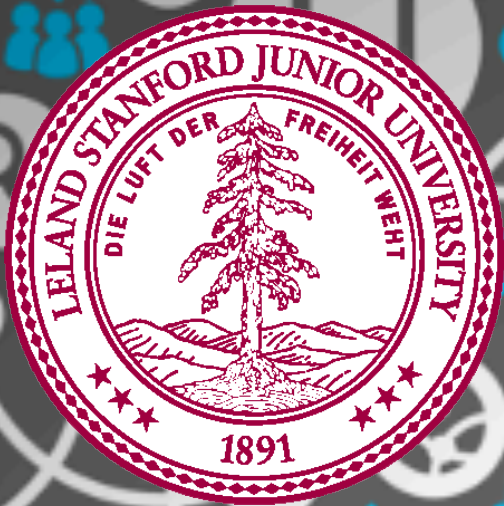




The Internet

Chris Piech and Mehran Sahami
CS106A, Stanford University

First, a cool demo

index.html

Chat Client

Send

The internet is a wild place...

Messages

Refresh

> [Chris] Hello world?

> [Laura] Here I am!!

> [Laura] This is fun!

> [Chris] Wahooooo :-)

> [Chris] We are on the internet...

> [Chris] This is like low-budget WhatsApp

> [Laura] But we made it, which is cool.

> [Terry] Hi everyone! Terry here too

> [Laura] Hi Terry!

> [Terry] The internet is a wild place...

backend — Python chat_server.py — 93x34

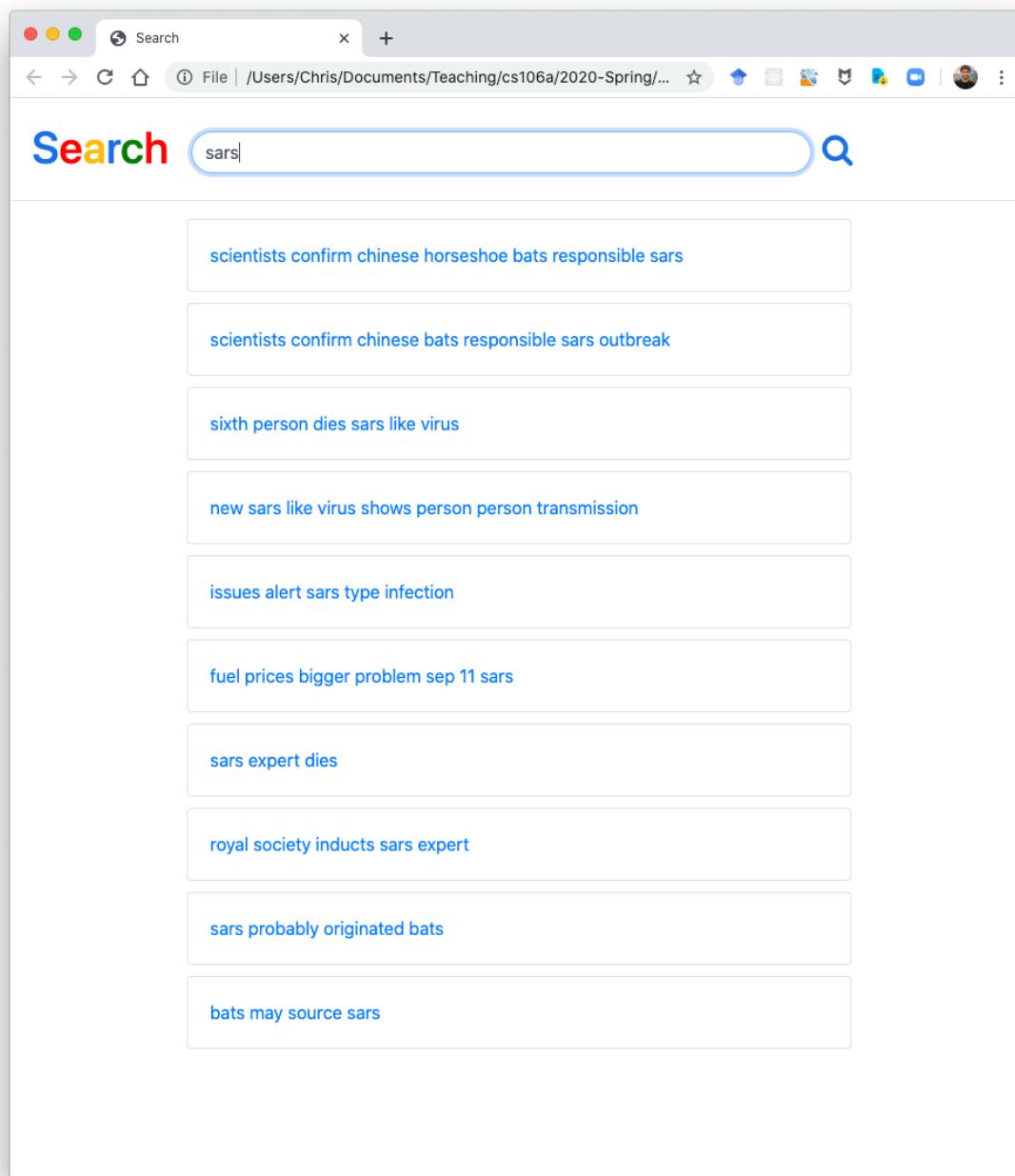
Chris@ndoto backend % python chat_server.py

Server running...

```
{'command': 'getMsgs', 'params': {'index': '0'}}
{'command': 'newMsg', 'params': {'msg': 'Hello world?', 'user': 'Chris'}}
{'command': 'getMsgs', 'params': {'index': '0'}}
{'command': 'getMsgs', 'params': {'index': '0'}}
{'command': 'newMsg', 'params': {'msg': 'Here I am!!', 'user': 'Laura'}}
{'command': 'getMsgs', 'params': {'index': '1'}}
{'command': 'newMsg', 'params': {'msg': 'This is fun!', 'user': 'Laura'}}
{'command': 'getMsgs', 'params': {'index': '2'}}
{'command': 'getMsgs', 'params': {'index': '1'}}
{'command': 'newMsg', 'params': {'msg': 'Wahooooo :-)', 'user': 'Chris'}}
{'command': 'getMsgs', 'params': {'index': '3'}}
{'command': 'newMsg', 'params': {'msg': 'We are on the internet...', 'user': 'Chris'}}
{'command': 'getMsgs', 'params': {'index': '4'}}
{'command': 'newMsg', 'params': {'msg': 'This is like low-budget WhatsApp', 'user': 'Chris'}}
{'command': 'getMsgs', 'params': {'index': '5'}}
{'command': 'getMsgs', 'params': {'index': '3'}}
{'command': 'getMsgs', 'params': {'index': '6'}}
{'command': 'getMsgs', 'params': {'index': '6'}}
{'command': 'getMsgs', 'params': {'index': '6'}}
{'command': 'newMsg', 'params': {'msg': 'But we made it, which is cool.', 'user': 'Laura'}}
{'command': 'getMsgs', 'params': {'index': '6'}}
{'command': 'getMsgs', 'params': {'index': '0'}}
{'command': 'newMsg', 'params': {'msg': 'Hi everyone! Terry here too', 'user': 'Terry'}}
{'command': 'getMsgs', 'params': {'index': '7'}}
{'command': 'newMsg', 'params': {'msg': 'Hi Terry!', 'user': 'Laura'}}
{'command': 'getMsgs', 'params': {'index': '7'}}
{'command': 'getMsgs', 'params': {'index': '8'}}
{'command': 'newMsg', 'params': {'msg': 'The internet is a wild place...', 'user': 'Terry'}}
{'command': 'getMsgs', 'params': {'index': '9'}}
{'command': 'getMsgs', 'params': {'index': '9'}}
```

Piech + Sahami, CS106A, Stanford University

The image is the official seal of Stanford University, featuring a red circular border with the text "STANFORD UNIVERSITY" and "1891" at the bottom. Inside the circle is a green landscape with a red tree and a red building.



Search Engine



<review>

Classes Review

Dog.py

```
class Dog:
    def __init__(self):
        self.times_barked = 0

    def bark():
        print('woof')
        self.times_barked += 1
```

life.py

```
def main():
    simba = Dog()
    juno = Dog()

    simba.bark()
    juno.bark()
    simba.bark()

    print(simba.__dict__)
    print(juno.__dict__)
```



Classes Review

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    print(juno.__dict__)
```

1. What happens when you make a **new** one?



Classes Review

Dog.py

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    print(juno.__dict__)
```

2. What **variables** does each instance store?



Classes Review

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    print(juno.__dict__)
```

2. What **methods** can you call on an instance?



Classes Review

Dog.py

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    simba.bark()

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    print(juno.__dict__)
```

Did I mention that a class is like a fancy dictionary?





Classes define new variable
types





Classes decompose your
program across files



Define New Variable Types

Song

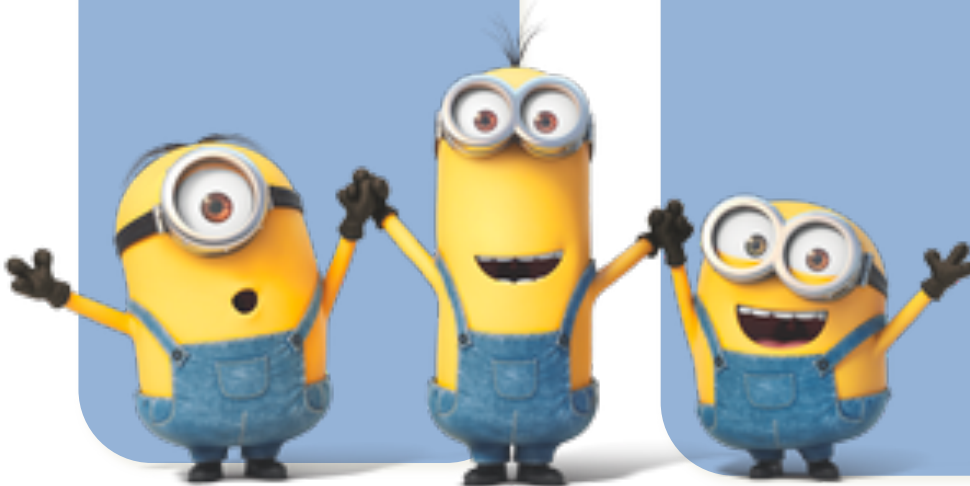
Playlist

User



Song Player

Song Retriever



</ review>

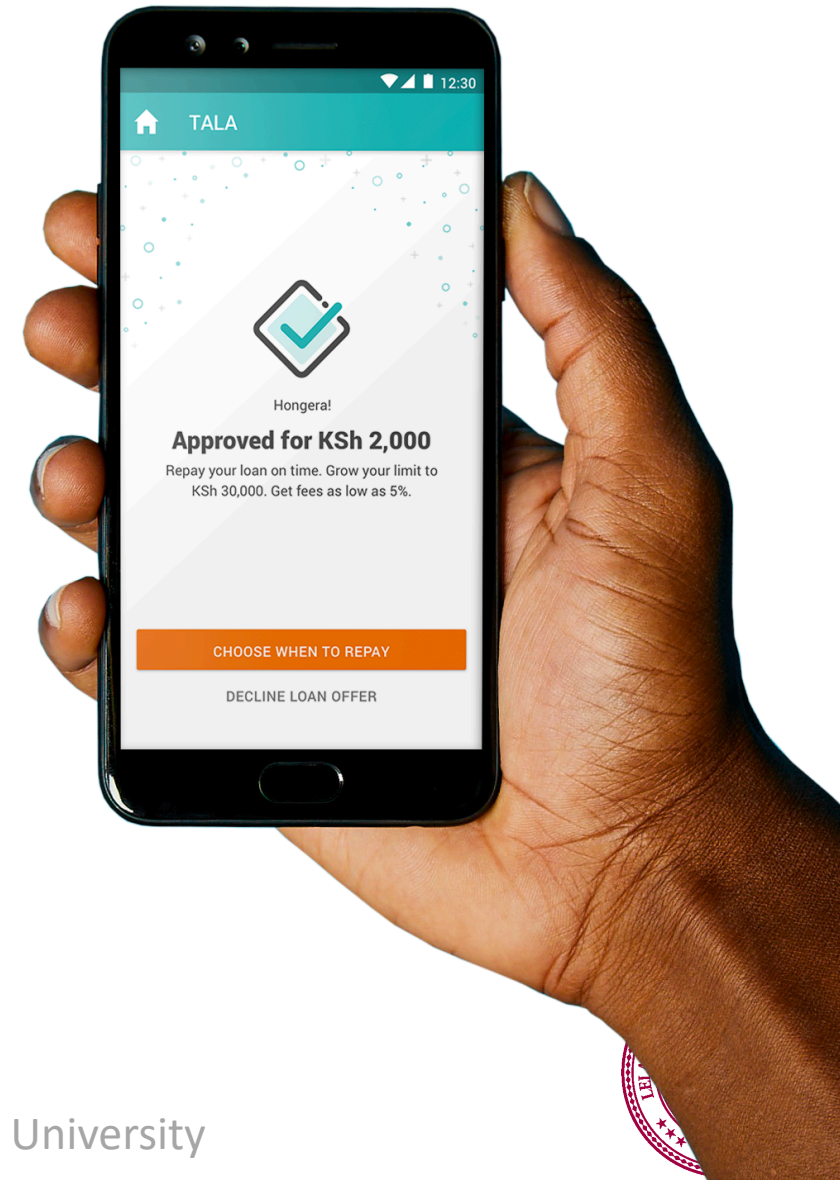
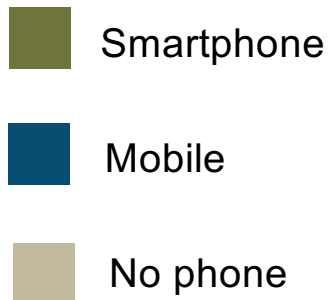
One reason programming is
fun is because of the
internet...

Smart Phone Access

Advanced Economies



Emerging Economies



For the third time ever in
CS106A:

Learning Goals

1. Write a program that can respond to internet requests



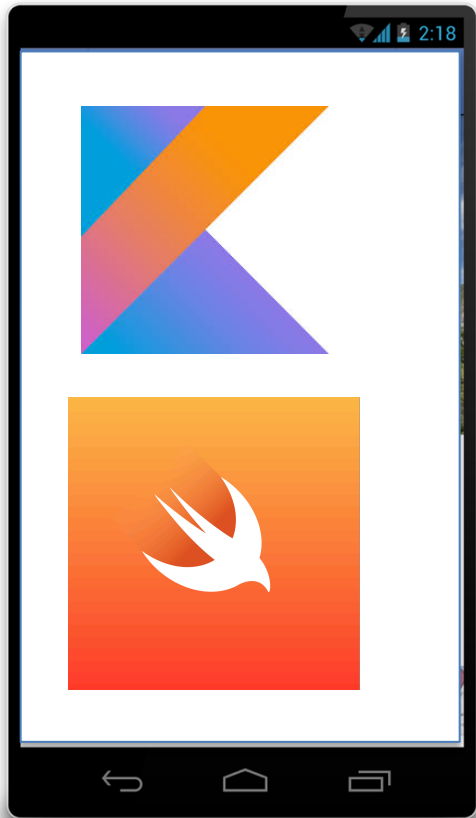
How does your phone
communicate with facebook?

The program on your phone
talks to the program at
Facebook

JavaScript
with HTML
are the
languages
of websites

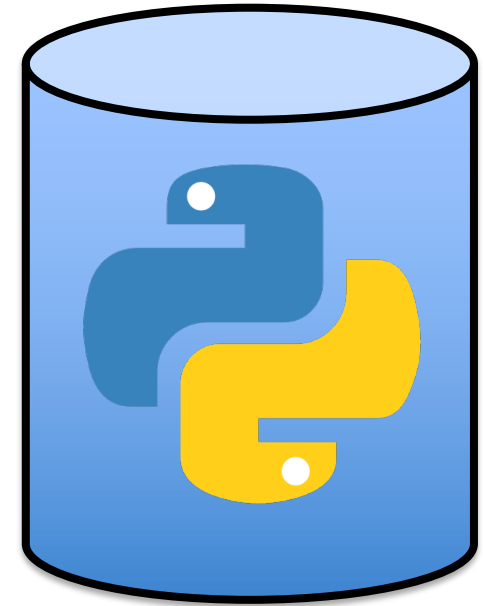


Kotlin is the
language
of Android
phones



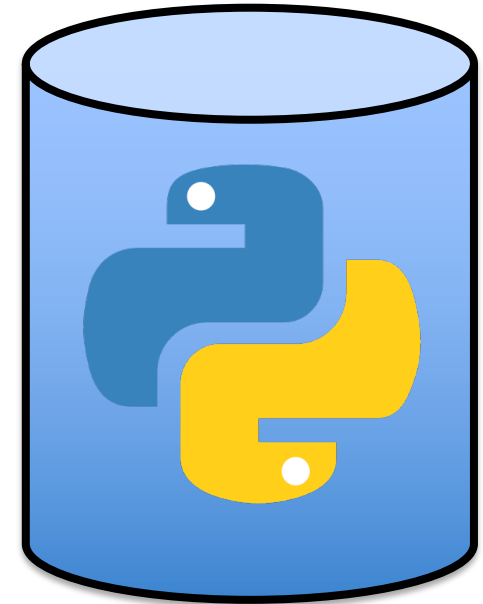
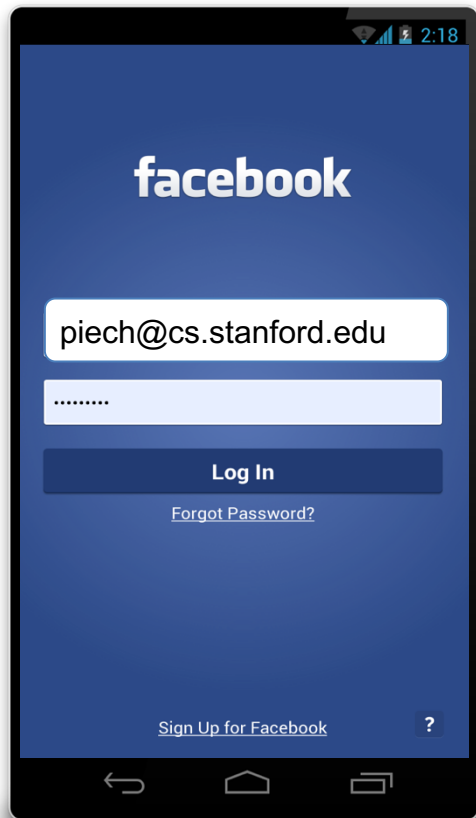
Swift is the
language
of Apple
phones

Face Book Server



Face Book Server

Is this legit?

