Python for Network Engineers

Onsite Training Session

$ whoami

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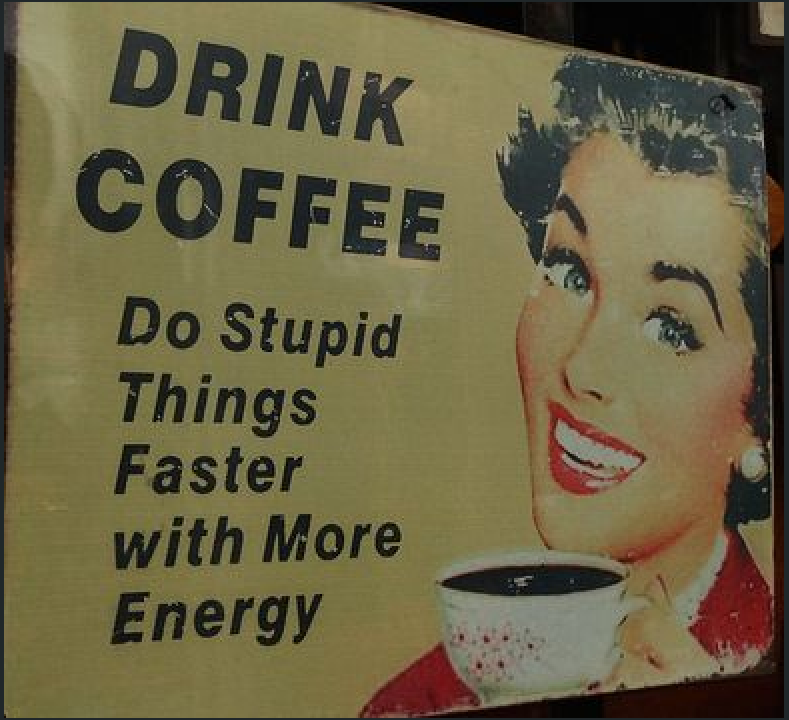
Netmiko
NAPALM

Teach Python and Ansible
SF Network Automation Meetup

General:

Lunch
Some breaks

Focused
Minimize Distractions
Exercises and Examples
Examples in the Python Shell
Try not to fall behind on day1 & 2



Flickr: Ben Sutherland

Day1 Schedule

1. GIT Basics

1a. VI in five minutes

2. Python Fundamentals - General

3. Strings

4. Numbers

5. Files

6. Lists / Tuples

7. Booleans / None

8. Conditionals

9. Loops

10. Dictionaries

Git

- Why care about Git?
- Git and GitHub
- Cloning a Project
- git init / git add / git rm / git commit
- git pull / git push
- Managing Git branches
- Making a Pull Request
- Git Rebase

Reference Commands:
{{ github_repo }}/git_notes/git_commands.md

Exercises:
./day1/git_ex1.txt
./day1/git_ex2.txt

VI in five minutes

SSH into lab environment

vi test1.txt

Two modes: edit-mode and command-mode (ESC is your path to safety).

i - insert (switch to edit-mode)
a - append (switch to edit-mode)

Never-absolutely never hit caps-lock it is the path to great destruction and ruin.

Use h, j, k, l to navigate (in command-mode)

VI in five minutes

Use h, j, k, l to navigate (in command-mode)

h - move left one space
j - move down one space
k - move up one space
l - move right one space

Arrow keys will also probably work.

x - delete a character
dw - delete a word
dd - delete a line

To exit

:wq - saves file and exits
:q!   - exits WITHOUT saving

REMEMBER:
<esc> is your friend

Why Python?

- Widely supported (meaning lots of library support)
- Easily available on systems
- Language accommodates beginners through advanced
- Maintainable
- Allows for easy code reuse
- High-level

Python Characteristics

Indentation matters.

Use spaces not tabs.

Python programmers are particular.

Py2 or Py3.

General Items

The Python interpreter shell

Assignment and variable names

Python naming conventions

Printing to standard out/reading from standard in

Creating/executing a script

Quotes, double quotes, triple quotes

Comments

dir() and help()

Strings

- String methods
- Chaining
- split()
- strip()
- substr in string
- unicode
- raw strings
- format() method

Exercises:
./day1/str_ex1.txt
./day1/str_ex2.txt

Numbers

Integers

Floats

Math Operators (+, -, *, /, **, %)

Strange Behavior of Integer Division

Exercises:
./day1/numbers_ex1.txt

Writing to a file/reading from a file:

```
with open(file_name, "w") as f:
    f.write(output)
```

```
with open(file_name) as f:
    output = f.read()
```

Exercises:
./day1/files_ex1.txt

Lists

Zero-based indices

.append()

.pop()

.join()

