1. Johdatus opiskeluun -kurssin IT-harjoitukset (Sanna Suoranta, sanna.suoranta@aalto.fi)
2. CS-A1121 Ohjelmoinnin peruskurssi Y2 (Sanna Suoranta, sanna.suoranta@aalto.fi)
3. Deep learning methods for large output spaces (Rohit Babbar, rohit.babbar@aalto.fi)
4. Computational Methods for Brain Imaging (Riku Linna, riku.linna@aalto.fi)
5. Machine Learning for Antimicrobial resistance prediction (Juho Rousu, juho.rousu@aalto.fi)
6. Deep learning for relational reasoning and model-based reinforcement learning (Alexander Ilin, alexander.ilin@aalto.fi)
7. Statistical or psychological theories for user security (Janne Lindqvist, jane.lindqvist@aalto.fi)
10. Machine learning for health (ML4H) (Pekka Marttinen, pekka.marttinen@aalto.fi)
11. Developing a MOOC version of the "Programming Parallel Computers" course (Jukka Suomela, jukka.suomela@aalto.fi)
12. Ohjelmoinnin peruskurssi Y1: harjoitustehtävien ja niiden automaattisen tarkistuksen laatiminen (Kerttu Pollari-Malmi, kerttu.pollari-malmi@aalto.fi)
13. Databases: automatic assessment of BCNF and functional dependencies exercises (Kerttu Pollari-Malmi, kerttu.pollari-malmi@aalto.fi)
14. Automated reasoning with complex datatypes (Jussi Rintanen, jussi.rintanen@aalto.fi)
15. Massively Parallel Algorithms for Graph Problems (Jara Uitto, jara.uitto@aalto.fi)
16. Pattern recognition from MHD simulations using Deep Learning (Maarit Käpylä, maarit.kapyla@aalto.fi)
17. Mapping CS research over time: Identifying Trends and Blind Spots (Elisa Mekler, elisa.mekler@aalto.fi; Barbara Keller, barbara.keller@aalto.fi)
18. Predicting Future Actions in First-Person Videos (Selen Pehlivan Tort, selen.pehlivantort@aalto.fi; Jorma Laaksonen, jorma.laaksonen@aalto.fi)
19. Agile Software Development in the Public Sector (2 positions) (Casper Lassenius, casper.lassenius@aalto.fi)
20. Game programmer and software designer for educational game (Fabian Fagerholm, fabian.fagerholm@aalto.fi)
21. Designing for better Developer Experience: Surveying the literature and creating materials for publications and the web (Fabian Fagerholm, fabian.fagerholm@aalto.fi)
22. Software for the design of DNA nanostructures (Pekka Orponen, pekka.orponen@aalto.fi)
23. Kinetic folding of RNA secondary structures with pseudo-knots (Pekka Orponen, pekka.orponen@aalto.fi; Vo Hong Thanh, thanh.vo@aalto.fi)
24. Web-based AR/VR application development (Antti Ylä-Jääski, antti.yla-jaaski@aalto.fi)
25. Web-based Augmented and Virtual Reality (Antti Ylä-Jääski, antti.yla-jaaski@aalto.fi)
26. A Relay HMD driver for Steam VR/OpenXR (Antti Ylä-Jääski, antti.yla-jaaski@aalto.fi)
27. Computer Assisted Bayesian Modeling Workflow (Aki Vehtari, aki.vehtari@aalto.fi)
28. Internships and thesis positions in computer vision and deep learning (Juho Kannala, juho.kannala@aalto.fi)
29. Distributed deep learning inference in fog networks (Mario Di Francesco, mario.di.francesco@aalto.fi; Thaha Mohammed, thaha.mohammed@aalto.fi)
30. Volumetric data streaming from smartphones (Mario Di Francesco, mario.di.francesco@aalto.fi; Gopika Prembsankar, gopika.prembsankar@aalto.fi)
31. Signal classification for cross-technology interference detection (Mario Di Francesco, mario.di.francesco@aalto.fi; Verónica Toro Betancur, veronica.torobetancur@aalto.fi)
32. Content optimization of tiled pervasive displays (Mario Di Francesco, mario.di.francesco@aalto.fi; Maria Lorena Montoya Freire, maria.montoyafreire@aalto.fi)
33. Camera-display communication with smartphones (Mario Di Francesco, mario.di.francesco@aalto.fi; Maria Lorena Montoya Freire, maria.montoyafreire@aalto.fi)
34. Cloud-native interactive labs (Mario Di Francesco, mario.di.francesco@aalto.fi)
35. Statistical machine learning and deep learning for personalized medicine (Harri Lähdesmäki, harri.lahdesmaki@aalto.fi)
36. Bayesian deep learning for designing bacterial genomes (Harri Lähdesmäki, harri.lahdesmaki@aalto.fi)
37. Bayesian deep learning (Harri Lähdesmäki, harri.lahdesmaki@aalto.fi)
38. Animal-Computer Interaction (ACI) Internship (Ilyena Hirskyj-Douglas, ilyena.hirskyj-douglas@aalto.fi)
39. Probabilistic interactive user models for interactive AI (Samuel Kaski, samuel.kaski@aalto.fi; Pierre-Alexandre Murena, pierre-alexandre.murena@aalto.fi)
40. Privacy-preserving machine learning (Samuel Kaski, samuel.kaski@aalto.fi; Joonas Jälkö, joonas.jalko@aalto.fi)
41. Bayesian deep learning (Samuel Kaski, samuel.kaski@aalto.fi; Markus Heinonen, markus.o.heinonen@aalto.fi)
42. Simulator-based Inference (Samuel Kaski, samuel.kaski@aalto.fi; Jukka Siren, jukka.2.siren@aalto.fi)
43. Bayesian Experimental Design for model-based Reinforcement Learning (Samuel Kaski, samuel.kaski@aalto.fi; Charles Gadd, charles.gadd@aalto.fi)
44. Probabilistic user models for interactive information visualization (Samuel Kaski, samuel.kaski@aalto.fi; Petrus Mikkola, petrus.mikkola@aalto.fi)
45. Probabilistic machine learning for genomics and precision medicine (Samuel Kaski, samuel.kaski@aalto.fi; Tianyu Cui, tianyu.cui@aalto.fi)
46. Electronic examining (A+ Python Web Development) (Markku Riekkinen, markku.riekkinen@aalto.fi)
47. Accessibility, usability, multilingual and ethical issues (A+ Python Web Development) (Markku Riekkinen, markku.riekkinen@aalto.fi)
48. Analytics in A+ (A+ Python Web Development) (Markku Riekkinen, markku.riekkinen@aalto.fi)
49. Interactive feedback (A+ Python Web Development) (Markku Riekkinen, markku.riekkinen@aalto.fi)
50. The code similarity analysis engine Radar (A+ Python Web Development) (Markku Riekkinen, markku.riekkinen@aalto.fi)
51. A+ Python Web Development (Markku Riekkinen, markku.riekkinen@aalto.fi)
52. Development with program animation and annotation libraries (JavaScript Developer) (Markku Riekkinen, markku.riekkinen@aalto.fi)
53. Next generation Javascript API for interactive exercises in A+ (JavaScript Developer) (Jaakko Kantojärvi, jaakko.kantojarvi@aalto.fi)
54. Cloud Native Learning Environment Initiative (Jaakko Kantojärvi, jaakko.kantojarvi@aalto.fi)
55. PeerWise via A+ (Ari Korhonen, ari.korhonen@aalto.fi)
56. Gradebook future with learning analytics (Anni Rytkönen, anni.rytkonen@aalto.fi)
57. Compare learning management systems for future needs (Anni Rytkönen, anni.rytkonen@aalto.fi)
58. Course developer for Scala courses (Jaakko Kantojärvi, jaakko.kantojarvi@aalto.fi)
59. Course developer for Python courses (Jaakko Kantojärvi, jaakko.kantojarvi@aalto.fi)
60. Course developer for Programming 1 (Scala) (Juha Sorva, juha.sorva@aalto.fi)
61. Course developer for language courses (Jan-Mikael Rybicki/Language centre, jan-mikael.rybicki@aalto.fi)
62. Course developer for Studio 2 (Scala) (Lauri Malmi, lauri.malmi@aalto.fi; Otto Seppälä, otto.seppala@aalto.fi)
63. Course developer Programming 2 (Mikko Kivelä, mikko.kivela@aalto.fi)
64. Analysing social networks and human behaviour data and models (Mikko Kivelä, mikko.kivela@aalto.fi)
1. Academic contact person for further information on topic: Sanna Suoranta (sanna.suoranta@aalto.fi)

