Malicious Behavior Detection Using Audit Logs

Beta Release

Team ID: 19

Project ID: CS_Egcert3_2023

Presented by :

Safaa Sarhan	300389876
Esraa Mahmoud	300389401
Salma Hasanin	300389877

Safaa Sarhan - 300389876

Project Mentor
Dr. Ahmed Hamdy

Project Sponsor:
EGCERT company

Ottawa support:
Dr. Miguel Garzon

Problem definition

Increasing Cybersecurity Threats

Insufficient Detection Mechanisms

Challenges in Manual Analysis of logs

Safaa Sarhan - 300389876

Users and Benefits

01 detect anomalies in user activity.

02 Improved threat detection and incident response

03 Reduced risk of successful attacks

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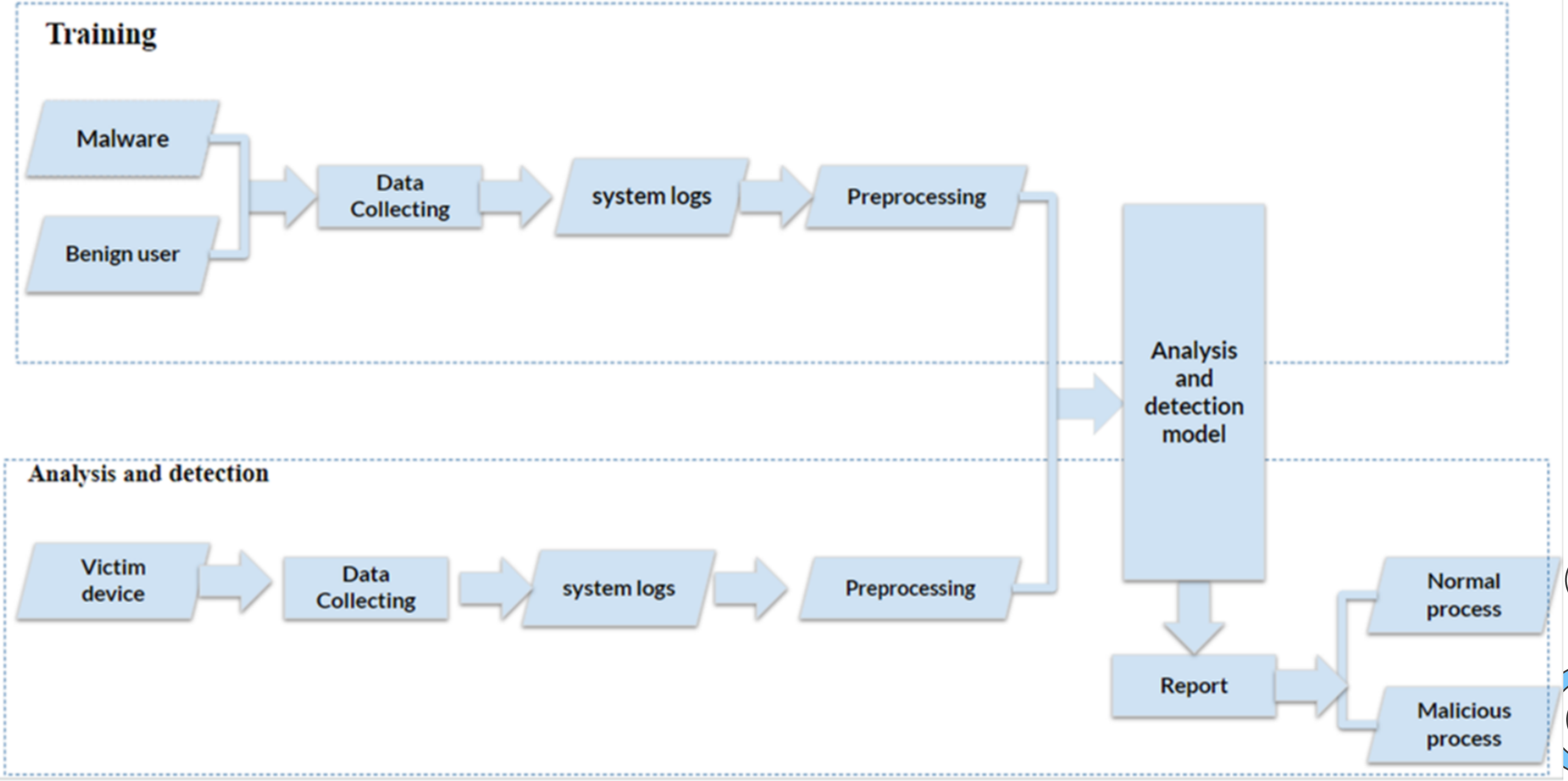
The proposed log analysis and detection method