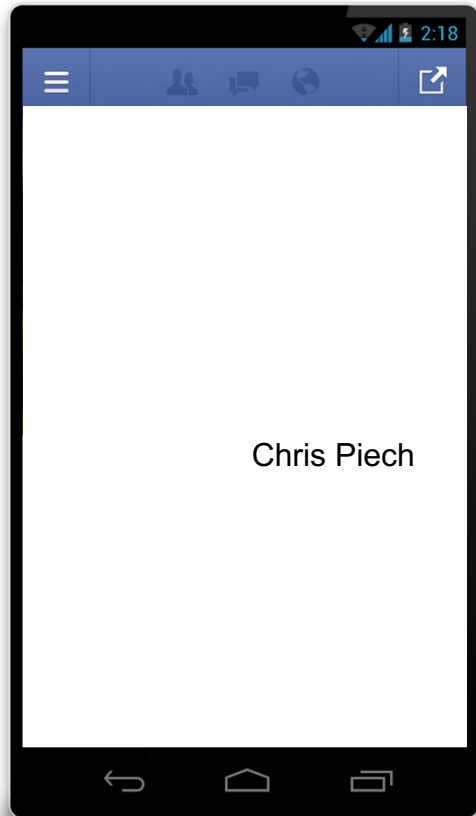
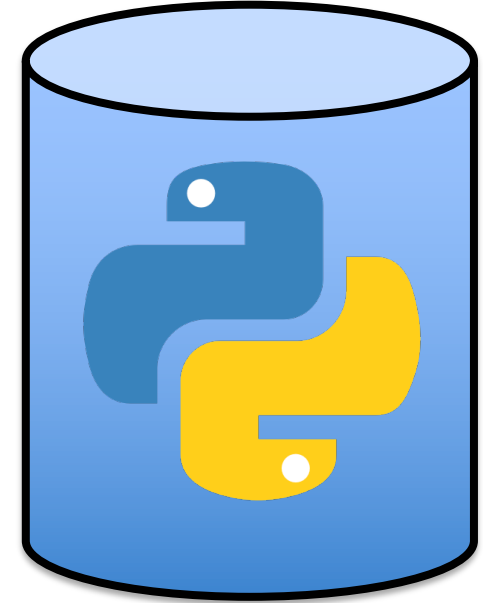


piech@cs.stanford.edu
is now logged in



Face Book Server

Send me the **full name** for
piech@cs.stanford.edu

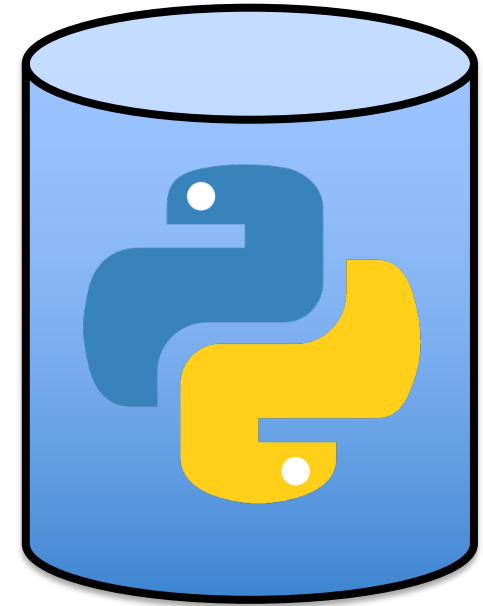


"Chris Piech"



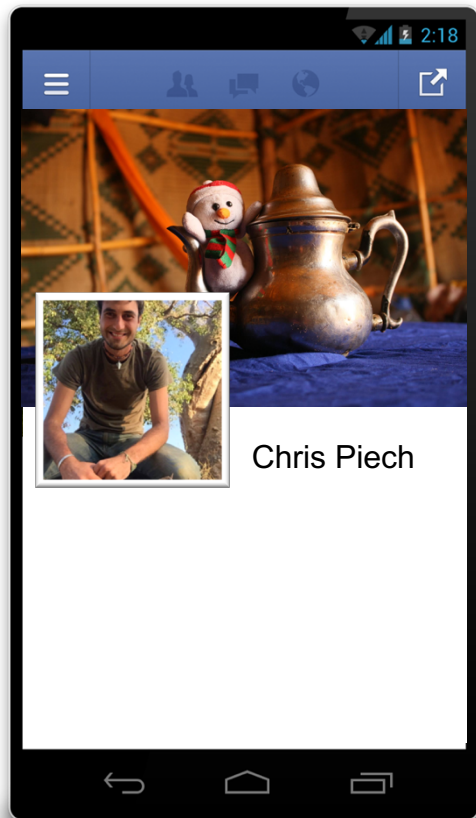
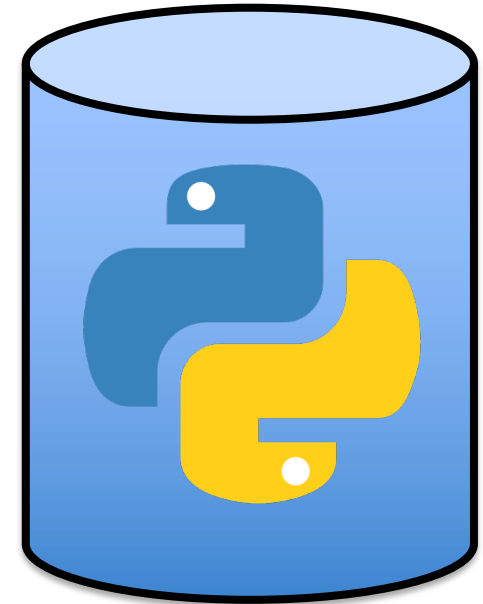
Face Book Server

Send me the **cover photo** for
piech@cs.stanford.edu



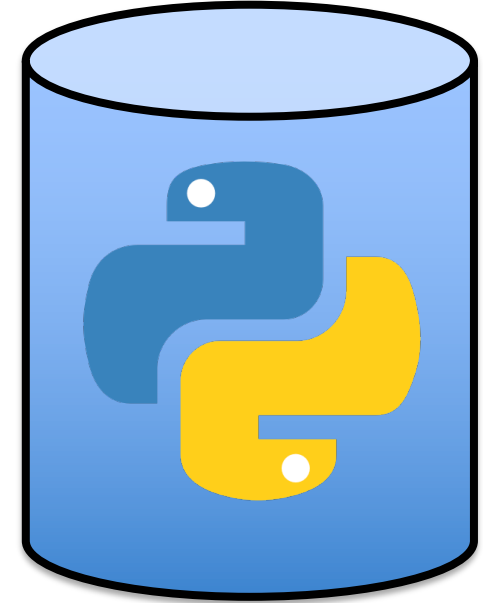
Face Book Server

Send the **profile photo** for
`piech@cs.stanford.edu`



Face Book Server

Send the **status** for
piech@cs.stanford.edu

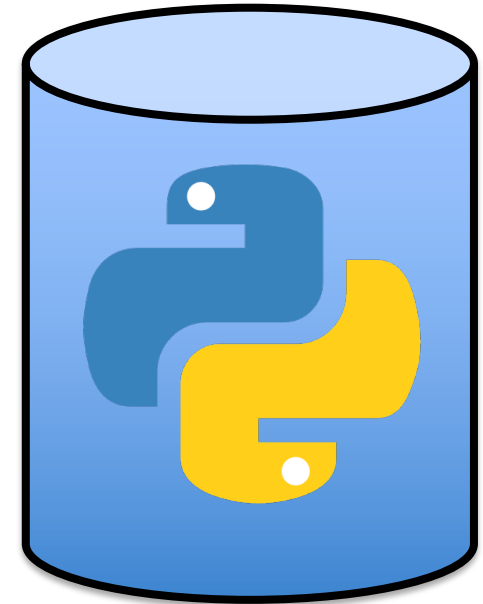


"chillin"



Set the **status** for
piech@cs.stanford.edu
to be **"lecturing"**

Face Book Server

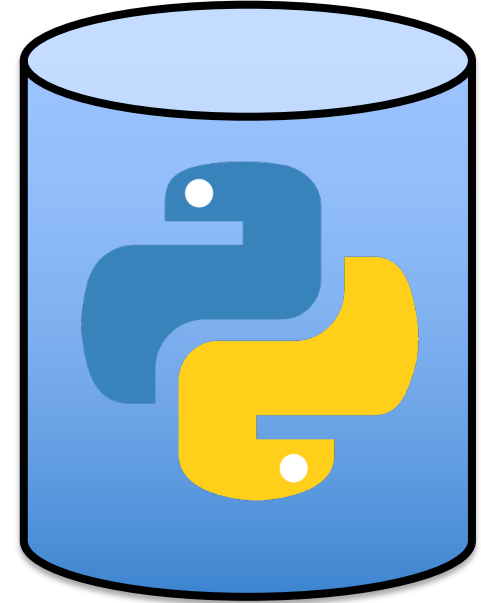


"success"



Send me the **status** for
piech@cs.stanford.edu

Face Book Server



"lecturing"



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*)



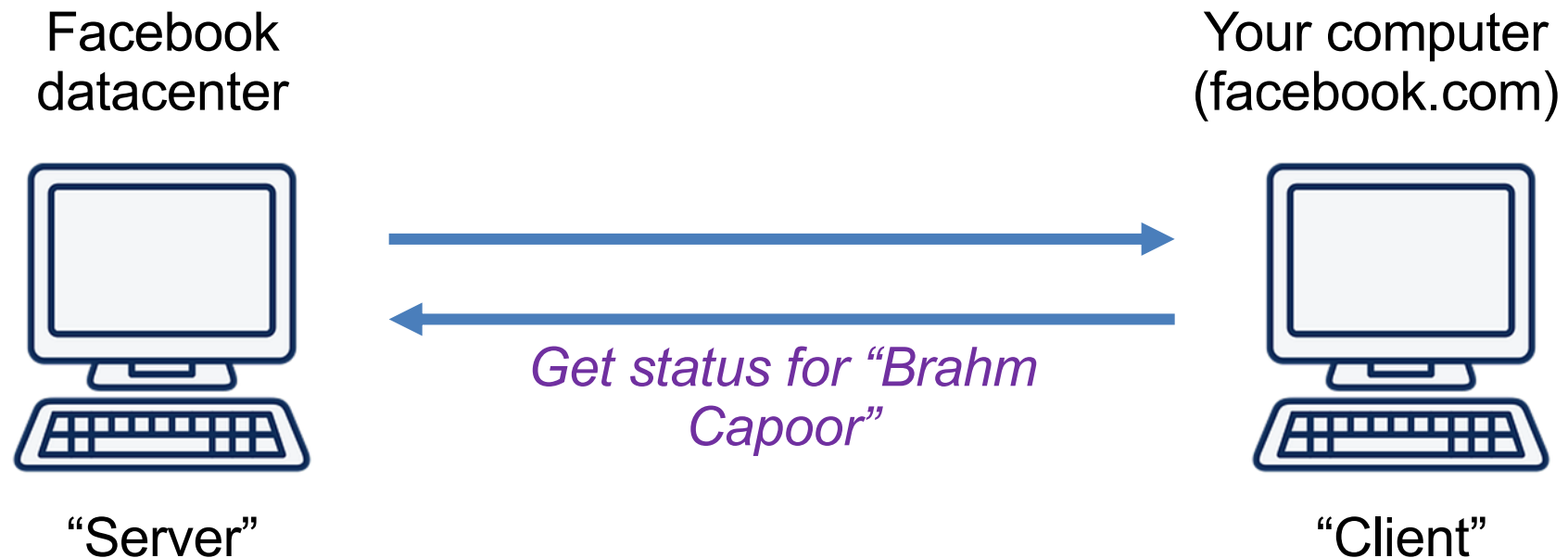
Background: The Internet



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



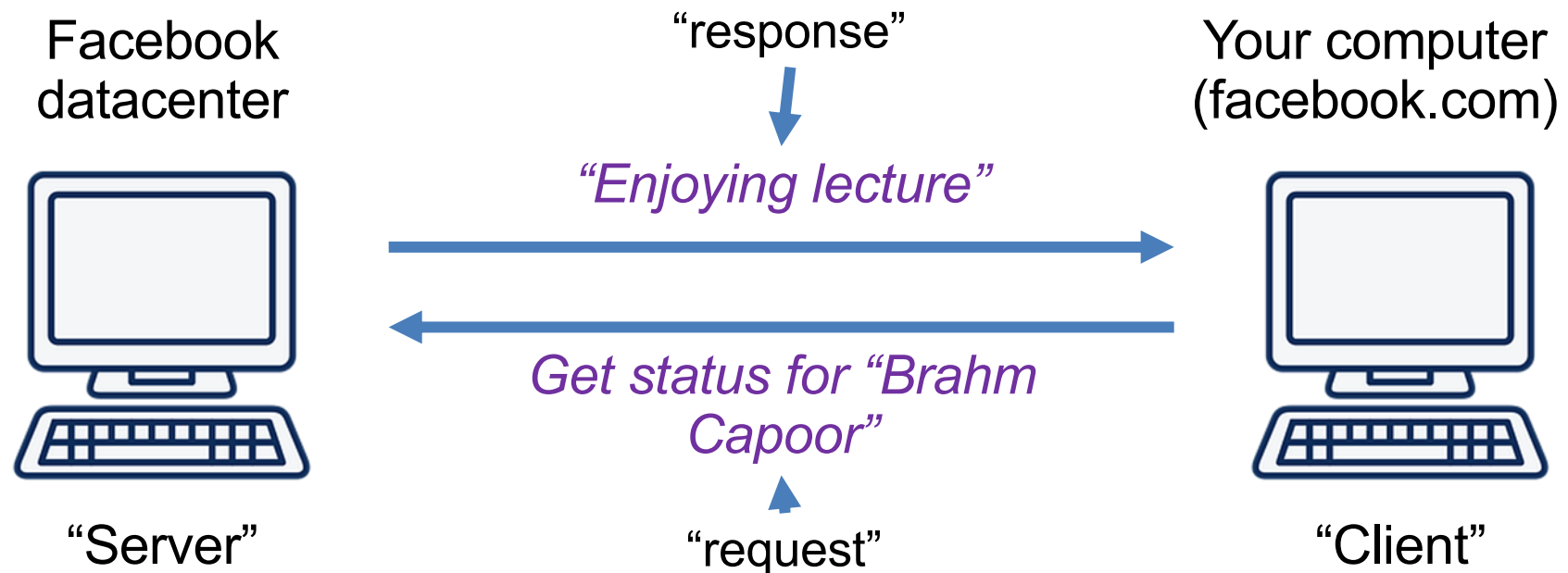
Background: The Internet



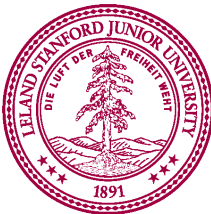
The internet is just many programs sending messages (as *Strings*)



Background: The Internet



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



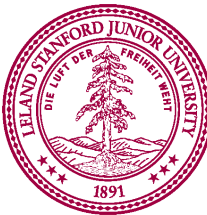
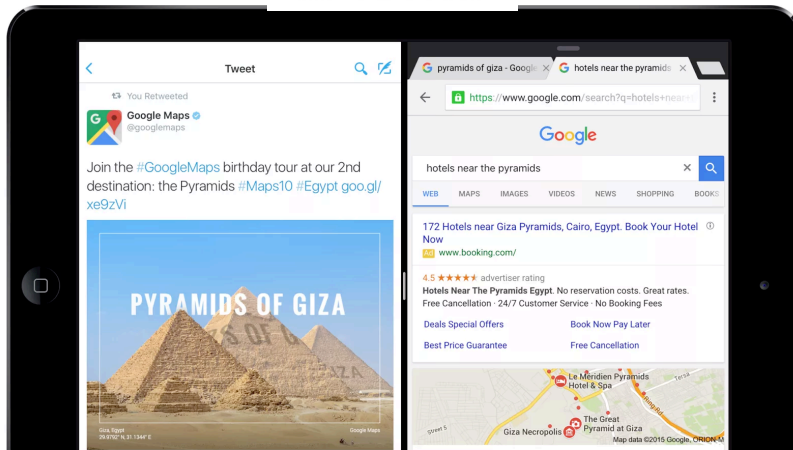


There are two types of
internet programs. Servers
and Clients



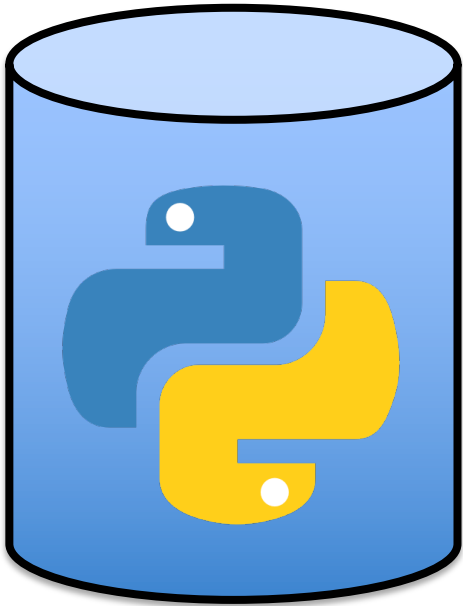
Internet 101

Computers on the internet



Servers are computers (running code)

