Internet

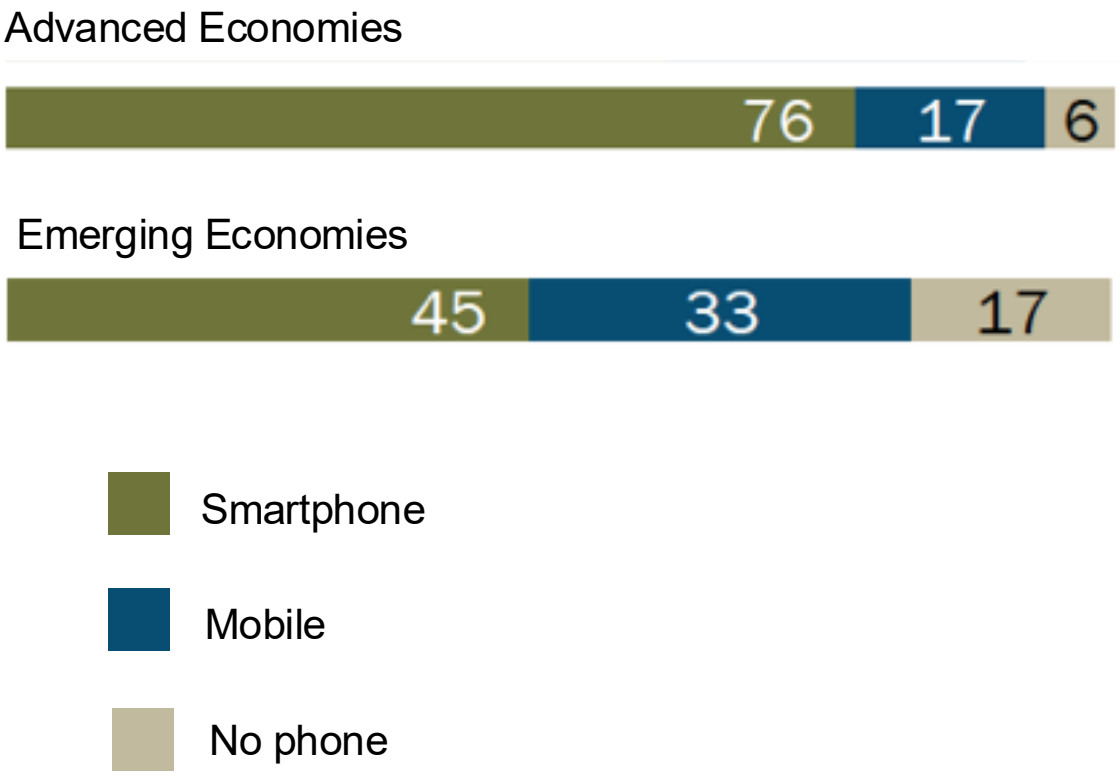
Neel Kishnani, CS106A, Summer 2026

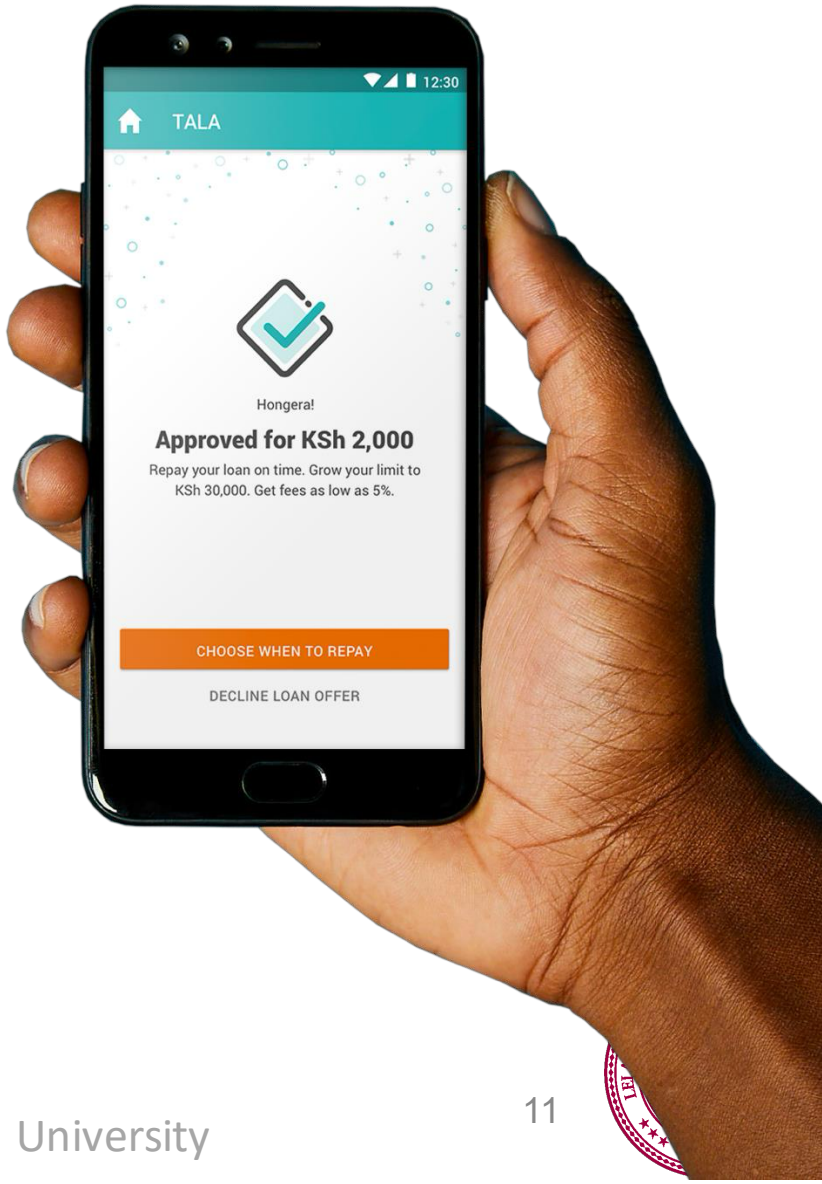
Stanford | ENGINEERING

Credit to Mehran Sahami and Chris Gregg for these awesome slides!

One reason programming is fun is because of the internet...

Smart Phone Access





Learning Goals

1. Write a program that can respond to internet requests

How does your phone communicate with instagram?

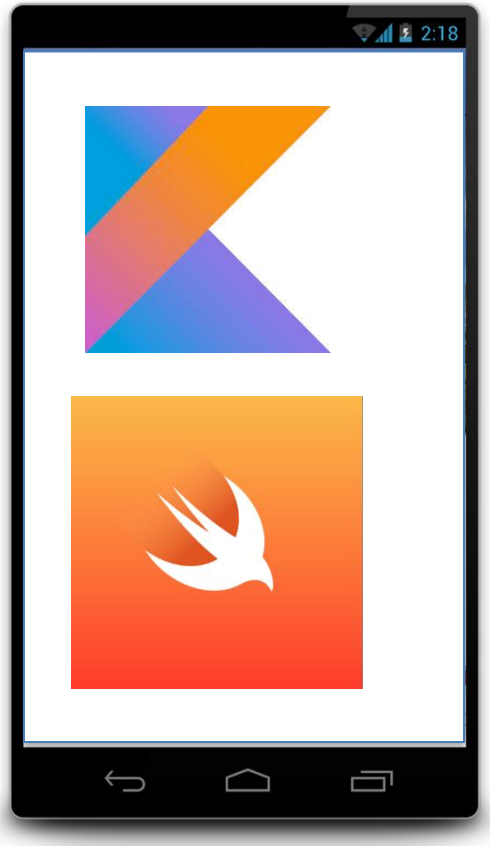
The program on your **phone**
talks to the program at
Instagram

JavaScript with HTML are the languages of websites

Instagram Server

Kotlin is the language of Android phones

Swift is the language of Apple phones

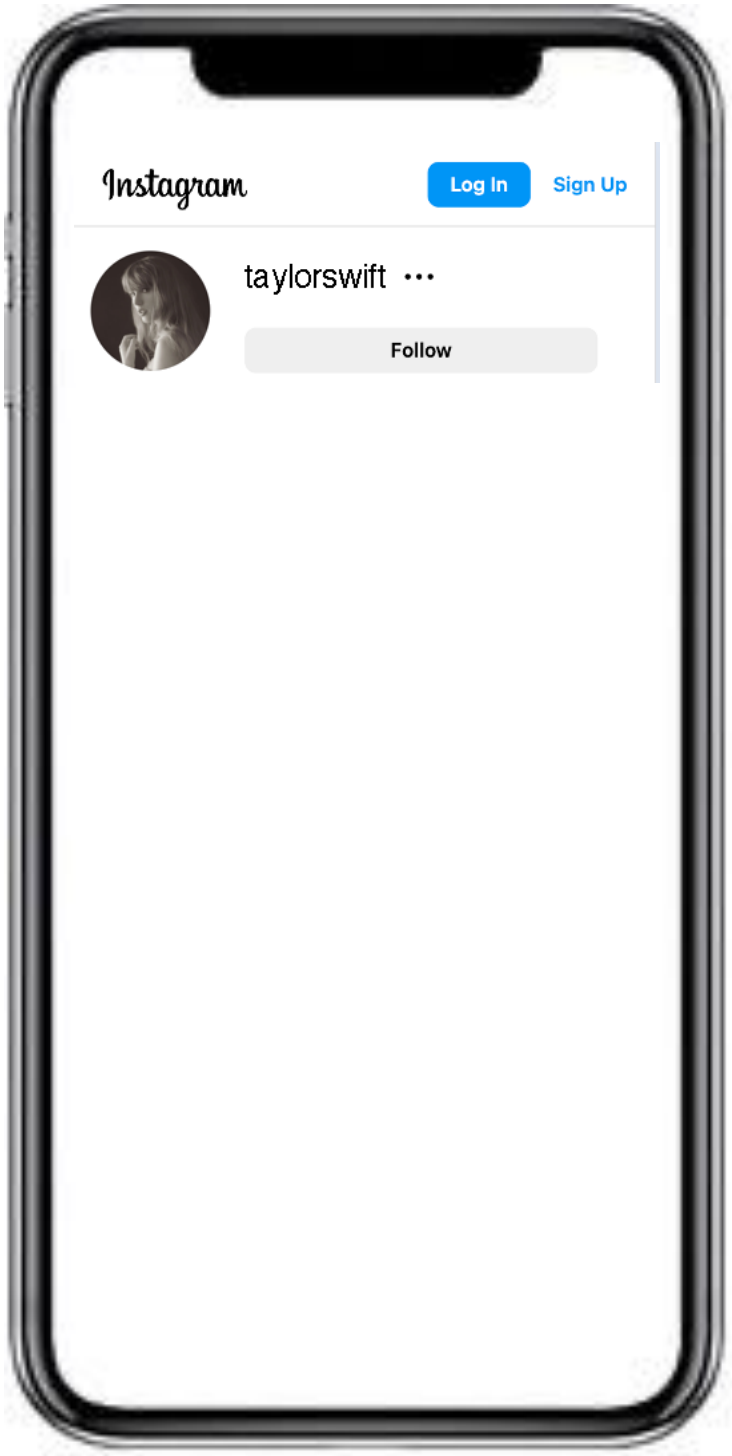


Send the
profile photo
for
taylorswift

Instagram Server

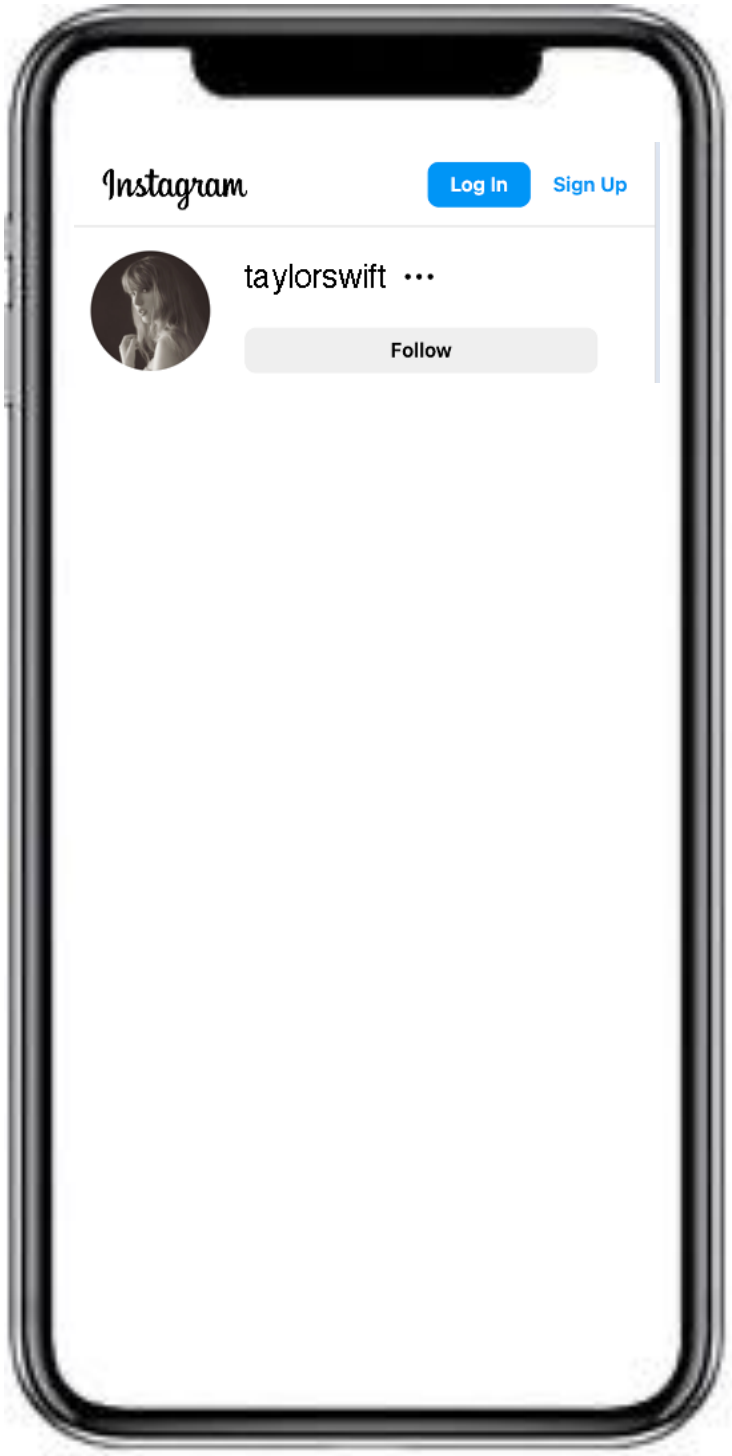
Send the
profile photo
for
taylorswift

Instagram Server

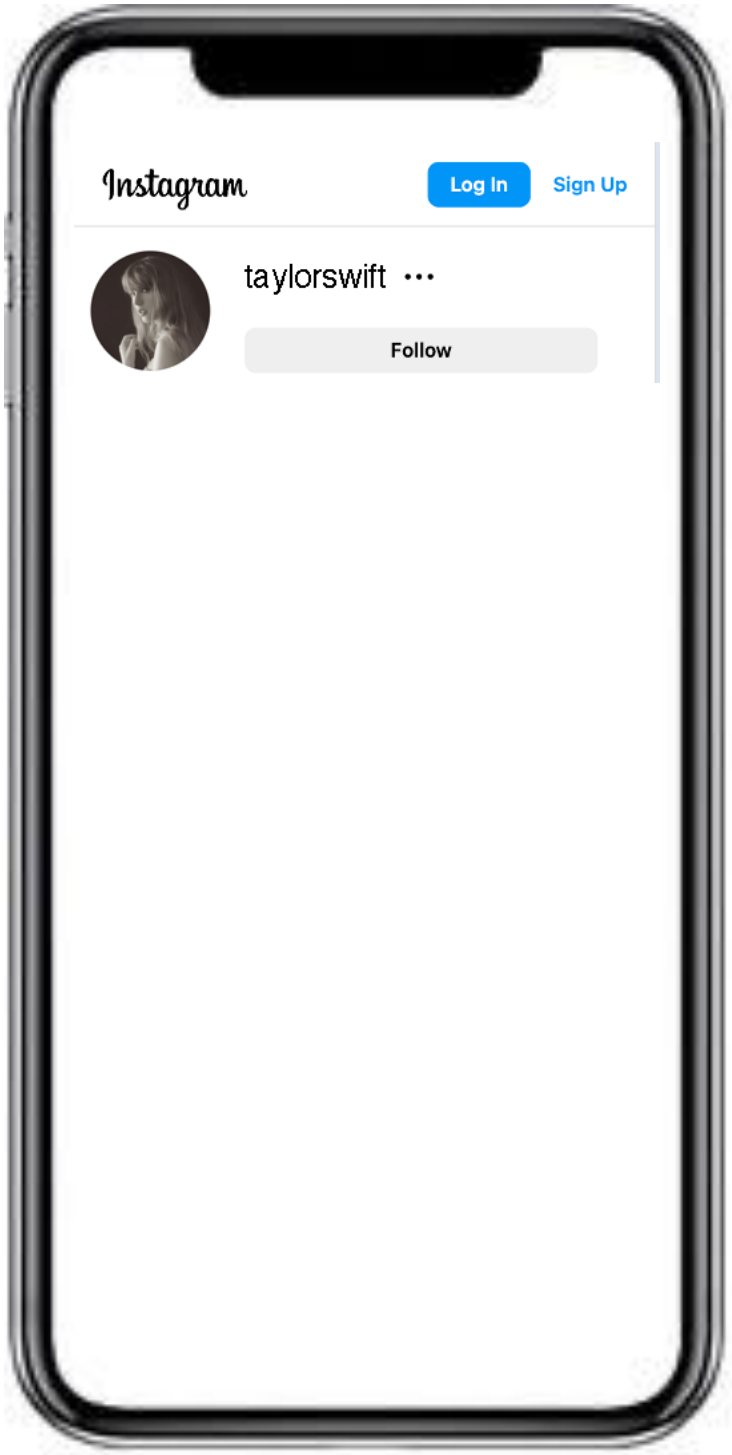


Send the profile photo for taylorswift

Instagram Server

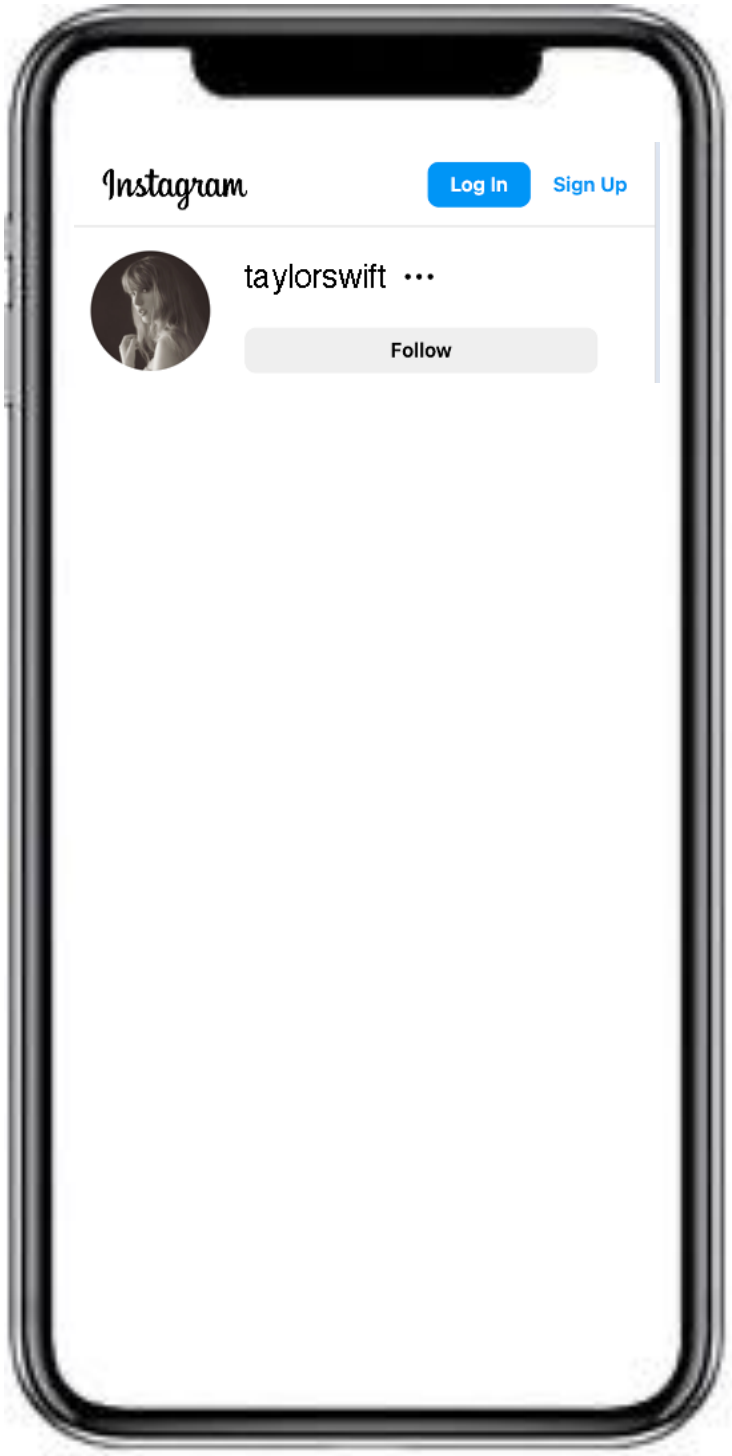


Instagram Server



Send the
user info for
taylorswift

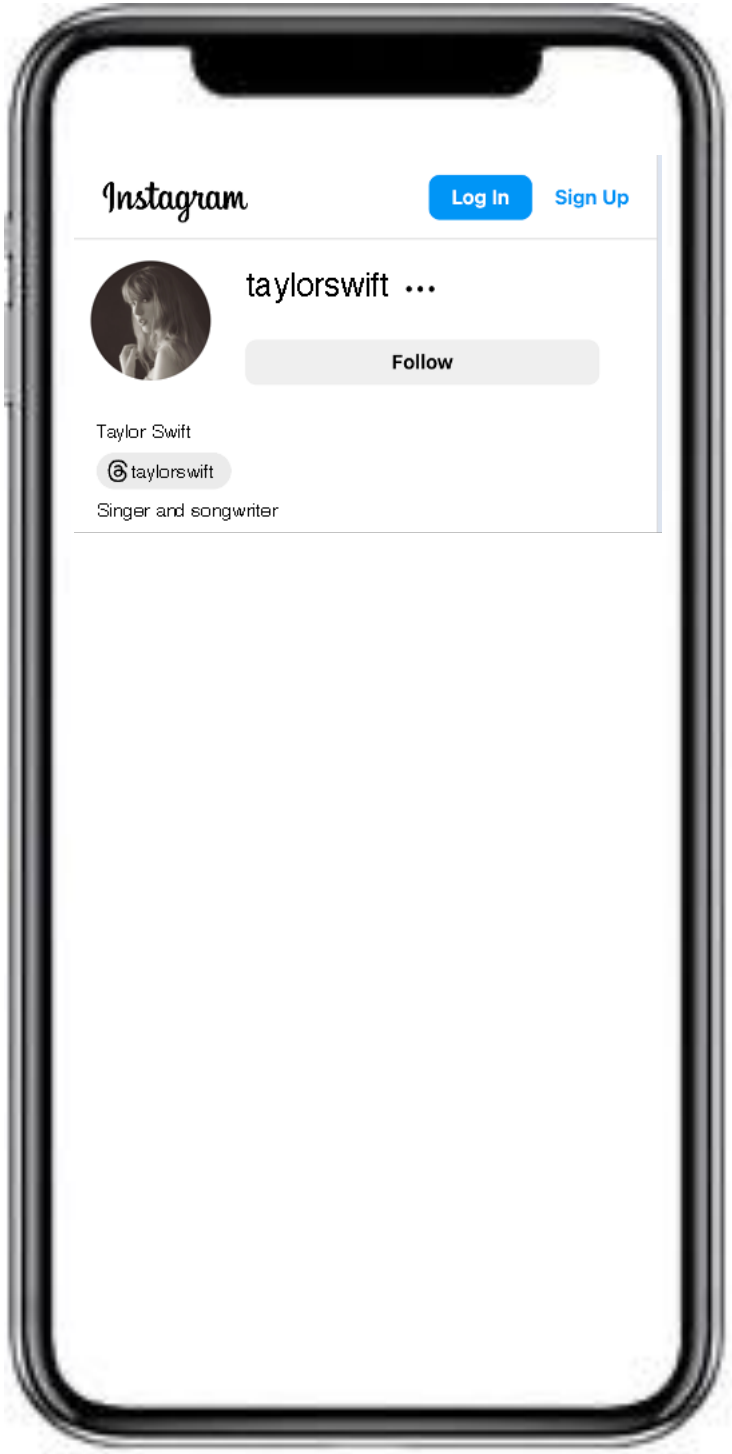
Instagram Server



Send the user info for taylorswift

Instagram Server

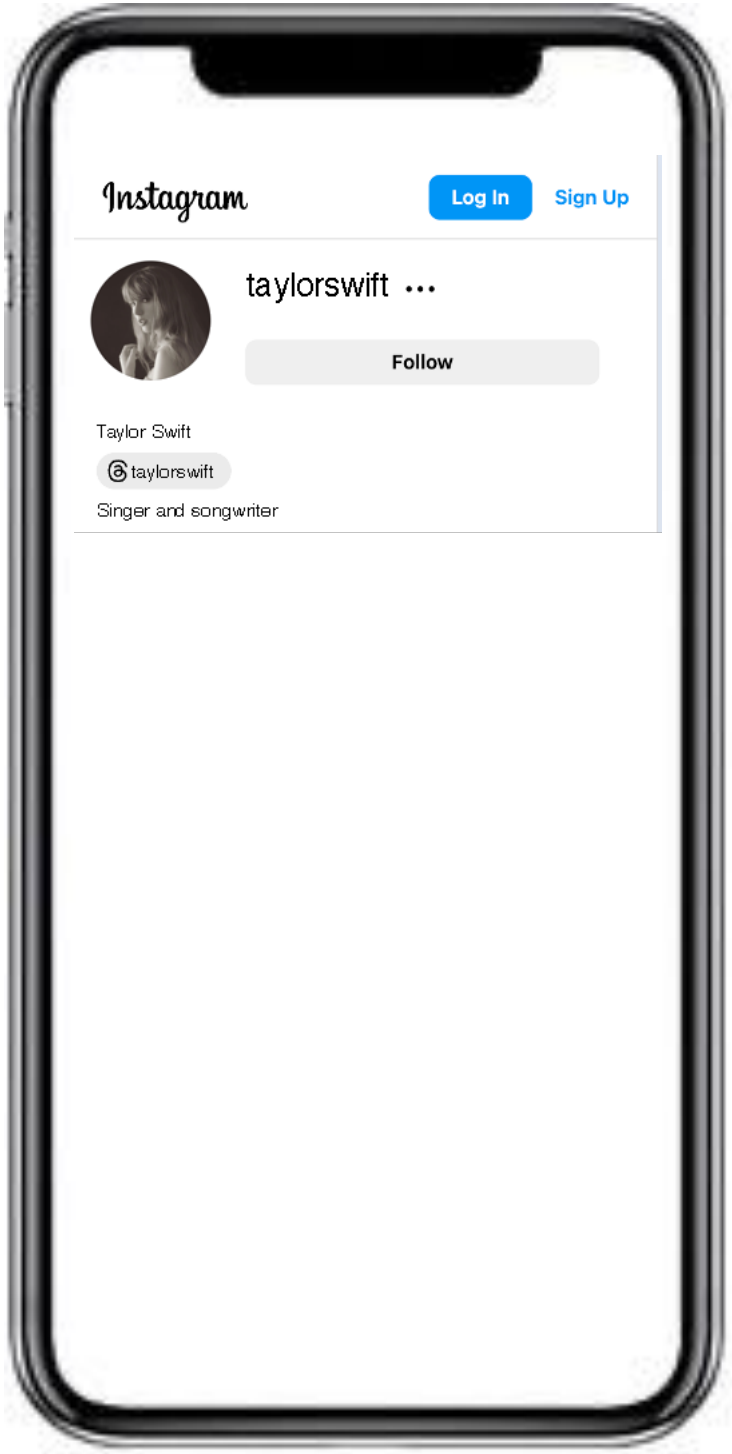
```
{
  "name": "Taylor Swift",
  "bio" : "Singer
        and songwriter"
}
```