Our Demo

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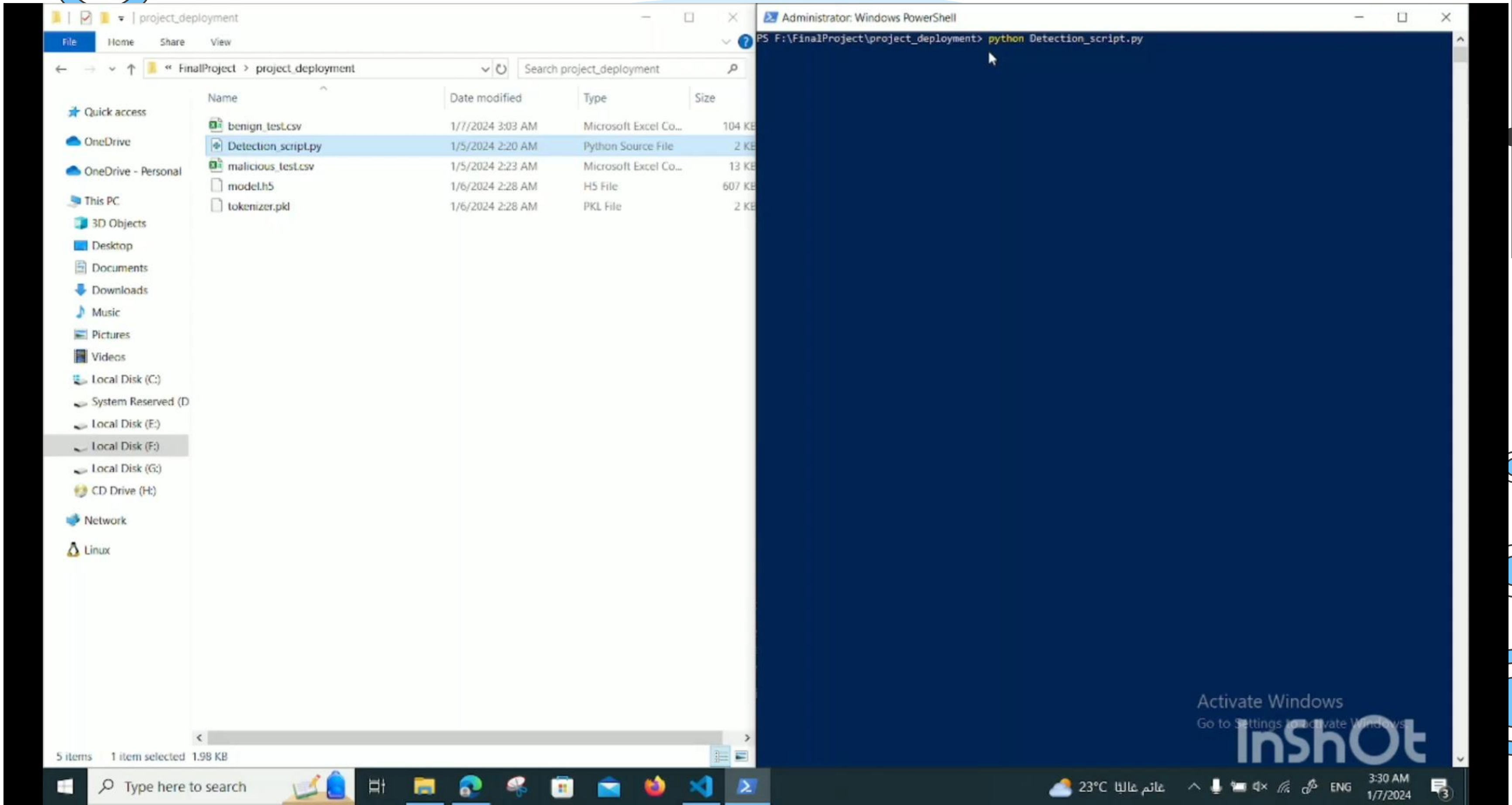

