

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/>

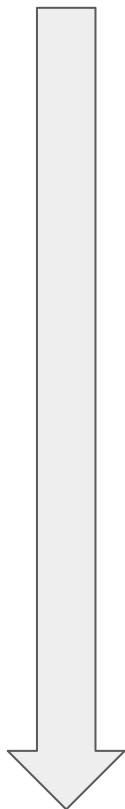
What Might be Your Moonshot?



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	<ul style="list-style-type: none">• <code>`Git`</code>• <code>`Python 3`</code>• <code>`Atom Text Editor`</code>• <code>`Putty`</code>• Your moonshot idea!
The Development Ecosystem 09:40-12:30	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Overview of providers and typical services available• Compute and storage• Security and network protocols
Interfaces 14:30-16:35	<ul style="list-style-type: none">• Application programmatic interfaces• Making simple <code>`API`</code> requests• Working with response payloads and understanding <code>`JSON`</code>• Create and deploy a simple web application
Debrief 17:00-17:20	<ul style="list-style-type: none">• Take away'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`, ...

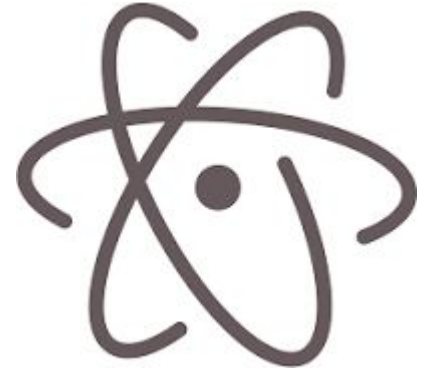
Syntax Highlighting and Debugging

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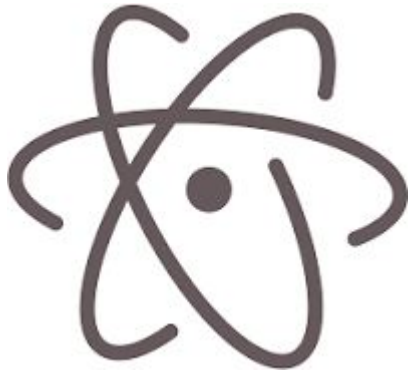
Demonstration



VS

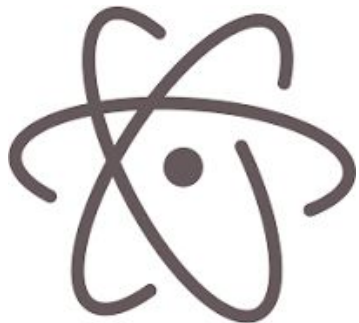


Some Text Editors



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

```
return (
  <React.Fragment>
    <Button
      iconLeft
      style={{ text: { color:"white", font: "Helvetica Neue", fontSize:15, fontWeight: "bold" }, container: { background-color:"white", height: 40, width: 100, display: "flex", align-items: "center", justify-content: "center" } }}
      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: "wrap" }}>
        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: 40, width: 100, display: "flex", align-items: "center", justify-content: "center" } }}
        text="Add Feedback"
        uppercase={false}
        icon="add"
        onPress={()=> this.submitConversation() }>
      </Button>
    </View>
  </React.Fragment>
)
```

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.

