THE POWER OF BEING UNDERSTOOD

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PYTHON FOR PENTESTERS

About

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Learning Objectives

- By the end of this training, you should be able to:
  - Understand the structure of well-formed script module and package
  - Create and setup a development environment
  - Describe the core API, common functions, and third party packages
  - Identify opportunities for using Python to automate repetitive tasks

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Introduction

Why should I care? I'm not a developer!

- Efficiency
  - More time for deeper analysis of "interesting" bugs
- Flexibility
  - Burp license expired? Kali update broke your tool? No problem!
- Knowledge
  - You might find a GraphQL endpoint that accepts valid Python ☺

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Lab Overview

- Hands on labs later in the course
- **Labs require a Python 3.6 or 3.7 environment!**
  - Start that setup now if you haven't already done so
- Labs will have difficulty "modes"
  - Select what's appropriate for your level
    - Easy mode – Update expressions
    - Normal mode – Write sections
    - Hard mode – DIY
- We'll provide the "reference implementation" later

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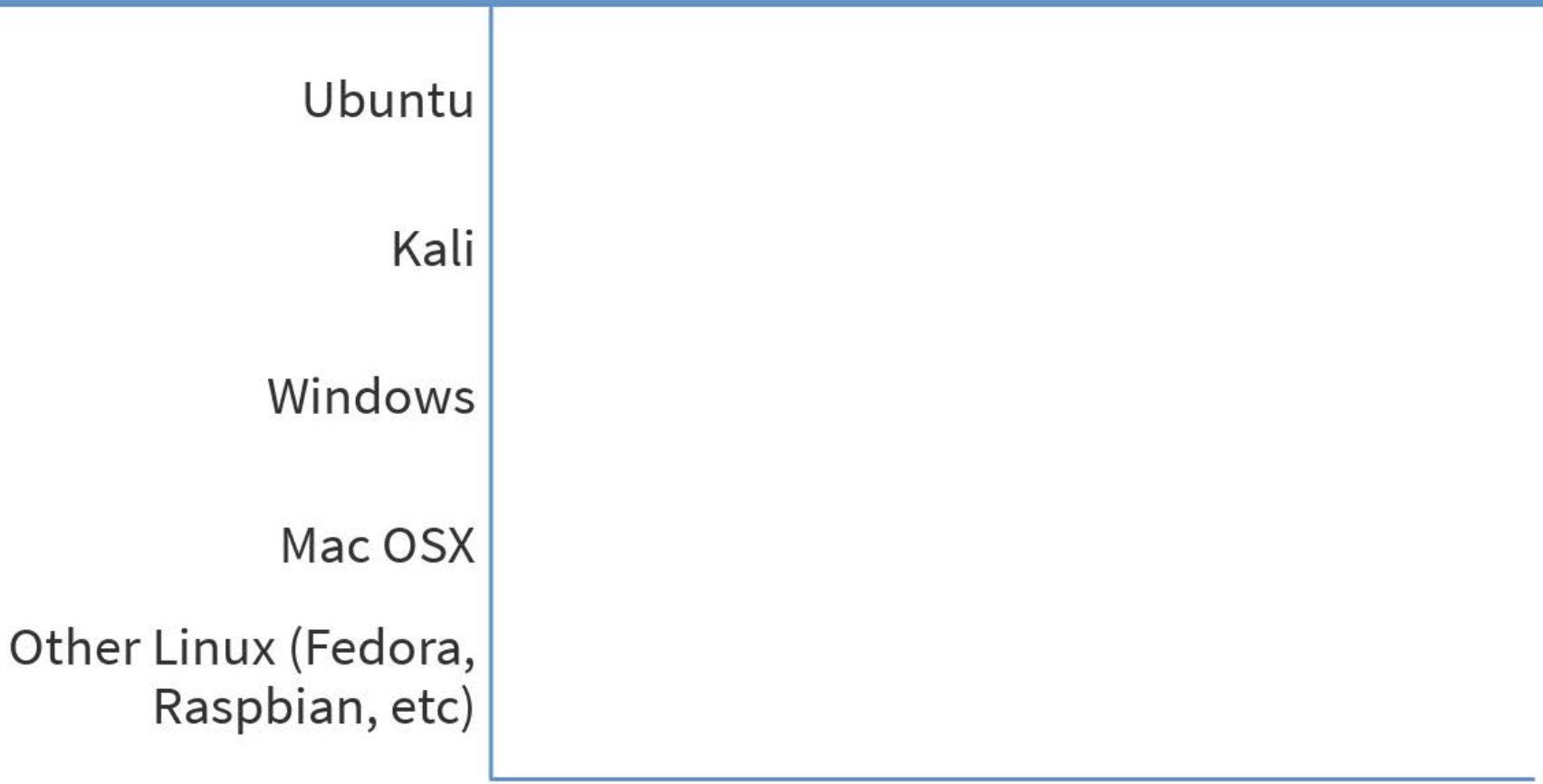
What operating system are you most interested in running Python on?



SETTING UP A DEVELOPMENT ENVIRONMENT

Development Environment

Choosing an IDE:

- Atom
- PyCharm
- Sublime
- IDLE
- Spyder
- Jupyter
- Geany

Considerations

- Free or Paid?
  - If you are a student with a .edu email, you can get a free PyCharm license (jetbrains.com/student)
- How much RAM can you sacrifice?
  - Some of these Electron apps can eat up a lot of resources
- What are you trying to accomplish?
  - Quick, one-off script vs. maintaining an open source project

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Enter Atom

- Good enough for this course
- Extensible with plugins / themes
- Downloadable from the “Releases” page on Github
  - https://github.com/atom/atom/releases/tag/v1.36
- Be careful with Electron apps ☺