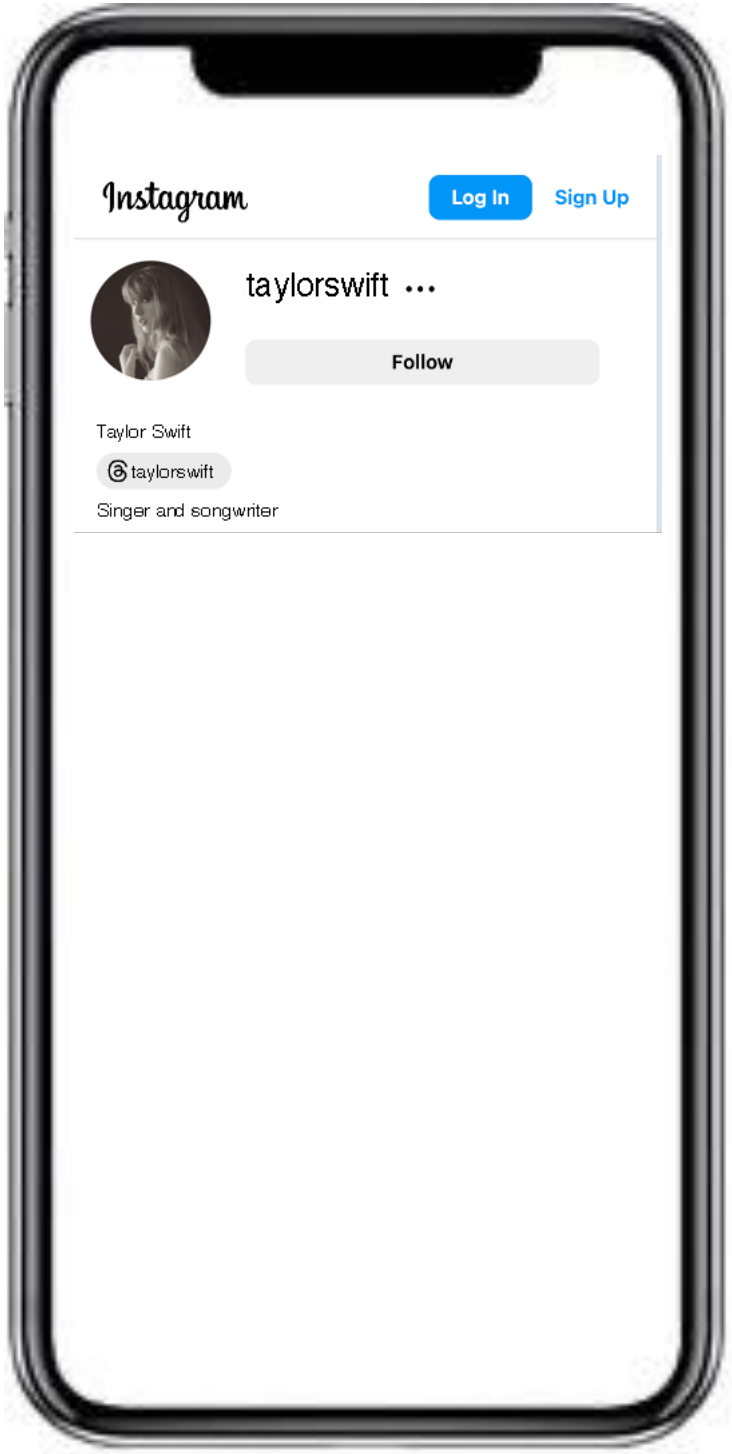
Send the user info for taylorswift

Instagram Server

```
{
 "name": "Taylor Swift",
 "bio" : "Singer
       and songwriter"
}
```

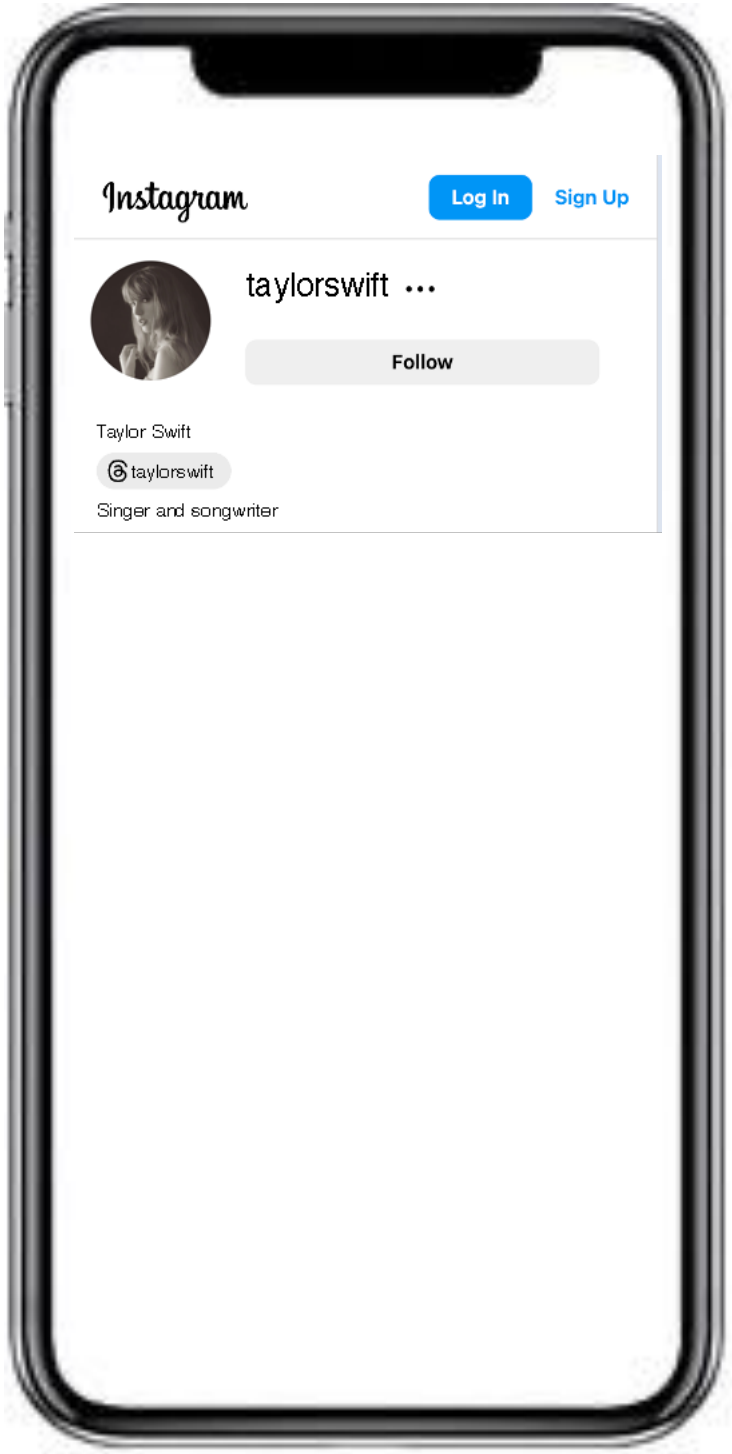


Instagram Server



Send the posts for taylorswift

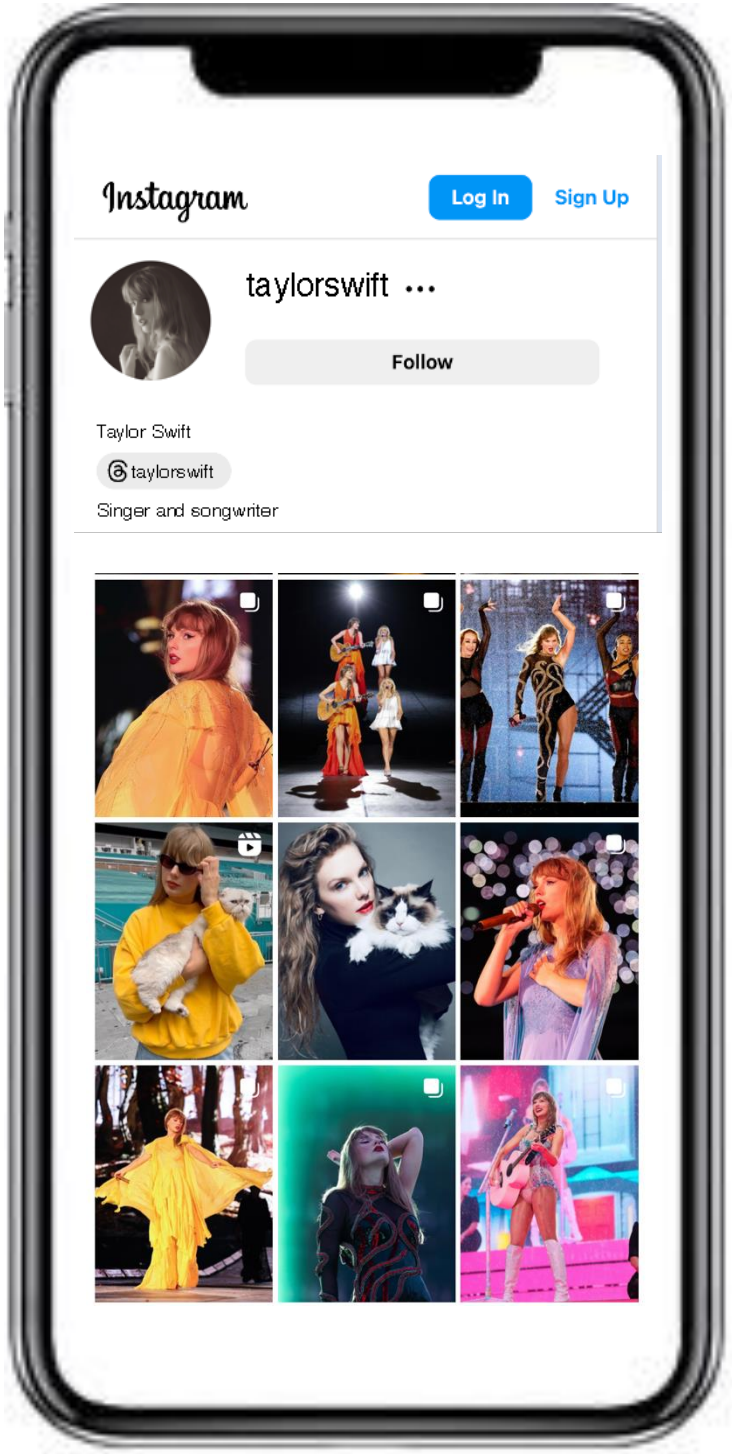
Instagram Server



Send the posts for taylorswift

Instagram Server

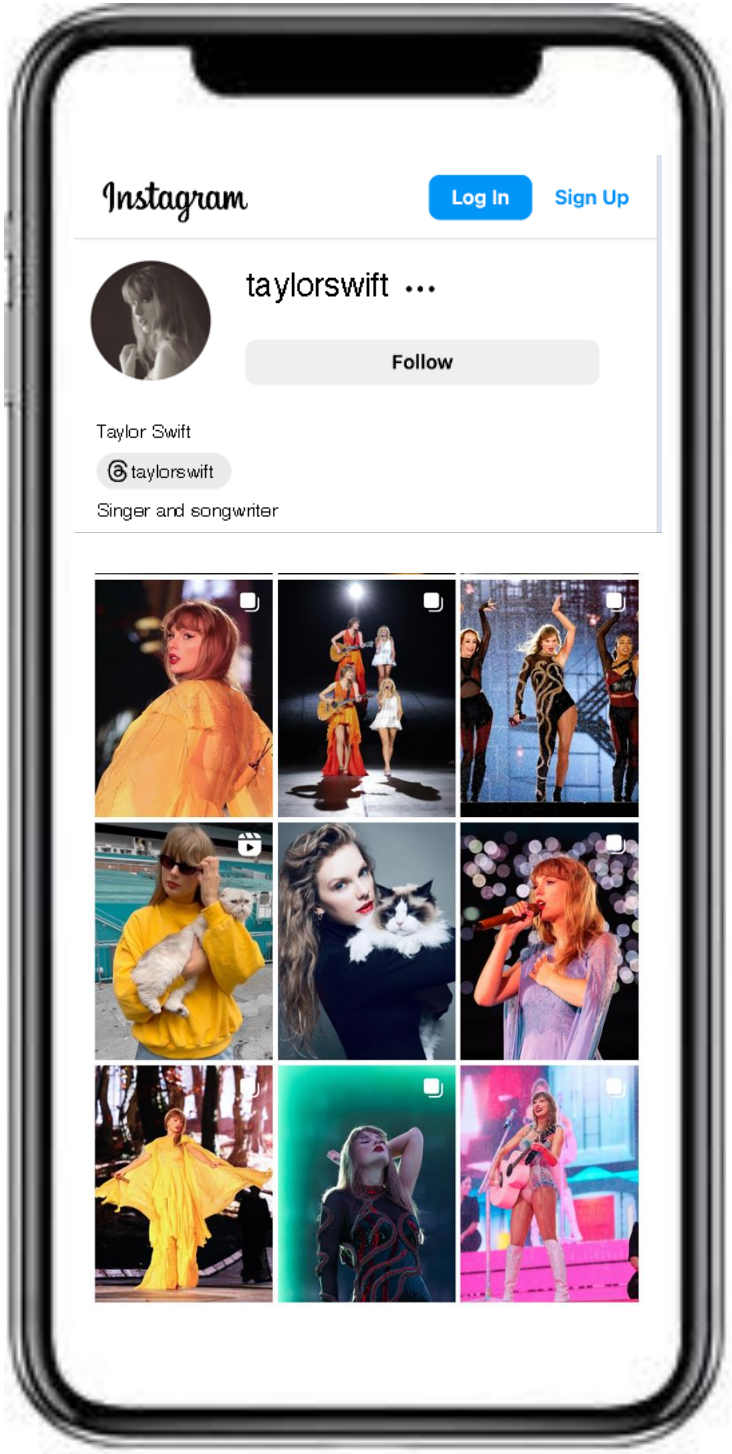
```
[
 "https://cdninstagram.com/CHvCmgPsJdO",
 "https://cdninstagram.com/Aslkj23dser",
 ...
]
```



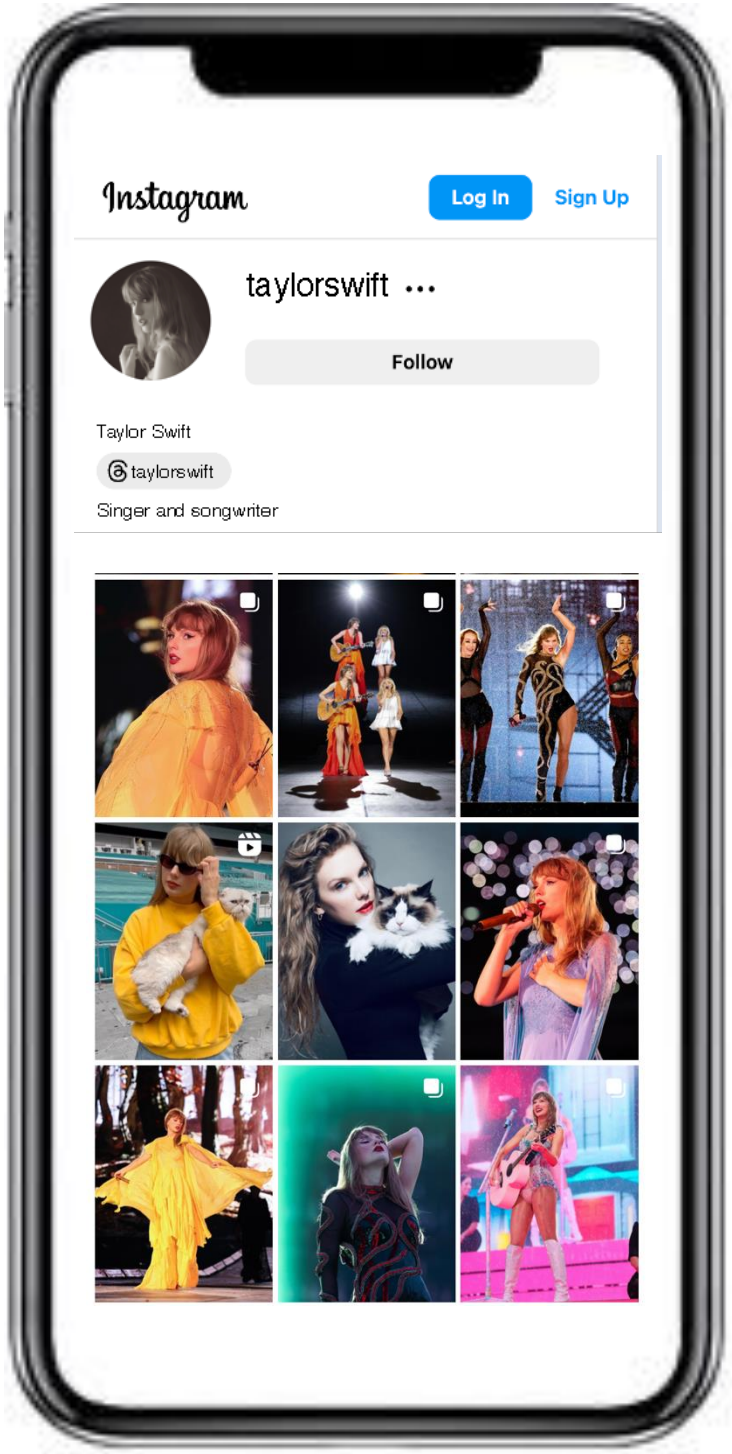
Send the posts for taylorswift

Instagram Server

```
[
 "https://cdninstagram.com/CHvCmgPsJdO",
 "https://cdninstagram.com/Aslkj23dser",
 ...
]
```

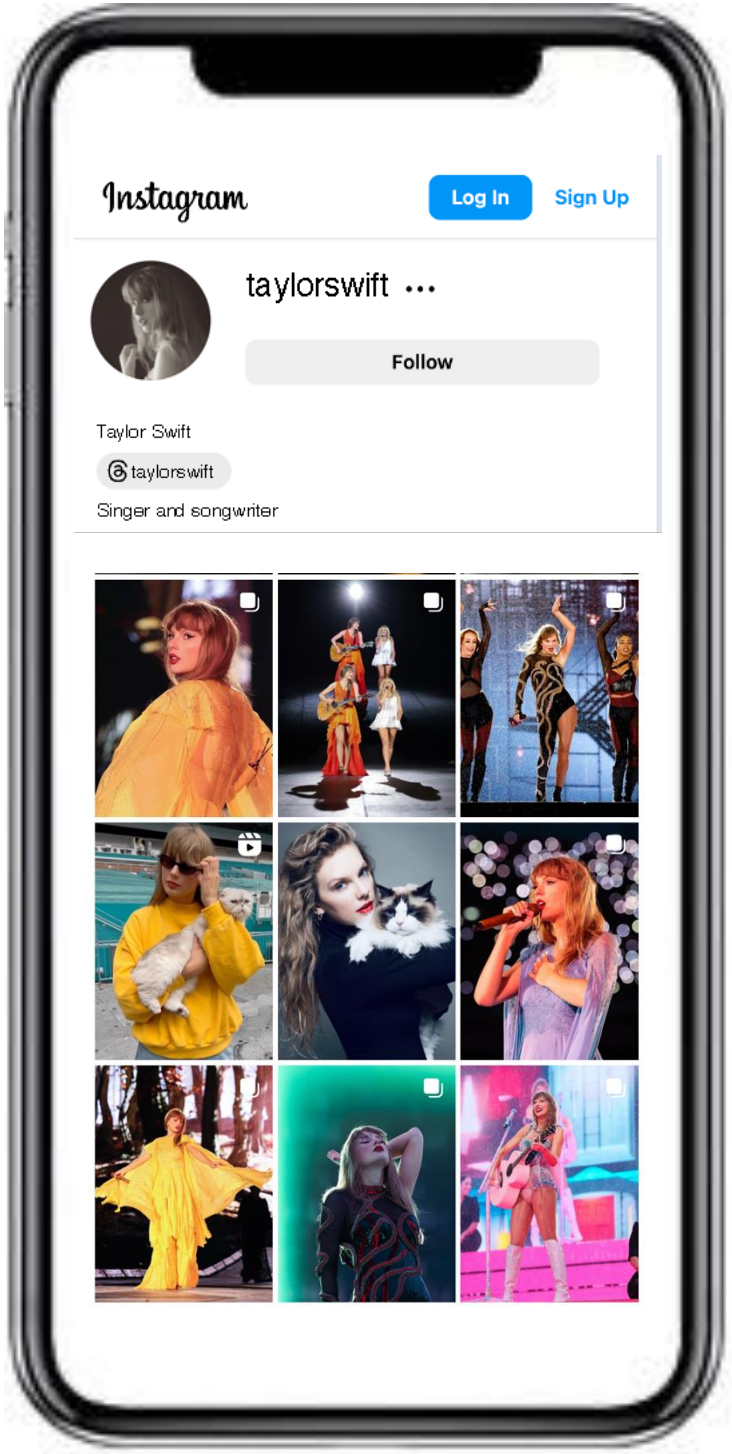


Instagram Server



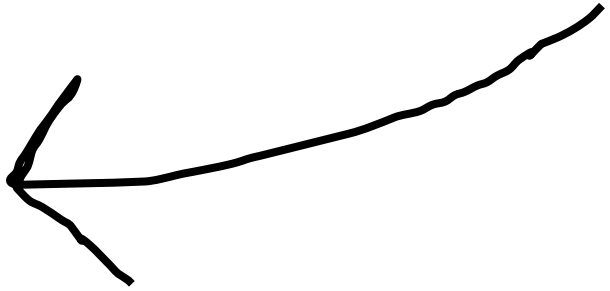

```
Set the bio for
  taylorswift
to be "Singing"
```