Name	Date modified	Type	Size
benign_test.csv	1/7/2024 3:03 AM	Microsoft Excel Co...	104 KB
Detection_script.py	1/5/2024 2:20 AM	Python Source File	2 KB
malicious_test.csv	1/5/2024 2:23 AM	Microsoft Excel Co...	13 KB
model.h5	1/6/2024 2:28 AM	H5 File	607 KB
tokenizer.pkl	1/6/2024 2:28 AM	PKL File	2 KB

5 items 1 item selected 1.98 KB

```
PS F:\FinalProject\project_deployment> python Detection_script.py
```

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01

Data collection

Why sysmon?

enable collection of detailed information : various system events, processes, network connections..etc.

benign data : collected from our daily used devices

malicious data *: Simulated almost 300 attacks from MITER ATT&CK matrix on a VM*

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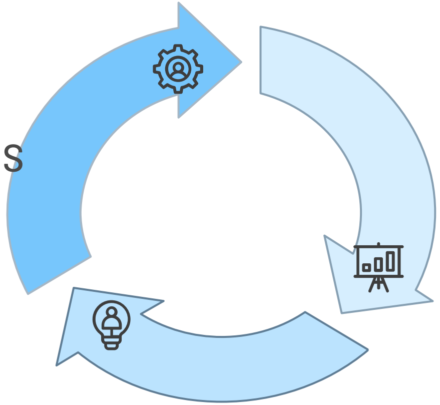
Malicious logs



Simulate attack
Using atomic red teams

Collect logs
as XML files using sysmon tool

Return to the VM fresh snapshot
To prevent log overlapping from previous attack

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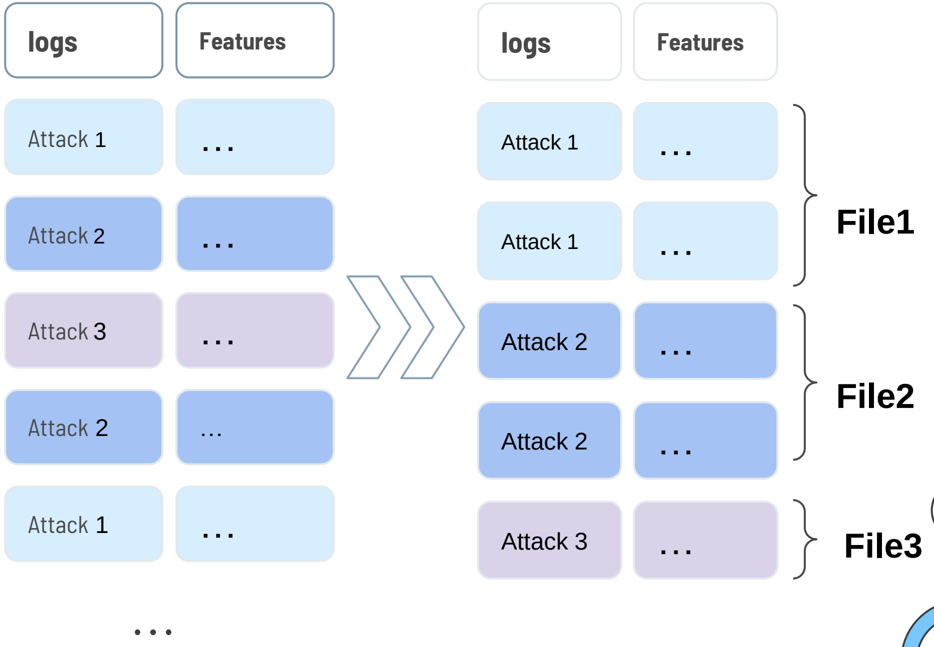
Why this cycle
and not simulate all attacks in one VM?

Why..?

analyse pattern behaviour

Some attacks generate logs after a while

it can interface with the logs of the next attack



logs	Features
Attack 1	...
Attack 2	...
Attack 3	...
Attack 2	...
Attack 1	...