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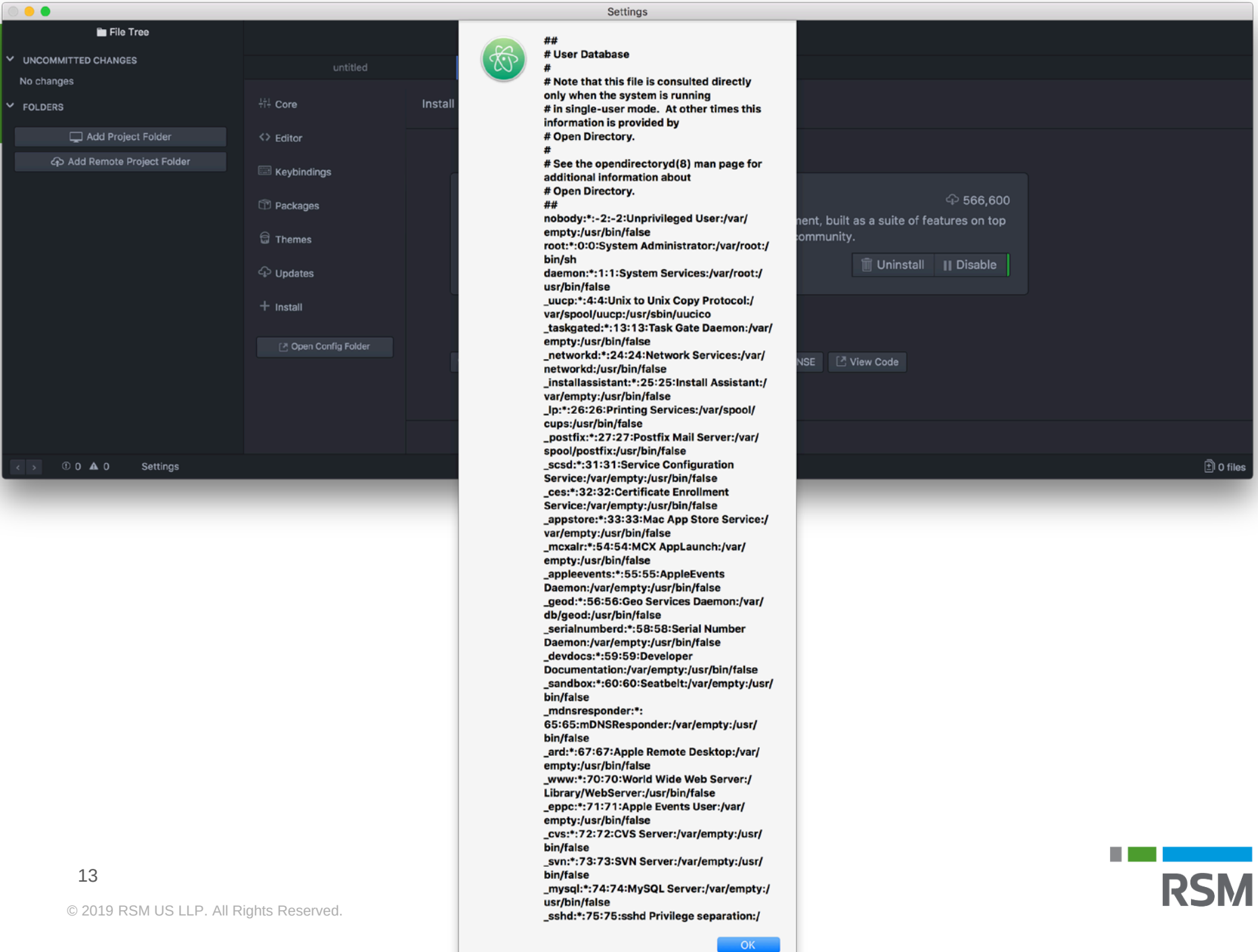

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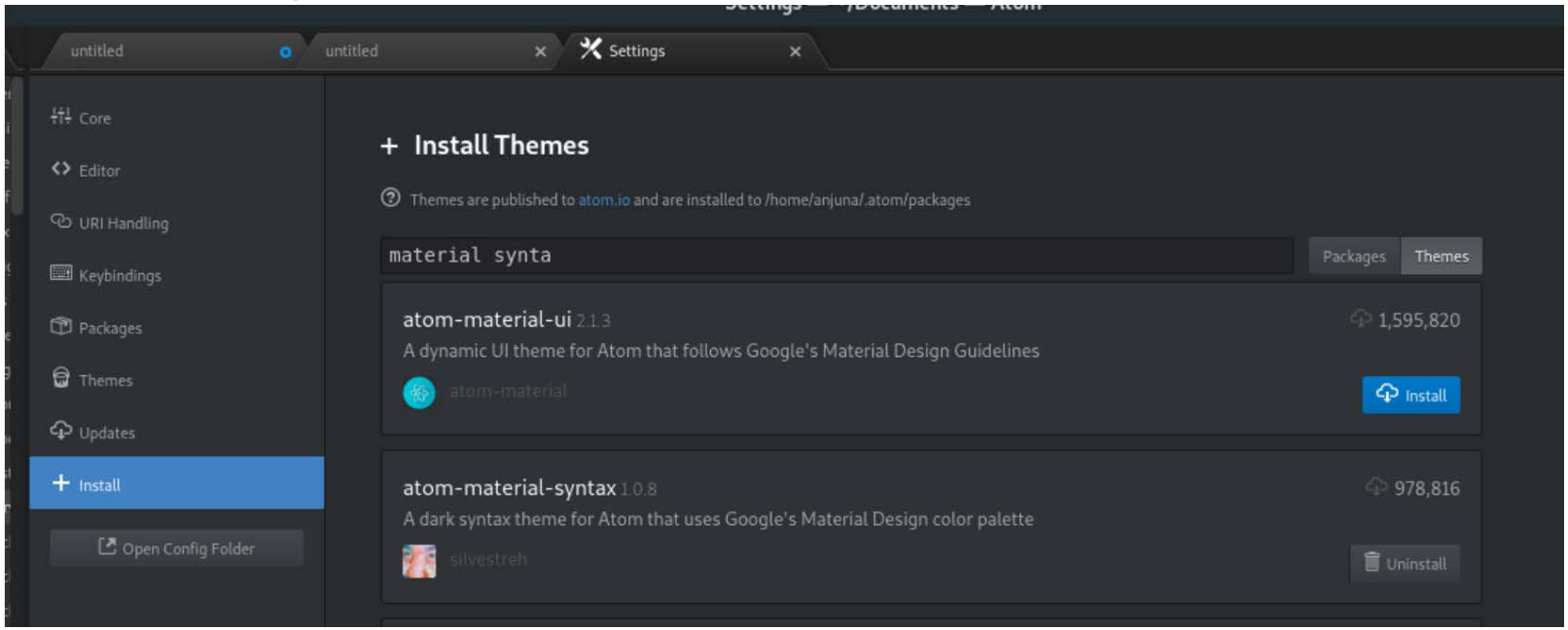
Install themes

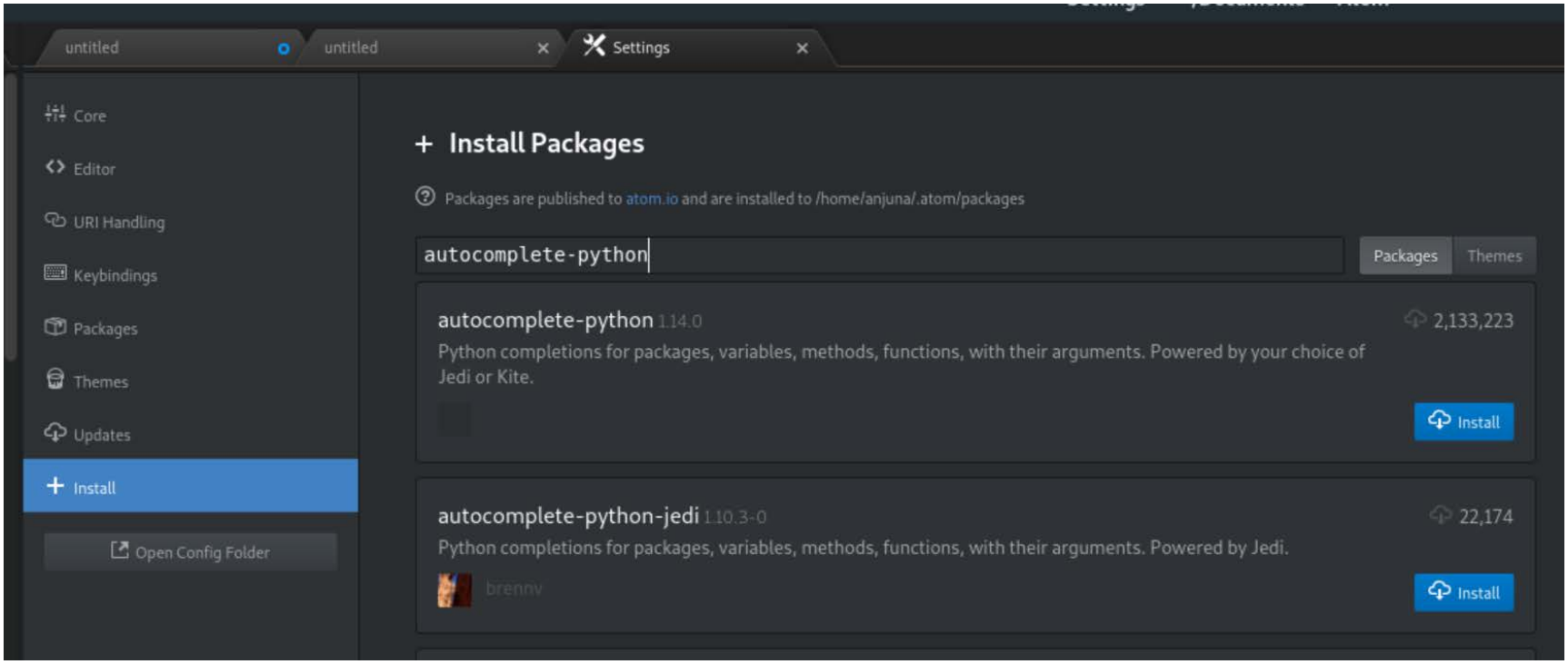
- Edit -> preferences
  - Themes – syntax themes
    - Up to preference, I prefer Material for projection because of the high contrast



