Multi-Purpose AI Password Analysis Tool

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Final Approval

This is to certify that we have read the report submitted by ***Osama Khalid 27971, Sardar Muhammad Zeeshan Khan 27969, Salman Ali 27667***, for the partial fulfillment of the requirements for the degree of the Bachelors of Science in Cyber Security (BSCY). It is our judgment that this report is of sufficient standard to warrant its acceptance by Riphah International University, Islamabad for the degree of Bachelors of Science in Cyber Security (BSCY).

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Declaration

We hereby declare that this document **"Multi-Purpose AI Password Analysis Tool"** neither as a whole nor as a part has been copied out from any source. It is further declared that we have done this project with the accompanying report entirely on the basis of our personal efforts, under the proficient guidance of our teachers, especially our supervisor **Mr. Osamah Ahmad.** If any part of the system is proved to be copied out from any source or found to be reproduction of any project from anywhere else, we shall stand by the consequences.

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Dedication

This project is dedicated to our friends, mentors, and educators, whose unwavering support and encouragement have been a constant source of strength throughout this journey. Their belief in our capabilities has fueled our determination to succeed. Additionally, we dedicate this work to our colleagues and the academic community, whose guidance and knowledge have been instrumental in shaping our professional growth. Their commitment to excellence has inspired us to push the boundaries of our potential. Thank you for being our pillars of support and for always believing in us.

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Abstract

In an increasingly digitized world, the security of personal and organizational data is paramount. This project presents a comprehensive solution in the form of a multi-purpose AI-driven password analysis tool. By harnessing the power of artificial intelligence, this tool offers dual functionality, serving both offensive and defensive purposes.

On the offensive front, it employs advanced algorithms to analyze and crack passwords, providing insights into their vulnerabilities and potential points of exploitation. This capability enables security professionals to understand the weaknesses inherent in various password configurations, thereby facilitating the development of more robust defense strategies.

Simultaneously, the tool acts as a guardian on the defensive front, evaluating the strength of passwords and identifying potential breaches through sophisticated pattern recognition and analysis. By proactively identifying compromised credentials, it empowers users to take preemptive action, mitigating the risks associated with data breaches and unauthorized access.

Through its intuitive interface and customizable features, this AI-powered tool becomes an indispensable asset for individuals and organizations seeking to fortify their digital security posture. By enabling users to test the resilience of their passwords and stay ahead of emerging threats, it serves as a proactive safeguard in an ever-evolving cybersecurity landscape.

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Chapter 1: Introduction

Project Title: Multi-Purpose AI Password Analysis Tool

1.1 Introduction

In today's world, where everything is becoming digital and online threats are on the rise, having strong password security is crucial. That's where the AI Multipurpose Password Analysis Tool comes in. It's a game-changing software that's here to revolutionize how we manage passwords. By combining cutting-edge artificial intelligence with traditional password analysis tools, this tool offers a complete solution for keeping our digital accounts safe. Whether it's cracking passwords or assessing password's strength, this tool covers multiple aspects of password security. And it doesn't stop there - it seamlessly works with popular tools like Hashcat, making it even more powerful. So, as we step into the future of password management, the AI Multipurpose Password Analysis Tool is leading the way, providing both analysis and cracking abilities to protect our sensitive information from the ever-evolving threats online.

1.2 Opportunity & Stakeholders

The key opportunities and primary stakeholders associated with this project are outlined as follows:

1.2.1 Opportunities

- **Enhanced Security Assessments:** Businesses and individuals can leverage the tool for penetration testing and vulnerability assessments, identifying potential weaknesses in their password security policies and practices.
- **AI-driven Offensive and Defensive Capabilities:** Utilizing AI for both offensive (password cracking) and defensive (password strength assessment) purposes provides a comprehensive approach to password security management.

1.2.2 Stakeholders

- **Businesses:** Companies aim to improve their overall cybersecurity posture by identifying and mitigating password-related vulnerabilities.
- **Security Professionals:** Penetration testers and security consultants who can use the tool for vulnerability assessments and ethical hacking activities.
- **Law Enforcement:** Agencies might leverage the tool for lawful investigations adhering to court orders and legal guidelines.