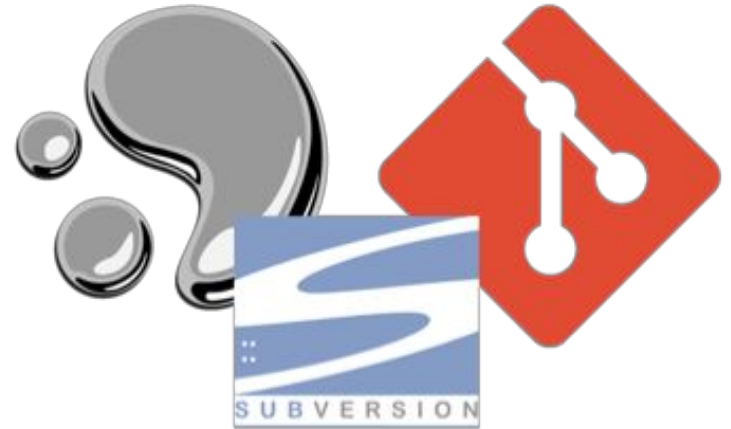
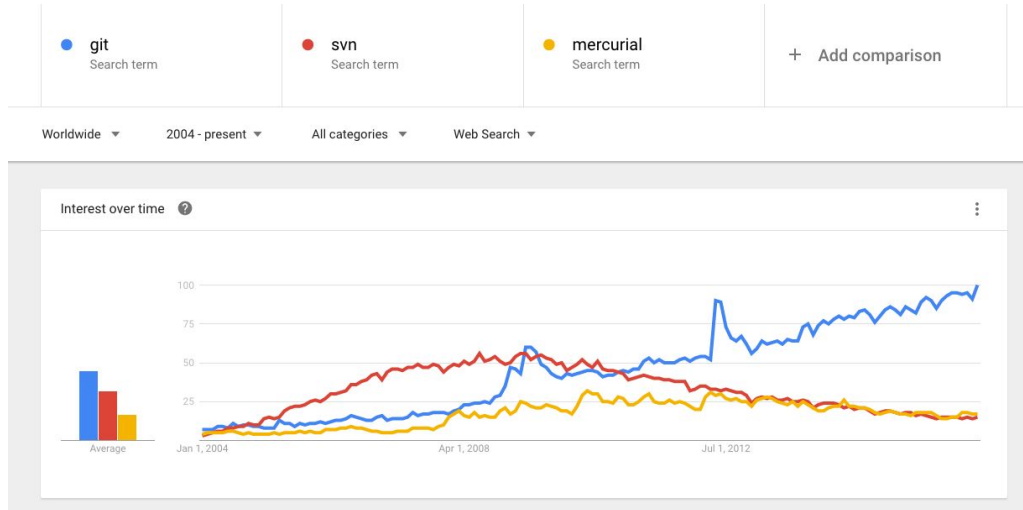
```
Using cached https://files.pythonhosted.org/packages/d8/f3/413bab4ff08e1fc4828dfc59996d721917df8e8583ea85385d51125dceff/pip-19.0.3-py2.py
3-none-any.whl
Installing collected packages: pip
  Found existing installation: pip 18.1
    Uninstalling pip-18.1:
      Successfully uninstalled pip-18.1
Successfully installed pip-19.0.3
(venv) LDNMLBNRHV2L:digital-foundations aidan.parkinson$ python hello-world.py
Hello, world!
```