List slices

Tuple

Copying a list

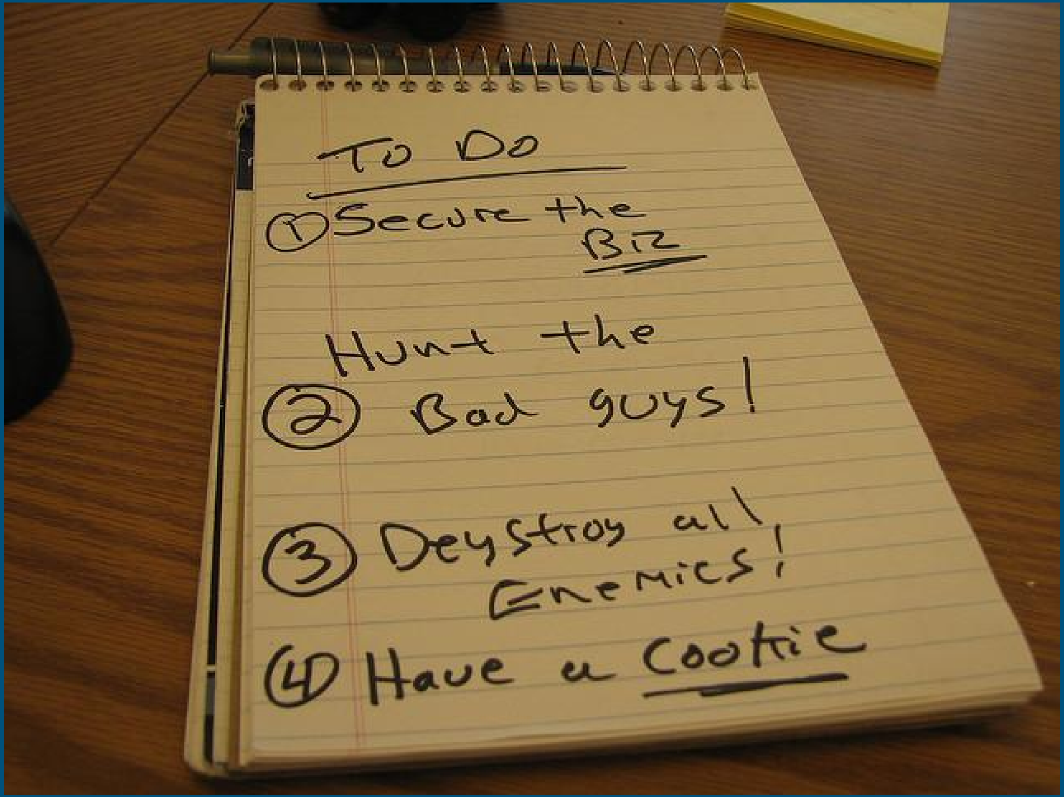


Photo: Purple Slog (Flickr)

Exercises:
./day1/lists_ex1.txt
./day1/lists_ex2.txt

Booleans and None

Boolean operators (and, or, not)

is

Truish

Comparison operators (==, !=, <, >, >=, <=)

None

Conditionals

```
if a == 15:
    print "Hello"
elif a >= 7:
    print "Something"
else:
    print "Nada"
```

Loops

- for
- while
- break
- continue
- range(len())
- enumerate

Photo: Mário Monte Filho (Flickr)

For/while syntax

```
for my_var in iterable:
    print my_var



i = 0
while i < 10:
    print i
    i += 1
```

Exercises:
./day1/loops_ex1.txt
./day1/loops_ex2.txt

Exercise:

Exercises:
./day1/for_bgp_parse_ex1.txt

Show IP BGP Parsing

Read the ‘show_ip_bgp.txt’ file.

Strip out the header information so you are just left with the routes.

Parse each BGP line such that you retrieve the prefix and the as_path.

Save the prefix and as_path to a file.

Exercise:

Exercises:
./day1/for_cond_show_ver_ex1.txt

Show Version Exercise
----

a. Read a show version output from a router (in a file named, “show_version.txt”.

b. Find the router serial number in the output.

c. Parse the serial number and return it as a variable. Use .split() and substr in str to accomplish this.

Dictionaries

- Creating
- Updating
- get()
- pop()
- Iterating over keys
- Iterating over keys and values

Exercises:
./day1/dict_ex1.txt

Photo: Holger Zscheyge (Flickr)

Day2

1. Exceptions
2. Regular Expressions
3. Functions
4. Python Code Structure
5. Linters
6. Classes and Objects
7. Managing Python Libraries
8. Modules and Packages

Family Church
Building The Church Through Building The Family
ANGER MGT CLASS POSTPONED FOR CLASSROOM REPAIRS

Flickr: au_tiger01

Exception Handling

```
try:
    my_dict[‘missing_key’]
except KeyError:
    do_something
```

- Trying to gracefully handle errors.
- finally: - always ran if you have a cleanup condition.