Face Book Server



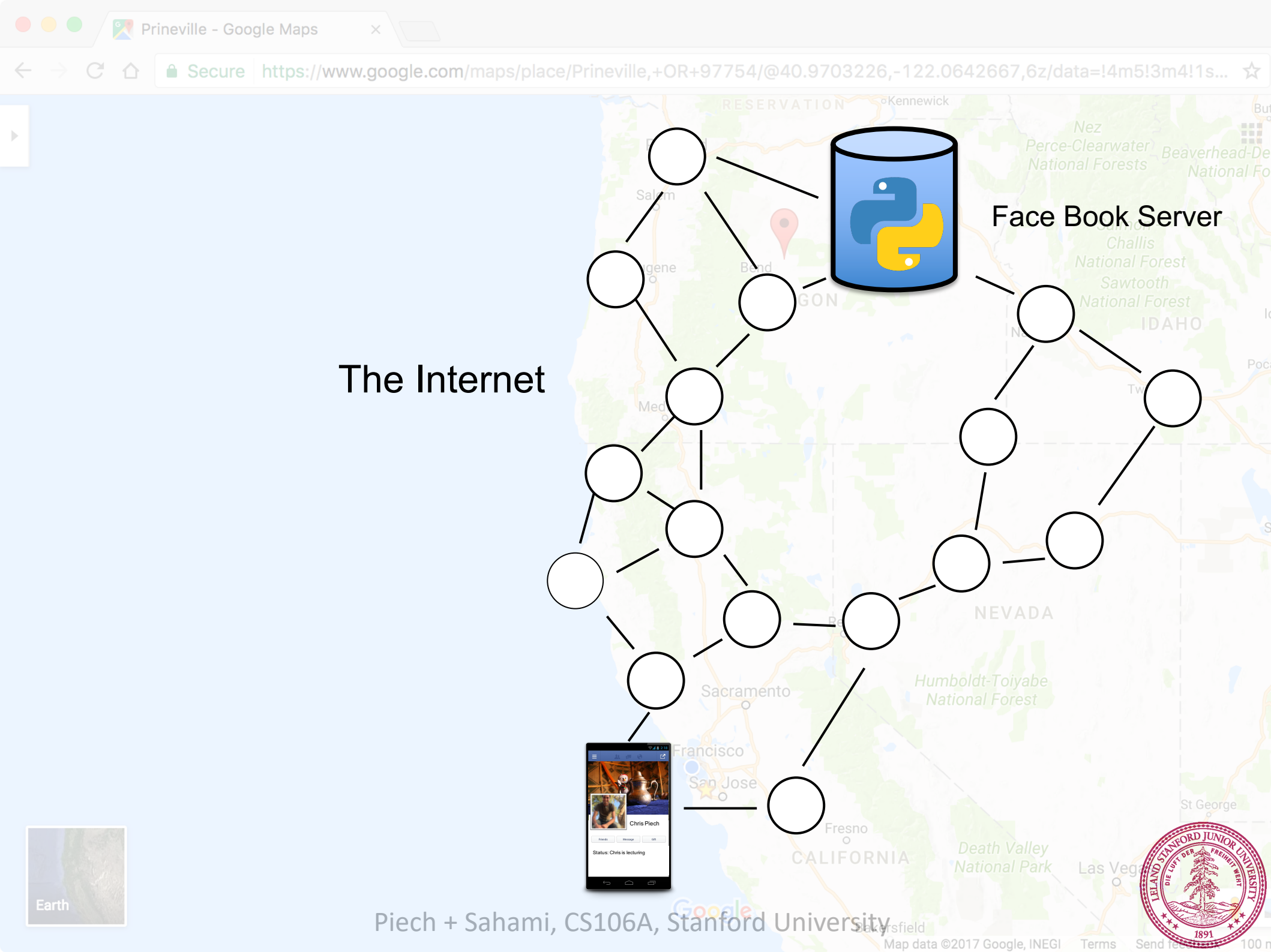
=



Facebook's closest
datacenter is here

I am here

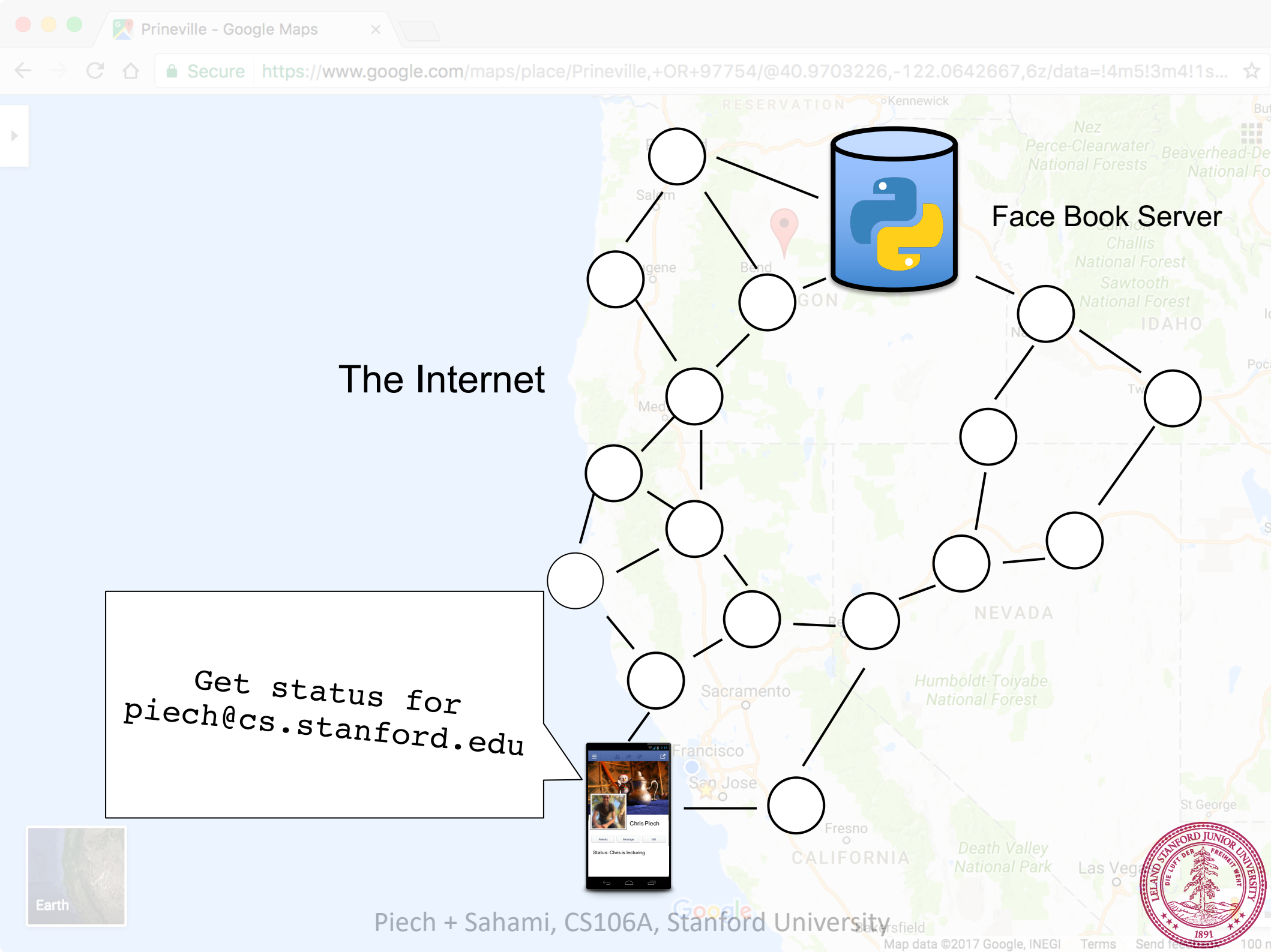




The Internet

Face Book Server

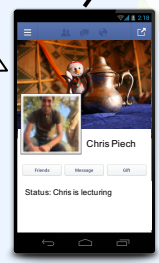


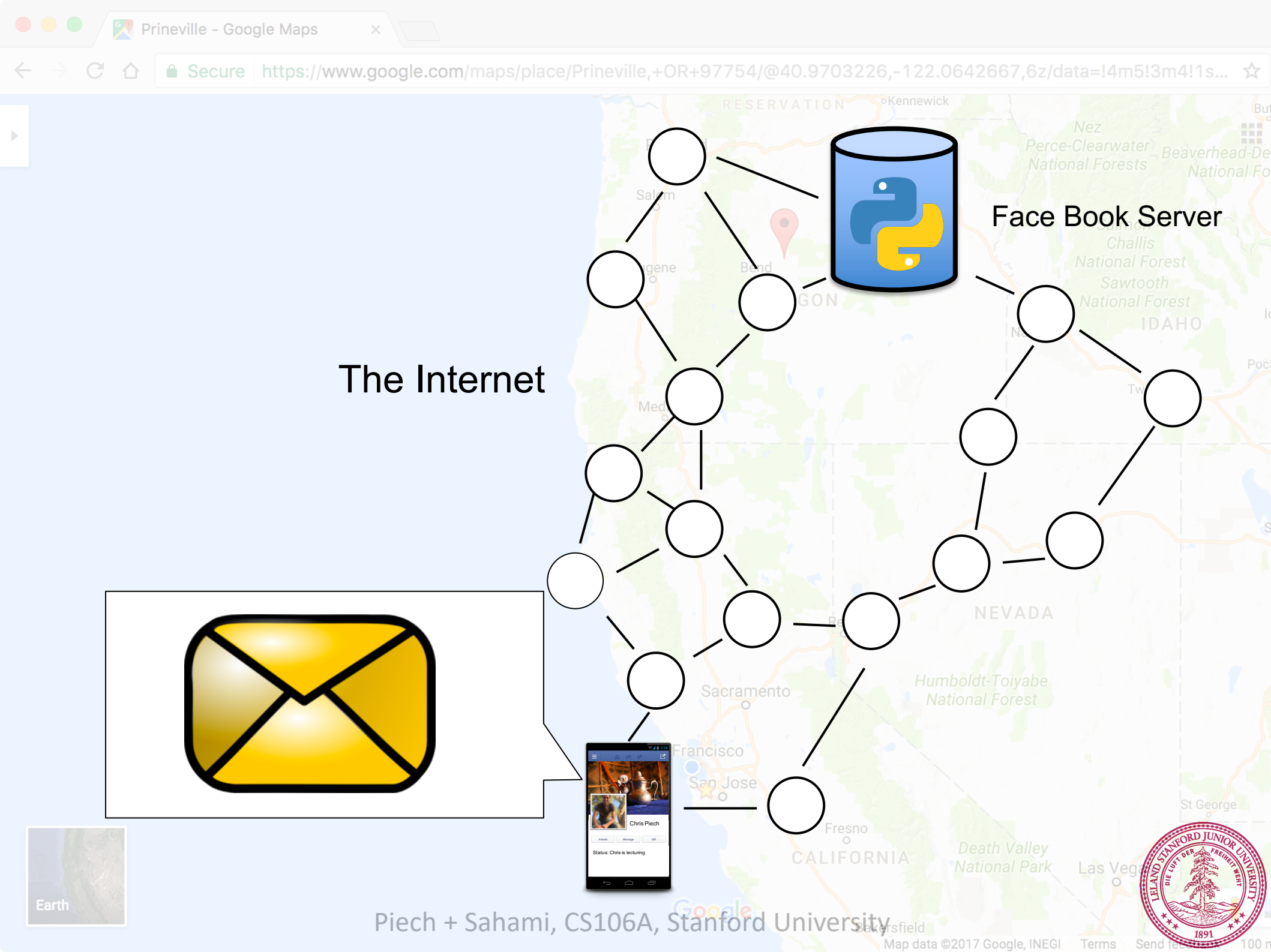


The Internet

Face Book Server

Get status for
`piech@cs.stanford.edu`

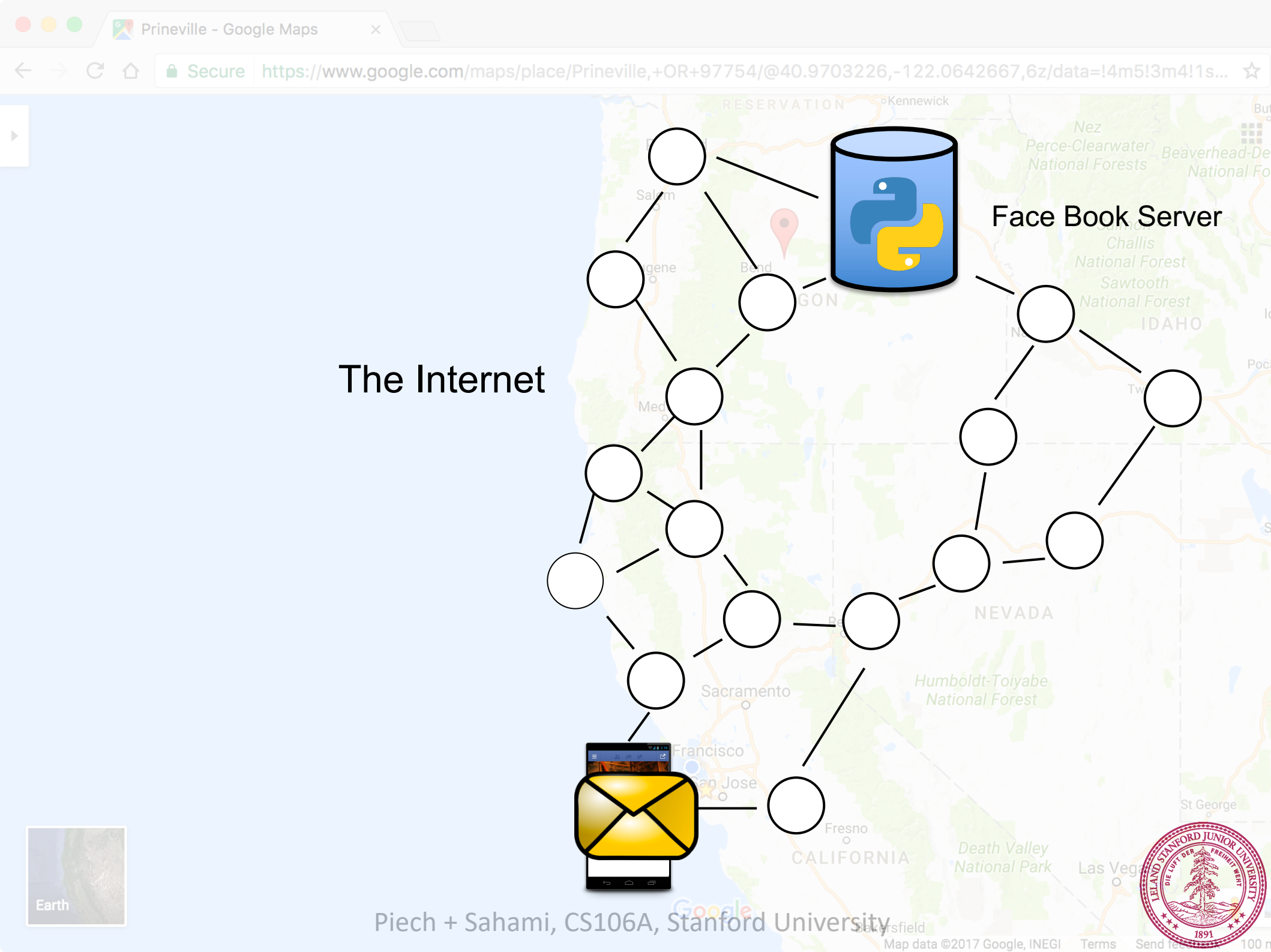




The Internet

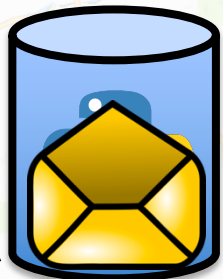
Face Book Server



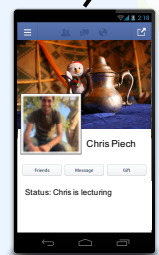


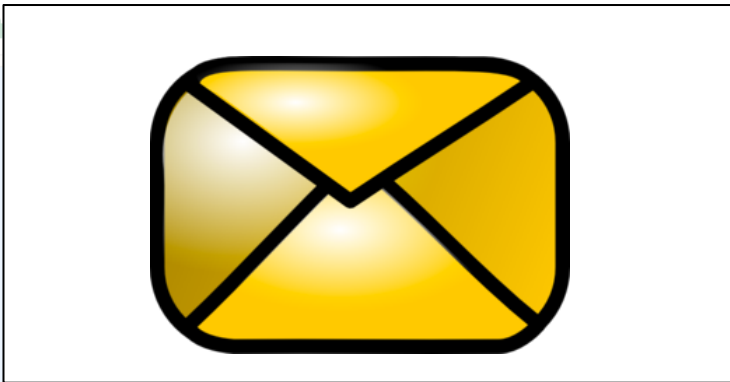
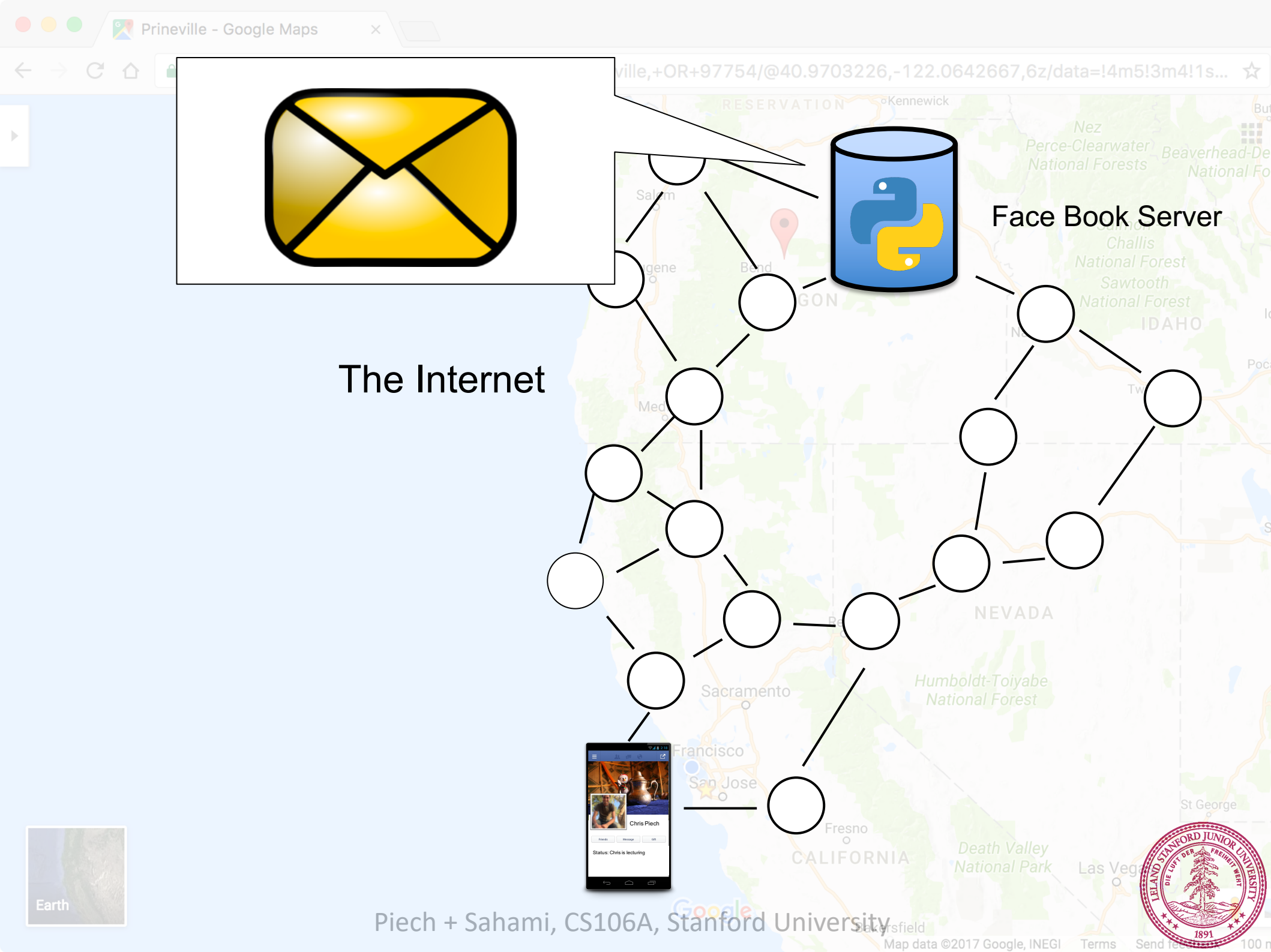
teaching