1.3 Motivation and Challenges

Outlined below are the motivations and challenges associated with our AI-driven password analysis tool.

1.3.1 Motivation

In the digital age, robust password security is more critical than ever. The need for an advanced, AI-driven password analysis tool arises from several key motivations.

1.3.1.1 Increasing Complexity of Passwords:

- As cyber threats evolve, users are encouraged to create more complex passwords to enhance security. However, the complexity often leads to users adopting predictable patterns, which can be exploited.
- Our tool aims to address this by leveraging AI to recognize and exploit these patterns, thereby improving both offensive and defensive security measures.

1.3.1.2 Advancements in AI and Machine Learning:

- The development of sophisticated AI algorithms offers new possibilities for password analysis and cracking. By integrating AI, our tool can stay ahead of traditional methods, providing more efficient and effective solutions.
- Utilizing state-of-the-art AI techniques ensures that our tool can handle the increasing complexity and diversity of modern passwords.

1.3.1.3 Comprehensive Security Assessments:

- Businesses and security professionals need comprehensive tools that can provide both offensive and defensive capabilities. By integrating password strength analysis with AI-driven password cracking, our tool offers a holistic approach to password security.
- This dual functionality supports thorough security assessments, identifying vulnerabilities and testing the robustness of password policies.

1.3.1.4 Growing Number of Data Breaches:

- The frequency and scale of data breaches are increasing, exposing millions of passwords. Our tool can analyze these breaches to understand common patterns and weaknesses, enhancing its cracking capabilities and providing insights into better password practices.
- By incorporating breach-checking features, our tool can alert users if their passwords have been compromised, enabling proactive security measures.

1.3.1.5 Enhancing Cybersecurity Awareness:

- Educating users about the importance of strong passwords and the risks of weak ones is crucial. Our tool can demonstrate the ease with which weak passwords can be cracked, promoting better password practices.
- Security professionals can use our tool to raise awareness and provide tangible evidence of the need for robust password policies.

1.3.2 Challenges

1.3.2.1 Data Collection and Quality:

- Obtaining a diverse and representative dataset of passwords is crucial for training the AI model. However, ethical and legal considerations must be adhered to when sourcing data from online leaks and breaches.
- Ensuring the dataset is comprehensive and free from sensitive or personally identifiable information requires rigorous data cleaning and preprocessing.

1.3.2.2 Balancing Offensive and Defensive Capabilities:

- Integrating both offensive (password cracking) and defensive (password strength analysis) functionalities in a single tool presents a significant challenge. The tool must be designed to operate ethically, with proper authorization and adherence to legal guidelines.
- Ensuring that the tool's offensive capabilities do not compromise its defensive functionalities, and vice versa, requires careful design and implementation.

1.3.2.3 Adapting to Evolving Password Practices:

- Password patterns and user behaviors are continuously evolving. Traditional methods often struggle to keep up with these changes, and our AI-driven approach must be flexible and adaptive to remain effective.
- Continuous updates and retraining of the AI model are necessary to handle new password trends and behaviors.

1.3.2.4 Efficiency and Scalability

- As passwords become more complex, traditional brute-force methods become impractical due to their time and resource-intensive nature. Our AI-powered tool must significantly reduce the search space and improve efficiency.
- Ensuring that the tool can scale effectively to handle large datasets and complex passwords without compromising performance is a critical challenge.

1.3.2.5 Security and Privacy Concerns:

- Implementing features such as breach checking involves integrating with online databases, which must be done securely to prevent exposure to sensitive information.
- Ensuring that the tool itself is secure and does not become a vector for attacks is paramount. This includes safeguarding against misuse by malicious actors.

1.4 Goals and Objectives

1.4.1 Goals

- Enhance Password Security
- Efficient Password Cracking
- Advanced Password Strength Analysis
- Comprehensive Vulnerability Assessments

1.4.2 Objectives

- Focus cracking efforts on statistically probable password patterns.
- Analyze password strength based on complexity metrics and AI-driven pattern recognition.
- Reduced cracking time.
- Improved vulnerability assessment.