Title of topic: Johdatus opiskeluun -kurssin IT-harjoitukset


2. Academic contact person for further information on topic: Sanna Suoranta (sanna.suoranta@aalto.fi)

Title of topic: CS-A1121 Ohjelmoinnin peruskurssi Y2


3. Professor in charge of topic: Rohit Babbar (rohit.babbar@aalto.fi)

Title of topic: Deep learning methods for large output spaces

Description: Large output spaces with hundreds of thousand labels are common in Machine learning problems such as ranking, recommendation systems and next word prediction (http://manikvarma.org/downloads/XC/XMLRepository.html). Apart from the computational problem of scalability, data scarcity for individual labels poses a statistical challenge and especially so for data hungry deep methods. The goal of the project is to investigate deep learning based architectures and adapting the well known techniques such as Attention mechanism for simultaneously addressing the computational and statistical challenge in learning with large output spaces. As the target domain is textual data, the project also involves exploring recent advances in NLP, such as Bert and TransformerXL, towards exploring the common grounds for further research in this area.

4. Academic contact person for further information on topic: Riku Linna (riku.linna@aalto.fi)

Title of topic: Computational Methods for Brain Imaging

Description: We are looking for motivated students to work with the development of computational methods for identification and prediction of brain states. The work is part of an ERC funded international collaborative project named 'Connect to Brain'. The computational methods will be used in a so called closed-loop TMS-EEG setup. In this setup EEG measurement and
transcranial magnetic stimulation of the brain are performed simultaneously in a closed loop in order to treat some brain malfunctions like Alzheimer’s disease and also as a cure for depression. The work involves data analysis and/or machine learning and/or computational modelling using for example concepts of nonlinear dynamics. The specific task will be specified according to the student’s background and interests.

5. Professor in charge of topic: Juho Rousu (juho.rousu@aalto.fi)

Title of topic: Machine Learning for Antimicrobial resistance prediction

Description: The discovery of antimicrobial agents was one of the great triumphs of the 20th century. The sobering news is that antibiotic resistance was part of the process as well. If nothing is done by 2050, antimicrobial resistance (AMR) will cost $100 trillion with 10M people/year expected to die. This internship relates to a transnational research project where the main goal is to develop and apply new machine learning approaches for modelling AMR for faster diagnosis, better surveillance and prediction of resistance emergence. Specifically, the team in Aalto will develop machine learning methods for finding in data highly non-linear patterns that are predictive of AMR.

6. Professor in charge of topic: Alexander Ilin (alexander.ilin@aalto.fi)

Title of topic: Deep learning for relational reasoning and model-based reinforcement learning

Description: The interest of our group is to combine the excellent perception capabilities of deep learning with the ability to reason and plan. Our approach includes models with relational inductive bias and model-based reinforcement learning (https://arxiv.org/abs/1903.11981). Recently relational models such as Transformers and Graph Neural Networks have seen increased popularity, and have given us ability to model relations between objects and entities across wide range of input modalities (https://arxiv.org/abs/1806.01261). Planning using learned world models has shown a lot of promise in increasing the sample complexity of reinforcement learning (https://arxiv.org/abs/1911.08265).

7. Professor in charge of topic: Janne Lindqvist (janne.lindqvist@aalto.fi)

Title of topic: Statistical or psychological theories for user security

Description: The Human-Computer Interaction and Security Engineering Lab http://lindqvistlab.org at the Aalto Department of Computer Science is recruiting a summer intern. We will be recruiting a student to contribute to our research on the application of statistical theory or psychological theory to the study of user security. For example, we will study the cognitive mechanisms responsible for password usability and the psychological principles driving security decisions. Our project will engage the summer intern in every step of the research process including research design, statistical analysis and provide the intern with a unique exposure to the application of psychology and statistics in human-computer interaction and usable security. Projects may also include Bayesian data analysis. Accepted student also has the opportunity to participate to activities of Helsinki-Aalto Center for Information Security (HAIC).

Relevant fields of study: Computer science, computer security, statistics, psychological science, social and behavioral sciences, cognitive science, computer engineering
8. Professor in charge of topic: Arno Solin (arno.solin@aalto.fi, http://arno.solin.fi)

**Title of topic:** Visual-inertial SLAM on a robot

**Description:** My research group is looking for motivated, skilled, and open-minded summer students with an interest in real-time inference and application of probabilistic machine learning methods to practical applications. This topic is specifically related to implementing the PIVO method (https://aaltovision.github.io/PIVO) to run on the MonsterBorg (https://www.piborg.org) robot platform that is used in the group. Successful applicants are expected to have an outstanding record in computer science and solid programming skills in C++ and Python.

9. Professor in charge of topic: Arno Solin (arno.solin@aalto.fi, http://arno.solin.fi)

**Title of topic:** Machine learning with probabilistic principles

**Description:** My research group is looking for motivated, skilled, and open-minded summer students with an interest in real-time inference and application of probabilistic machine learning methods to practical applications. Depending on the background and interests of the student, this project can be either more applied or leaning more towards theory and methods development. This project builds on recent progress in Bayesian methods in deep learning, real-time inference and sensor fusion (see recent publications at http://arno.solin.fi). The student would get hands-on experience in Bayesian methods, Gaussian processes, stochastic differential equations, deep learning, and coding (primarily Python). Successful applicants are expected to have an outstanding record in computer science, mathematics, statistics, or a related field, and familiarity with some of the topics mentioned above.

10. Professor in charge of topic: Pekka Marttinen (pekka.marttinen@aalto.fi)

**Title of topic:** Machine learning for health (ML4H)

**Description:** Recent years have witnessed an accumulation of massive amounts of health related data, enabling researchers to address diverse problems such as: how to allocate healthcare resources fairly and efficiently, how to provide personalized guidance and treatment to users based on real-time data from wearable self-monitoring devices, or how to use genomic data to understand disease or antibiotic resistance. Central challenges in ML4H include the massive amount of diverse data from multiple data sources, going beyond correlation to learn about causal relations between relevant variables, interpreting the models, and assessing the uncertainty of predictions, to name a few. We tackle these by developing new models and algorithms which leverage on modern principles of machine learning, using techniques such as deep neural networks, probabilistic methods, interactive machine learning, attention, and generative models. Examples of our ongoing interdisciplinary projects include: analysis of nationwide healthcare register data, mobile health, genomics, antibiotic resistance, and epidemiology. We are looking for summer interns with an outstanding study record in computer science, statistics, applied mathematics, or a related field, and a passion to put these skills to use in an interdisciplinary research project to address some of the most burning challenges in today’s society.
11. **Professor in charge of topic: Jukka Suomela** ([jukka.suomela@aalto.fi](mailto:jukka.suomela@aalto.fi))

**Title of topic:** Developing a MOOC version of the "Programming Parallel Computers" course

**Description:** We will create an open online version of the CS-E4580 Programming Parallel Computers course (http://ppc.cs.aalto.fi/) in collaboration with the University of Helsinki. You will take part in the development of the course infrastructure.

We expect that you have already taken part in the Programming Parallel Computers course. You should have strong C++ programming skills, and ideally also lots of practical experience with modern web technologies. In the project, there will be plenty of need for diverse skills, ranging from user interface design to back-end development.