Version Control Systems

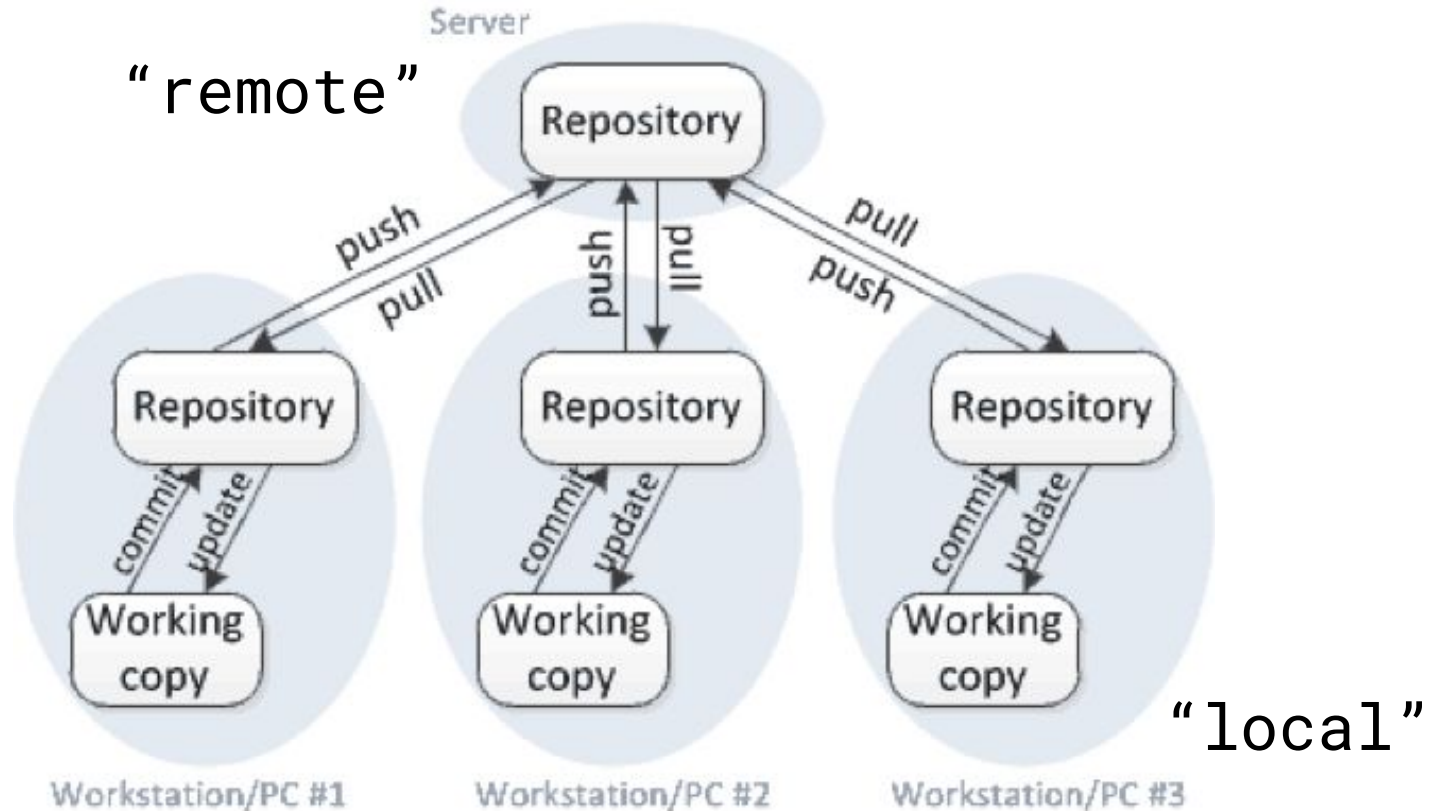
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System Software

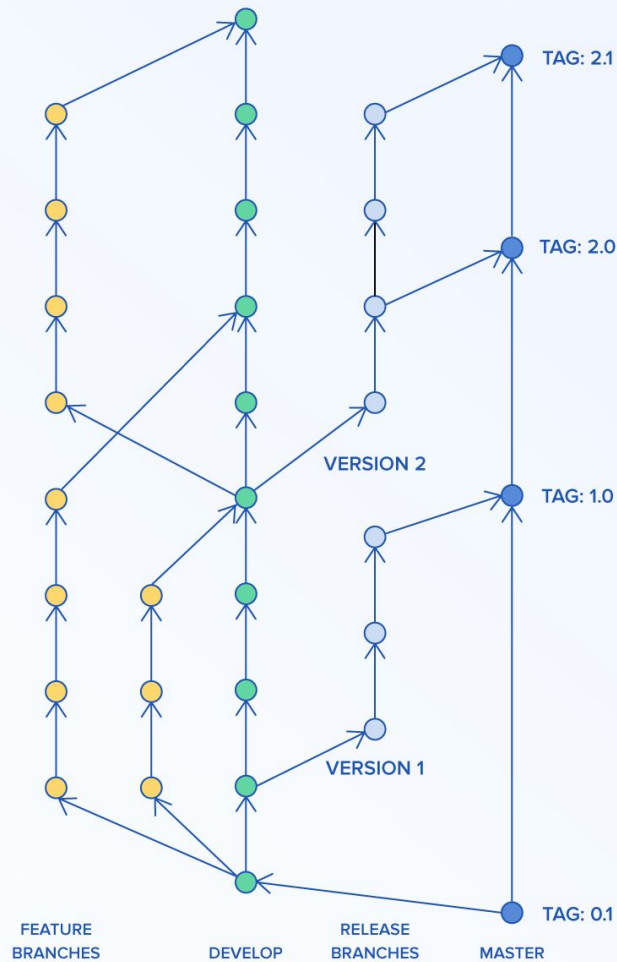
- Tracks changes to computer files and coordinating work on those files among multiple agents.
- Primarily used for source code management in software development
- May also be used to keep track of changes to any set of files.



