COURSE DESCRIPTION CARD - SYLLABUS

Course name
Programmable devices [S1Cybez1>UP]

Course

Field of study
Cybersecurity

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
16

Laboratory classes
16

Other
0

Tutorials
0

Projects/seminars
16

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student enrolling in the course should have knowledge of high-level programming languages such as Python and C++. They should also be familiar with the basics of using the Linux operating system. Furthermore, they should understand how computer networks function and be knowledgeable about the network devices used in them, such as network cards, switches, and routers.

Course objective

The goal of the course is to familiarize students with: - available programmable devices, - P4, NPL, Verilog, and VHDL programming languages, -the potential uses of programmable devices.

Course-related learning outcomes

Knowledge:
The student has advanced knowledge of programming languages such as P4 and NPL. [K1_W06]
The student possesses detailed knowledge of programmable electronic circuits. [K1_W08]

The student has in-depth knowledge of the lifecycle of programs used in building SDN networks. [K1_W09]

Skills:
• The student is able to use literature sources, integrate acquired information, evaluate and interpret it, and draw conclusions. [K1_U01]
• The student can develop simple programs running on PSA (Portable Switch Architecture) and TNA (Tofino Native Architecture). [K1_U02]
• The student is able to use simulation tools to verify the functionality of prepared programs. [K1_U04]

Social competences:
• The student understands the importance of enhancing professional, personal, and social competencies and is aware that knowledge and skills in the field of cybersecurity evolve rapidly. [K1_K01]
• The student recognizes the significance of knowledge in solving cybersecurity problems and is aware of the necessity to consult experts when addressing engineering tasks beyond their own competencies. [K1_K02]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge gained in the lecture is verified by a written or oral credit. In the written exam, students must answer 7-10 questions (a combination of multiple-choice and open-ended), each carrying different point values. There are three or four separate scoring groups. In the case of the oral exam, a student draws one question from each scoring group. During the oral exam, for each drawn question, the student may be asked an additional follow-up question related to the one drawn. The grade for each question (including both the main and the follow-up question) reflects the scope of the answer and the depth of understanding of the topic. A set of 50-60 questions is prepared for each exam. To pass, a student must earn at least 50% of the total possible points.
Projects: Skills acquired through project work are assessed based on the projects presented. The evaluation considers the student's engagement in project preparation, the tools used, and the additional knowledge the students had to acquire. Projects can be done individually or in pairs. The grading scale ranges from 2.0 to 5.0.
Laboratories: Skills gained in laboratory classes are assessed on an ongoing basis. In each lab session, the
correctness of the completed exercises is graded on a scale of 0 to 10 points. To pass the lab component, a student must earn at least 50% of the total possible points.
Percentage of Points Grade
<=50% 2,0
51% - 60% 3,0
61% - 70% 3,5
71% - 80% 4,0
81% - 90% 4,5
91% - 100% 5,0
In each form of the course assessment, the grade depends on the number of points the student earns relative to the maximum number of required points. Earning at least 50% of the possible points is a prerequisite for passing. The relationship between the grade and the number of points is defined by the Study Regulations. Additionally, the course completion rules and the exact passing thresholds will be communicated to students at the beginning of the semester through the university's electronic systems and during the first class meeting (in each form of classes).

Programme content

During the course, students will acquire knowledge about the use of programmable network devices as well as programmable digital devices. They will also learn about the programming languages employed, including their structure, syntax, and available functions.

Course topics

I. P4 Language

1. Basic architectures and target platforms
2. Program structure
3. Basic functional blocks, packet paths
4. Data types
5. Lookup tables, registers
6. Parsers and deparsers
7. Principles of running programs in emulators and on physical devices
II. NPL Language
1. Logical bus
2. Data types and parser
3. Functions
4. Logic registers and logic tables
5. Special functions
6. Processing resolution
7. Editor construct
8. Packet counter
9. Packet dropping and packet tracking
III. eBPF
IV. Basics of VHDL and Verilog Languages

Teaching methods

Lecture: Multimedia presentation supplemented with examples illustrated on the board.
Laboratory Exercises: Practical group work using network devices and virtualized environments.
Project Classes: Projects undertaken individually or in pairs.

Bibliography

Basic:
1. P4_16 language specification - https://p4.org/wp-content/uploads/2024/10/P4-16-spec-v1.2.5.pdf
2. Network card specification (PNA) - https://p4.org/p4-spec/docs/PNA-v0.7.pdf
3. Portable Switch Specification (PSA) - https://p4.org/p4-spec/docs/PSA-v1.2.pdf
4. P4Runtime specification - https://p4.org/wp-content/uploads/2024/10/P4Runtime-Spec-v1.4.1.pdf

Additional:
1.Liz Rice, Learning eBPF - Programming the Linux Kernel for Enhanced Observability, Networking, and Security, O'Reilly Media, Inc., 2023

Breakdown of average student's workload

	Hours	ECTS
Total workload	88	3,00
Classes requiring direct contact with the teacher	48	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50