12. **Academic contact person for further information on topic: Kerttu Pollari-Malmi** ([kerttu.pollari-malmi@aalto.fi](mailto:kerttu.pollari-malmi@aalto.fi))

**Title of topic:** Ohjelmoinnin peruskurssi Y1: harjoitustehtävien ja niiden automaattisen tarkistuksen laatiminen

**Description:** Kesäharjoittelijan tehtävänä on laatia uusia harjoitustehtäviä kurssille CS-A1111 Ohjelmoinnin peruskurssi Y1 sekä toteuttaa niiden ratkaisujen automaattinen arvostelu A+-järjestelmään. Koska kurssi ja harjoitustehtävät ovat suomeksi, hyvä suomen kielen taito on tehtävissä välttämätön. Tehtävissä tarvitaan hyvää ohjelmointitaitoa, Python-kielen osaamista sekä paljon luovuutta ja mielikuvitusta uusien tehtäväideoiden keksimiseen.

13. **Academic contact person for further information on topic: Kerttu Pollari-Malmi** ([kerttu.pollari-malmi@aalto.fi](mailto:kerttu.pollari-malmi@aalto.fi))

**Title of topic:** Databases: automatic assessment of BCNF and functional dependencies exercises

**Description:** CS-A1150 Databases course uses A+ system. Some of the exercises, like SQL and relational algebra queries are evaluated automatically, but some are still graded by hand. The task of this intern is to design and implement an automatic assessment in A+ for problems where a relation has to be decomposed to Boyce-Codd normal form and for functional dependencies (like calculating a closure of given attributes) problems. The intern has to have a good knowledge of databases and good programming skills.

14. **Professor in charge of topic: Jussi Rintanen** ([jussi.rintanen@aalto.fi](mailto:jussi.rintanen@aalto.fi))

**Title of topic:** Automated reasoning with complex datatypes

**Description:** We are using an automated reasoning procedure for software synthesis, which involves complex datatypes as in conventional programming languages. The procedure combines different types of discrete, numeric and relational reasoning methods. The goal of the work is to formalize and prove the correctness of these reasoning methods, as well as to identify cases in which reductions to standard reasoning methods are not possible (or practical), and to propose new reasoning methods for those cases. Prerequisites are interest in theoretical computer science and automated reasoning, as well as familiarity with logic, mathematical reasoning, and relational algebra.
15. **Professor in charge of topic: Jara Uitto** ([jara.uitto@aalto.fi](mailto:jara.uitto@aalto.fi))

**Title of topic:** Massively Parallel Algorithms for Graph Problems

**Description:** Parallel processing of data and distributed computing are gaining attention and becoming more and more vital as the data sets and networks we want to process are overgrowing the capacity of single processors. To understand the potential of modern parallel computing platforms, many mathematical models have emerged to study the theoretical foundations of parallel and distributed computing. In this project, we study algorithm design in these models with a particular focus on the Massively Parallel Computing (MPC) and Local Computation Algorithms (LCA) models.

The problems we study are often in (but not limited to) the domain of graphs, that serve as a very flexible representation of data. We are interested in, for example, the computational complexities of classic problems such as finding large independent sets, matchings, flows, clustering problems, etc.

The applicant is assumed to have a solid knowledge of mathematics, knowledge on the basics of graph theory, and a good command of English. No prior knowledge in distributed computing is required, although it might be helpful.

16. **Professor in charge of topic: Maarit Käpylä** ([maarit.kapyla@aalto.fi](mailto:maarit.kapyla@aalto.fi))

**Title of topic:** Pattern recognition from MHD simulations using Deep Learning

**Description:** Pencil Code (PC), is a high-order finite-difference code for solving partial differential equations for magnetohydrodynamics, needed for example when modelling the magnetic activity of the Sun that drives space weather. Ever increasing mesh sizes are used by the scientists to reach for more turbulent regimes, corresponding to the conditions in the modelled objects themselves. Approaching the Exa-scale era, scientists performing such simulations are facing serious challenges, as it is not evident even how to store system states for re-starting, not to mention auxiliary data for more detailed data analysis. In this tricky future prospect, machine learning can be of great help – the long-term aim of the project is to develop an online or offline structure-detector assistant for the PC.

The tasks of the summer intern include: generating training data for the neural network using idealised PC setups; use the generated training data for deep learning network, the topology of which can be chosen by the student; apply the trained network to detect the predefined structures and track their evolution in time from the real simulation data. Prerequisites: Interest in applying ML in the domain of fluid simulations is a strong bonus. Basic knowledge on ML is required, and being familiar with toolboxes like Keras or Tensorflow is an extra benefit. Fluency in a high-level programming language (e.g. Python or C++) is required.

17. **Professor in charge of topic: Elisa Mekler** ([elisa.mekler@aalto.fi](mailto:elisa.mekler@aalto.fi))

**Academic contact person for further information on topic:** Barbara Keller ([barbara.keller@aalto.fi](mailto:barbara.keller@aalto.fi))
**Title of topic:** Mapping CS research over time: Identifying Trends and Blind Spots

**Description:** Publication networks such as co-author networks and citation networks yield a vast amount of information. As these networks tend to have thousands of nodes, a simple visualization of the network usually looks chaotic and does not lead to information gain. Here network analysis comes into play. Centrality measures and clustering algorithms help to sort and categorize information inherent to the network. The goal of this project is to analyze computer science related networks to gain interesting insights about underlying mechanisms and developments in CS and Human-Computer Interaction research over time, and present our findings in a visually appealing way.

Required Skills: Fluency in English, Programming experience, Interest in Human-Computer Interaction research and network analysis
Desired Skills: Experience with programming in python and graph visualization tools such as gephi, knowledge of data analysis methods.

**18. Academic contact person for further information on topic:** Selen Pehlivan Tort (selen.pehlivantort@aalto.fi), Jorma Laaksonen (jorma.laaksonen@aalto.fi)

**Title of topic:** Predicting Future Actions in First-Person Videos

**Description:** Action understanding in first-person view is one of the challenging problems of computer vision. With the increasing availability and popularity of the wearable cameras, recordings with these cameras have become a part of daily life and evaluation of daily human actions gain importance with new applications for health monitoring, robotics, autonomous driving, and entertainment. In the field, cooking videos have one particular interest with fine-grained actions including various type of human-object interactions in spatial-temporal domain. The EPIC-Kitchens dataset (https://epic-kitchens.github.io/2019) is the largest dataset on cooking videos in first-person vision with segment and object annotations. In this project, the objective is on action anticipation in first-person videos (predicting future action) by investigating recurrent models and developing a system using verb and object pairs.

Prerequisite: familiarity with video processing and computer vision, knowledge of deep learning frameworks and pytorch

**19. Professor in charge of topic:** Casper Lassenius (casper.lassenius@aalto.fi)

**Title of topic:** Agile Software Development in the Public Sector (2 positions)

**Description:** Agile software development is increasingly being adopted in public sector organizations, as part of the trends towards digitalization of services. These adoptions are not without challenges, and there is a pressing need for better understanding how to successfully transform such organization to use modern development methodologies and tools.

This position can be tailored to the student’s interests and background knowledge. For students with knowledge of Finnish or Swedish / Norwegian, there is a possibility to work with data from real public sector organizations (e.g Kela in Finland, and the taxation and welfare agencies in Norway).

In case the candidate does not have the language proficiency required for data analysis, there is a possibility to do quantitative analysis of Jira data, or of focusing on a literature study.
To be successful in this topic, the students need to have a working understanding of agile software development. Experience with qualitative or quantitative data analysis or Jira, and coursework related to organizational change management and organizational psychology are considered merits.

