Welcome!

Foundations in Digital Development
(for the Cloud)

Introduction

Foundations in Digital Development (for the Cloud)

Pre-Work

- Install \`Git\`: https://git-scm.com/downloads
- Install \`Python 3\`: https://www.python.org/downloads/
- Install \`Atom Text Editor\`: https://atom.io
- Install \`Putty\`: https://www.putty.org/
- Sign-up to \`Github\`: https://github.com/

What Might be Your Moonshot?

Learning Outcomes

1. Set-up a fit for purpose Intelligent Development Environment (IDE).
2. Write and execute basic programs in `Python`.
3. Use a Version Control System through making requests using `Git Bash`.
4. Clone and make changes to a pre-prepared website.
5. Log-in to an `AWS` environment.
6. Set-up security groups and access policies for cloud services.
7. Upload content to an `AWS S3` bucket and view via a URL.
8. Launch an `AWS EC2` instance, work with AMI’s, establish secure connections and configure a web server.
9. Make requests to a `REST API`.
10. Read `JSON` and work with the response payload.
11. Create and deploy a simple web application.

Course Outline

Preparation 09:00-09:30	● `Git` ● `Python 3` ● `Atom Text Editor` ● `Putty` ● Your moonshot idea!
The Development Ecosystem 09:40-12:30	● Code and language support ● Intelligent development environments ● Syntax highlighting and debugging ● First-steps in programming ● Libraries, packages and re-factoring ● Version control systems
Cloud Services 12:50-14:15	● Overview of providers and typical services available ● Compute and storage ● Security and network protocols
Interfaces 14:30-16:35	● Application programmatic interfaces ● Making simple `API` requests ● Working with response payloads and understanding `JSON` ● Create and deploy a simple web application
Debrief 17:00-17:20	● Takeaway's ● Summary

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Code and Language Support

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Python Basics

- No need to declare variable types
- External variables need importing
- Uses indentation to declare sub-processes
- Processes run sequentially
- Processes run at latest opportunity
- Supports definition of classes and class variables
- Logic statements often applied
- Often used for analytics and server-side processes (though very versatile)
- Often run in a `virtual environment` using `pip` for package management

```
String = “Hello world”

if Python == Python 3:
     Print(String)
Out: “Hello world”

elif Python == Python 2:
     Print String
Out: “Hello World”

List = [5,6,7,8,9,11]
List[0] + List[4]
Out: 14

Tuple = (“hello”, “world”)
Tuple[1]
Out: “world”
```

Example code: https://gitlab.arup.com/technology-costmodelling/lifecycle-cost/building.py

Javascript Basics

- No need to declare variable types
- External variables need importing
- Uses brackets to declare variables
- Declaration of sub-processes end with ";"
- Processes often run asynchronously
- Supports definition of class variables
- Output typically logged or alerted, rather than printed in terminal
- Logic statements often applied
- Often used to handle `JSON` payloads with HTML interfaces (though very versatile)
- Often run in `Node.js` using `NPM` for package management

```
String = "Hello world";
console.log(String);
Out: "Hello world"

List = [5,6,7,8,9,11];
console.log(List[0] + List[4]);
Out: 14

words: {
     "first": "Hello",
     "second": "world"
};
console.log(words.second);
Out: "world"
```

Example code: https://gitlab.arup.com/technology-IAM/cofRN/App.js

HTML Basics

- Renders static content
- Uses a system of dividers, containers and elements
- Elements may be inherent or imported
- Containers and elements may have declared properties and styles
- Indentation is used to declare element hierarchy.
- `HTML` is able to render `JSON` as text

```
<section>
     <body
     display=”block”
     margin=”8px”>
          Hello world
     </body>
     <table
     style="width:100%">
          <tr>
               <th>0</th>
               <th>1</th>
               <th>2</th>
          </tr>
          <tr>
               <td>5</td>
               <td>6</td>
               <td>7</td>
          </tr>
     </table>
</section>
```

Example code: https://gitlab.arup.com/technology-bus-methodology/bus-website/index.html

Other Common Languages

`C`,

`C++`,

`C#`,

`Java`,

`Scala`,

`VisualBasic`,

`Fortran`,

`Matlab`, ...