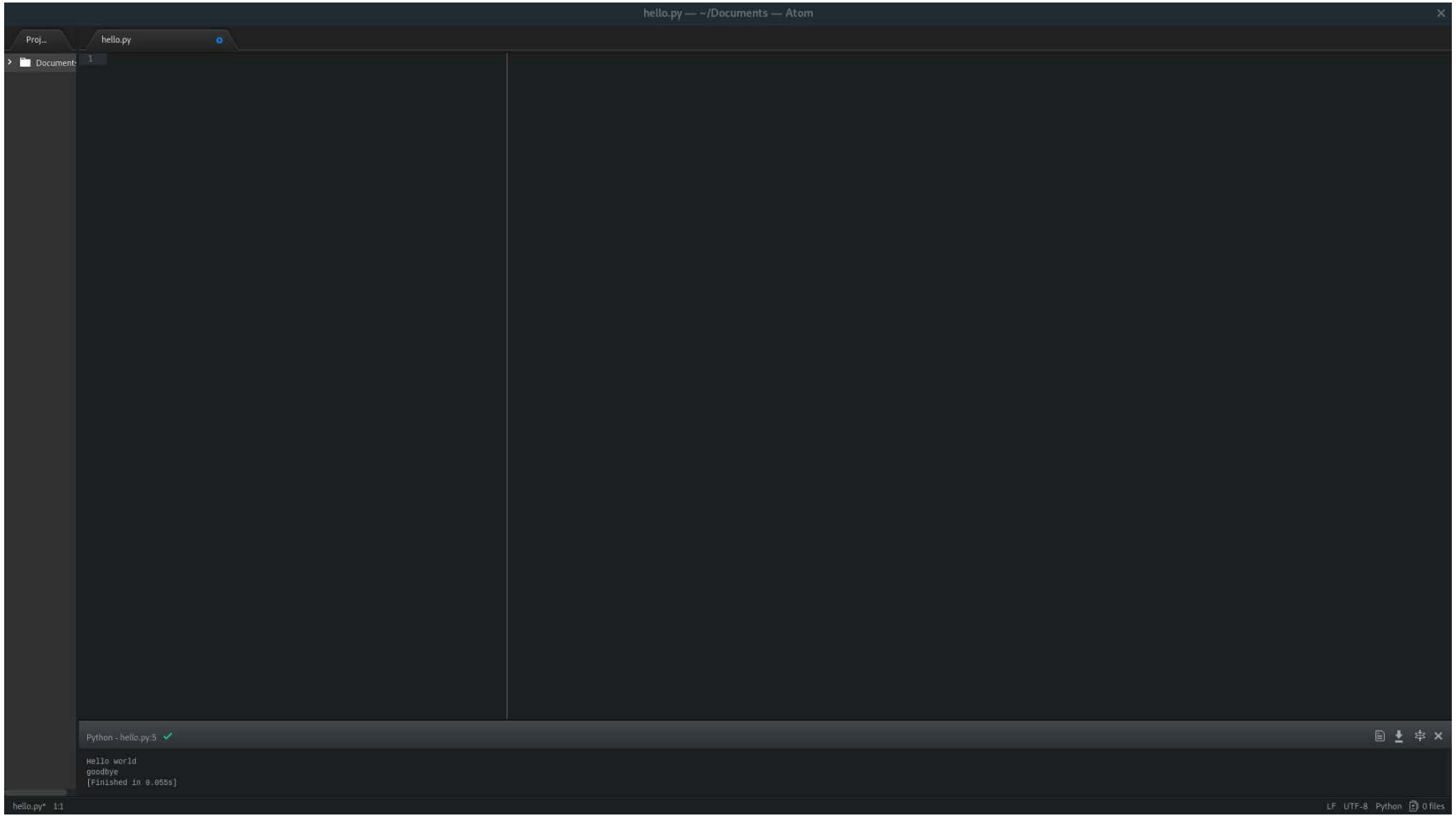
Install packages

Packages

– Python-autocomplete, autopep8, script, atom-ide-ui



Script: Shift-Control-B



Heavy-weight Alternative: PyCharm

- “Fully Featured” IDA (lots of features)
  - Best debugging, remote capabilities even
  - Remote file management (push / pull over SFTP)
  - Database integration
  - Powerful refactoring capabilities
    - Context-sensitive not just find / replace
  - Run / Debug configurations with templates
  - Pipenv / Venv integration
- Best used for large projects and complex tasks
  - More than ~3 source files

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To pay or not to pay?

- PyCharm comes in a free and Paid Version
- Paid version includes additional features
  - Framework integrations like Flask, Django
  - Remote capabilities
    - File management
    - Debugging
  - Database manager
  - UML and SQLAlchemy diagram generation

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crimson-forge [~/Repositories/crimson-forge] - .../crimson_forge/analysis.py [crimson-forge] - PyCharm

File Edit View Navigate Code Refactor Run Tools VCS Window Help HIDPI profiles

crimson-forge 〉 crimson_forge 〉 analysis.py x86 Reverse TCP Git:

