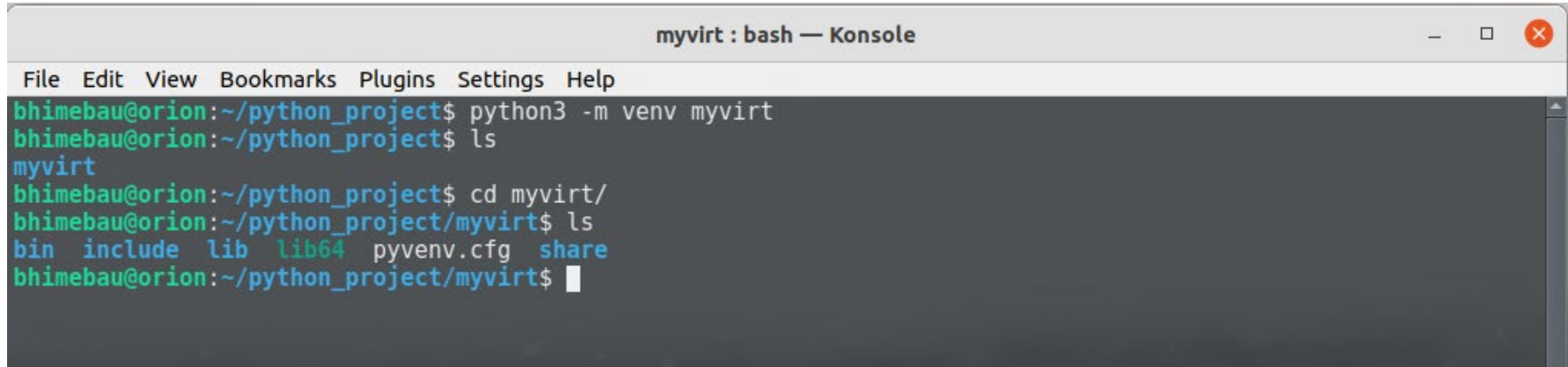
Example

A terminal window titled "python_project : bash — Konsole" with a menu bar containing "File", "Edit", "View", "Bookmarks", "Plugins", "Settings", and "Help". The terminal shows a user prompt "bhimebau@orion:~/python_project\$" followed by the command "python3 -m venv myvirt" and a subsequent prompt "bhimebau@orion:~/python_project\$" with a cursor.

```
python_project : bash — Konsole
File Edit View Bookmarks Plugins Settings Help
bhimebau@orion:~/python_project$ python3 -m venv myvirt
bhimebau@orion:~/python_project$
```



Adds python related infrastructure



```
myvirt : bash — Konsole
File Edit View Bookmarks Plugins Settings Help
bhimebau@orion:~/python_project$ python3 -m venv myvirt
bhimebau@orion:~/python_project$ ls
myvirt
bhimebau@orion:~/python_project$ cd myvirt/
bhimebau@orion:~/python_project/myvirt$ ls
bin include lib lib64 pyvenv.cfg share
bhimebau@orion:~/python_project/myvirt$
```



Initiating the virtual environment

```
bhimebau@orion:~/python-venv$ ls
myvenv
bhimebau@orion:~/python-venv$ cd myvenv/
bhimebau@orion:~/python-venv/myvenv$ ls
bin  include  lib  lib64  pyvenv.cfg  share
bhimebau@orion:~/python-venv/myvenv$ cd bin/
bhimebau@orion:~/python-venv/myvenv/bin$ ls
activate      activate.fish  easy_install  pip  pip3.9  python3
activate.csh  Activate.psl  easy_install-3.9  pip3  python  python3.9
bhimebau@orion:~/python-venv/myvenv/bin$ source activate
(myvenv) bhimebau@orion:~/python-venv/myvenv/bin$
```