Instagram Server

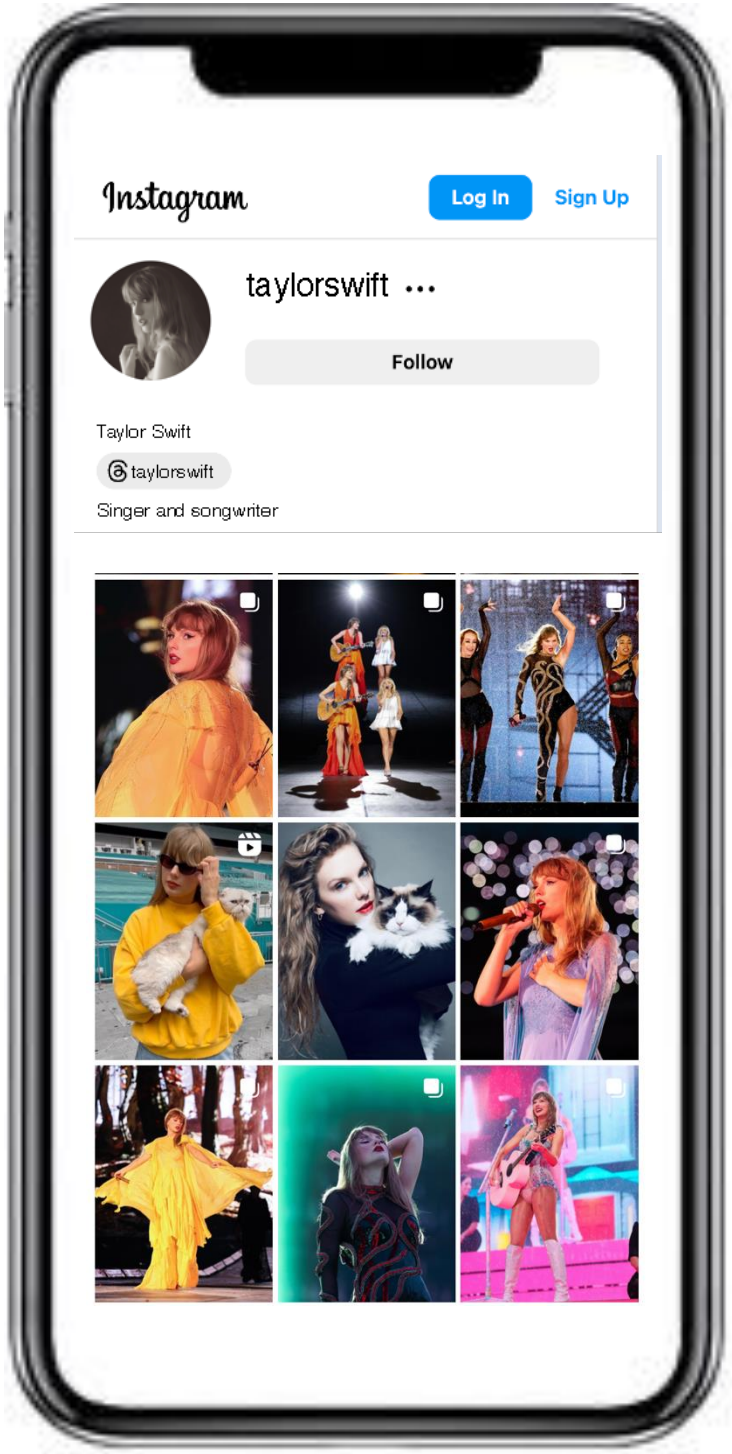


Instagram Server

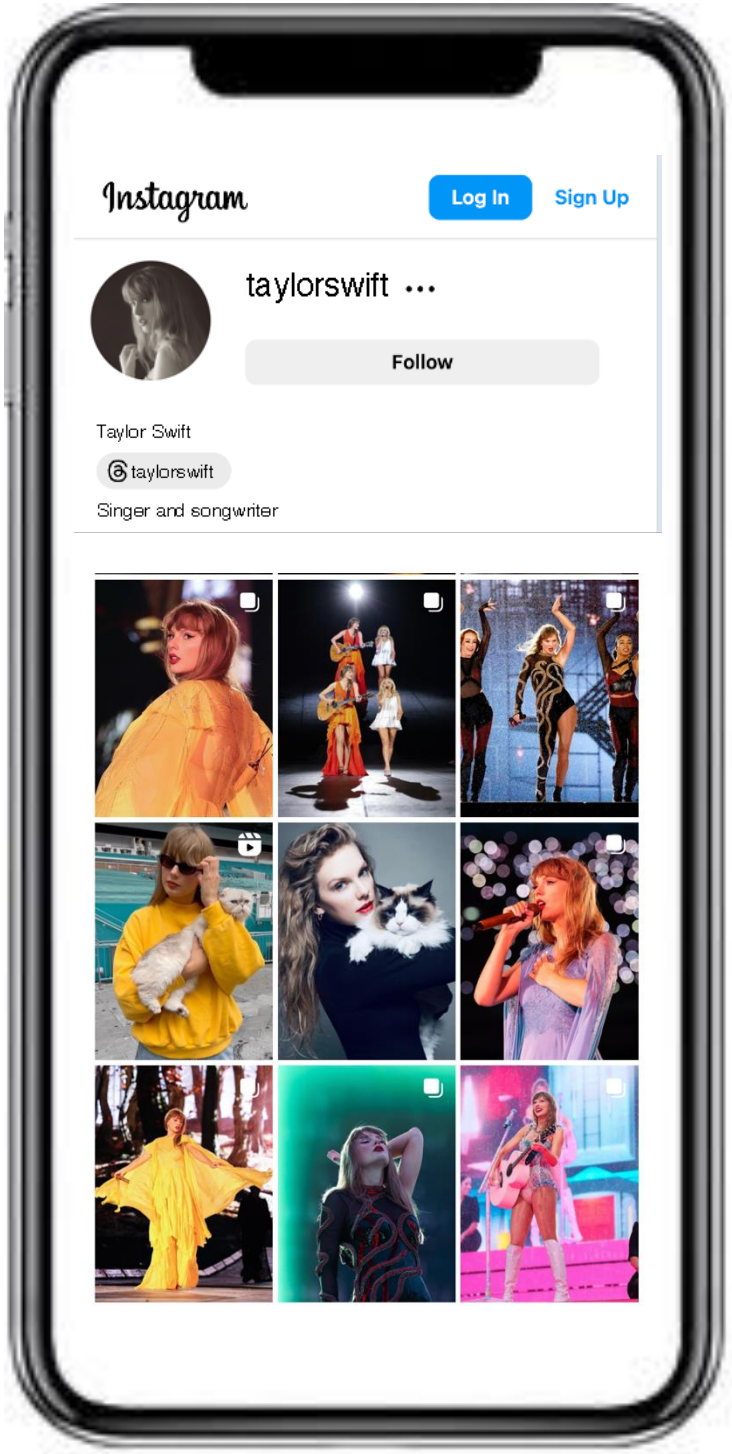
```
Set the bio for
  taylorswift
to be "Singing"
```



"success"

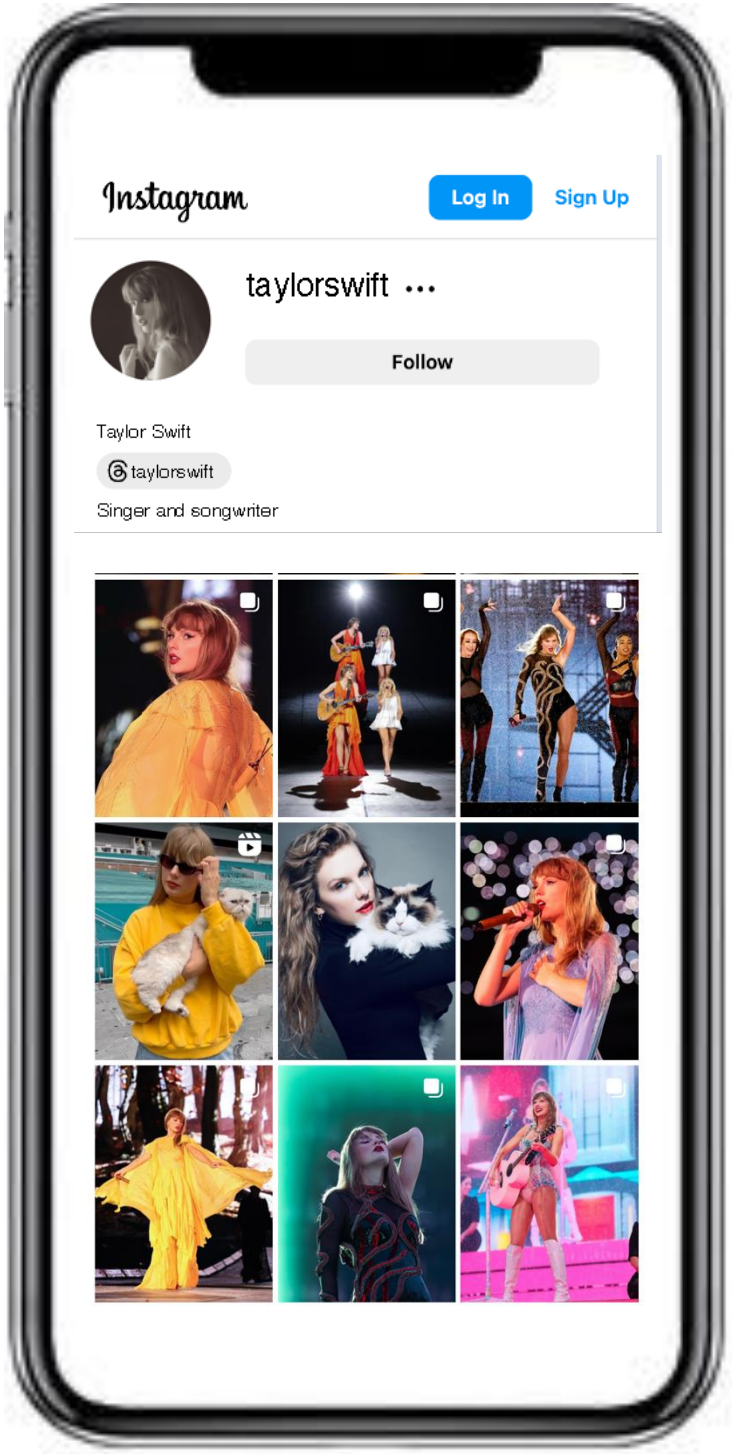


Instagram Server



Send the user info for taylorswift

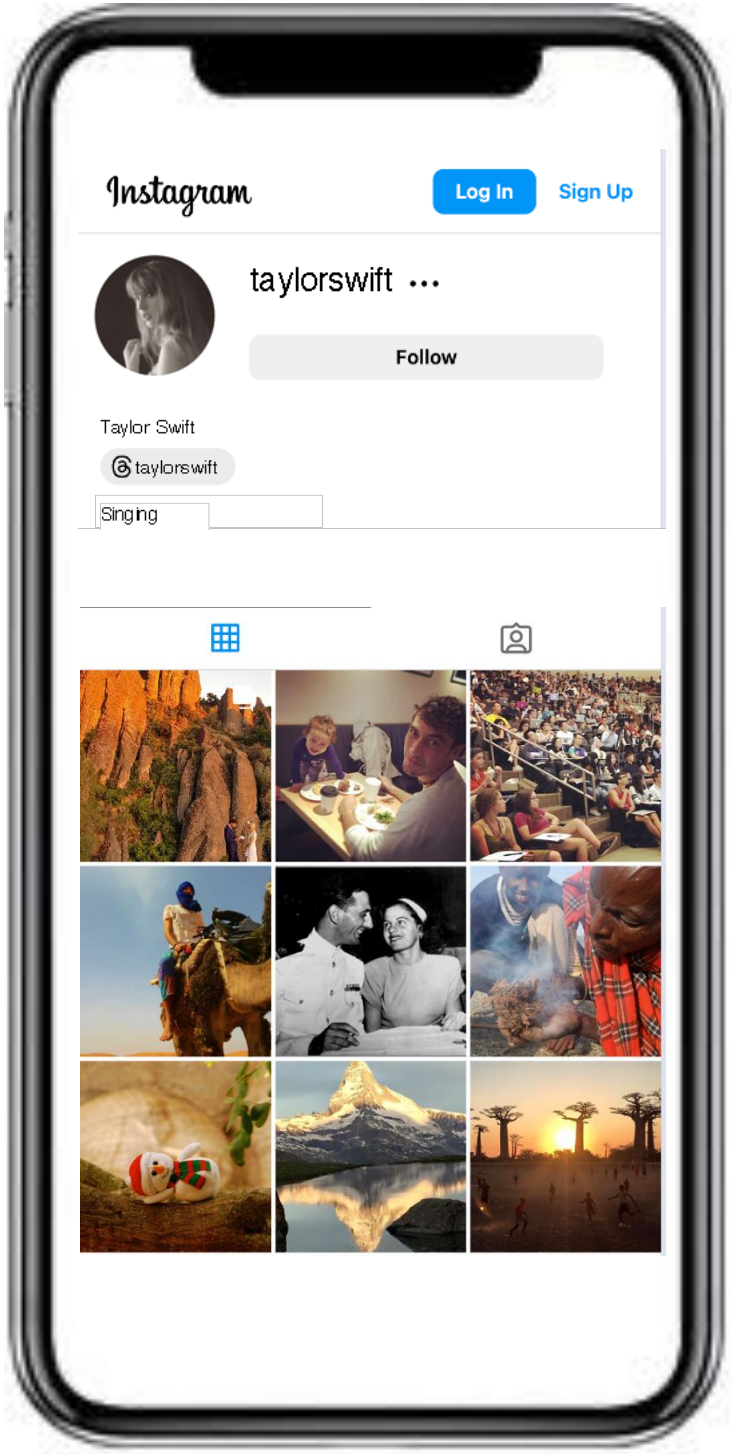
Instagram Server



Send the user info for taylorswift

Instagram Server

```
{
  "name": "Taylor Swift",
  "bio" : "Singing"
}
```



Send the user info for taylorswift

Instagram Server

```
{
  "name": "Taylor Swift",
  "bio" : "Singing"
}
```

Background: The Internet

The internet is just many programs sending messages (as *Strings*)

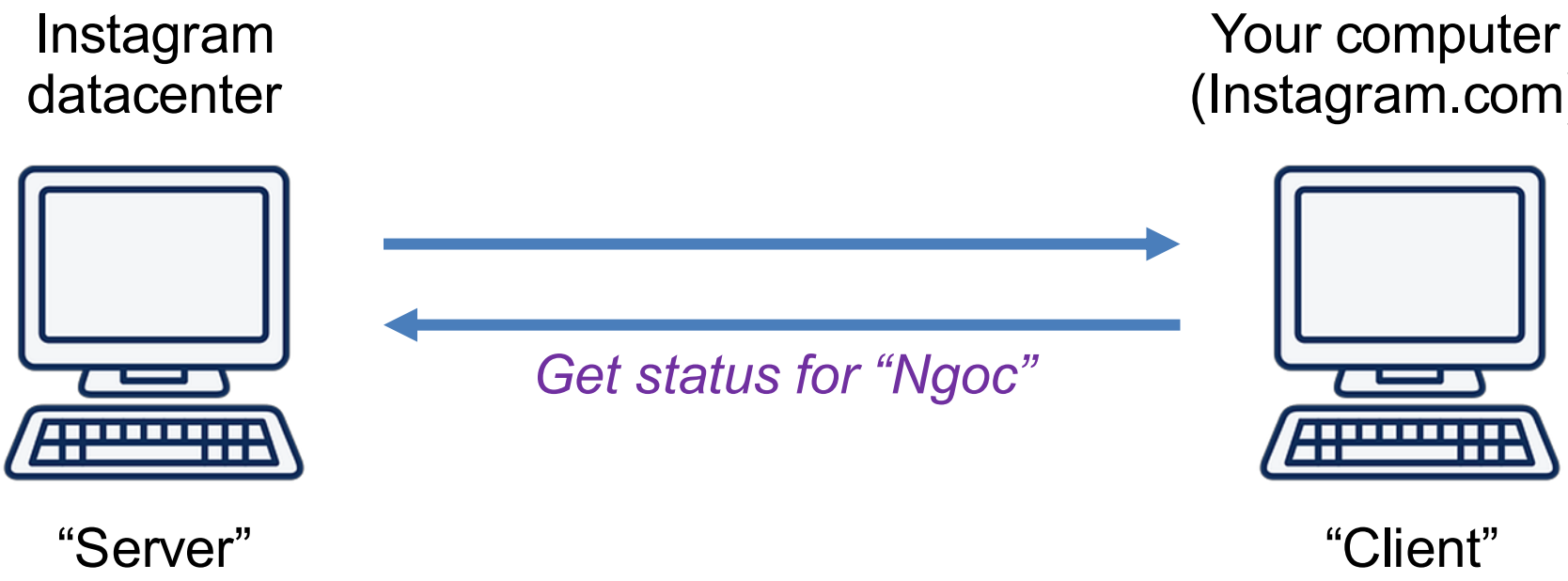
Background: The Internet

The internet is just many programs sending messages (as *Strings*)

Background: The Internet

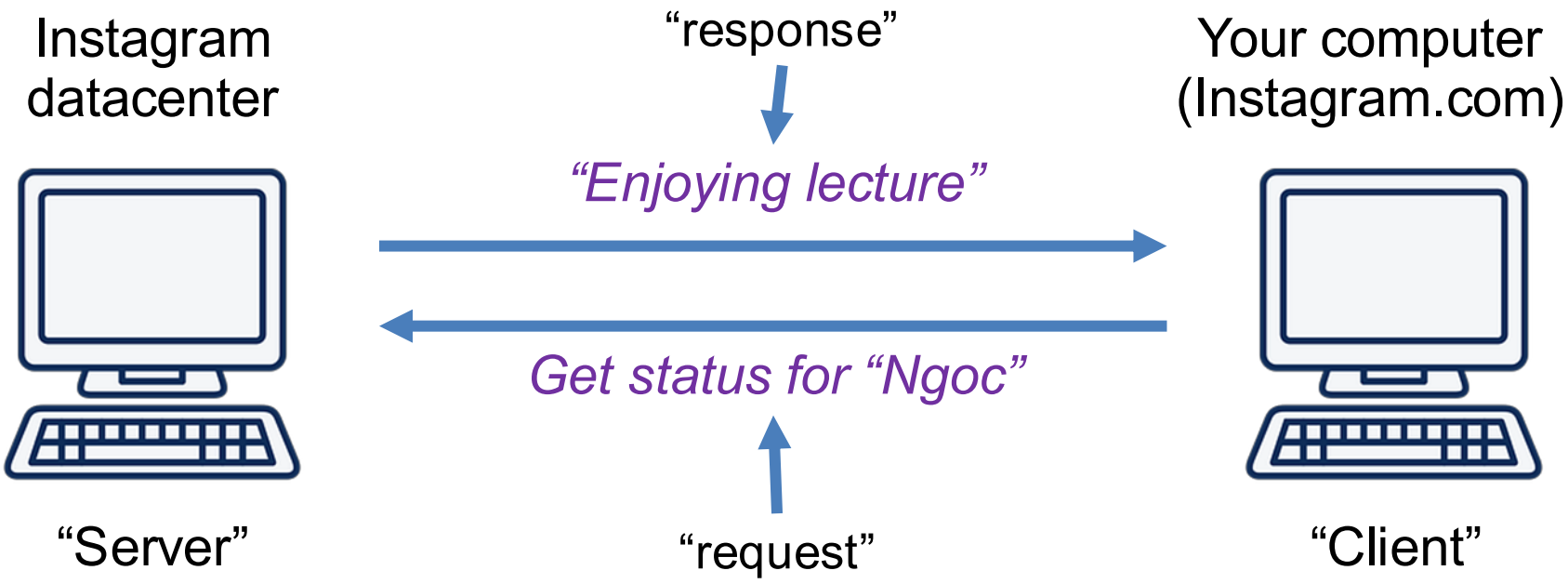
The internet is just many programs sending messages (as *Strings*)

Background: The Internet



The internet is just many programs sending messages (as *Strings*)

Background: The Internet

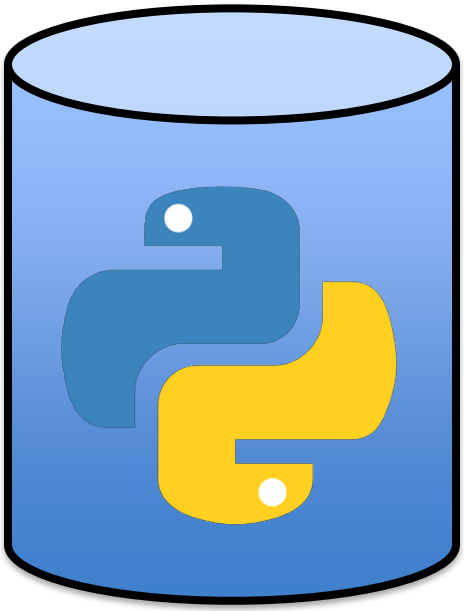


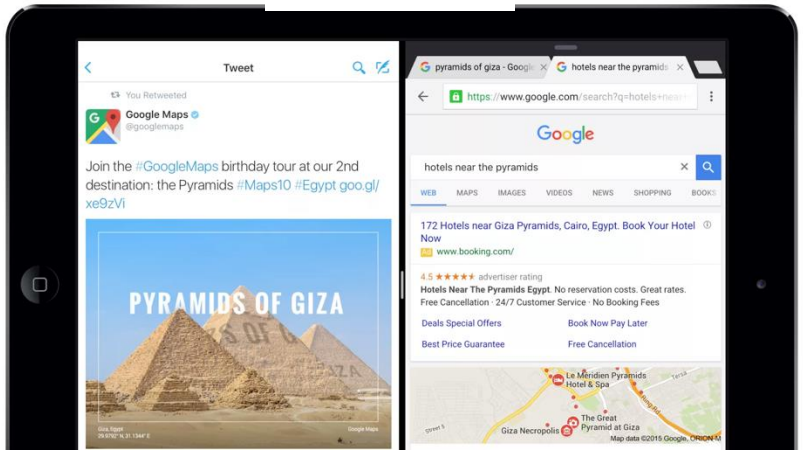
The internet is just many programs sending messages (as *Strings*)