Project

- crimson-forge ~/Repositories/crin
  - crimson_forge
  - data
    - stubs
      - amd64
      - macros.asm
    - templates
    - catalog.json
    - common-arguments.txt
    - crimson-forge-logo.png
  - docs
  - files
  - metasploit
  - tools
    - assembler.py
  - .gitignore
  - crimson-forge

analysis.py | assembler.py | block_api.asm

```
71      #     * stack: the address on the stack where the reference was pla
72      #     * referenced: the address that is referenced
73      Reference = collections.namedtuple('Reference', ('instruction', 'sta
74      ReferenceExpression = collections.namedtuple('ExpressionReference',
75      def __init__(self, blocks, copied=False):...
83
84      @classmethod
85      def _breakpoint(cls, state, event_type):...
93
94      def _breakpoint_expr(self, state):
95          expr = state.inspect.expr_result
96          if not expr.symbolic:
97              return
98          if expr in self.expressions:
99              return
100         if any(symbol.variables & expr.variables for symbol in self.ex
101             self.expressions[expr] = self.ReferenceExpression(expr, Non
102             logger.info('New tainted expression identified')
103
104     def _breakpoint_mem_read(self, state):...
124
125     def __addr_is_on_stack(self, state, stack_addr, address):...
136
137     def __breakpoint_mem_write(self, state, stack_addr, ip_addr):...
157
```

SelfReferenceTracker 〉 _breakpoint_expr()

6: TODO 9: Version Control Terminal Python Console Event Log

95:41 LF ÷ UTF-8 Tab ÷ Git: master ÷

Git

- Version control system
- Advantages:
  - Saving and tracking incremental changes
  - Collaborating with others
  - “Topic” branches to test new features (eg, master vs. dev vs. experimental)
- Can easily publish to a site such as Github, Gitlab, Bitbucket, Keybase… etc

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Git basics

- New project?
  - `git init`
    - Creates a .git file
- Working off someone elses?
  - `git clone https://github.com/securestate/king-phisher.git`
  - `git clone –b dev <url>`
- Made your changes and you want to record them?
  - `git commit –m “Updated helper function”`
- Forgot the last thing you did?
  - `git log`
- Ready to publish your changes?
  - `git push`

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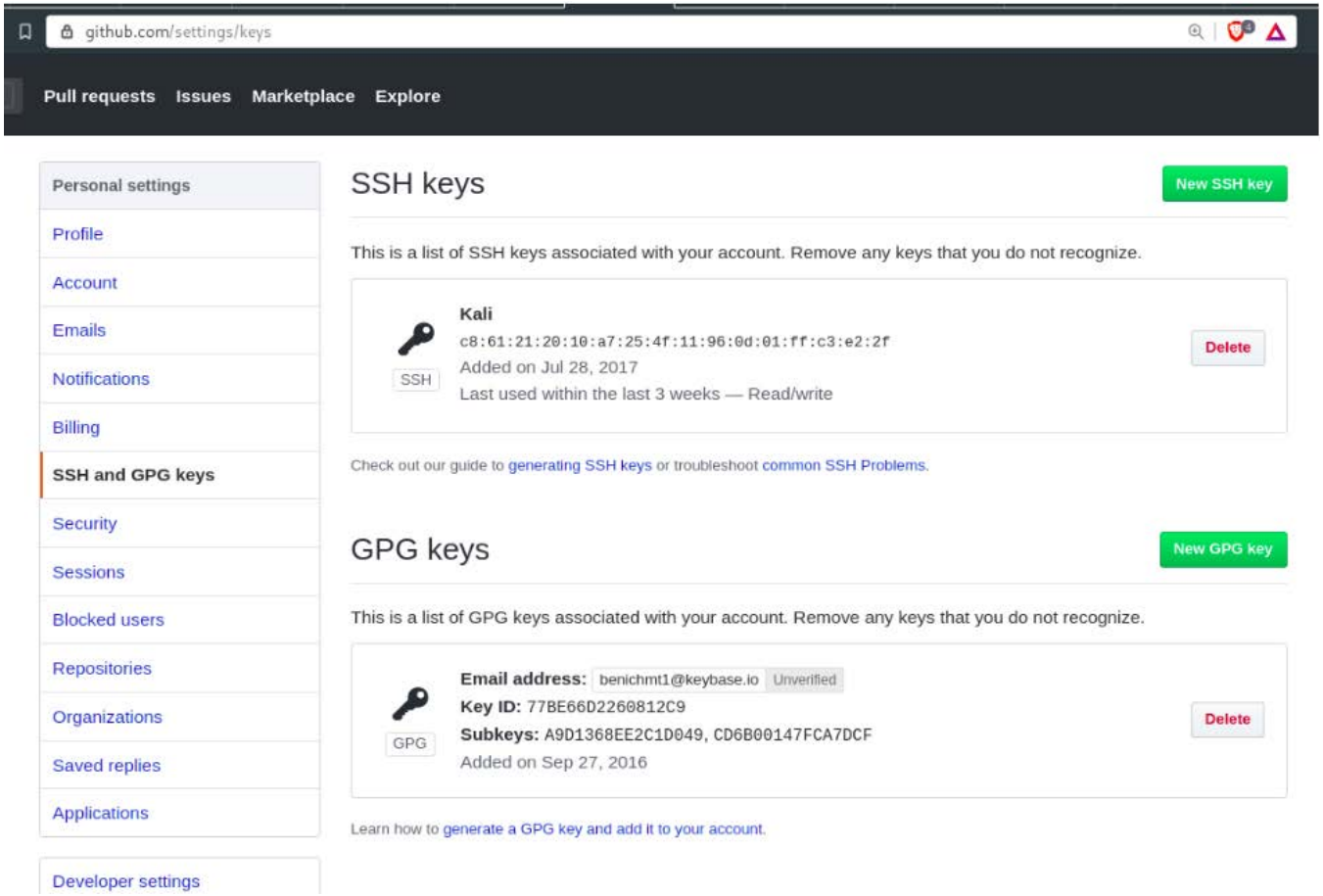
Git keys



Git GUIs

- GUIs are ideal for complex Git tasks
  - Merging / Rebasing
- Searching through commit logs
- Cherry-picking commits