1.5 Solution Overview

Our proposed AI-powered tool enhances password security by leveraging advanced algorithms and human-like password data. It focuses on both offensive and defensive capabilities:

1.5.1 Focused Cracking Efforts: Utilizes AI to identify statistically probable password patterns, reducing the search space and accelerating the cracking process compared to traditional brute-force methods.

1.5.2 Password Strength Analysis: Employs AI-driven pattern recognition and complexity metrics to analyze and identify weaknesses in complex passwords, aiding in targeted cracking attempts.

1.5.3 Reduced Cracking Time: Enhances efficiency by concentrating on likely password patterns, significantly reducing the time required for cracking.

1.5.4 Improved Vulnerability Assessment: Provides comprehensive assessments of password vulnerabilities, helping to identify and address weak points proactively.

1.5.5 Scope of the Project

- **Defensive capabilities:**

Password strength assessment: Analyze password complexity, identify dictionary words, and check for patterns using AI.

Optional

- **Breach checking:** Integrate with online databases to verify if entered passwords and email addresses have been exposed in known data breaches.

- **Offensive capabilities: (For Ethical purposes only)**

  AI-powered password cracking: Utilize correlation of password data and advanced algorithms to efficiently crack passwords within a specified scope and with proper authorization.

1.6 Report Outline

The project report for the "Multi-Purpose AI Password Analysis Tool" begins with an introduction, providing a comprehensive background on password security and the impetus for developing this tool. It identifies key opportunities and stakeholders who will benefit from enhanced password analysis. The report then reviews existing password analysis tools such as John the Ripper, Brutus, and Wfuzz, highlighting their limitations and setting the context for the problem statement and proposed solution. Our proposed solution leverages AI to focus on statistically probable password patterns and complexity metrics, aiming to reduce cracking time and improve vulnerability assessment. The objectives and scope of the project are clearly defined, emphasizing defensive capabilities like password strength assessment and breach checking, as well as ethical offensive capabilities like AI-powered password cracking. The evaluation plan outlines a comprehensive assessment using diverse datasets from real-world breaches, password dictionaries, and synthetic data. The development and training section details the process of acquiring and preparing relevant datasets, training and optimizing the AI model, and selecting appropriate algorithms. Implementation focuses on core functionalities for password strength analysis and breach checking, with optional automated password cracking. The report also discusses the design and development of a user-friendly interface, ensuring seamless integration with the AI model and functionalities. Thorough testing and refinement processes are

documented to ensure the tool's effectiveness and usability. Finally, the report includes references and a list of figures to support the content and provide visual clarity.

Chapter 2:

Market Review

Chapter 2: Market Review

2.1 Background

2.2 Market Review / Technologies Overview

2.3 Summary

Chapter 2: Market Review

2.1 Background

Traditional password cracking tools have relied on brute force techniques or precomputed dictionaries to decipher passwords. While these methods have been effective to some extent, they suffer from several limitations and challenges.

1. **Limited Efficiency**: Brute force attacks iterate through all possible combinations of characters, making them time-consuming and resource-intensive, especially for complex passwords.
2. **Dependence on Dictionaries**: Dictionary attacks rely on precompiled lists of commonly used passwords or words found in dictionaries. However, these lists may not encompass all possible variations, especially when users employ complex or unique passwords.
3. **Lack of Adaptability**: Traditional tools often struggle with adaptive password generation techniques, such as adding special characters or changing letter cases, making them less effective against modern password practices.
4. **Inability to Detect Breached Credentials**: Many password cracking tools do not have built-in mechanisms to cross-reference passwords with known breaches, leaving users unaware if their passwords have already been compromised.
5. **Scalability Issues**: As passwords become longer and more complex to enhance security, traditional methods face scalability challenges in terms of processing power and memory requirements.

2.2 Market Review / Technologies Overview

The foundation of password security lies in its ability to resist unauthorized access, primarily achieved through encryption and hashing techniques. Over the years, several tools and methodologies have been developed to analyze and crack passwords, each with its unique strengths and weaknesses.

Existing Systems

The following are the Existing systems that exist in the market for about more than a decade.

John the Ripper

Limitations:

1. Relies on traditional methods of password cracking such as dictionary attacks, brute-force attacks, and rainbow tables.
2. While powerful, it may not effectively adapt to evolving password patterns and behaviors without continuous updates and modifications.

