**CS395 INTERNSHIP PROJECT REPORT**

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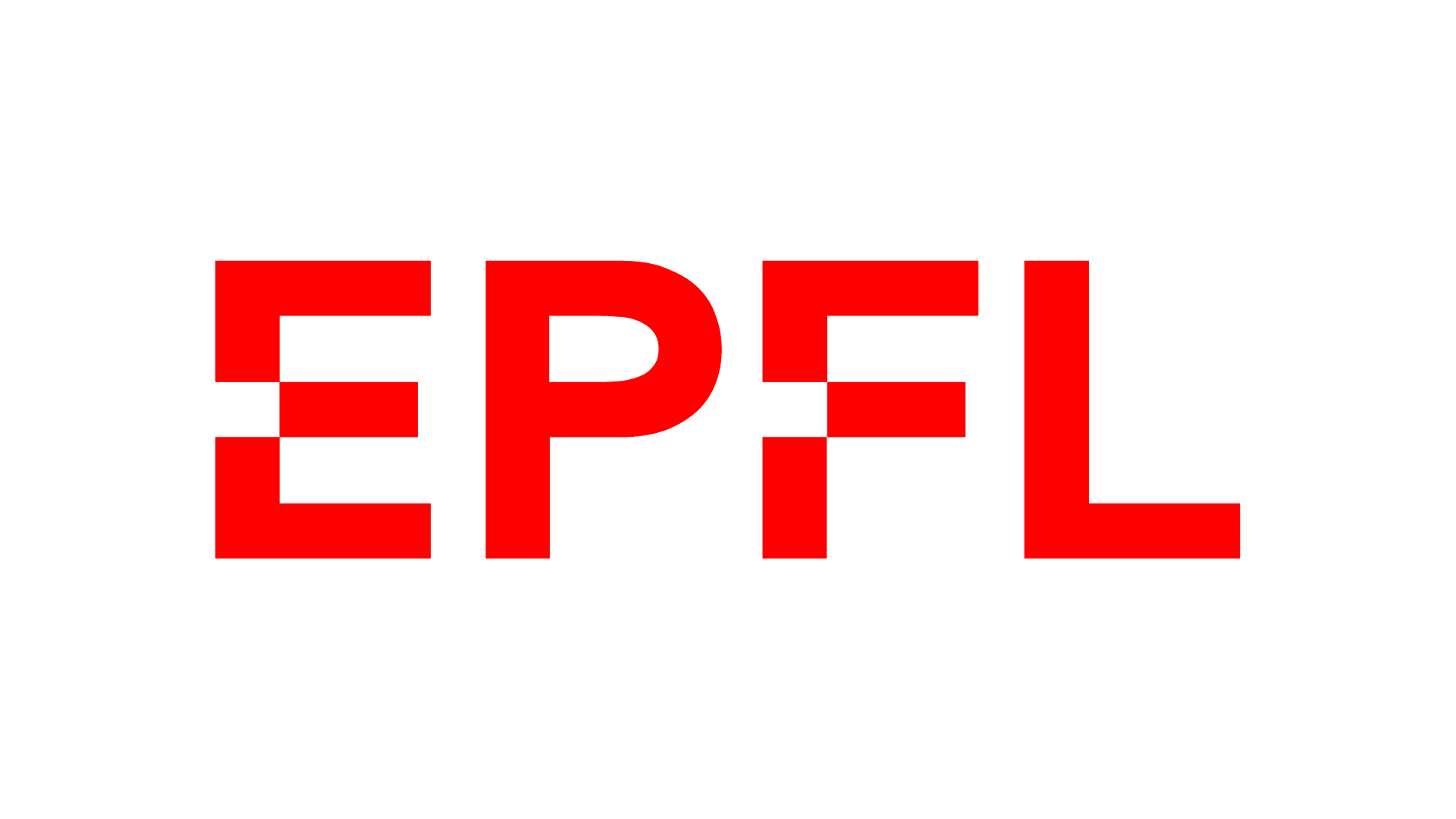


EPFL – Scalable Computing Systems Laboratory

Supervised by Rafael Pires

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**ABSTRACT**

EPFL is a Swiss public university which is ranked as 6th among the other universities in Europe according to QS. It includes laboratories from very different fields with the leading of outstanding professors. Scalable Computing Systems is one of the laboratories within the university that mainly works on privacy and security in machine learning specifically federated and decentralized.

In this project, the goal is to develop a private user-based K-nn movie recommendation system using Intel Software Guarded Extensions. Then, it is aimed to find out the overhead of SGX by comparing the app with and without SGX by latency-throughput tests.