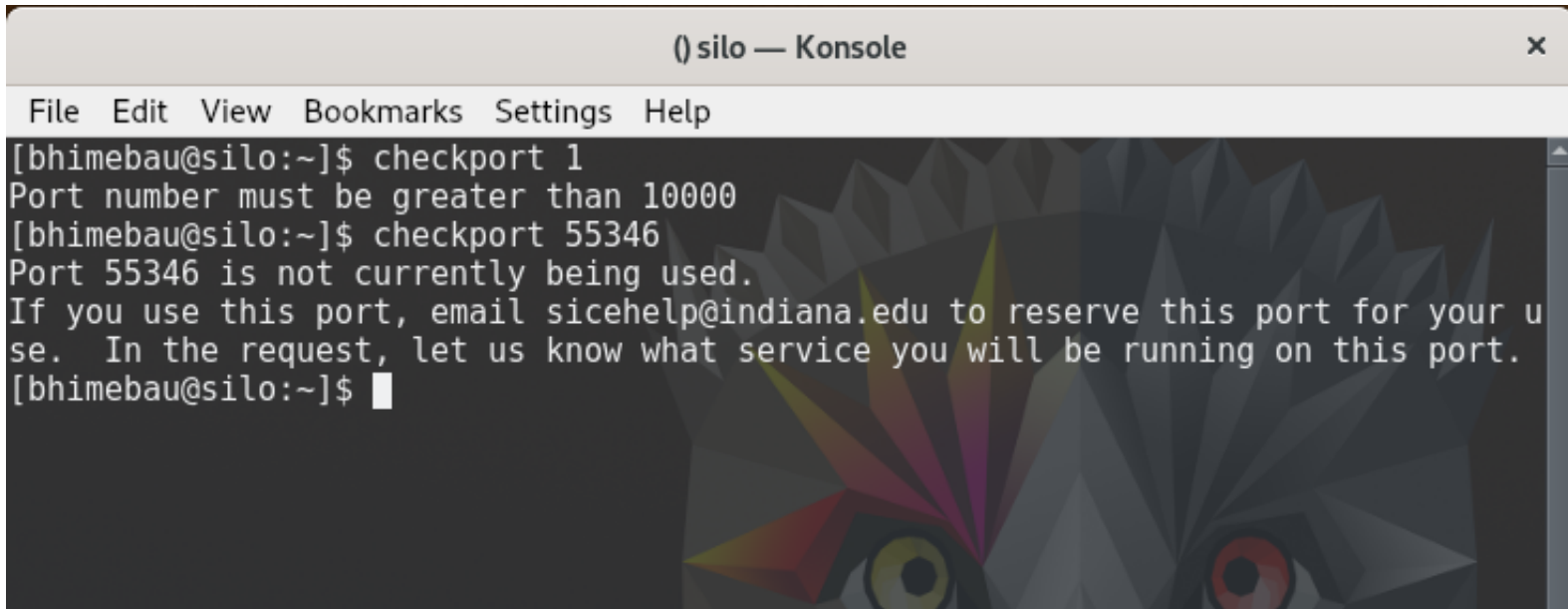
Installing Packages

```
(myvenv) bhimebau@orion:~/python-venv$ pip3 install flask
Collecting flask
  Downloading Flask-2.0.2-py3-none-any.whl (95 kB)
    |████████████████████████████████████████| 95 kB 3.8 MB/s
Collecting itsdangerous>=2.0
  Downloading itsdangerous-2.0.1-py3-none-any.whl (18 kB)
Collecting Werkzeug>=2.0
  Downloading Werkzeug-2.0.3-py3-none-any.whl (289 kB)
    |████████████████████████████████████████| 289 kB 14.4 MB/s
Collecting click>=7.1.2
  Downloading click-8.0.3-py3-none-any.whl (97 kB)
    |████████████████████████████████████████| 97 kB 12.0 MB/s
Collecting Jinja2>=3.0
  Downloading Jinja2-3.0.3-py3-none-any.whl (133 kB)
    |████████████████████████████████████████| 133 kB 14.6 MB/s
Collecting MarkupSafe>=2.0
  Downloading MarkupSafe-2.0.1-cp39-cp39-manylinux_2_5_x86_64.manylinux1_x86_64.manylinux_2_12_x86_64.manylinux2010_x86_64.whl (30 kB)
Installing collected packages: MarkupSafe, Werkzeug, Jinja2, itsdangerous, click, flask
Successfully installed Jinja2-3.0.3 MarkupSafe-2.0.1 Werkzeug-2.0.3 click-8.0.3 flask-2.0.2 itsdangerous-2.0.1
(myvenv) bhimebau@orion:~/python-venv$
```



