SIGPwny

SP2025 Week 1 • 2025-1-30

Web Hacking III

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Announcements

2025-02-02 • This Sunday

- First seminar meeting!
- Come and discuss new and interesting topics in security!

2025-02-07 • Next Friday

- Our first CTF of the semester, LACTF!
- CTF starts at 10 pm CST.
- Many beginner friendly challenges available.

ctf.sigpwny.com

sigpwny{everything_is_unsafe}

Overview for Today

Command Injection

- Overview
- Example

Template Injection

- Overview
- Injection
- Example

Path Traversal

- Overview
- Example

SSRF

- Overview
- Example

Command Injection

Malicious user input modifies shell commands & arguments

Overview

- User input gets executed as a shell command!
- Example
  - Web application calls external scripts and passes in arguments
    - Very common, think of web tools that download videos off of YouTube.
  - Similar to SQL injections, user input could escape quoting and inject arbitrary commands!
  - Running multiple shell commands in one line with && or ;
    - `ls; cd /secret; cat flag.txt`
  - Bash tricks will take you far with these challenges.

Example

```
def cowsay():
 input = request.json.get('input', 'Give me some input')

 command = f'/usr/games/cowsay "{input}"'
 output = os.popen(command).read()

 return jsonify({
   'output': output
 })
```

Example

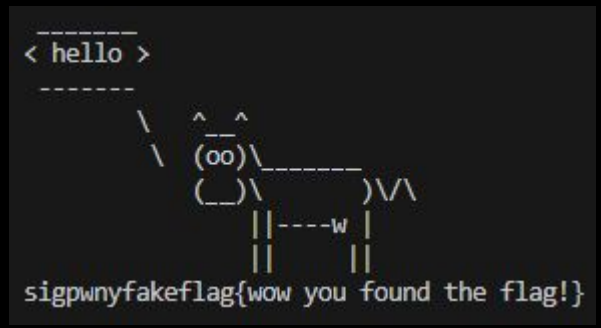
```
def cowsay():
 input = request.json.get('input', 'Give me some input')

 command = f'/usr/games/cowsay "{input}"'
 output = os.popen(command).read()

 return jsonify({
   'output': output
 })
```

input -> 'hello" && cat "flag.txt'

becomes /usr/games/cowsay "hello" && cat "flag.txt"



Template Injection

Malicious user injects server-side template syntax to execute code

Also known as Server-Side Template Injection (SSTI)

Overview: Templates

- Web templates are similar to static files, but they can incorporate variables & expressions
- Templates are "rendered" before being sent to the user!

```
<!DOCTYPE html>
<html lang="en">
<head>
 <title>{{ title }}</title>
</head>
<body>
 <h1>It’s {{ title }}!</h1>
</body>
</html>
```

```
render_template("index.html", title="Title!")
```

Overview: Typical Template Syntax

- Typical support for:
  - Statements (no output)
  - Expressions (prints output)
- Example: Python Flask + Jinja2
  - Statements with {% … %}
  - Expressions with {{ … }}
- {{ 7 * 7 }} → substituted with 49
- {{ request }} → substituted with the request object!

Injection: Exploiting Templates

- Example are for Jinja, but similar ideas apply to others
- Available variables include (source):
  - config (Flask configuration)
  - request (Flask request object)
- {{ config.items() }}
  - return all Flask config items (even keys!)
- {{ request.application.__globals__ }}
  - with some Python magic variables, we can access & run lots of Python functions

Example: Python Flask & Jinja

```
from flask import Flask, request, render_template_string


app = Flask(__name__)


@app.route('/')
def index():
    user = request.args.get('user', 'guest')
    my_template = "Stick around, " + user
    return render_template_string(my_template)
```

User input is injected into the template!

Example: Python Flask & Jinja

```
from flask import Flask, request, render_template_string


app = Flask(__name__)


@app.route('/')
def index():
    user = request.args.get('user', 'guest')
    my_template = "Stick around, {{ 1+1 }}"
    return render_template_string(my_template)
```

After string concatenation!