The Git Version Control System



Branching



For Use Today



GitLab

<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

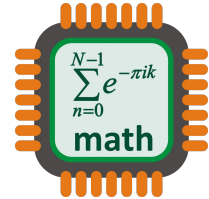
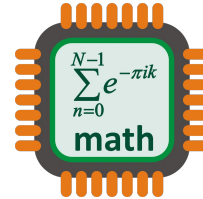
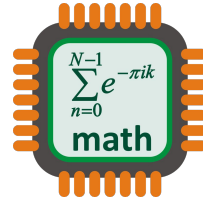
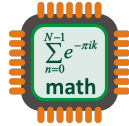
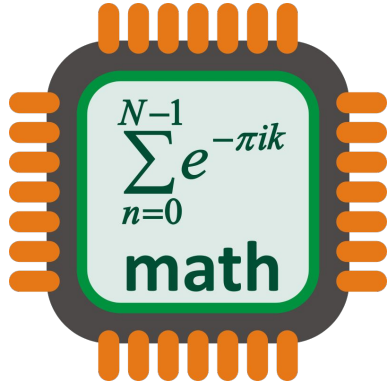


Azure



Common Cloud Services

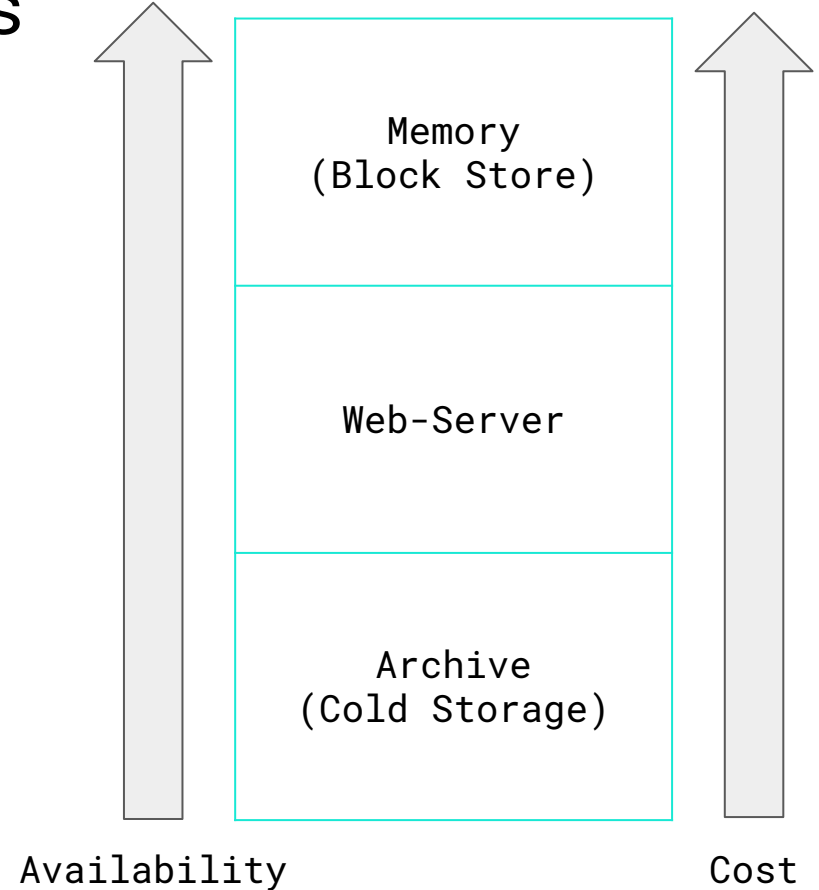
- Compute



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)	<div> Facebook</div> <div> Google</div> <div> Login with Amazon</div>
Policies	<div> SAML</div> <div> OpenID Connect</div>