Running the Code on Silo

Find an Open Port

A terminal window titled "() silo — Konsole" with a close button. The window has a menu bar with "File", "Edit", "View", "Bookmarks", "Settings", and "Help". The terminal text shows a user at the prompt [bhimebau@silo:~]\$ running the command 'checkport 1', which returns the message "Port number must be greater than 10000". The user then runs 'checkport 55346', which returns "Port 55346 is not currently being used." followed by a notice: "If you use this port, email sicehelp@indiana.edu to reserve this port for your use. In the request, let us know what service you will be running on this port." The prompt [bhimebau@silo:~]\$ is followed by a cursor. The terminal background features a stylized, low-poly illustration of a character's face with colorful spikes on top and large, expressive eyes.

```
() silo — Konsole
File Edit View Bookmarks Settings Help
[bhimebau@silo:~]$ checkport 1
Port number must be greater than 10000
[bhimebau@silo:~]$ checkport 55346
Port 55346 is not currently being used.
If you use this port, email sicehelp@indiana.edu to reserve this port for your use.
In the request, let us know what service you will be running on this port.
[bhimebau@silo:~]$ █
```



Screen Command

1. Versatile Linux Utility
2. Allows User Processes to Continue to Run after Terminal Closes
 - Detach and Reattach
3. Key Bindings: https://www.gnu.org/software/screen/manual/html_node/Default-Key-Bindings.html



Running Screen

```
() silo — Konsole
File Edit View Bookmarks Settings Help
[bhimebau@silo:~/forge/SICE-E210/flask_hello]$ screen
```

New Screen Process

```
() silo — Konsole
File Edit View Bookmarks Settings Help
[bhimebau@silo:~/forge/SICE-E210/flask_hello]$
```

Start Server

```
() silo — Konsole
File Edit View Bookmarks Settings Help
[bhimebau@silo:~/forge/SICE-E210/flask_hello]$ python3 helloWorld.py
* Serving Flask app "helloWorld" (lazy loading)
* Environment: production
WARNING: This is a development server. Do not use it in a production deployment.
Use a production WSGI server instead.
* Debug mode: off
* Running on http://0.0.0.0:5000
Press CTRL-C to stop
```

Detach with Server
Still Running

C-a d

C-a C-d

(detach)

Detach screen from this terminal. See [Detach](#).

```
() silo — Konsole
File Edit View Bookmarks Settings Help
[bhimebau@silo:~/forge/SICE-E210/flask_hello]$ screen
[detached from 15382.pts-9.silo]
[bhimebau@silo:~/forge/SICE-E210/flask_hello]$
```



~ : bash — Konsole

File Edit View Bookmarks Settings Help

```
[bhimebau@silo:~/forge/SICE-E210/flask_hello]$ screen  
[detached from 15382.pts-9.silo]  
[bhimebau@silo:~/forge/SICE-E210/flask_hello]$ exit  
logout  
Connection to silo closed.  
bhimebau@orion:~$
```