There are two types of internet programs. Servers and Clients

Internet 101

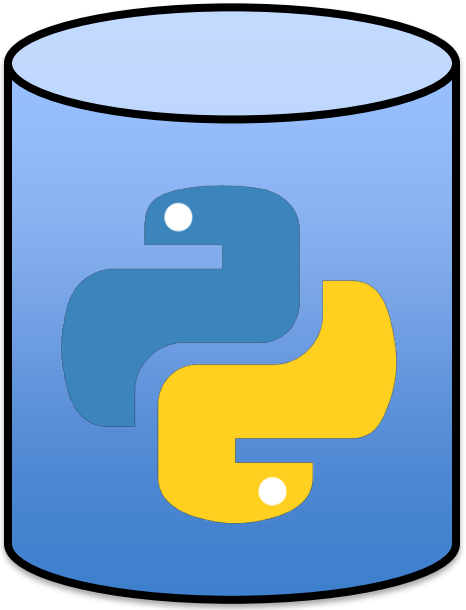
Computers on the internet



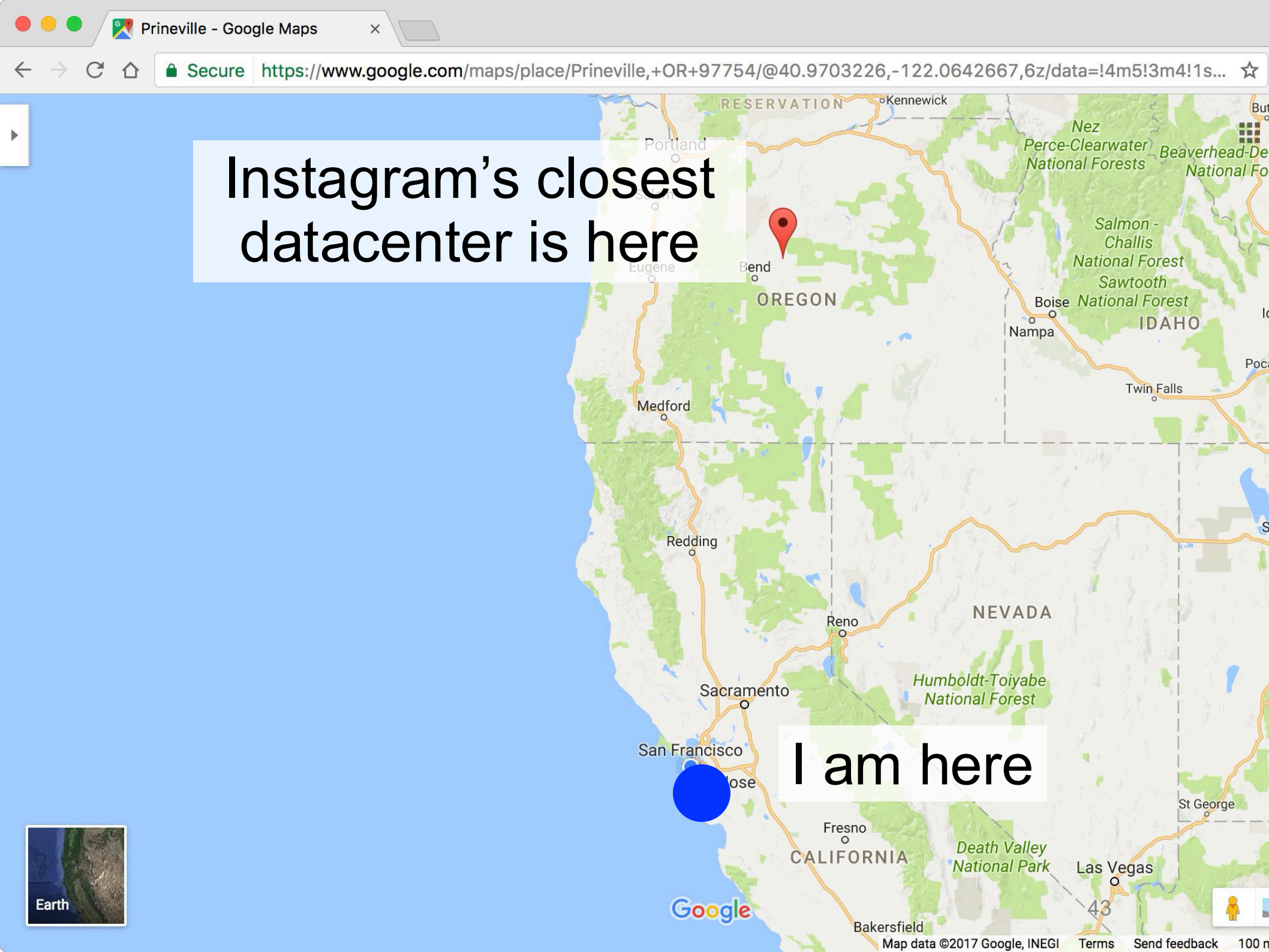


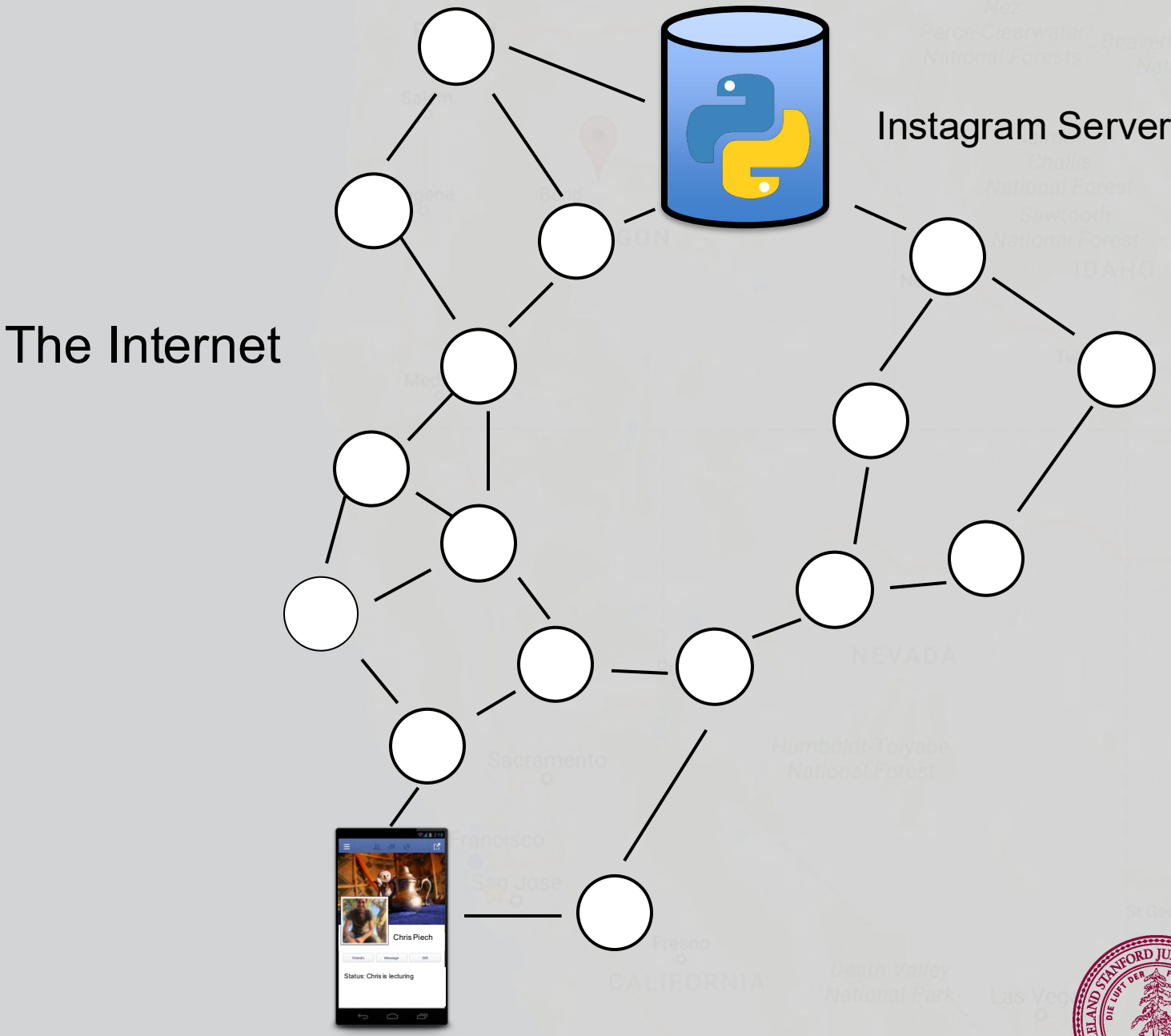
Servers are computers (running code)

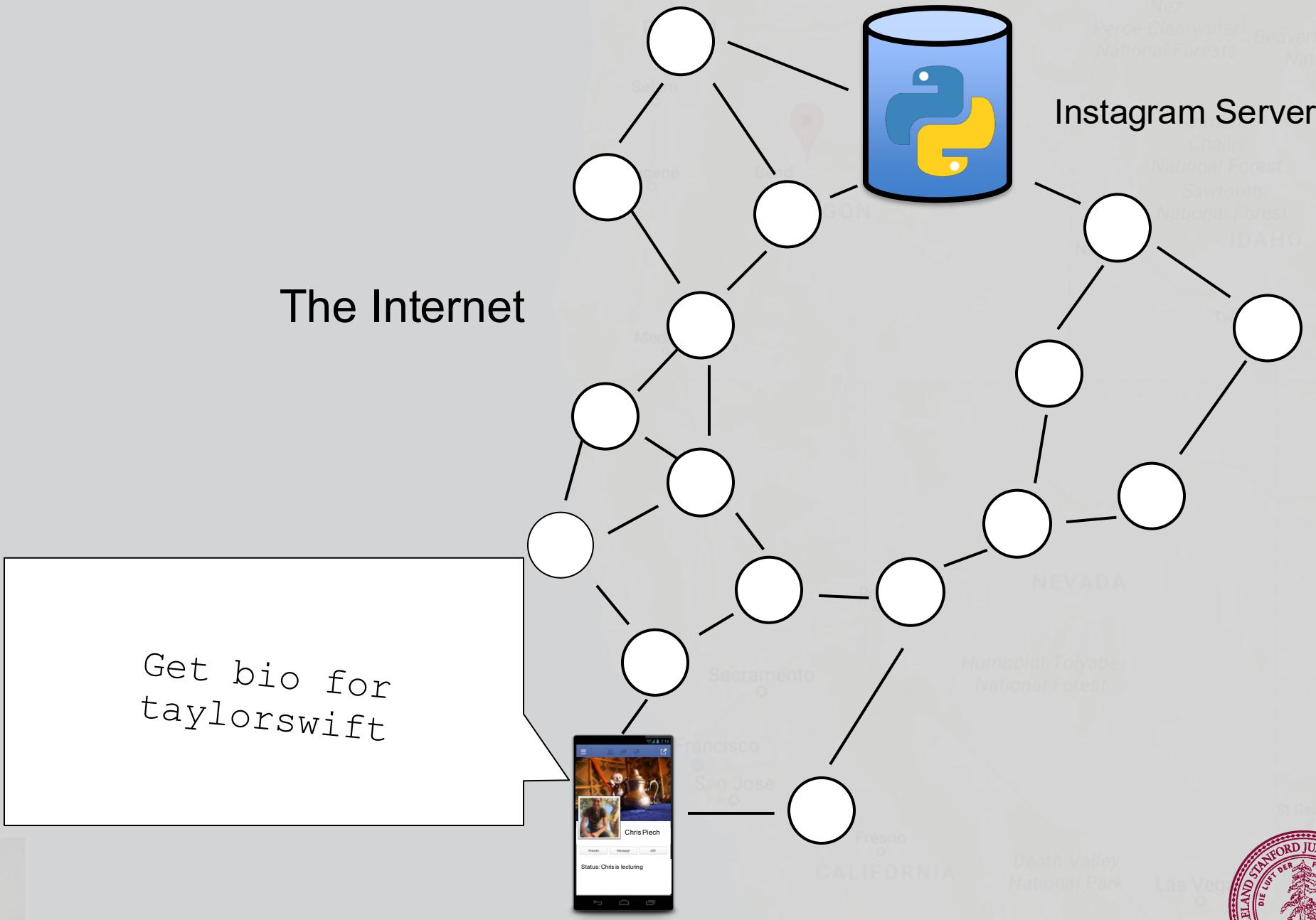
Instagram Server

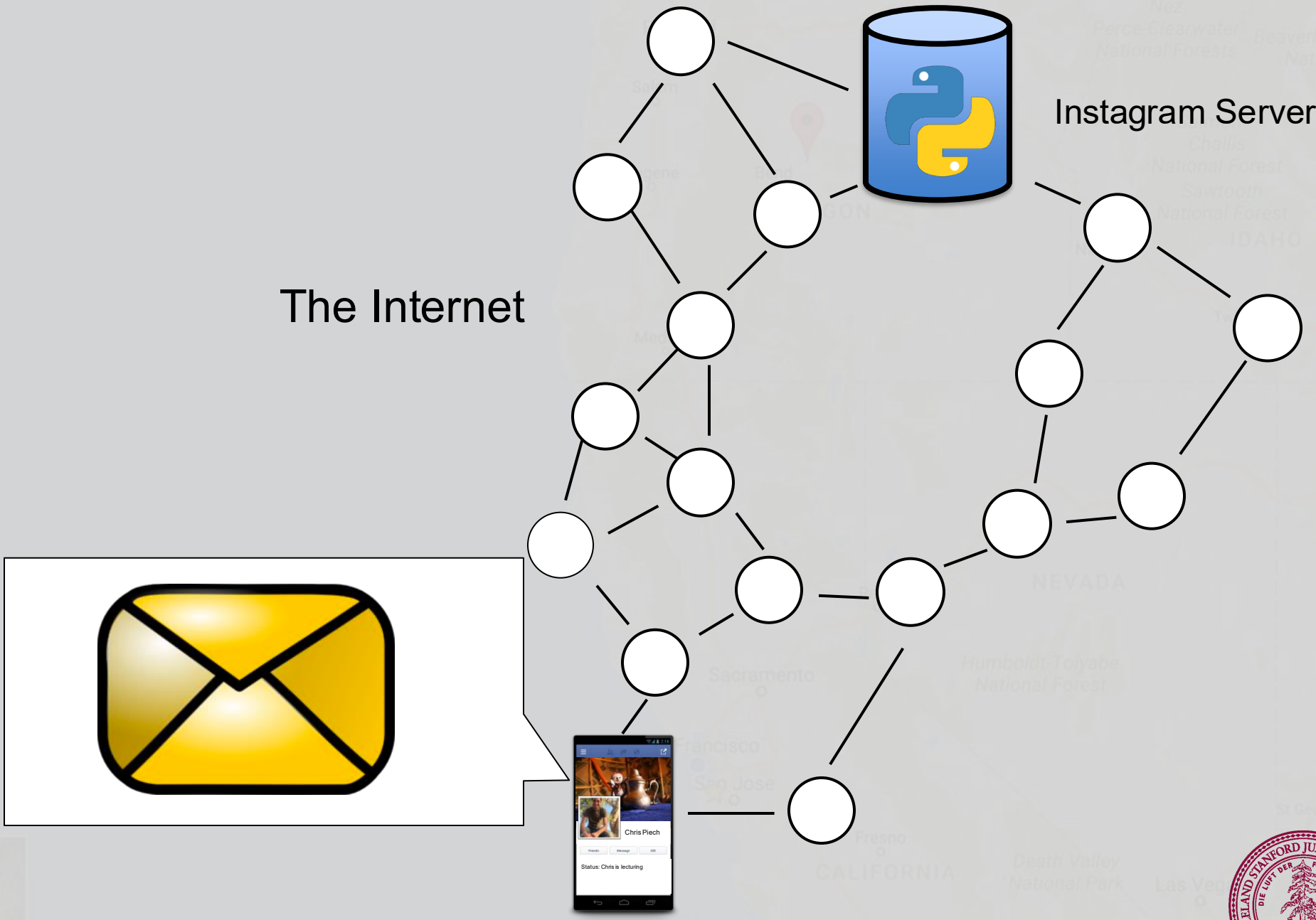


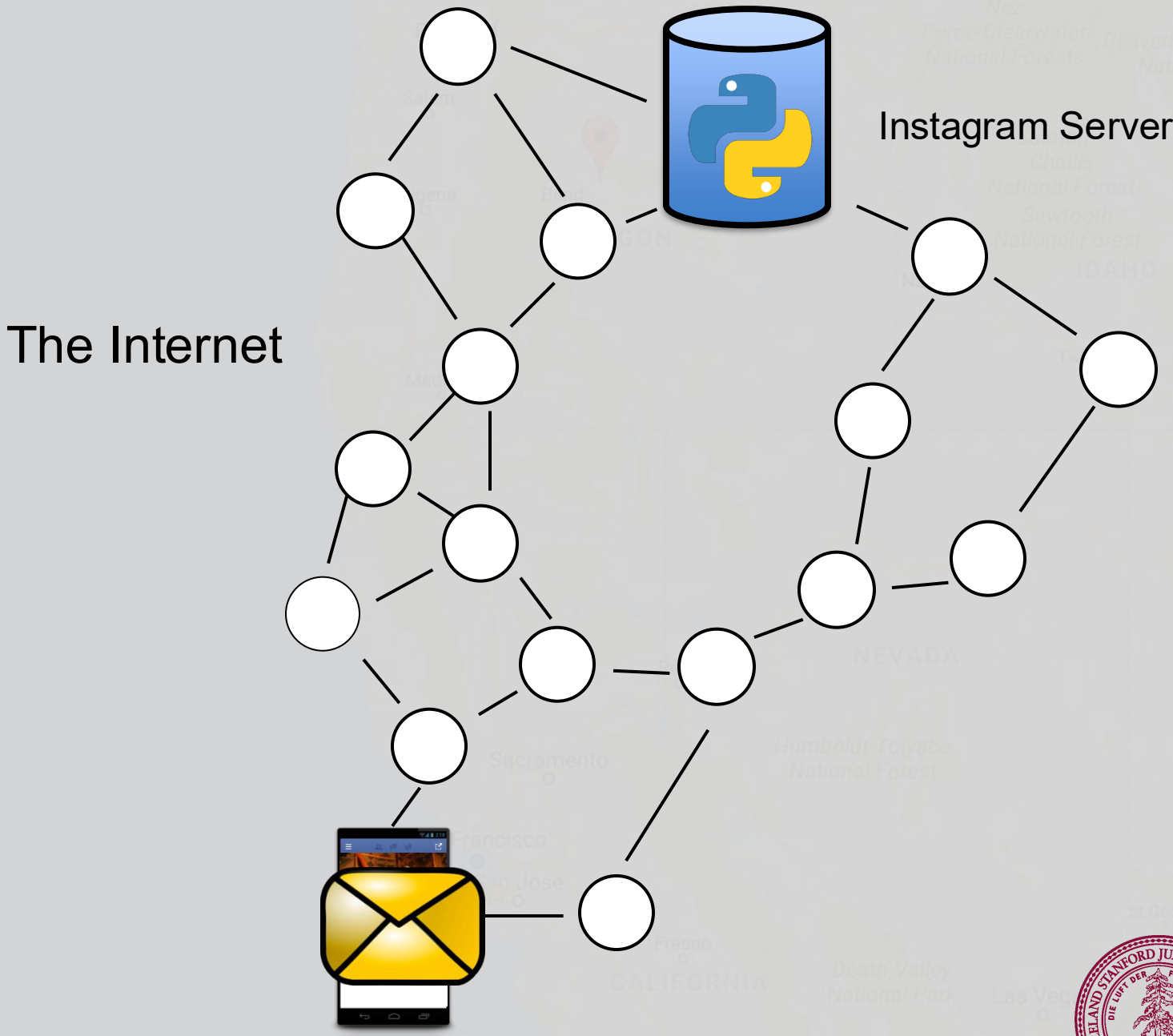
=

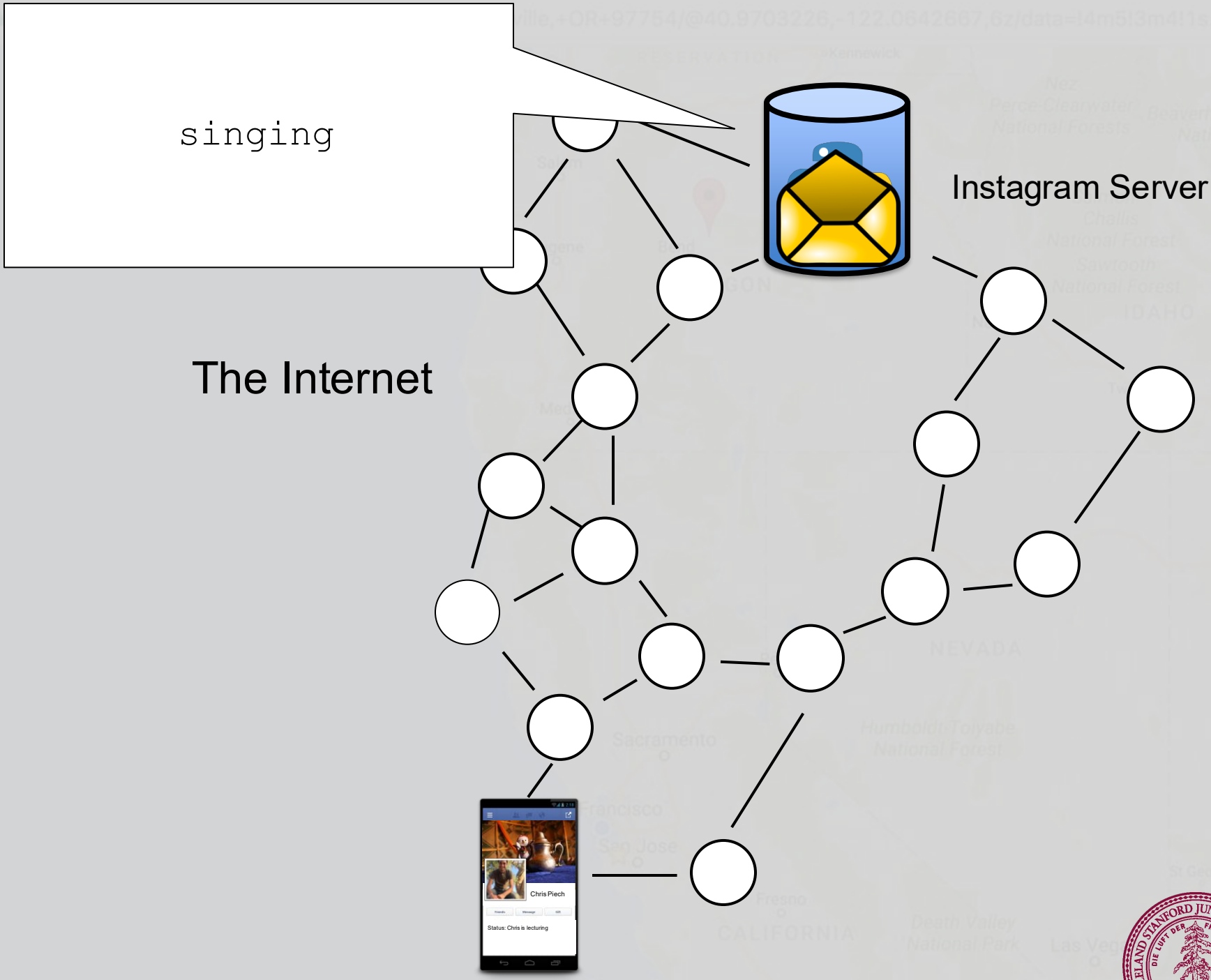

Prineville - Google Maps
Secure
https://www.google.com/maps/place/Prineville,+OR+97754/@40.9703226,-122.0642667,6z/data=!4m5!3m4!1s...
Instagram's closest datacenter is here
I am here
RESERVATION
Kennewick
Portland
Nez Perce-Clearwater National Forests
Salmon - Challis National Forest
Sawtooth National Forest
Eugene
Bend
OREGON
Boise
Nampa
IDAHO
Twin Falls
Medford
Redding
NEVADA
Reno
Humboldt-Toiyabe National Forest
Sacramento
San Francisco
St George
Fresno
CALIFORNIA
Death Valley National Park
Las Vegas
Bakersfield
Earth
Google
Map data ©2017 Google, INEGI
Terms
Send feedback