Example: Running Code

- Testing locally
- http://127.0.0.1:5000/?user={{ config.items() }}
  - Stick around, dict_items([('ENV', 'production'), ('DEBUG', False), ('TESTING', False), ('PROPAGATE_EXCEPTIONS', None), ('SECRET_KEY', 'NO_SO_SECRET_ANYMORE'), …])!
- Going further for arbitrary shell command execution…

{{request.application.__globals__.__builtins__.__import__('os').system('ls')}}

remember your pyjail training =)

Example: Running Code

- http://127.0.0.1:5000/?user={{ request.application.__globals__ }}
  - There are functions that can be used to run shell commands!

Stick around, {'__name__': 'werkzeug.wrappers.request', '__doc__': None, '__package__': 'werkzeug.wrappers', '__loader__': <_frozen_importlib_external.SourceFileLoader object at 0x105fe20b0>, '__spec__': ModuleSpec(name='werkzeug.wrappers.request', loader=<_frozen_importlib_external.SourceFileLoader object at 0x105fe20b0>, origin='/Users/louis/.pyenv/versions/3.10.8/lib/python3.10/site-packages/werkzeug/wrappers/request.py'), '__file__': '/Users/louis/.pyenv/versions/3.10.8/lib/python3.10/site-packages/werkzeug/wrappers/request.py', '__cached__': '/Users/louis/.pyenv/versions/3.10.8/lib/python3.10/site-packages/werkzeug/wrappers/__pycache__/request.cpython-310.pyc', '__builtins__': {'__name__': 'builtins', '__doc__': "Built-in functions, exceptions, and other objects.\n\nNoteworthy: None is the `nil' object; Ellipsis represents `...' in slices.", '__package__': '', '__loader__': <class '_frozen_importlib.BuiltinImporter'>, '__spec__': ModuleSpec(name='builtins', loader=<class '_frozen_importlib.BuiltinImporter'>, origin='built-in'), '__build_class__': <built-in function __build_class__>, '__import__': <built-in function __import__>, 'abs': <built-in function abs>, 'all': <built-in function all>, 'any': <built-in function any>, 'ascii': <built-in function ascii>, 'bin': <built-in function bin>, 'breakpoint': <built-in function breakpoint>, 'callable': <built-in function callable>, 'chr': <built-in function chr>, 'compile': <built-in function compile>, 'delattr': <built-in function delattr>, 'dir': <built-in function dir>, 'divmod': <built-in function divmod>, 'eval': <built-in function eval>, 'exec': <built-in function exec>, 'format': <built-in function format>, 'getattr': <built-in function getattr>, 'globals': <built-in function globals>, 'hasattr': <built-in function hasattr>, 'hash': <built-in function hash>, 'hex': <built-in function hex>, 'id': <built-in function id>, 'input': <built-in function input>, 'isinstance': <built-in function isinstance>, 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'ZeroDivisionError': <class 'ZeroDivisionError'>, 'SystemError': <class 'SystemError'>, 'ReferenceError': <class 'ReferenceError'>, 'MemoryError': <class 'MemoryError'>, 'BufferError': <class 'BufferError'>, 