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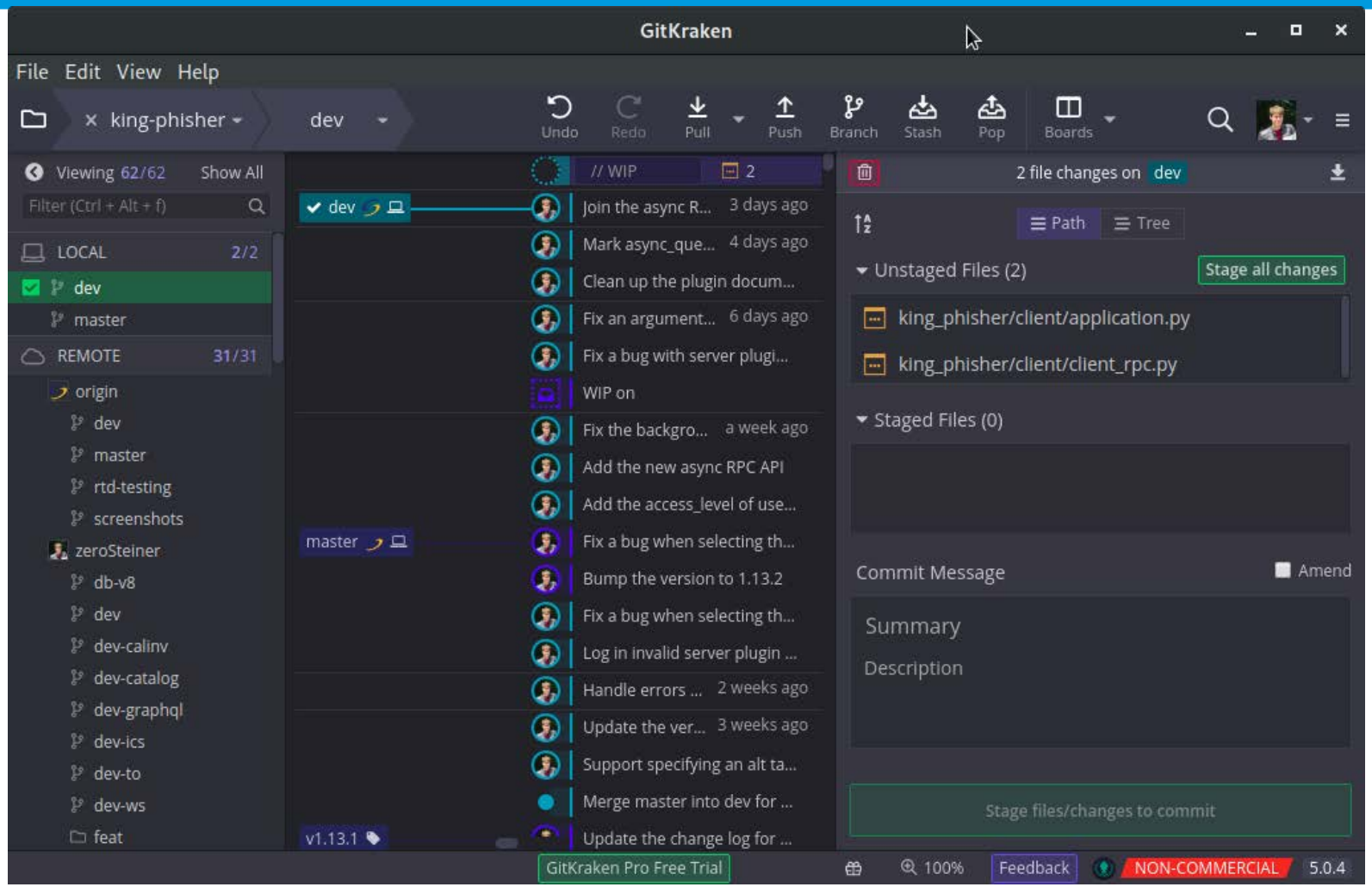
GitKraken



Pip

- Pip – python package manager
  - `pip / pip2 / pip3 install <package name>`
- Previously if you wanted to get going with a project, you would `git clone` it, and then `pip install –r requirements.txt`
- This usually solved most of the errors that stem from not recognizing an import
- But what about when requirements conflict, or are not backwards compatible?

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Enter PIPENV

- Allows developers to replicate the same environment
  - `Why does it work on YOUR machine but not on mine?`
- Can replicate the exact same environment, PER PROJECT (eg, we have all the same requirements, and they are all a specific version)
- `pip install pipenv`

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PipEnv in 60 seconds

- `Pipenv shell`
  - Creates an environment
- `pipenv install dependency==1.0.0`
  - Installs dependency version
- Can replicate the exact same environment, PER PROJECT (e.g., we have all the same requirements, and they are all a specific version)
- `pipenv graph`
  - A list of the dependencies you have
- `pipenv lock`
  - Updates your lock file when you are ready to go

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PYTHON BASICS

Python Variables

- Python is often recommended to beginners for many reasons, one of which is dynamic variable types
- Python tries to “autodetect” the variable type for you (compared to C++/Java where you have to define types)
  - `C++: int i = 1; (i is an integer type)`
  - `Python: i = 1 (i is assumed to be an integer)`

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Python Types

- X = 1
  - Int (integer)
- X = 1.0
  - Float (calculations with precision)
- X = “one”
  - String (character or characters)
- X = [1,2,3]
  - List
- X = (1,2,3)
  - Tuple
- {“x”:1}
  - Dict (dictionary)

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Mutable / Immutable Objects

Mutable	Immutable
list	str
dict	int
set	float
Can change its contents	Cannot change its contents

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Mutable / Immutable Objects

```
print("-------------- Immutable (int)-------------“)
x = 1
y = x
print("The object id of x is: {}".format(id(x)))
print("The object id of y is: {}".format(id(y)))
y = y+1
print("The value of y is {}".format(y))
print("The value of x is {}".format(x))
print("The object id of x is: {}".format(id(x)))
print("The object id of y is: {}".format(id(y)))
```

Mutable / Immutable Objects

```
print("-------------- Mutable -------------“)
a = [1,2,3]
b = a
print("The object id of a is: {}".format(id(a)))
print("The object id of b is: {}".format(id(b)))
a.append(4)
print("Do these have the same identity? {}".format(a is b))
print("The object id of a is: {}".format(id(a)))
print("The object id of b is: {}".format(id(b)))
print("The value of a is: {}".format(a))
print("The value of b is: {}".format(b))
```

Warning

```
def bad_function(thing, items=[0, 1, 2]):
    items.append(thing.favorite_item)
    return process_items(items)
```

- Don’t use mutable types in function signatures
  - The default items instance will persist between function calls

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String Format Operations

```
company = "RSM"

years = 3

dollars = 100000.0


print("I have worked for %s for %d years and earned %.2f
dollars" % (company, years, dollars))


print("My friend also works for {0} for {1} years and earned
{2:.2f} dollars".format("Charlie's Chocolate Factory", 5,
dollars+34000))
```

Functions

```
print("----- Simple Function ------“)

def reversefunction(company):
    bwstring = ''.join(reversed(company))
    return bwstring
myco = "RSM"
print("{} backwards is {}".format(myco,reversefunction(myco)))
```

Using *args

```
print("--- Using *args ----“)
def moneyfunction(*pricelist):
    total = 0
    for n in pricelist:
        total = total + n
    print("The total cost is ${} ".format(total))
pricesheet = (24,58)
moneyfunction(*pricesheet)

pricesheet2 = (17,37,21,442)
moneyfunction(*pricesheet2)
```

**kwargs

```
print("--- Using **kwargs ----“)
def employeedata(**data):
    for key, value in data.items():
        print("{}:{}".format(key,value))

employeedata(Name="John", Age="22")
employeedata(Name="Sandy", Location="Ohio")
```

**kwargs usage

```
# Unconditionally set consultant keys
def consultantdata(**data):
        data['Type'] = 'Consultant'
        data['Utilization'] = 1.0
        return employeedata(**data)

# Set default consultant keys
def consultantdata(**data):
        data['Type'] = data.get('Type', 'Consultant')
        data['Utilization'] = data.get('Utilization', 1.0)
        return employeedata(**data)
```


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Working with Files

- Files can be opened with various modes
  - r (read only)
  - w (write only)
  - r+ (read and write)
  - a (append)
  - b (binary)
- As a simple example, you can read a file from the same directory as the script is in
- f = open("input.txt","r")
- g = open("output.txt","w")

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Reading and Writing Text Files

- Once you open a text file, you can process it in a number of different ways
  - **read** – read all into one string
    - Good for shorter files
  - **readline** – read individual lines
  - **readlines** – read all lines and return as a list
- **Warning:** Opening a file in write mode (without “r”) will overwrite the contents
  - Will also create a new, empty file