Syntax Highlighting and Debugging

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Demonstration

vs

Some Text Editors

Visual Studio

eclipse

Notepad++

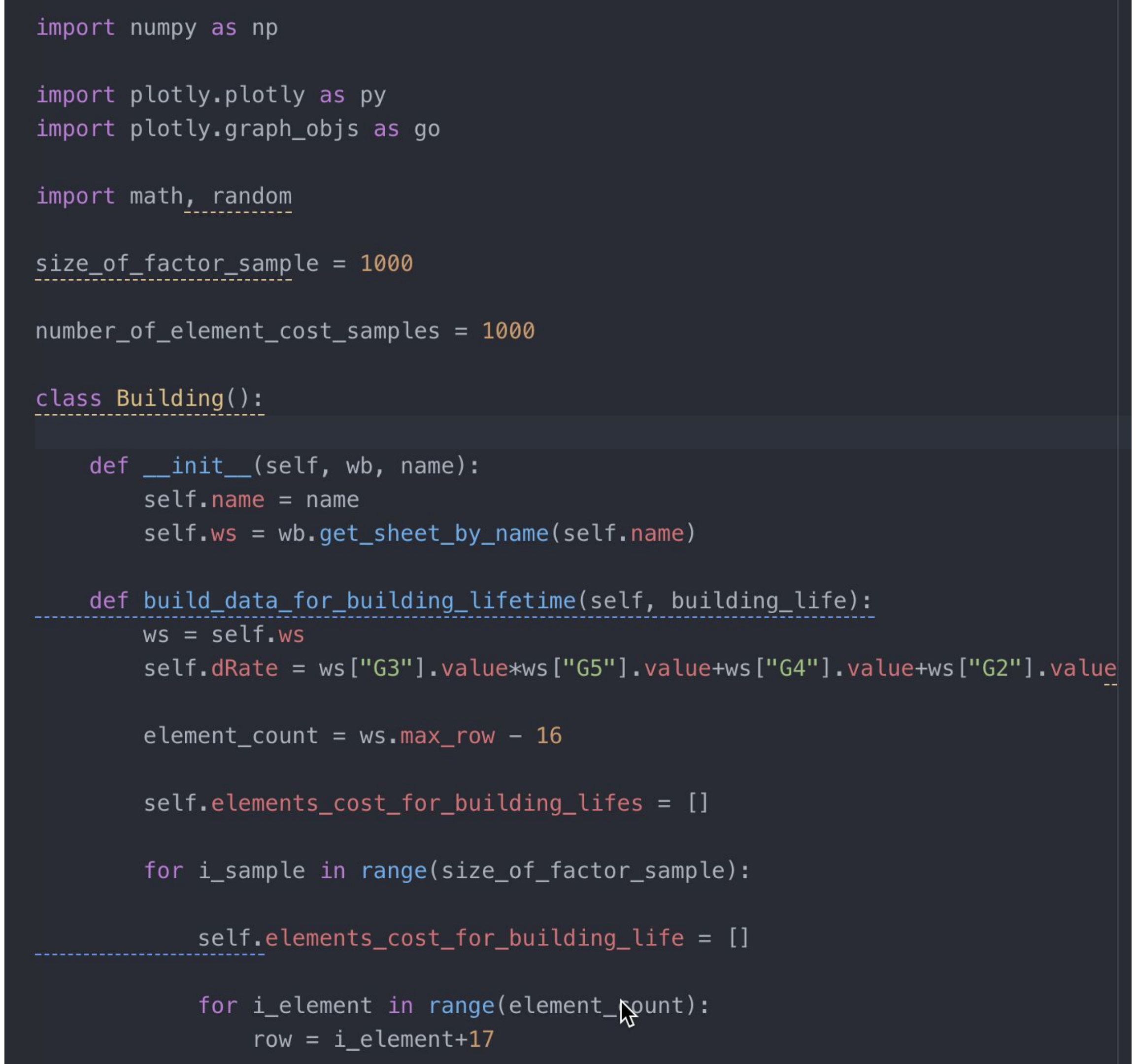
SPYDER

IJ

Activity

1. Set-up `Python` language support for `Atom`: https://atom.io/packages/ide-python
2. Set-up `HTML` language support for `Atom`: https://atom.io/packages/ide-html
3. Set-up `Jupyter Notebook` file support for `Atom`: https://atom.io/packages/jupyter-notebook
4. Explore Atom project folder, file management, file and terminal views

Python



```
import numpy as np

import plotly.plotly as py
import plotly.graph_objs as go

import math, random

size_of_factor_sample = 1000

number_of_element_cost_samples = 1000

class Building():


    def __init__(self, wb, name):
        self.name = name
        self.ws = wb.get_sheet_by_name(self.name)

    def build_data_for_building_lifetime(self, building_life):
        ws = self.ws
        self.dRate = ws["G3"].value*ws["G5"].value+ws["G4"].value+ws["G2"].value

        element_count = ws.max_row - 16

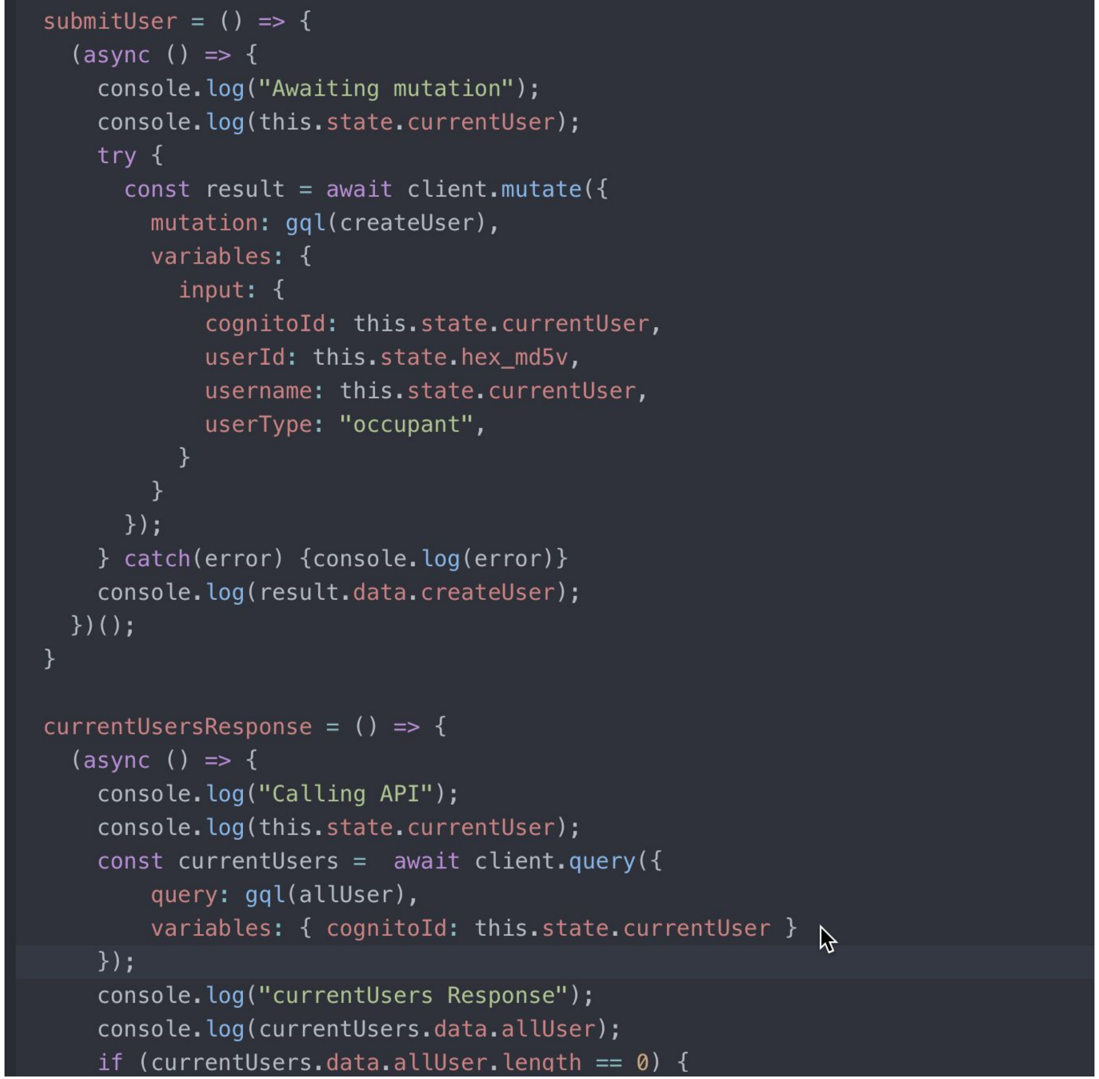
        self.elements_cost_for_building_lifes = []

        for i_sample in range(size_of_factor_sample):

            self.elements_cost_for_building_life = []

            for i_element in range(element_count):
                row = i_element+17
```

