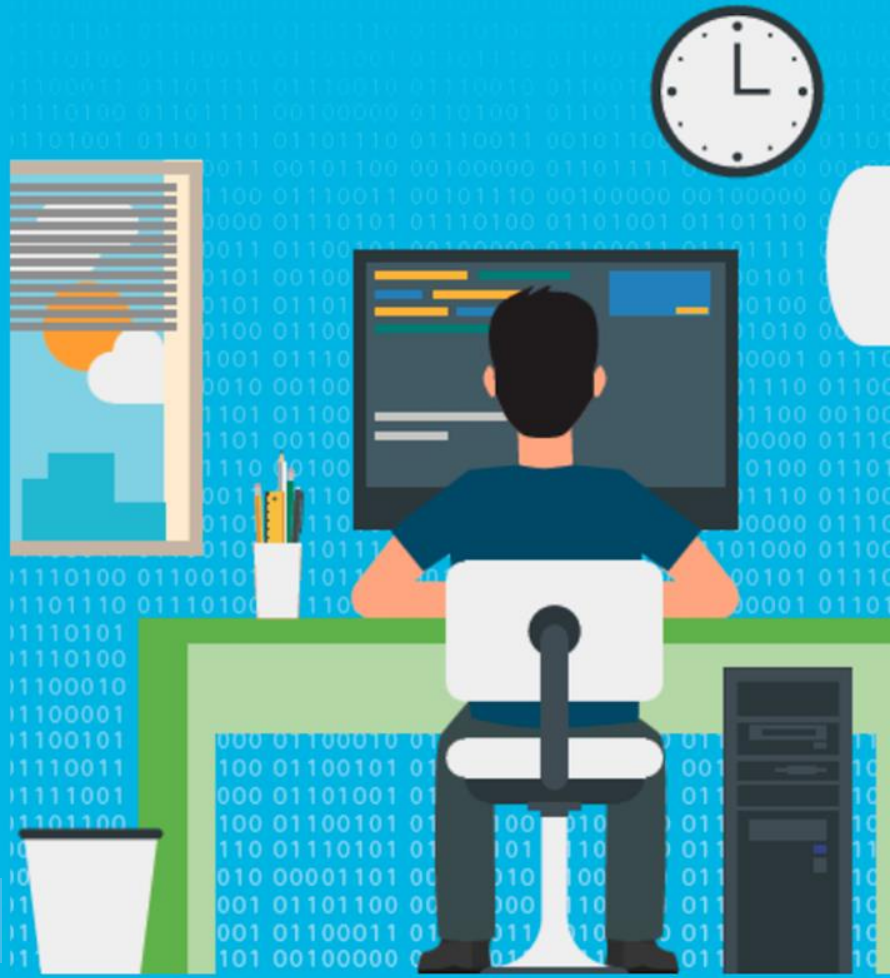
Networking Academy

Python & JSON Workshop

Presentation v1.65



2021 February IPD Week

#NetAcadIPD

Yvan Rooseleer, Belgian IT Academy Support Center BiASC
Odisee University Of Applied Sciences, Brussels <yvan@biasc.be>

Yvan Rooseleer

Brussels, Belgium

Senior Lecturer

Odisee, Brussels

- University of Applied Sciences

BiASC Country Manager

- Instructor Trainer

> 10.000 h
Software Development
Database Development
> 10.000 h
Database Administration
IT Infrastructure Management
> 10.000 h
Network & Security Management
Problem-based challenges

Agenda

Practical examples with Python & JSON

1

Response Data in JSON

RESTCONF
Cisco DNA Center
Webex
Ansible
Docker

2

Processing data from Excel

Transforming data into a JSON tree structure


```
{
    "ietf-interfaces:interfaces": {
      "interface": [{
                "name": "GigabitEthernet1",
                "description": "VBox",
                "type": "iana-if-type:ethernetCsmacd",
                "enabled": true,
                "ietf-ip:ipv4": {
                    "address": [{
                        "ip": "192.168.56.101",
                        "netmask": "255.255.255.0"
                    }]
                },
                "ietf-ip:ipv6": {}
            },
            {
                "name": "Loopback9",
                "description": "Lo9",
                "type": "iana-if-type:softwareLoopback",
                "enabled": true,
                "ietf-ip:ipv4": {
                    "address": [{
                        "ip": "10.9.9.9",
                        "netmask": "255.255.255.0"
                    }]
                },                "ietf-ip:ipv6": {}
            }
        ]
    }
}
```

Parts of the Workshop

Part 1: DevNet Associate: Filtering JSON Data

Description: This part covers some aspects of the DevNet Associate course. Join to learn how to interpret JSON data coming from Webex Teams API, DNAC API, Docker inspect, Ansible.

Part 2: DevNet Associate: Generating JSON Data

Description: This part covers some aspects of the DevNet Associate course. Join to learn how to generate JSON data for Webex Teams API, IP Devices and Network Services from a source in the Excel format.

The examples in this workshop are based on the Emerging Technology Workshops and on the recent DevNet Associate Course from Cisco Networking Academy.

Useful Coding Skills for NetAcad Instructors

If you are teaching the DevNet Associate Course or the Emerging Technology Workshops, the following Python coding skills are relevant:

- ✓ Constructing API Calls using Python
  - o URI, URL
  - o Authentication & Authorization
- ✓ Managing JSON Exchange Data using Python *= This Workshop*
  - o Response data
  - o Data Types
  - o Data Conversion
- ✓ Using existing Python Code and Libraries

  Coding from scratch is not a requirement

  This workshop focuses on JSON Data & Python dict and list

Python & JSON Workshop Part 1

Part 1: DevNet Associate: Filtering JSON Data

Description: This part covers some aspects of the DevNet Associate course. Join to learn how to interpret JSON data coming from Webex Teams API, DNAC API, Docker inspect, Ansible.

Part 2: DevNet Associate: Generating JSON Data

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Problem Statement

Response Data in JSON Format

- Machine readable
- Hierarchical Tree structure
- Overwhelming for humans


```
[
    {
        "Name": "bridge",
        "Id": "566a72fc961157e2e71cc257fc2132beebc491a712967ef42bddcab70cbdbb23",
        "Created": "2020-12-09T17:51:15.816558163Z",
        "Scope": "local",
        "Driver": "bridge",
        "EnableIPv6": false,
        "IPAM": {
            "Driver": "default",
            "Options": null,
            "Config": [
                {
                    "Subnet": "172.17.0.0/16",
                    "Gateway": "172.17.0.1"
                }
            ]
        },
        "Internal": false,
        "Attachable": false,
        "Ingress": false,
        "ConfigFrom": {
            "Network": ""
        },
        "ConfigOnly": false,
        "Containers": {
            "4e99a64e10dfcf6608a1d47f4349676c745bf234cebd52826d786db9a3be2811": {
                "Name": "samplerunning",
                "EndpointID": "22bbd3fa7e76635c3172446813fe5104537c8f69c6c23474272b379dede44fe7",
                "MacAddress": "02:42:ac:11:00:03",
                "IPv4Address": "172.17.0.3/16",
                "IPv6Address": ""
            }
        },
        "Options": {
            "com.docker.network.bridge.default_bridge": "true",
            "com.docker.network.bridge.enable_icc": "true",
            "com.docker.network.bridge.enable_ip_masquerade": "true",
            "com.docker.network.bridge.host_binding_ipv4": "0.0.0.0",
            "com.docker.network.bridge.name": "docker0",
            "com.docker.network.driver.mtu": "1500"
        },
        "Labels": {}
    }
]
```

Example 1: JSON RESPONSE DATA

RESTCONF URL Example/ Virtual Router

```
"https://192.168.56.101/restconf/data/ietf-interfaces:interfaces"
```

Authentication header is needed

Raw Response (serialized, machine readable)


```
{"ietf-interfaces:interfaces": {"interface": [{"name": "GigabitEthernet1", "description":
"VBox", "type": "iana-if-type:ethernetCsmacd", "enabled": true, "ietf-ip:ipv4":
{"address": [{"ip": "192.168.56.101", "netmask": "255.255.255.0"}]}, "ietf-ip:ipv6": {}},
{"name": "Loopback9", "description": "999", "type": "iana-if-type:softwareLoopback",
"enabled": true, "ietf-ip:ipv4": {"address": [{"ip": "10.9.9.9", "netmask":
"255.255.255.0"}]}, "ietf-ip:ipv6": {}}]}}
```

Example 2: JSON RESPONSE DATA

DNA CENTER CLIENT HEALTH REQUEST

```
import requests
import json

# f-string is used for string formatting of request url
# Authentication header is needed

get_resp = requests.get(f"https://{host}/dna/intent/api/v1/client-health",
                        headers=headers, params=params)
```

RAW RESPONSE DATA FRAGMENT

```
{'response': [{'siteId': 'global', 'scoreDetail': [{'scoreCategory': {'scoreCategory':
'CLIENT_TYPE', 'value': 'ALL'}, 'scoreValue': 29, 'clientCount': 82, 'clientUniqueCount':
82, 'starttime': 1611071700000, 'endtime': 1611072000000}, {'scoreCategory':
{'scoreCategory': 'CLIENT_TYPE', 'value': 'WIRED'}, 'scoreValue': 100, 'clientCount': 2,
'clientUniqueCount': 2, 'starttime': 1611071700000, 'endtime': 1611072000000, 'scoreList':
[{'scoreCategory': {'scoreCategory': 'SCORE_TYPE', 'value': 'POOR'}, 'scoreValue': -1,
'clientCount': 0, 'clientUniqueCount': 0, 'starttime': 1611071700000, 'endtime':
1611072000000}, ...
```