Exercises:
./day2/except_dict_ex1.txt

Python Regular Expresions

import re

Other re methods

re.split()

re.sub()

re.findall()

Exercises:
./day2/regex_ex1.txt
./day2/regex_ex2.txt

re.search(pattern, string)

- always use raw strings
- re.M/re.MULTILINE
- re.DOTALL
- re.I
- Parenthesis to retain patterns
- greedy/not greedy (.*?)

match.group(0)
match.groups()
match.groupdict()

Named patterns

(?P<software_ver>Ver.*)

Functions:

- Defining a function
- Positional arguments
- Named arguments
- Mixing positional and named arguments
- Default values
- Passing in *args, **kwargs
- Functions and promoting the reuse of code

Exercises:
./day2/func_ex1.txt
./day2/func_ex2.txt
./day2/func_ex3.txt
./day2/func_ex4.txt

Python Code Structure:

- Imports at top of the file
- CONSTANTS
- Functions / classes
- if __name__ == "__main__":
- Main code or main() function call

Exercises:
./day2/reuse_ex1.txt

Python Linters

pylint or pycodestyle

Consistency and conventions make your life easier.

Finds obvious errors. Finds problems you might not be aware of (reuse of builtins).

```
pylint my_file.py
pycodestyle my_file.py
```

Classes and Objects

```
class NetDevice(object):
    def __init__(self, ip_addr, username, password):
        self.ip_addr = ip_addr
        self.username = username
        self.password = password

    def test_method(self):
        print "Device IP is: {}".format(self.ip_addr)
        print "Username is: {}".format(self.username)


    rtr1 = NetDevice('10.22.1.1', 'admin', 'passw')
    rtr1.test_method()
```

Exercises:
./day2/classes_ex1.txt
./day2/classes_ex2.txt

Libraries

sys.path

PYTHONPATH

Installing packages (pip)

import x

from x import y

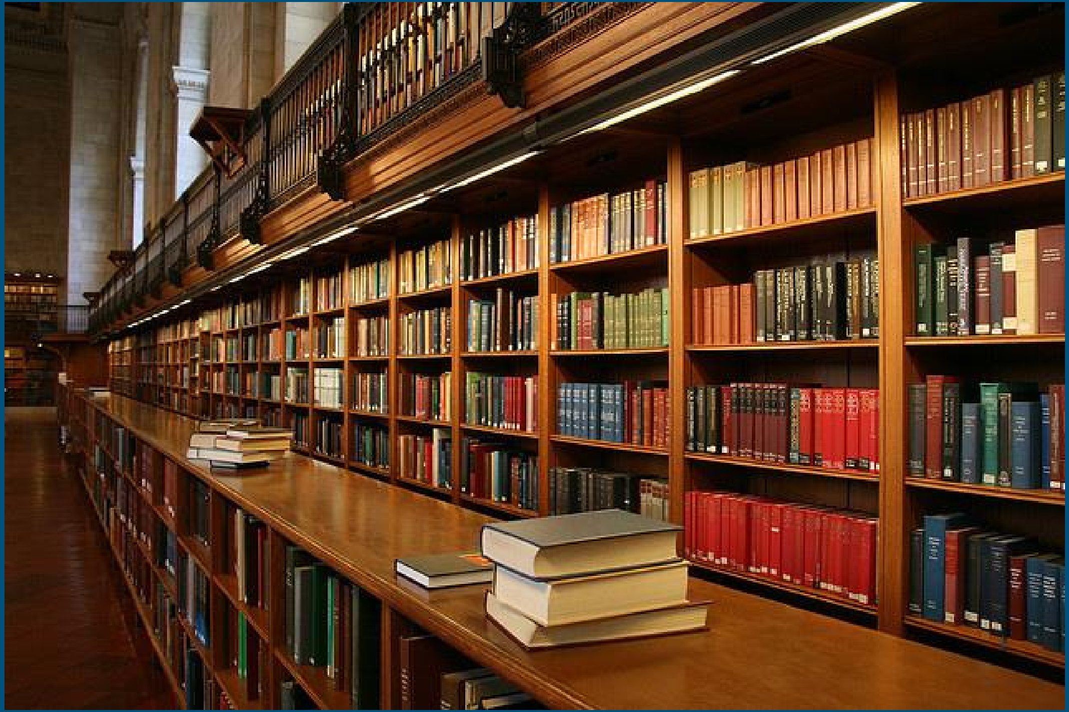


Photo: Viva Vivanista (Flickr)

Modules and Packages

Python Module

A Python file that you can import into another Python program

Example, storing device’s definitions in an external file.