silosice.indiana.edu:55346

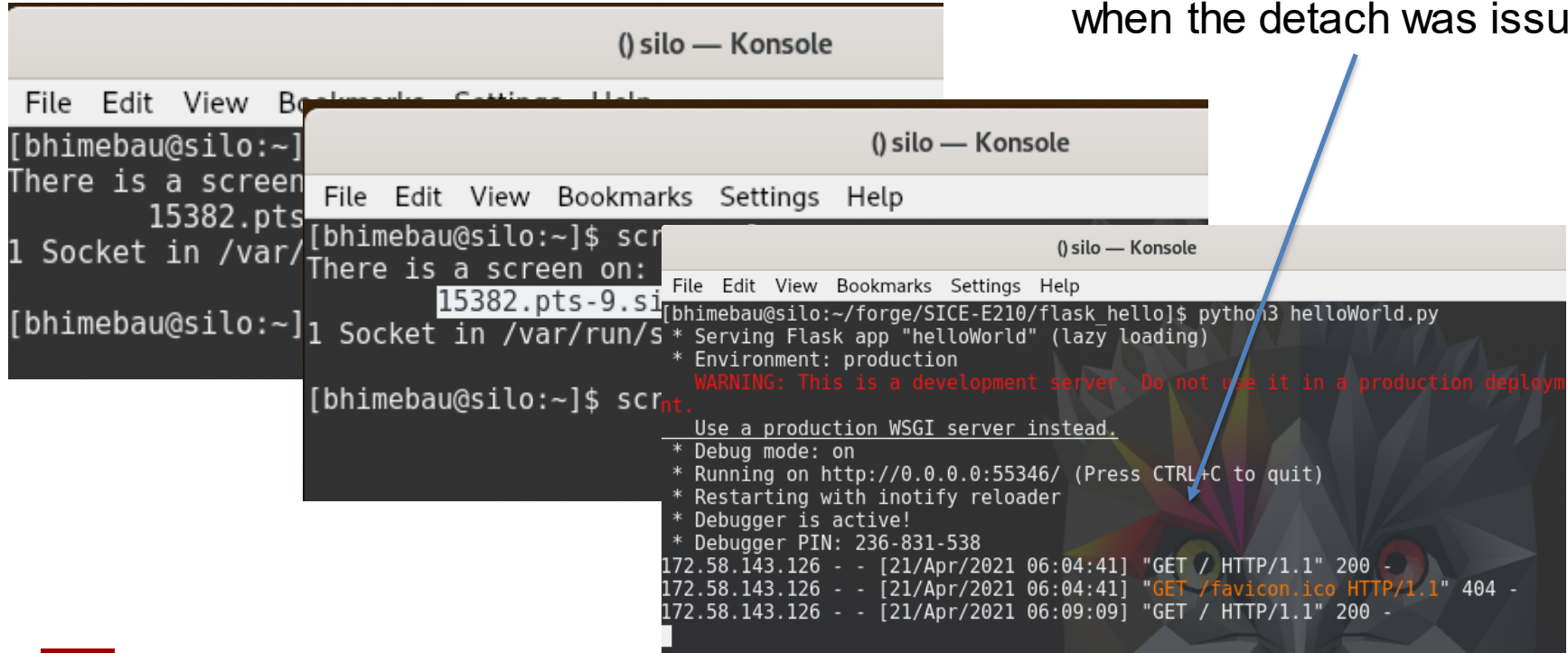
Not secure | http://silosice.indiana.edu:55346