Example 3: JSON RESPONSE DATA

Webex API Call: "https://api.ciscospark.com/v1/people/me"

Partial Output (with some response data highlighted)

{"id":"Y2lzY29zcGFya...NlYzQ5NjI5MGY","emails":["Yvan.rooseleer@biasc.be"],"sipAddresses":[{"type":"personal-room","value":"838744612@biasc.webex.com","primary":false},{"type":"personal-room","value":"yvan.rooseleer@biasc.webex.com","primary":false},{"type":"cloud-calling","value":"Yvan.rooseleer@biasc.calls.webex.com","primary":true}],"displayName":"YvanRooseleer","nickName":"Yvan","firstName":"Yvan","lastName":"Rooseleer","avatar":"https://avatar-prod-us-east-2.webexcontent.com/Avtr~V1~e4d4112d-2548-4a47-810e-04fe64-a79b-49c5-823a-92cec494bb9c1d1de6~1600","orgId":"Y2lzY29zcGFyazovL3VzL09SR0FOSctODEwZS0wNGZlNDVlYTE4MWY","roles":["Y2lzY29zcGFya9hZG1pbg"],"licenses":["Y2lTQtNDExZS1hYThkLTA1MDI3N2Y3ZjdlOQ","Y2lzY29zcGFyazovL3VzL0xJQ0VOy53ZWJleC5jb20","Y2lzY29zcGFyazovL3VzL0xJQ0VOUxYmJlZTU2LWQwZmItNGFiNy1hMTYyLTlmNjQ2OGIyYmU5ZA","Y2lzYVOU0UvZTRkNDExMmQtMjU0OC00MWBiNDI4MmQ5NmY5NA","Y2lzYTJhNTNfZmlhc2Mud2ViZXguY29t","Y2lzYZWExODFmOkZTU18xYjcyOGZmOS03ZGU4LTRjYjctOTU0MC0yOTMyMGI1YTQyY2I","Y2lzY29zUtMDRmZTZ1ZWExODFmOkZUTV9mNWZkZTM1Zi00NzA0LTQ2MGEtODEwZi00YzVkMzUyNDFlNjk","Y2lzY29zcExODFmOkNHXzVkYjcwNjYyLWNmYTItNGFjZC04MZRlLTgwYjNiNWVkZjNlZA","Y2lzY29zcGFyazovL3jQ3MzgyOC1hOTgwLTQ3MmYtODE5ZC02YjZjY2UwOGU5MmI","Y2lzY29zcGFyazovLmOZZNU185ZWNhNzgxNC0zMzEzLTQ2NGYtOTY0Mi0wMjM5ODc1YmM5Zjg","Y2lzY29zcGFyazovLNDExMmQtMjU0OGE3NSZhNDNmLTBkYmJhMjIyNzg3Zl9iaWFzYy53ZWJleC5jb20","Y2lMwMjFkLTgwYjctNDFiYi1iZThhLWM0YjFiZjcyNTE4YV9iaWFzYy53ZWJleC5jZ20","Y2lzY29zcGFyazovZ3V0YTQ3LTgxMGUtMDRmZTQ1ZWExODFmOk1kYmFiMDcxYmY0NA","Y2lzY29zcGFyazovL3VzL0xJQ0VOUXzNZMDU3N2RiLTFjOGItNDQ4My1hMTBjLzYy53ZWJleC5jb20"],"created":"2016-12-23T08:38:22.877Z","lastModified":"2021-01-26T17:55:07.662Z","lastActivity":"2021-01-26T17:54:24.481Z","status":"active","invitePending":false,"loginEnabled":true,"type":"person","trainSiteNames":["biasc.webex.com"]}

Example 4: JSON RESPONSE DATA

$ ansible webservers -m gather_facts --tree ./tmp_facts

URL for the complete response file:

Partial Output (with some response data highlighted)


```
{"ansible_facts": {"ansible_all_ipv4_addresses": ["192.0.2.1", "192.0.2.2", "192.0.2.3", "192.0.2.4", "192.0.2.5", "10.0.2.15", "172.17.0.1"],
"ansible_all_ipv6_addresses": ["fe80::9002:c8ff:fee8:bb09", "fe80::3c67:a5ff:fe17:e4cf", "fe80::a00:27ff:fee9:3de6", "fe80::42:3ff:fef6:9477"],
"ansible_apparmor": {"status": "enabled"}, "ansible_architecture": "x86_64", "ansible_bios_date": "12/01/2006", "ansible_bios_version": "VirtualBox",
"ansible_cmdline": {"BOOT_IMAGE": "/boot/vmlinuz-5.4.0-37-generic", "quiet": true, "ro": true, "root": "UUID=fb261367-cf98-4bce-b682-42b3de0a8ab9", "vga":
"792", "zswap.enabled": "1"}, "ansible_date_time": {"date": "2021-01-20", "day": "20", "epoch": "1611160850", "hour": "16", "iso8601": "2021-01-
20T16:40:50Z", "iso8601_basic": "20210120T164050181658", "iso8601_basic_short": "20210120T164050", "iso8601_micro": "2021-01-20T16:40:50.181774Z",
"minute": "40", "month": "01", "second": "50", "time": "16:40:50", "tz": "UTC", "tz_offset": "+0000", "weekday": "Wednesday", "weekday_number": "3",
"weeknumber": "03", "year": "2021"}, "ansible_default_ipv4": {"address": "10.0.2.15", "alias": "enp0s3", "broadcast": "10.0.2.255", "gateway": "10.0.2.2",
"interface": "enp0s3", "macaddress": "08:00:27:e9:3d:e6", "mtu": 1500, "netmask": "255.255.255.0", "network": "10.0.2.0", "type": "ether"},
"ansible_default_ipv6": {}, … , "ansible_distribution": "Ubuntu", "ansible_distribution_file_parsed": true, "ansible_distribution_file_path": "/etc/os-
release", "ansible_distribution_file_variety": "Debian", "ansible_distribution_major_version": "20", "ansible_distribution_release": "focal",
"ansible_distribution_version": "20.04", "ansible_dns": {"nameservers": ["127.0.0.53"], … , "ansible_nodename": "labvm", "ansible_os_family": "Debian",
"ansible_pkg_mgr": "apt", "ansible_proc_cmdline": {"BOOT_IMAGE": "/boot/vmlinuz-5.4.0-37-generic", "quiet": true, "ro": true, "root": "UUID=fb261367-cf98-
4bce-b682-42b3de0a8ab9", "vga": "792", "zswap.enabled": "1"}, "ansible_processor": ["0", "GenuineIntel", "Intel(R) Core(TM) i7-7600U CPU @ 2.80GHz", "1",
"GenuineIntel", "Intel(R) Core(TM) i7-7600U CPU @ 2.80GHz"], "ansible_processor_cores": 2, "ansible_processor_count": 1,
"ansible_processor_threads_per_core": 1, "ansible_processor_vcpus": 2, "ansible_product_name": "VirtualBox", "ansible_product_serial": "NA",
"ansible_product_uuid": "NA", "ansible_product_version": "1.2", "ansible_python": {"executable": "/usr/bin/python3", "has_sslcontext": true, "type":
"cpython", "version": {"major": 3, "micro": 2, "minor": 8, "releaselevel": "final", "serial": 0}, "version_info": [3, 8, 2, "final", 0]},
"ansible_python_version": "3.8.2", "ansible_real_group_id": 900, "ansible_real_user_id": 900, "ansible_selinux": {"status": "disabled"},
"ansible_selinux_python_present": true, "ansible_service_mgr": "systemd", … , "ipv6": [{"address": "fe80::3c67:a5ff:fe17:e4cf", "prefix": "64", "scope":
"link"}], "macaddress": "3e:67:a5:17:e4:cf", "mtu": 1500, "promisc": true, "speed": 10000, "timestamping": ["tx_software", "rx_software", "software"],
"type": "ether"}, "ansible_virtualization_role": "guest", "ansible_virtualization_type": "virtualbox", "discovered_interpreter_python":
"/usr/bin/python3", "gather_subset": ["all"], "module_setup": true}, "changed": false, "deprecations": [], "warnings": []}
```