Python Package

An importable Python directory

__init__.py

Exercises:
./day2/reuse_ex2.txt
./day2/reuse_ex3.txt

Review Exercise

Process the 'show_ip_int_brief.txt' file and create a data structure from it.

1. Create a dictionary of dictionaries.
2. The keys for the outermost dictionary should be the interface names.
3. The value corresponding to this interface name is another dictionary with the fields 'ip_address', 'line_status', and 'line_protocol'.
4. Use pretty-print to print out your data structure.

Your output should be similar to the following:

```
{'FastEthernet0': {'ip_address': 'unassigned',
                   'line_protocol': 'down',
                   'line_status': 'down'},
 ... }
```

Exercises:
./day2/review_ex1.txt

Review Exercise

Process the 'show_arp.txt' file and create a data structure from it.

1. Create a dictionary where the keys are the ip addresses and the corresponding values are the mac-addresses.

2. Create a second dictionary where the keys are the mac-addresses and the corresponding values are the ip addresses.

3. Use pretty print to print these two data structures to the screen.

Exercises:
./day2/review_ex2.txt

Day3 Schedule

1. Writing reusable code
2. Virtualenv
3. Namespaces

Python Applied to Network Engineering

4. Python + SNMP
5. Sending Email Notifications
6. CiscoConfParse
7. Python and SSH
8. netmiko-tools

Flickr: Pierre-Olivier Carles

Writing reusable code

Basic Building Blocks (functions/classes)
Python Modules
if __name__
Python Packages
Don’t repeat yourself

Flickr: Koka Sexton

Virtualenv

```
virtualenv -p /usr/bin/python27 test_venv

source /path/to/virtualenv/bin/activate

deactivate

pip list

pip install netmiko==1.4.3
pip install pycodestyle
```

Exercises:
./day3/virtualenv_ex1.txt

Namespaces (very briefly)

General rules:

1. Look in function first.
2. Look in global.
3. Look in builtins.

```
global my_var               # generally avoid doing this
```

Python + SNMP

Using PySNMP library

Using helper library I created, see:

~/python-libs/snmp_helper.py

Reference Material in {{ github_repo }}/snmp_example

Exercises:
./day3/snmp_ex1.txt
./day3/snmp_ex2.txt

Email notifications

Reference Material in:

{{ github_repo }}/email_example

Using helper library I created, see:

~/python-libs/email_helper.py

```
-------------------
from email_helper import send_mail

sender = 'twb@twb-tech.com'
recipient = 'ktbyersx@gmail.com'
subject = 'This is a test message.'
message = '''Whatever'''

send_mail(recipient, subject, message, sender)
```

CiscoConfParse

```
#!/usr/bin/env python
from ciscoconfparse import CiscoConfParse

cisco_file = 'cisco_config.txt'
cisco_cfg = CiscoConfParse(cisco_file)
intf_obj = cisco_cfg.find_objects(r"^interf")
print
for intf in intf_obj:
    print intf.text
    for child in intf.children:
        print child.text
    print
```

Reference Material in:
    {{ github_repo }}/confparse_example

Exercises:
./day3/confparse_ex1.txt
./day3/confparse_ex2.txt

Paramiko & Netmiko

Paramiko is the standard Python SSH library.

Netmiko is a multi-vendor networking library based on Paramiko.

Netmiko Vendors

Regularly tested

- Arista vEOS
- Cisco ASA
- Cisco IOS
- Cisco IOS-XE
- Cisco IOS-XR
- Cisco NX-OS
- Cisco SG300
- HP Comware7
- HP ProCurve
- Juniper Junos
- Linux

Limited testing

- Alcatel AOS6/AOS8
- Avaya ERS
- Avaya VSP
- Brocade VDX
- Brocade ICX/FastIron
- Brocade MLX/NetIron
- Cisco WLC
- Dell-Force10 DNOS9
- Dell PowerConnect
- Huawei
- Mellanox
- Palo Alto PAN-OS
- Pluribus
- Vyatta VyOS

Experimental

- A10
- Accedian
- Alcatel-Lucent SR-OS
- Aruba
- Ciena SAOS
- Cisco Telepresence
- CheckPoint Gaia
- Enterasys
- Extreme EXOS
- Extreme Wing
- F5 LTM
- Fortinet
- MRV Communications OptiSwitch

Key Netmiko Methods

.send_command()
.send_command_timing()

.send_config_set()
.send_config_from_file()

.commit()
.enable()
.disconnect()

.write_channel()
.read_channel()