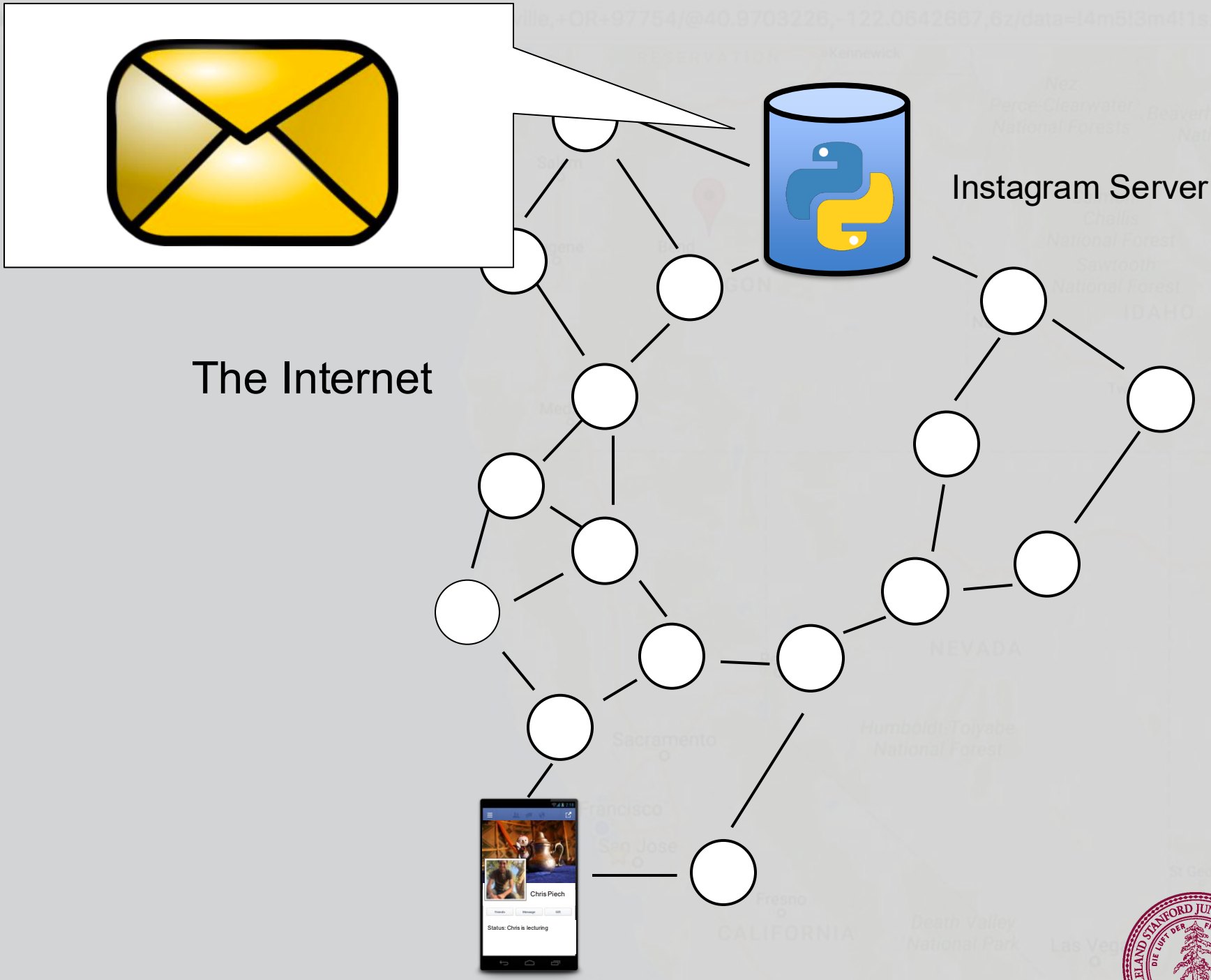

Instagram Server
The Internet
Chris Piech
Status: Chris is lecturing

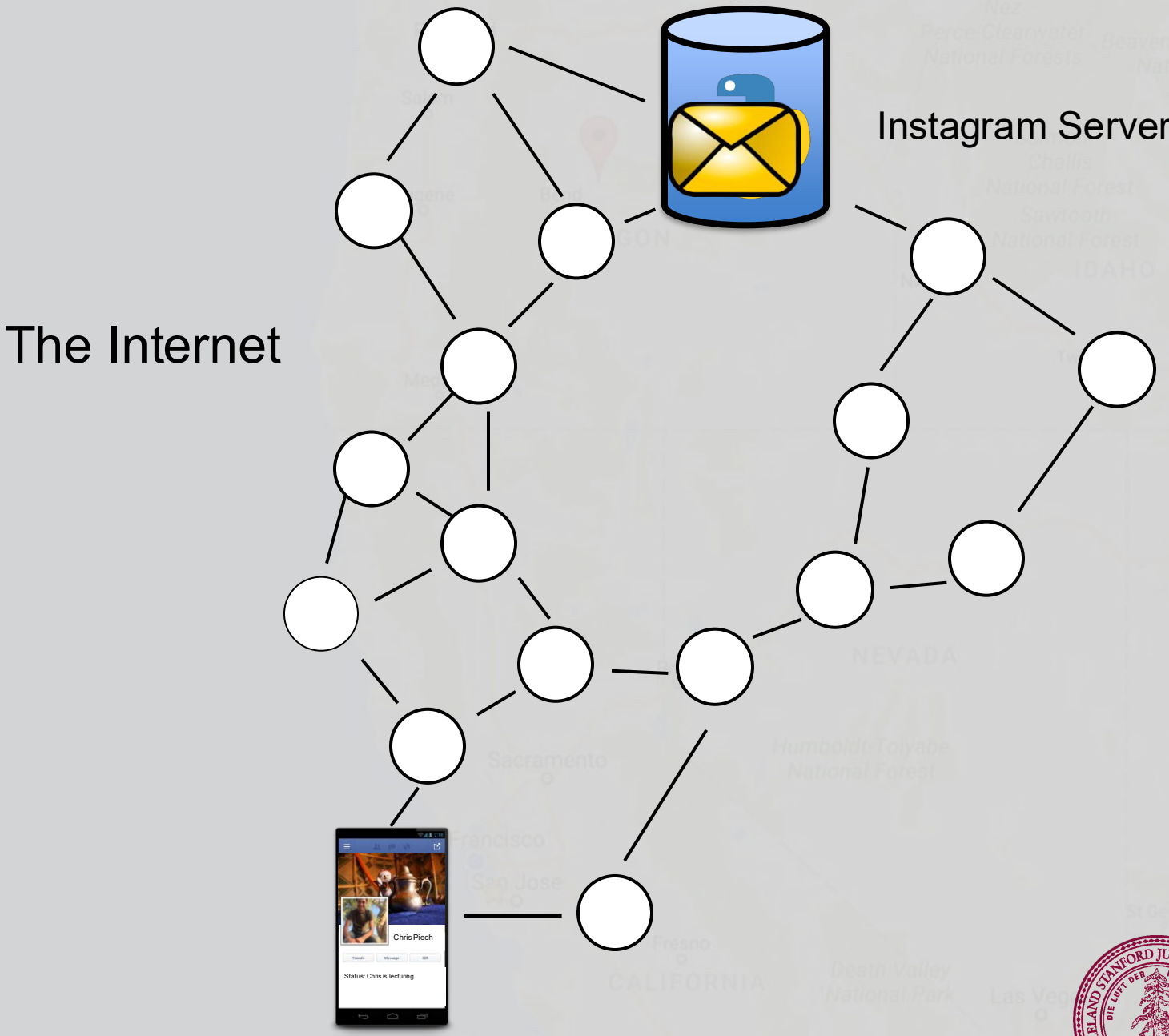

Instagram Server
The Internet
Get bio for taylorswift
Chris Piech
Status: Chris is lecturing


Instagram Server
The Internet
Chris Piech
Status: Chris is lecturing

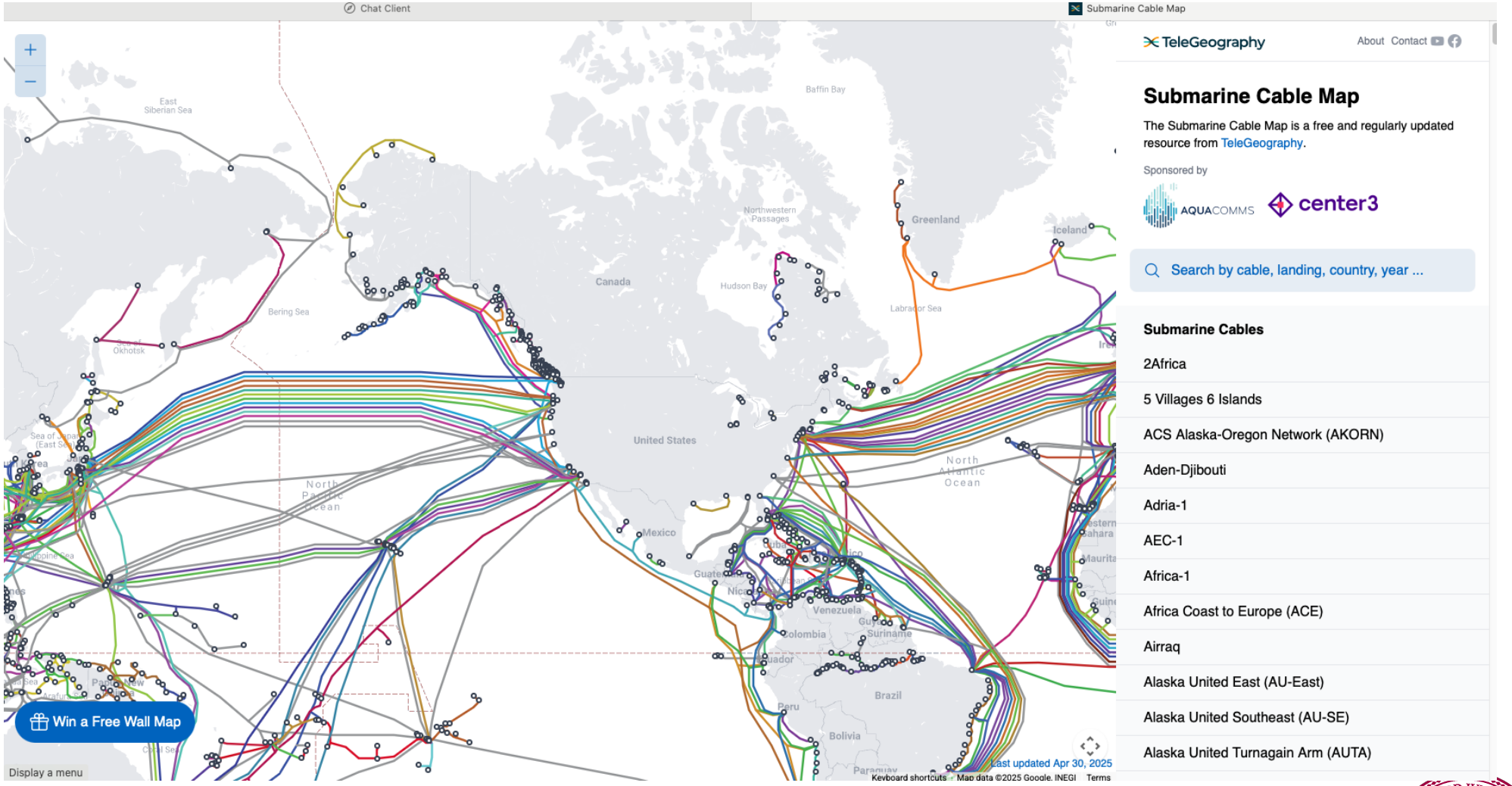

Instagram Server
The Internet


singing
Instagram Server
The Internet
Chris Piech
Status: Chris is lecturing


Instagram Server
The Internet
Chris Piech
Status: Chris is lecturing

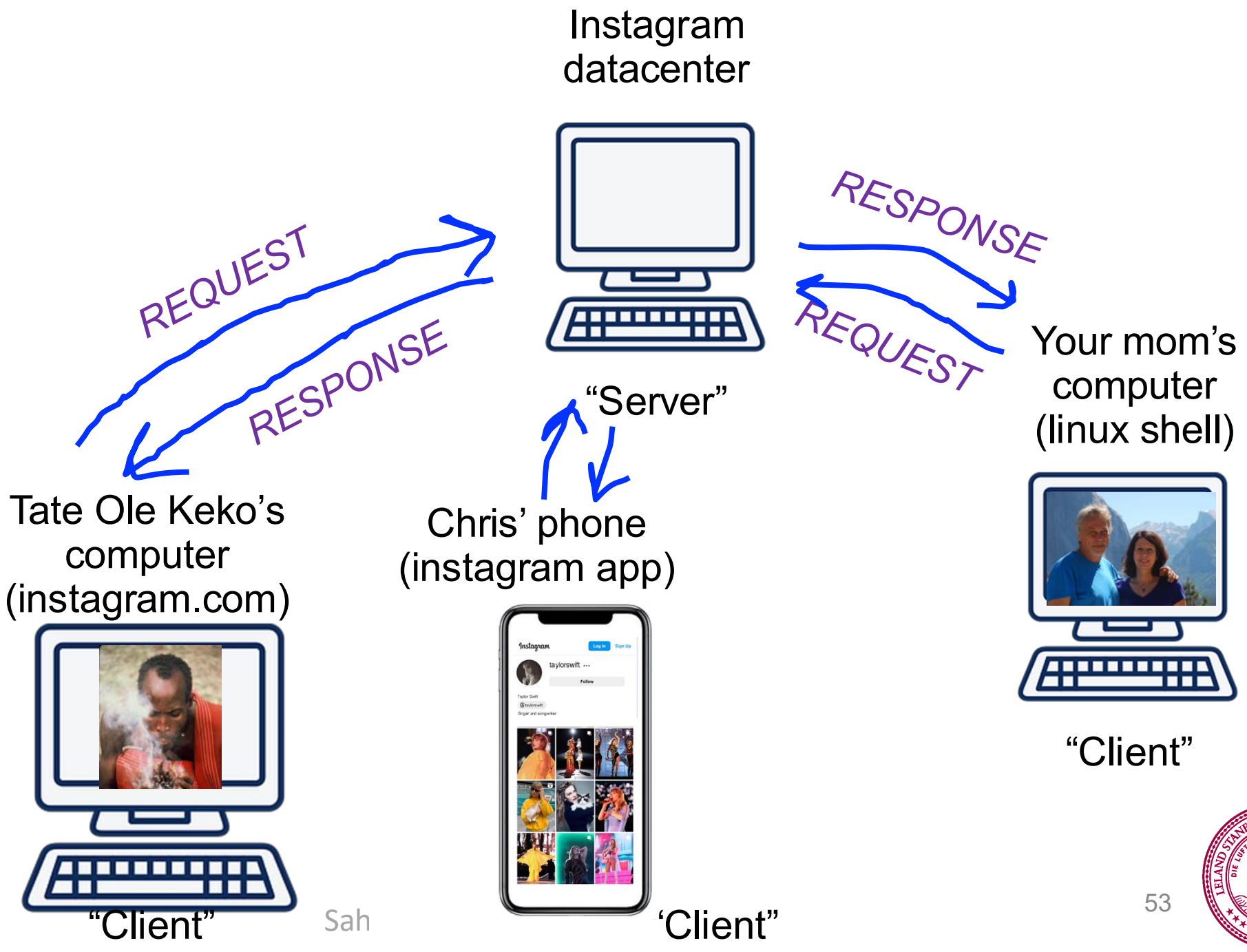

Instagram Server
The Internet
Chris Piech
Status: Chris is lecturing

Aside: submarine cables: https://www.submarinecablemap.com

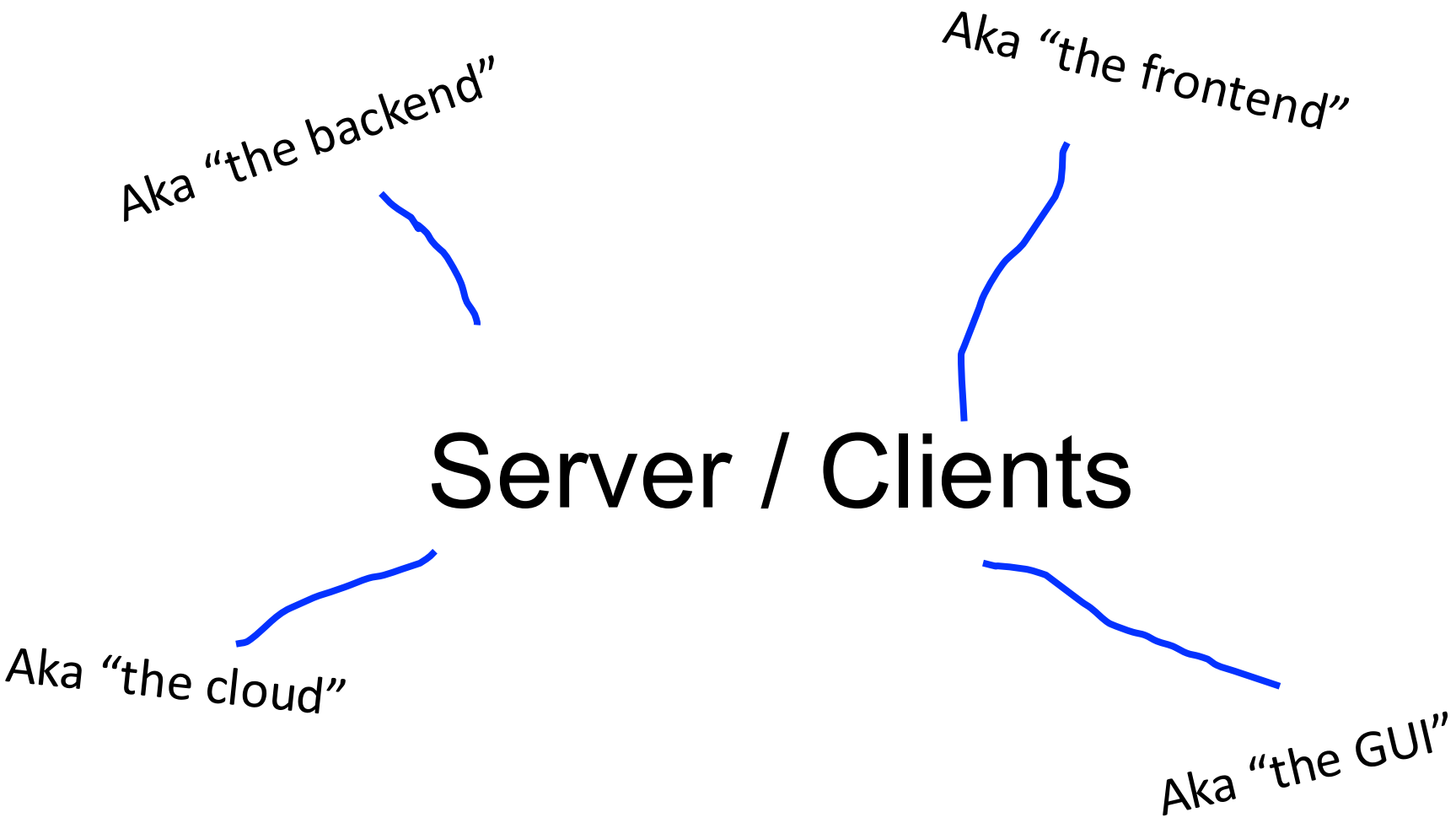


Many computers can connect to the same server

The Internet



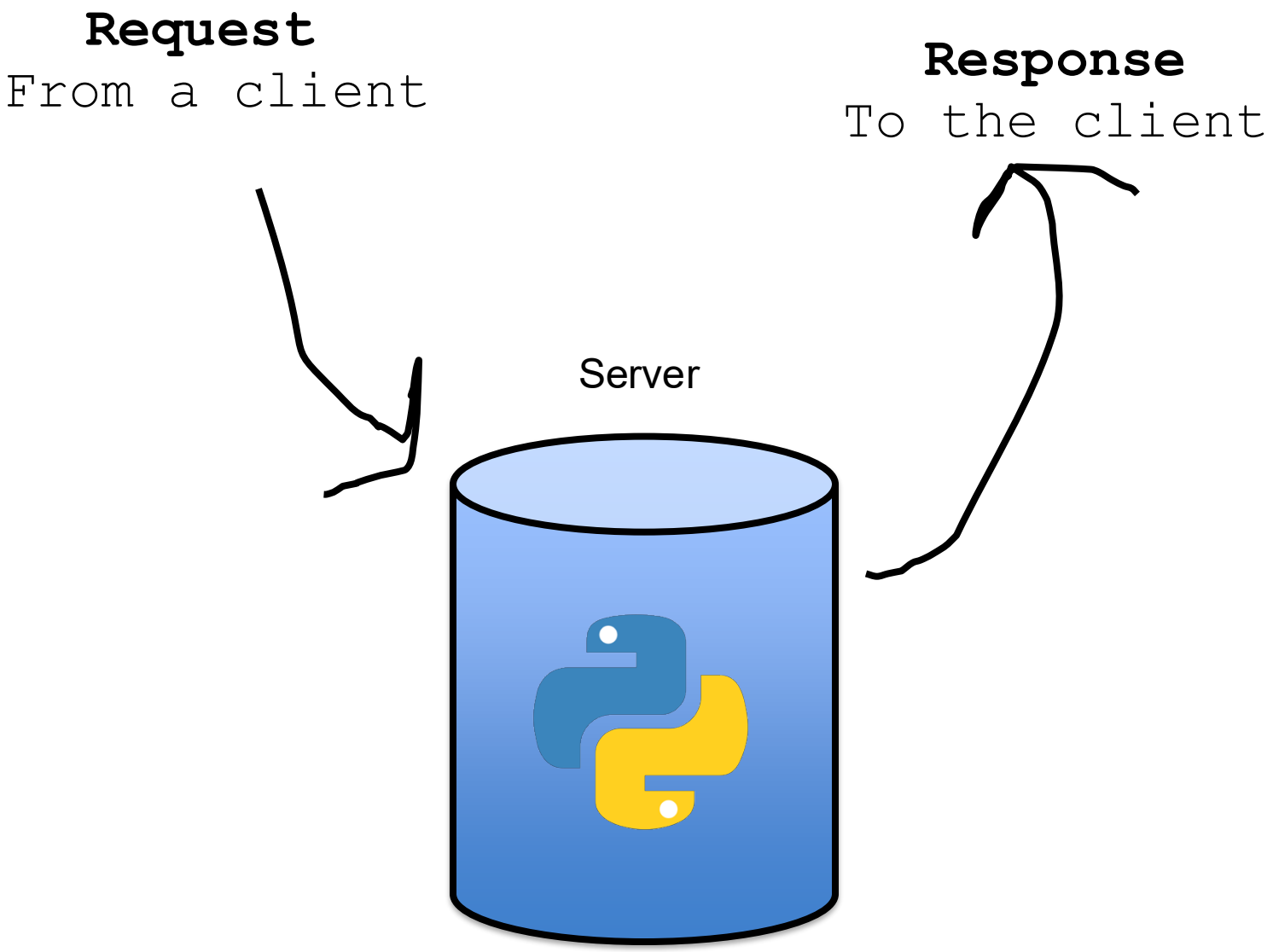
Most of the Internet



Today, the server

A server's main job is to respond to requests

A Server's Simple Purpose



A Server's Simple Purpose

Request
`someRequest`

String
`serverResponse`

Servers on one slide

1

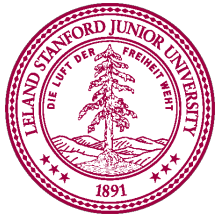
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = MyServer()
    # start the server!
    SimpleServer.run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = HitServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

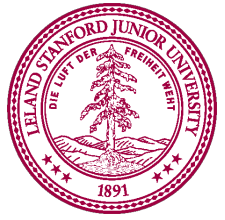
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = HitServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

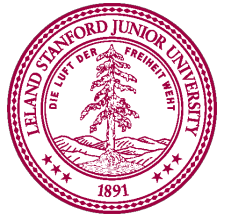
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = HitServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

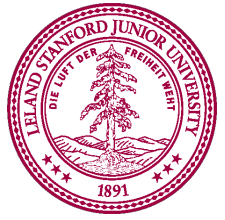
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = HitServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

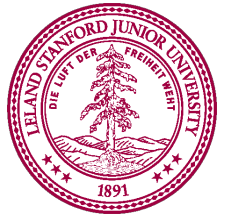
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = HitServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

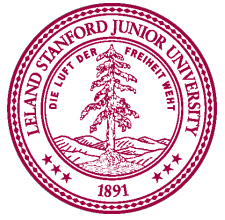
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = HitServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    return "hello world"
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = HitServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

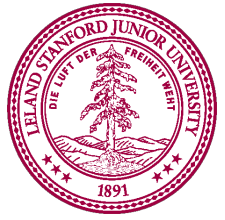
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = HitServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

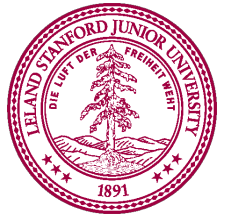
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = MyServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

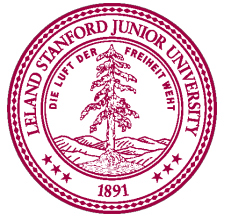
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = MyServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

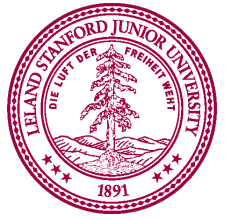
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = MyServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

What is a Port?

Servers on one slide

1

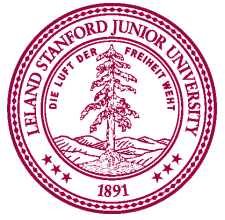
```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = MyServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

Servers on one slide

1

```
# handle server requests (must be in a class)
class MyServer:
  def handle_request(self, request):
    # return a string response!
```

2

```
# turn on the server
def main():
    # make an instance of your server class
    handler = HitServer()
    # start the server!
    run_server(handler, 8000)
```

3

```
# enjoy
```

What is a Request?

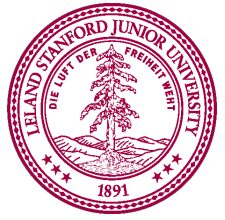
```
/* Request has a command */
command (type is string)

/* Request has parameters */
params (type is dict)
```

```
// methods that the server calls on requests
request.get_command()
request.get_params()
```

```
class Request:
    '''
    The request class packages the key information from an internet requ
    An internet request has both a command and a dictionary of parameter
    This class defines a special function __str__ which means if you hav
    instance of a request you can put it in a print function.
    '''
    def __init__(self, request_command, request_params):
        # every request has a command (string)
        self.command = request_command
        # every request has params (dictionary). Can be {}
        self.params = request_params

    def get_params(self):
        # a 'getter' method to get the params
        return self.params


    def get_command(self):
        # a 'getter' method to get the command
        return self.command


    def __str__(self):
        # a special method which says what happens when you 'print' a re
        return 'command=\'' + self.command + '\' params=' + str(self.par
```

First Server Example!

```
from SimpleInternet import run_server
import json


class MyServer:
    def __init__(self):
        ''' You can store data in your server! '''
        pass

    # this is the server request callback function.
    def handle_request(self, request):
        ''' This function gets called every time someone makes a
        request to our server.'''
        return 'hello world'



def main():
    # make an instance of your server class
    handler = MyServer()
    # start the server to handle internet requests!
    run_server(handler, 8000)
```

Housekeeping

- Assignment 5 (last assignment!) due back Wednesday August 12th at 11:59PM
- Final exam logistics + materials on course website now
- Last lecture: Monday August 10th (final exam review)

Who makes requests?

Who makes requests?

Other programs can send requests!

