



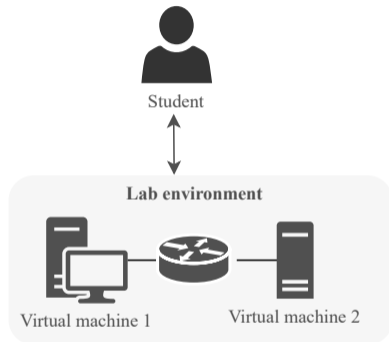
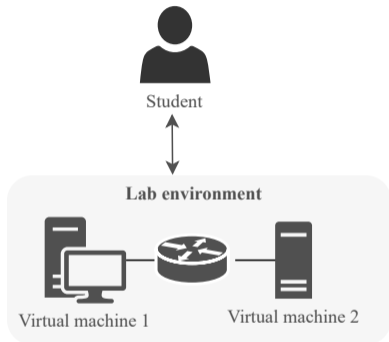
Preventing Cheating in Hands-on Lab Assignments

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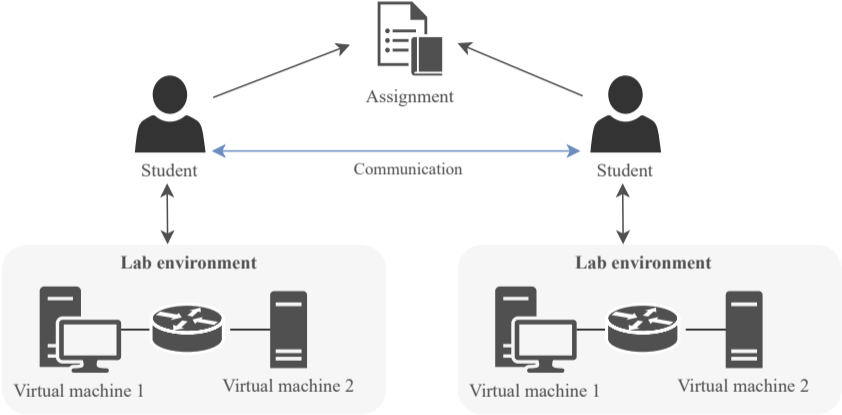
Masaryk University, Brno, Czech Republic

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Format of Hands-on Cybersecurity Classes

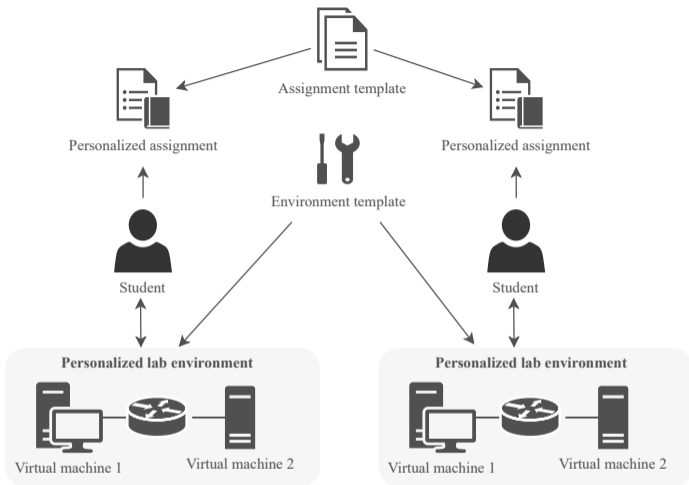


Motivation

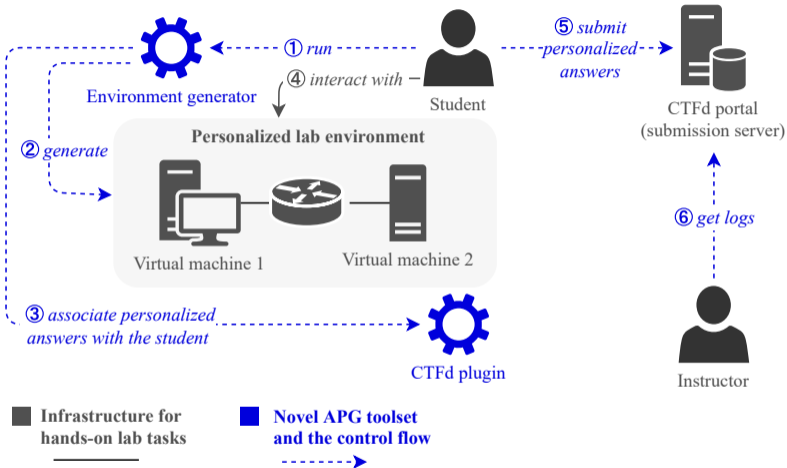


Paper Contribution

- Methods and toolset for automatic problem generation for tasks in a lab environment.
- Case study in an authentic teaching context.