The Internet



Face Book Server



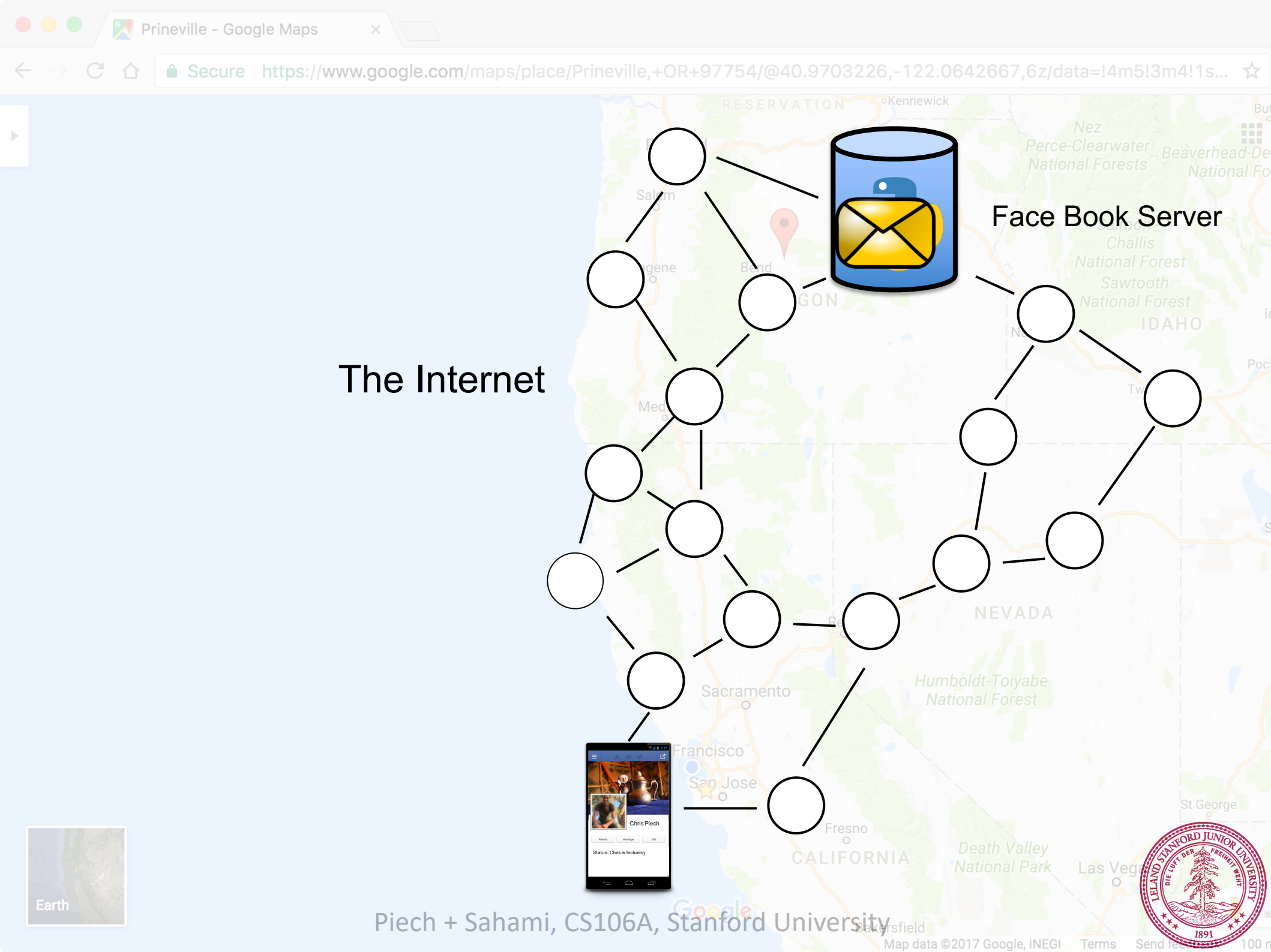


The Internet



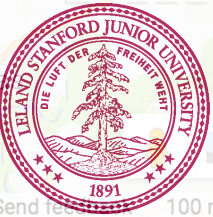
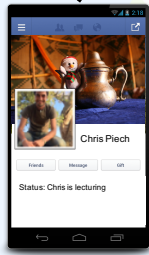
Face Book Server





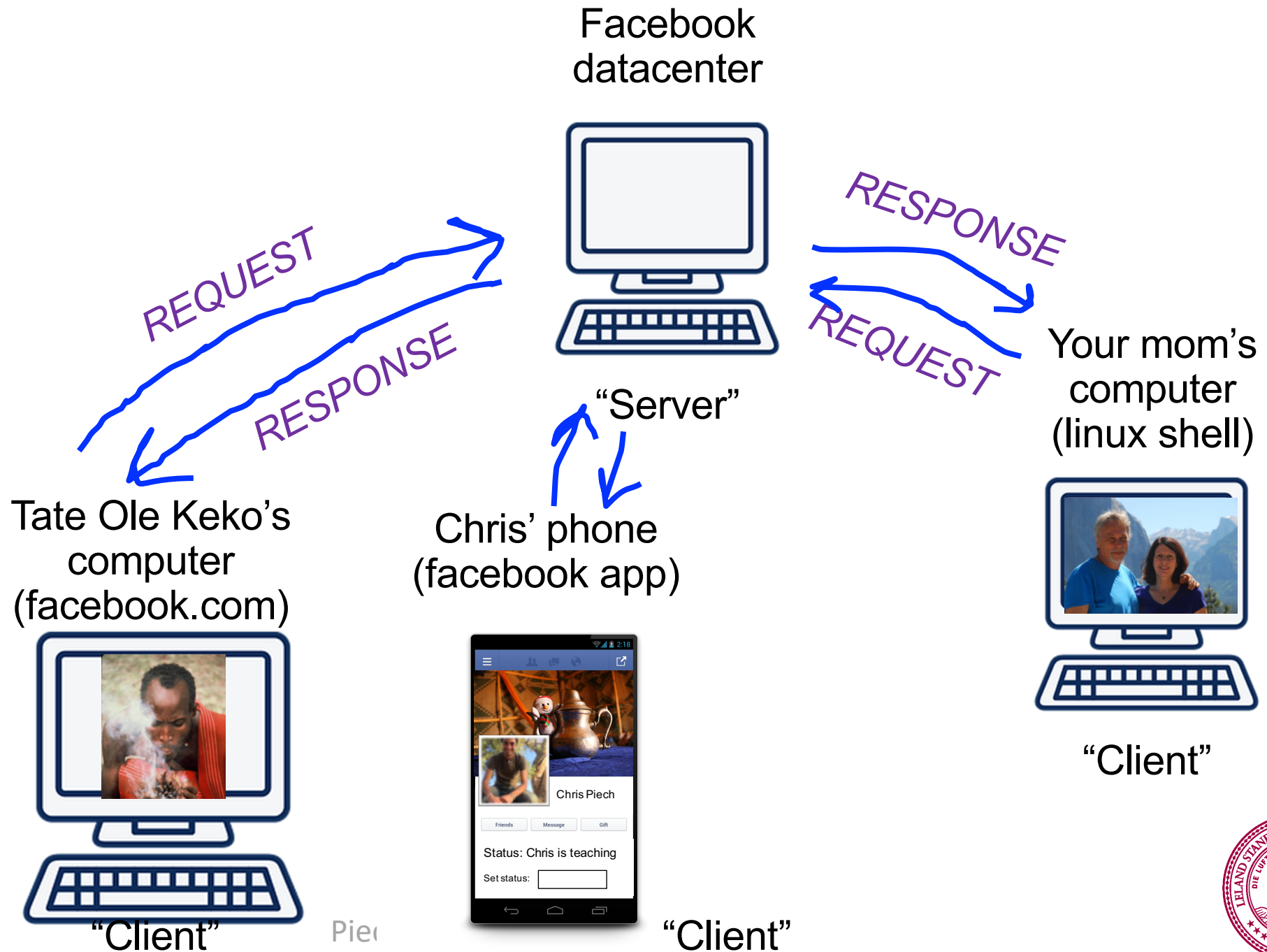
The Internet

Face Book Server

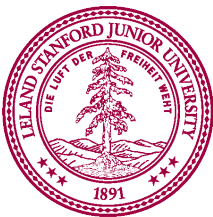
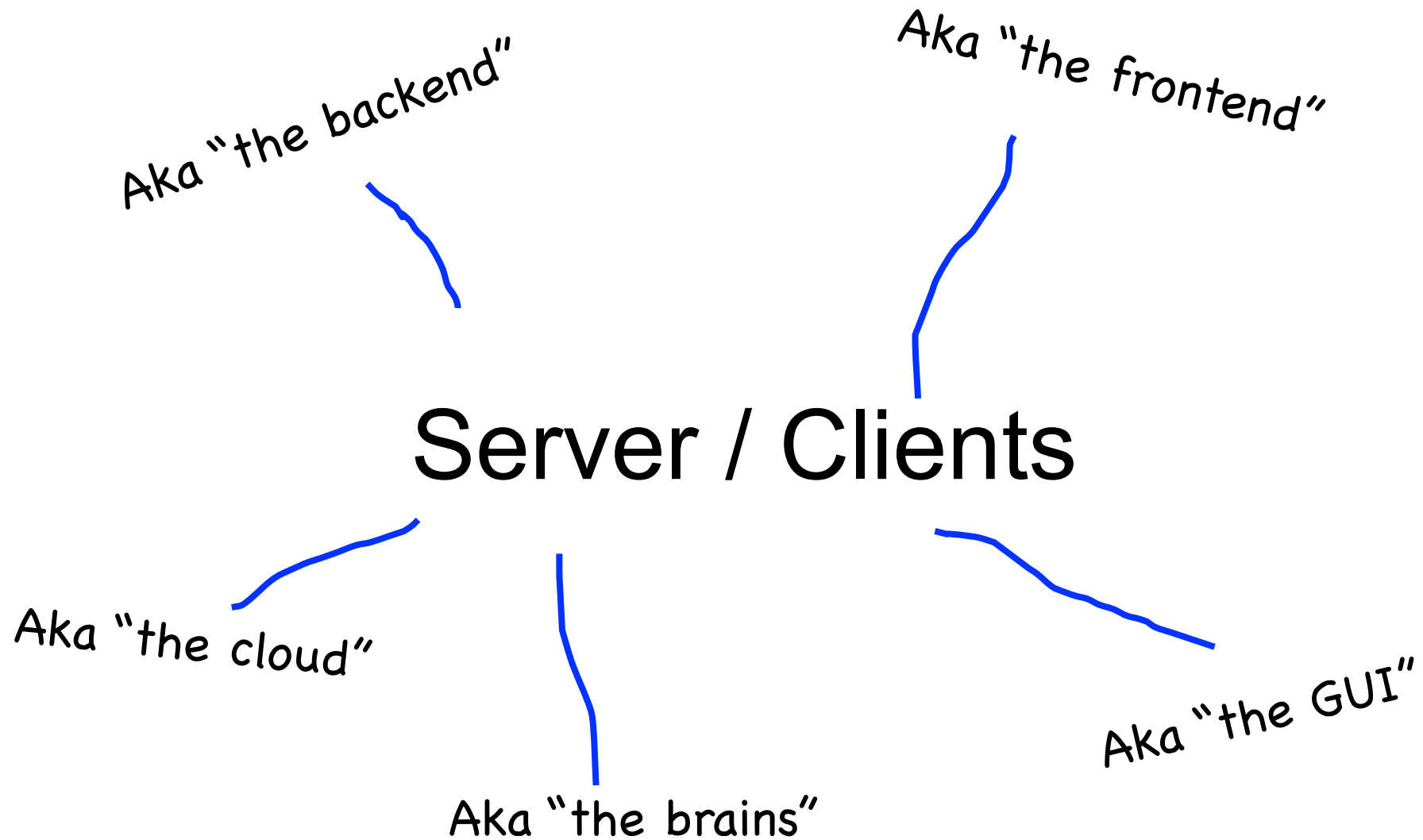


Many computers can connect
to the same server

The Internet



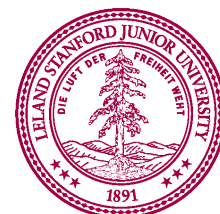
Most of the Internet



Today, the server



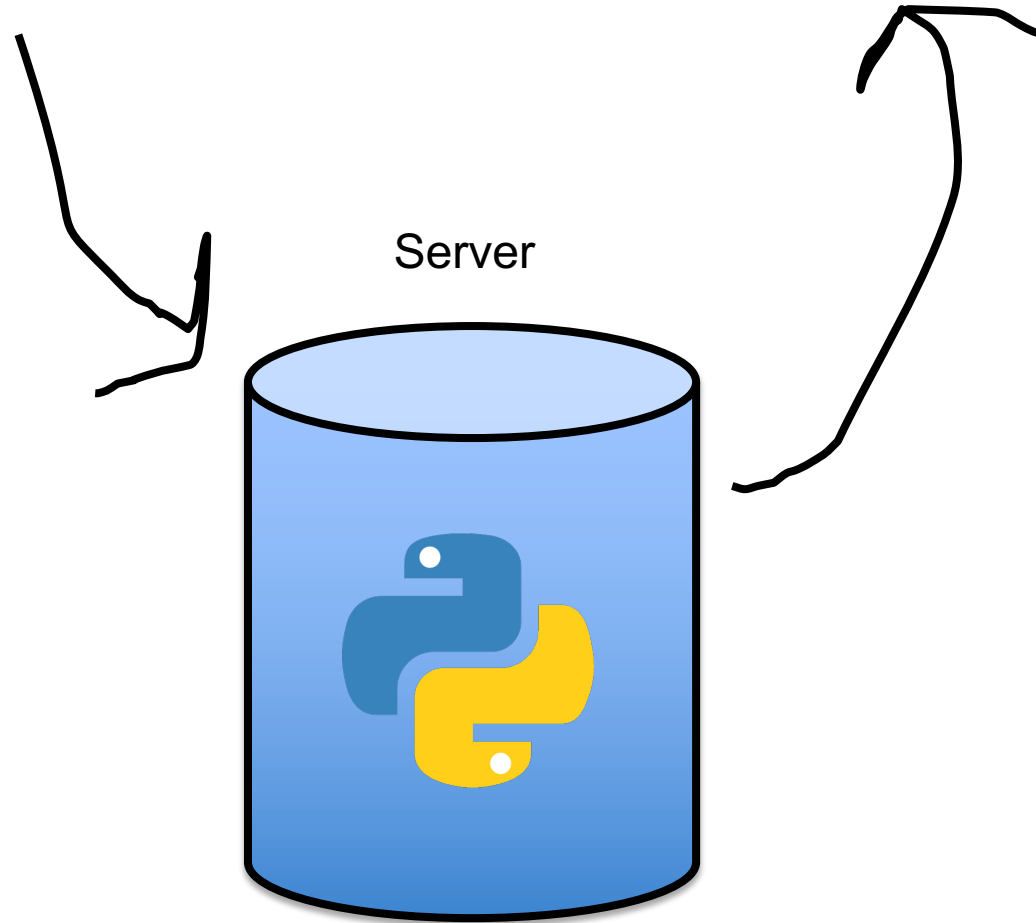
A server's main job is to
respond to requests



A Server's Simple Purpose

Request
From a client

Response
To the client



A Server's Simple Purpose

Request
someRequest

String
serverResponse

```
ChatServer
Starting server on port 8080...
getMsgs
newMsg
Added new message
getMsgs
Returned 1 messages
getMsgs
Returned 1 messages
newMsg
Added new message
getMsgs
Returned 1 messages
getMsgs
```



Servers on one slide

1

```
# handle server requests (must be in a class)
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

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def main():
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```

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Servers on one slide

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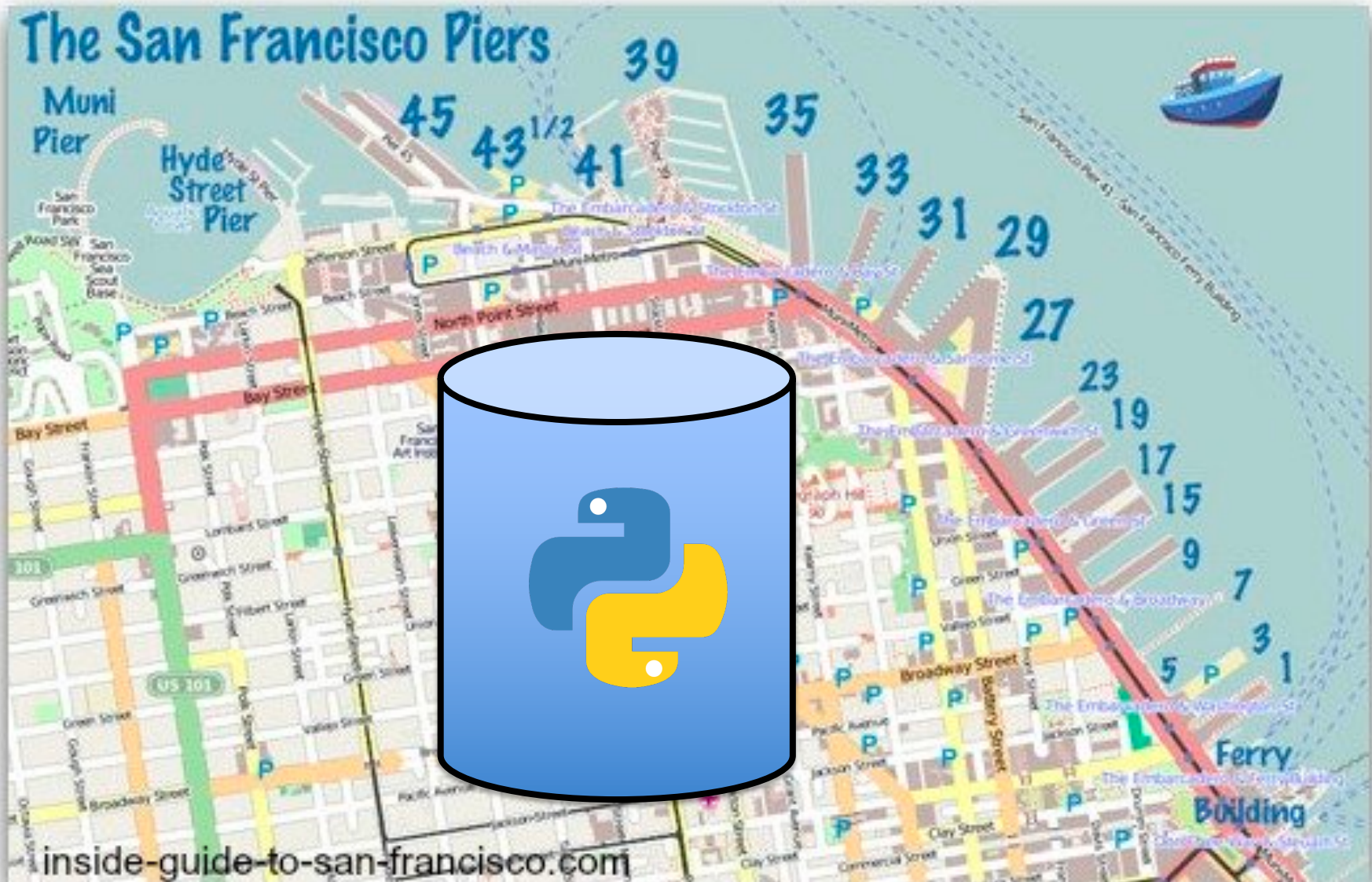
3

enjoy



What is a Port?

80 is a **special port** for a server that wants to talk to **web browsers**



Servers on one slide

1

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

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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.command  
request.params
```



```
class Request:
```

```
'''
```

The request class packages the key information from an internet request. An internet request has both a command and a dictionary of parameters. This class defines a special function `__str__` which means if you have an 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 request
```

```
return 'command=\' + self.command + \'\' params=\' + str(self.params) + \'\'
```

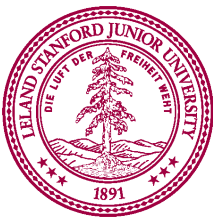
First Server Example!