```
response = requests.get('https://xkcd.com/353/')
```

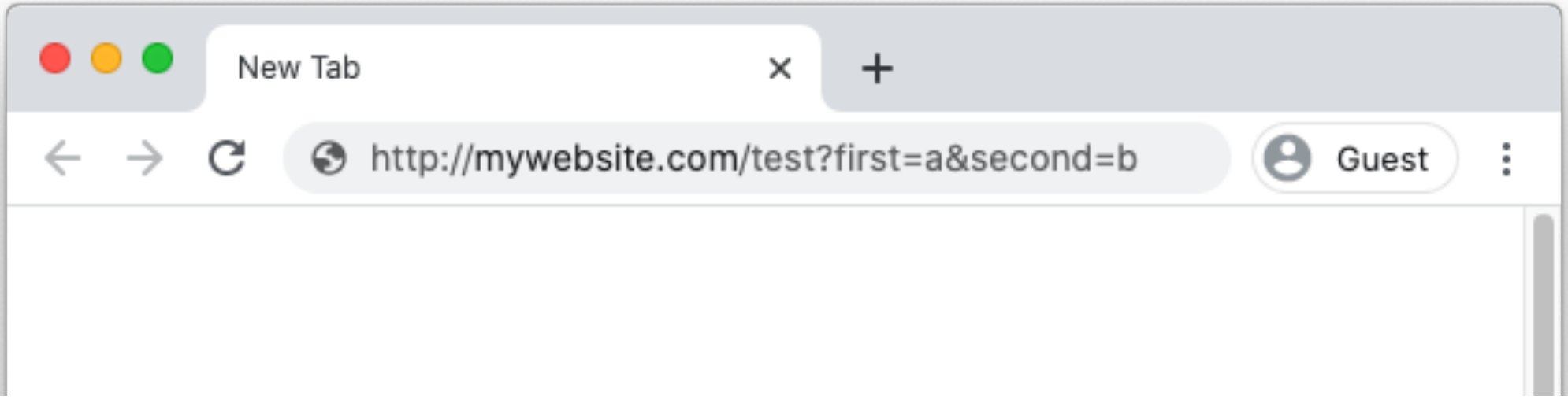
Who makes requests?

Other programs can send requests!

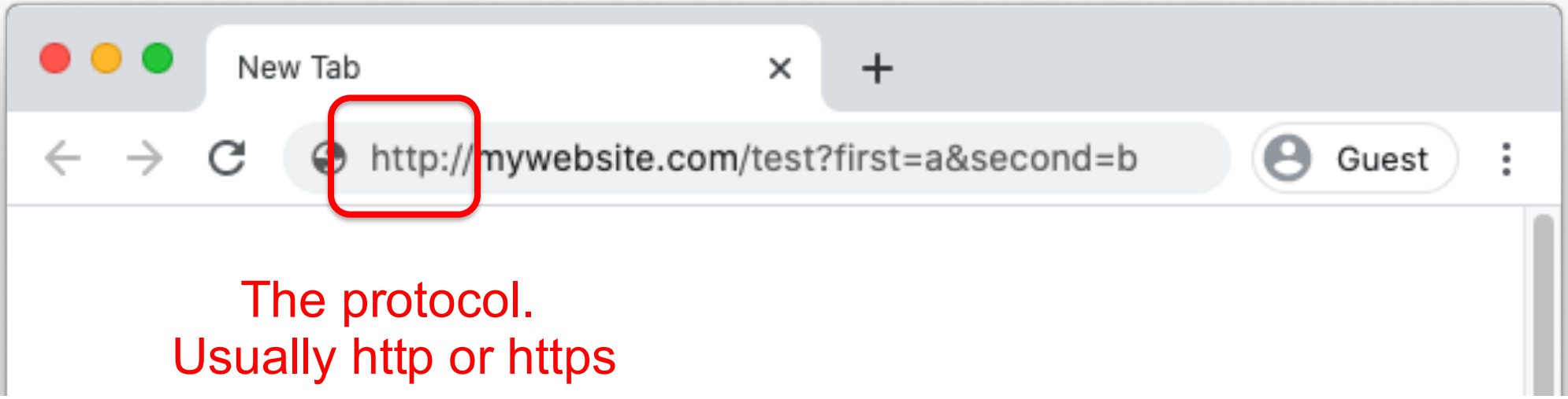
```
response = requests.get('https://xkcd.com/353/')
```

Web browsers can send requests!

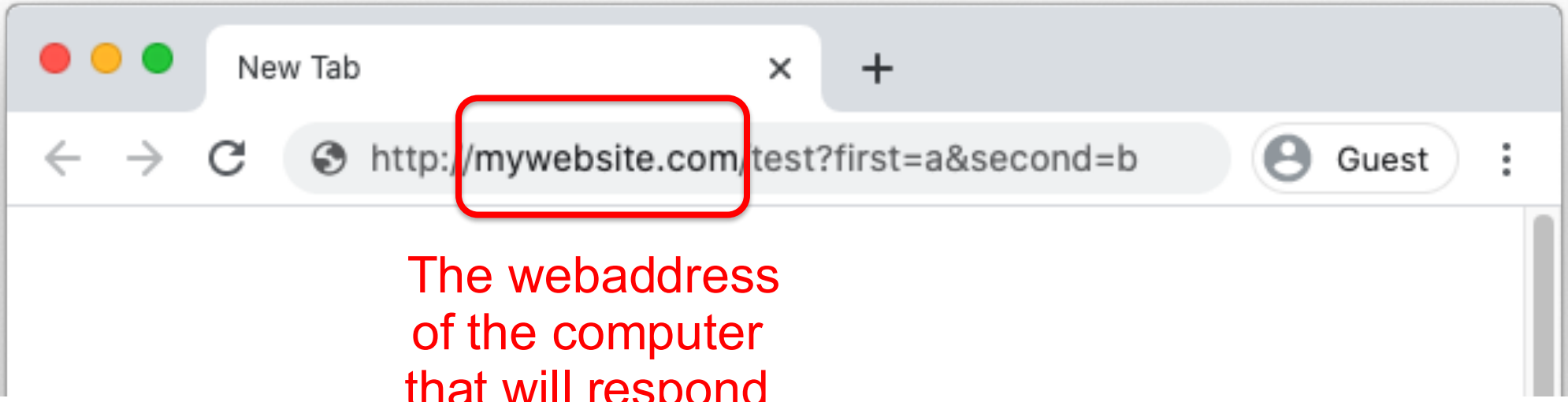
Anatomy of a Browser Request



Anatomy of a Browser Request

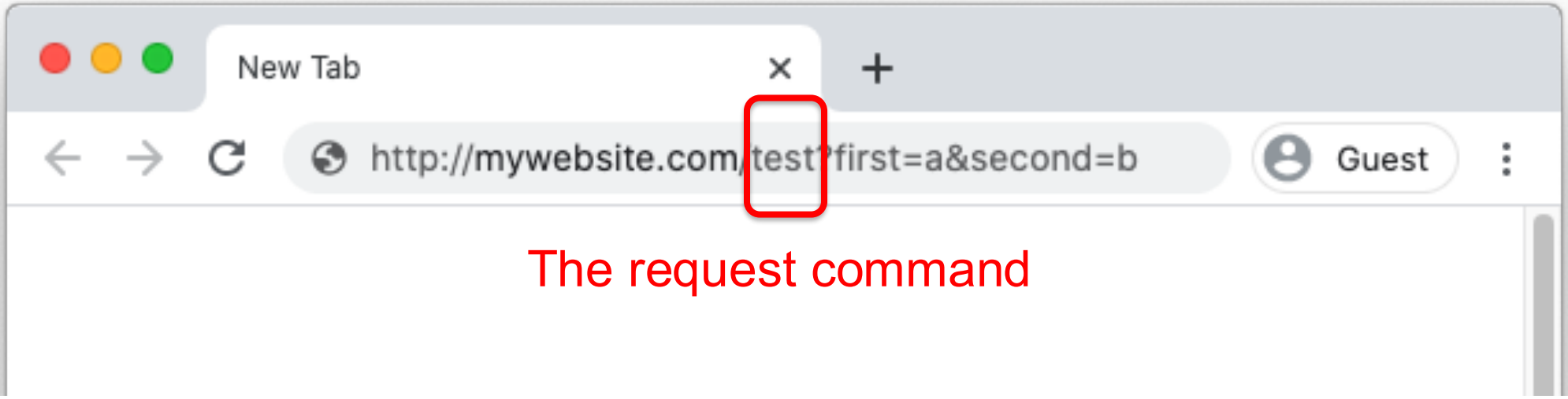


Anatomy of a Browser Request

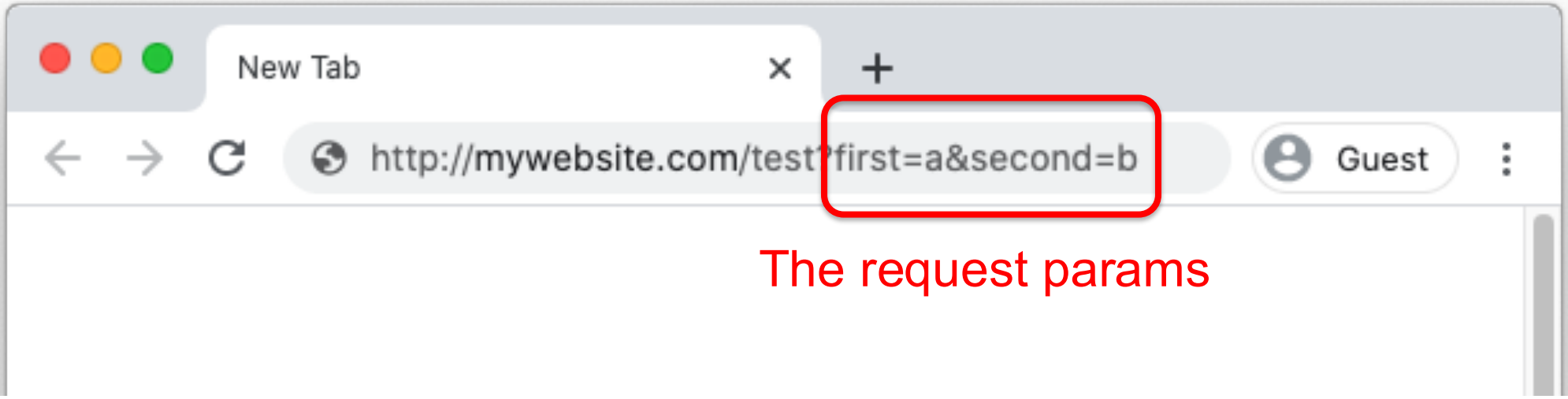


The webaddress of the computer that will respond to the request

Anatomy of a Browser Request

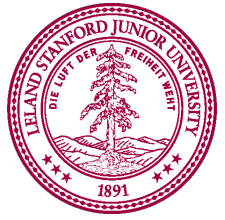


Anatomy of a Browser Request



First Server Example!

```
from SimpleInternet import run_server
import json


class MyServer:
    def __init__(self):
        ''' You can store data in your server! '''
        pass

    # this is the server request callback function.
    def handle_request(self, request):
        ''' This function gets called every time someone makes a
        request to our server.'''
        return 'hello world'



def main():
    # make an instance of your server class
    handler = MyServer()
    # start the server to handle internet requests!
    run_server(handler, 8000)
```

Recall Requests

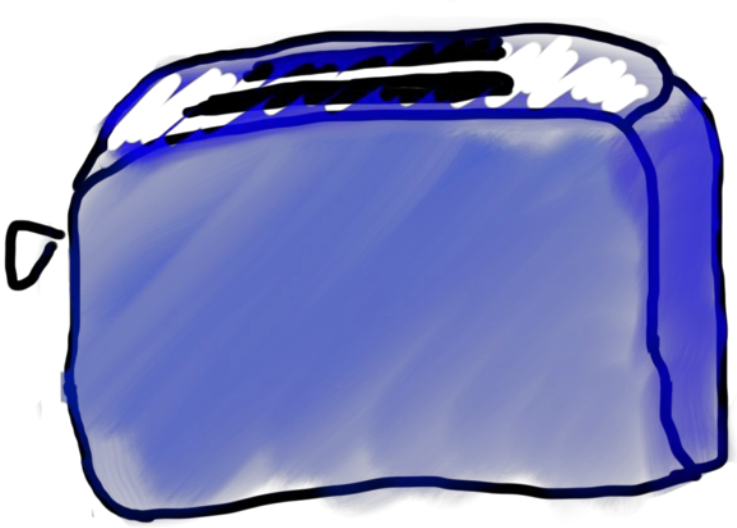
```
/* Request has a command */
command (string)