'Warning': <class 'Warning'>, 'UserWarning': <class 'UserWarning'>, 'EncodingWarning': <class 'EncodingWarning'>, 'DeprecationWarning': <class 'DeprecationWarning'>, 'PendingDeprecationWarning': <class 'PendingDeprecationWarning'>, 'SyntaxWarning': <class 'SyntaxWarning'>, 'RuntimeWarning': <class 'RuntimeWarning'>, 'FutureWarning': <class 'FutureWarning'>, 'ImportWarning': <class 'ImportWarning'>, 'UnicodeWarning': <class 'UnicodeWarning'>, 'BytesWarning': <class 'BytesWarning'>, 'ResourceWarning': <class 'ResourceWarning'>, 'ConnectionError': <class 'ConnectionError'>, 'BlockingIOError': <class 'BlockingIOError'>, 'BrokenPipeError': <class 'BrokenPipeError'>, 'ChildProcessError': <class 'ChildProcessError'>, 'ConnectionAbortedError': <class 'ConnectionAbortedError'>, 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All Rights Reserved. Copyright (c) 2000 BeOpen.com. All Rights Reserved. Copyright (c) 1995-2001 Corporation for National Research Initiatives. All Rights Reserved. Copyright (c) 1991-1995 Stichting Mathematisch Centrum, Amsterdam. All Rights Reserved., 'credits': Thanks to CWI, CNRI, BeOpen.com, Zope Corporation and a cast of thousands for supporting Python development. See www.python.org for more information., 'license': Type license() to see the full license text, 'help': Type help() for interactive help, or help(object) for help about object.}, 'functools': <module 'functools' from '/Users/louis/.pyenv/versions/3.10.8/lib/python3.10/functools.py'>, 'json': <module 'json' from '/Users/louis/.pyenv/versions/3.10.8/lib/python3.10/json/__init__.py'>, 'typing': <module 'typing' from '/Users/louis/.pyenv/versions/3.10.8/lib/python3.10/typing.py'>, 't': <module 'typing' from '/Users/louis/.pyenv/versions/3.10.8/lib/python3.10/typing.py'>, 'BytesIO': <class '_io.BytesIO'>, '_wsgi_decoding_dance': <function _wsgi_decoding_dance at 0x105ea3be0>, 'CombinedMultiDict': <class 'werkzeug.datastructures.CombinedMultiDict'>, 'EnvironHeaders': <class 'werkzeug.datastructures.EnvironHeaders'>, 'FileStorage': <class 'werkzeug.datastructures.FileStorage'>, 'ImmutableMultiDict': <class 'werkzeug.datastructures.ImmutableMultiDict'>, 'iter_multi_items': <function iter_multi_items at 0x105f465f0>, 'MultiDict': <class 'werkzeug.datastructures.MultiDict'>, 'default_stream_factory': <function default_stream_factory at 0x105ff9240>, 'FormDataParser': <class 'werkzeug.formparser.FormDataParser'>, '_SansIORequest': <class 'werkzeug.sansio.request.Request'>, 'cached_property': <class 'werkzeug.utils.cached_property'>, 'environ_property': <class 'werkzeug.utils.environ_property'>, '_get_server': <function _get_server at 0x105fda680>, 'get_input_stream': <function get_input_stream at 0x105fda830>, 'BadRequest': <class 'werkzeug.exceptions.BadRequest'>, 'Request': <class 'werkzeug.wrappers.request.Request'>}!