...

logs	Features	
Attack 1	...	File1
Attack 1	...	
Attack 2	...	File2
Attack 2	...	
Attack 3	...	File3

Esraa Mahmoud - 300389401

02

Data preprocessing

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How to process the data for anomaly detection?

specific sequence of benign logs

≠

1 normal log

the analysis will be done by collection not one log “Pattern analysis”

logs	Features
Benign 1	…
Benign 2	…
Benign 3	…
Benign 4	…

Malicious

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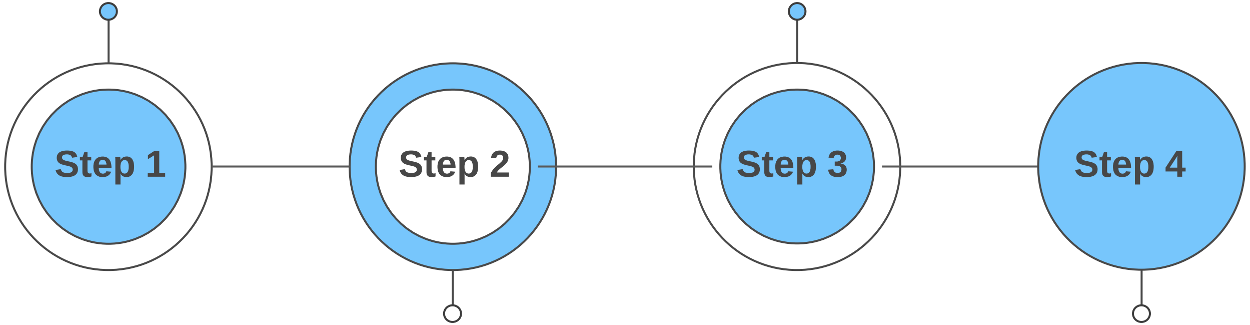
Our Process