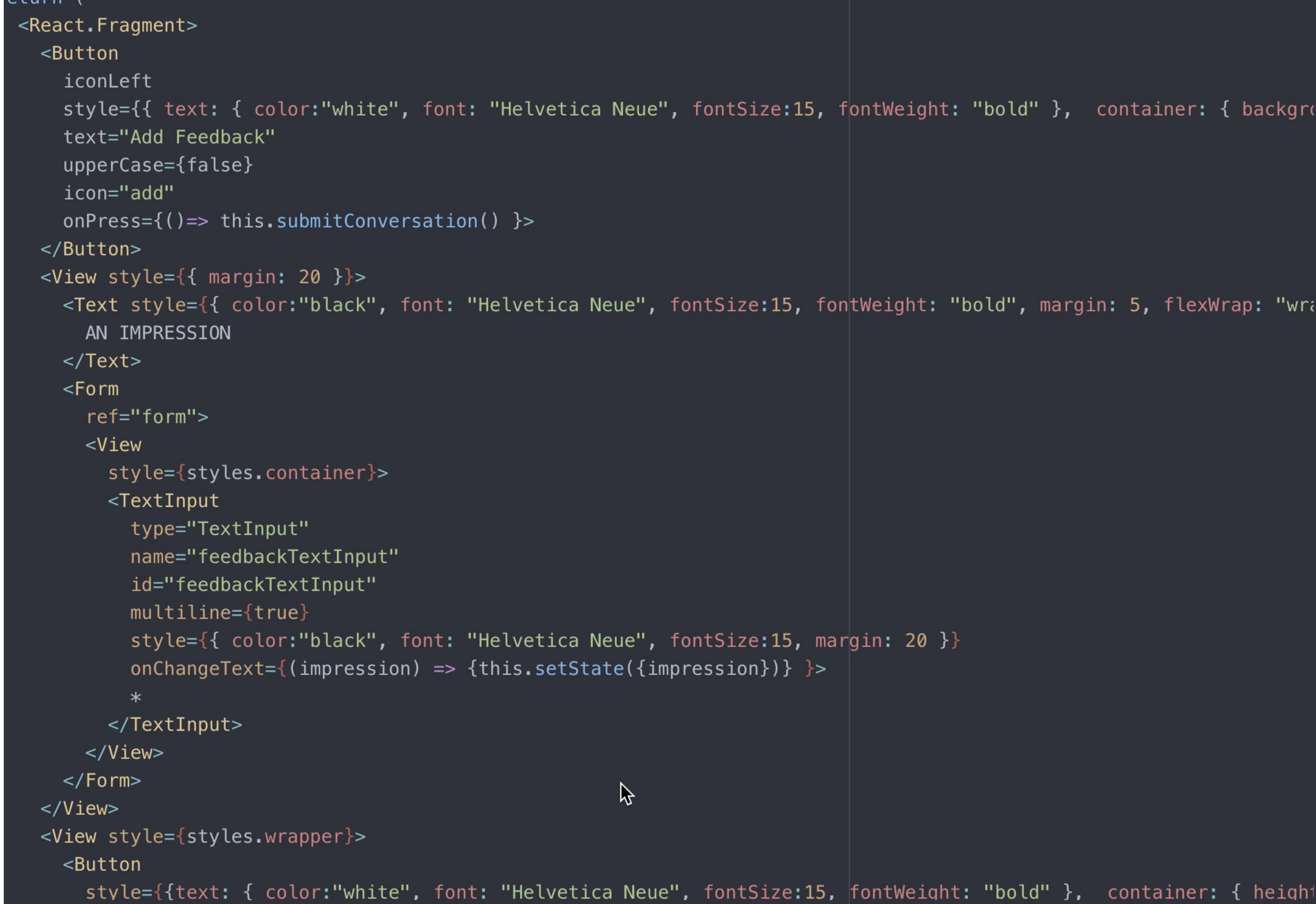
Javascript



```
submitUser = () => {
  (async () => {
    console.log("Awaiting mutation");
    console.log(this.state.currentUser);
    try {
      const result = await client.mutate({
        mutation: gql(createUser),
        variables: {
          input: {
            cognitoId: this.state.currentUser,
            userId: this.state.hex_md5v,
            username: this.state.currentUser,
            userType: "occupant",
          }
        }
      });
    } catch(error) {console.log(error)}
    console.log(result.data.createUser);
  })();
}

currentUsersResponse = () => {
  (async () => {
    console.log("Calling API");
    console.log(this.state.currentUser);
    const currentUsers =  await client.query({
        query: gql(allUser),
        variables: { cognitoId: this.state.currentUser }
    });
    console.log("currentUsers Response");
    console.log(currentUsers.data.allUser);
    if (currentUsers.data.allUser.length == 0) {
```

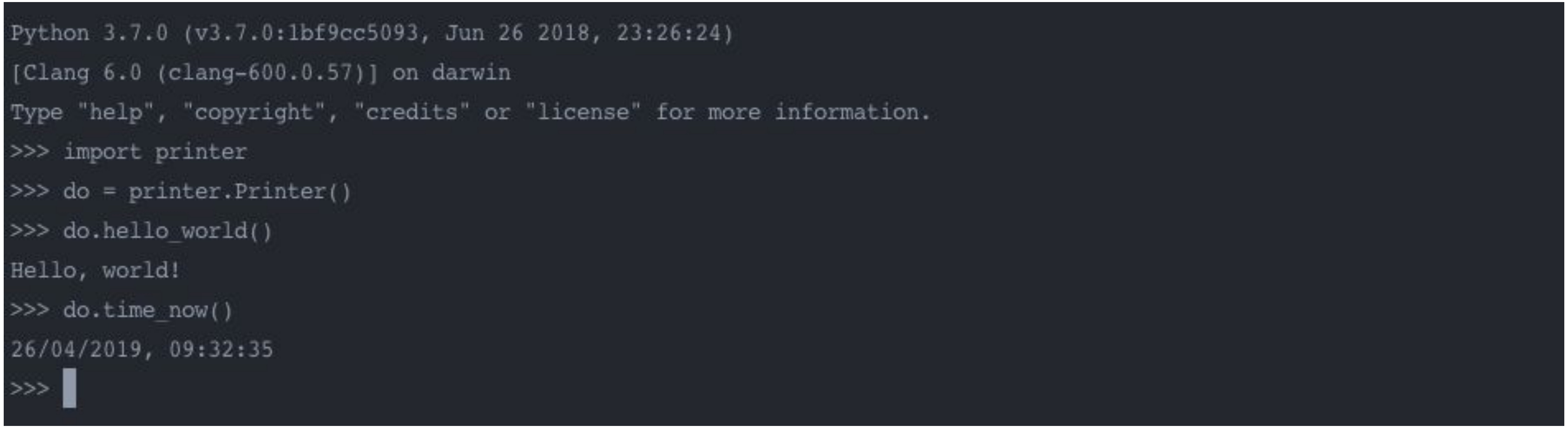
HTML



```
eturn (
 <React.Fragment>
   <Button
     iconLeft
     style={{ text: { color:"white", font: "Helvetica Neue", fontSize:15, fontWeight: "bold" },  container: { backgro
     text="Add Feedback"
     upperCase={false}
     icon="add"
     onPress={()=> this.submitConversation() }>
   </Button>
   <View style={{ margin: 20 }}>
     <Text style={{ color:"black", font: "Helvetica Neue", fontSize:15, fontWeight: "bold", margin: 5, flexWrap: "wra
       AN IMPRESSION
     </Text>
     <Form
       ref="form">
       <View
         style={styles.container}>
         <TextInput
           type="TextInput"
           name="feedbackTextInput"
           id="feedbackTextInput"
           multiline={true}
           style={{ color:"black", font: "Helvetica Neue", fontSize:15, margin: 20 }}
           onChangeText={(impression) => {this.setState({impression})} }>
           *
         </TextInput>
       </View>
     </Form>
   </View>
   <View style={styles.wrapper}>
     <Button
       style={{text: { color:"white", font: "Helvetica Neue", fontSize:15, fontWeight: "bold" },  container: { height
```

