

# New Approaches to Cybersecurity Education: CTF 101 Elective

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## 1. Introduction

Despite being one of the fastest growing fields, it is estimated that there will be 3.5 million unfilled cybersecurity positions by 2021 according to a recent report by Cybersecurity Ventures [1]. The reasons behind this cybersecurity labour crises are many, however one of the significant contributing factors is the lack of cybersecurity knowledge and skills. Individuals who obtain their degrees in areas such as computer science have a weak foundation in security principals. The approach used to introduce students to computer security usually involves either only introducing security in upper level courses or integrating security into the curriculum by quickly brushing over the theory behind the related security concepts with little to no practical exercises. In both cases, the students of such institutions graduate without a solid foundation in the basic computer security concepts. Introducing security across the curriculum through practical exercises is not a new concept and has been suggested by academia over and over again [2] [3]. Although the approach taken by institutions to implement this change has been lacking and many improvements can be suggested, this is not the focus of this proposal.

This proposal is inspired by an elective mathematics course implemented by the University of Ottawa in order to introduce students to the field of statistics and probability. The course is called Poker 101 [4] and was introduced as a creative way to teach students across all faculties about core concepts in probability and statistics. The course was first offered in 2011, and although it was offered as an elective, students from several faculties registered and successfully completed the course [5]. Using this innovative approach to teach probability and statistics, this proposal suggests the implementation of a course teaching the core concepts of computer security using the methods in capture the flag security competitions.

## **2. Capture the Flag 101 Course**

The idea is simple. Capture the flag security competitions are known to be attended by individuals from diverse academic backgrounds. Due to the lack of security education in non-cybersecurity degrees such as computer science and software engineering, these individuals are also usually self-taught. However, due to the nature of capture the flag competitions where participants are given exercises to complete with little to no information or prior training on how to approach these exercises, many promising individuals might shy away from participating in such competitions, especially individuals that belong to minority groups. As a result, such individuals miss out on a great opportunity to learn and practice the security skills that the industry is in desperate need of.

This report proposes the implementation of an elective course that teaches the core concepts and skill sets required to participate and complete capture the flag competitions. This would include topics such as forensics, cryptography, web exploitation, reverse engineering and binary exploitation. The concepts would be introduced and taught to the students with the tools necessary to understand these concepts. Then students are presented with challenges to apply these concepts.

An implementation of such a course, especially at an early stage of a degree, will inspire students to pursue a career in cybersecurity or at the very least compel these students to be more security aware when taking other courses in their degrees. Another direct benefit of such a course is that students will be more encouraged to participate in CTF competitions and therefore further their skill set.

## **3. Conclusion**

This report proposes the implementation on an elective course that teaches the core computer security concepts in the style of a capture the flag competition. This was inspired by a successful mathematics course introduced by the University of Ottawa, called Poker 101, that introduced the core concepts in the field of probability and statistics. Offering such a course can inspire students to pursue a career in cybersecurity and make students more security aware in the degrees they pursue. Implementation of such a course is very feasible and is likely to be successful considering the significant interest in CTF competitions from individuals pursuing both cybersecurity and non-cybersecurity degrees.

## References

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## **Author's Biography**

Rana obtained her Bachelor of Computer Science and Mathematics at the University of Ottawa and is currently pursuing her Master of Computer Science with a focus on open source web application vulnerability scanners. During her time at university, Rana took upon herself various volunteer and leadership roles which included University of Ottawa ambassador for Seeds for the Future Huawei Canada, Orphan Sponsorship Initiative Vice Chair, Women Startup Network Peer Mentor, IEEE University of Ottawa Student Branch VP Academic and IEEE University of Ottawa Student Branch Women in Engineering Vice Chair.

Rana has worn many hats during her work in the public and private sector. She held positions as a spectrum engineer assistant, automated tester, software developer, security analyst and as a ransomware researcher. Rana currently works at the University of Ottawa as a Teaching Assistant for several second and third year Computer Science courses. As a teaching assistant, Rana teaches weekly lab/tutorial sessions, holds weekly office hours, marks theory and programming assignments and proctors midterms and final exams.

Rana is deeply passionate about her degree in computer science with a deep interest in computer security and is determined to make a difference using the degree she is pursuing.