At the end of the internship, the project is successfully completed, and it is found that …

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7. **COMPANY INFORMATION**

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Web page: <https://www.epfl.ch/en/> (University Web page)

<https://summer.epfl.ch/> (Summer@EPFL Program Web page)

EPFL is a public research university in Lausanne, Switzerland which controlled by Swiss federal government. In 1853, a few students started at the Ecole Spéciale de Lausanne in subjects such as chemistry, physics, mathematics, drawing, architecture, and civil engineering. In 1890, the Academy was transformed into a university. In 1945, it changed its name to Ecole polytechnique de l’Université de Lausanne, in other words EPUL. The university Ecole Polytechnique Fédérale de Lausanne was officially founded in 1969.

As of 2022, the university has more than 17000 students and employees where the 30% of the students are female and 57% foreign nationals. There are around 500 laboratories and research groups in various disciplines such as math, life sciences, architecture, and engineering. It is ranked 14th in the QS World University ranking, alongside Columbia and Yale Universities.

The university offers five schools and two colleges as:

One of the main competitors of EPFL is ETH Zurich which is one of the prestigious universities in Switzerland that holds the 8th place in the QS World University rankings.

1. **PROJECT BACKGROUND** 
   1. Department Information

Two bachelor programs one in Computer Science and one in Communications, four master programs as Comp. Sci., Communication, Data Science and Cyber Security are offered.

There are 55 professors, 267 PhD students, 666 master students and 1036 bachelor students currently studying/working at the IC department.

At the faculty School of Computer and Communication Sciences, there are 48 laboratories mainly divided into three as Systems, AI, and Theory. The labs have a wide range of subjects from ML, distributed systems to security, computer graphics. The full list of laboratories can be found on this [link.](https://www.epfl.ch/labs/)

The laboratory that I have been working with is SaCS in other words Scalable Computing Systems which is led by Prof. Anne-Marie Kermarrec. One professor, two post-docs, four PhD students and 8 trainees (including me) work in SaCS Lab. Some of their current projects are on decentralized federated learning, trusted executed environments and differential privacy. They also have collaborated projects with Distributed Computing Lab (DCL) which is led by Rachid Guerraoui.

Their research interests are system support for machine learning, federated learning systems, large-scale recommenders, graph-based systems, privacy-aware recommendation systems, collaborative computing.

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  1. Status of the Project

In addition to full professor position, Anne-Marie is the CEO of [Mediego](https://www.mediego.com/en/) app which is a start-up that mainly works on recommendation systems. With Mediego, you can send highly customized content to your customers, identify their preferences, interests, and their potential to purchase, all in real time. And earlier this year, my supervisor and the others from the same lab published a paper about TEE-based decentralized recommender system called REX which uses trusted execution environment provided by Intel (SGX) to make effective recommendations while preserving privacy.

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     1. Motivation

Recommendation using machine learning to recommend any type of item such as books, movies, news, Instagram posts, advertisements to users is one of the important

3.3.2 Project Description

* 1. Related Literature

1. **INTERNSHIP PROJECT**

4.1 Project Objective

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1. **INTERNSHIP EXPERIENCE**
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   4. A typical day

My day at work starts around 8.30-9.00 am. I work in an office that I share with other interns from my lab and two other labs. Firstly, I usually revise what I have done on the previous day and then I make a plan as an outline to see how much I need to progress to achieve my weekly goals. I use my laptop to work and connect to one of the computers at IC cluster via ssh.

If it is Monday, we have a lab reading group session in which one of the members of SaCS presents a scientific paper for us to know about what’s happening in CS around the world. Because it is not possible to read all the papers published considering that thousands of papers about ML and/or privacy are published each year. These sessions are organised in every two weeks with the leadership of Akash Dhasade who is one of the PhD students at SaCS.

If the day is Tuesday, we have a weekly laboratory meeting, which everyone joins, at 10 am in the morning. In these meetings, we discuss what everyone has been doing since the last meeting, their problems, and any interesting ideas/findings that they might want to share. Those meetings enable us to know about each other’s projects and progress. Also, we sometimes use these meetings for master students’ final project presentations or for PhD students’ candidacy exam preparations. Those meetings usually last for an hour.

Again, if it is Tuesday, we have a weekly meeting to discuss the project that I am involved in with two PhD students and a post-doc from Distributed Computing Lab (DCL), me, my supervisor, and the professor from SaCS at 11 am after the lab meeting. However, the PhD student who will contribute to the project mainly had to finish another project first. Therefore, these meetings lasted for three weeks only. After that, we had weekly meetings only with my supervisor to discuss my progress, the problems/bugs that I encountered and my solution ideas.

After the meetings, I work for one and half an hour more then we have a lunch break at 12.30 which lasts about an hour where we eat together with people from my lab at the cafeteria. After the lunch, I continue to work until 17.00-18.00 depending on my workload that day. I go to my supervisor’s office if I cannot solve an error or if I have some question about an implementation issue.

Before I leave the office, I keep notes about what I have done that day and what the current issue is so that I can start from there directly next day.

1. **CONCLUSIONS**
2. **RECOMMENDATIONS**
3. **REFERENCES**
4. **APPENDICES**