Activity

1. Write a programme to `print` “Hello, world” in `Python` using command line.
2. Update programme to `print` current date instead using `datetime Python` module.



```
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 26 2018, 23:26:24)
[Clang 6.0 (clang-600.0.57)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> import printer
>>> do = printer.Printer()
>>> do.hello_world()
Hello, world!
>>> do.time_now()
26/04/2019, 09:32:35
>>> 
```

Version Control Systems

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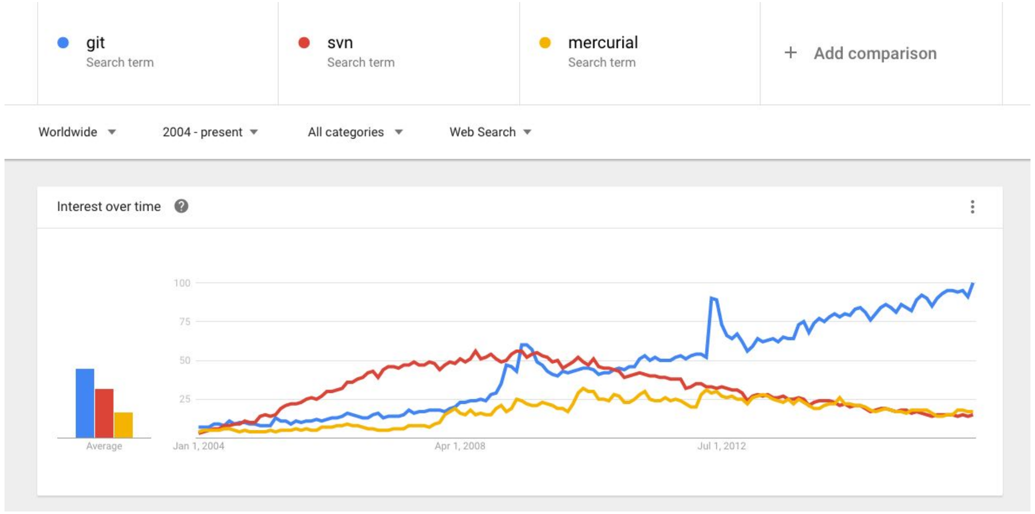
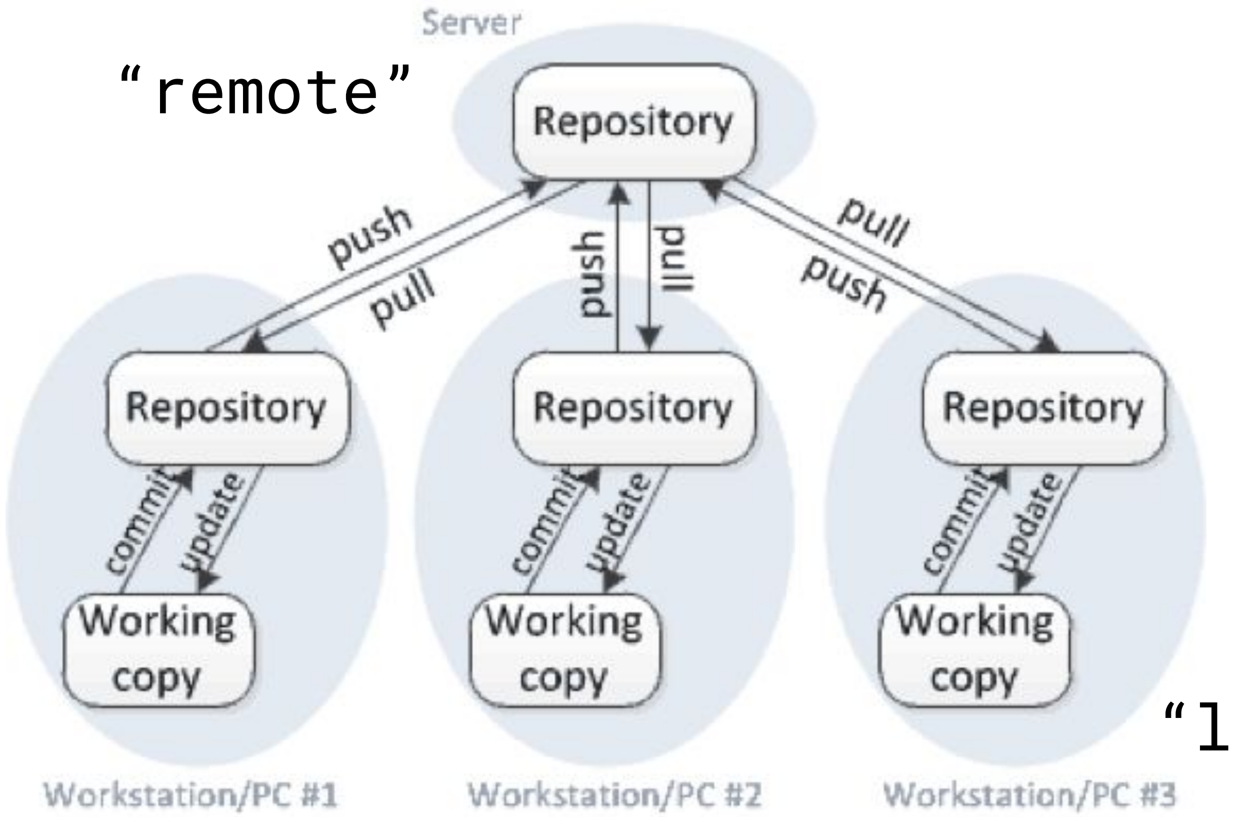
System Software

- Tracks changes to computer files and coordinating work on those files among multiple agents.
- Primarily used for source code management in software development
- May also be used to keep track of changes to any set of files.