Step 1

data cleaning

Step 2

Select most important features to use

Step 3

Combine each log features in one column

Step 4

Combine the logs of each file in one row

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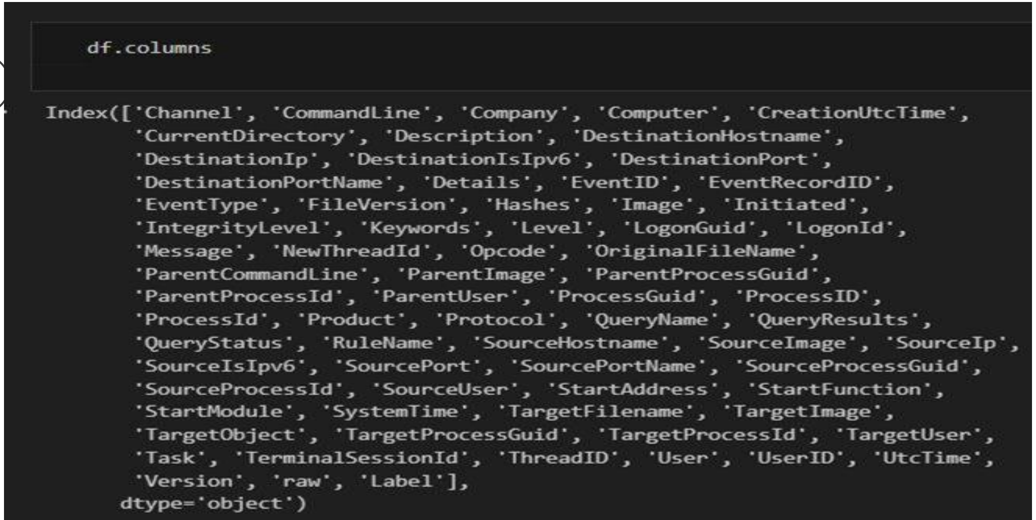
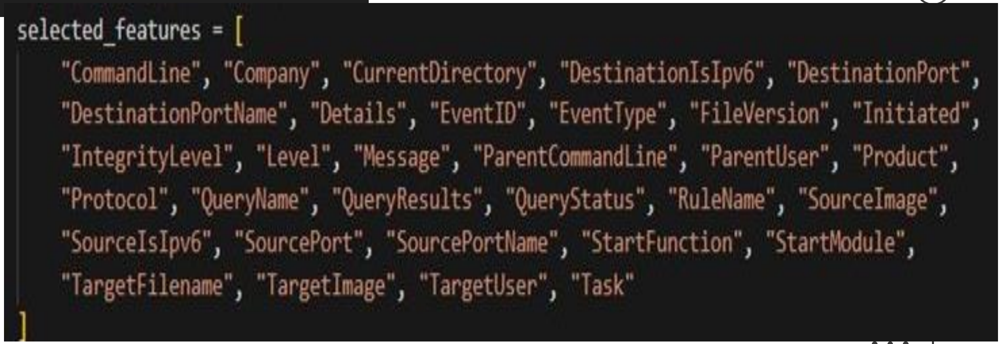
Selected features



```
df.columns
```

```
Index(['Channel', 'CommandLine', 'Company', 'Computer', 'CreationUtcTime',
       'CurrentDirectory', 'Description', 'DestinationHostname',
       'DestinationIp', 'DestinationIsIpv6', 'DestinationPort',
       'DestinationPortName', 'Details', 'EventID', 'EventRecordID',
       'EventType', 'FileVersion', 'Hashes', 'Image', 'Initiated',
       'IntegrityLevel', 'Keywords', 'Level', 'LogonGuid', 'LogonId',
       'Message', 'NewThreadId', 'Opcode', 'OriginalFileName',
       'ParentCommandLine', 'ParentImage', 'ParentProcessGuid',
       'ParentProcessId', 'ParentUser', 'ProcessGuid', 'ProcessID',
       'ProcessId', 'Product', 'Protocol', 'QueryName', 'QueryResults',
       'QueryStatus', 'RuleName', 'SourceHostname', 'SourceImage', 'SourceIp',
       'SourceIsIpv6', 'SourcePort', 'SourcePortName', 'SourceProcessGuid',
       'SourceProcessId', 'SourceUser', 'StartAddress', 'StartFunction',
       'StartModule', 'SystemTime', 'TargetFilename', 'TargetImage',
       'TargetObject', 'TargetProcessGuid', 'TargetProcessId', 'TargetUser',
       'Task', 'TerminalSessionId', 'ThreadID', 'User', 'UserID', 'UtcTime',
       'Version', 'raw', 'Label'],
      dtype='object')
```



```
selected_features = [
    "CommandLine", "Company", "CurrentDirectory", "DestinationIsIpv6", "DestinationPort",
    "DestinationPortName", "Details", "EventID", "EventType", "FileVersion", "Initiated",
    "IntegrityLevel", "Level", "Message", "ParentCommandLine", "ParentUser", "Product",
    "Protocol", "QueryName", "QueryResults", "QueryStatus", "RuleName", "SourceImage",
    "SourceIsIpv6", "SourcePort", "SourcePortName", "StartFunction", "StartModule",
    "TargetFilename", "TargetImage", "TargetUser", "Task"
]
```

Esraa Mahmoud - 300389401

03

Analysis and detection model

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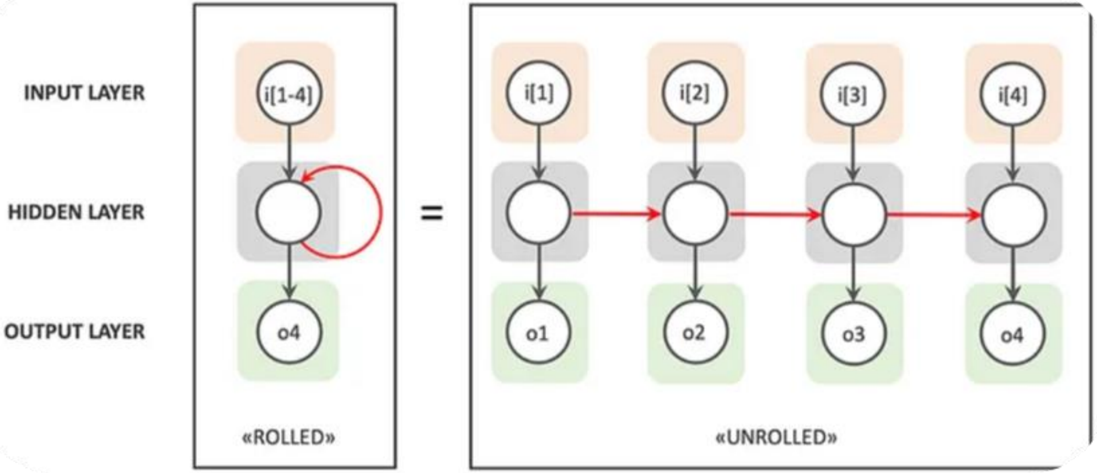
RNN Model