/* Request has parameters */
params (dict)
```

```
// methods that the server calls on requests
request.get_command()
request.get_params()
```

Requests are like Remote Method Calls

Server has a bunch of discrete things it can do

Server



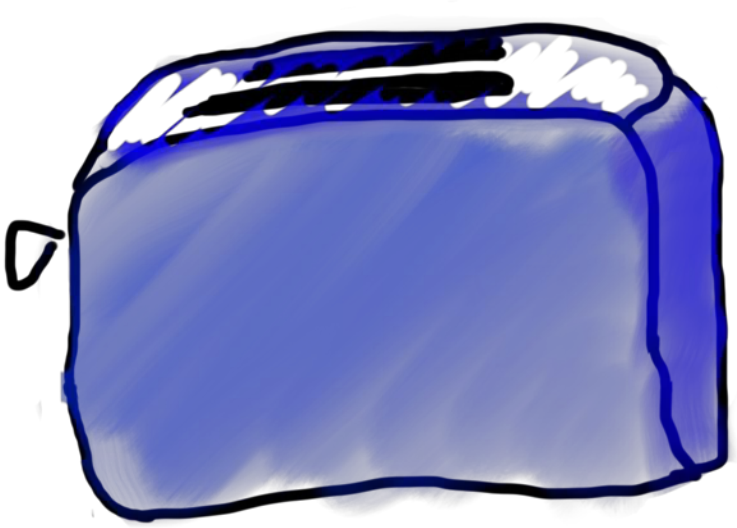
make_toast

blend

Requests are like Remote Method Calls

Server has a bunch of discrete things it can do

Server

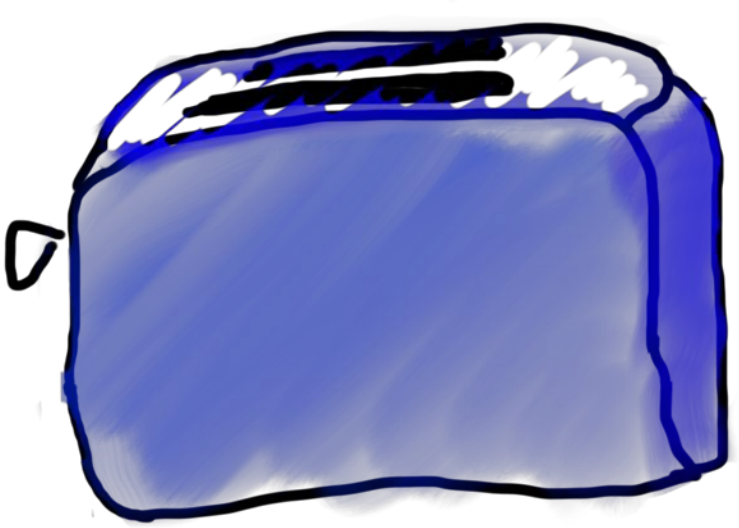


get_status

add_user

Requests are like Remote Method Calls

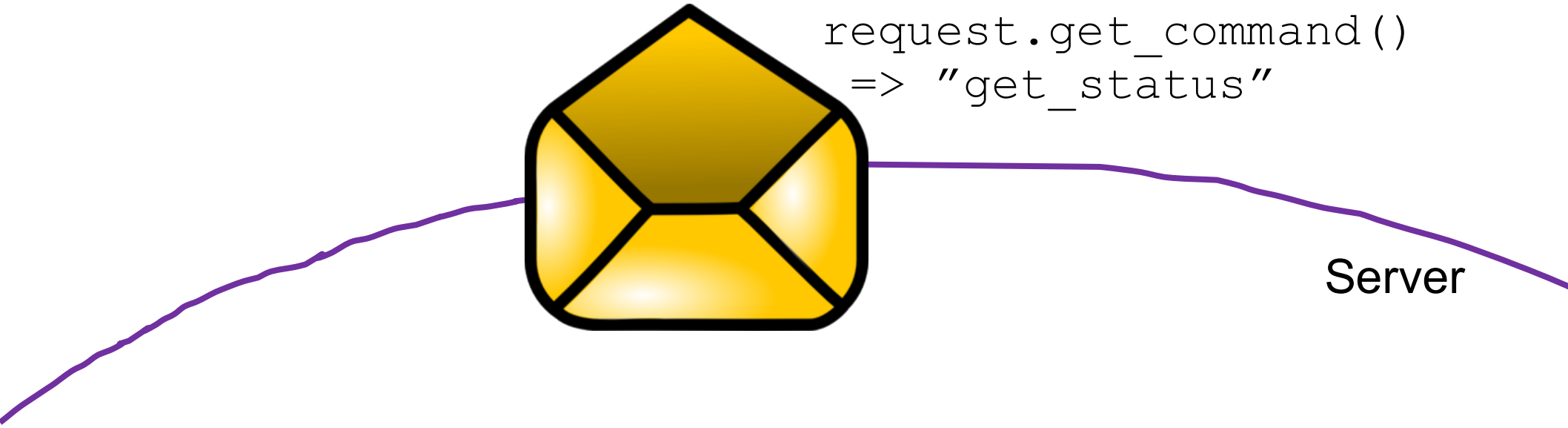
Server

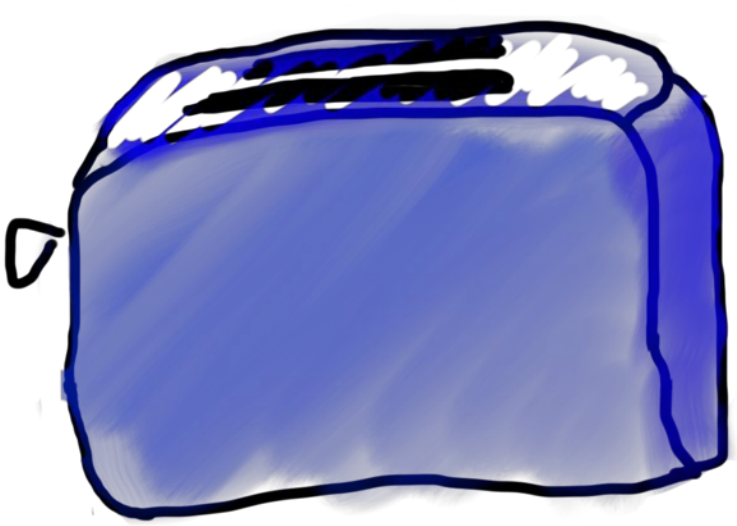


get_status

add_user

Requests are like Remote Method Calls



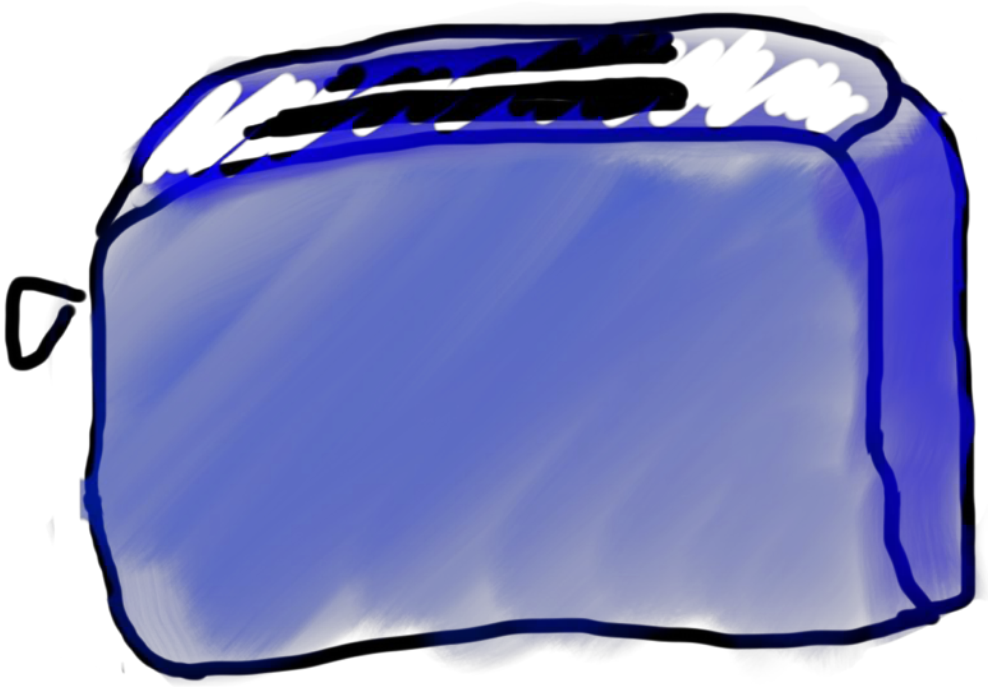


get_status

add_user

Requests are like Remote Method Calls

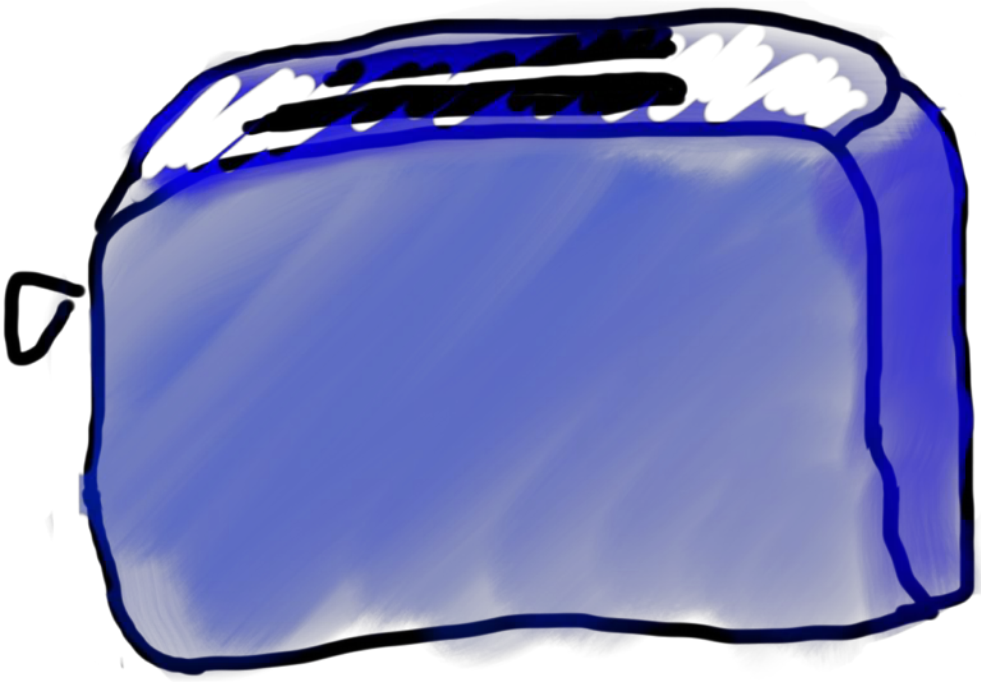
To make toast, I need a parameter which is the kind of bread



get_status

Requests are like Remote Method Calls

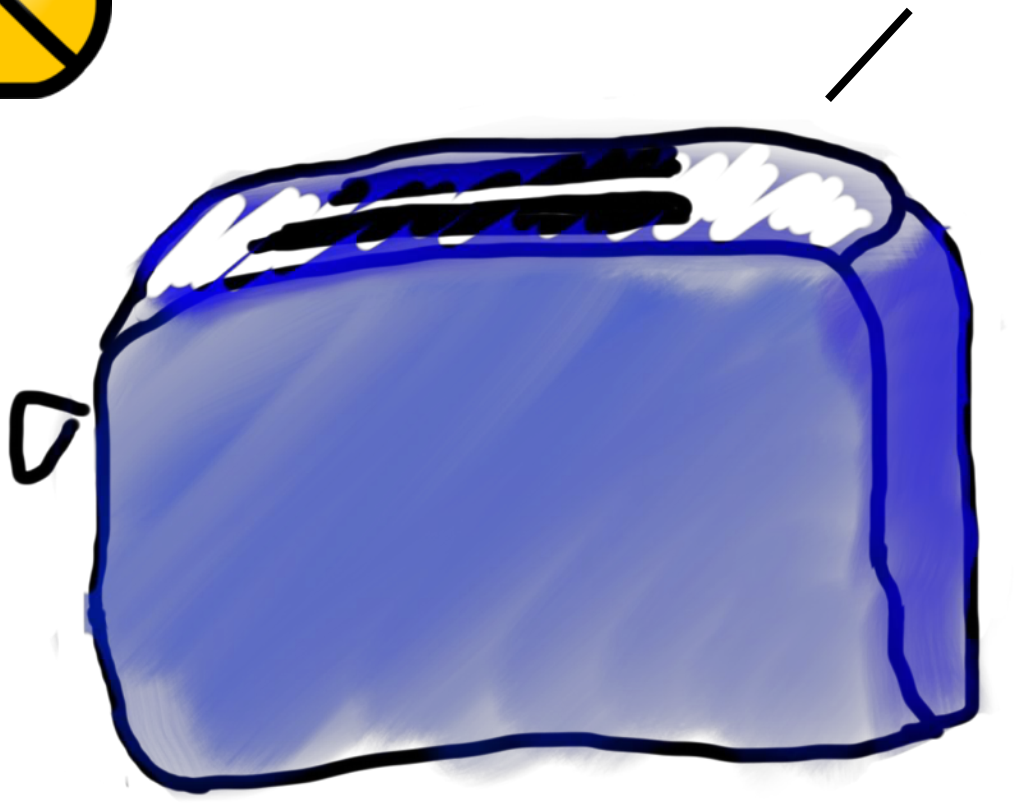
I was given a parameter!



get_status

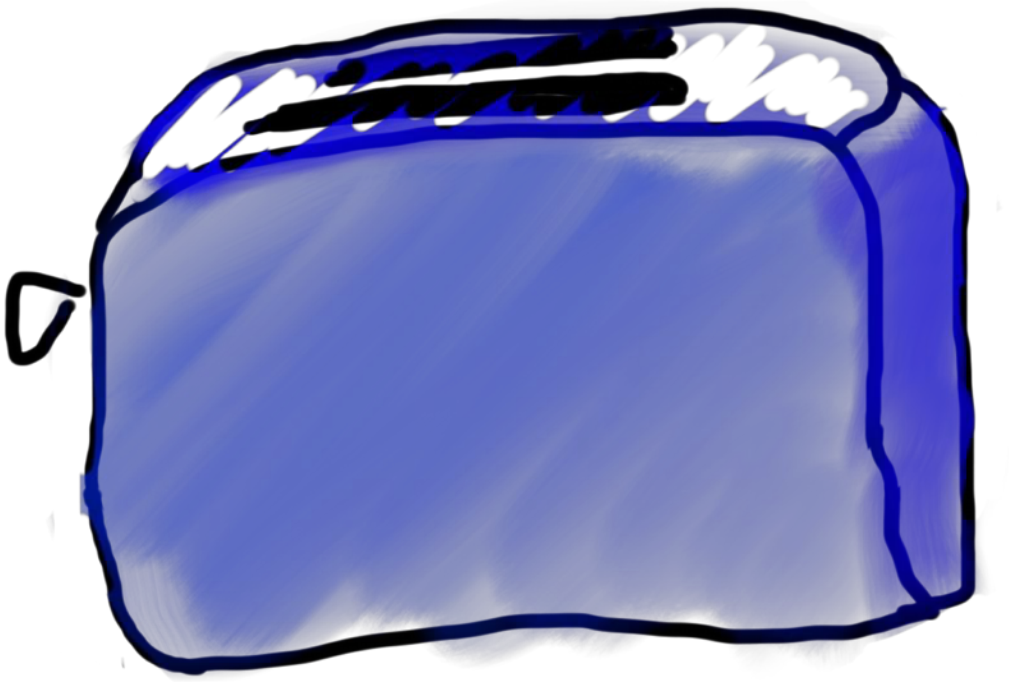
Requests are like Remote Method Calls

`request.params["userName"]`



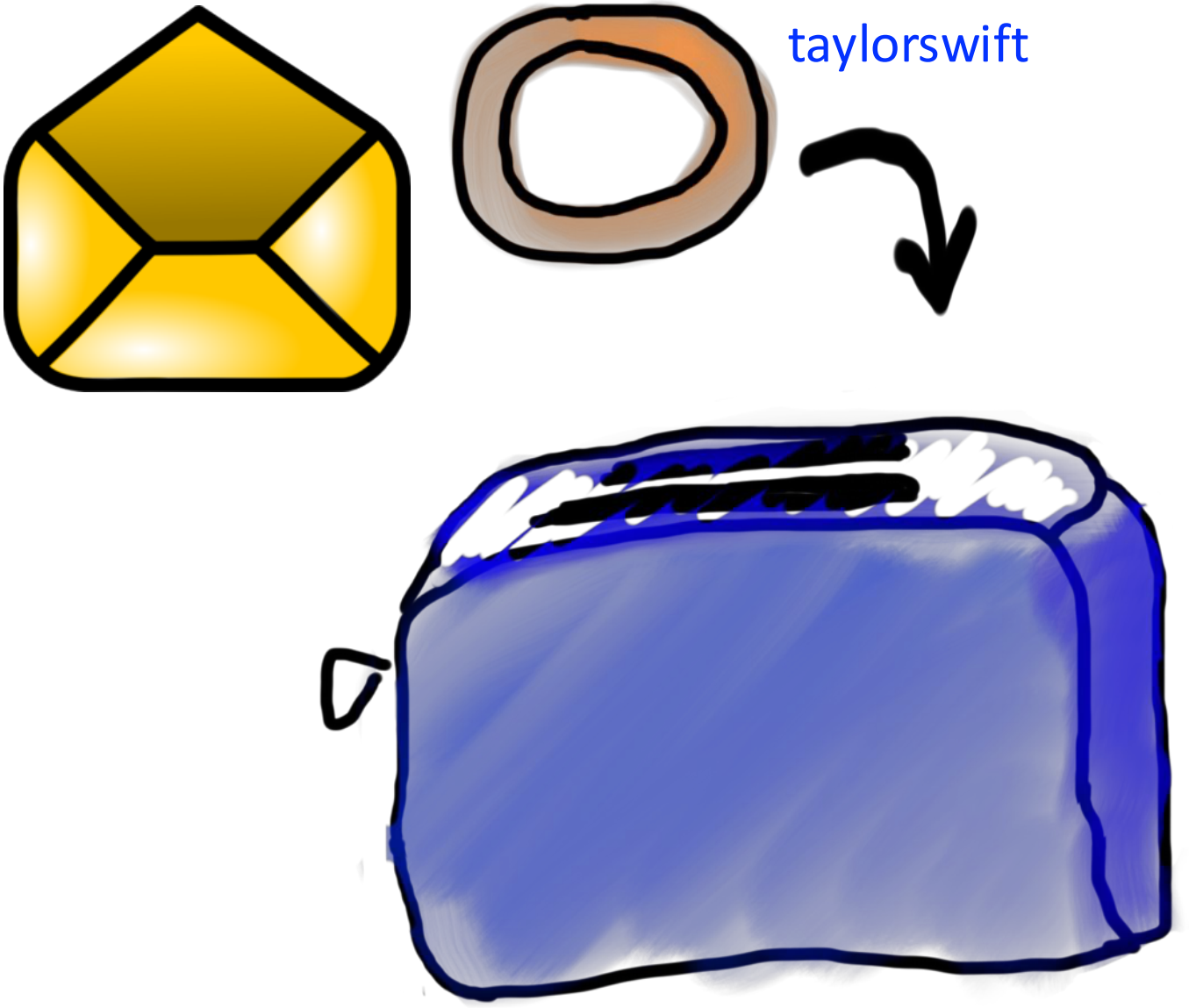
get_status

Requests are like Remote Method Calls

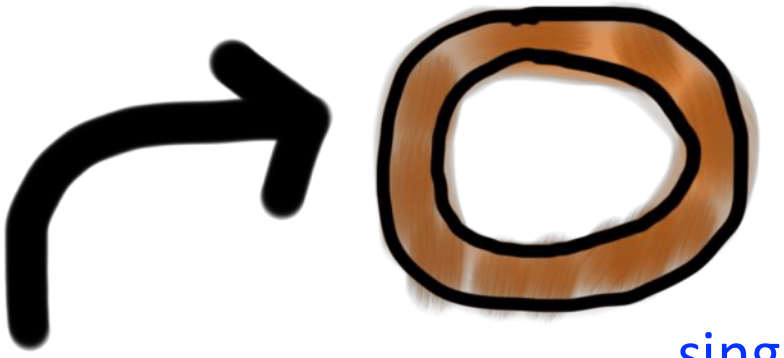


get_status

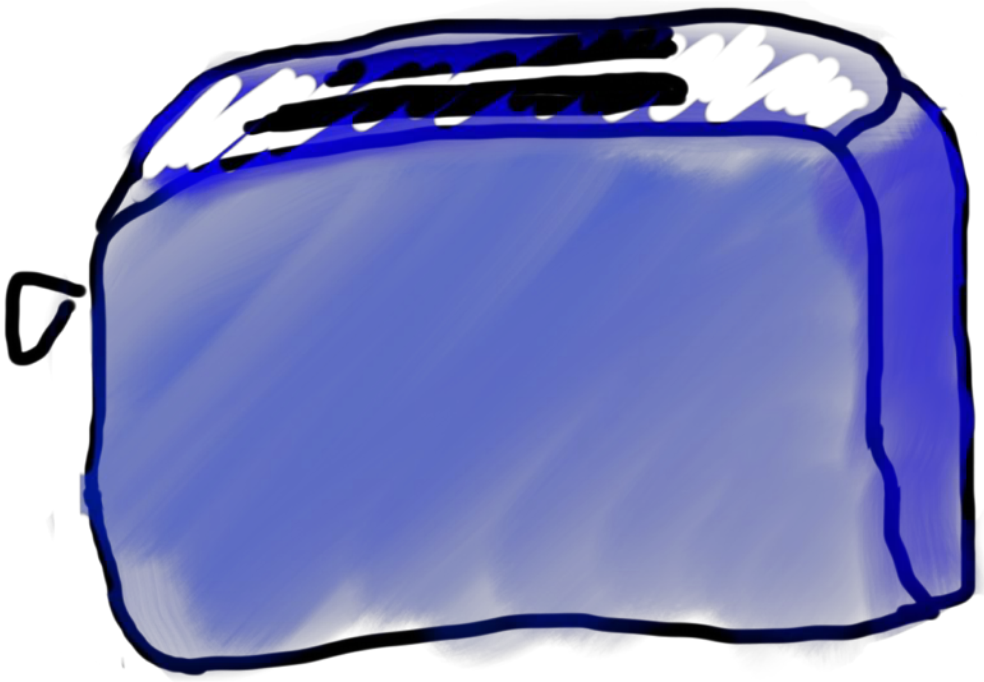
Requests are like Remote Method Calls



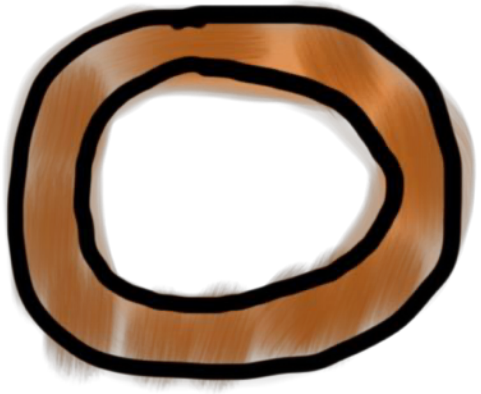
Requests are like Remote Method Calls



singing

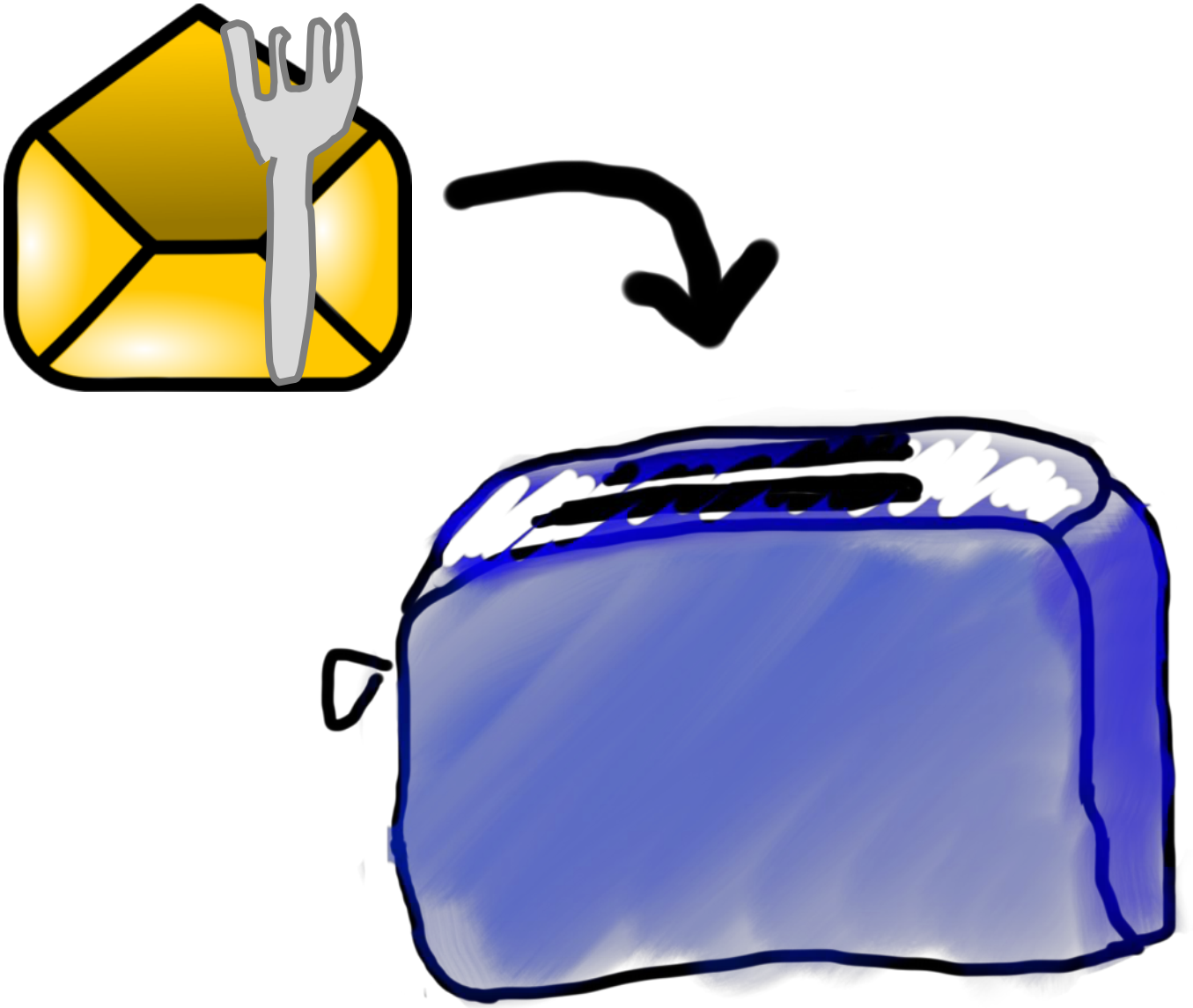


```
def handle_request(self, request):
    cmd = request.command
    if cmd == 'get_status':
        user = request.params['userName']
        status = self.get_status(user)
        return status
```



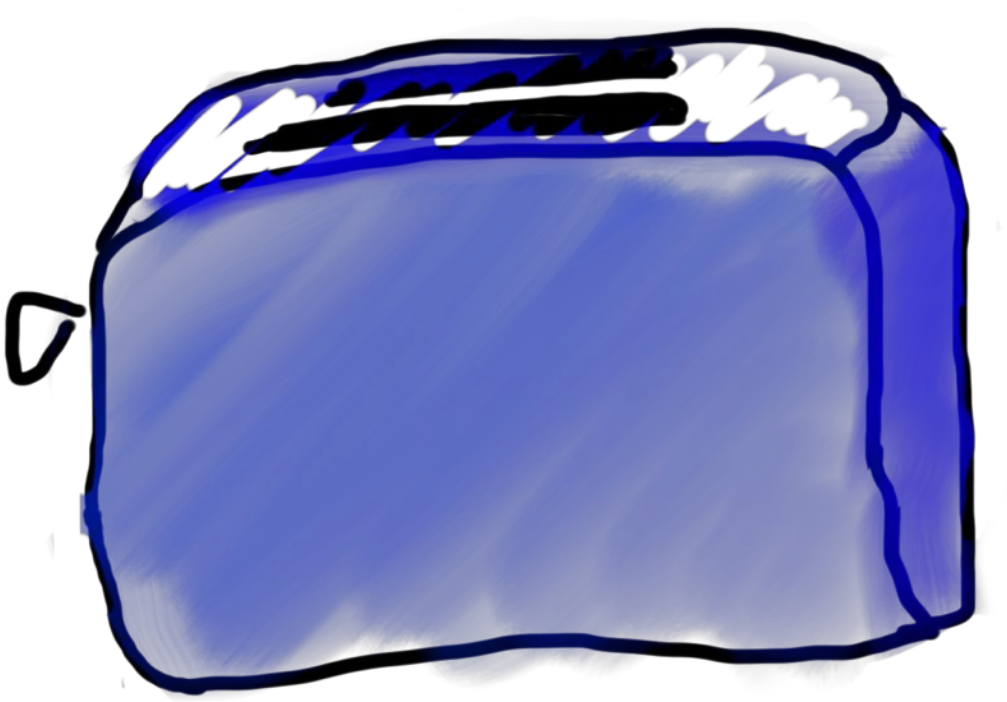
Must be a string!

Requests are like Remote Method Calls

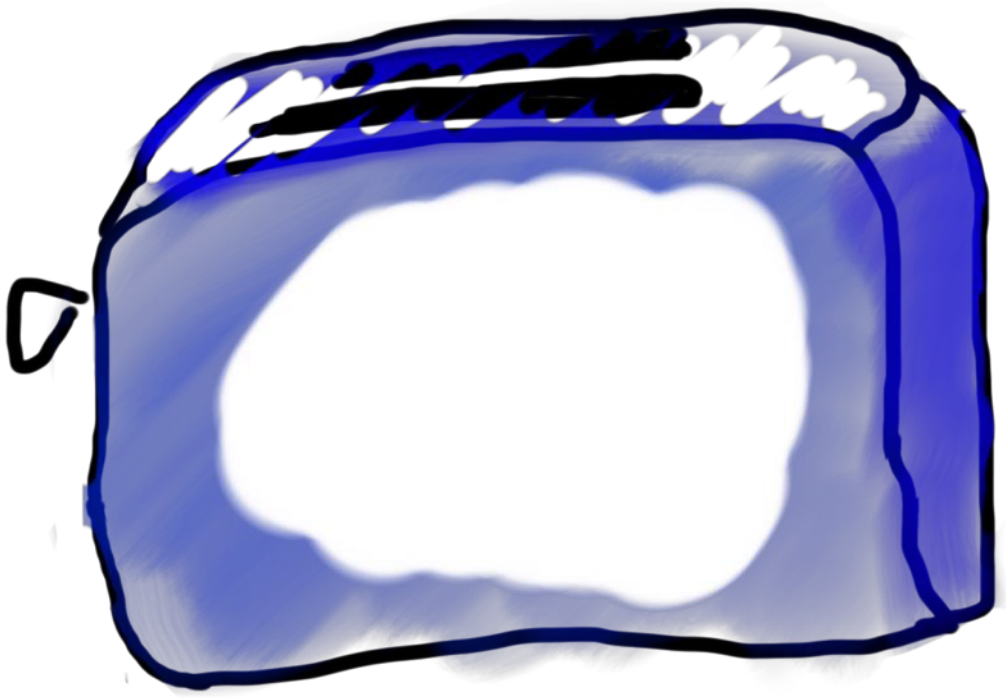


Requests are like Remote Method Calls

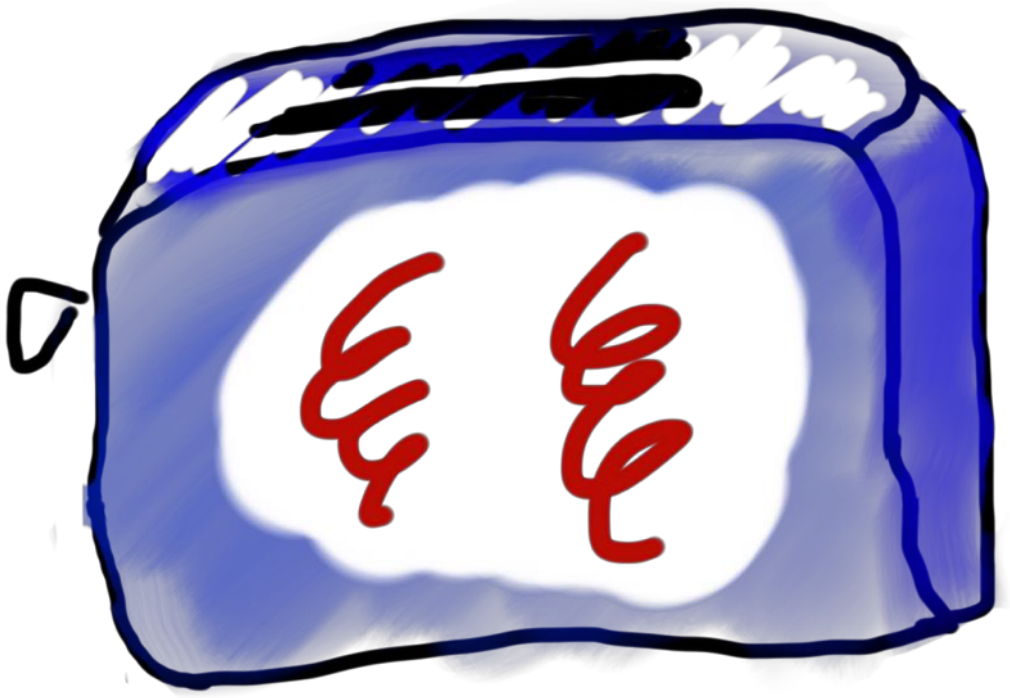
Requests are like Remote Method Calls



Requests are like Remote Method Calls



Requests are like Remote Method Calls



Internet sends data as strings…

How do you send a list or a dictionary?

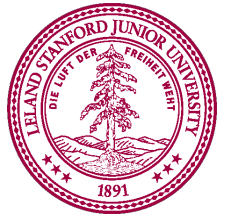
Requests responses are strings, often encoded using JSON

Recall JSON

ages.json

```
{
        "Chris":32,
        "Gary":70,
        "Mehran":50,
        "Brahm":23,
        "Rihanna":32,
        "Adele":32
}
```

```
import json

# load data
data = json.load(open('ages.json'))

# save data
json.dump(data, open('ages.json'))
```

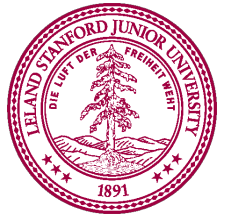



Recall JSON

ages.json

```
{
        "Chris":32,
        "Gary":70,
        "Mehran":50,
        "Brahm":23,
        "Rihanna":32,
        "Adele":32
}
```