```
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)
```



Who makes requests?

Who makes requests?

Other programs can send requests!

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

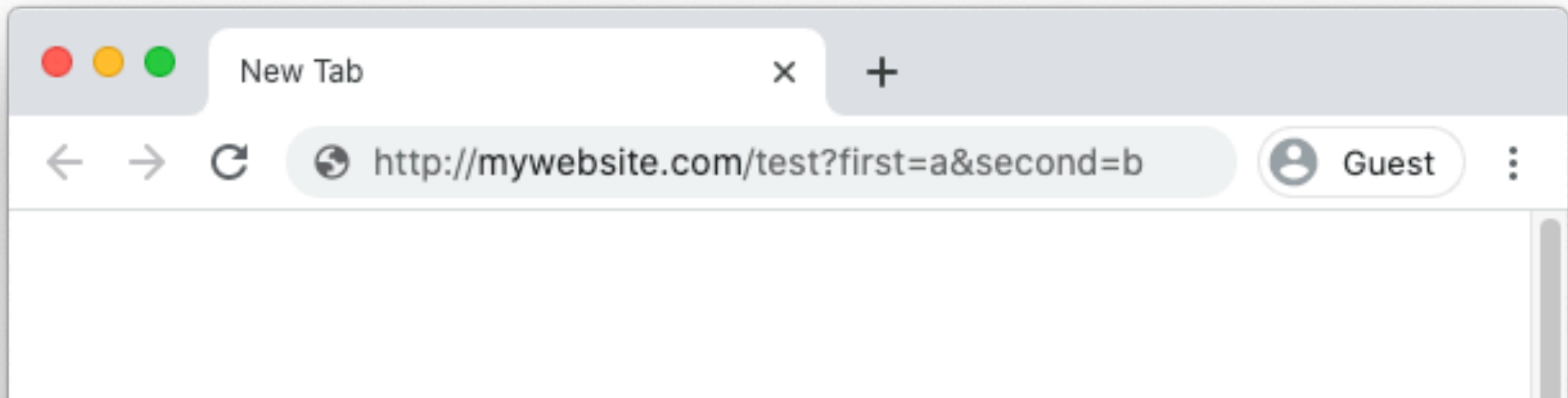
Who makes requests?

Other programs can send requests!

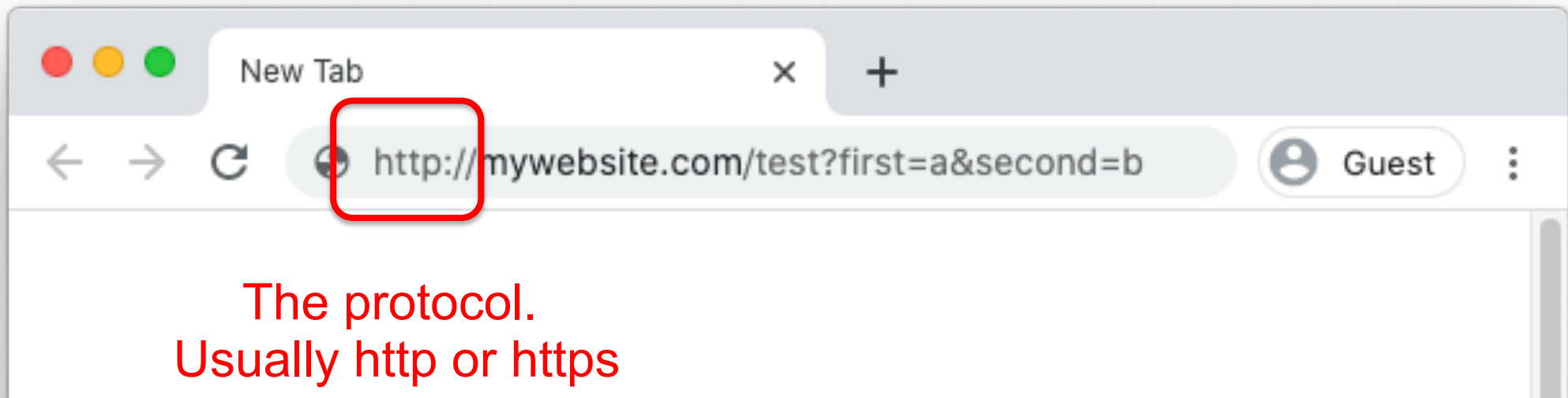
```
response = requests.get('https://xkcd.com/353/')
```

Web browsers can send requests!

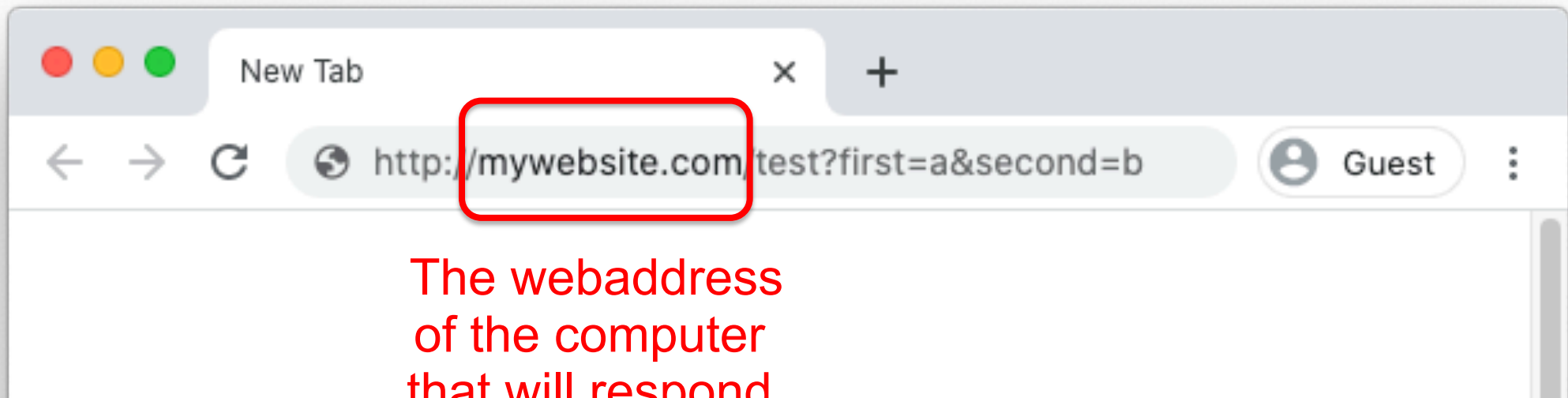
Anatomy of a Browser Request



Anatomy of a Browser Request



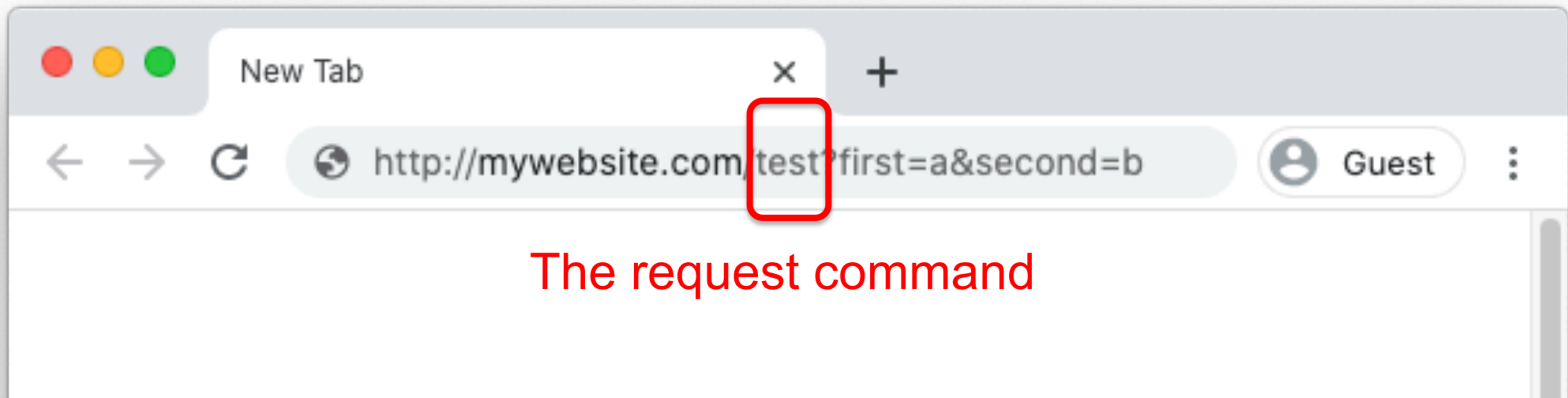
Anatomy of a Browser Request



The webaddress
of the computer
that will respond
to the request



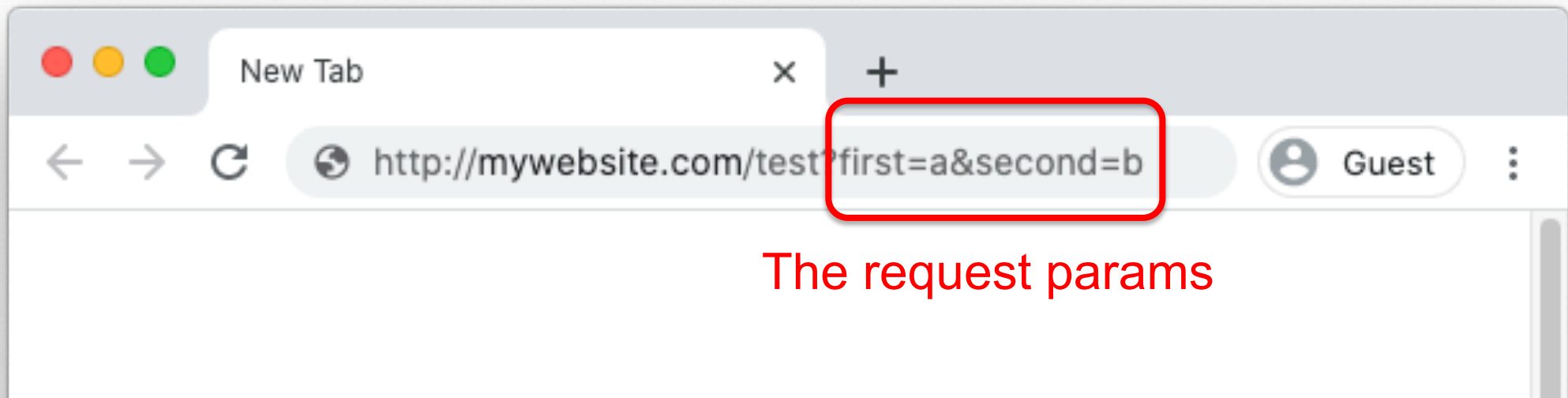
Anatomy of a Browser Request



The request command



Anatomy of a Browser Request



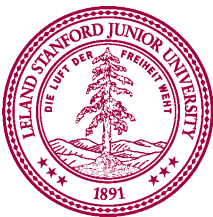
First Server Example!

```
from SimpleInternet import run_server
import json

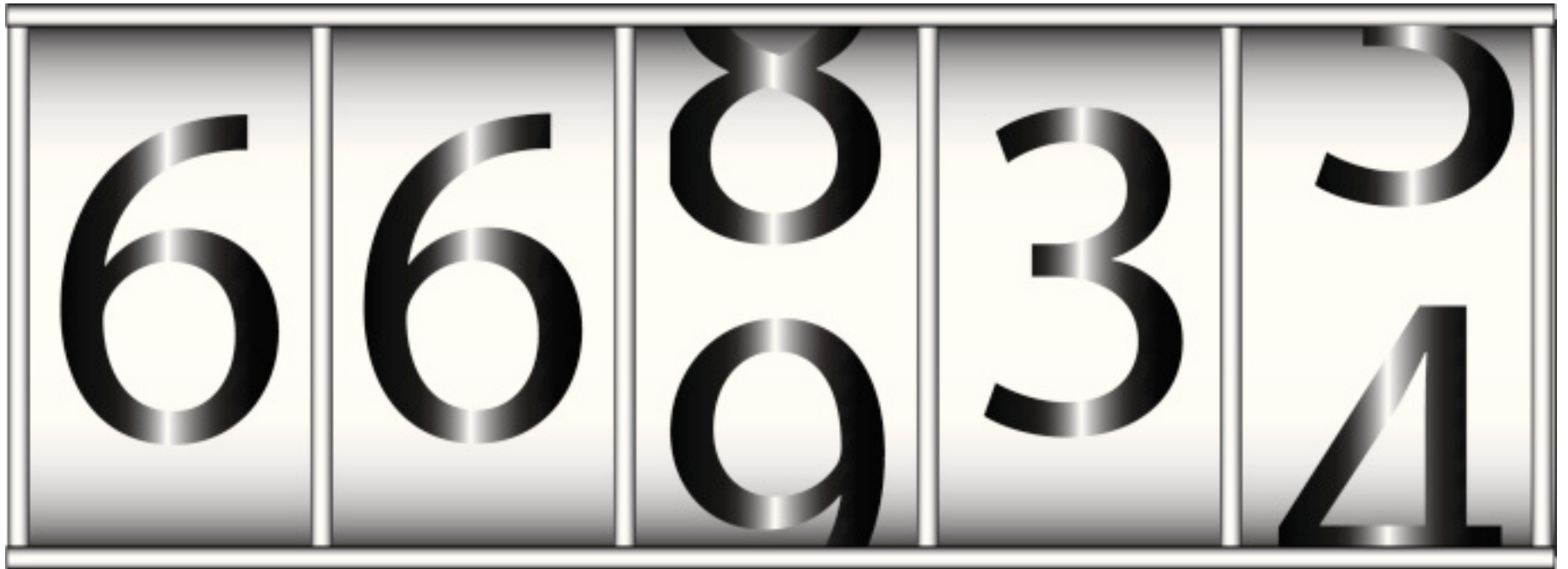
class MyServer:
    def __init__(self):
        ''' You can store data in your server! '''
        pass