Recurrent Neural Networks model (RNN)

designed to process sequential data

takes some specific input and returns output (Many to one)

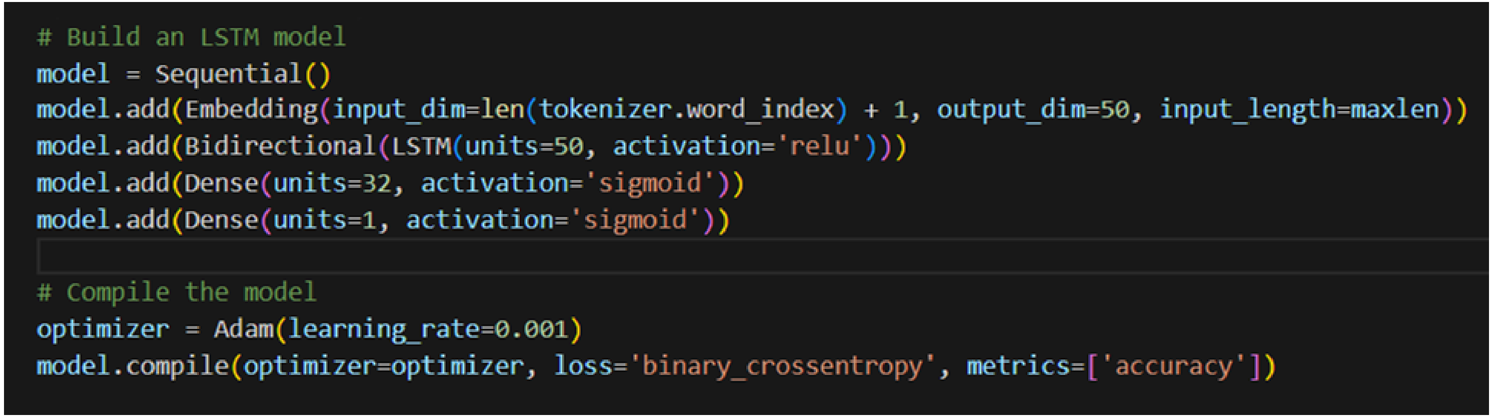


libraries: Pandas, NumPy and TensorFlow.

Building the RNN Model:

Contains of :

1. embedding layer
2. bidirectional LSTM layer
3. 2 dense layers with a 'sigmoid' activation function



```
# Build an LSTM model
model = Sequential()
model.add(Embedding(input_dim=len(tokenizer.word_index) + 1, output_dim=50, input_length=maxlen))
model.add(Bidirectional(LSTM(units=50, activation='relu')))
model.add(Dense(units=32, activation='sigmoid'))
model.add(Dense(units=1, activation='sigmoid'))


# Compile the model
optimizer = Adam(learning_rate=0.001)
model.compile(optimizer=optimizer, loss='binary_crossentropy', metrics=['accuracy'])
```