Example 5: JSON RESPONSE DATA

$ docker image inspect ubuntu

Output (with some response data highlighted)


```
[{"Id": "sha256:9140108b62dc87d9b278bb0d4fd6a3e44c2959646eb966b86531306faa81b09b", "RepoTags": ["ubuntu:latest"], "RepoDigests":
["ubuntu@sha256:bc2f7250f69267c9c6b66d7b6a81a54d3878bb85f1ebb5f951c896d13e6ba537"], "Parent": "", "Comment": "", "Created": "2020-09-
25T22:34:30.2958070362", "Container": "1046a5d685aef5c37d1829040ca8083b94e4c069ca4963f4b16a6ade2e077b06", "ContainerConfig": {"Hostname":
"1046a5d685ae", "Domainname": "", "User": "", "AttachStdin": false, "AttachStdout": false, "AttachStderr": false, "Tty": false,
"OpenStdin": false, "StdinOnce": false, "Env": ["PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin"], "Cmd": ["/bin/sh",
"-c", "#(nop) ", "CMD [\"/bin/bash\"]"], "ArgsEscaped": true, "Image":
"sha256:4ff2090064e7e38688bce713d50f3202d227b3c89fecea1434271c912ccd47e0", "Volumes": null, "WorkingDir": "", "Entrypoint": null,
"OnBuild": null, "Labels": {}}, "DockerVersion": "18.09.7", "Author": "", "Config": {"Hostname": "", "Domainname": "", "User": "",
"AttachStdin": false, "AttachStdout": false, "AttachStderr": false, "Tty": false, "OpenStdin": false, "StdinOnce": false, "Env":
["PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin"], "Cmd": ["/bin/bash"], "ArgsEscaped": true, "Image":
"sha256:4ff2090064e7e38688bce713d50f3202d227b3c89fecea1434271c912ccd47e0", "Volumes": null, "WorkingDir": "", "Entrypoint": null,
"OnBuild": null, "Labels": null}, "Architecture": "amd64", "Os": "linux", "Size": 72875723, "VirtualSize": 72875723, "GraphDriver":
{"Data": {"LowerDir": "/var/lib/docker/overlay2/5d66f43ef0d92430a195045c4715ff3d49ee88ccb0bb7f6e69ccc5d60fde0ece /diff:/var/lib/docker/
overlay2/0b75d53292ccb20230879e49c7fe6eea157addb083d414ba3d0485959cd35086/diff", "MergedDir": "/var/lib/docker/
overlay2/c3bab8487f590bfd66e53db0b1902ab5a8b8fbfa1f02cfc3b4f0f9fa25158f2d/merged", "UpperDir": "/var/lib/docker/
overlay2/c3bab8487f590bfd66e53db0b1902ab5a8b8fbfa1f02cfc3b4f0f9fa25158f2d/diff", "WorkDir": "/var/lib/docker/
overlay2/c3bab8487f590bfd66e53db0b1902ab5a8b8fbfa1f02cfc3b4f0f9fa25158f2d/work"}, "Name": "overlay2"}, "RootFS": {"Type": "layers",
"Layers": ["sha256:d42a4fdf4b2ae8662ff2ca1b695eae571c652a62973c1beb81a296a4f4263d92",
"sha256:90ac32a0d9ab11e7745283f3051e990054616d631812ac63e324c1a36d2677f5",
"sha256:782f5f011ddaf2a0bfd38cc2ccabd634095d6e35c8034302d788423f486bb177"]}, "Metadata": {"LastTagTime": "0001-01-01T00:00:00Z"}}]
```

Example 6: JSON RESPONSE DATA

```
device = []
try:
    # The request and response of "GET /network-device" API
    resp = get(api="network-device")
    status = resp.status_code
    # Get the json-encoded content from response
    response_json = resp.json()
    # all network-device detail is in "response"
    device = response_json["response"]

    # Try un-comment the following line to see what can we get
    print(json.dumps(device,indent=4))
except:
    print ("Something wrong, cannot get network device information")
    sys.exit()

if status != 200:
    print (resp.text)
    sys.exit()

if device == [] :   # response is empty, no network-device is discovered.
    print ("No network device found !")
    sys.exit()

device_list = []
# Now extract host name, ip and type to a list. Also add a sequential number in front
i=0
for item in device:
    i+=1
    device_list.append([i,item["hostname"],item["managementIpAddress"],item["type"],item["instanceUuid"]])

# We use tabulate module here to print a nice table format. You should use "pip" tool to install in your local machine
# For the simplicity we just copy the source code in working directory, didn't instal
# Not showing id to user, it's just a hex string
print (tabulate(device_list, headers=['number','hostname','ip','type'],tablefmt="rst"))
```

This line of code generates the output on the right. Each block - { } - represents one device.

This for loop iterates through the device list


```
[
    {
        "location": null,
        "type": "Cisco Nexus 3064 Switch",
        "snmpLocation": "",
        "role": "ACCESS",
        "collectionStatus": "Managed",
        "macAddress": "60:73:5c:e3:d5:7c",
        "platformId": "N3K-C3064PQ-10GE",
        "managementIpAddress": "10.10.30.16",
        "tunnelUdpPort": null,
        "roleSource": "AUTO",
        "errorDescription": null,
        "inventoryStatusDetail": "<status><general code=\"SUCCESS\"/></status>",
        "lastUpdated": "2016-11-12 02:36:43",
        "apManagerInterfaceIp": "",
        "upTime": "20 days, 23:26:23.62",
        "bootDateTime": "2016-10-22 03:10:36",
        "id": "a70f2449-be50-4454-8ff0-87e9fbcaefff",
        "hostname": "Nexus3k",
        "locationName": null,
        "series": "Data Center Switches",
        "interfaceCount": "67",
        "instanceUuid": "a70f2449-be50-4454-8ff0-87e9fbcaefff",
        "serialNumber": "FOC1637R0HS",
        "family": "Switches and Hubs",
        "snmpContact": "",
        "reachabilityStatus": "Reachable",
        "lastUpdateTime": 1478918203729,
        "softwareVersion": null,
        "memorySize": "3903836",
        "errorCode": null,
        "tagCount": "0",
        "lineCardId": "29471366-1b88-479b-a539-c439028cae06",
        "reachabilityFailureReason": "",
        "lineCardCount": "1"
    },
    {
        "location": null,
        "type": "Cisco Cloud Services Router 1000V",
```

Tips for NetAcad Instructors and Students

- Learn how to recognize **data type**
  - `ietf_ipv4 = {'address': [{'ip': '192.168.56.101', 'netmask': '255.255.255.0'}]}`
    - `print(type(ietf_ipv4))`
    - `Output: <class 'dict'>`
  - `multiple_addresses = [{'ip': '192.168.56.101', 'netmask': '255.255.255.0'},`
    `{'ip': '192.0.2.1', 'netmask': '255.255.255.252'} ]`
    - `print(type(multiple_addresses))`
    - `Output: <class 'list'>`
- Practice how to **select or filter** a data element
  - `print(ietf_ipv4['address'][0]['ip'])` *`### first ip address selected`*
  - `Output: 192.168.56.101`
  - Use the **keys()** function to determine the keys used in the response

Tips for NetAcad Instructors and Students (2)

- Practice how to **transform** data structures if necessary
  - `json.dumps`
  - `json.loads`
- Only **hands-on practice** helps to grasp the rules and procedures
  - Experiment with the code

Don’t reinvent the wheel, don’t program from scratch

- Import the necessary libaries in your Python scripts
  - `import requests`
  - `import json`
- Learn from example scripts

Data Types & Data Conversion

The following elements are necessary to grasp for this workshop:

data type

- str, int, boolean, dict, list and many more …
- JSON = dict + list

dictionary: keys and values

- `{'hostname': 'CSR1kv'}`
- `{'ip address': '192.168.56.100'}`

list

- `['name', 'description', 'type', 'enabled', 'ietf-ip:ipv4', 'ietf-ip:ipv6']`

import json

- **Convert to dict:** `json.loads`
- **Convert to json** (serialization): `json.dumps`

Demo A - Managing IP Addresses with Python

Python Data Structures for IP Addresses and Subnet Masks

```
Data Structures
single_address     =  {'ip': '192.168.56.101', 'netmask': '255.255.255.0'}
multiple_addresses = [{'ip': '192.168.56.101', 'netmask': '255.255.255.0'},
                      {'ip': '192.0.2.1', 'netmask': '255.255.255.252'}]
ietf_ipv4          =  {'address': [{'ip': '192.168.56.101', 'netmask': '255.255.255.0'}]}
```

Recognize Data Type & Select IP Address

```
print(type(single_address))                          =>  <class 'dict'>
-
print(type(multiple_addresses))                      =>  <class 'list'>
--
print(type(ietf_ipv4))                               =>  <class 'dict'>
---
print(ietf_ipv4['address'][0]['ip'])                 =>  192.168.56.101
```

Demo B - Managing IP Prefixes with Python

Python Data Structure for Network Prefixes and Subnet Masks (*fragment*)

```
prefix_subnet_masks = {
    '/24': '255.255.255.0',
    '/25': '255.255.255.128',
    '/26': '255.255.255.192'
    }

# example 1 -- using square brackets to select a key

subnet_mask_1 = prefix_subnet_masks['/24']
Output: 255.255.255.0

# example 2 -- using get() function to select a key

subnet_mask_2 = prefix_subnet_masks.get('/26')

Output: 255.255.255.192
```