FileTransfer Class

Netmiko example

```
#!/usr/bin/env python
from getpass import getpass
from netmiko import ConnectHandler

if __name__ == "__main__":
    password = getpass("Enter password: ")
    srx = {
        'device_type': 'juniper_junos',
        'ip':   '184.105.247.76',
        'username': 'pyclass',
        'password': password
    }

    net_connect = ConnectHandler(**srx)
    print net_connect.find_prompt()
```

Reference Material in:

{{ github_repo }}/netmiko_example
{{ github_repo }}/paramiko_example
{{ github_repo }}/pexpect_example

Exercises:
./day3/netmiko_ex1.txt
./day3/netmiko_ex2.txt

Netmiko Tools

```
git clone https://github.com/ktbyers/netmiko_tools

# In your .bashrc file if you want to retain it
export PATH=~/netmiko_tools/netmiko_tools:$PATH

~/.netmiko.yml

netmiko-grep
netmiko-show
netmiko-cfg
```

Day4 Schedule

1. Serialization: JSON and YAML
2. Concurrency: Threads and Processes
3. Arista eAPI
4. Juniper, NETCONF, and PyEZ

Data Serialization

Why do we need data serialization?

Characteristics of JSON

Characteristics of YAML

Reference Material in:
{{ github_repo }}/json_yaml

Exercises:
./day4/yaml_ex1.txt
./day4/yaml_ex2.txt

Threads/Processes

- Concurrency
- Python and the GIL
- Example with threads
- Example with processes
- Example with a queue

Reference Material in:
{{ github_repo }}/threads_procs

Exercises:
./day4/threads_ex1.txt

Arista eAPI

Reference Material in:
{{ github_repo }}/arista_pyeapi_example

```
import ssl
import jsonrpclib
from getpass import getpass

ssl._create_default_https_context = ssl._create_unverified_context
ip = '184.105.247.72'
username = 'admin1'
password = getpass()
url = 'https://{}:{}@{}:{}/command-api'.format(username, password, ip, port='443')

eapi_connect = jsonrpclib.Server(url)
response = eapi_connect.runCmds(1, ['show version'])
```

Using pyeapi library

```
import pyeapi

pynet_sw = pyeapi.connect_to("pynet-sw2")
show_version = pynet_sw.enable("show version")
```

~/.eapi.conf file contains connection definition information

Exercises:
./day4/arista_ex1.txt
./day4/arista_ex2.txt

Juniper, NETCONF, and PyEZ

- What is NETCONF?
- PyEZ
- PyEZ get operations
- PyEZ config operations

NETCONF

NETCONF by Example
https://trac.ietf.org/trac/edu/raw-attachment/wiki/IETF94/94-module-3-netconf.pdf

```
<rpc message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get/>
</rpc>

<rpc-reply message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <data>
        <!-- ... entire set of data returned ... -->
    </data>
</rpc-reply>
```

NETCONF Operations

The base protocol includes the following protocol operations:

- get
- get-config
- edit-config
- copy-config
- delete-config
- lock
- unlock
- close-session
- kill-session

*From RFC6241

PyEZ simple connect / facts

```
from jnpr.junos import Device
from getpass import getpass
from pprint import pprint

juniper_srx = {
        "host": “184.105.247.76”,
        "user": "pyclass",
        "password": getpass(),
    }

a_device = Device(**juniper_srx)
a_device.open()
pprint(a_device.facts)
```

Reference Material in:
{{ github_repo }}/juniper_example

Exercises:
./day4/juniper_ex1.txt

PyEZ table operations

```
from jnpr.junos import Device
from jnpr.junos.op.ethport import EthPortTable
from getpass import getpass

juniper_srx = {
    "host": "184.105.247.76",
    "user": "pyclass",
    "password": getpass(),
}
a_device = Device(**juniper_srx)
a_device.open()
eth_ports = EthPortTable(a_device)
eth_ports.get()
```

Reference Material in:
{{ github_repo }}/juniper_example

PyEZ config operations

Reference Material in:
{{ github_repo }}/juniper_example

Exercises:
./day4/juniper_cfg_ex1.txt

```
#!/usr/bin/env python
from jnpr.junos import Device
from jnpr.junos.utils.config import Config
from getpass import getpass

juniper_srx = {
    "host": "184.105.247.76",
    "user": "pyclass",
    "password": getpass(),
}
a_device = Device(**juniper_srx)
a_device.open()
cfg = Config(a_device)
```

```
cfg.load("set system host-name test1", format="set", merge=True)
cfg.load(path="load_hostname.conf", format="text", merge=True)
cfg.load(path="load_hostname.xml", format="xml", merge=True)

cfg.diff()
cfg.rollback(0)
cfg.commit()
```