20. Academic contact person for further information on topic: Fabian Fagerholm
   (fabian.fagerholm@aalto.fi)

Title of topic: Game programmer and software designer for educational game

Description: Are you interested in game development? Would you like to help develop and design a digital component for an educational board game? Then this job may be for you!

We are developing a game that helps software developers learn about important development decisions in a fun way. We have designed a board game where players take on different roles in a software project and have to deliberate on development and project management decisions as they try to ship their product and build their company. The game now needs a digital component (an app that can be run on, e.g., a tablet) that can be used interactively alongside the physical game pieces to keep track of the game state, give instructions to the players, and make the game even more fun and engaging. It also enables new opportunities for research.

Your task would be to implement a first complete prototype of the digital component. You would also help develop the software architecture for the component and participate in play testing to validate the playability of the game. You could focus more on the game user interface or the internal game logic, but would be expected to contribute to both.

We are looking for applicants with the following profile:
- Active and self-directed team player
- An understanding of making maintainable software and working creatively with others
- Proficient in at least one modern programming language
- Ability to quickly learn a new programming environment
- Interested in game programming

We value:
- Python, C# and/or C++ skills
- Knowledge of modern game engines, particularly Open Source engines
- An understanding of game design
- Knowledge of game user interface programming and basics of UX
- An understanding of game logic programming
- An interest in educational games

It is possible to combine the summer job with a Master’s Thesis, depending on the status of your studies, your interests, and the match of the thesis topic to the project goals. This will be negotiated on an individual basis. The position is tentatively scheduled for 3-4 months from May to August 2020, but this is negotiable. The salary will be according to Aalto University policies.

21. Academic contact person for further information on topic: Fabian Fagerholm
   (fabian.fagerholm@aalto.fi)
Title of topic: Designing for better Developer Experience: Surveying the literature and creating materials for publications and the web

Description: Developer experience refers to the cognitive, motivational, and affective experience that software developers have with a process, tool, framework, or other experience object in the social setting of software development.

To design for better developer experience, we need to know more about the things that contribute to it. While the term developer experience is relatively new, there is an abundance of research that has examined factors related to the experience of software developers. Such research ranges from basic cognitive processes to complex, systemic views. However, it is often difficult to relate the research results to the experiential aspects of software development and get an overview of the state of the art.

Your task would be to help prepare new research on developer experience by collecting, organising, summarising, and synthesising existing research in the area. Part of the work would be manual and part would entail creating automated scripts for selected steps. You would also produce content for reporting the results in articles and on the web.

In the process, you would gain an extensive overview of research in software engineering, computer-supported cooperative work, cooperative and human aspects of software engineering, software design and development tools and frameworks, and related fields. You would also learn essential research skills and work with experts in the area.

We are looking for applicants with the following profile:
- Active and self-directed team player
- An interest in developer experience
- Ability to read and write academic text in English
- A basic understanding of literature reviews, including classification of articles, or a willingness to learn about them
- A basic understanding of psychological concepts or a willingness to learn about them

We value:
- Experience with reading scientific articles
- Knowledge of qualitative research methods to create classification schemes from rich, textual data
- Knowledge of methods for automated classification (e.g., machine learning)
- Skills in creating visualisations of data, including for presentation on the web
- Skills in creating web content

It is possible to combine the summer job with a Master's Thesis, depending on the status of your studies, your interests, and the match of the thesis topic to the project goals. This will be negotiated on an individual basis. The position is tentatively scheduled for 3-4 months from May to August 2020, but this is negotiable. The salary will be according to Aalto University policies.

22. Professor in charge of topic: Pekka Orponen (pekka.orponen@aalto.fi)

Title of topic: Software for the design of DNA nanostructures

Description: The area of DNA nanotechnology [1] employs DNA as generic building material for assembling nanoscale objects with dimensions in the order of 10-100 nanometres. In a significant contribution to this area, our group presented in 2015, together with a biochemistry team from...
Karolinska Institutet in Stockholm, a general technique for rendering almost arbitrary 3D wireframe designs into biomolecules folded from a single long DNA strand [2]. Our method, which has since then been widely applied and cited in international publications almost 300 times, is presently available as part of the DNA nanostructure design suite vHelix, hosted at the Karolinska Institutet [3].

The task in the present project is to improve the versatility and usability of the vHelix suite, by (i) separating the graphical and DNA design parts of the software into different modules, (ii) developing simple input and output interfaces to the DNA design module, so that it can be conveniently integrated to different graphical design tools, and (iii) developing a web interface for submitting graphical designs for processing on a server-based DNA design module.

The project requires good programming skills and preferably some experience in software-engineering type of work. Previous knowledge of biomolecules is not necessary, but familiarity with 3D design suites such as Maya or Blender is an asset. The work is performed in the context of research project “Algorithmic designs for biomolecular nanostructures (ALBION)”, funded by the Academy of Finland. For further information, please see the research group webpage at http://research.cs.aalto.fi/nc/.

Online sources:

23. Professor in charge of topic: Pekka Orponen (pekka.orponen@aalto.fi)

Academic contact person for further information on topic: Vo Hong Thanh (thanh.vo@aalto.fi)

Title of topic: Kinetic folding of RNA secondary structures with pseudo-knots

Description: RNA has recently been used as an emerging material for nanotechnology [1]. The topic of this internship project is to learn about the kinetic approach and its applications for investigating the self-assembly of RNA to fold nanostructures. We model the additions/deletions of base pairs in the current structure to form a new one as random processes. The structure formation is then realized by executing stochastic simulation [2].

The project aims to extend our current computational methods for modeling, simulating and analysing stochastic dynamics of the folding of RNA to include basic pseudo-knotted structures such as kissing hairpins. The project requires familiarity with basic probability and algorithm design techniques, together with good programming skills. Previous knowledge of biochemistry is not necessary, although it is an asset. The work is performed in the context of research project “Algorithmic designs for biomolecular nanostructures (ALBION)”, funded by the Academy of Finland. For further information, please see the research group webpage at http://research.cs.aalto.fi/nc/.

References:
24. **Professor in charge of topic: Antti Ylä-Jääski (antti.yla-jaaski@aalto.fi)**

**Title of topic:** Web-based AR/VR application development

**Description:** Currently, most of the Augmented and Virtual Reality content is created using game engines such as Unity and Unreal. Recently, new web-based tools such as Amazon Sumerian [1] and A-frame [2] have emerged which utilize browsers [3] as the build target for XR applications. In this topic, the student is expected to develop an AR/VR application with the existing web-based frameworks and report their maturity for XR development. The details of the particular developed XR application are discussed with the applicant before summer.


25. **Professor in charge of topic: Antti Ylä-Jääski (antti.yla-jaaski@aalto.fi)**

**Title of topic:** Web-based Augmented and Virtual Reality

**Description:** Virtual Reality and Augmented Reality are expected to rapidly gain momentum in the next few years. Currently, most of the VR and AR applications are build on top of game engines like Unity and Unreal. Web-based XR (AR & VR) could however simplify the development process and bring the same content to a variety of different client devices with only one code base and with no need to install a specific application for each use case. Early implementations of Web-based VR and AR have already been implemented a few years ago [1]. However, there were some shortcomings in its performance and easy of use.

At the moment the focus of Web-based XR is in the new WebXR specification [4, 6]. Third-party libraries (such as Three.js [2] & Aframe [3]) can also lower the technical barriers to entry for web-based XR development. In addition, OpenXR [5] could potentially solve parts of the XR development fragmentation by exposing a common API for different devices.

The purpose of this topic is to study the current maturity of XR development on the web. The student is expected to introduce the history and current state of Web-based XR technologies and to identify the existing limitations compared to native or game engine-based XR applications. A key factor to measure is the performance of Web-based XR against for example the same content build using a game engine.