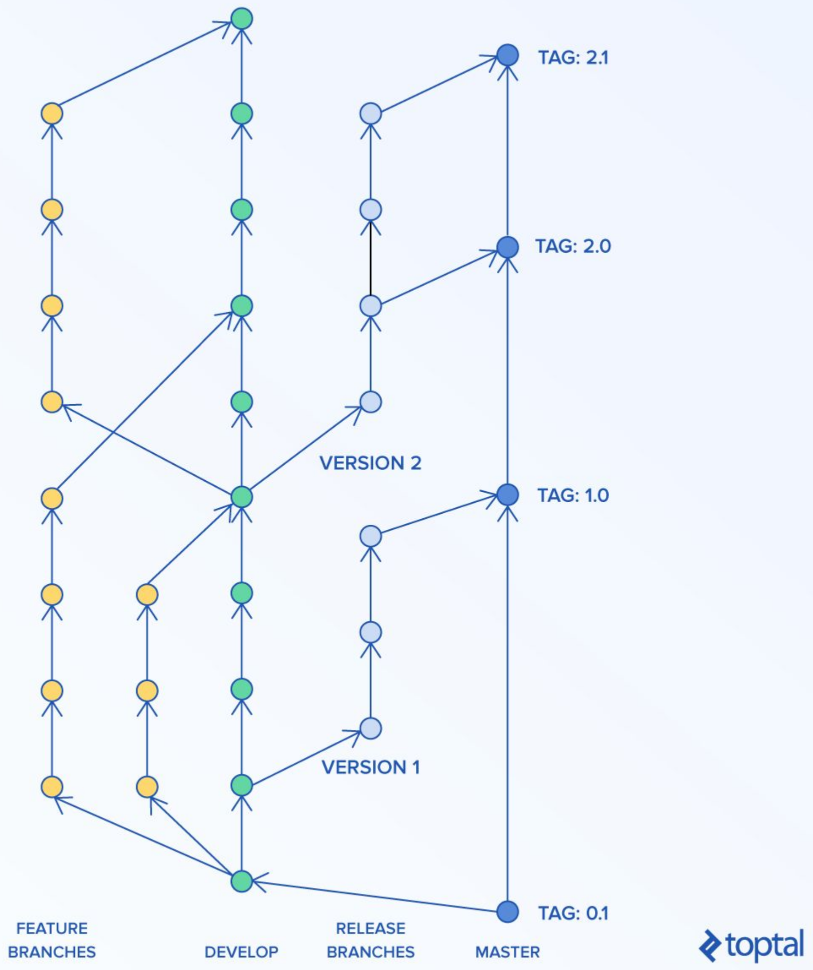
The Git Version Control System

“remote”



“local”

Branching



TAG: 2.1
TAG: 2.0
VERSION 2
TAG: 1.0
VERSION 1
TAG: 0.1
FEATURE BRANCHES
DEVELOP
RELEASE BRANCHES
MASTER
toptal

For Use Today

https://gitlab.arup.com

https://github.com/

Activity

- \`Add\` trainee’s to lesson \`Github\` project
- \`Clone\` course repository from https://github.com/ArupAus/digital-foundations-cloud.git
- \`Add\` trainee’s “Hello World” python programmes developed previously.
- \`Commit\` local changes.
- \`Push\` changes to new feature branch.
- \`Fetch\` latest changes on remote.
- \`Checkout\` another trainee’s feature branch.
- Make changes to “my-first-page.html”.
- \`Push\` changes to new feature branch of \`remote\`.

Question

- Do you think that a `Git` Version Control System could be employed on any of your current projects to keep track of a shared set of files?

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Cloud Services

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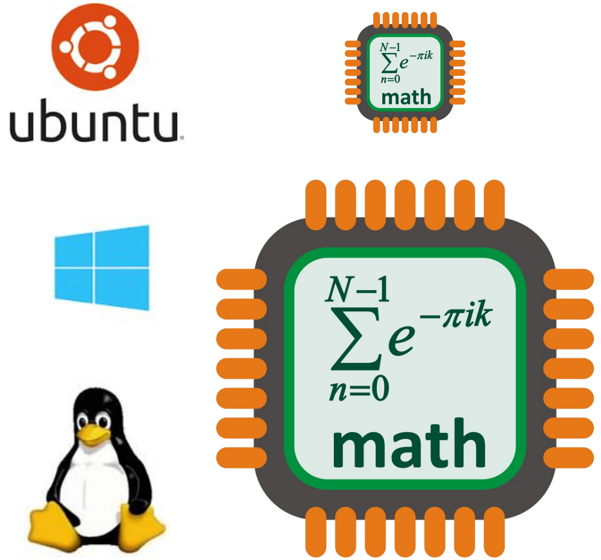
Major Cloud Service Providers

