Crakd Showcase

Crakd is a learning environment, teaching complete beginners the basics of Python, C++, Linux and Ethical Hacking.

Combining the skills of 4 Ethical Hackers and 2 Computer Scientists, our cross-course knowledge enabled us to create a learning environment that is unique, innovative and educational.

The Crakd environment is split into three main elements: the Virtual Machine, the Tasks and the Blockchain.

Virtual Machine

The Virtual Machine (VM) is the heart of the Crakd learning environment. Linux based, it can be run on any virtualisation software.

Providing a robust and secure platform, users can complete tasks as they see fit, with no fear.

Uniquely identified by its VM Hash, the task progress of a specific VM can be loaded onto a new VM by simply providing the Hash.

Unfortunately, due to time constraints, we were unable to design bespoke Crakd VM Hashes. Hence, we identify VMs via asking a user to name them.

Automated Processes subject users to less repetition, enabling them to focus on learning and prevent fatigue. The main Automated Processes are:

- Task Checking
- Task Configuration
- Task Switching

Open Sourcing the VM and its contents enables other developers to create their own learning environment, bespoke to their needs.

Crakd has been extensively documented, hopefully making adoption of its tools a seamless exercise.

The Tasks

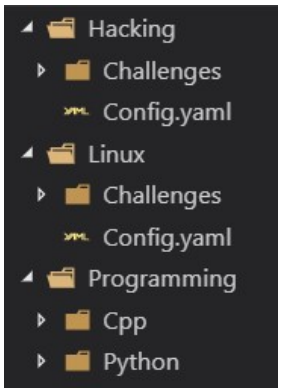
Initialised by the Virtual Machine on start-up, the Tasks are automatically configured and initialised by the VM's configuration parser into Learning Pathways.

Learning Pathways are a collection of related tasks, ranging in difficulty and complexity.

Our Pathways provide a well-rounded introduction, to Ethical Hacking, Programming and Linux CLI.

The tasks begin with simple challenges and as users advance, challenges will become more complicated, requiring more thought.

Below are Crakd's learning pathways, as highlighted above.



Upon completion of the task, users will be rewarded with a flag, these flags can be turned into the Front-end Website to save their progress.

Complete with an array of hints and tips, users should not have to use the Internet to solve tasks.

Blockchain

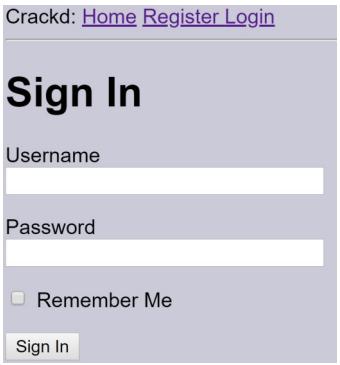
A distributed, immutable database, the Blockchain is a future-oriented solution to data storage.

Storing data in the form of "blocks" simultaneously across all servers currently connected to the network, it completely negates the risk of data loss.

Immutability of data within the Blockchain prevents task skipping, hence, users cannot falsify progress.

A Website, the front-end of the Crakd environment, allows users to submit their tasks and save their progress to the Blockchain through a User Interface.

Due to time constraints, the Front-end website is functional, but has no User Interface design and does not automatically connect with the VMs.



Though not currently implemented, a leader board system was proposed. Aiming to give users a sense of competition, they can pit themselves against all of Crakd's userbase.

Personal Contribution

Leading the team whilst developing both the Blockchain and Front-end website has enabled me to hone a wide variety of skills.

Project Management

Nominated into leading the project, I strived to efficiently organise development time, enabling each team member to work to their full potential.

Matching individuals to their strengths helped to greatly accelerate project development.

Completed by:	Harry	Joe
04/03/2019	User Blockchain	Linux Basics
	Connect BC w/ VM	Linux Basics Config
	Front-end Website	Linux Adv. Config
18/03/2019	Connect BC w/ website	Program PenFramework
	Integreation testing	Program PenFramework
25/03/2019	Testing, final implementation and presentation pr	
01/04/2019	Final Week write up	

Using a spreadsheet to keep track of member's tasks proved better than using a Gantt chart, which some group members struggled to understand.

I was responsible for organising weekly meetings and setting goals bespoke to each group member on a regular basis.

Leading the team has greatly developed my leadership, planning and inter-personal communication skills.

Blockchain

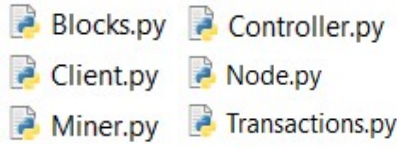
I was also responsible for developing the Blockchain, for use as an immutable, decentralised database.