26. **Professor in charge of topic: Antti Ylä-Jääski (antti.yla-jaaski@aalto.fi)**

**Title of topic:** A Relay HMD driver for Steam VR/OpenXR
Virtual Reality (VR) is envisioned to be the next "killer app" for both entertainment and productivity. One of the challenges of VR technology is the need for high computational power for rendering VR content. This limits the possibilities of un-tethered (or mobile) VR. Remote rendered VR is a possible solution [1]. In remote rendered VR, rendering is done on high powered hardware in the cloud or network edge and rendered graphics are streamed as encoded video to a "thin client" head mounted display (HMD). This approach allows displaying VR experiences even on devices with low compute and energy resources, e.g Google Daydream + smartphone. The cloud VR solutions proposed so far need some integration with the rendering engine (e.g Unity or Unreal) and cannot work with VR experiences developed for existing VR platforms like SteamVR and Oculus VR.

This topic will explore "Cloudifying" off the shelf VR experiences aimed at SteamVR. This can be done by developing a "relay" HMD driver which emulates a SteamVR compatible physical HMD and receives the rendered output from SteamVR, but instead of rendering it, the relay HMD would encode the graphics output and stream it to a Client device. Further, the relay HMD would receive sensor data from the client and relay it to SteamVR in a transparent fashion. This way, any SteamVR VR experience can be run on any client device, akin to cloud gaming platform GamingAnywhere [3].

Although such drivers are available in the market [2], they are not open source. This topic will go beyond just emulating the HMD driver and implement novel mechanisms for viewport adaptation which is important to mitigate latency and bandwidth issues in Cloud VR [4]. This topic starts off with development of the relay HMD as a summer project and is extensible to a bachelor's or master's thesis depending upon student interest.


27. Professor in charge of topic: Aki Vehtari (aki.vehtari@aalto.fi)

Title of topic: Computer Assisted Bayesian Modeling Workflow

Description: You will participate in a research project in which we will develop theory and methods for a principled and robust computer assisted Bayesian modeling workflow. To guarantee wide applicability of the project results in data science industry and academic research, the novel methods will be evaluated on a range of practical machine learning models and implemented as part of the leading open-source probabilistic programming systems. Prerequisite is knowledge Bayesian methods and probabilistic programming. Experience with Stan is preferred but not mandatory.

28. Professor in charge of topic: Juho Kannala (juho.kannala@aalto.fi)

Title of topic: Internships and thesis positions in computer vision and deep learning
**Description:** Computer vision is a rapidly developing field that is at the forefront of recent advances in artificial intelligence. Our group has broad research interests within computer vision. We are pursuing problems both in geometric computer vision (including topics such as visual SLAM, visual-inertial odometry, optical flow, image-based 3D modeling and localization) and in semantic computer vision (including topics such as object detection and recognition, and deep learning). We are looking for students interested in both basic research and applications of computer vision. Students with good programming skills and strong background in mathematics are especially encouraged to apply. The precise topics of the research will be chosen together with the students to match their personal interests. Examples of our recent papers include https://aaltovision.github.io/PIVO/, https://aaltovision.github.io/pioneer/, https://arxiv.org/abs/1808.04999 and https://arxiv.org/abs/1810.08393. For more papers and further information visit: https://users.aalto.fi/~kannalj1/

29. **Professor in charge of topic:** Mario Di Francesco ([mario.di.francesco@aalto.fi](mailto:mario.di.francesco@aalto.fi))

**Academic contact person for further information on topic:** Thaha Mohammed ([thaha.mohammed@aalto.fi](mailto:thaha.mohammed@aalto.fi))

**Title of topic:** Distributed deep learning inference in fog networks

**Description:** The proliferation of resource-constrained mobile devices and smart objects in the Internet of Things has led to the generation of a large amount of data. Due to the recent advancements in Deep Learning (DL), services and applications based on Artificial Intelligence (AI) have become an enabler of smart cities, factories, intelligent transport systems and much more. DL models are often built from collected data (training), to enable the detection, classification, and prediction of future events (inference). Due to the limited computing resources at end devices, these models are often offloaded to powerful computing nodes such as cloud servers. However, it is difficult to satisfy latency, reliability, and bandwidth constraints while offloading data to cloud servers for training and inference of AI models. Thus, in recent years, AI services and tasks have been pushed closer to the end users – to the fog – to meet these requirements. The main objective of this project is to implement a DNN inference offloading framework over fog networks developed in our research group and to evaluate its performance.

Required skills: background in deep learning and distributed computing; proficiency in Python. Desired skills: proficiency in any deep learning framework and Docker containers.

30. **Professor in charge of topic:** Mario Di Francesco ([mario.di.francesco@aalto.fi](mailto:mario.di.francesco@aalto.fi))

**Academic contact person for further information on topic:** Gopika Premsankar ([gopika.premsankar@aalto.fi](mailto:gopika.premsankar@aalto.fi))

**Title of topic:** Volumetric data streaming from smartphones

**Description:** Smartphones are increasingly being equipped with depth sensors, which measure depth directly and thus can be used in 3D reconstructions as well as volumetric streaming. In fact, recently, Samsung has recently released 3D scanning app that runs on their latest Samsung Galaxy Note and S10 5G smartphones. This application creates small-scale 3D models on the phone. The rise of 5G and edge computing will play a key role in enabling applications that can process large-scale depth data offloaded from smartphones. For instance, tele-presence applications can directly use depth data to reconstruct 3D models of people to enable new and immersive forms of
communication. Another promising application is the real-time streaming of the 3D environment in which a user is present. The goal of the project is to evaluate how to offload depth data from smartphones and to build a simple application that relies on such data generated by smartphones. The project will investigate the wireless bandwidth requirements of such applications and propose new schemes to efficiently offload such data.

Required skills: some background in computer graphics; proficiency in C++.
Desired skills: proficiency in computer graphics; experience with Android development.

31. Professor in charge of topic: Mario Di Francesco (mario.di.francesco@aalto.fi)

Academic contact person for further information on topic: Verónica Toro Betancur (veronica.torobetancur@aalto.fi)

Title of topic: Signal classification for cross-technology interference detection

Description: The Internet of Things (IoT) has motivated employing different technologies to satisfy diverse application-specific requirements. As a result, heterogeneous networks have to coexist in the same physical space and share the same frequency band, resulting in throughput degradation. Several works in the literature have addressed the problem of detecting interfering technologies; however, they focus on one or a few technologies. Moreover, the use of Machine Learning (ML) techniques as a tool to classify the signals and detect their native technology has not been carefully studied, even though it is recognized as a promising approach. The goal of this project is to implement a platform-independent ML algorithm to classify foreign interfering technologies, such as WiFi, ZigBee, Bluetooth, and so on. The project involves carrying out both simulations and experiments with software-defined radios to show the effectiveness of the algorithm.

Required skills: background in wireless communications and signal processing; proficiency in Python or C++.
Desired skills: experience with software-defined radios.

32. Professor in charge of topic: Mario Di Francesco (mario.di.francesco@aalto.fi)

Academic contact person for further information on topic: Maria Lorena Montoya Freire (maria.montoyafreire@aalto.fi)

Title of topic: Content optimization of tiled pervasive displays

Description: Pervasive displays are widely employed in public spaces to convey information to users. For instance, they are deployed in airports to provide information about flights status and in malls to show offers available at the stores therein. However, displays tend to be ignored by users if they are found to be neither informative nor interesting. Thus, a key challenge is the design of solutions that provide interesting content to users with limited time and attention. In particular, content selection is particularly challenging for tiled pervasive displays that show multiple content items at the same time. The goal of this project is to extend an existing approach developed in our group which relies on the information foraging theory for adaptive selection of display content based on audience data. The project involves analysis of data collected from a depth camera as well as the evaluation of the improved solution under real settings.

Required skills: proficiency in Python and Javascript; some experience with data analysis.
**Desired skills:** some knowledge on human computer interaction.