Toolset



Configuration Generation

web:

type: port

challenge_id: 1

min: 8000

max: 65000

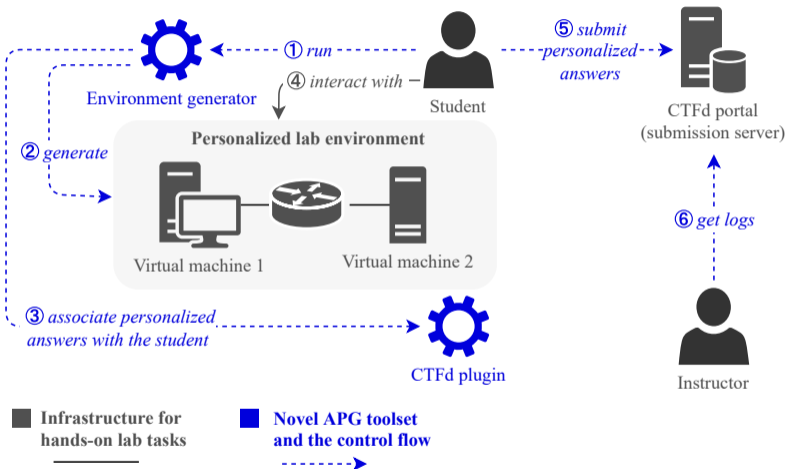
prohibited: [8080,8888]

secret:

type: text

challenge_id: 2

Submission Server



Case Study

- Individual homework assignment in an **introductory computer security course**.
- Taught at Masaryk University in the Czech Republic in Spring 2021.
- The course was enrolled by **207 undergraduate students**.
- Topics covered: **network attacks** on authentication of **Telnet** and **SSH** servers, **securing** an SSH server, and **analyzing SSH network traffic**.

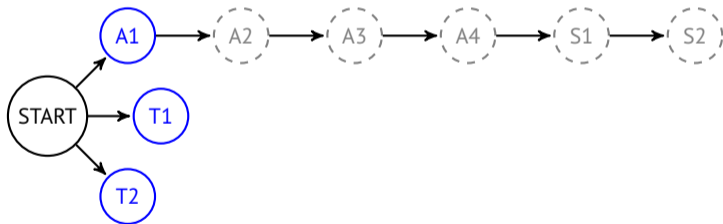
Case Study – Personalized Environment

Each student had a **personalized environment**:

- a host running the Telnet server at a **random network port**,
- one user account with a **random username**,
- another user account with a **random password**, and
- a file containing a **random sentence**.

Tasks

- **8 tasks** in total.
- **1 chain of 6 consecutive tasks.**
- At the beginning, students **can choose from 3 tasks** (A1, T1, and T2).



Cheating Detection

- **Someone else's answers** – the most reliable; incorrect submissions of correct answers of other students.
- **Task chains** – students' solve time for consecutive tasks less than *minimal possible solve time*.
- **Submission proximity** – *time proximity* or *location proximity* of two or more submissions.

Results

- **Someone else's answers** – 3 cases.
 - The most conclusive case:
Student A submitted the correct answer 41247 for A1.
Student B submitted the incorrect answer 41247 twice, several days later, and before the first interaction with the lab environment.
- **Task chains (consecutive tasks)** – 2 cases.
 - One of two cases:
Three students completed the A3 task in 58 seconds.
The minimal possible solve time was 45 seconds. The assignment text: 102 words.
- **Submission proximity** – 2 cases.
 - One confirmed case using location proximity:
Students K and L submitted their answers to T2 within 68 seconds.
Student K confessed he had cooperated with L. They share the same dormitory room.

Post-Homework Survey

- **Optional** survey after the assignment – **45 students** answered.
- **Forty students (89%)** would **prefer the provided format** of completing assignments.
- **Only one student** would prefer the **traditional homework assignment**.
- Students' answers to other questions are reported in our paper.

Limitations


- A single exercise in one course – however, the number of participants is considerably larger than in the vast majority of published works.
- The detection methods analyze only students' actions at the submission server.
- Estimating the location proximity using the same IP address of the submission is a double-edged sword.
- Advanced students may reverse-engineer the environment generator and obtain the answers without interaction with the personalized lab environment.
- The answers of 45 out of 195 students may not represent opinions of all students, particularly the critical voices.

Conclusions


- **Prevention and detection of cheating** in hands-on assignments involving the lab environment is **possible in large and remote classes**.
- Automated provisioning of the lab environment with **personalized values generated locally at students' computers** is a feasible approach.
- Our **case study** revealed **seven suspicious cases** using three detection methods.
- **Students** enjoyed the assignment and its format and **did not perceive cheating prevention disruptively**.

Publicly Available Contributions

Full paper and slides:

 <https://www.muni.cz/en/research/publications/1816366>

Open-source toolset:

 <https://gitlab.fi.muni.cz/cybersec/apg>

Stay in Touch

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Acknowledgments

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