```
import json

# load data
data = json.load(open('ages.json'))

# save data
json.dump(data, open('ages.json'))
```

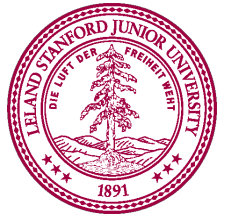



Recall JSON

ages.json

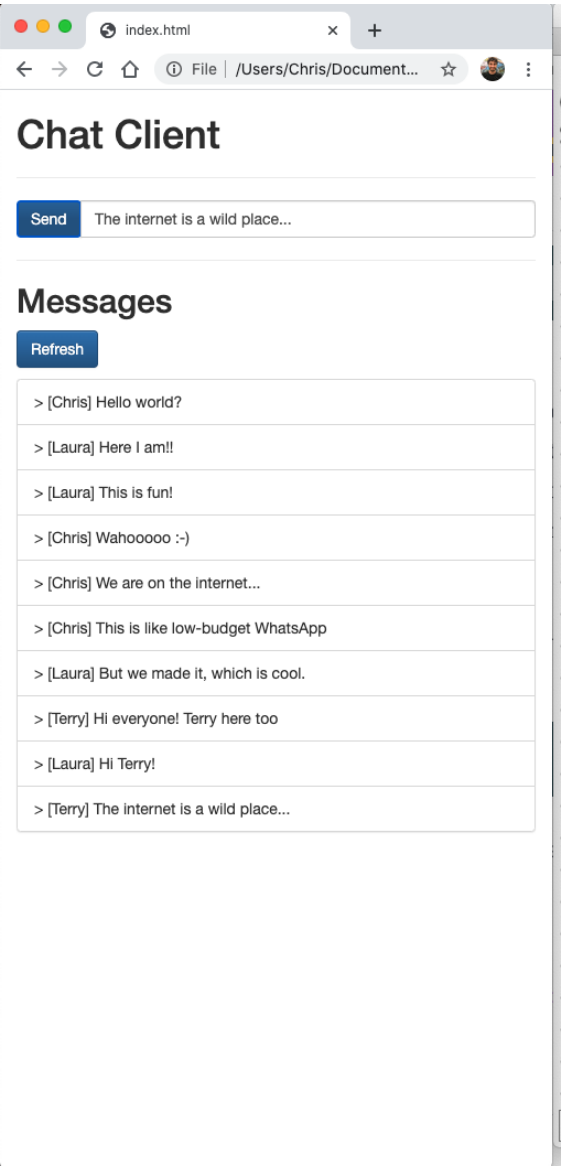
```
{
        "Chris":32,
        "Gary":70,
        "Mehran":50,
        "Brahm":23,
        "Rihanna":32,
        "Adele":32
}
```

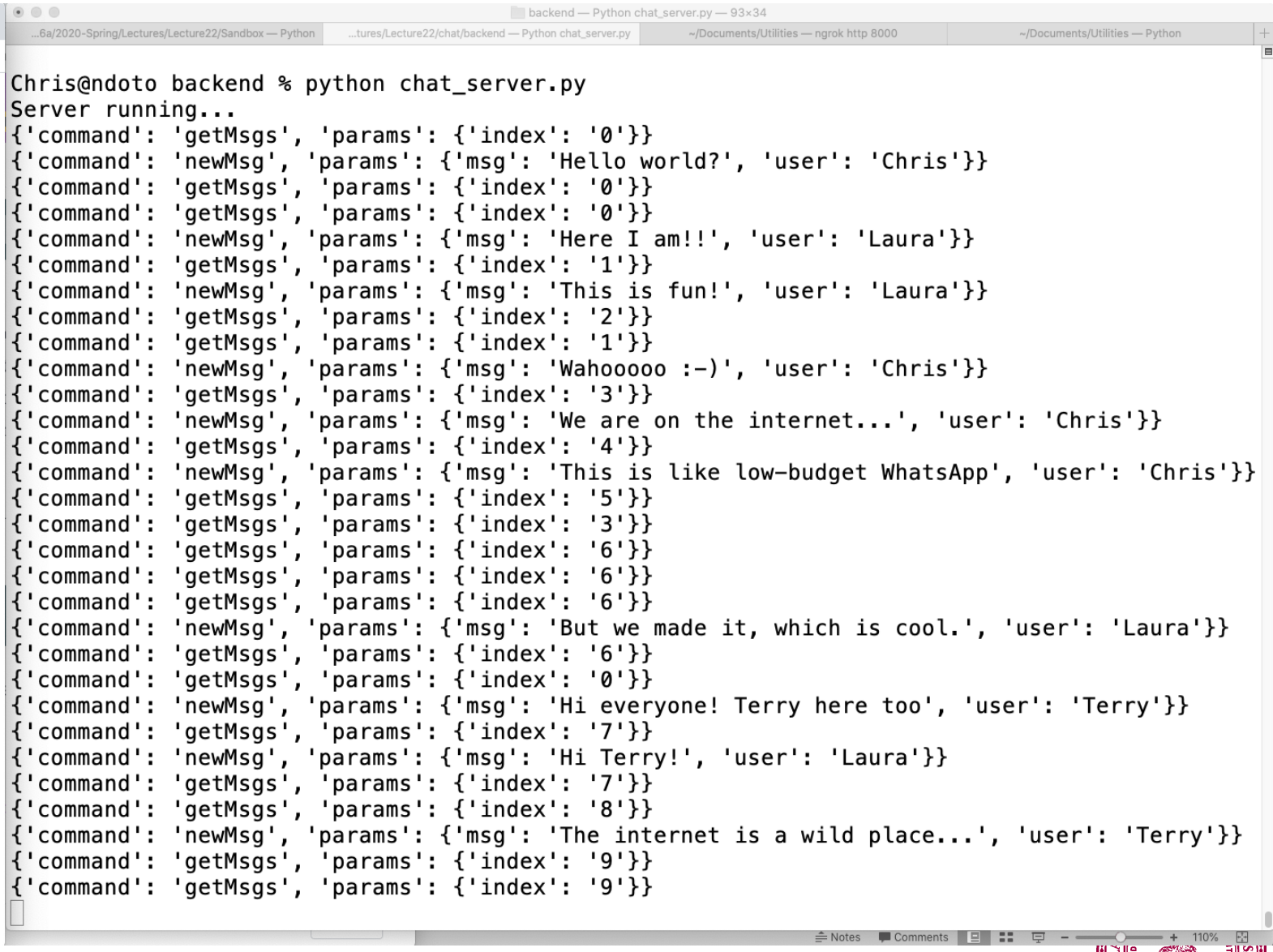
```
import json

# load data
data = json.load(open('ages.json'))

# save data
json.dump(data, open('ages.json'))

# write a variable to a string
data_str = json.dumps(data)
```

Time for a little chat

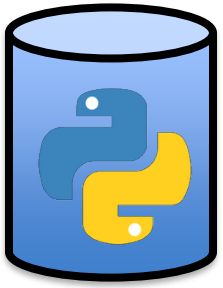
Chat Server and Client





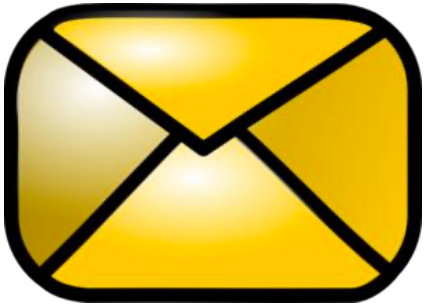
Chat Server

`Chat Server`

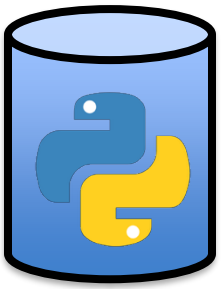


`newMsg`
`msg = text`
`user = user`

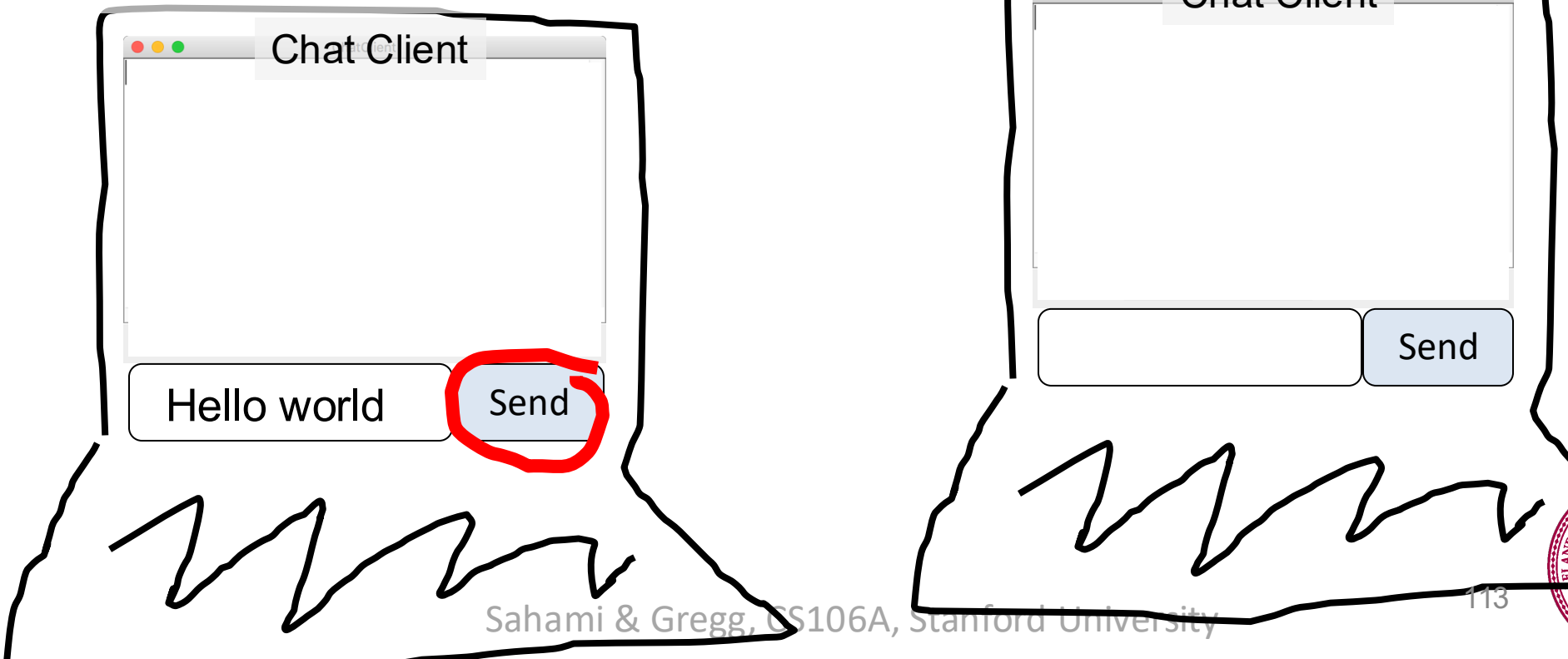
`getMsgs`
`index = start_index`

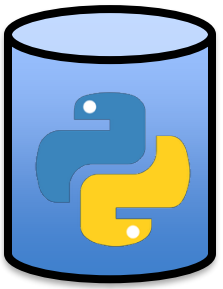


```
history = [
]
```



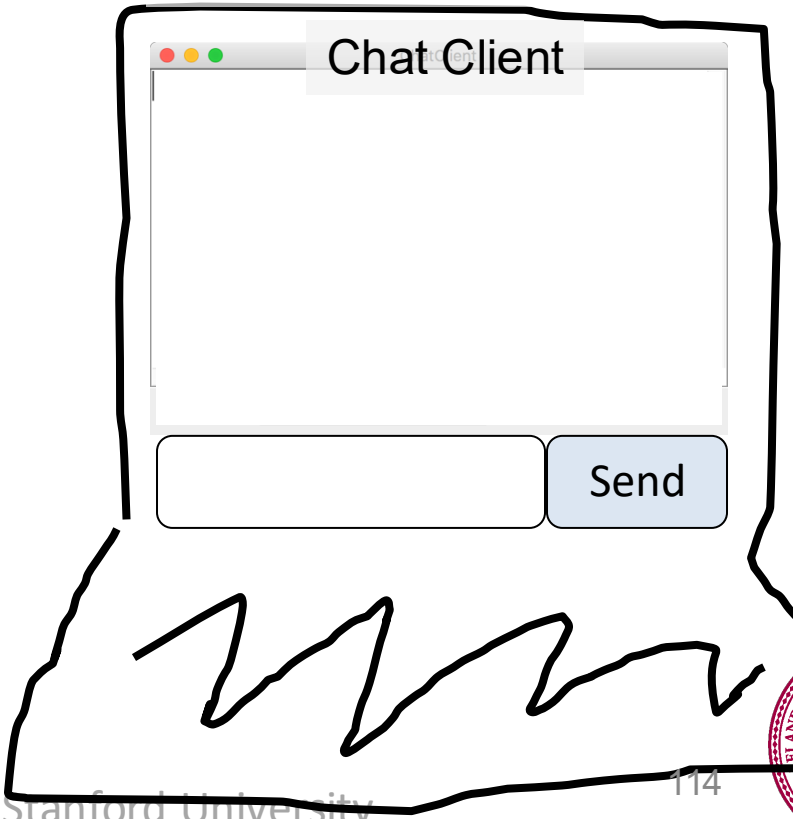
```
newMsg
{
    'msg' : Hello world,
    'user' : 'C'
}
```

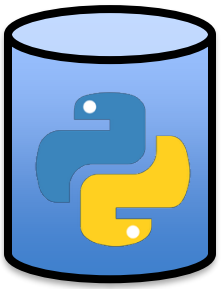




```
history = [
    '[C] Hello world'
]
```

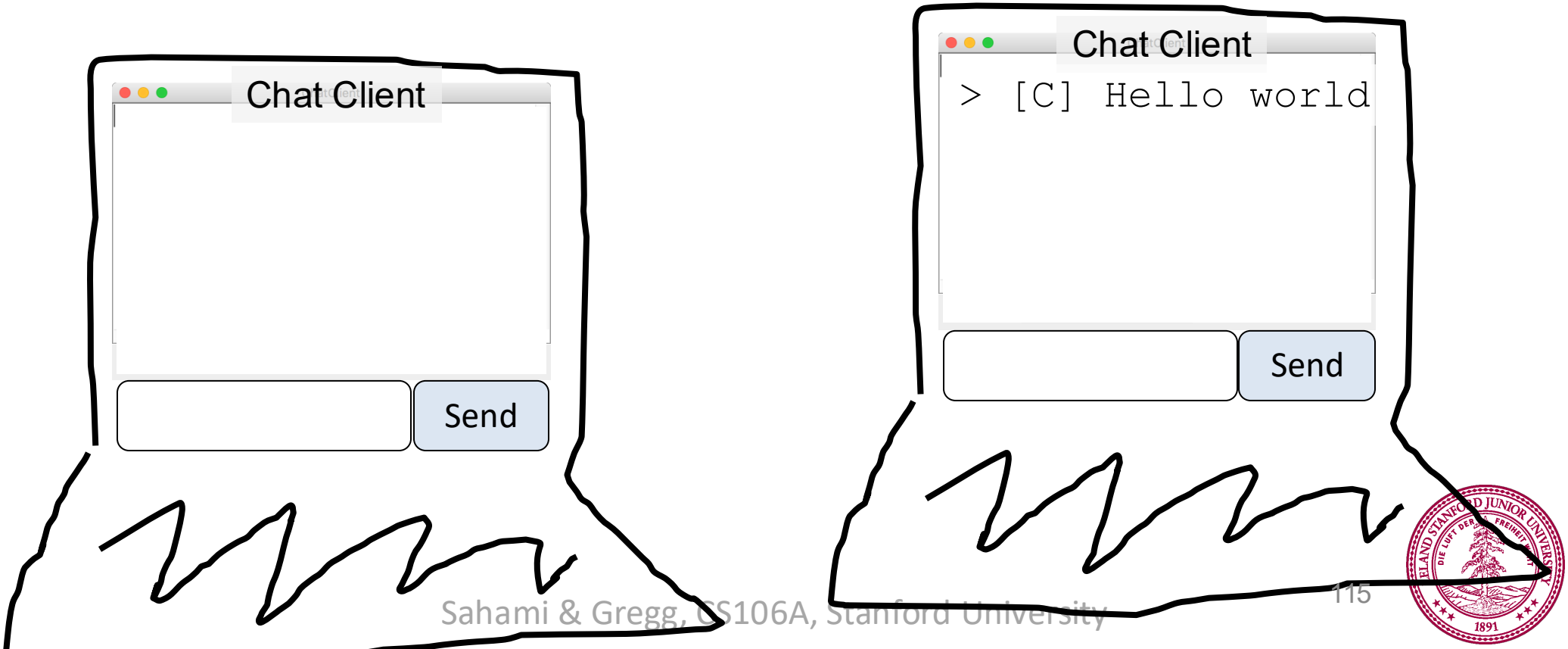
```
getMsgs
{
    'index' : 0
}
```

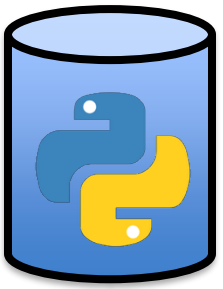




```
history = [
    '[C] Hello world'
]
```

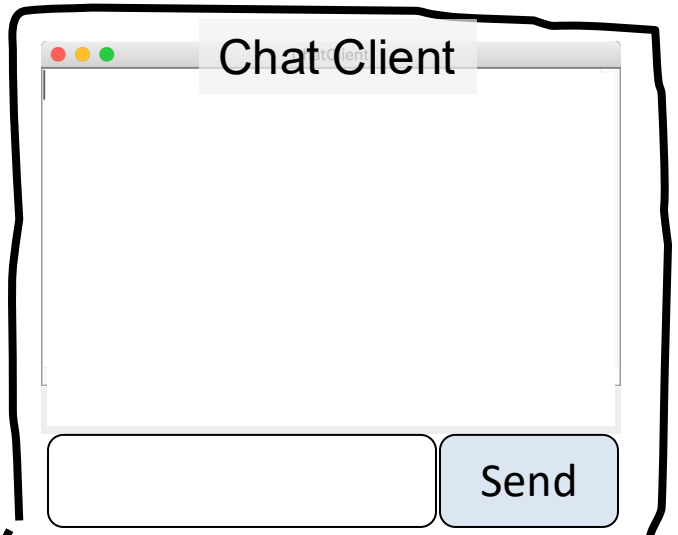
```
'["[C] Hello world"]'
```

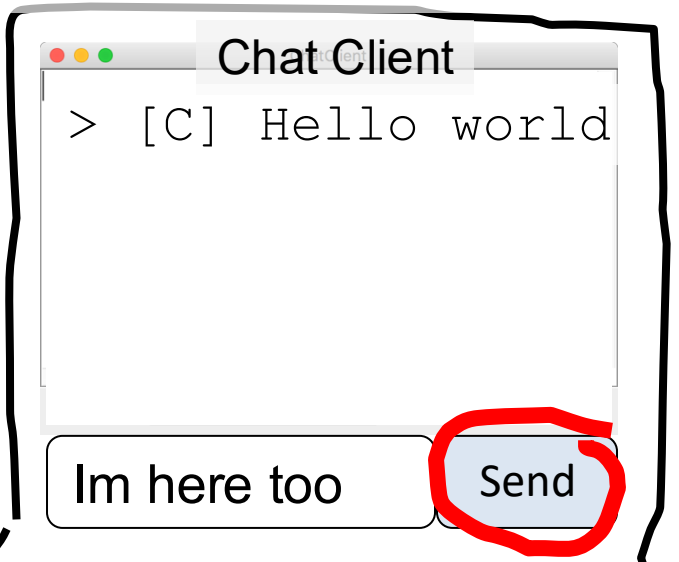


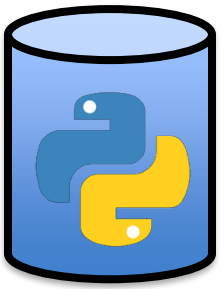


```
history = [
    '[C] Hello world'
]
```

```
newMsg
{
    'msg' : 'Im here too'
    'user' : 'B'
}
```

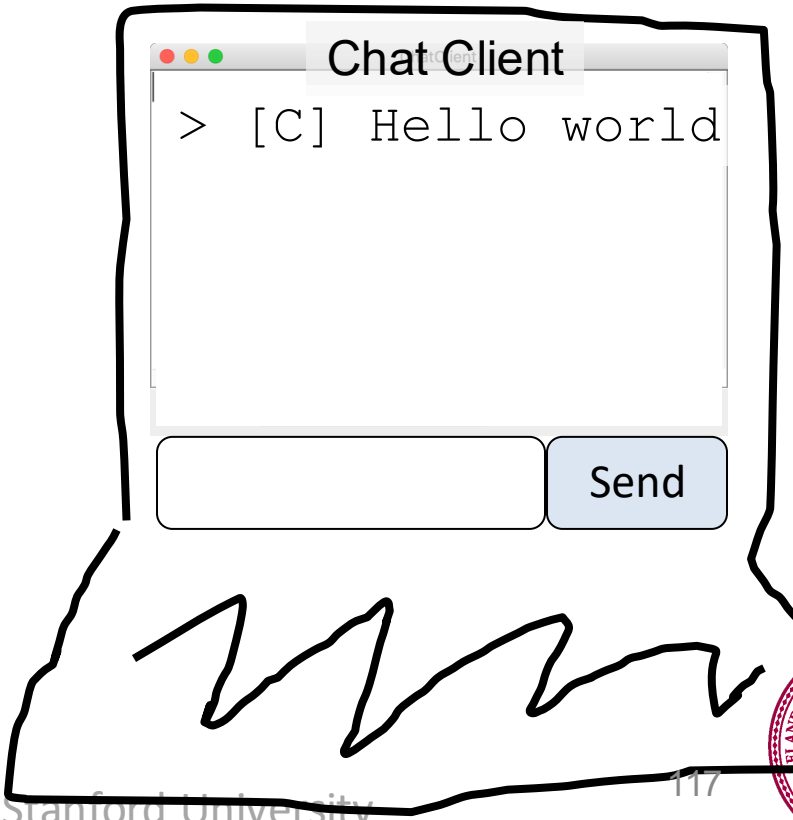






```
history = [
    '[C] Hello world',
    '[B] Im here too'
]
```

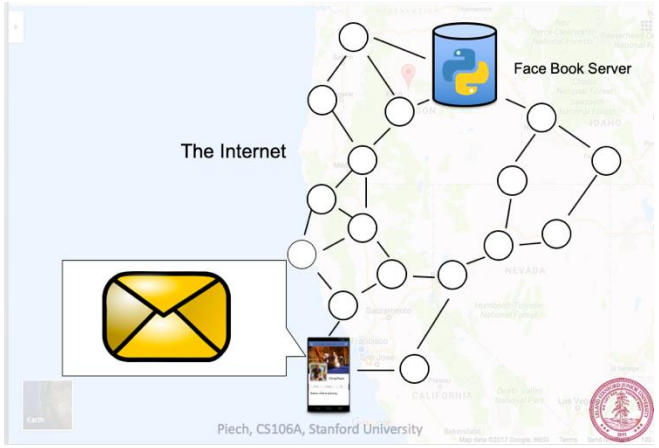
```
'Got it'
```

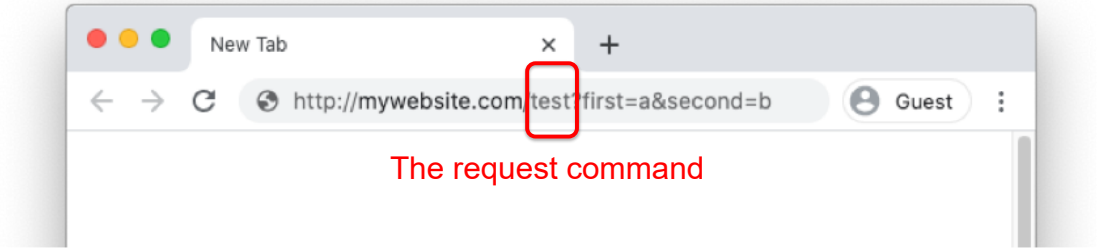


Learning Goals

1. Write a program that can respond to internet requests

Things we saw along the way

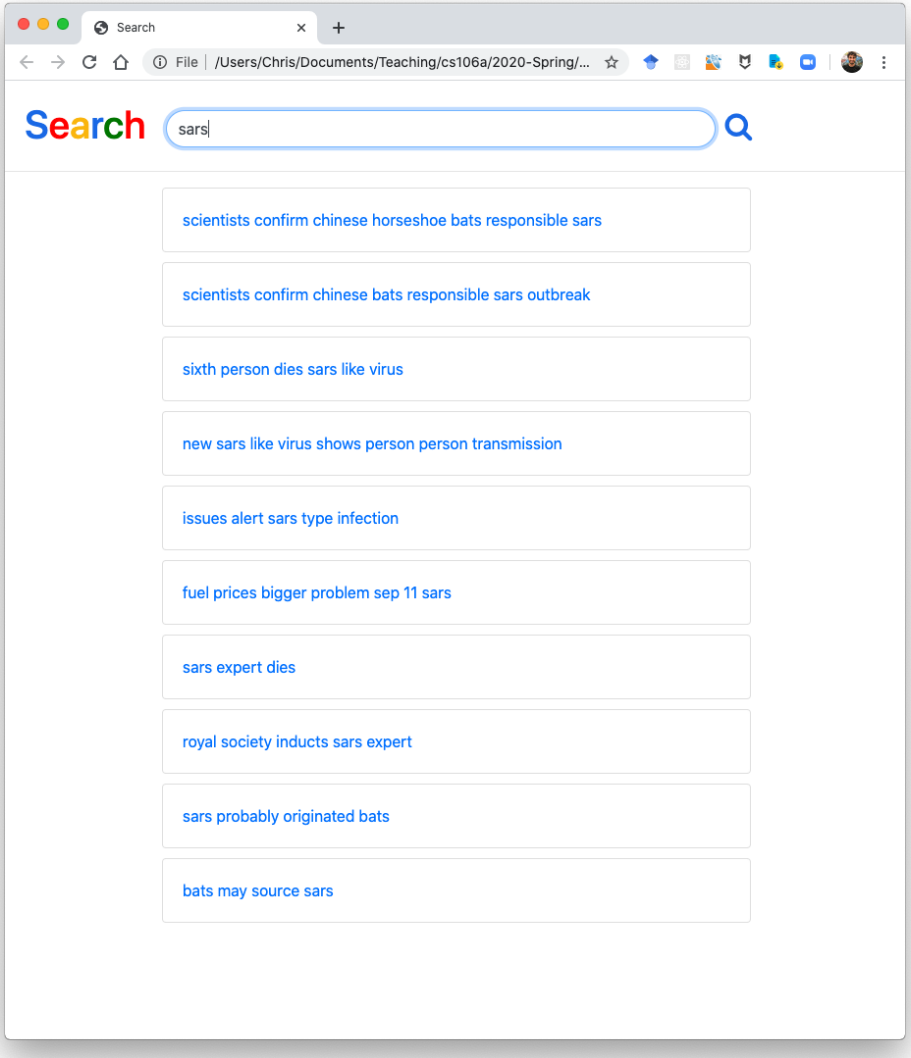




response = requests.get(url)

data_str = json.dumps(data)

Bajillion Extension



Search Engine