33. **Professor in charge of topic:** Mario Di Francesco ([mario.di.francesco@aalto.fi](mailto:mario.di.francesco@aalto.fi))

**Academic contact person for further information on topic:** Maria Lorena Montoya Freire ([maria.montoyafreire@aalto.fi](mailto:maria.montoyafreire@aalto.fi))

**Title of topic:** Camera-display communication with smartphones

**Description:** Camera-display communication is a very interesting paradigm for exchanging data between devices (particularly, smartphones) by using their screen (as a transmitter) and their camera (as a receiver). This form of communication has a potential for several applications, for instance, those leveraging bi-directional data exchange. However, significant challenges related to both dependability and ease of use need to be overcome for practical use. The goal of this project is to extend an existing prototype for camera-display communication with focus on its performance (namely, throughput and reliability) as well as usability in real settings.

**Required skills:** experience with Android application development; some background on networking protocols and human-computer interactions.

**Desired skills:** familiarity with qualitative research methods and experience in conducting user studies; as an alternative, proficiency in C/C++ development and Android NDK.

34. **Professor in charge of topic:** Mario Di Francesco ([mario.di.francesco@aalto.fi](mailto:mario.di.francesco@aalto.fi))

**Title of topic:** Cloud-native interactive labs

**Description:** Learning about new technologies is challenging if not adequately supported by appealing hands-on activities. A compelling approach is represented by interactive labs: an online environment made available to users as a web application over the Internet. Users can then follow a tutorial and carry out the related tasks directly in the browser, without the need to install any software locally on their computer. This is particularly beneficial for many cloud-native technologies (such as Docker and Kubernetes), the installation and setup of which could be very cumbersome in the first place. The goal of this project is to build an online learning environment for interactive labs as a web application, similar to Katacoda. The web application enables users to carry out interactive tutorials directly in their browser and allows an administrator (e.g., a teacher) to keep track of the progress / outcome of the labs. The project work includes the realization of a prototype with at least some of the features of a complete system.

**Required skills:** solid background in cloud computing technologies and web development.

**Desired skills:** hands-on experience with container deployment and orchestration; interest in applying cloud technologies to education.

35. **Professor in charge of topic:** Harri Lähdesmäki ([harri.lahdesmaki@aalto.fi](mailto:harri.lahdesmaki@aalto.fi))

**Title of topic:** Statistical machine learning and deep learning for personalized medicine

**Description:** We are looking for summer internship students to work on probabilistic machine learning and Bayesian deep learning models for biomedical and health applications. Our on-going research projects involve several important clinical challenges, such as (i) personalized prediction...
of immunotherapy efficiency for cancer patients using e.g. modern single-cell data, (ii) time-series analysis of multi-omics data from biomedical studies, (iii) (semi-)supervised analysis of extremely large-scale heterogeneous health data from Finnish biobanks, and (iv) novel cancer diagnostic methods using cell-free DNA time-series. Your work would include familiarising yourself with one of these projects (based on your preference), contribute to developing statistical/deep learning methods, and apply them to exciting real-world data from our national or international collaborators. Applicants are expected to have good knowledge of machine learning/statistics, programming, and interest in developing/applying probabilistic methods for bioinformatics and biomedicine. Research work can be continued after the summer. For more information and relevant recent work, see (http://research.cs.aalto.fi/csb/publications) or contact Harri Lähdesmäki (harri.lahdesmaki@aalto.fi).

36. Professor in charge of topic: Harri Lähdesmäki (harri.lahdesmaki@aalto.fi)

**Title of topic:** Bayesian deep learning for designing bacterial genomes

**Description:** Synthetic biology aims to manipulate and optimize bacterial species that are used in industrial and sustainable biotechnology. Advanced computational and bioinformatics methods have a central role in analysing large data sets from synthetic biology experiments and in designing bacterial proteins/genomes to achieve desired bioengineering goals. We are looking for summer interns to develop Bayesian deep generative models to analyse large-scale genetic data sets from high-throughput screening experiments and to optimize bacterial genomes to optimize protein expression in selected species relevant for industrial applications. Your work would include familiarising yourself with the state-of-the-art machine learning and deep learning methods, contribute to developing new statistical/deep learning techniques, and apply them to exciting real-world data from our collaborators in Europe. Applicants are expected to have good knowledge of machine learning/statistics, programming, and interest in developing/applying probabilistic methods for bioinformatics and synthetic biology. Research work can be continued after the summer. For more information and relevant recent work, see (http://research.cs.aalto.fi/csb/publications) or contact Harri Lähdesmäki (harri.lahdesmaki@aalto.fi).

37. Professor in charge of topic: Harri Lähdesmäki (harri.lahdesmaki@aalto.fi)

**Title of topic:** Bayesian deep learning

**Description:** Bayesian inference methods for deep learning models promises to provide robust learning that are not sensitive to overfitting and provide reliable uncertainty estimates. Our recent work include recently proposed deep/nonparametric differential equation models make it possible to learn arbitrary continuous-time dynamics from data without any prior knowledge. These models can also be used to implement state-of-the-art deep learning methods in the context of deep Gaussian processes or neural networks. These high-capacity continuous-time models can, however, suffer from over-fitting. Building on our recent results, your work involves further developing the models and implementing Bayesian inference methods (MCMC, variational inference) for robust inference. The work will include non-parametric probabilistic modelling, deep continuous-time models, deep Gaussian processes, and/or deep generative models (based on your preference). The goal of the summer internship is to contribute to development of these models and to implement these methods in e.g. Pytorch. The project requires good knowledge of machine learning, mathematics, statistics, and programming. Research work can be continued after the summer. For more information and relevant recent work, see
38. **Academic contact person for further information on topic**: Ilyena Hirskyj-Douglas  
(ilyena.hirskyj-douglas@aalto.fi)

**Title of topic**: Animal-Computer Interaction (ACI) Internship

**Description**: The design and building of technologies for animals is gaining attention in the field of Animal-Computer Interaction (ACI). To understand more how animals can use technologies, ACI researchers are further building technologies that connect animals together and allow animals to take control of their environment. Taking insight from Human-Computer Interaction (HCI), ACI is especially interested in interaction mechanisms and what it means to be an animal on the internet. There is also scope within this internship to work with the animals in Helsinki Zoo. You can view more about ACI and Ilyena at her personal website: https://ilyenahirskyjdouglas.wordpress.com/

**Requirements**:
- You should be comfortable with system design, building with micro-controller technologies with ideally some programming background to draw from.
- Prior skills in prototyping
- You must also speak English and Finnish.

39. **Professor in charge of topic**: Samuel Kaski (samuel.kaski@aalto.fi)

**Academic contact person for further information on topic**: Pierre-Alexandre Murena (pierre-alexandre.murena@aalto.fi)

**Title of topic**: Probabilistic interactive user models for interactive AI

**Description**: Most machine learning systems operate with us humans, to augment our skills and assist us in our tasks. In environments containing human users, or, more generally, intelligent agents with specific goals and plans, the system can only help them reach those goals if it understands them. Since the goals can be tacit and changing, they need to be inferred from observations and interaction. Join us in developing the probabilistic interactive user models and inference techniques needed to understand other agents and how to assist them more efficiently! Additional keywords: active learning, experimental design, knowledge elicitation, multi-agent learning, machine teaching, reinforcement learning


40. **Professor in charge of topic**: Samuel Kaski (samuel.kaski@aalto.fi)

**Academic contact person for further information on topic**: Joonas Jälkö (joonas.jalko@aalto.fi)

**Title of topic**: Privacy-preserving machine learning

**Description**: We develop methods for learning from data given the constraint that privacy of the data needs to be preserved. This problem can be formulated in terms of a concept called
differential privacy, and we have for instance introduced ways of sharing strongly anonymized versions of data (https://arxiv.org/abs/1912.04439). A couple of “minor” problems still remain; come to solve them with us! Requirements: strong background in math, especially in probability, decent skills in programming, and/or a steep gradient in the learning curve.