    # 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)
```



Hit Counter



Recall Requests



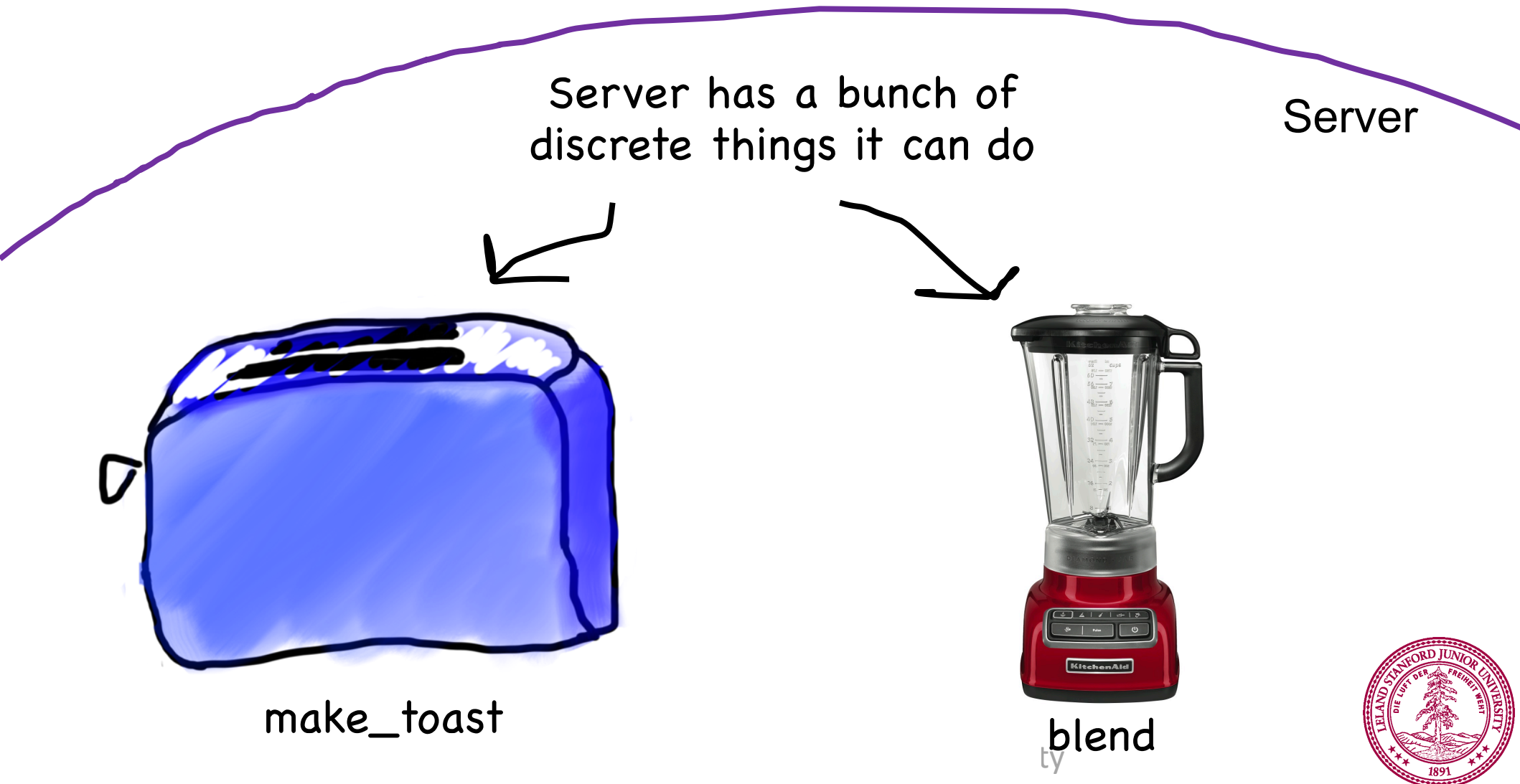
```
/* Request has a command */  
command (string)
```

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

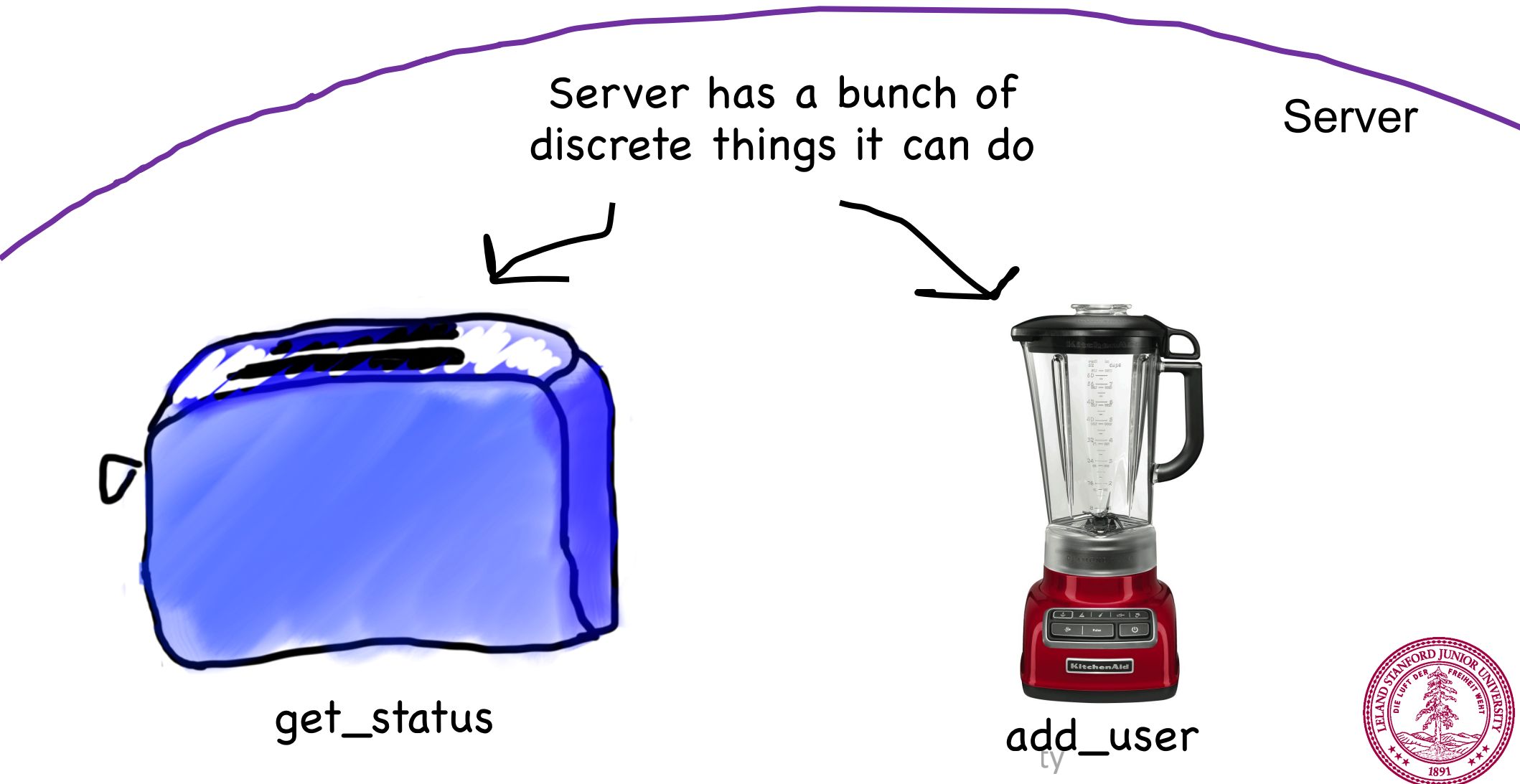
```
// methods that the server calls on requests  
request.command  
request.params
```



Requests are like Remote Method Calls



Requests are like Remote Method Calls



Requests are like Remote Method Calls

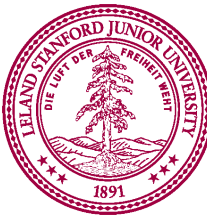
Server



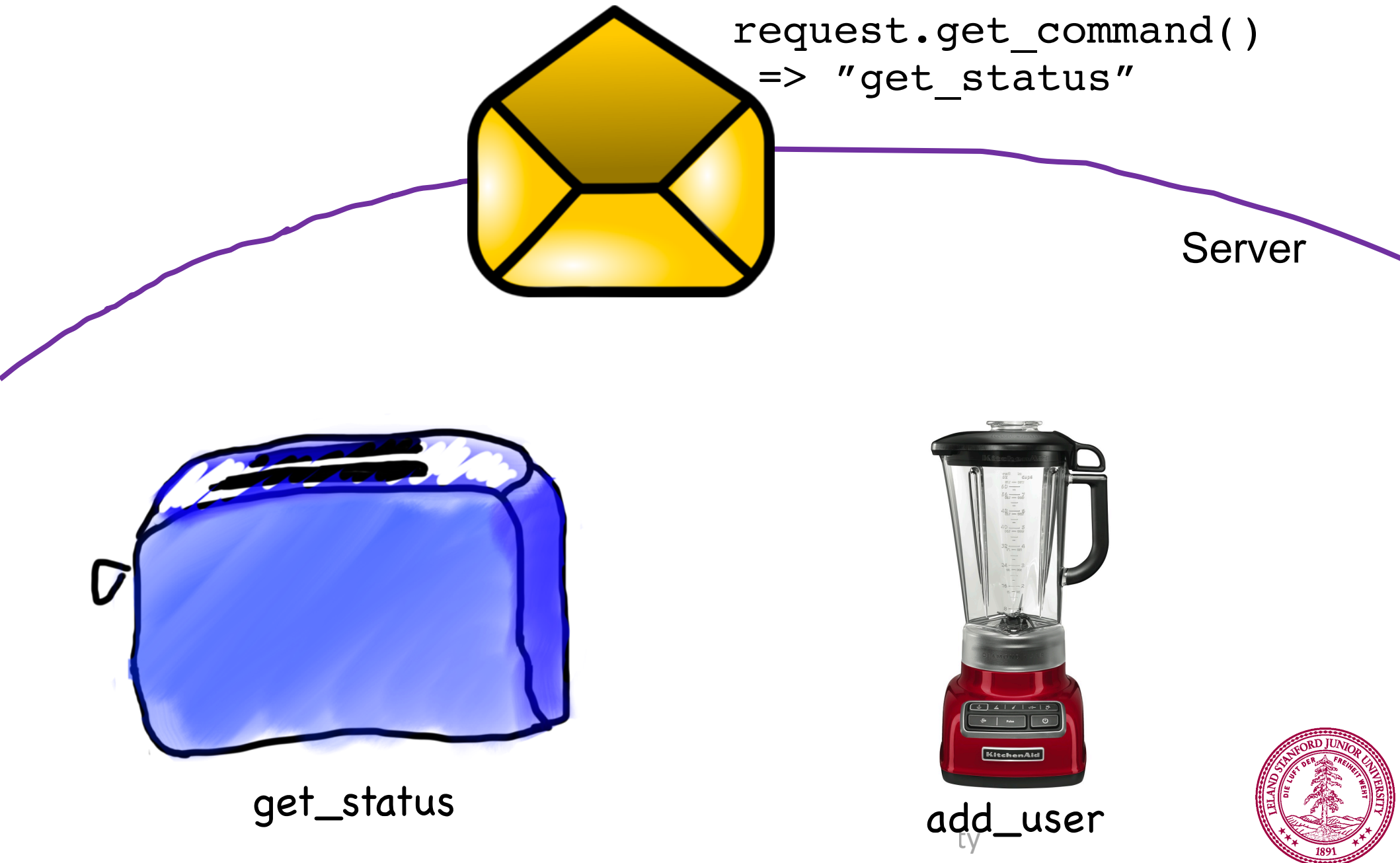
get_status



add_user



Requests are like Remote Method Calls



Requests are like Remote Method Calls



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



get_status

ty



Requests are like Remote Method Calls



I was given a parameter!



get_status

ty



Requests are like Remote Method Calls



`request.params["userName"]`



`get_status`

ty



Requests are like Remote Method Calls

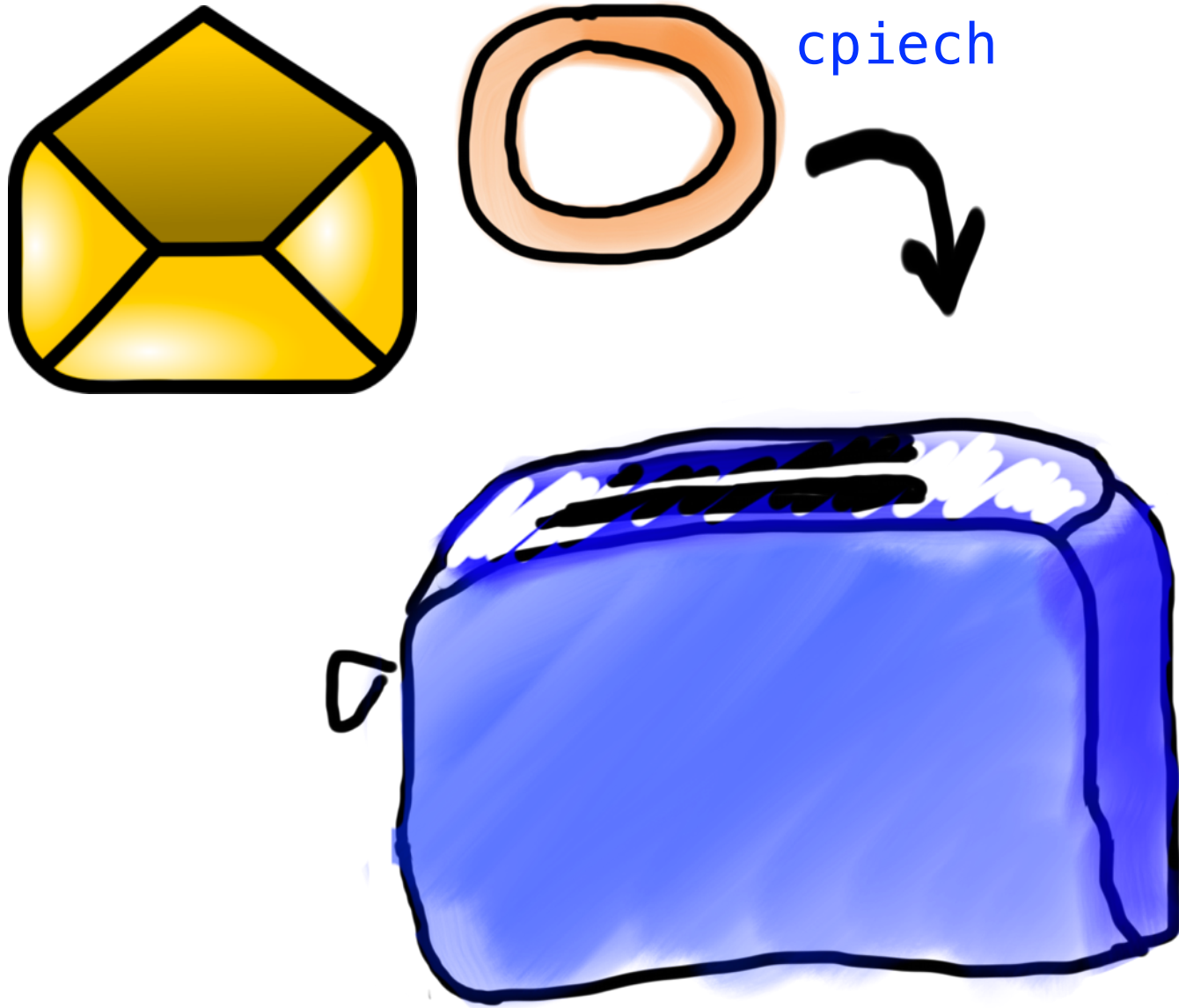


get_status

ty



Requests are like Remote Method Calls

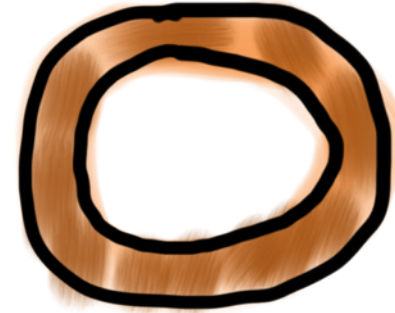


get_status

ty



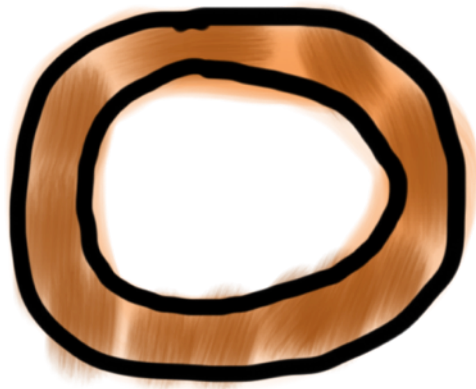
Requests are like Remote Method Calls



teaching



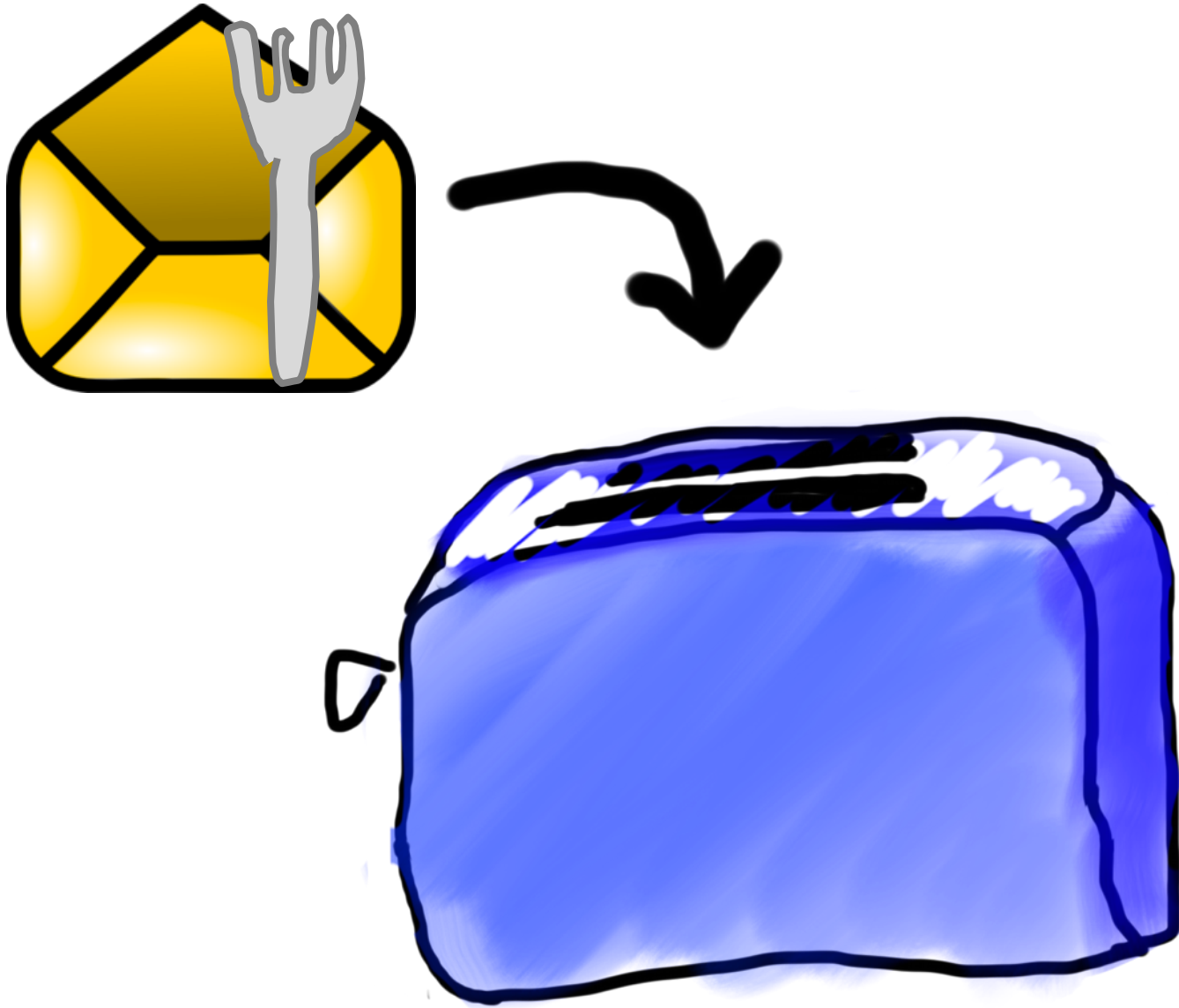