Problems:

1. Lack of advanced AI integration for targeted password list generation based on learned patterns.
2. Limited defensive capabilities in analyzing password strength beyond basic dictionary checks.

Brutus

Limitations:

1. Primarily designed for online password cracking through network protocols like HTTP, FTP, SMB, etc.
2. May lack advanced AI-driven capabilities for generating targeted password lists.

Problems:

1. Limited applicability for offline password analysis and cracking scenarios.
2. May not integrate well with the defensive aspects of the proposed tool, such as analyzing password strength and checking for breached credentials.

Wfuzz

Limitations:

1. Primarily focuses on web application security testing, including fuzzing and brute-forcing directories and files.
2. May lack specialized features for password cracking and analysis.

Problems:

1. Not specifically tailored for password analysis and cracking tasks, thus requiring significant adaptation to fit into the proposed project's scope.
2. Limited or no integration with AI-driven password analysis and cracking techniques.

Comparison

Tool	John the Ripper	RainbowCrack	OphCrack
Type	Password Cracker	Password Cracker	Password Cracker
Supported Platforms	Windows, Linux, macOS	Windows, Linux	Windows, Linux
Password Hashes Supported	Various (Unix, Windows, etc.)	LM, NTLM, MD5, SHA1, SHA256, SHA512	LM, NTLM
Attack Methods	Dictionary, Brute Force, Hybrid	Precomputed Hash Tables	Rainbow Tables, Brute Force
Speed	Fast	Depends on Rainbow Table size	Moderate
User Interface	Command Line	Command Line	GUI
License	Open Source	Freeware	Open Source
Usage	Penetration Testing, Password Auditing	Password Cracking	Password Recovery

Figure 1.1

Tool	L0phtCrack	Aircrack-ng
Type	Password Cracker	Wi-Fi Network Security Tool
Supported Platforms	Windows	Linux, macOS
Password Hashes Supported	LM, NTLM	WEP, WPA, WPA2
Attack Methods	Dictionary, Brute Force	Dictionary, Brute Force, WPS PIN
Speed	Fast	Depends on hardware and complexity of the password
User Interface	GUI	Command Line
License	Commercial	Open Source
Usage	Password Cracking	Wi-Fi Network Security Testi

Comparison Table 1.2

2.3 Summary

The evolution of password security technologies reflects the ongoing battle between cybersecurity professionals and cybercriminals. Traditional tools like John the Ripper, Brutus, and Wfuzz continue to play crucial roles in password cracking and security testing. However, the advent of AI and machine learning has ushered in a new era of password security, offering more efficient and effective methods for analyzing and cracking passwords.

The integration of human-like passwords data with advanced algorithms represents a significant leap forward, enabling more targeted and successful password cracking attempts. This literature review underscores the need for continuous innovation in password security, highlighting the potential of AI-powered tools to enhance our defenses against evolving cyber threats.

By understanding the strengths and limitations of existing tools and technologies, this review sets the stage for the development of a comprehensive AI-powered password analysis tool. Such a tool aims to address the current gaps in password security, providing a more robust and reliable means of protecting sensitive data in an increasingly digital world.