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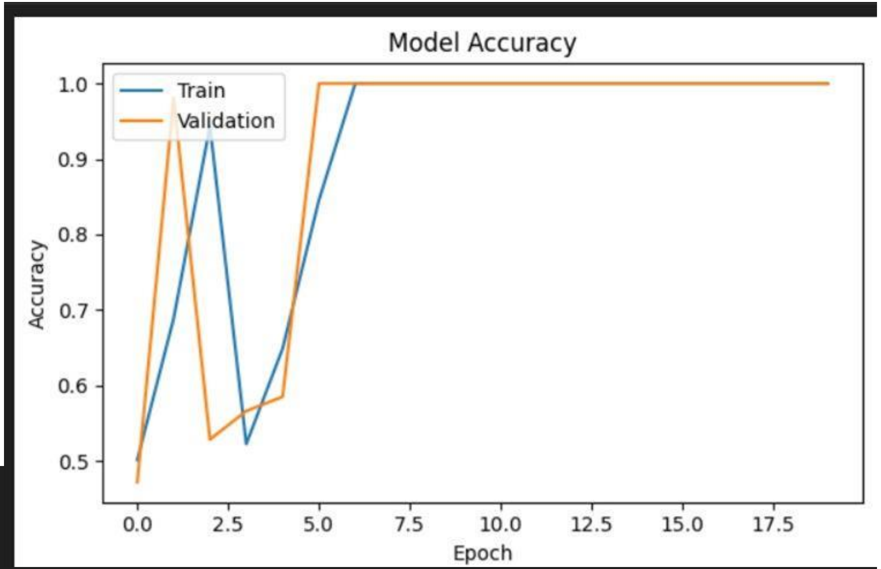
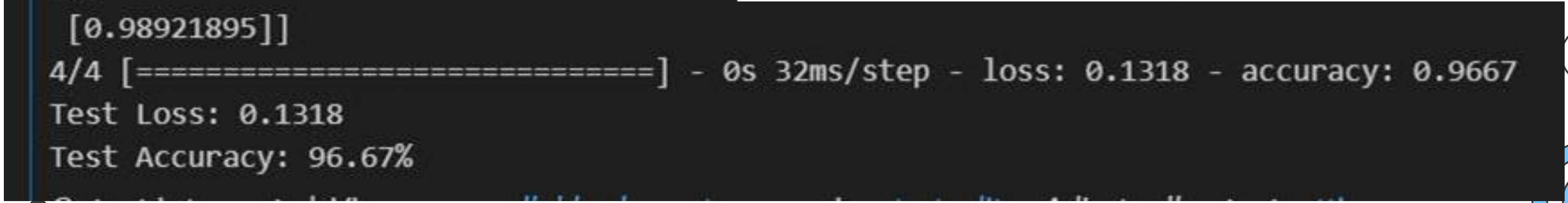
Model accuracy

In each iteration:

validation and accuracy are monitored to check for overfitting and model's performance.





```
 [0.98921895]
...
 [0.98921895]]
4/4 [==============================] - 0s 32ms/step - loss: 0.1318 - accuracy: 0.9667
Test Loss: 0.1318
Test Accuracy: 96.67%
```

Salma Hasanin - 300389877

04

Deployment

Deployment Plan

01

Extract the XML log

The end-user able to use windows sysmon logs , or a one query log at a time.

02

Anomaly Detection

The end-user can query for anomaly in any of those two files.

Salma Hasanin - 300389877

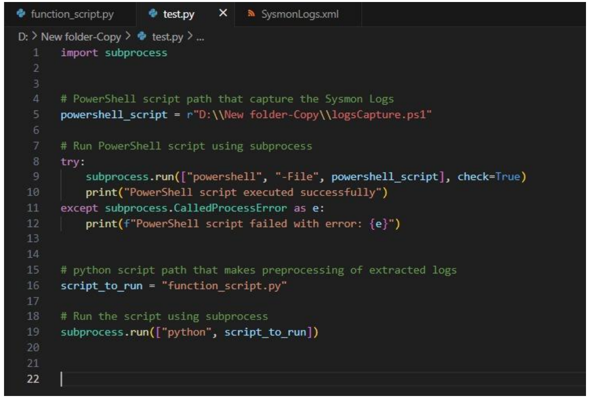
Deployment Plan

1

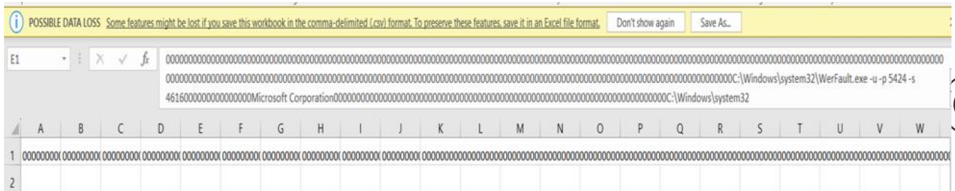
Since **XML** logs requires a lot of effort to be processed, in our deployment we configure a one united script to deals with more than XML format .