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Reading and Writing Text Files

```
f = open("input.txt","r")
g = open("output.txt","w")
sentencesfromfile = f.readlines()
for line in sentencesfromfile:
        print(line)
print("The first line is:")
print(sentencesfromfile[0])
g.write(sentencesfromfile[0])
f.close()
g.close()
```


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Exception Handling

- Try to keep the body of the try: block as small as possible
- Do not catch all Exceptions without logging useful information
  - If you need to use blanket exception handling log a stack trace
    - `traceback.print_exc` will explicitly print the stack trace
    - Logging `exc_info=True` will log the stack trace (only useful if logging is configured

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Exception Handling: Bad Example

```
• try:
    user = ‘alice’
    data = some_faulty_method(user)
    data += some_other_method(user)
• except Exception:
    print(‘something went wrong’)
```

Exception Handling: Good Example

```
• user = 'alice'
• try:
    some_faulty_method(user)
• except TypeError:
    traceback.print_exc()
• else:
    data += some_other_method(user)
• finally:
    logout(user)
```

What is the output of the following code?

main.py saved

```
def myfunction():
    try:
        print("a")
    except TypeError:
        print ("b")
    finally:
        print("c")
myfunction()
```

a

a b

a b c

a c

b

c

PYTHON PACKAGES

Python Packages and Modules

- Python can be extremely useful and timesaving through the use of packages – don't reinvent the wheel!
- Packages can be installed via pip.
  - Pip install –r requirements.txt
  - Pip install requests
- One of the most basic troubleshooting skills – did you install all of the required packages first?
- For this course, we will not be creating our own packages, but we will show the usefulness of working with others'.
- Packages are collections of modules – a module is a singular import

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Python Modules

```
import os
os.listdir()
my_directory = os.getcwd()
print(my_directory)
```

Python Modules

```
import os, re
if os.path.isfile("/etc/vsftpd/vsftpd.conf")
        fileopen = open("/etc/vsftpd/vsftpd.conf","r")
        data = fileopen.read()
        match = re.search("anonymous_enable=YES",data)
        if match:
                print("[!] Insecure configuration! Anonymous FTP enabled!")
```


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Command Line Arguments

Arguments are the placeholders

python3 file.py **input.txt**

```
import sys
print(“Arguments:",len(sys.argv)-1)
print("Your first argument is:",(sys.argv[0])
print("Your second argument is:",(sys.argv[1])
```

Command Line Arguments

A more robust way of dealing with user input is through **argparse**

```
import argparse

parser = argparse.ArgumentParser()

parser.add_argument("-V","-v","--version",help="show the version",
action='store_true')

parser.add_argument("-F","-f","--face",help="show the weird face
emoji",action='store_true')

parser.add_argument("-P","-p","--port",help="change the port")

args = parser.parse_args()

if args.version:

    print("Web Server 0.0/0")

if args.face:

    print("0_______o")

if args.port:

    print(args.port)
```

Debugging Python

- What is debugging?
- Allows you to inspect the state of things as they're running.
  - Check values
  - Trace logic

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Options

- CLI:
  - pdb – Integrated Python debugger, pretty basic
  - ipdb – pdb, but with IPython-like capabilities
  - rpdb – Remote PDB, a network-capable variant of pdb
- GUI:
  - PyCharm – Heavy weight IDE for Python (authors choice)

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pdb / ipdb / rpdb

- All command line based, easy to use when running a script as root
- Only pdb is included in Python, use it in restricted environments
- Use rpdb when connecting to stdin / stdout isn't possible
  - Where Python forks into the background, injects in another process etc.
  - Opens a socket, connect in with netcat

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Starting The Debugger

- Easiest is to set a “breakpoint”
  - The script will pause at this point for inspection
- `pdb.set_trace()`
  - rpdb, ipdb all have set_trace functions
- New `breakpoint()` built in function (Python 3.7+)
- Commands are intermixed with expressions
  - Prefix an expression with ! if it overlaps

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Basic Debugging Commands

- next – Run the next line of code, **stepping over functions** and then pause
- step – Run the next line of code, **stepping into functions** and then pause
- continue – Resume normal execution
- where – Print a stack trace

PyCharm Debugger

- Editor's Choice
- Community (Free) version available, includes the debugger
- Has some advanced features
  - Pause all threads vs just one
  - Conditional breakpoints
  - Watchpoints
  - Stores breakpoints across sessions

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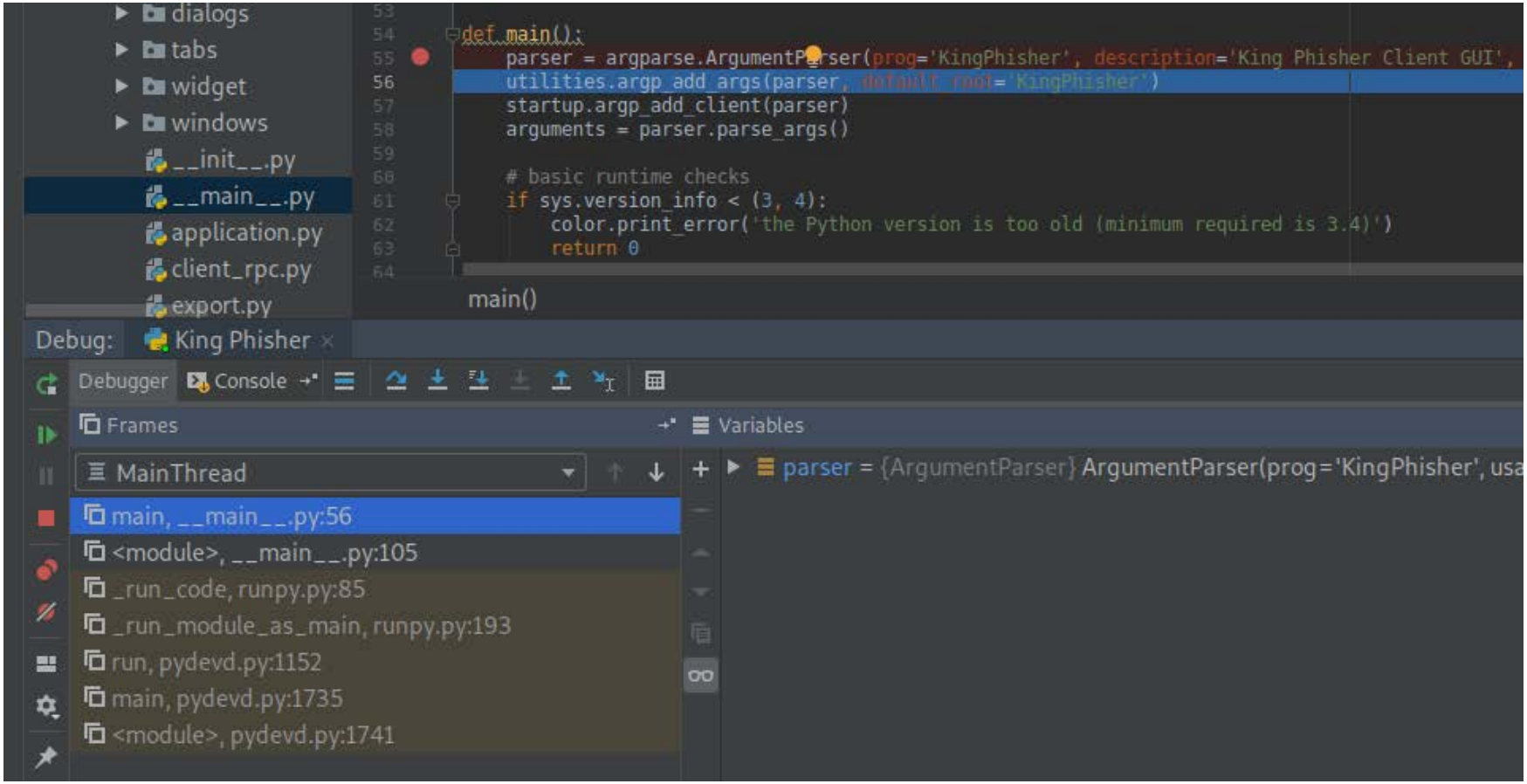