Demo C - Managing IP Subnets with Python

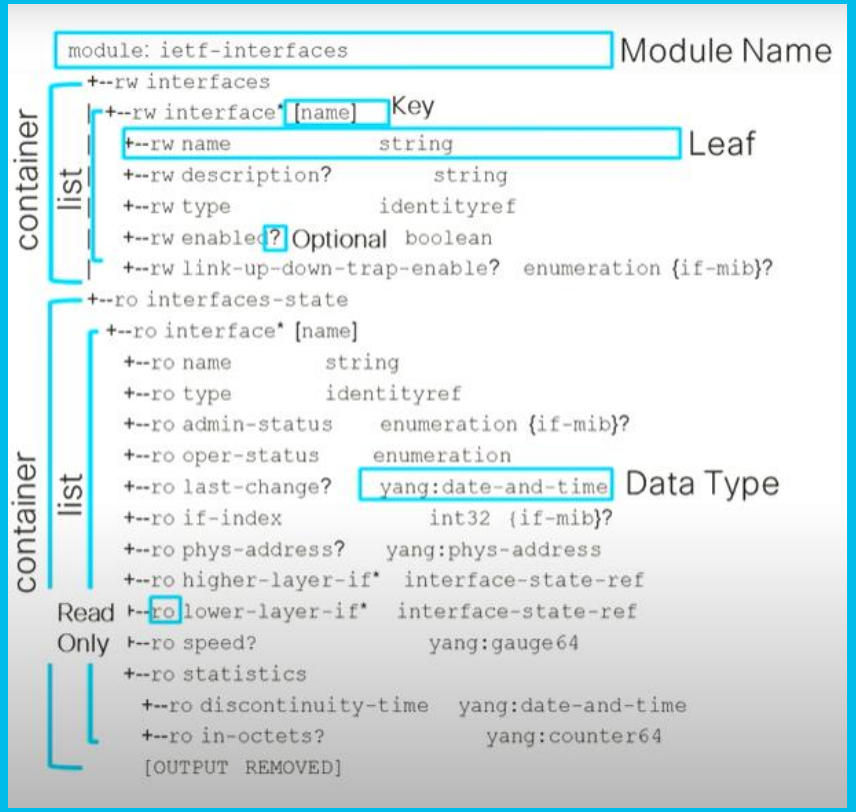
Python Data Structure for Network Subnet Masks and Prefixes (*fragment*)

```
netmask_prefixes = {
     '255.255.255.252': '/30'
    ,'255.255.255.248': '/29'
    ,'255.255.255.240': '/28'
    ,'255.255.255.224': '/27'
    ,'255.255.255.192': '/26'
    ,'255.255.255.128': '/25'
    ,'255.255.255.0'  : '/24'
    ,'255.255.254.0'  : '/23'
    }

# Adapt to code fragment below to produce the output given
Prefix_1 = netmask_prefixes["your answer"]

Output: /27
```

YANG Data Model => RESTCONF JSON Example




```
{
    "ietf-interfaces:interfaces": {

        "interface": [{
            "name": "GigabitEthernet1",
            "description": "VBox",
            "type": "iana-if-type:ethernetCsmacd",
            "enabled": true,
            "ietf-ip:ipv4": {
                "address": [{
                    "ip": "192.168.56.101",
                    "netmask": "255.255.255.0"
                }]
            },
            "ietf-ip:ipv6": {}
        }]
    }
}
```

Demo RESTCONF Response Data from CSR1000v

RESTCONF URL Example

URL: "https://192.168.56.101/restconf/data/ietf-interfaces:interfaces"

Authentication header needed

Raw Response (serialized, machine readable)


```
{"ietf-interfaces:interfaces": {"interface": [{"name": "GigabitEthernet1", "description":
"VBox", "type": "iana-if-type:ethernetCsmacd", "enabled": true, "ietf-ip:ipv4":
{"address": [{"ip": "192.168.56.101", "netmask": "255.255.255.0"}]}, "ietf-ip:ipv6": {}},
{"name": "Loopback9", "description": "999", "type": "iana-if-type:softwareLoopback",
"enabled": true, "ietf-ip:ipv4": {"address": [{"ip": "10.9.9.9", "netmask":
"255.255.255.0"},{"ip": "172.29.0.9", "netmask": "255.255.255.0"}]}, "ietf-ip:ipv6":
{}}]}}
```

Demo RESTCONF Pretty Response with json.dumps


```
{
        "ietf-interfaces:interfaces": {

                "interface": [{
                        "name": "GigabitEthernet1",
                        "description": "VBox",
                        "type": "iana-if-type:ethernetCsmacd",
                        "enabled": true,
                        "ietf-ip:ipv4": {
                                "address": [{
                                        "ip": "192.168.56.101",
                                        "netmask": "255.255.255.0"
                                }]
                        },
                        "ietf-ip:ipv6": {}
                }]
        }
}
```

Demo RESTCONF Filter Response Data

PYTHON CODE TO FILTER JSON DATA FROM CSR1000v (no loop, only indexes used)

```
interface_name = resp["ietf-interfaces:interfaces"]["interface"][0]["name"])
ip   = resp["ietf-interfaces:interfaces"]["interface"][0]["ietf-ip:ipv4"]["address"]

ip1 = resp["ietf-interfaces:interfaces"]["interface"][0]["ietf-ip:ipv4"]["address"][0]["ip"]
ip2 = resp["ietf-interfaces:interfaces"]["interface"][1]["ietf-ip:ipv4"]["address"][0]["ip"]
ip3 = resp["ietf-interfaces:interfaces"]["interface"][1]["ietf-ip:ipv4"]["address"][1]["ip"]
```

OUTPUT

```
=> Filtered response (first interface)
Interface Name                  => GigabitEthernet1
IP Address + Mask      => [{'ip': '192.168.56.101', 'netmask': '255.255.255.0'}]

=> Filtered response (three interfaces)
192.168.56.101
10.9.9.9
172.29.0.9
```

Demo Cisco DNA Center API Token

PYTHON API REQUEST

```
import requests
import json

### View the                to examine the API call URL and authentication parameters
url = "https://sandboxdnac.cisco.com/dna/system/api/v1/auth/token"
resp = requests.post( url, auth=auth, verify=False )
```

RAW RESPONSE


```
{"Token":"eyJ0eXAiOiJKV1QiLCJhbGciOiJSUzI1NiJ9.eyJzdWIiOiI1ZTlkYmI3NzdjZDQ3ZTAwNGM2N2RkMGUiLCJhdXRo
U291cmNlIjoiaW50ZXJuYWwiLCJ0ZW5hbnROYW1lIjoiVE5UMCI6IxT1u9Vr9I_pj8EmkC3zIUSx5Hjr__TA-8VG86IGwW5-
eTRRYaAcf2g8t6UkMs8Y9aGbfcDRgWfxmJOtPxx4_20J7tQIIgzQ9Iod9xY4UYCg8g6qu1DQuEoikWFLW_lH6aA"}
```


PYTHON FILTER to isolate token

```
token = resp["Token"]
print(token)
```


```
eyJ0eXAiOiJKV1QiLCJhbGciOiJSUzI1NiJ9.eyJzdWIiOiI1ZTlkYmI3NzdjZDQ3ZTAwNGM2N2RkMGUiLCJhdXRoU291cmNlIj
oiaW50ZXJuYWwiLCJ0ZW5hbnROYW1lIjoiVE5UMCI6IxT1u9Vr9I_pj8EmkC3zIUSx5Hjr__TA-8VG86IGwW5-
eTRRYaAcf2g8t6UkMs8Y9aGbfcDRgWfxmJOtPxx4_20J7tQIIgzQ9Iod9xY4UYCg8g6qu1DQuEoikWFLW_lH6aA
```

Demo DNA Center Response Data - Network Device List

Url: "https://sandboxdnac.cisco.com:443/dna/intent/api/v1/network-device"

Authentication header needed

JSON Response (partial)


```
{
        "response": [{
                "family": "Switches and Hubs",
                "hostname": "cat_9k_1",
                "macAddress": "f8:7b:20:67:62:80",
                "serialNumber": "FCW2136L0AK",
                "upTime": "25 days, 19:42:18.12",
                "softwareType": "IOS-XE",
                "softwareVersion": "17.3.1",
                "bootDateTime": "2020-12-24 17:11:54",
                "managementIpAddress": "10.10.22.66",
                "platformId": "C9300-24UX",
                "reachabilityStatus": "Reachable",
                "series": "Cisco Catalyst 9300 Series Switches",
                "type": "Cisco Catalyst 9300 Switch",
                "role": "ACCESS",
                "instanceUuid": "21335daf-f5a1-4e97-970f-ce4eaec339f6",
                "id": "21335daf-f5a1-4e97-970f-ce4eaec339f6"
        }],
        "version": "1.0"
}
```

Demo DNA Center Response Data - Network Device List

```
dev_list = []    #creating empty list

# looping through results and filter needed information
# creating new JSON structure

for device in resp_devices_json['response']:
    dev_dict = {} #create empty dict
    dev_dict ['hostname'] = device['hostname']
    dev_dict ['type'] = device['type']
    dev_dict ['macAddress'] = device['macAddress']
    dev_dict ['managementIpAddress'] = device['managementIpAddress']
    dev_dict ['serialNumber'] = device['serialNumber']
    dev_dict ['softwareType'] = device['softwareType']
    dev_dict ['softwareVersion'] = device['softwareVersion']
    dev_dict ['reachabilityStatus'] = device['reachabilityStatus']
    dev_list.append(dev_dict )
```

Demo DNA Center Response Data - Client Health

DNA CENTER REQUEST

```
import requests
import json

# f-string is used for string formatting of request url
get_resp = requests.get(f"https://{host}/dna/intent/api/v1/client-health",
                        headers=headers, params=params)
```

RAW RESPONSE DATA FRAGMENT

```
{'response': [{'siteId': 'global', 'scoreDetail': [{'scoreCategory': {'scoreCategory':
'CLIENT_TYPE', 'value': 'ALL'}, 'scoreValue': 29, 'clientCount': 82, 'clientUniqueCount':
82, 'starttime': 1611071700000, 'endtime': 1611072000000}, {'scoreCategory':
{'scoreCategory': 'CLIENT_TYPE', 'value': 'WIRED'}, 'scoreValue': 100, 'clientCount': 2,
'clientUniqueCount': 2, 'starttime': 1611071700000, 'endtime': 1611072000000, 'scoreList':
[{'scoreCategory': {'scoreCategory': 'SCORE_TYPE', 'value': 'POOR'}, 'scoreValue': -1,
'clientCount': 0, 'clientUniqueCount': 0, 'starttime': 1611071700000, 'endtime':
1611072000000}, ...
```