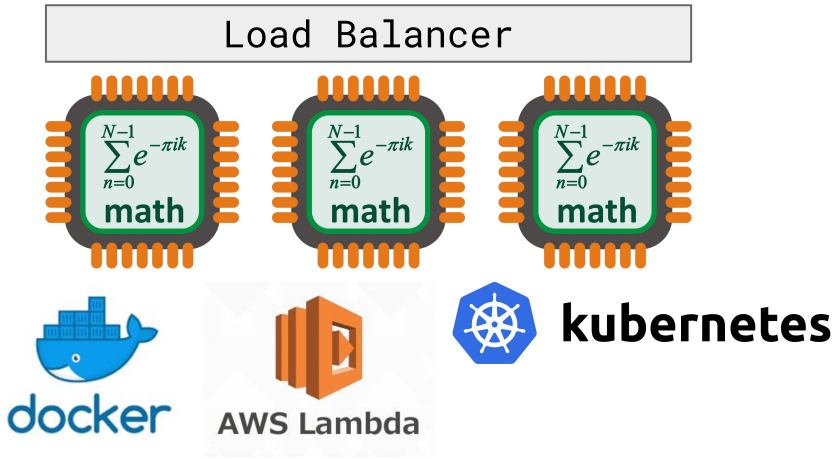
aws

Azure

Common Cloud Services

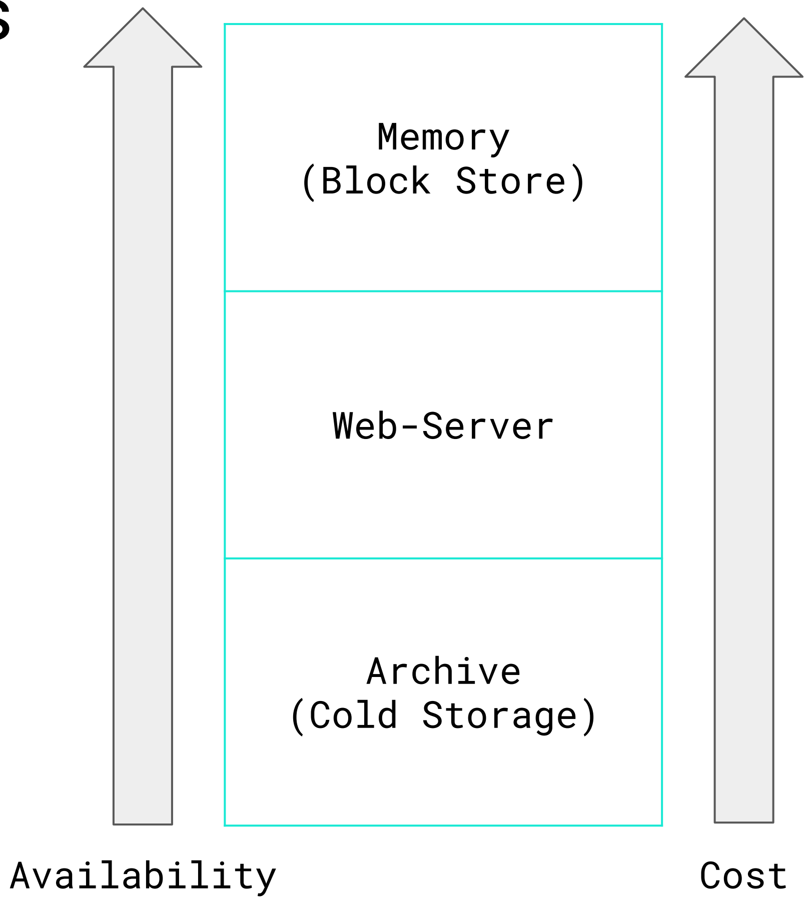
- Compute


ubuntu
$\sum_{n=0}^{N-1} e^{-\pi i k}$
math
$\sum_{n=0}^{N-1} e^{-\pi i k}$
math


Load Balancer
$\sum_{n=0}^{N-1} e^{-\pi i k}$
math
$\sum_{n=0}^{N-1} e^{-\pi i k}$
math
$\sum_{n=0}^{N-1} e^{-\pi i k}$
math
docker
AWS Lambda
kubernetes

Common Cloud Services

- Compute
- Storage



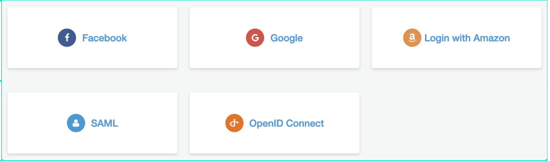
Common Cloud Services

- Compute
- Storage
- **Database**

PostgreSQL Relational MySQL®	mongoDB® amazon DynamoDB Non-Relational Firebase Realtime Database
neo4j Graph GraphQL	Search-Engine elasticsearch

Common Cloud Services

- Compute
- Storage
- Database
- Access Management

Identity and Access Management	**User Authentication**
Users (Human)	Application users
UI and/or Programmatic	May or may not be federated
Roles (Human or Resource)	 Facebook Google Login with Amazon SAML OpenID Connect
Policies	

Common Cloud Services

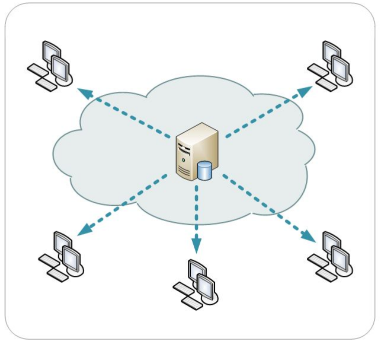
- Compute
- Storage
- Database
- Access Management
- Security

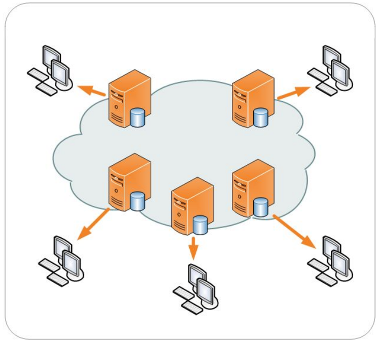
Virtual Private Cloud (VPC) designation and peering
Restrict outbound/inbound traffic by IP address/protocol/geography eg. TCP from 193.17.187.246
Data encryption
Message encryption
Key/secrets management
Request rate limiting

Common Cloud Services

- Compute
- Storage
- Database
- Access Management
- Security
- Distribution

DNS Records	**Content Delivery**
Name Servers	Distributed Networks
Mail Exchange	Security Automation
C Names	Monitoring
A Names	





Common Cloud Services

- Compute
- Storage
- Database
- Access Management
- Security
- Distribution
- Management and Governance

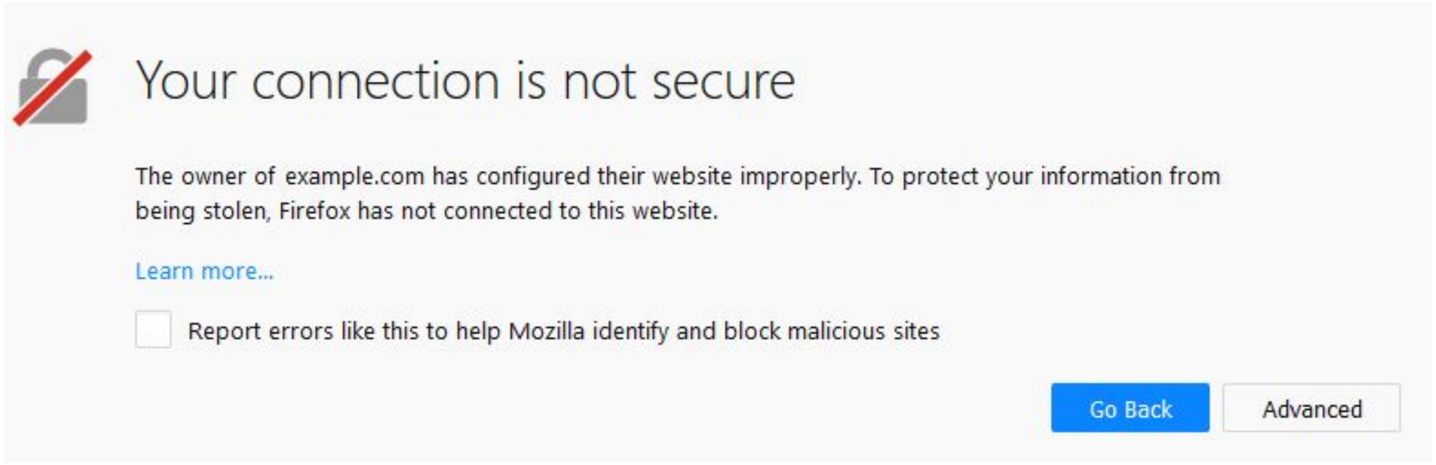
Logging	Alarms
Accounting	Optimisation

Activity

- Log in to `AWS Console` at https://aws.arup.com
- Create an `S3` bucket and upload website created earlier
- Configure the bucket policy to allow access from current `IP address`.
- View website content on web browser via `S3 URL`.
- Create Amazon Linux `EC2` instance and log in using key file and `Putty`.
- Explore instance directory structure.
- Install `Git` and `Python 3` using `yum install` commands.
- `Clone` course repository to `EC2` instance and checkout trainee’s feature branch.
- Run `Hello World` programme using `Python` on instance.
- Install and start the LAMP Web Server on instance by following this guide: https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/install-LAMP.html
- Copy “my-first-page.html” from instance version of repository and add to directory “/var/www/html”

Question

- The web content you have made available is accessed using `HTTP` protocol. Why shouldn’t we trust this web content?
- How could we ensure that such web content can be trusted?