Stack Trace

- Each “frame” of the stack trace takes two lines
- First line is file and line number
- Second (indented) is the expression
- Lower frames are more recent
  - Last line is most often an exception
- Variable values are not included

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Stack Trace Example

```
Traceback (most recent call last):
  File "/home/saurus/king-phisher/king_phisher/client/application.py", line 488, in do_server_connected
    campaign = self.get_graphql_campaign() if campaign_id else None
  File "/home/saurus/king-phisher/king_phisher/client/application.py", line 371, in get_graphql_campaign
    campaign = self.rpc.graphql_find_file('get_campaign.graphql', id=campaign_id)
  File "/home/saurus/king-phisher/king_phisher/client/client_rpc.py", line 241, in graphql_find_file
    return self.graphql_file(path, query_vars=query_vars)
  File "/home/saurus/king-phisher/king_phisher/client/client_rpc.py", line 224, in graphql_file
    return self.graphql(query, query_vars=query_vars)
  File "/home/saurus/king-phisher/king_phisher/client/client_rpc.py", line 205, in graphql
    query_vars=query_vars
king_phisher.errors.KingPhisherGraphQLQueryError
```

Start Debugging

- Set a breakpoint on the line before the exception
  - In our example this would be client_rpc.py:204
- Inspect the values
  - If the code works “sometimes”, a value is probably not what you expect
  - If the code has never worked (you’re writing it) the usage is probably incorrect
    - Look up the documentation for what you’re using

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Common Exceptions

- TypeError – A value of an incompatible type was used e.g. using a string when an integer was expected
- KeyError – A key doesn't exist in a dictionary
  - `my_data['this does not exist']`
- AttributeError – A requested attribute doesn't exist
  - my_data.this_does_not_exist

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SCRIPT STRUCTURE

Script Structure

- Top of the file will be the comment splat
  - This usually includes the license information (BSD, GPL, MIT, etc.)
- Import statements
  - Pro-tip: group these by origin, for example native Python, current package, and third-party

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Script Structure

- Any values including constants
- Functions, classes, exceptions
- Finally if the file is a script utilize:
- `if __name__ == '__main__':`

  `main()`
- This allows the file to be executable and importable
  - The entry point is the `main()` function, so ensure it's defined

Script Structure

```python
#!/usr/bin/env python3
# -*- coding: utf-8 -*-
#
#  protocon
#
#  Redistribution and use in source and binary forms, with or without
#  modification, are permitted provided that the following conditions are
#  met:
#
#  * Redistributions of source code must retain the above copyright
#    notice, this list of conditions and the following disclaimer.
#  * Redistributions in binary form must reproduce the above
#    copyright notice, this list of conditions and the following disclaimer
#    in the documentation and/or other materials provided with the
#    distribution.
#  * Neither the name of the project nor the names of its
#    contributors may be used to endorse or promote products derived from
#    this software without specific prior written permission.
#
#  THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS
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#  LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR
#  A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT
#  OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL,
#  SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT
#  LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE,
#  DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY
#  THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT
#  (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE
#  OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.
#
```

```python
import argparse
import functools
import os
import sys

get_path = functools.partial(os.path.join, os.path.abspath(os.path.dirname(__file__)))
sys.path.append(get_path('lib'))

import protocon
```

```python
EPILOG = """\
target_url examples:
  null:
  serial:///dev/ttyUSB0?baudrate=9600&bytesize=8&parity=N&stopbits=1
  tcp://1.2.3.4:123
  tcp4://0.0.0.0:123/?type=server
  tcp6://[fe80::800:27ff:fe00:10]:4444/?ip6-scope-id=eth0
  udp://1.2.3.4:123
  udp4://1.2.3.4:123/?size=8192
"""
```

```python
def main():
        parser = argparse.ArgumentParser(description='protocon', conflict_handler='resolve', formatter_class=argpars
        parser.add_argument('-q', '--quiet', action='store_true', default=False, help='initialize quiet to True')
        parser.add_argument('-v', '--version', action='version', version='%(prog)s Version: ' + protocon.__version__
        parser.add_argument('target_url', help='the connection URL')
        parser.add_argument('scripts', metavar='script', nargs='*', help='the script to execute')
        parser.epilog = EPILOG
        arguments = parser.parse_args()

        try:
                engine = protocon.Engine.from_url(arguments.target_url)
        except protocon.ProtoconDriverError as error:
                protocon.print_error('Driver error: ' + error.message)
        else:
                engine.entry(arguments.scripts)
                engine.connection.close()
        return 0

if __name__ == '__main__':
        sys.exit(main())
```

- https://github.com/zeroSteiner/protocon/blob/master/protocon

Script vs Module vs Package

- Scripts and Modules are single files
  - Modules and packages are sometimes generically called “libraries”
- A module can also be a script
  - Scripts are executable from the command line
  - Modules are `import`-able
- A package is a directory with one or more modules
  - Must have a __init__.py file (can be empty)
  - Package can have sub-packages

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HTTP REQUESTS

Making HTTP Requests

- The painful way (using the builtin modules)
  - urllib.request
- The easier way: use requests
- Following example will show the same POST request
  - With a proxy
  - With parameters
  - Ignore self-signed SSL certificates

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Using urllib.request

- `params = urllib.parse.urlencode({'id': 123}).encode('utf-8')`
- `context = ssl.create_default_context()`
- `context.check_hostname = False`
- `context.verify_mode = ssl.CERT_NONE`
- `req = urllib.request.Request(url, params, context=context)`
- `req.set_proxy('localhost:8080', 'http')`
- `resp = urllib.request.urlopen(req)`
- `data = resp.read()`

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Using requests

- `requests.post(url, data={'id': 123}, verify=False)`

- But wait, where's the proxy?
  - It's in the `HTTP_PROXY` environment variable… where it belongs

Lab Time – Objective

- Build an HTTP bruteforcer / crawler
- Start with a URL and a wordlist
  - Check the URL for subpaths from the wordlist
  - For each page that is found, parse it for links
- Helps with enumeration for web applications
  - Tweak it targeted tasks (ie, looking for specific file types)
- Script is incomplete, complete the lines listed with todo

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Lab Time – Recap

- Anyone have any questions?
- Did anyone add any features or otherwise improve the script?