Demo DNA Center Response Data - Client Health

FILTERING DATA IN THE RESPONSE

```
print(type(get_resp_json))

print(get_resp_json["response"][0]["scoreDetail"][0]["clientCount"])
```

OUTPUT

```
-
Output 1: <class 'dict'>
-
Output 2:
Number of clients in first group: 82
```

Demo Webex Response Data /people/me

Webex API Call: "https://api.ciscospark.com/v1/people/me"

Partial Output (with some response data highlighted)


```
{"id":"Y2lzY29zcGFya...NlYzQ5NjI5MGY","emails":["Yvan.rooseleer@biasc.be"],"sipAddresses":[{"type":"
personal-room","value":"838744612@biasc.webex.com","primary":false},{"type":"personal-
room","value":"yvan.rooseleer@biasc.webex.com","primary":false},{"type":"cloud-
calling","value":"Yvan.rooseleer@biasc.calls.webex.com","primary":true}],"displayName":"Yvan Roosele
er","nickName":"Yvan","firstName":"Yvan","lastName":"Rooseleer","avatar":"https://avatar-prod-us-
east-2.webexcontent.com/Avtr~V1~e4d4112d-2548-4a47-810e-04fe64-a79b-49c5-823a-
92cec494bb9c1d1de6~1600","orgId":"Y2lzY29zcGFyazovL3VzL09SR0FOSctODEwZS0wNGZlNDVlYTE4MWY","roles":["
Y2lzY29zcGFya9hZG1pbg"],"licenses":["Y2lTQtNDExMS1hYThkLTA1MDI3N2Y3ZjdlOQ","Y2lzY29zcGFyazovL3VzL0xJ
Q0VOy53ZWJleC5jb20","Y2lzY29zcGFyazovL3VzL0xJQ0VOUxYmJlNTU2LWQwZmItNGFiNy1hMTYyLTlmNjQ2OGIyYmU5ZA","
Y2lzYVOU0UvZTRkNDExMmQtMjU0OC00MWBiNDI4MmQ5NmY5NA","Y2lzYTJhNTNfYmlhc2Mud2ViZXguY29t","Y2lzYZWExODFm
OkZTU18xYjcyOGZmOS03ZGU4LTRjYjctOTU0MC0yOTMyMGI1YTQyY2I","Y2lzY29zUtMDRmZTQ1ZWExODFmOkZUTV9mNWZkZTM1
Zi00NzA0LTQ2MGEtODEwZi00YzVkMzUyNDFlNjk","Y2lzY29zcExODFmOkNHXzVkYjcwNjYyLWNmYTItNGFjZC04MTRlLTgwYjN
iNWVkZjNlZA","Y2lzY29zcGFyazovL3jQ3MzgyOC1hOTgwLTQ3MmYtODE5ZC02YjljY2UwOGU5MmI","Y2lzY29zcGFyazovLmO
kZNU185ZWNhNzgxNC0zMzEzLTQ2NGYtOTY0Mi0wMjM5ODc1YmM5Zjg","Y2lzY29zcGFyazovLNDExMmQtMjU0OGE3NS1hNDNmLT
BkYmJhMjIyNzg3Zl9iaWFzYy53ZWJleC5jb20","Y2lMwMjFkLTgwYjctNDFiYi1iZThhLWM0YjFiZjcyNTE4YV9iaWFzYy53ZWJ
leC5jb20","Y2lzY29zcGFyazovL3V0YTQ3LTgxMGUtMDRmZTQ1ZWExODFmOk1kYmFiMDcxYmY0NA","Y2lzY29zcGFyazovL3Vz
L0xJQ0VOUXzNkMDU3N2RiLTFjOGItNDQ4My1hMTBjLzYy53ZWJleC5jb20"],"created":"2016-12-
23T08:38:22.877Z","lastModified":"2021-01-26T17:55:07.662Z","lastActivity":"2021-01-
26T17:54:24.481Z","status":"active","invitePending":false,"loginEnabled":true,"type":"person","train
SiteNames":["biasc.webex.com"]}
```

Demo Webex Filtering Response Data

Display Filtered Results From Webex

```
print("Name: " + resp['displayName'])
print("Created: " + resp['created'])
print("User Type: " + resp['type'])
print("User Status: " + resp['status'])
```

Output

```
Displaying partial information
Name: Yvan Rooseleer
Created: 2016-12-23T08:38:22.877Z
User Type: person
User Status: active
```

Demo Ansible Response Data

Ansible command to gather facts from the webservers inventory

$ ansible webservers -m gather_facts --tree ./tmp_facts

URL for the complete response file:

Partial Output (with some response data highlighted)


```
{"ansible_facts": {"ansible_all_ipv4_addresses": ["192.0.2.1", "192.0.2.2", "192.0.2.3", "192.0.2.4", "192.0.2.5", "10.0.2.15", "172.17.0.1"],
"ansible_all_ipv6_addresses": ["fe80::9002:c8ff:fee8:bb09", "fe80::3c67:a5ff:fe17:e4cf", "fe80::a00:27ff:fee9:3de6", "fe80::42:3ff:fef6:9477"],
"ansible_apparmor": {"status": "enabled"}, "ansible_architecture": "x86_64", "ansible_bios_date": "12/01/2006", "ansible_bios_version": "VirtualBox",
"ansible_cmdline": {"BOOT_IMAGE": "/boot/vmlinuz-5.4.0-37-generic", "quiet": true, "ro": true, "root": "UUID=fb261367-cf98-4bce-b682-42b3de0a8ab9", "vga":
"792", "zswap.enabled": "1"}, "ansible_date_time": {"date": "2021-01-20", "day": "20", "epoch": "1611160850", "hour": "16", "iso8601": "2021-01-
20T16:40:50Z", "iso8601_basic": "20210120T164050181658", "iso8601_basic_short": "20210120T164050", "iso8601_micro": "2021-01-20T16:40:50.181774Z", "minute":
"40", "month": "01", "second": "50", "time": "16:40:50", "tz": "UTC", "tz_offset": "+0000", "weekday": "Wednesday", "weekday_number": "3", "weeknumber":
"03", "year": "2021"}, "ansible_default_ipv4": {"address": "10.0.2.15", "alias": "enp0s3", "broadcast": "10.0.2.255", "gateway": "10.0.2.2", "interface":
"enp0s3", "macaddress": "08:00:27:e9:3d:e6", "mtu": 1500, "netmask": "255.255.255.0", "network": "10.0.2.0", "type": "ether"}, "ansible_default_ipv6": {}, …
, "ansible_distribution": "Ubuntu", "ansible_distribution_file_parsed": true, "ansible_distribution_file_path": "/etc/os-release",
"ansible_distribution_file_variety": "Debian", "ansible_distribution_major_version": "20", "ansible_distribution_release": "focal",
"ansible_distribution_version": "20.04", "ansible_dns": {"nameservers": ["127.0.0.53"], … , "ansible_nodename": "labvm", "ansible_os_family": "Debian",
"ansible_pkg_mgr": "apt", "ansible_proc_cmdline": {"BOOT_IMAGE": "/boot/vmlinuz-5.4.0-37-generic", "quiet": true, "ro": true, "root": "UUID=fb261367-cf98-
4bce-b682-42b3de0a8ab9", "vga": "792", "zswap.enabled": "1"}, "ansible_processor": ["0", "GenuineIntel", "Intel(R) Core(TM) i7-7600U CPU @ 2.80GHz", "1",
"GenuineIntel", "Intel(R) Core(TM) i7-7600U CPU @ 2.80GHz"], "ansible_processor_cores": 2, "ansible_processor_count": 1,
"ansible_processor_threads_per_core": 1, "ansible_processor_vcpus": 2, "ansible_product_name": "VirtualBox", "ansible_product_serial": "NA",
"ansible_product_uuid": "NA", "ansible_product_version": "1.2", "ansible_python": {"executable": "/usr/bin/python3", "has_sslcontext": true, "type":
"cpython", "version": {"major": 3, "micro": 2, "minor": 8, "releaselevel": "final", "serial": 0}, "version_info": [3, 8, 2, "final", 0]},
"ansible_python_version": "3.8.2", "ansible_real_group_id": 900, "ansible_real_user_id": 900, "ansible_selinux": {"status": "disabled"},
"ansible_selinux_python_present": true, "ansible_service_mgr": "systemd", … , "ipv6": [{"address": "fe80::3c67:a5ff:fe17:e4cf", "prefix": "64", "scope":
"link"}], "macaddress": "3e:67:a5:17:e4:cf", "mtu": 1500, "promisc": true, "speed": 10000, "timestamping": ["tx_software", "rx_software", "software"],
"type": "ether"}, "ansible_virtualization_role": "guest", "ansible_virtualization_type": "virtualbox", "discovered_interpreter_python": "/usr/bin/python3",
"gather_subset": ["all"], "module_setup": true}, "changed": false, "deprecations": [], "warnings": []}
```

Demo Ansible Response Data

Parsing And Filtering Ansible JSON Data -- Keys Level 1

Code

```
ansible_dict = json.loads(ansible_json_doc)
print(ansible_dict.keys())
```

Output (Level 1)

```
['ansible_facts', 'changed', 'deprecations', 'warnings']
```

Demo Ansible Response Data

Parsing And Filtering Ansible JSON Data -- Keys Level 2

Code

```
print(ansible_dict['ansible_facts'].keys())
```

Output (Level 2)

```
['ansible_all_ipv4_addresses', 'ansible_all_ipv6_addresses',
'ansible_default_ipv4', 'ansible_default_ipv6', 'ansible_distribution',
'ansible_distribution_file_variety', 'ansible_distribution_major_version',
'ansible_distribution_release', 'ansible_distribution_version', 'ansible_env',
'ansible_kernel', 'ansible_kernel_version', 'ansible_python_version']
```