Link: http://research.cs.aalto.fi/pml/

41. Professor in charge of topic: Samuel Kaski (samuel.kaski@aalto.fi)

Academic contact person for further information on topic: Markus Heinonen (markus.o.heinonen@aalto.fi)

Title of topic: Bayesian deep learning

Description: In this summer project the goal is to explore Bayesian deep learning, which studies how we can embed performance-boosting neural networks into statistical models, or how to encode depth into Bayesian models. We have a number of exciting internship project ideas available! You will work as part of the PML research group that has several active complementary research projects on deep Bayes. You will learn how to utilise modern techniques such as probabilistic programming, Tensorflow, GPU’s during the summer project. Requirements: strong background in math, statistics or computer science and eagerness to learn the rest.

Link: https://research.cs.aalto.fi/pml

42. Professor in charge of topic: Samuel Kaski (samuel.kaski@aalto.fi)

Academic contact person for further information on topic: Jukka Siren (jukka.2.siren@aalto.fi)

Title of topic: Simulator-based Inference

Description: We are looking for a summer trainee to join the Aalto Probabilistic Machine Learning Group to do both basic and applied research in simulation-based inference. The summer project contains theoretical investigations and also hands-on application of the methods within our software package ELFI – Engine for Likelihood-free Inference. Students having strong background mathematics and interest in modelling and inference are especially encouraged to apply. Skills and interest in Python programming are considered a plus.


43. Professor in charge of topic: Samuel Kaski (samuel.kaski@aalto.fi)

Academic contact person for further information on topic: Charles Gadd (charles.gadd@aalto.fi)

Title of topic: Bayesian Experimental Design for model-based Reinforcement Learning

Description: In this summer project the goal is to explore Bayesian Experimental Design approaches for controlling the exploration-exploitation trade-off in model-based Reinforcement Learning. Within Reinforcement learning we aim to choose the optimal actions to achieve a task, and Bayesian Experimental Design gives a framework to make these decisions under the model
uncertainty. You will work as part of the PML research group, which has many complementary research projects in model-based Reinforcement Learning and Experimental Design. Requirements: a strong background in statistics or computer science.

Link: https://research.cs.aalto.fi/pml

44. Professor in charge of topic: Samuel Kaski (samuel.kaski@aalto.fi)

Academic contact person for further information on topic: Petrus Mikkola (petrus.mikkola@aalto.fi)

Title of topic: Probabilistic user models for interactive information visualization

Description: Successful machine learning techniques have been developed for Information Visualization, for “looking at the data”, which is a challenging task for high-dimensional data sets. What the techniques do not solve successfully yet, is how to personalize the visualizations for the user and the visualization task. We now have new ideas on how to do that based on advanced interactive user modelling, and we would welcome a student excited on this problem to join us solve the challenge. The work requires a strong background in computer science or statistics, and a willingness to learn quickly.

Links: https://research.cs.aalto.fi/pml/

45. Professor in charge of topic: Samuel Kaski (samuel.kaski@aalto.fi)

Academic contact person for further information on topic: Tianyu Cui (tianyu.cui@aalto.fi)

Title of topic: Probabilistic machine learning for genomics and precision medicine

Description: We are looking for a summer trainee to join us in developing new methods for finding genomic interactions underlying disease risk and other phenotypes. The work involves probabilistic modelling and deep learning, and the methods will also be needed and used in precision medicine later.

Link: http://research.cs.aalto.fi/pml/

46. Academic contact person for further information on topic: Markku Riekkinen (markku.riekkinen@aalto.fi)

Title of topic: Electronic examining (A+ Python Web Development)

Description: Come and develop the concept of and needs for electronic examining for programming and other subject-specific needs in Computer Science! The Exam studio concept is available at Aalto University, and it already includes the possibility to take for example programming exams using A+. Now, the electronic lecture hall exams with students’ own computers should be developed to be more straight-forward and tempting for teachers, so that an increasing number of teachers would provide students with electronic exams instead of exams with pen and paper.
Services within A+ family aim to provide efficient development and delivery of interactive online learning materials. The environment is used at Aalto University and Tampere University. At Aalto, there are around 25 courses, 4,000 Aalto users, 1,000 MOOC users and 500,000 exercise submissions per year. You can read more about A+ learning management system at https://apluslms.github.io/. As an A+ developer, you will be impacting the learning experience for thousands of current and future students in Finnish Higher Education, and in a starting international community!

Special requirements: Basic knowledge in Python or work experience in another high level programming language, Basic knowledge in web technologies including HTTP, HTML, CSS, Javascript, Familiarity with Django is beneficial, but not required.

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and EDIT's technical lead Markku Riekkinen markku.riekkinen@aalto.fi

47. Academic contact person for further information on topic: Markku Riekkinen (markku.riekkinen@aalto.fi)

Title of topic: Accessibility, usability, multilingual and ethical issues (A+ Python Web Development)

Description: The user experience A+ provides for teachers and students can always be developed. We invite you to come and tackle some of the major concerns and to promote aspects close to your heart. Tasks range from fixing problems around multilingual use to evaluating our systems against the EU accessibility directives. We hope that you are creative, have some insight on usability and want to take stand to the accessibility needs. Teachers also need further instructions, which we want you to develop. In addition, this is a splendid position to learn about ethical concerns or issues!

Services within A+ family aim to provide efficient development and delivery of interactive online learning materials. The environment is used at Aalto University and Tampere University. At Aalto, there are around 25 courses, 4,000 Aalto users, 1,000 MOOC users and 500,000 exercise submissions per year. You can read more about A+ learning management system at https://apluslms.github.io/. As an A+ developer, you will be impacting the learning experience for thousands of current and future students in Finnish Higher Education, and in a starting international community!

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Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and EDIT's technical lead Markku Riekkinen markku.riekkinen@aalto.fi

48. Academic contact person for further information on topic: Markku Riekkinen (markku.riekkinen@aalto.fi)

Title of topic: Analytics in A+ (A+ Python Web Development)
**Description:** Students submit numerous assignments in A+, but teachers don’t yet have versatile enough views for the weekly overall status of the situation. Come and help our teachers get a better picture of the situation, so that the course overall situation and per-student status can be visualised and e.g. students with additional support needs can be found and given more support. Services within A+ family aim to provide efficient development and delivery of interactive online learning materials. The environment is used at Aalto University and Tampere University. At Aalto, there are around 25 courses, 4,000 Aalto users, 1,000 MOOC users and 500,000 exercise submissions per year. You can read more about A+ learning management system at https://apluslms.github.io/. As an A+ developer, you will be impacting the learning experience for thousands of current and future students in Finnish Higher Education, and in a starting international community!

Special requirements: Basic knowledge in Python or work experience in another high level programming language, Basic knowledge in web technologies including HTTP, HTML, CSS, Javascript, Familiarity with Django is beneficial, but not required.

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and EDIT's technical lead Markku Riekkinen markku.riekkinen@aalto.fi

49. **Academic contact person for further information on topic:** Markku Riekkinen (markku.riekkinen@aalto.fi)

**Title of topic:** Interactive feedback (A+ Python Web Development)

**Description:** The Jutut service is used to collect student feedback regularly throughout a course. It is designed for interactive use and handling massive amounts of submissions. Teachers are able to answer students’ questions or react to expressed issues in the course whenever something arise. Furthermore, teachers analyse the feedback, so that they can improve and develop their courses. In this position, the focus of development is in the teacher’s interface; in making it more reactive and streamlined. Additionally, we are prepared for using machine learning in assisting teachers with the amount of messages.

Services within A+ family aim to provide efficient development and delivery of interactive online learning materials. The environment is used at Aalto University and Tampere University. At Aalto, there are around 25 courses, 4,000 Aalto users, 1,000 MOOC users and 500,000 exercise submissions per year. You can read more about A+ learning management system at https://apluslms.github.io/. As an A+ developer, you will be impacting the learning experience for thousands of current and future students in Finnish Higher Education, and in a starting international community!

