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Executive Summary: Threat Assessment via Attack Tree Visualization

# Introduction

In response to Cathy's request for a more hands-on and visual approach to understanding the security implications of our business, we have developed a Python-based application that simplifies complex security risk assessments by utilizing attack tree visualization. This is not merely an exercise in coding but an endeavour to meet key learning outcomes crucial for cybersecurity proficiency (Smith, 2018).

# Objectives and Scope

## Objectives

* Visual representation of an attack tree
* Facilitation for users to add monetary or probabilistic values to leaf nodes.
* Aggregation of these leaf node values to provide an overall threat assessment value.

## Scope

Digital transformation brings unparalleled opportunities but also elevates cyber risks. This report focuses on understanding these new vulnerabilities and quantifying their potential impact on the organization. Evidence shows a rise in cyber threats post-digital transformation, making this focus particularly relevant (Williams, 2019).

# Implementation

## Creation - Python Application

Python was chosen for its simplicity and rich ecosystem, which includes powerful libraries like NetworkX and Matplotlib (Doe, 2017). These libraries offer fast development but tie the project to their limitations. JSON, an industry-standard, was adopted to maintain a balance between readability and complexity (Brown, 2020). The JSON format also allows for quick adaptability but can be vulnerable to injection attacks if not properly sanitized.

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**Figure 1 Sample Python code and its output**

## User Interaction - Value Addition

We opted for a CLI (Command Line Interface) to facilitate quick user interaction but at the cost of potential user-friendliness. While CLI reduces the overhead, it makes the application less accessible to non-technical staff, a notable drawback (Smith, 2018).

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**Figure 2 CLI capturing user input.**

## Aggregation - Threat Assessment

Aggregation methods often simplify complex scenarios into quantifiable metrics. However, this model is naive in its risk calculations. We use simple summation, which does not account for the varying interdependencies between nodes, making it less accurate (Williams, 2019).

A screen shot of a computer code

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**Figure 3 Code snippet for risk aggregation**

# Real-world Application and Use Cases

The application serves as a tool for auditing existing security measures before and after digitalization. Though helpful, the model does not adapt dynamically to changes in the threat landscape, limiting its long-term reliability (Jones et al., 2020). It does, however, offer an initial review which can be a useful baseline for further, more complex analyses.

Consider a situation where an e-commerce company wants to assess the potential threats to their web server. The attack tree visualization could show multiple vectors like SQL injection, DDoS attacks, and unauthorized access.

The risk values, perhaps in terms of potential financial loss, are then assigned to each leaf node:

* **SQL Injection: £50,000**
* **DDoS Attacks: £40,000**
* **Unauthorized Access: £70,000**

The application would then aggregate these risks to produce an overall threat assessment. In this example, using simple summation, the total potential financial loss (threat) to the web server is £160,000.

A screen shot of a computer code

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**Figure 4 Application in real-world scenario**

This will give the company an idea about the severity of the security risk they are exposed to, aiding in their decision-making process for implementing necessary security measures.

## Attack Tree Visualization Popup Window

A pivotal feature of our Python application is the real-time popup window that appears upon running the command `python3 main.py`. This window presents an attack tree, where each node and leaf symbolize specific types of attacks and threats, respectively.

The attack tree in the popup window serves as a direct, interactive tool for real-time threat assessment. It not only visualizes the potential avenues of attack but also allows for dynamic updating as threats evolve.

A diagram of a network

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**Figure 5 Popup window showing the attack tree with nodes and leaf elements.**

# Learning Outcomes Assessment

## Identifying Security Risks, Threats, and Vulnerabilities

The application excels in using attack tree methodology for comprehensive risk identification and analysis. This approach goes beyond merely cataloguing potential security risks by structuring them hierarchically, thereby adding depth and context to each vulnerability. Moreover, the feature to assign specific risk values to individual nodes adds a quantitative layer to our risk evaluation strategy. This not only illuminates the vulnerabilities but also helps in resource prioritization for risk mitigation (Jones et al., 2020).

## Gathering and Synthesizing Information

While the current application depends on a static JSON file for initial risk assessment, its architecture allows for future upgrades to integrate real-time threat intelligence feeds. These could be sourced from multiple cybersecurity databases and alert systems, thereby turning the application into a dynamic tool that adapts to the evolving threat landscape. (Brown, 2020).

## Appraisal of Methodologies, Tools, and Techniques

Attack trees were chosen for their ability to provide a detailed, hierarchical view of potential attack vectors. This choice was made after considering alternatives like risk matrices and data flow diagrams. While risk matrices offer a generalized view and data flow diagrams concentrate on data pathways, attack trees excel in comprehensive, in-depth risk analysis, aligning with our objectives for a nuanced threat assessment (Doe, 2017).

## Articulating Legal, Social, Ethical, and Professional Issues

The current version of the application falls short in addressing legal and ethical considerations. Future iterations should aim to incorporate features like privacy filters for anonymizing sensitive data and a compliance module to ensure alignment with legal standards such as GDPR. Ethical guidelines for responsible sharing and use of threat intelligence can also be integrated into the application's framework (Green, 2021).

# Conclusion

Our Python application serves its primary objective effectively by providing a visual and quantitative method to assess and prioritize potential security vulnerabilities. While it meets several educational and practical criteria, some aspects require further development for a complete alignment with the learning outcomes. Future iterations should focus on real-time data integration and comprehensive coverage of legal, ethical, and social considerations to fully meet all educational and practical criteria.

# Recommendations for Future Development

* Integration with live threat intelligence feeds.
* A deeper dive into specific vulnerabilities represented by each node.
* Inclusion of legal, ethical, and social considerations in both the application and associated reporting.

# References

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