Demo Ansible Response Data

Parsing And Filtering Ansible JSON Data -- Keys Level 2

Code

```
O1 = ansible_dict["ansible_facts"]["ansible_distribution"])
O2 = ansible_dict["ansible_facts"]["ansible_distribution_release"])
O3 = ansible_dict["ansible_facts"]["ansible_distribution_version"])
```

Output Level 2

```
Ansible Distribution: Ubuntu
Ansible Distribution Release: focal
Ansible Distribution Version: 20.04
```

Demo Ansible Response Data

Parsing And Filtering Ansible JSON Data -- Keys Level 2 and 3

Code

```
print("Ansible Kernel: "  + ansible_dict["ansible_facts"]["ansible_kernel"])
print("Ansible Home: " + \
ansible_dict["ansible_facts"]["ansible_env"]["HOME"])
print("Ansible User: "  + \
ansible_dict["ansible_facts"]["ansible_env"]["USER"])
print("IP Address: " + \
ansible_dict["ansible_facts"]["ansible_default_ipv4"]["address"])
```

Output Level 2-3

```
Output Ansible Kernel: 5.4.0-37-generic
Output Ansible Home: /home/devasc
Output Ansible User: devasc
Output IP Address: 10.0.2.15
```

Demo Docker Response Data -- docker image (partial)

$ docker image inspect ubuntu

Output (with some response data highlighted)


```
[{"Id": "sha256:9140108b62dc87d9b278bb0d4fd6a3e44c2959646eb966b86531306faa81b09b", "RepoTags": ["ubuntu:latest"], "RepoDigests":
["ubuntu@sha256:bc2f7250f69267c9c6b66d7b6a81a54d3878bb85f1ebb5f951c896d13e6ba537"], "Parent": "", "Comment": "", "Created": "2020-09-
25T22:34:30.2958070362", "Container": "1046a5d685aef5c37d1829040ca8083b94e4c069ca4963f4b16a6ade2e077b06", "ContainerConfig": {"Hostname":
"1046a5d685ae", "Domainname": "", "User": "", "AttachStdin": false, "AttachStdout": false, "AttachStderr": false, "Tty": false,
"OpenStdin": false, "StdinOnce": false, "Env": ["PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin"], "Cmd": ["/bin/sh",
"-c", "#(nop) ", "CMD [\"/bin/bash\"]"], "ArgsEscaped": true, "Image":
"sha256:4ff2090064e7e38688bce713d50f3202d227b3c89fecea1434271c912ccd47e0", "Volumes": null, "WorkingDir": "", "Entrypoint": null,
"OnBuild": null, "Labels": {}}, "DockerVersion": "18.09.7", "Author": "", "Config": {"Hostname": "", "Domainname": "", "User": "",
"AttachStdin": false, "AttachStdout": false, "AttachStderr": false, "Tty": false, "OpenStdin": false, "StdinOnce": false, "Env":
["PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin"], "Cmd": ["/bin/bash"], "ArgsEscaped": true, "Image":
"sha256:4ff2090064e7e38688bce713d50f3202d227b3c89fecea1434271c912ccd47e0", "Volumes": null, "WorkingDir": "", "Entrypoint": null,
"OnBuild": null, "Labels": null}, "Architecture": "amd64", "Os": "linux", "Size": 72875723, "VirtualSize": 72875723, "GraphDriver":
{"Data": {"LowerDir": "/var/lib/docker/overlay2/ 5d66f43ef0d92430a195045c4715ff3d49ee88ccb0bb7f6e69ccc5d60fde0ece
/diff:/var/lib/docker/overlay2/0b75d53292ccb20230879e49c7fe6eea157addb083d414ba3d0485959cd35086/diff", "MergedDir":
"/var/lib/docker/overlay2/c3bab8487f590bfd66e53db0b1902ab5a8b8fbfa1f02cfc3b4f0f9fa25158f2d/merged", "UpperDir":
"/var/lib/docker/overlay2/c3bab8487f590bfd66e53db0b1902ab5a8b8fbfa1f02cfc3b4f0f9fa25158f2d/diff", "WorkDir":
"/var/lib/docker/overlay2/c3bab8487f590bfd66e53db0b1902ab5a8b8fbfa1f02cfc3b4f0f9fa25158f2d/work"}, "Name": "overlay2"}, "RootFS":
{"Type": "layers", "Layers": ["sha256:d42a4fdf4b2ae8662ff2ca1b695eae571c652a62973c1beb81a296a4f4263d92",
"sha256:90ac32a0d9ab11e7745283f3051e990054616d631812ac63e324c1a36d2677f5",
"sha256:782f5f011ddaf2a0bfd38cc2ccabd634095d6e35c8034302d788423f486bb177"]}, "Metadata": {"LastTagTime": "0001-01-01T00:00:00Z"}}]
```

Demo Docker Response Data

Code Example

```
import json

### Converting json string to dict
docker_dict = json.loads(docker_json_file)

### Filtering Response Data from dict
print(docker_dict[0]["Created"])
print(docker_dict[0]["Architecture"])
print(docker_dict[0]["Os"])
```

Output

```
Created          => 2020-09-25T22:34:30.295807036Z
Architecture     => Amd64
OS                      => Linux
```

Demo Docker Response Data -- docker image (partial)

```
$ docker network inspect \
bridge
```


```
[
    {
        "Name": "bridge",
        "Id": "566a72fc961157e2e71cc257fc2132beebc491a712967ef42bddcab70cbdbb23",
        "Created": "2020-12-09T17:51:15.816558163Z",
        "Scope": "local",
        "Driver": "bridge",
        "EnableIPv6": false,
        "IPAM": {
            "Driver": "default",
            "Options": null,
            "Config": [
                {
                    "Subnet": "172.17.0.0/16",
                    "Gateway": "172.17.0.1"
                }
            ]
        },
        "Internal": false,
        "Attachable": false,
        "Ingress": false,
        "ConfigFrom": {
            "Network": ""
        },
        "ConfigOnly": false,
        "Containers": {
            "4e99a64e10dfcf6608a1d47f4349676c745bf234cebd52826d786db9a3be2811": {
                "Name": "samplerunning",
                "EndpointID": "22bbd3fa7e76635c3172446813fe5104537c8f69c6c23474272b379dede44fe7",
                "MacAddress": "02:42:ac:11:00:03",
                "IPv4Address": "172.17.0.3/16",
                "IPv6Address": ""
            }
        },
        "Options": {
            "com.docker.network.bridge.default_bridge": "true",
            "com.docker.network.bridge.enable_icc": "true",
            "com.docker.network.bridge.enable_ip_masquerade": "true",
            "com.docker.network.bridge.host_binding_ipv4": "0.0.0.0",
            "com.docker.network.bridge.name": "docker0",
            "com.docker.network.driver.mtu": "1500"
        },
        "Labels": {}
    }
]
```

Demo Python Script - Filtering Response Data from Docker

Code Example

```
import json

### Converting json string to dict, and showing keys at level 1
docker_net_dict = json.loads(docker_json_file2)

### Filtering from dict
print(docker_net_dict[0]["Name"])
print(docker_net_dict[0]["Created"])
print(docker_net_dict[0]["Containers"]["4e9a64e...bd52b811"]["IPv4Address"])
```

Output

```
bridge
2020-12-09T17:51:15.816558163Z
172.17.0.3/16
```

Demo - Webex Groups Dict Example

```
groups_struc = {
  "groups": [
       { "group": { "group_id": "G-A"
                  , "group_name": "DEVASC_A" ,
                    "members": [
                      {"person_id": "P-1" , "person_name": "Noel", "email": "noel@odisee.be"},
                      {"person_id": "P-2" , "person_name": "Mary", "email": "mary@odisee.be"},
                      {"person_id": "P-3" , "person_name": "Jens", "email": "jens@odisee.be"}
                    ]
                  }
       },
       { "group": { "group_id": "G-B"
                  , "group_name": "DEVASC_B" ,
                    "members": [
                      {"person_id": "P-4" ,"person_name": "Ives", "email": "ives@odisee.be"},
                      {"person_id": "P-5" ,"person_name": "John", "email": "john@odisee.be"},
                      {"person_id": "P-6" ,"person_name": "Alec", "email": "alec@odisee.be"}
                    ]
                  }
       }
    ]
}
```

Demo - Webex Groups Python Script

Code Example ### First group with first member, second group with first member

```
### Select first group, first person
resp_a1 = groups_struc["groups"][0]["group"]["group_name"]
resp_a2 = groups_struc["groups"][0]["group"]["members"][0]["person_name"]

### Select second group, only the first person
resp_b1 = groups_struc["groups"][1]["group"]["group_name"]
resp_b2 = groups_struc["groups"][1]["group"]["members"][0]["person_name"]
```

Output

```
First group, First person
DEVASC_A => Noel
Second group, First person
DEVASC_B => Ives
```

And so on … (more groups, more members)

Demo - Webex Groups Python Script

Code Example ### All groups with members and email addresses

```
for g in groups_struc["groups"]:
    print(g["group"]["group_name"])
    for p in g["group"]["members"]:
        print(p["person_name"] + " => " + p["email"])
```