Your connection is not secure

The owner of example.com has configured their website improperly. To protect your information from being stolen, Firefox has not connected to this website.

Learn more...

Report errors like this to help Mozilla identify and block malicious sites

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Application Programmatic Interfaces

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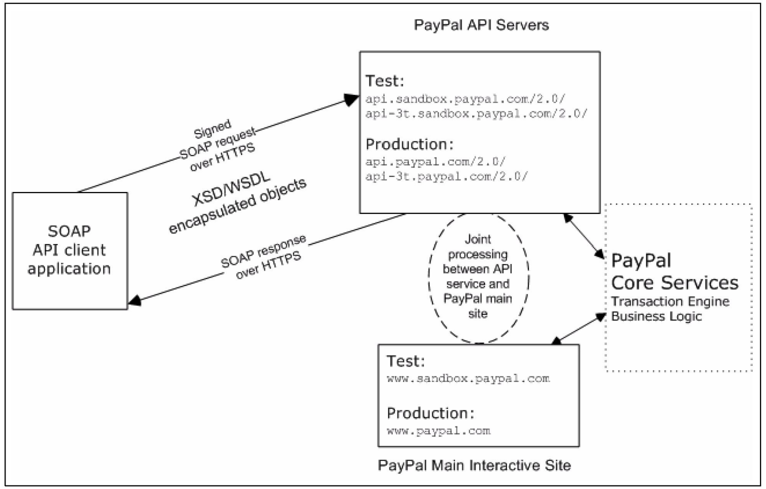
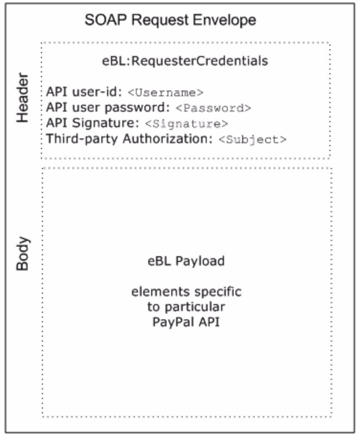
Question

- Do applications need store and manage all dependent data themselves?

SOAP

***FIGURE* 1.1 PayPal SOAP High-level Diagram**


PayPal API Servers
Test:
api.sandbox.paypal.com/2.0/
api-3t.sandbox.paypal.com/2.0/
Production:
api.paypal.com/2.0/
api-3t.paypal.com/2.0/
Signed SOAP request over HTTPS
XSD/WSDL encapsulated objects
SOAP response over HTTPS
SOAP API client application
Joint processing between API service and PayPal main site
PayPal Core Services
Transaction Engine
Business Logic
Test:
www.sandbox.paypal.com
Production:
www.paypal.com
PayPal Main Interactive Site


SOAP Request Envelope
Header
eBL:RequesterCredentials
API user-id: <Username>
API user password: <Password>
API Signature: <Signature>
Third-party Authorization: <Subject>
Body
eBL Payload
elements specific to particular PayPal API

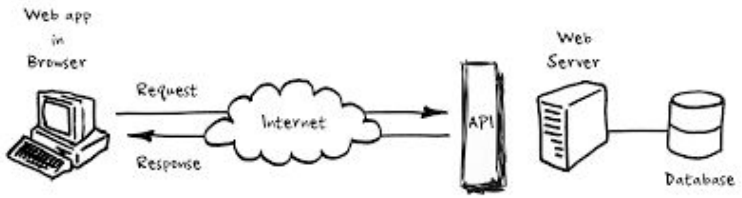
PayPal SOAP API Architecture

SOAP Implementation

```
<?xml version="1.0"?>
<SOAP-ENV:Envelope
     xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
     xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xmlns:xsd="http://www.w3.org/2001/XMLSchema"
     xmlns:xs="http://www.w3.org/2001/XMLSchema"
     xmlns:cc="urn:ebay:apis:CoreComponentTypes"
     xmlns:wsu="http://schemas.xmlsoap.org/ws/2002/07/utility"
     xmlns:saml="urn:oasis:names:tc:SAML:1.0:assertion"
     xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
     xmlns:wsse="http://schemas.xmlsoap.org/ws/2002/12/secext"
     xmlns:ebl="urn:ebay:apis:eBLBaseComponents"
     xmlns:ns="urn:ebay:api:PayPalAPI">
     <SOAP-ENV:Header>
        <Security
           xmlns="http://schemas.xmlsoap.org/ws/2002/12/secext"
           xsi:type="wsse:SecurityType"
        />
        <RequesterCredentials xmlns="urn:ebay:api:PayPalAPI"
           xsi:type="ebl:CustomSecurityHeaderType">
           <Credentials
              xmlns="urn:ebay:apis:eBLBaseComponents"
              xsi:type="ebl:UserIdPasswordType"
           />
        </RequesterCredentials>
     </SOAP-ENV:Header>
     <SOAP-ENV:Body id="_0">
        <specific_api_name_Response xmlns="urn:ebay:api:PayPalAPI">
           <Timestamp xmlns="urn:ebay:api:PayPalAPI">
              dateTime_in_UTC/GMT
           </TIMESTAMP>
           <Ack xmlns="urn:ebay:apis:eBLBaseComponents">Success</Ack>
           <Version xmlns="urn:ebay:apis:eBLBaseComponents">
              serviceVersion
           </Version>
           <CorrelationId xmlns="urn:ebay:apis:eBLBaseComponents">
              applicationCorrelation
           </CorrelationID>
           <Build xmlns="urn:ebay:apis:eBLBaseComponents">
              api_build_number
           </Build>
           <elements_for_specific_api_response>
              data
           </elements_for_specific_api_response>
        </specific_api_name_Response>
     </SOAP-ENV:Body>
```