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

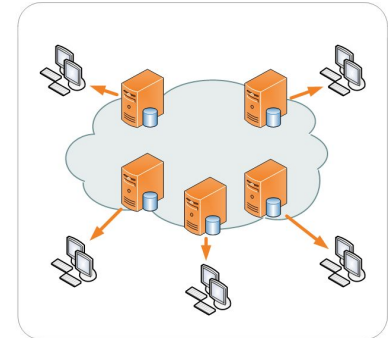
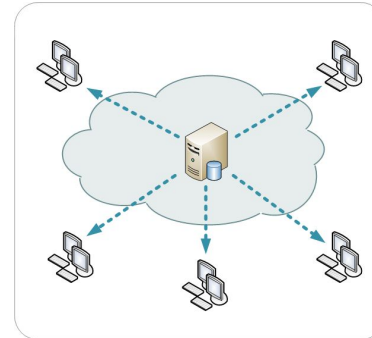
Key/secrets management

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



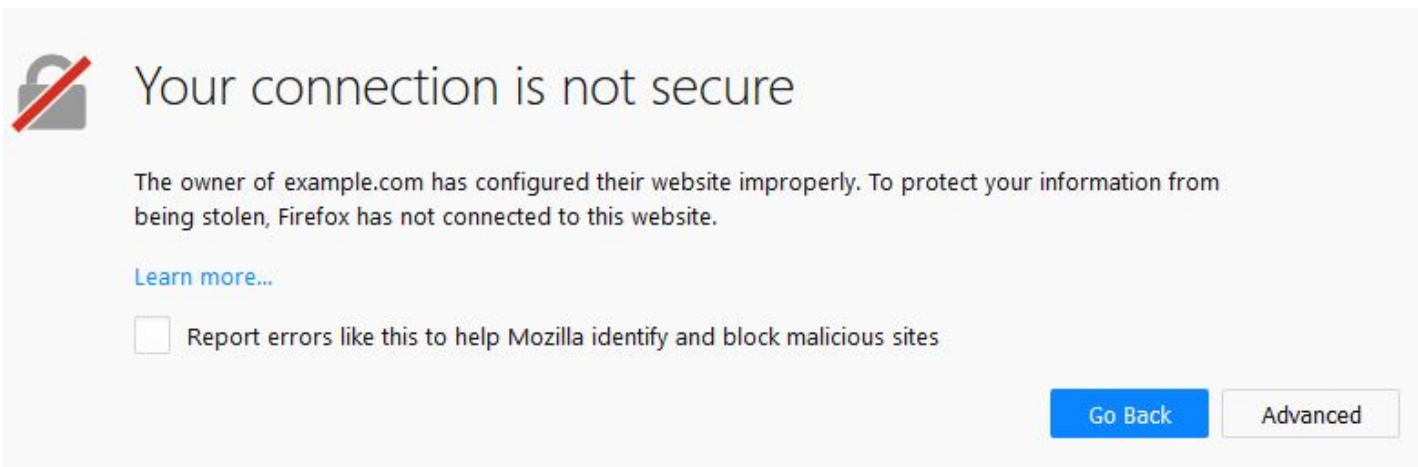
Logging	Alarms
Accounting	Optimisation

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?



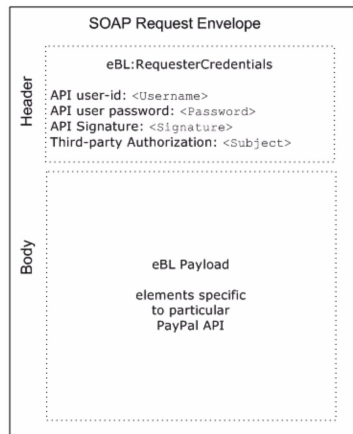
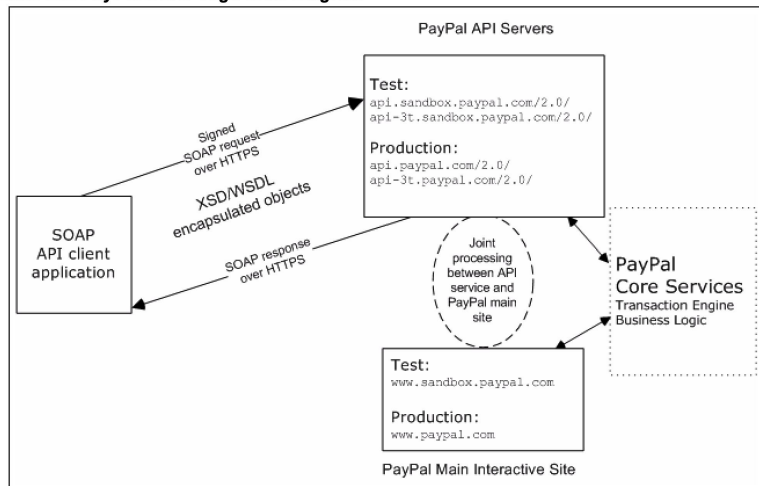
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Application Programmatic Interfaces