```
def handle_request(self, request):  
    cmd = request.command  
    if cmd == 'get_status':  
        user = request.params['userName']  
        status = self.get_status(user)  
        return status
```



Must be a string!



Requests are like Remote Method Calls



Requests are like Remote Method Calls



Requests are like Remote Method Calls



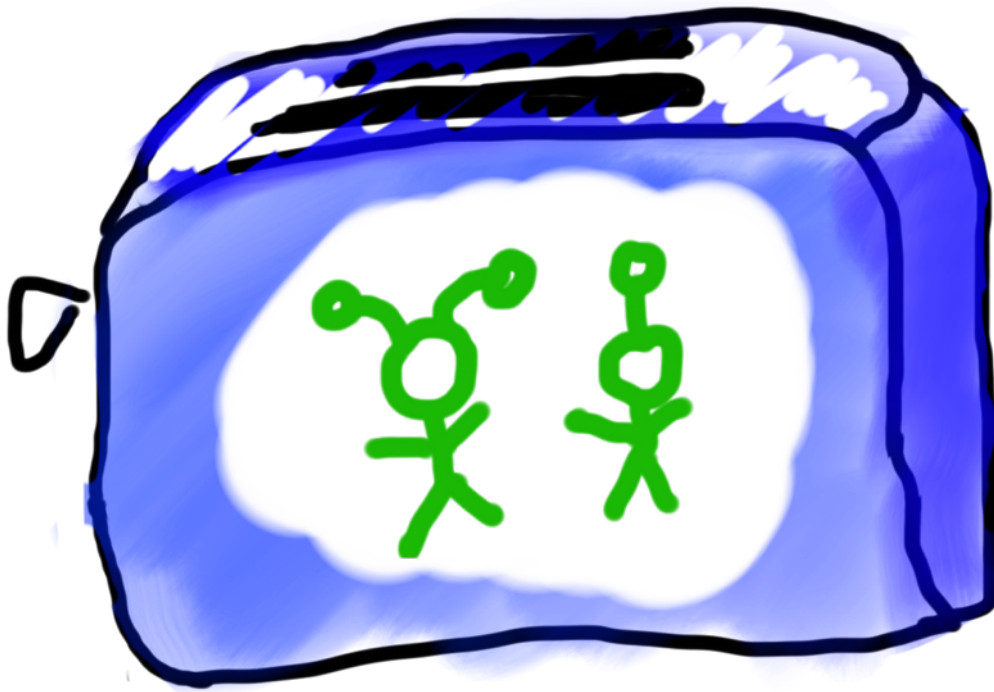
Requests are like Remote Method Calls



Requests are like Remote Method Calls



Requests are like Remote Method Calls





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

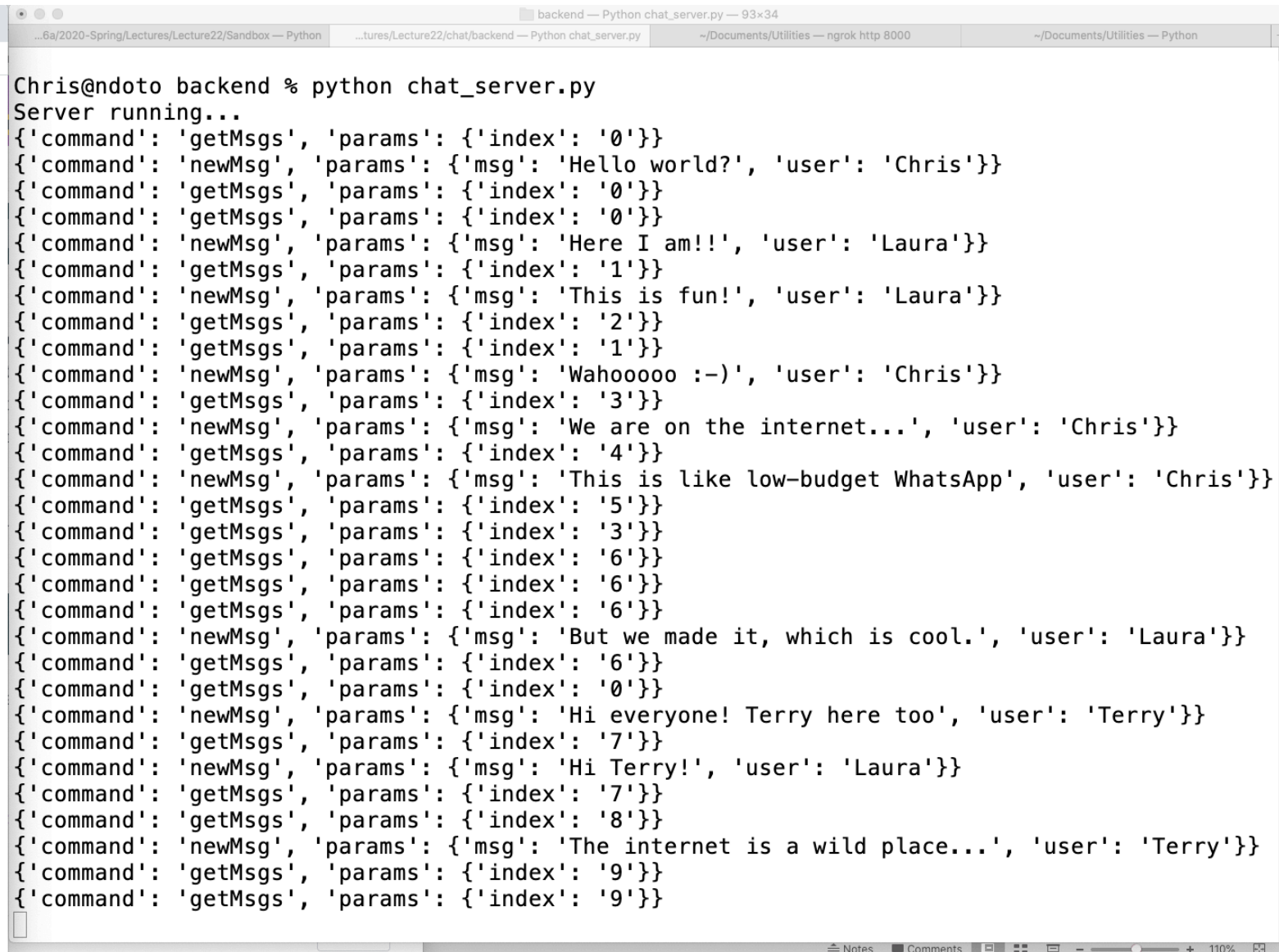
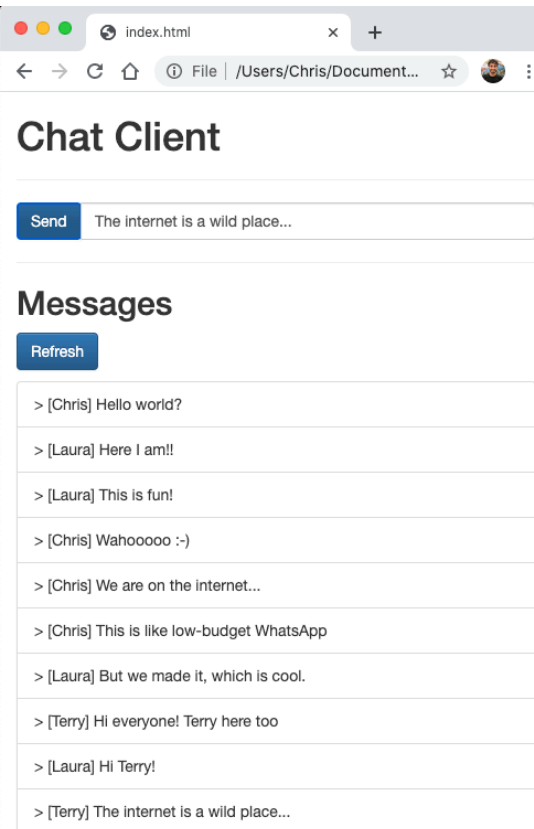
```
{  
    "Chris":32,  
    "Gary":70,  
    "Mehran":50,  
    "Brahm":23,  
    "Rihanna":32,  
    "Adele":32  
}
```

```
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



```
history = [
]
```



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

Chat Client

Hello world

Send

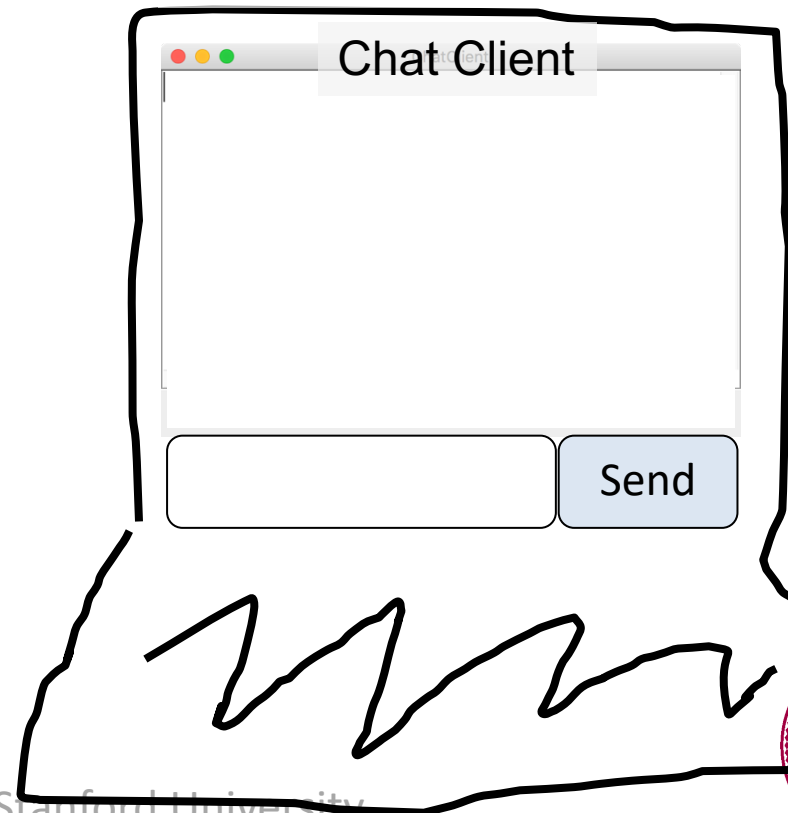
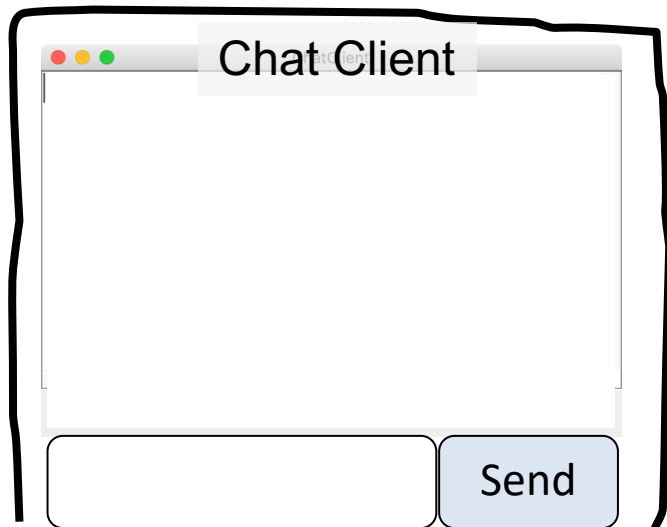
Chat Client

Send



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

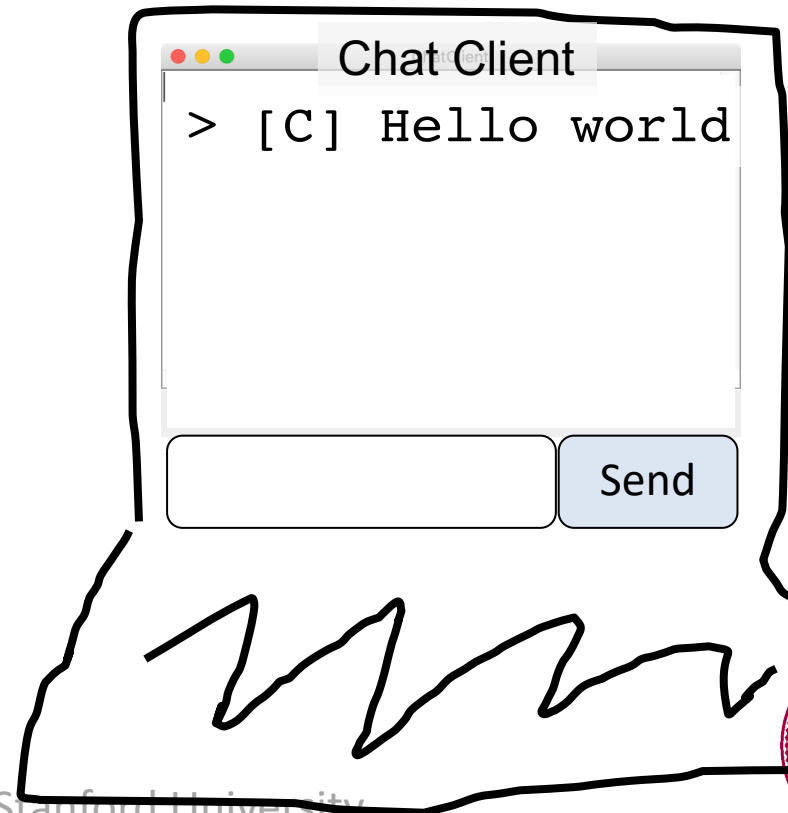
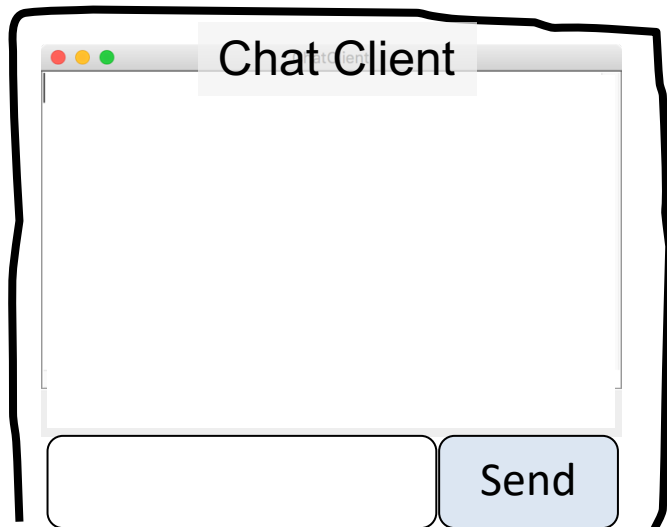
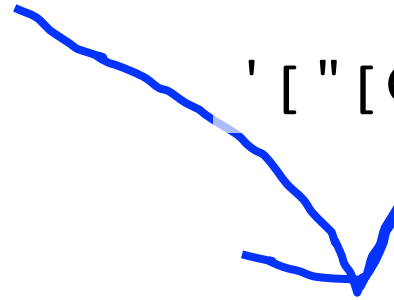
```
getMsgs  
{  
    'index' : 0  
}
```





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

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





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

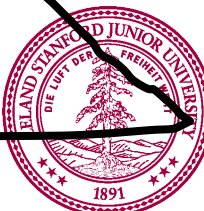
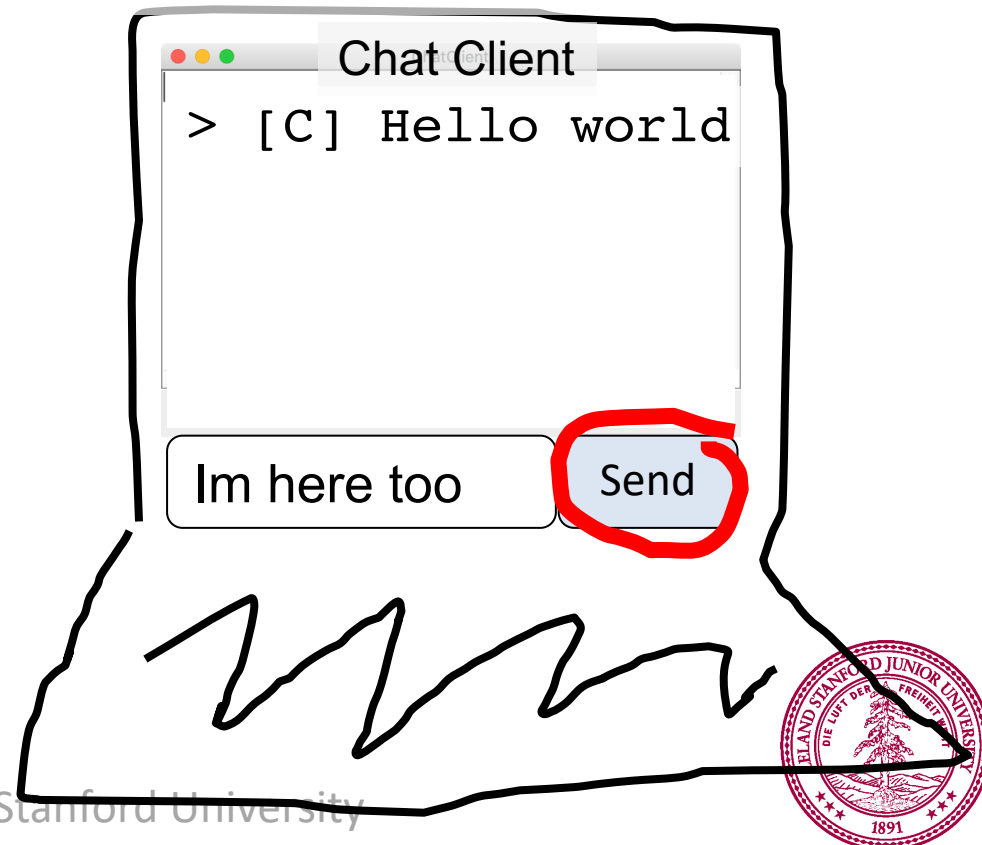
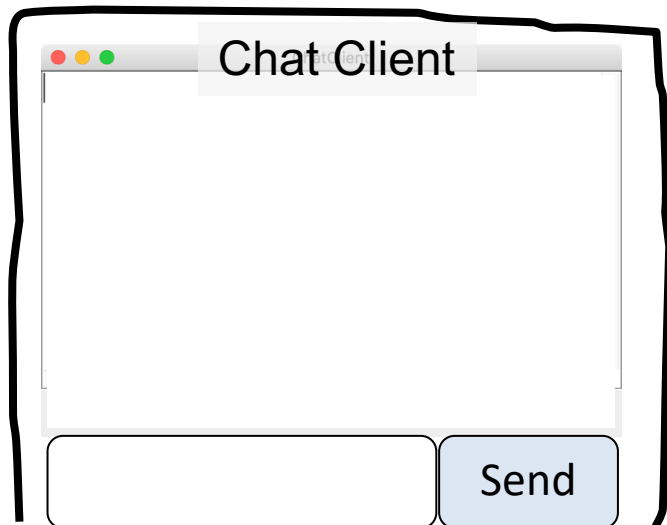
addMsg

{

'msg' : 'Im here too'

'user' : 'B'