Chapter 3:
Requirement Engineering

Chapter 3: Requirement Engineering

3.1 Introduction

3.2 Problem Scenarios

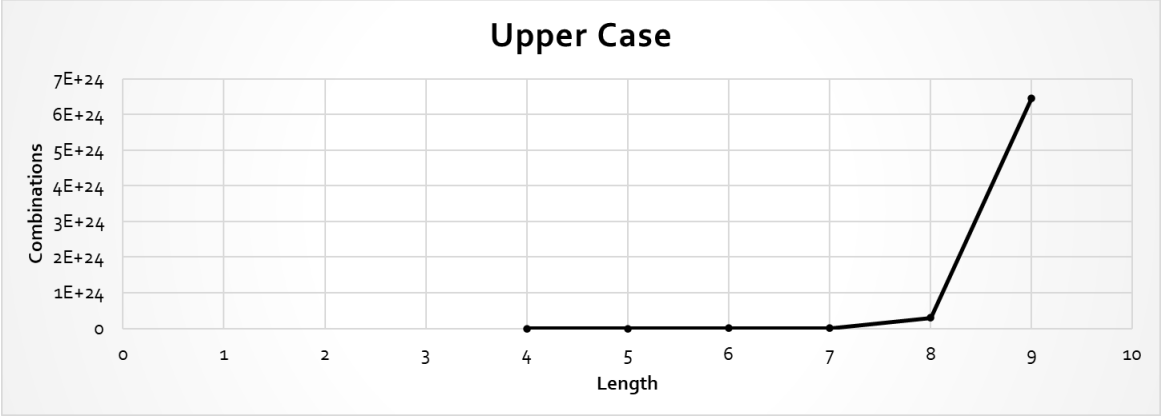
Chapter 3: Requirement Engineering

3.1 Introduction

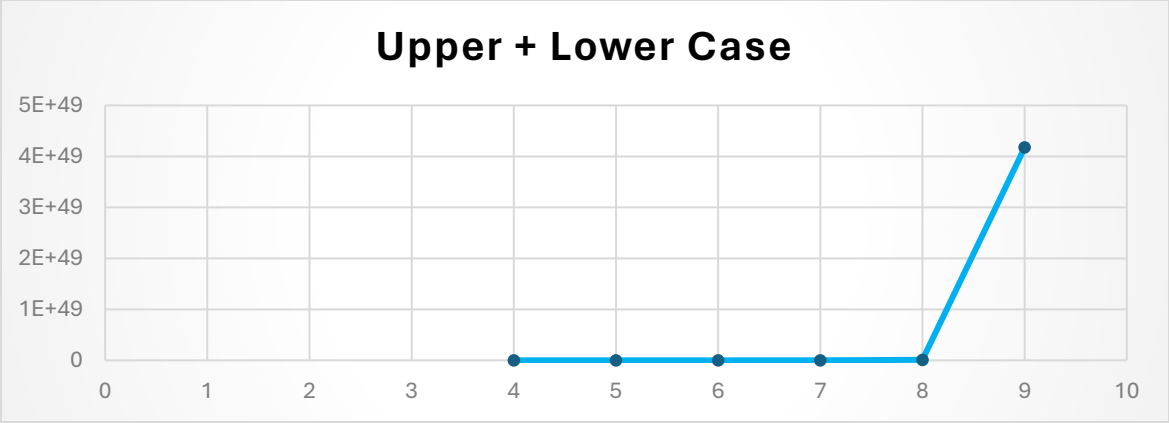
Requirement engineering is a critical phase in the development of our Multi-purpose AI Analysis Tool, focusing on systematically capturing, analyzing, and managing both functional and non-functional requirements. This process ensures that our AI tool aligns with the needs of stakeholders, addressing specific objectives such as password strength analysis, breach checking, and AI-powered password cracking. By meticulously defining these requirements, we can mitigate risks associated with miscommunication and evolving needs, ultimately leading to a robust, efficient, and user-centric AI solution. This foundational step is essential for guiding the development process and ensuring the successful delivery of a high-quality product.

3.2 Problem Scenarios

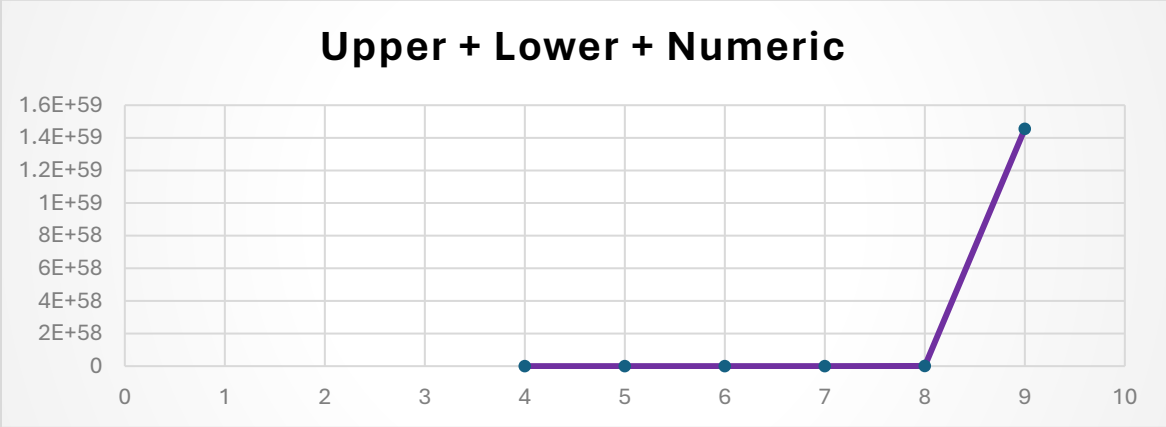
With increasing password complexity requirements, brute-force attacks become significantly slower and less efficient.