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SOAP

FIGURE 1.1 PayPal SOAP High-level Diagram



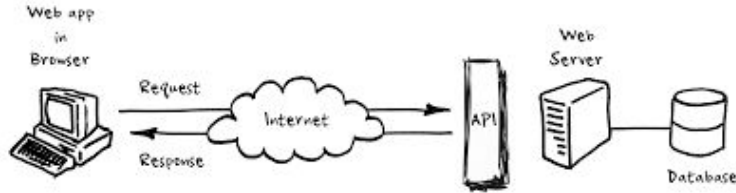
PayPal SOAP API Architecture

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:wssse="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">
        dateInUTC/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]



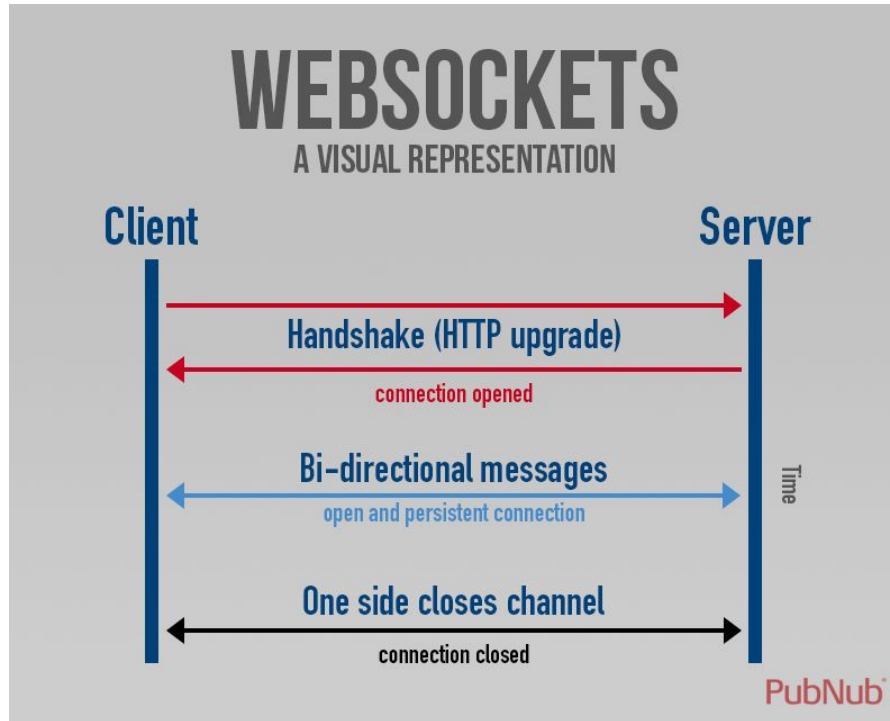
`fetch("https://api.mapbox.com/geocoding/v5/mapbox.places/-122.406417,37.785834.json?access_token=pk.eyJ1IjoiiYWlkYW5wYXJraW5zb24iLCJhIjoiiY2prOXZscDVRMnIwMzNrbzJyYmhdHV3MiJ9.HtB81oxPLG6o1ZEn8J3Gdg")`

```
{
  "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": [-122.406417, 37.785834],
        "geometry": {
          "type": "Point",
          "coordinates": [-122.406417, 37.785834]
        },
        "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",
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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.

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 examples “plotter.py” and “my-first-web-application.html” in course repository for assistance.

Preparation 09:00-09:30	<ul style="list-style-type: none"> • Git • Python 3 • Atom Text Editor • Putty • Your moonshot idea!
The Development Ecosystem 09:40-12:30	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Overview of providers and typical services available • Compute and storage • Security and network protocols
Interfaces 14:30-16:35	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.