Output

```
DEVASC_A
Noel => noel@odisee.be
Mary => mary@odisee.be
Jens => jens@odisee.be

DEVASC_B
Ives => ives@odisee.be
John => john@odisee.be
Alec => alec@odisee.be
```


And so on … (more groups)

Demo Loop - Network Devices Dict Example

```
rack_struc = {
 "rack": [
      { "device": { "dev_id": "D1" ,
                    "dev_name": "R1" ,
                    "role": "router"  ,
                    "interfaces": [
                      {"interface": "GigabitEthernet1" ,
                       "ipaddress": "10.0.1.1",
                       "subnet_mask": "255.255.255.0"},
                      {"interface": "GigabitEthernet2" ,
                       "ipaddress": "10.0.3.1",
                       "subnet_mask": "255.255.255.0"},
                      {"interface": "GigabitEthernet3" ,
                       "ipaddress": "10.0.4.1",
                       "subnet_mask": "255.255.255.0"}
                    ]
                  }
      }
   ]
}
```


And so on … (if more network devices)

Demo Loop - Network Devices Python Script

Code Sample ### All network devices interfaces and ip addresses

```
for g in rack_struc["rack"]:
    print(g["device"]["dev_name"])
    for p in g["device"]["interfaces"]:
        print(p["interface"]+" => "+p["ipaddress"])
```

Output

```
R1
GigabitEthernet1 => 10.0.1.1
GigabitEthernet2 => 10.0.3.1
GigabitEthernet3 => 10.0.4.1
C1
VLAN1 => 10.0.1.2
VLAN2 => 10.0.2.1
VLAN20 => 10.0.20.1
AC
VLAN2 => 10.0.2.2
```


And so on … (if more network devices)

Python & JSON Workshop Part 2

Part 1: DevNet Associate: Filtering JSON Data

Description: This part covers some aspects of the DevNet Associate course. Join to learn how to interpret JSON data coming from Webex Teams API, DNAC API, Docker inspect, Ansible.

Part 2: DevNet Associate: Generating JSON Data

Description: This part covers some aspects of the DevNet Associate course. Join to learn how to generate JSON data for Webex Teams API, IP Devices and Network Services from a source in the Excel format.

Problem Statement

Create Webex spaces and members from Source Data in Excel Format
Transform 2-dimensional structure into hierarchical tree structure
Simpler than YANG Model: less hierarchical levels

	A	B	C
1	**group**	**name**	**email**
2	GROUP_ALPHA	Vincent Cassata	vincent.cassata@student.bxl.be
3	GROUP_ALPHA	Giovanni Di Tulio	Giovanni .ditullio@student.bxl.be
4	GROUP_ALPHA	Milan Vandevelde	milan.vandevelde@student.bxl.be
5	GROUP_ALPHA	Tomas Vertessen	tomas.vertessen@student.bxl.be
6	GROUP_ALPHA	Mehdi Dahli	mehdi.dahli@student.bxl.be
7	GROUP_KAPPA	Ur Salangpour	ur.salangpour@student.bxl.be
8	GROUP_KAPPA	Mon Gallin	mon.gallin@student.bxl.be
9	GROUP_KAPPA	Artur Ikiya	artur.Ikiya@student.bxl.be
10	GROUP_KAPPA	Bram Vanbever	bram.vanbever@student.bxl.be
11	GROUP_KAPPA	JR Ibara	jr.ibara@student.bxl.be
12	GROUP_DELTA	Jona Ferbiest	jona.ferbiest@student.bxl.be
13	GROUP_DELTA	Bart Siperius	bart.siperius@student.bxl.be
14	GROUP_DELTA	Joren Huysegoms	joren.huysegoms2@student.bxl.be
15	GROUP_DELTA	Sam Bulduk	sam.bulduk@student.bxl.be
16	GROUP_DELTA	Ferre Van Malder	ferre.vanmalder@student.bxl.be
17	GROUP_DELTA	Mikail Defossez	mikail.defossez@student.bxl.be
18	** names are non-existent*		

```
{
    "groups": [{
            "group": {
                "group_name": "GROUP_ALPHA",
                "members": [{
                        "person_name": "Vincent Cassata",
                        "email": "vincent.cassata@student.bxl.be"
                    },
                    {
                        "person_name": "Giovanni Di Tulio",
                        "email": "Giovanni.ditullio@student.bxl.be"
                    },
                    {
                        "person_name": "Milan Vandevelde",
                        "email": "milan.vandevelde@student.bxl.be"
                    }, ...

    ]
}
```

Task 1 - Source Spreadsheet Webex Groups

	A	B	C
1	**group**	**name**	**email**
2	GROUP_ALPHA	Vincent Cassata	vincent.cassata@student.bxl.be
3	GROUP_ALPHA	Giovanni Di Tulio	Giovanni .ditullio@student.bxl.be
4	GROUP_ALPHA	Milan Vandevelde	milan.vandevelde@student.bxl.be
5	GROUP_ALPHA	Tomas Vertessen	tomas.vertessen@student.bxl.be
6	GROUP_ALPHA	Mehdi Dahli	mehdi.dahli@student.bxl.be
7	GROUP_KAPPA	Ur Salangpour	ur.salangpour@student.bxl.be
8	GROUP_KAPPA	Mon Gallin	mon.gallin@student.bxl.be
9	GROUP_KAPPA	Artur Ikiya	artur.Ikiya@student.bxl.be
10	GROUP_KAPPA	Bram Vanbever	bram.vanbever@student.bxl.be
11	GROUP_KAPPA	JR Ibara	jr.ibara@student.bxl.be
12	GROUP_DELTA	Jona Ferbiest	jona.ferbiest@student.bxl.be
13	GROUP_DELTA	Bart Siperius	bart.siperius@student.bxl.be
14	GROUP_DELTA	Joren Huysegoms	joren.huysegoms2@student.bxl.be
15	GROUP_DELTA	Sam Bulduk	sam.bulduk@student.bxl.be
16	GROUP_DELTA	Ferre Van Malder	ferre.vanmalder@student.bxl.be
17	GROUP_DELTA	Mikail Defossez	mikail.defossez@student.bxl.be
18	** names are non-existent*		

Business Context

At a recent meeting it was decided that a number of new **Webex** groups should be created, each with several members. A member has a name and an email address.

The **spreadsheet** on the left was created by communication and sent to Webex admin.

The decision was made that **JSON** should be used as an intermediate format to automate the creation of new groups and memberships.

Task 1 - Target Structure Webex Groups

```
groups_struc = {
 "groups": [
      { "group": { "group_id": "G-A"
                 , "group_name": "DEVASC_A" ,
                   "members": [
                     {"person_id": "P-1" , "person_name": "Noel", "email": "noel@odisee.be"},
                     {"person_id": "P-2" , "person_name": "Mary", "email": "mary@odisee.be"},
                     {"person_id": "P-3" , "person_name": "Jens", "email": "jens@odisee.be"}
                   ]
                 }
      },
      { "group": { "group_id": "G-B"
                 , "group_name": "DEVASC_B" ,
                   "members": [
                     {"person_id": "P-4" ,"person_name": "Ives", "email": "ives@odisee.be"},
                     {"person_id": "P-5" ,"person_name": "John", "email": "john@odisee.be"},
                     {"person_id": "P-6" ,"person_name": "Alec", "email": "alec@odisee.be"}
                   ]
                 }
      }
   ]
}
```

Task 1 - Step 1: Define Python Data Rules

```
### REWRITING RULES TO GENERATE THE DATA STRUCTURE

Most of the time you will have to manage structures of type dict
and list. These are very common for JSON data exchange.

member_dict    =>  {"person_name": "x", "email": "y", "group":"z"}
member_list    =>  [member_dict]

group_dict     =>  {group_name, member_list} | {group_name, [member_dict]}
group_list     =>  [group_dict]

groups_struc   =>  {group_list} | {[group_dict]}
```

Task 1 - Step 2: Read Two Excel Records

```
### Simplified code: converting Excel into Python dict

import xlrd    # library to manage excel spreadsheets
import json    # library to manage JSON classes and functions

wb = xlrd.open_workbook("webex_groups.xlsx")
sheet = wb.sheet_by_index(0)  # read data from the first tab

member_dict["group"]         = sheet.cell_value(1, 0)
member_dict["person_name"]   = sheet.cell_value(1, 1)
member_dict["email"]         = sheet.cell_value(1, 2)

member_dict["group"]         = sheet.cell_value(2, 0)
member_dict["person_name"]   = sheet.cell_value(2, 1)
member_dict["email"]         = sheet.cell_value(2, 2)
```

Result Example in Python dict format:

```
{'group': 'GROUP_ALPHA', 'person_name': 'Vincent Cassata', 'email': 'vincent.cassata@student.bxl.be'}
{'group': 'GROUP_ALPHA', 'person_name': 'Giovanni Di Tulio', 'email': '                              '}
```

Task 1 - Step 3: Read All Excel Records (loop)

```
### Simplified code: converting Excel data into Python dict
import xlrd    # library to manage excel spreadsheets
import json    # library to manage JSON classes and functions

def find_all_persons_and_groups(xlf):
    wb = xlrd.open_workbook(xlf)
    sheet = wb.sheet_by_index(0)
    number_rows = sheet.nrows
    member_list = []
    for r in range(number_rows):
        if r > 0: ### first row contains column names
            member_dict["group"]         = sheet.cell_value(r, 0)
            member_dict["person_name"]   = sheet.cell_value(r, 1)
            member_dict["email"]         = sheet.cell_value(r, 2)
            member_list.append(member_dict.copy())
    return member_list
```