Hello world



Reattaching

Right back where we left off
when the detach was issued

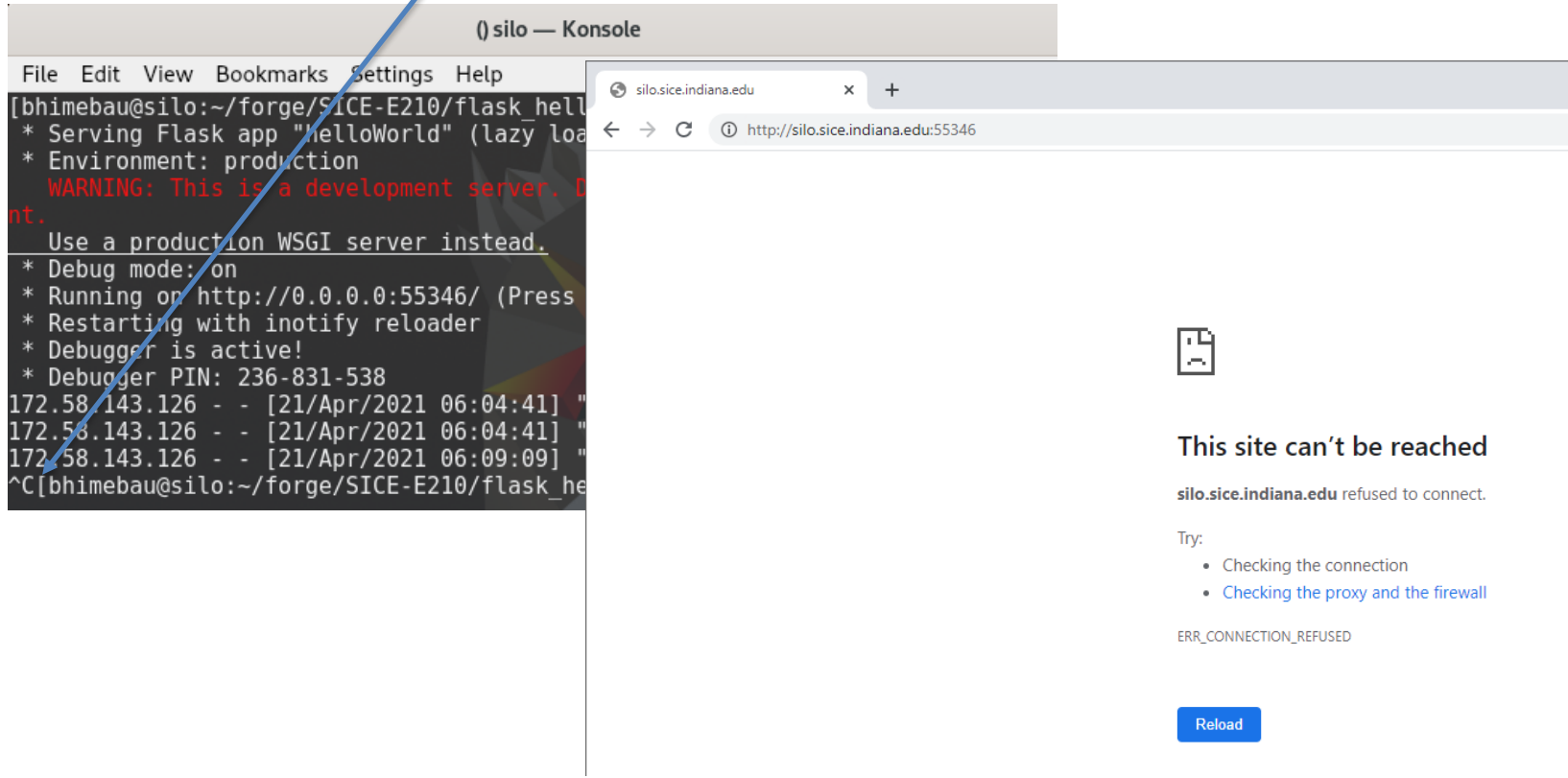


The image shows three overlapping terminal windows. The top window is titled '() silo — Konsole' and shows a menu bar with 'File Edit View Bookmarks Settings Help'. The middle window is also titled '() silo — Konsole' and shows the same menu bar. The bottom window is titled '() silo — Konsole' and shows the same menu bar. The bottom window contains the following text:

```
[bhimebau@silo:~/forge/SICE-E210/flask hello]$ python3 helloWorld.py
* Serving Flask app "helloWorld" (lazy loading)
* Environment: production
WARNING: This is a development server. Do not use it in a production deployment.
Use a production WSGI server instead.
* Debug mode: on
* Running on http://0.0.0.0:55346/ (Press CTRL+C to quit)
* Restarting with inotify reloader
* Debugger is active!
* Debugger PIN: 236-831-538
172.58.143.126 - - [21/Apr/2021 06:04:41] "GET / HTTP/1.1" 200 -
172.58.143.126 - - [21/Apr/2021 06:04:41] "GET /favicon.ico HTTP/1.1" 404 -
172.58.143.126 - - [21/Apr/2021 06:09:09] "GET / HTTP/1.1" 200 -
```



CTRL-C to stop



The image shows a terminal window on the left and a web browser on the right. A blue arrow points from the text 'CTRL-C to stop' to the terminal window. The terminal window title is '() silo — Konsole'. The terminal output shows the following text:

```
File Edit View Bookmarks Settings Help
[bhimebau@silo:~/forge/SICE-E210/flask_hell
* Serving Flask app "helloWorld" (lazy loa
* Environment: production
WARNING: This is a development server. D
nt.
Use a production WSGI server instead.
* Debug mode: on
* Running on http://0.0.0.0:55346/ (Press
* Restarting with inotify reloader
* Debugger is active!
* Debugger PIN: 236-831-538
172.58.143.126 - - [21/Apr/2021 06:04:41] "
172.58.143.126 - - [21/Apr/2021 06:04:41] "
172.58.143.126 - - [21/Apr/2021 06:09:09] "
^C[bhimebau@silo:~/forge/SICE-E210/flask_he
```

The web browser window title is 'silo.sice.indiana.edu'. The address bar shows 'http://silo.sice.indiana.edu:55346'. The browser content shows a 'This site can't be reached' error message with a sad face icon. The error message reads: 'This site can't be reached silo.sice.indiana.edu refused to connect. Try: • Checking the connection • Checking the proxy and the firewall ERR_CONNECTION_REFUSED'. A 'Reload' button is visible at the bottom of the error message.



System Architecture