REGULAR EXPRESSIONS PRIMER

What are Regular Expressions

- Also abbreviated as regex
- A patter for matching text
- Not specific to Python
  - Any substantial language includes support
    - Perl, Ruby, C, Javascript, Powershell
  - Also command line tools like grep
  - Some have slight syntatic differences but are for the most part the same

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Regular Expressions

- Given the string: “Hello, my name is Spencer”
- To match regardless of name
  - “my name is \w+”
- The “my name is” portion is static
- The “\w+” portion is *one or more instances of the \w set*
  - \w is a shortcut for [a-zA-Z0-9_] and is functionally equivalent
  - The same regex could be “my name is [a-zA-Z0-0_]+”

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Character Sets

- Important part of regexs, provides the “fuzzy” matching
- Sets are enclosed in square brackets and can include ranges
  - All numbers: “[0-9]”
  - Only vowels: “[aeiou]”
  - Anything but letters: “[^a-z]”
    - The leading ^ implies “anything but this set”, this example would include numbers, whitespace and special characters

Common Character Sets

- \d – Decimal digits
- \s – Whitespace (spaces, tabs, newline etc.)
- \w – Word characters (alphanumeric and underscore)
- Any of these can be inverted by capitalizing their respective letter

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Repeating Characters

- \w matches “a” but to match “aa” use a range
- \w* – *zero or more instances of \w*
- \w+ – *one or more instances of \w*
- \w{3} – *exactly three instances of \w*
- \w{3,6} – *between three and six instances of \w*

Groups

- Useful for extracting text
- Enclose the pattern in parenthesis
  - “my name is (\w+)” will extract the name
- Python supports named groups, useful for large regexs
  - “my name is (?P<name>\w+)”

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Logical OR

- Use | (the pipe character)
- a|b – matches either a or b
- Example: “(hello|goodbye)\sSpencer”
  - Matches both:
    - “hello Spencer”
    - “goodbye Spencer”

Writing Regexs

- Online tools are helpful
  - https://www.debuggex.com
  - https://regexcrossword.com
- Use Python's "raw" strings (r prefix)
  - r"some(regex)"
  - Makes escaping easier

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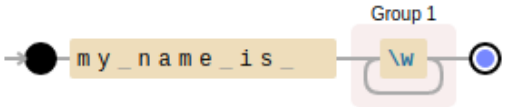
Debuggex.com

Untitled Regex No description

Embed on StackOverflow



Python

View Cheatsheet

Flags

```
1  my name is (\w+)
```

Result: **Does not match** starting at the black triangle slider

```
1  Hello, my name is Spencer
```

START

POSITION

Regex Module Primer

- Python provides the builtin re module
- Pro-tip: `re.compile` isn't necessary
  - All the main methods are cached automatically
- Regexs are great for parsing and searching text-based file, not binary

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Main Regex Methods

- `match()` vs `search()`
  - `match()` requires that the start of the string matches the regex
- Example:

```
re.match(r'Liddle', 'Alice Liddle') # =>
  failure

re.search(r'Liddle', 'Alice Liddle') # =>
  success
```

Regex Flags

- Flags modify the behavior of regexs
- Two most useful:
  - IGNORECASE / I
    - Match regexs while ignoring the case of alphabetic characters
  - MULTILINE / M
    - Changes ^ / $ to match the beginning and end of lines instead of the start and end of the string
- Combine flags with the bitwise OR
  - `flags=re.IGNORECASE | re.MULTILINE`

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Flag Example

- # case sensitive version does not match
- re.match(r’alice’, ‘Alice’) # => no match
- # case insensitive version does match
- re.match(r’alice’, ‘Alice’, flags=re.IGNORECASE)

Extracting Information

- Use Python's named groups
  - Allows the regex to be updated without breaking the group index
  - (?P<name>…)
- Example:

```
match = re.match(
    r'^\s+password:\s+(?P<password>\S+)$',
    '  password: supersecret'
)
match.group('password') # => 'super secret'
```

Additional Regex Methods

- `sub()`
  - Replace parts of a string with another string or a callback function
- `findall()`
  - Find all matches of a regex within a string
  - Don’t forget the `MULTILINE` flag

Regex Crosswords

Tutorial The OR symbol

A|B

A|Z A

Validate

Next puzzle coming up in 2 seconds

« 1 2 3 4 5 6 7 8 9 »

Home

Lab: Regex Crossword Puzzles

- https://regexcrossword.com/
- We'll spend 15 minutes here
- Solve as many as you can
- If you know regexs, start with the higher levels

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PARAMIKO PRIMER

Paramiko Overview

- Fully Python implementation of SSH
  - Includes a server and a client
  - Server implementation is much newer and has less documentation and examples
- Works best with OpenSSH, but can be used for network devices like Cisco IOS, etc.
- Supports running commands, SFTP, TCP forwarding, etc.

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Paramiko Connections

- Initialize the SSHClient instance (a lower-level Transport class is available as well)
- Set the missing host key policy
  - Technically optional, but necessary if connecting to new devices
- Connect and authenticate to the server

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Paramiko Connection Example

```
• # initialize the client
• ssh_client = paramiko.SSHClient()
• # define and add the policy
• policy = paramiko.AutoAddPolicy()
• ssh_client.set_missing_host_key_policy(policy)
• # connect and authenticate
• ssh.connect(target, port, username=username,

  password=password)
```

Executing Commands

- Use the exec_command method
  - Returns stdin, stdout, stderr streams
  - Being streams, these must be read
- Specify `get_pty=True`
  - Changes the execution behavior to more closely resemble running the command through a shell

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SSH Command Example

```
# this is a long line
stdin, stdout, stderr = \
ssh_client.exec_command('env', get_pty=with_pty)
# read from the stdout stream
data = stdout.read()
# decode the stream to a string
data = data.decode('utf-8')
```

Paramiko SFTP

- From a connected client, open an SFTP channel
  - This returns a new SFTP object
- Provides basic methods for
  - Opening files
  - Listing directories
  - Reading and changing permissions

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Paramiko SFTP Example

- `sftp = ssh_client.open_sftp()`
- `file_stat = sftp.stat('path/to/some/file')`
- `# use the stat module flags and file_stat.st_mode`
- `file_handle = sftp.open('path/to/some/file', 'r')`
- `# paramiko ignores the 'r' flag, always uses bytes`
- `data = file_handle.read()`
- `data = data.decode('utf-8')`

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Lab Time - Objective

- Write a script that will SSH into a Linux server, read a file and extract data using a regex
- Multiple file paths, and regexs are provided
- Again the script is incomplete

Lab Time – Recap

- Anyone have any questions?
- Did anyone add any features or otherwise improve the script?

Python in your toolset

Burp Extensions

- Requires the Jython .JAR file to run Python

```
from burp import IBurpExtender
```

https://laconicwolf.com/2018/04/13/burp-extension-python-tutorial/

Powershell Empire

- Powershell is in the name, but modules are written in Python
- https://github.com/EmpireProject/Empire

Immunity Debugger

- Python API
- https://www.corelan.be/index.php/2010/01/26/starting-to-write-immunity-debugger-pycommands-my-cheatsheet/

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Python is great!

- Mahatma Gandhi

THANK YOU FOR YOUR TIME AND ATTENTION

QUESTIONS AND ANSWERS

TEST YOUR KNOWLEDGE

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