Function Call in Python Script

```
member_list = find_all_persons_and_groups("webex_groups.xlsx")
```

Result Example:

```
[{'group': 'GROUP_ALPHA', 'person_name': 'Vincent Cassata', 'email':
'vincent.cassata@student.bxl.be'}, {'group': 'GROUP_ALPHA', 'person_name': 'Giovanni Di Tulio',
'email': 'Giovanni .ditullio@student.bxl.be'}, … ]
```

Task 1 - Step 4: Create Structure Level 1

```
### Simplified code: making list of groups from Python dict
def make_list_of_groups(member_list):
    group_list = []
    for rec in member_list:
        group_list.append(rec["group"])
    return group_list # => return the list of groups
```

Function Call in Python Script

```
group_list  = make_list_of_groups(member_list)
```

Result Example: list of groups

```
['GROUP_ALPHA', 'GROUP_KAPPA', 'GROUP_DELTA']
```

Task 1 - Step 5: Create Structure Level 2

```
### Simplified code: attaching group members to group
def attach_members_to_groups(group_rec, member_list):
    mem_dict = {}
    mem_list = [mem_dict]
    for membr in member_list:
        if membr["group"] == group_rec:
            mem_dict["person_name"]  = membr["person_name"]
            mem_dict["email"] = membr["email"]
            mem_list.append(mem_dict.copy())
    return mem_list
```

Function Call in Python Script:

```
for group_rec in group_list:
    all_members = attach_members_to_groups(group_rec, member_list)
```

Result Example

```
{'group': {'group': {'group_name': 'GROUP_ALPHA', 'members': [{'person_name': 'Vincent Cassata', 'email':
'vincent.cassata@student.bxl.be'}, {'person_name': 'Giovanni Di Tulio', 'email':
'Giovanni.ditullio@student.bxl.be'}, ...
```

Task 1 - Step 6: Run main() function

```
### Simplified code: calling functions creating data structure
def main():
    member_list = find_all_persons_and_groups("webex_groups.xlsx")
    group_list  = make_list_of_groups(member_list)
    all_members = []
    for group_rec in group_list:
        all_members = attach_members_to_groups(group_rec, member_list)
        group_dict["group"] = { "group": {"group_name": group_rec, "members": all_members }}
        groups_struc["groups"].append(group_dict["group"])
    js_groups = json.dumps(groups_struc)
```

Function Call in Python Script

```
#### execute main() when called directly
if __name__ == '__main__':
    main()
```

Result Example

see next slide

Task 1 - Step 7: Verify or Validate Results (RAW)


```
{"groups": [{"group": {"group_name": "GROUP_ALPHA", "members": [{"person_name": "Vincent
Cassata", "email": "vincent.cassata@student.bxl.be"}, {"person_name": "Giovanni Di Tulio",
"email": "Giovanni.ditullio@student.bxl.be"}, {"person_name": "Milan Vandevelde", "email":
"milan.vandevelde@student.bxl.be"}, {"person_name": "Tomas Vertessen", "email":
"tomas.vertessen@student.bxl.be"}, {"person_name": "Mehdi Dahli", "email":
"mehdi.dahli@student.bxl.be"}]}}, {"group": {"group_name": "GROUP_KAPPA", "members":
[{"person_name": "Ur Salangpour", "email": "ur.salangpour@student.bxl.be"}, {"person_name":
"Mon Gallin", "email": "mon.gallin@student.bxl.be"}, {"person_name": "Artur Ikiya",
"email": "artur.lkiya@student.bxl.be"}, {"person_name": "Bram Vanbever", "email":
"bram.vanbever@student.bxl.be"}, {"person_name": "JR Ibara", "email":
"jr.ibara@student.bxl.be"}]}}, {"group": {"group_name": "GROUP_DELTA", "members":
[{"person_name": "Jona Ferbiest", "email": "jona.ferbiest@student.bxl.be"}, {"person_name":
"Bart Siperius", "email": "bart.siperius@student.bxl.be"}, {"person_name": "Joren
Huysegoms", "email": "joren.huysegoms2@student.bxl.be"}, {"person_name": "Sam Bulduk",
"email": "sam.bulduk@student.bxl.be"}, {"person_name": "Ferre Van Malder", "email":
"ferre.vanmalder@student.bxl.be"}, {"person_name": "Mikail Defossez", "email":
"mikail.defossez@student.bxl.be"}]}}]}
```

Task 1 - Step 7b: Verify or Validate Results (Tree)


```
{
    "groups": [{
            "group": {
                "group name": "GROUP_ALPHA",
                "members": [{
                        "person name": "Vincent Cassata",
                        "email": "vincent.cassata@student.bxl.be"
                    },
                    {
                        "person name": "Giovanni Di Tulio",
                        "email": "Giovanni.ditullio@student.bxl.be"
                    },
                    {
                        "person name": "Milan Vandevelde",
                        "email": "milan.vandevelde@student.bxl.be"
                    }, …
                ]
}
```

Task 2 - Source Spreadsheet Network Devices

	A	B	C	D	E
1	**device**	**role**	**interface**	**ipaddress**	**subnetmask**
2	RTR1	router	GigabitEthernet 0	192.0.2.254	255.255.255.0
3	RTR1	router	GigabitEthernet 1	10.0.1.1	255.255.255.0
4	RTR1	router	GigabitEthernet 2	10.0.2.1	255.255.255.0
5	MLS1	core switch	VLAN 1	10.0.1.2	255.255.255.0
6	MLS1	core switch	VLAN 2	10.0.2.1	255.255.255.0
7	MLS2	core switch	VLAN 1	10.0.1.3	255.255.255.0
8	MLS2	core switch	VLAN 2	10.0.2.2	255.255.255.0
9	ASW2	access switch	VLAN 1	10.0.1.2	255.255.255.0
10	ASW3	access switch	VLAN 1	10.0.1.3	255.255.255.0
11	ASW4	access switch	VLAN 1	10.0.1.4	255.255.255.0
12	ASW5	access switch	VLAN 1	10.0.1.5	255.255.255.0
13	ASW6	access switch	VLAN 2	10.0.2.6	255.255.255.0
14	ASW7	access switch	VLAN 2	10.0.2.7	255.255.255.0
15	ASW8	access switch	VLAN 2	10.0.2.8	255.255.255.0
16	ASW9	access switch	VLAN 2	10.0.2.9	255.255.255.0

Business Context

This **spreadsheet** was created by IT staff and sent to the Networking Team.

There are eleven **network devices** that need to be configured with one or more interfaces and ip addresses.

The task is to transform the spreadsheet into J**SON format** and to transmit the resulting data to a network automation tool.

The **automation tool** is able to accept and transform JSON data.

Task 2 - Target Structure Network Devices - 2 levels

```
{
        "rack": [{
                "device": {
                        "dev_name": "RTR1",
                        "role": "router"
                },
                "interfaces": [{
                                "interface": "GigabitEthernet 0",
                                "ipaddress": "192.0.2.254",
                                "subnetmask": "255.255.255.0"
                        },
                        {
                                "interface": "GigabitEthernet 1",
                                "ipaddress": "10.0.1.1",
                                "subnetmask": "255.255.255.0"
                        },
                        {
                                "interface": "GigabitEthernet 2",
                                "ipaddress": "10.0.2.1",
                                "subnetmask": "255.255.255.0"
                        }
                ]
        }, ...
```

=> Develop a Python script based on the example explained in task 1.

Task 2 - Target Structure Network Devices - YANG


```
{{
    "ietf-interfaces:interfaces": {
      "interface": [{

            "name": "GigabitEthernet1",
            "description": "VBox",
            "type": "iana-if-type:ethernetCsmacd",
            "enabled": true,
            "ietf-ip:ipv4": {
                "address": [{
                    "ip": "192.168.56.101",
                    "netmask": "255.255.255.0"
                }]
             },
            "ietf-ip:ipv6": {}
        },
        {
            "name": "Loopback9",
            "description": "Lo9",
            "type": "iana-if-type:softwareLoopback",
            "enabled": true,
            "ietf-ip:ipv4": {
                "address": [{
                    "ip": "10.9.9.9",
                    "netmask": "255.255.255.0"
                }]
             },
            "ietf-ip:ipv6": {}
          }
                ]
    }
}
```


=> Adapt the previous Python script using the YANG model (shown on this slide)

Time for Questions & Remarks

1	2	3	4	5
Class Activities		**Study & Prep**	**Practical Activities**	
Teaching & Evaluating		Open Learning Center	Team Work	
Structuring Planning Briefings Formal Evaluation Debriefings		Self-Study Self-Evaluation Simulation exercises Preparations	Virtual hands-on labs Remote hands-on labs Physical hands-on labs Case Studies & Projects Work Placement & Internships	
2/5 - 80 h		1/5 - 40 h	2/5 - 80 h	

References

Slide Deck for This Workshop

URL: https://docs.google.com/presentation/d/1_yR5CA_V2rDrvUag58gyCHxQncATbBoBxxLTf_4NK_M/edit?usp=sharing

Data Files for the Practical Examples and Exercises of This Workshop

URL: https://drive.google.com/drive/folders/1Ip6nw4uxTHb5t9TxHEC3xcRPGzsTgEnH?usp=sharing

Background Document For This Workshop

URL:
https://docs.google.com/document/d/1jWNaW4OMkcCu1wnXZbQSMKxy23dIcq6ds4CBnEEXe0Q/edit?usp=sharing

My Recent Badges

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