Capable of storing a user's Virtual Machine Hashes and tasks it can be accessed even in event of a Front-end website failure.

Developed in Python3, due to its vast array of libraries and Duck typing, the Blockchain was developed over the course of six weeks forming the majority of my project contribution.

The Blockchain includes a Proof of Work algorithm and Miner; Transaction manager complete with a Binary (Merkel) Tree and a Remote Protocol Call (RPC) server.

Nodes are designed as RESTful servers and are capable of functioning independently, or within a distributed network.



Developing competence in the following skills:

- Object Oriented Programming
- Algorithmic thinking
- Distributed networking
- Version Control Management
- Application of hash functions
- RESTful API Development

I feel I have successfully delivered upon my task and am very proud of my work.

Front-end Website

Alongside the Blockchain, I was responsible for creating the functional side of a website.

Complete with a user login system and task submission page. The website took three weeks and concluded my contribution to the project

Hosted via Python's Flask framework, I was able to efficiently create functionality for the website.

Studying Cybersecurity, I wished to prevent some common web-based vulnerabilities. These can be seen below:

Developing the Website has helped me apply my theoretical knowledge to a real-world scenario.

This has aided my confidence when discussing website security protections and evaluating other sites for such vulnerabilities.

Cross Site Scripting

I decided to use Flask-WTForms to protect from XSS attacks, it automatically encodes special characters into their HTML entity-encoded format, preventing malicious code execution.

Hello, <script>alert();</script>!

Cross Site Request Forgery

Using the class CSRFProtect provided by Flask-WTForms, I automatically generated a CSRF Token for each request. Meaning an attacker cannot forge someone's identity

Bad Request

The CSRF token has expired.

SQL Injections

Flask-SQLAlchemy uses MySQL for its database engine. It defaults to using prepared queries and placeholders within its queries, mitigating the risk of SQL Injections.

```
INSERT INTO "Users" (username,
                     email,
                     passwordHash)
            VALUES (?,?,?);
```

Reflections

We wished to design an educational platform introducing complete beginners to Coding, Linux and Hacking wherein no previous experience in necessary. At the beginning of the project, we devised a list of features we wished to include within the Crakd learning environment, this list can be seen below. Sadly, due to time constraints we were unable to completely integrate all aspects of our project, we are aiming to complete this integration within our own time.

Project deliverable	**Successful Delivery?**
A widely accessible platform	Yes
Release for Open Source	Yes
Wide variety of learning paths	Yes
Prevention of task skipping	Yes
Randomised Flags	No
Leader board System	No

Group Performance

Meeting the majority of deliverables, we worked well as a team wherein our passion for the project aided development and meant we were completing tasks ahead of schedule. I was particularly proud of this as I took time to plan everyone's development time ahead of schedule, meaning they could keep working without consulting the team. The extra planning helped to streamline the development process, enabling some deliverables—particularly the learning paths—to be completed quicker than expected. I would make this planning a priority when working on future projects, even if I am not leading the team I will make sure to plan my time effectively so I can work efficiently and support my teammates when necessary. I can do this by planning my development time in advance and setting personal goals/milestones.

Randomised Flags and a Leader board system, even though a key piece of our project, were not delivered upon. People struggled to balance the workload in the final weeks of the semester, these features would have completed the project. I feel if I had managed people's time better and swapped development tasks between people, we may have completed these features. Hence, in the future I am going to make it a personal goal to ensure all aspects of a project are completed, even if I have to take up an additional task to support a struggling team member.

Personal Performance

Tasked with both managing, and developing an integral part of the project, I feel I have managed my own time effectively, completing all that was expected from me. Struggling to understand Blockchains, I decided to take a week out and research all aspects within a Blockchain. This research greatly informed my development, supporting my programming and ultimately enabling completion of my task within the timeline. The realisation that proper research delivers proper results is now an important aspect I wish to take with me going forward. I am going to ensure I research extensively into required subject matter as it was a great help during the development of the Blockchain.

I found tracking the group's progress a difficult task. Our group decided to use a spreadsheet instead of a Gantt Chart—the chart was too complex for constant updating and editing of tasks. To simplify the process I colour coded the spreadsheet, wherein colours signified different levels of task completion. My group would sometimes forget to update their progress or colour their progress incorrectly. As a result, the Randomised Flags and Leader boards remained incomplete. I should have been more proactive and identified that people were failing to declare the progress of their tasks. Going forward, I will strive to be a better communicator and consider the impact my decisions make on a team. I must listen to my team and use their input to influence my decisions.

Summary

The past 11 weeks have been extremely enjoyable, having the opportunity to work with a team of likeminded individuals to develop a real-world project was an amazing experience. I have learnt a great deal from this experience and will take into consideration all aspects of this project moving forward.