Path Traversal

Malicious user uses ../ and absolute paths to access arbitrary files

Overview: UNIX Paths

- Absolute paths
  - `/usr/bin/share`
- Relative paths
  - `./build/bin/main`

- Current directory (`.`)
- Parent directory (`..`)
  - `/home/sigpwny/../../secret_files/flag.txt` refers to `/secret_files/flag.txt`

Example: Python Path Traversal

```
import os
from flask import Flask, request
app = Flask(__name__)

@app.route('/')
def index():
    file_name = request.args.get('file', 'default.txt')
    file_path = os.path.join('/my_lovely_images, file_name)
    with open(file_path, 'r') as f:
        return f.read()
```

localhost/?file=../etc/passwd

Read about the behavior of `os.path.join`!

Server Side Request Forgery (SSRF)

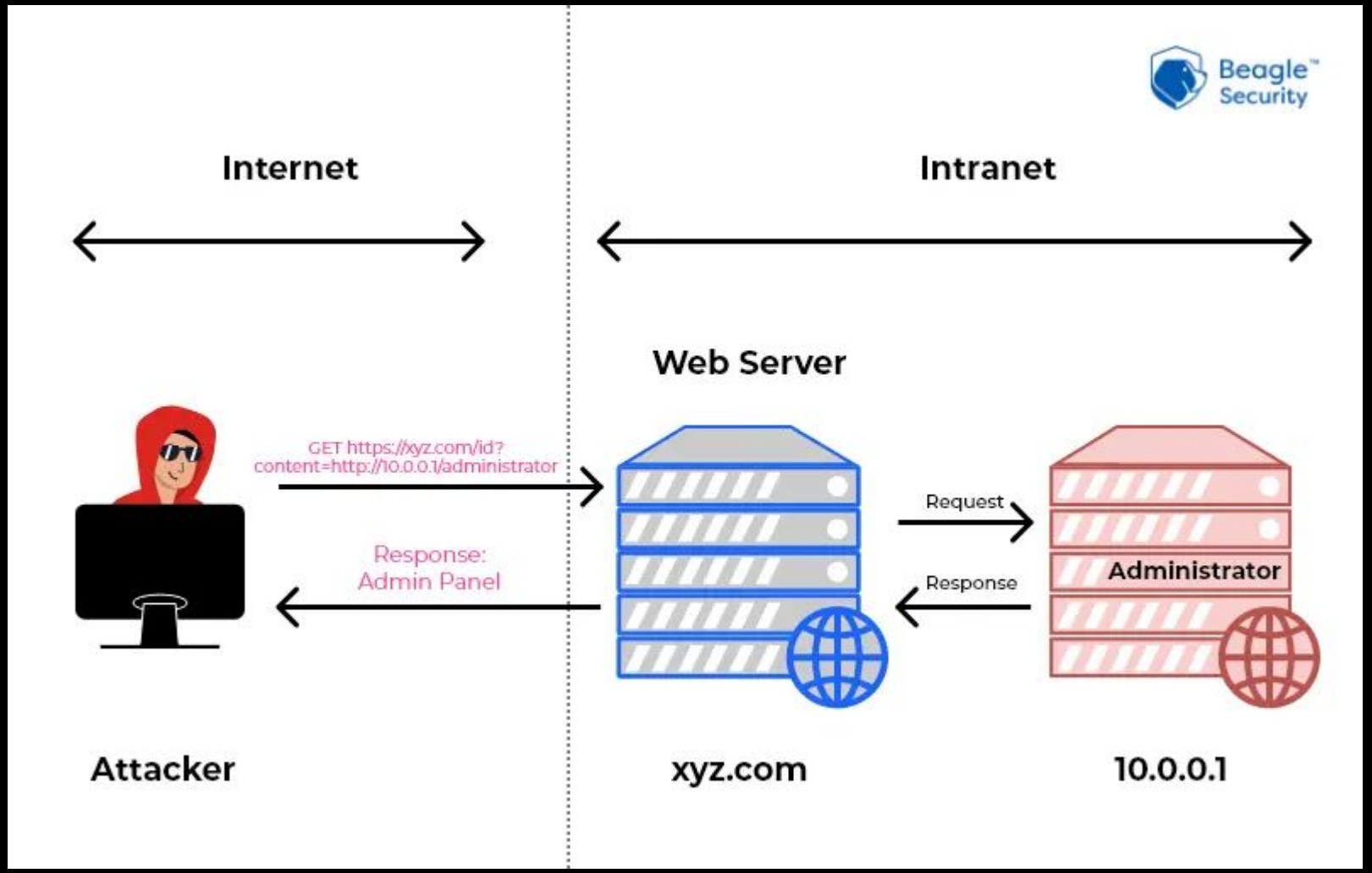
Accessing private resources using the server

Overview: SSRF Idea

- Server returns the data from internal/external services that are meant to be impossible for the end user to directly access.

- Places to look:
  - HTML to PDF/image renderers
  - Link preview generators
  - Webhooks
  - External resource imports
  - Referer headers

Overview: Vulnerable Network



Overview: Exploiting SSRF

- Internal port scanning
- Network enumeration
- Local File Inclusion— using the file:/// protocol
- Cloud instance metadata services
  - Many cloud services provide a REST interface where config details and auth keys can be exposed.
  - AWS: http://169.254.169.254/latest/meta-data
- Database HTTP interfaces

Example: SSRF with Python Flask

```python
@app.route('/fetch')
def get_files():
    url = request.args.get('url')
    return requests.get(url).text
```

Example: SSRF with Python Flask

```python
@app.route('/fetch')
def get_files():
    url = request.args.get('url')
    return requests.get(url).text
```

```
/fetch?url=http://10.0.0.2/flag
```

Extension: Blind SSRF

- SSRF without being able to read the response

- Do we have:
  - Response codes?
  - Response time?
  - Error messages?

Next Meetings

2025-02-02 • **This Sunday**

- First seminar meeting!
- Come and discuss new and interesting topics in security!

Practice

https://ctf.sigpwny.com

- Command Injection
  - Cowsay As A Service, Word Counter III (requires you to solve Word Counter I first), Shiny Button, tux.tv
- Path Traversal
  - Budget Dalle
- Template Injection
  - Meme Machine (hard!) — see this article if you get stuck
- SSRF
  - SSRF challenges

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Meeting content can be found at sigpwny.com/meetings.

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