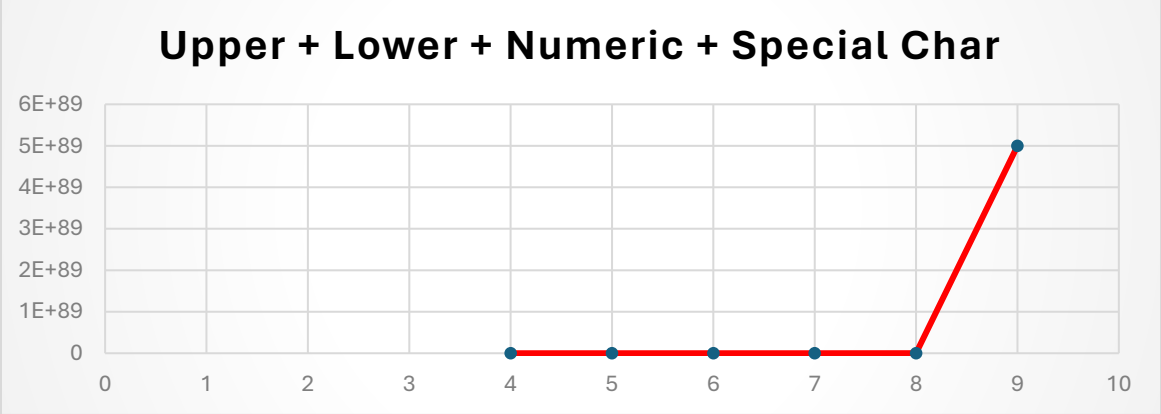
Upper Case Graph 1.1



Upper- and Lower-Case Graph 1.2



1 Upper, Lower and Numeric Graph 1.3



Upper, Lower, Numeric and Special Char Graph 1.4

Users often employ longer and more complex passwords (e.g., 8+ characters, combination of uppercase, lowercase, symbols) making traditional brute-force methods impractical.

Length	Combination
4^{26+26}	22204460492503130808472633361816406 25
$4^{26+26+10}$	212676479325586539664609129644855132 16
5^{26+26}	290981259887315061831530256164353065615 36
$5^{26+26+10}$	216840434497100886801490560173988342285156 25

Password Combination Table 1.2

Length	Upper Case	Upper + Lower Case	Upper + Lower + Numeric	Upper + Lower + Numeric + Special Char
4	4.5036E+15	2.02824E+31	2.12676E+37	3.92319E+56
5	1.49012E+18	2.22045E+36	2.1684E+43	5.04871E+65
6	1.70582E+20	2.90981E+40	1.75945E+48	1.40029E+73
7	9.38748E+21	8.81248E+43	2.48931E+52	2.74926E+79
8	3.02231E+23	9.13439E+46	9.80797E+55	7.77068E+84
9	6.46108E+24	4.17456E+49	1.45558E+59	4.998E+89

Password Combination Table 1.2

Chapter 4:
System Design

Chapter 4: System Design

4.1 Introduction

4.2 Research and select Appropriate AI Algorithm

4.3 Acquiring / Preparing relevant password datasets for training

4.4 Evaluation Plan

Chapter 4: System Design

4.1 Introduction

Chapter 5:
Testing and Refinement

Chapter 5: Testing and Refinement

1.1 Conduct thorough testing of all functionalities with various password scenarios.

2.1 Refine the AI model, user interface, and functionalities based on testing results.

3.1 Document user manuals and instructions for the completed tool.

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