PyEZ RPC operations

Reference Material in:
{{ github_repo }}/juniper_example

```
show version | display xml rpc
```

```
pyclass@juniper1> show version | display xml rpc
<rpc-reply xmlns:junos="http://xml.juniper.net/junos/15.1F4/junos">
    <rpc>
        <get-software-information>
        </get-software-information>
    </rpc>
...
</rpc-reply>
```

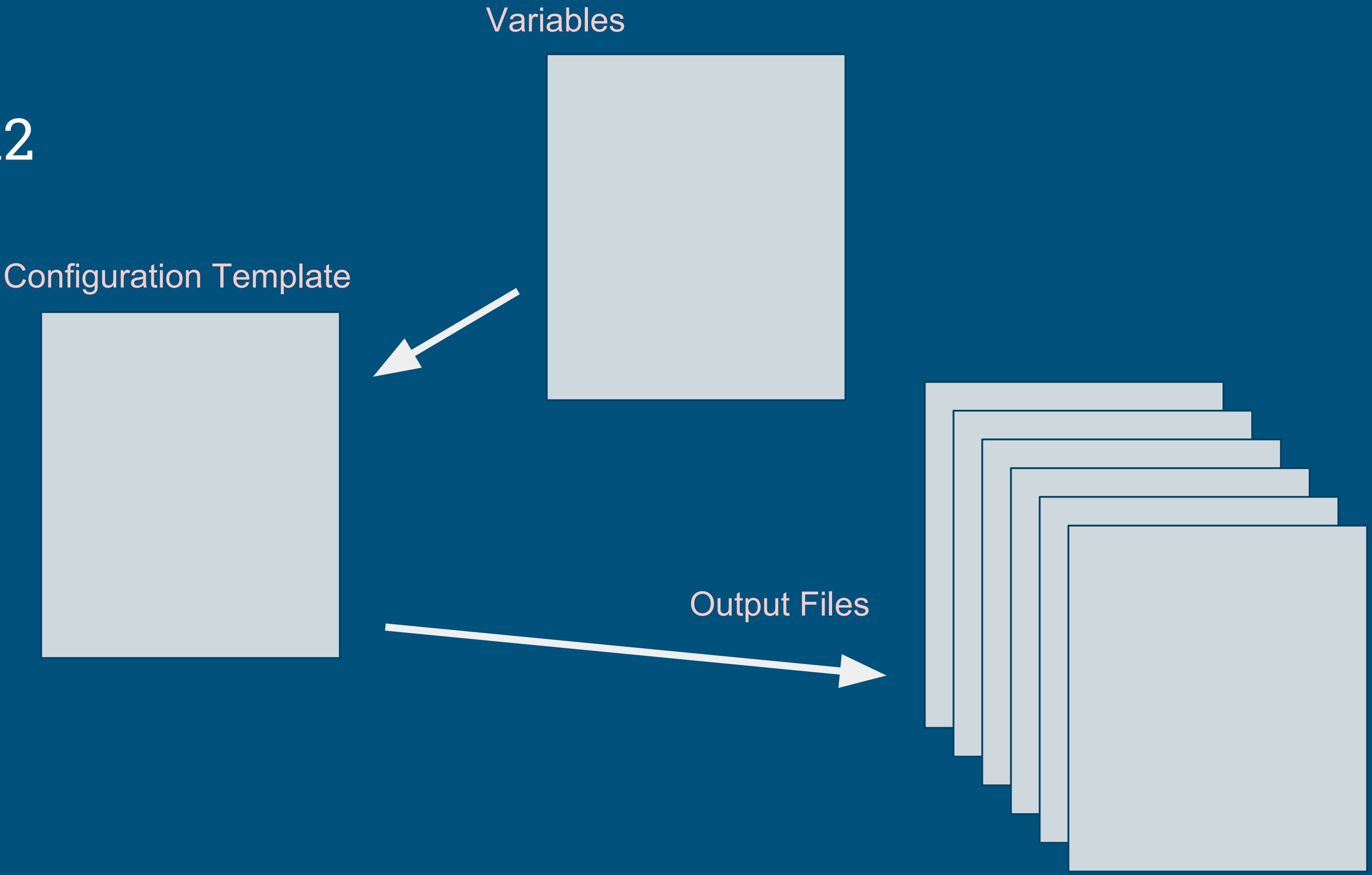
```
show_version = a_device.rpc.get_software_information()
```

Exercises:
./day4/juniper_ex2.txt

Day5 Schedule

1. Jinja2 Templating
2. Integrating to a Database
3. NAPALM
4. Pulling data from a CSV file
5. Unit Testing
6. Continuous Integration

Jinja2



Jinja2 Template - the double curly-brace

```
import jinja2

my_dict = {'a': 'whatever'}

my_template = '''
Some text
of something
{{ a }}
something
'''

t = jinja2.Template(my_template)
print(t.render(my_dict))
```

Reference Material in:

{{ github_repo }}/jinja2_example/jinja2_simple.py
{{ github_repo }}/jinja2_example/jinja2_bgp.py
{{ github_repo }}/jinja2_example/jinja2_bgp2.py

Jinja2 Template - Loading Template from a File

```
import jinja2

template_file = 'juniper_bgp.j2'
with open(template_file) as f:
    bgp_template = f.read()

my_vars = {
    'peer_as': '22',
    'neighbor1': '10.10.10.2',
    'neighbor2': '10.10.10.99',
    'neighbor3': '10.10.10.220',
}

template = jinja2.Template(bgp_template)
print(template.render(my_vars))
```

Reference Material in:
{{ github_repo }}/jinja2_example/jinja2_bgp_file.py

Exercises:
./day5/jinja_ex1.txt

Jinja2 Template - Conditionals

```
{% if SNMPv3 %}
access-list 98 remark *** SNMP ***
access-list 98 permit any
!
snmp-server view VIEWSTD iso included
snmp-server group READONLY v3 priv read VIEWSTD access 98
snmp-server user pysnmp READONLY v3 auth sha auth_key priv aes 128
encrypt_key
{% endif %}
```

Jinja2 Template - Loops

```
protocols {
    bgp {
        group external-peers {
            type external;
            {% for neighbor_ip, neighbor_as in my_list %}
                neighbor {{ neighbor_ip }} {
                    peer-as {{ neighbor_as }};
                }
            {% endfor %}
        }
    }
}
```

Reference Material in:
{{ github_repo }}/jinja2_example/jinja2_bgp_loop.py

Exercise

On juniper1.twb-tech.com and juniper2.twb-tech.com configure an IP address on the ge-0/0/2 interface. Additionally configure eBGP peering between the two devices.

Use the ./day5/build_bgp.j2 template to accomplish this.

At the end of the configuration, you should be able to ping across the ge-0/0/2 links and BGP should be in the established state.

Integrating to a DB

- Django ORM
- Defining the DB
- Creating the DB
- Primary Keys, Foreign Keys
- CRUD Operations

Reference notes in:
{{ github_repo }}/django/django_notes.txt

Defining the Database Fields (models.py)

```
class NetworkDevice(models.Model):
    device_name     = models.CharField(primary_key=True, max_length=80)
    device_type     = models.CharField(max_length=50)
    ip_address      = models.GenericIPAddressField()
    port            = models.IntegerField()
    vendor          = models.CharField(max_length=50, blank=True, null=True)
    model           = models.CharField(max_length=50, blank=True, null=True)
    os_version      = models.CharField(max_length=100, blank=True, null=True)
    serial_number   = models.CharField(max_length=50, blank=True, null=True)
    uptime_seconds  = models.IntegerField(blank=True, null=True)
    credentials     = models.ForeignKey(Credentials, blank=True, null=True)
```

Initializing the DB

```
cd ~/DJANGOX/djproject

$ python manage.py makemigrations
Migrations for 'net_system':
  0001_initial.py:
    - Create model Credentials
    - Create model NetworkDevice

$ python manage.py migrate
...
```

Exercises:
Initialize your Django Database

See:
./day5/db_ex1a_solution.txt

Create/Delete Objects

```
cd ~/DJANGOX/djproject/
$ python manage.py shell
...
>>> from net_system.models import NetworkDevice
>>> pynet_sw2 = NetworkDevice(
...         device_name='pynet-sw2',
...         device_type='arista_eos',
...         ip_address='184.105.247.73',
...         port=22,
... )
>>> pynet_sw2.save()
>>> pynet_sw2.delete()
>>> pynet_sw2 = NetworkDevice.objects.get_or_create(…)
```

Load Data into the DB

```
$ cd ~/DJANGOX/djproject/net_system

$ python load_devices.py
(<NetworkDevice: NetworkDevice object>, True)
(<NetworkDevice: NetworkDevice object>, True)
(<NetworkDevice: NetworkDevice object>, True)
(<NetworkDevice: NetworkDevice object>, True)
(<NetworkDevice: NetworkDevice object>, True)
(<NetworkDevice: NetworkDevice object>, True)

$ python load_credentials.py
(<Credentials: Credentials object>, True)
(<Credentials: Credentials object>, True)
```

Exercises:
Load your data.