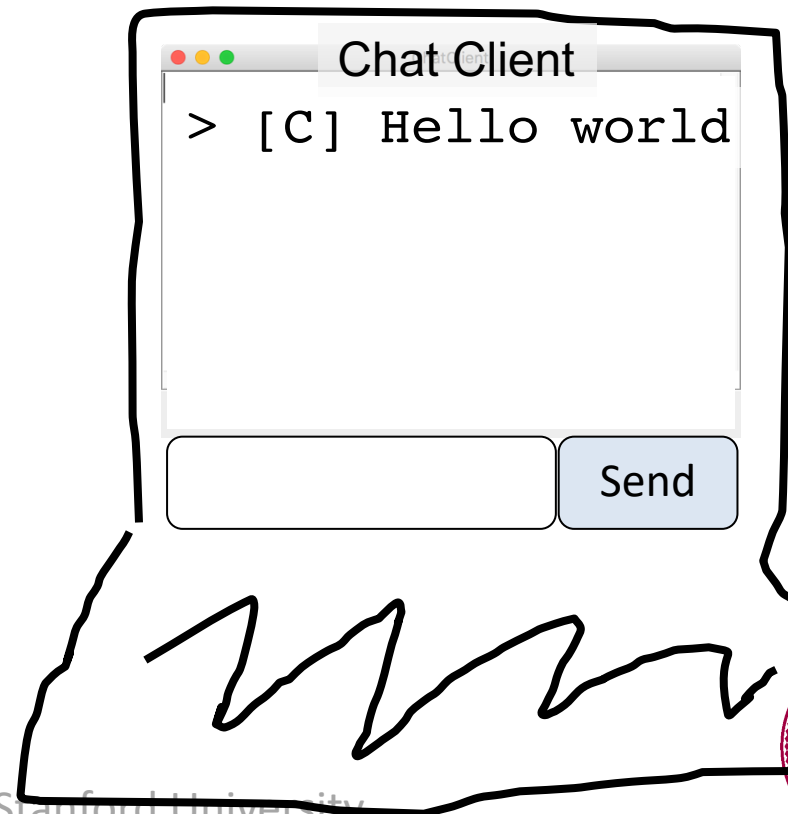
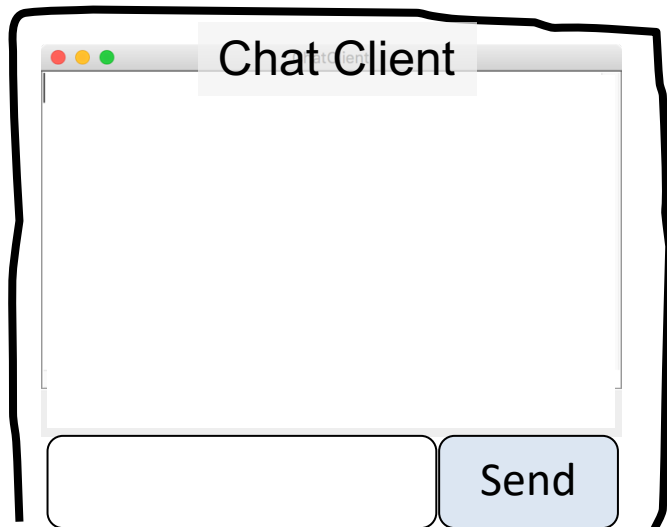
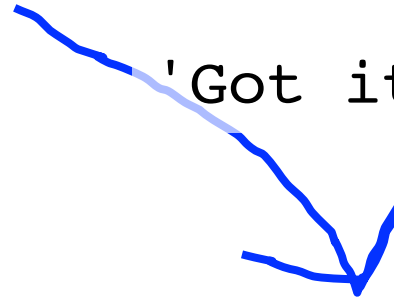
}





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

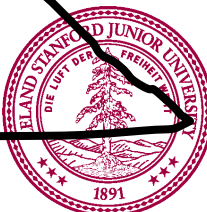
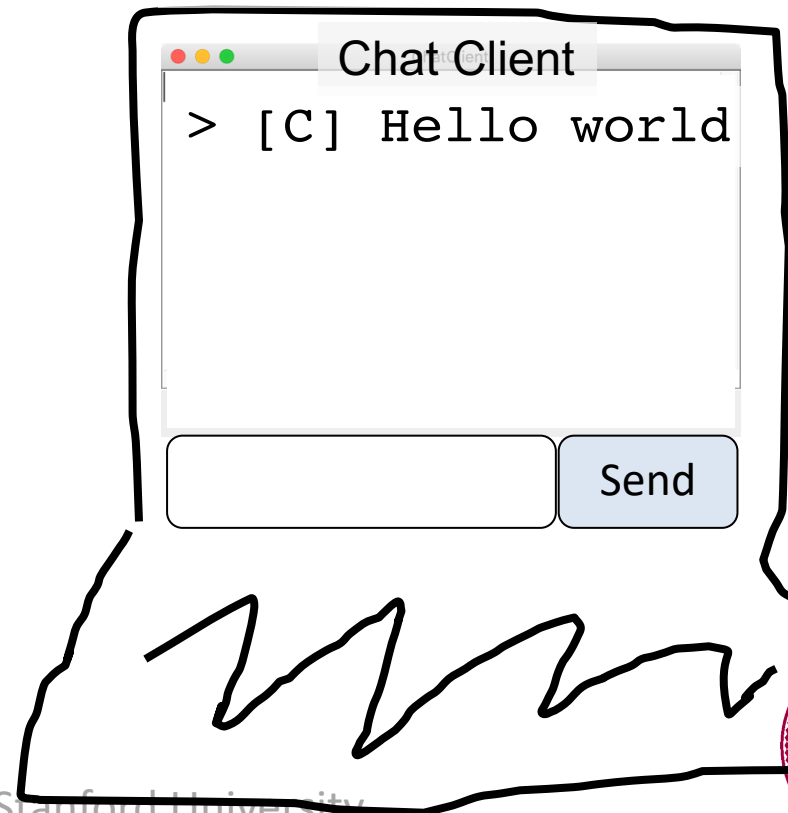
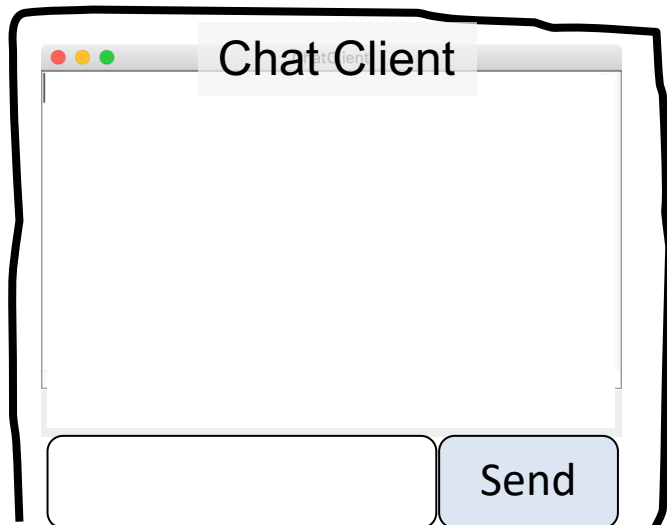
'Got it'





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

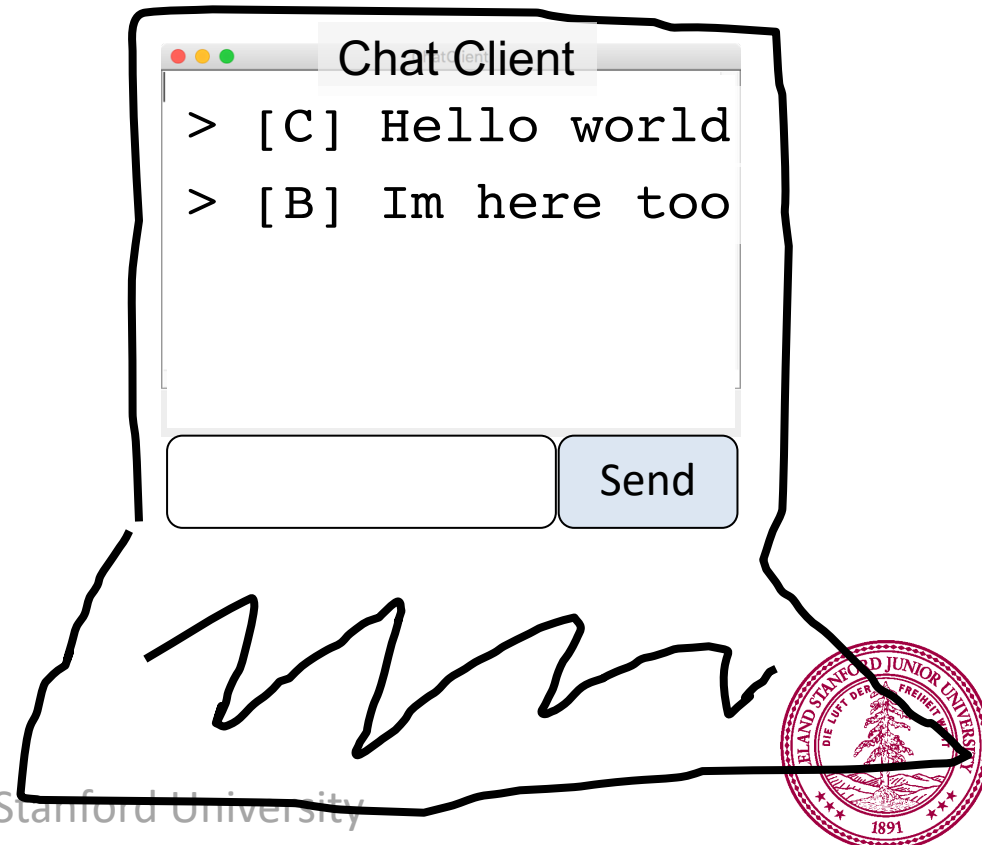
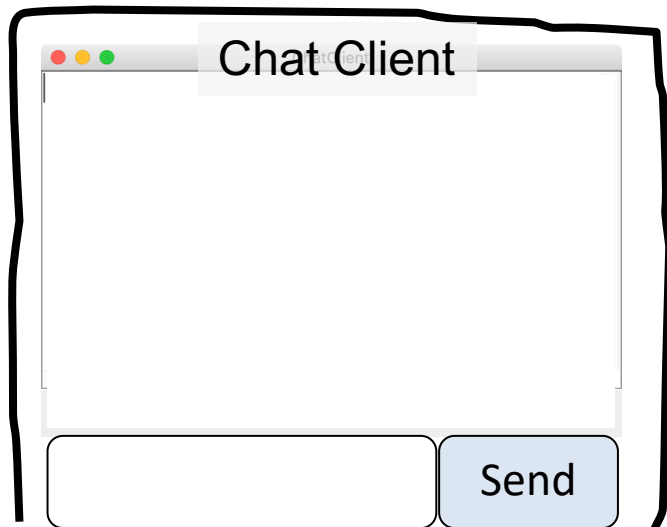
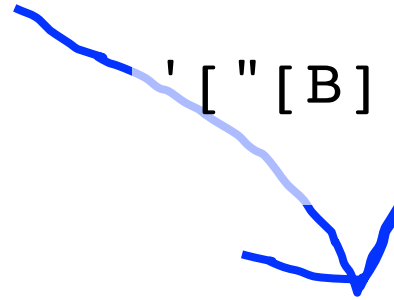
```
getMsgs  
{  
    'index' : 1  
}
```





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

'["[B] Im here too"]'





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

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

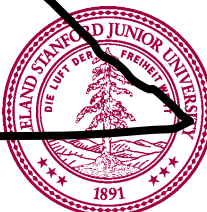
Chat Client

Send

Chat Client

```
> [C] Hello world  
> [B] Im here too
```

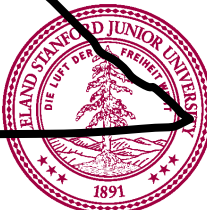
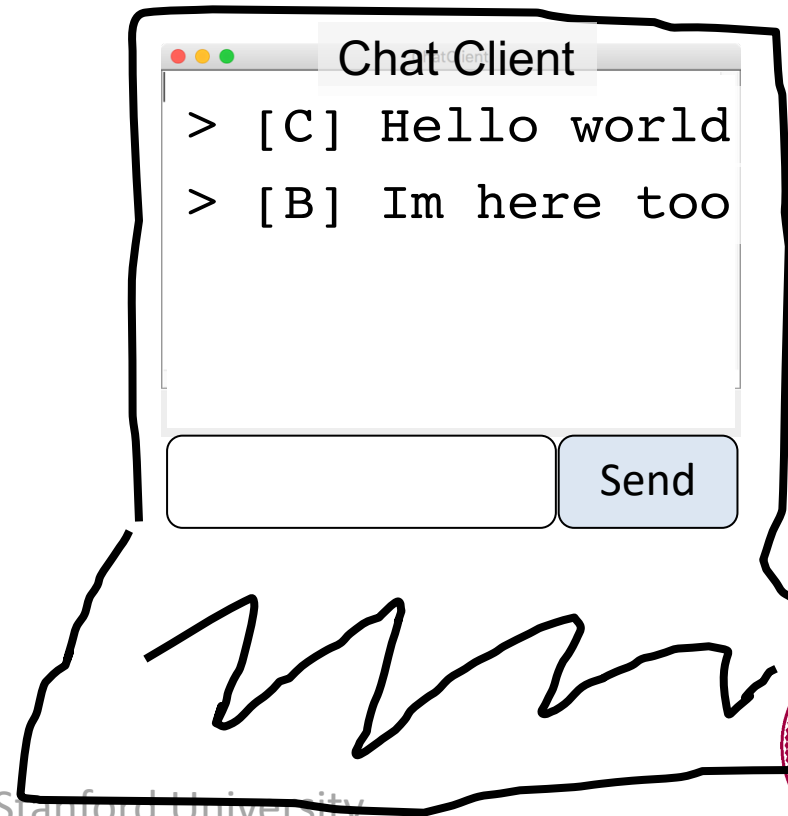
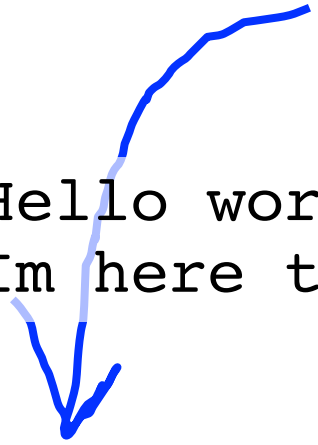
Send





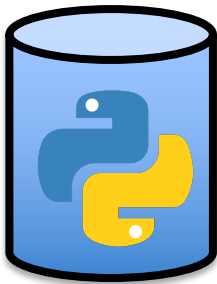
```
history = [  
    '[C] Hello world',  
    '[B] Im here too'  
]
```

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



Chat Server

Chat Server



```
addMsg  
msg = text  
user = user
```



```
getMsgs  
index = start_index
```

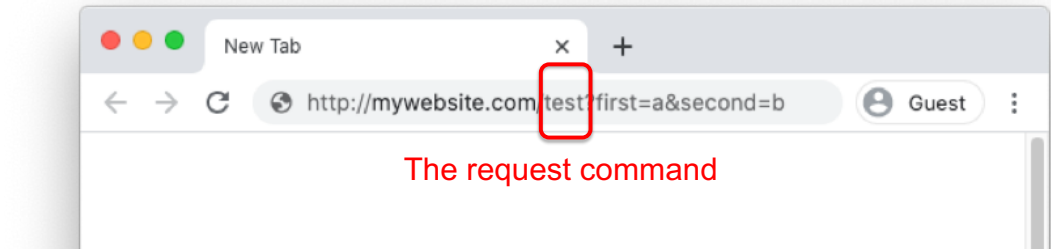
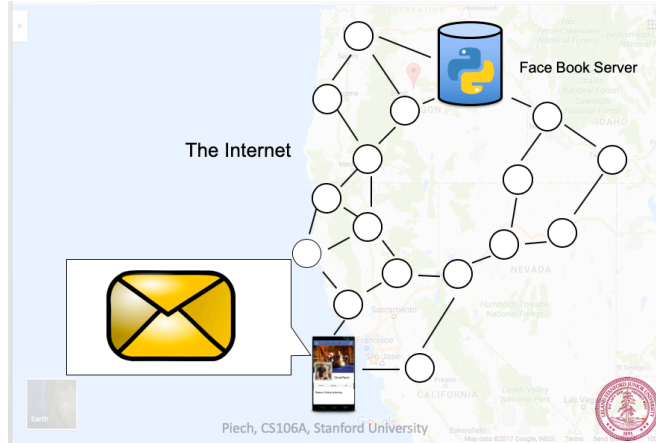


Learning Goals

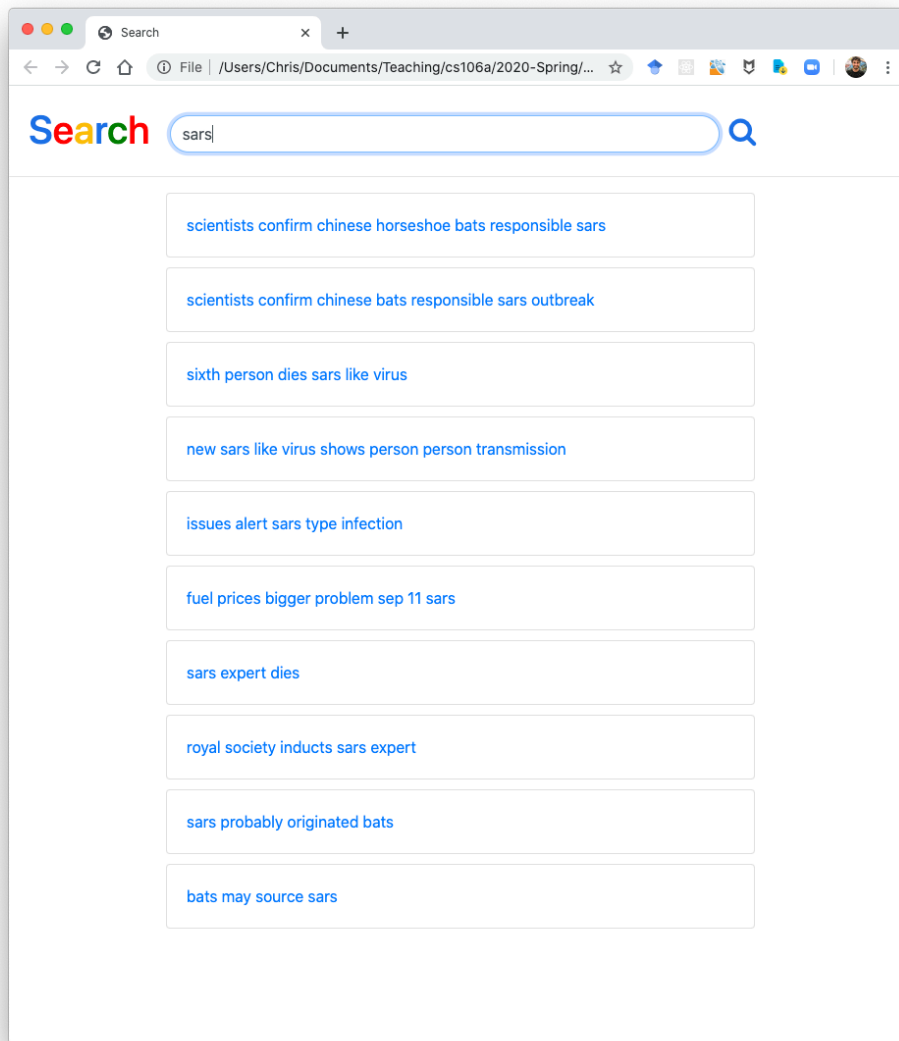
1. Write a program that can respond to internet requests



Things we saw along the way



```
data_str = json.dumps(data)
```



Search Engine

