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Faculty of Health, Science and Technology  
Computer Science

## Syllabus

### Capture-the-Flag Challenges in Computer Security

**Course Code:** 7DAV010  
**Course Title:** Capture-the-Flag Challenges in Computer Security  
**Subject:** Computer Science  
**Credits:** 4 ECTS  
**Degree Level:** Doctoral

#### Course Approval

The syllabus was approved by the Faculty of Health, Science, and Technology, 9 November 2022 is valid from the autumn semester 2022.

#### Language of instruction

English is the course language.

#### Prerequisites

This course is intended for doctoral students in Computer Science, but can also be taken by PhD students from other domains that have an interest in Capture-the-Flag (CTF) challenges. The course is primarily for PhD students at Karlstad University and secondly for PhD students admitted to other universities.

#### Learning Outcomes

After having completed the course, students should:

- understand and explain the different approaches of CTF challenges;
- understand and solve common CTF challenges posed by others;
- be able to design and implement new CTF challenges;
- be able to analyze and critically evaluate the solvability of new CTF challenges;
- be able to reason about the relevance of CTFs for cybersecurity education;
- be able to use and work with technical CTF platforms;
- have enough competence to participate in CTF challenge competitions, e.g., on the Swedish or European level;
- be able to present and discuss their CTF challenge activities.

## **Course Content**

The term “Capture-the-Flag challenge” refers to various interactive computer-based tasks in cybersecurity education and computer science in general. All of them have in common that a challenge is posed to the participants that need to be solved, e.g., within a given timeframe or as a team in a CTF contest.

In this course, students explore the different variations of CFTs, solve existing CTF challenges, and develop their own CTF challenges to pose to others.

## **Reading List**

See separate document.

## **Examination**

To pass the course, the students successfully complete the following tasks:

- Participate in at least four different CTF events from the course CTF contest whitelist (managed by the course convener), documenting the solutions found and the pathway to achieving this. For each contest, at least one challenge must be solved correctly.
- Design, implement, and integrate at least one new CTF challenge
- Create instructions and solution documentation for the newly created CTF challenge
- Write a report consisting of the four CTF challenge solutions documentation and the instruction and solution documents for the newly created CTF challenge
- Present and discuss the report contents and new CTF challenge in class

## **Grades**

One of the grades, Fail (U) or Pass (G), is awarded in the course examination.

## **Quality Assurance**

The course convener has a duty to encourage a continuous dialogue on learning processes and goal fulfillment. A written evaluation is carried out after the course, combined with a joint student-teacher discussion of all aspects. The evaluation result is collated and made available under *The Higher Education Ordinance*, Chapter 1, § 14.

## **Course Certificate**

A course certificate is issued on request.

## Goal matrix

Goals that, after completing the course, are fulfilled for the doctoral or licentiate degree are marked with an X.

	Doctoral			Licentiate	
	Knowledge and understanding			Knowledge and understanding	
1a	- demonstrate broad knowledge and systematic understanding of the research field and	X		1a demonstrate knowledge and understanding in the field of research including	X
1b	advanced and up-to-date specialised knowledge in a limited area of this field, and	X		1b current specialist knowledge in a limited area of this field as well as	X
1c	familiarity with research methodology in general and the methods of the specific field of research in particular.			1c specialised knowledge of research methodology in general and the methods of the specific field of research in particular	
	Competence and skills			Competence and skills	
2a	- demonstrate capacity for scholarly analysis and synthesis as well as			2a demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively and to	X
2b	to review and assess new and complex phenomena, issues and situations autonomously and critically	X		2b plan and use appropriate methods to undertake a limited piece of research and other qualified tasks within predetermined time frames in order to contribute to the formation of knowledge	X
3a	- demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to	X		2c as well as to evaluate this work	X
3b	plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work			3a demonstrate the ability in both national and international contexts to present and discuss research and research findings in speech and writing and in dialogue with the academic community and	
4	- demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research			3b society in general	X

5a	- demonstrate the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing and in dialogue with the academic community and		4	demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity.	X
5b	society in general	X			
6	- demonstrate the ability to identify the need for further knowledge and	X			
7	- demonstrate the capacity to contribute to social development and support the learning of others both through research and education and in some other qualified professional capacity.	X			
<b>Judgement and approach</b>				<b>Judgement and approach</b>	
8a	- demonstrate intellectual autonomy and disciplinary rectitude as well as		5	demonstrate the ability to make assessments of ethical aspects of his or her own research	X
8b	the ability to make assessments of research ethics, and	X	6	demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used	
9	- demonstrate specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.		7	demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.	X