See:
./day5/db_ex1b_solution.txt

Query the Database

Exercises:
Manually query the database

See:
./day5/db_ex1c.txt

```
$ python manage.py shell
...
>>> from net_system.models import NetworkDevice
>>> all_devices = NetworkDevice.objects.all()
>>> all_devices
[<NetworkDevice: pynet-rtr1>, <NetworkDevice: pynet-rtr2>, <NetworkDevice: pynet-sw1>,
<NetworkDevice: pynet-sw2>, <NetworkDevice: pynet-sw3>, <NetworkDevice: pynet-sw4>,
<NetworkDevice: juniper-srx>]

>>> all_devices[0]
<NetworkDevice: pynet-rtr1>
>>> all_devices[0].ip_address
'184.105.247.70'
```

Link to credentials

```
>>> NetworkDevice.objects.get(ip_address='184.105.247.72')
<NetworkDevice: pynet-sw1>
>>> arista1 = NetworkDevice.objects.get(ip_address='184.105.247.72')

>>> from net_system.models import Credentials
>>> creds = Credentials.objects.all()
>>> creds
[<Credentials: pyclass>, <Credentials: admin1>]

>>> arista_creds = creds[1]
>>> arista1.credentials = arista_creds
>>> arista1.save()
```

Exercises:
./day5/db_ex1d.txt

Solution:
./day5/db_ex1d_solution.txt
./day5/db_ex1d.py

Retrieving all objects using a given credential

```
>>> arista_creds
<Credentials: admin1>

>>> arista_creds.networkdevice_set.all()
[<NetworkDevice: pynet-sw1>, <NetworkDevice: pynet-sw2>]
```

Exercises:
./day5/db_ex2.txt
./day5/db_ex3.txt
./day5/db_ex4.txt

NAPALM

Purpose of NAPALM: create a standard set of operations across a range of platforms.

Operations fall into two general categories: Config Operations + Getter Operations.

Reference Material in:
{{ github_repo }}/napalm_example

NAPALM Vendors

CORE

Arista EOS

Cisco IOS

Cisco IOS-XR

Cisco NX-OS

Juniper JunOS

COMMUNITY

Fortinet Fortios

Mikrotik RouterOS

Palo Alto NOS

Pluribus

VyOS

NAPALM Getters

Exercises:
./day5/napalm_ex1.txt
./day5/napalm_ex2.txt

get_facts
get_environment
get_snmp_information
get_ntp_peers
get_ntp_stats
get_mac_address_table
get_arp_table
get_interfaces
get_interfaces_ip
get_lldp_neighbors
get_lldp_neighbors_detail
get_bgp_neighbors
get_bgp_neighbors_detail
get_bgp_config
get_route_to
get_probes_config
get_probes_results
get_users
get_optics

NAPALM Config Operations

device.load_merge_candidate()
device.load_replace_candidate()

device.compare_config()
device.discard_config()

device.commit_config()

device.rollback()

Exercises:
./day5/napalm_ex3.txt
./day5/napalm_ex4.txt

CSV Examples

```
device_name,device_type,host,username,password
pynet-rtr1,cisco_ios,184.105.247.70,pyclass,my_pass
pynet-rtr2,cisco_ios,184.105.247.71,pyclass,my_pass
------------------------------------
file_name = 'test_net_devices.csv'
with open(file_name) as f:
    read_csv = csv.DictReader(f)
    for entry in read_csv:
        print(entry)
```

Reference Material in:
{{ github_repo }}/csv_example

Unit Testing

```
import pytest

# Functions
def func(x):
    return x + 1

# Tests
def test_answer():
    assert func(3) == 4
```

Reference Material in:
{{ github_repo }}/unittest_example

Unit Testing

```
py.test -s -v test_simple.py
========================= test session starts ==========================
platform linux -- Python 3.5.1, pytest-3.2.3, py-1.4.34, pluggy-0.4.0 --
/home/kbyers/VENV/py35_venv/bin/python35
cachedir: .cache
rootdir: /home/kbyers/pynet-ons-oct17/unittest_example, inifile:
plugins: pylama-7.4.3
collected 1 item

test_simple.py::test_answer PASSED
```

Creating a fixture

```
@pytest.fixture(scope="module")
def netmiko_connect():
    cisco1 = {
        'device_type': 'cisco_ios',
        'ip':   '184.105.247.70',
        'username': 'pyclass',
        'password': getpass()
    }
    return ConnectHandler(**cisco1)
```

Using a fixture

```
def test_prompt(netmiko_connect):
    print(netmiko_connect.find_prompt())
    assert netmiko_connect.find_prompt() == 'pynet-rtr1#'

def test_show_version(netmiko_connect):
    output = netmiko_connect.send_command("show version")
    assert 'Configuration register is 0x2102' in output
```

Continuous Integration using Travis CI

Define a .travis.yml file in your repository.

Link Travis-CI to GitHub account

Add linting

Add automated testing

```
---
language: python
python:
   - "2.7"
   - "3.5"
   - "3.6"
install:
   - pip install -r
requirements.txt
script:
   - pylama travis_test/
   - py.test tests/
```

The end...

Questions?

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