REST

```
[get, put, post, patch, delete]
```



fetch(“https://api.mapbox.com/geocoding/v5/mapbox.places/-122.406417,37.785834.json?access_token=pk.eyJ1IjoiYWlkYW5wYXJraW5zb24iLCJhIjoiY2prOXZscDVrMnIwMzNrbzJyYmh0dHV3MiJ9.HtB81oxPLG6olZEn8J3Gdg”)

```
{"type":"FeatureCollection","query":[-122.406417,37.785834],"features":
[{"id":"poi.25769853785","type":"Feature","place_type":
["poi"],"relevance":1,"properties":{"landmark":true,"category":"jewelry,
watches, accessories, shop","address":"833 Market St Ste
508"},"text":"Zaki's Jewelry","place_name":"Zaki's Jewelry, 833 Market St
Ste 508, San Francisco, California 94102, United States","center":
[-122.40647,37.78586],"geometry":{"coordinates":
[-122.40647,37.78586],"type":"Point"},"context":
[{"id":"neighborhood.293547","text":"Downtown"},
{"id":"postcode.644855979161210","text":"94102"},
{"id":"place.15734669613361910","wikidata":"Q62","text":"San Francisco"},
{"id":"region.11319063928738010","short_code":"US-
CA","wikidata":"Q99","text":"California"},
{"id":"country.9053006287256050","short_code":"us","wikidata":"Q30","text"
:"United States"}]},
{"id":"neighborhood.293547","type":"Feature","place_type":
["neighborhood"],"relevance":1,"properties":
{},"text":"Downtown","place_name":"Downtown, San Francisco, California
94102, United States","bbox":
[-122.420691,37.782213,-122.403401,37.792311],"center":
[-122.4112,37.7881],"geometry":{"type":"Point","coordinates":
[-122.4112,37.7881]},"context":
[{"id":"postcode.644855979161210","text":"94102"},
{"id":"place.15734669613361910","wikidata":"Q62","text":"San Francisco"},
{"id":"region.11319063928738010","short_code":"US-
CA","wikidata":"Q99","text":"California"},
{"id":"country.9053006287256050","short_code":"us","wikidata":"Q30","text"
:"United States"}]},
{"id":"postcode.644855979161210","type":"Feature","place_type":
["postcode"],"relevance":1,"properties":
{},"text":"94102","place_name":"San Francisco, California 94102, United
States","bbox":
[-122.429931001842,37.7694394579571,-122.40474104605,37.7892279476408],"ce
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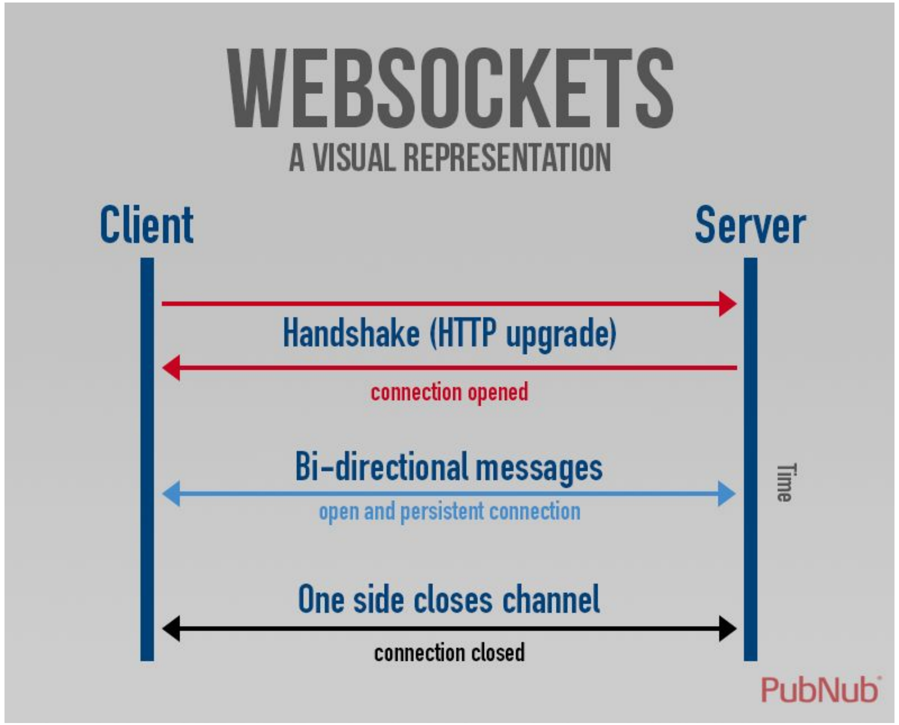
Web-Sockets

[publish, subscribe]



Activity

- \`Checkout\` master branch of training course repository.
- Create a virtual environment.
- Activate the virtual environment.
- Use \`pip\` to install project dependencies listed in “requirements.txt”.
- Launch \`jupyter notebook\`.
- Run notebook “my-first-request.ipynb” to make a RESTful GET request to an Arup Elasticsearch domain containing sensor data.
- Change notebook environment variables to retrieve most recent “temperature” record.
- Change notebook environment variables and code to retrieve a time-stamped 10-minute period of “temperature” records and \`print\` as a \`pandas DataFrame\`.

Question

- First to complete the task is to volunteer an explanation of the `JSON` response payload received from the `Elasticsearch` domain and how to query parts of it.

Activity

- `Checkout` the feature branch for the website you created earlier.
- Develop a simple `Flask` application that will allow users to define a time-period to visualise a bar graph of “temperature” records from the `Elasticsearch` domain on your website.
- Demonstrate the application works on `localhost` using a web browser.
- See example in “./app” folder of course repository for assistance.

Preparation 09:00-09:30	• Git • Python 3 • Atom Text Editor • Putty • Your moonshot idea!
The Development Ecosystem 09:40-12:30	• Code and language support • Intelligent development environments • Syntax highlighting and debugging • First-steps in programming • Libraries, packages and re-factoring • Version control systems
Cloud Services 12:50-14:15	• Overview of providers and typical services available • Compute and storage • Security and network protocols
Interfaces 14:30-16:35	• Application programmatic interfaces • Making simple API requests • Working with response payloads and understanding JSON • Create and deploy a simple web application
Debrief 17:00-17:20	• Takeaway's • Summary

Activity

- Explain two key learning outcomes that you will take away from the course to each other in pairs.

Learning Outcomes

1. Set-up a fit for purpose Intelligent Development Environment (IDE).
2. Write and execute basic programs in `Python`.
3. Use a Version Control System through making requests using `Git Bash`.
4. Clone and make changes to a pre-prepared website.
5. Log-in to an `AWS` environment.
6. Set-up security groups and access policies for cloud services.
7. Upload content to an `AWS S3` bucket and view via a URL.
8. Launch an `AWS EC2` instance, work with AMI's, establish secure connections and configure a web server.
9. Make requests to a `REST API`.
10. Read `JSON` and work with the response payload.
11. Create and deploy a simple web application.