The united script

Final shape of data



```python
import subprocess


# PowerShell script path that capture the Sysmon Logs
powershell_script = r"D:\\New folder-Copy\\logsCapture.ps1"

# Run PowerShell script using subprocess
try:
    subprocess.run(["powershell", "-File", powershell_script], check=True)
    print("PowerShell script executed successfully")
except subprocess.CalledProcessError as e:
    print(f"PowerShell script failed with error: {e}")


# python script path that makes preprocessing of extracted logs
script_to_run = "function_script.py"

# Run the script using subprocess
subprocess.run(["python", script_to_run])


```



Some features might be lost if you save this workbook in the comma-delimited (.csv) format. To preserve these features, save it in an Excel file format.

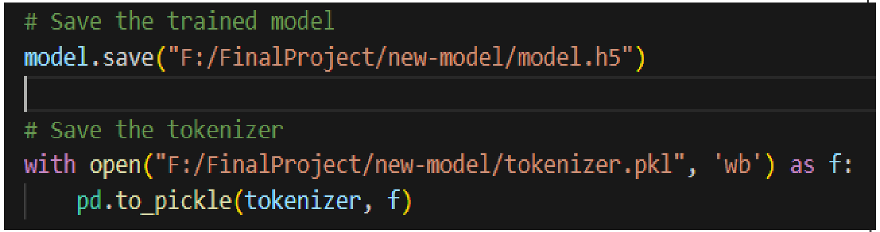
```
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000C:\Windows\system32\WerFault.exe -u -p 5424 -s
4616000000000000000Microsoft Corporation0000000000000000000000000000000000000000000000000000000000000C:\Windows\system32
```

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	00000000(	00000000(	00000000(	00000000(	00000000(	00000000(	00000000(	00000000(	00000000(	00000000(	0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000												
2																							

Salma Hasanin - 300389877

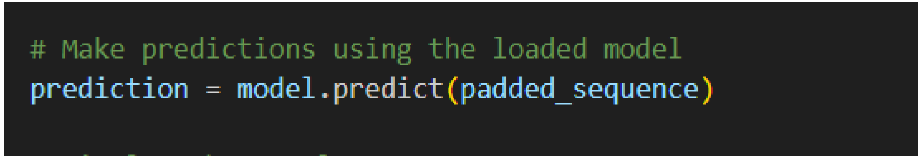
Deployment Plan

1 We saved the model in a pickle file



```
# Save the trained model
model.save("F:/FinalProject/new-model/model.h5")

# Save the tokenizer
with open("F:/FinalProject/new-model/tokenizer.pkl", 'wb') as f:
    pd.to_pickle(tokenizer, f)
```

2 Feeding the model with the final shape of data to be predicted .



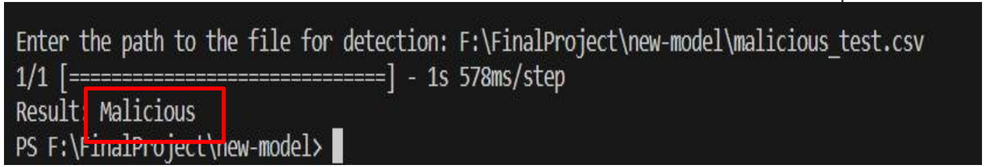
```
# Make predictions using the loaded model
prediction = model.predict(padded_sequence)
```

Salma Hasanin - 300389877

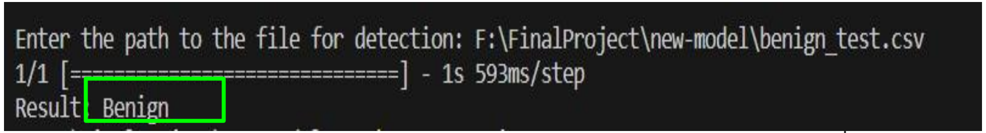
Deployment Plan

3

test a new log file -> “malicious” or “benign”



```
Enter the path to the file for detection: F:\FinalProject\new-model\malicious_test.csv
1/1 [==============================] - 1s 578ms/step
Result: Malicious
PS F:\FinalProject\new-model> 
```



```
Enter the path to the file for detection: F:\FinalProject\new-model\benign_test.csv
1/1 [==============================] - 1s 593ms/step
Result: Benign
```

4

CMD interface enable end-users / security Analysts to test logs from their environments with minimal installation effort , and from only one script.

Salma Hasanin - 300389877

Future Work

1 **Generate reports and dashboards to provide insights into the overall security posture.**

2 **Improve the model with more threats types**

Thanks!

Do you have any questions?