Special requirements: Basic knowledge in Python or work experience in another high level programming language, Basic knowledge in web technologies including HTTP, HTML, CSS, Javascript, Familiarity with Django is beneficial, but not required.

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and EDIT's technical lead Markku Riekkinen markku.riekkinen@aalto.fi
50. Academic contact person for further information on topic: Markku Riekkinen (markku.riekkinen@aalto.fi)

Title of topic: The code similarity analysis engine Radar (A+ Python Web Development)

Description: The Radar service is a code similarity analysis engine. Currently, it is mainly used for, though not limited to, detecting plagiarism cases in our programming courses. Development areas range from improving stability and the performance, usability of the teacher’s interface and extending analytical features of the system.

Services within A+ family aim to provide efficient development and delivery of interactive online learning materials. The environment is used at Aalto University and Tampere University. At Aalto, there are around 25 courses, 4,000 Aalto users, 1,000 MOOC users and 500,000 exercise submissions per year. You can read more about A+ learning management system at https://aplusms.github.io/. As an A+ developer, you will be impacting the learning experience for thousands of current and future students in Finnish Higher Education, and in a starting international community!

Special requirements: Basic knowledge in Python or work experience in another high level programming language, Basic knowledge in web technologies including HTTP, HTML, CSS, Javascript, Familiarity with Django is beneficial, but not required.

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and EDIT’s technical lead Markku Riekkinen markku.riekkinen@aalto.fi

51. Academic contact person for further information on topic: Markku Riekkinen (markku.riekkinen@aalto.fi)

Title of topic: A+ Python Web Development

Description: When used A+ for your studies, did you notice anything that might have worked better? Come and develop A+ to be still better! We have a long list of ideas for improvement. You can also suggest your own ideas and get hired to implement them!

Services within A+ family aim to provide efficient development and delivery of interactive online learning materials. The environment is used at Aalto University and Tampere University. At Aalto, there are around 25 courses, 4,000 Aalto users, 1,000 MOOC users and 500,000 exercise submissions per year. You can read more about A+ learning management system at https://aplusms.github.io/. As an A+ developer, you will be impacting the learning experience for thousands of current and future students in Finnish Higher Education, and in a starting international community!

Special requirements: Basic knowledge in Python or work experience in another high level programming language, Basic knowledge in web technologies including HTTP, HTML, CSS, Javascript, Familiarity with Django is beneficial, but not required.

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and EDIT’s technical lead Markku Riekkinen markku.riekkinen@aalto.fi
52. **Academic contact person for further information on topic:** Markku Riekkinen ([markku.riekkinen@aalto.fi](mailto:markku.riekkinen@aalto.fi))

**Title of topic:** Development with program animation and annotation libraries (JavaScript Developer)


- **Special requirements:**
  - Working knowledge in Javascript
- **Experience with following will be beneficial but not required and will be included in what you will learn:**
  - Compilers, transpilers and scala internals (for JSVEE)
  - Container technologies and/or Docker

*Additional information with further requirements, positions and instructions for the applications: [https://wiki.aalto.fi/display/EDIT/Internships+2020](https://wiki.aalto.fi/display/EDIT/Internships+2020) and EDIT’s technical lead Markku Riekkinen [markku.riekkinen@aalto.fi](mailto:markku.riekkinen@aalto.fi)*

53. **Academic contact person for further information on topic:** Jaakko Kantojärvi ([jaakko.kantojarvi@aalto.fi](mailto:jaakko.kantojarvi@aalto.fi))

**Title of topic:** Next generation Javascript API for interactive exercises in A+ (JavaScript Developer)

**Description:** Design and development of next generation Javascript API for interactive exercises in A+

- **Special requirements:**
  - Working knowledge in Javascript
  - Basic knowledge about interface design
  - Mindset for security

*Additional information with further requirements, positions and instructions for the applications: [https://wiki.aalto.fi/display/EDIT/Internships+2020](https://wiki.aalto.fi/display/EDIT/Internships+2020) and A+ lead developer Jaakko Kantojärvi [jaakko.kantojarvi@aalto.fi](mailto:jaakko.kantojarvi@aalto.fi)*

54. **Academic contact person for further information on topic:** Jaakko Kantojärvi ([jaakko.kantojarvi@aalto.fi](mailto:jaakko.kantojarvi@aalto.fi))

**Title of topic:** Cloud Native Learning Environment Initiative

**Description:** A+ provides automated assessment for a range of use cases and A+ is even implemented using modern technologies. We are now in the progress of maturing the project and migrating components to cloud-based technologies. Our major goal is to make the A+ learning management system a cloud-native service. The positions below include development tasks from local material production and automated cloud deployment to supporting massive open online courses in scale.
The current focus is to support teachers by implementing course CI/CD tools with an easy-to-use and minimalistic interface. The service would facilitate building the course material and configuring our Kubernetes cluster for the course specific needs. Development areas range from user interface design to Kubernetes configuration and implementing deployment interfaces to backend services.

Special requirements: Working experience in Python and basic knowledge about web APIs, e.g. RESTful.

Experience with following is beneficial, but not required and will be included in what you will learn: Python web frameworks like Flask or Django, Kubernetes clusters, DevOps, CI/CD tools, Orchestration.

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and A+ lead developer Jaakko Kantojärvi jaakko.kantojarvi@aalto.fi

55. Academic contact person for further information on topic: Ari Korhonen (ari.korhonen@aalto.fi)

Title of topic: PeerWise via A+  

Description: PeerWise via A+: PeerWise (https://peerwise.cs.auckland.ac.nz/) supports students in creating, sharing and answering peer questions, which in turn supports students in learning, and reaching the intended learning outcomes in the course. Now, PeerWise will be be taken to use at the CS department, integrated in a meaningful way in the existing system setup. This includes at least authentication and grading interfaces, but can also include design and implementation of a research setup, in which case the work can continue as a Master's thesis in collaboration with e.g. the course TRAK Y in Autumn 2020.

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and Senior University Lecturer Ari Korhonen ari.korhonen@aalto.fi

56. Academic contact person for further information on topic: Anni Rytkönen (anni.rytkonen@aalto.fi)

Title of topic: Gradebook future with learning analytics

Description: Assignment grades and other points that affect the course grade are collected at the CS department in a specific gradebook service called Osasuoritusrekisteri. The idea of the services is to a) save the data, e.g. count the course grades, and b) use the data for follow-up and learning analytics. Similar systems are used at the Math department at Aalto and the CS department at the University of Helsinki, among others. All the services are reaching the ends of their life cycles, and should be replaced. We are looking for an intern who can support us in finding a meaningful solution for the future. The tasks range from comparing tools to requirements engineering. This topic suits for either a summer intern or, preferably, for a Bachelor's or Master's thesis.

Additional information, including further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and EDIT's team leader, Staff scientist Anni Rytkönen anni.rytkonen@aalto.fi
57. Academic contact person for further information on topic: Anni Rytkönen
(anni.rytkonen@aalto.fi)

Title of topic: Compare learning management systems for future needs

Description: The CS department at Aalto provides the A+ learning management system for subject-specific needs in Computer Science. Corresponding systems are provided at the University of Helsinki (TMC), at Jyväskylä University (TIM), at Tampere University (Weto) and at the University of Turku (ViLLE). We are looking for an intern who can provide us with deeper, comparative knowledge on the systems, their pros and cons, and the innovative, unique elements in them that provide added values for students and teachers. This topic suits for either a summer intern or, preferably, for a Bachelor's or Master's thesis.

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and EDIT's team leader, Staff scientist Anni Rytkönen anni.rytkonen@aalto.fi

58. Academic contact person for further information on topic: Jaakko Kantojärvi
(jaakko.kantojarvi@aalto.fi)

Title of topic: Course developer for Scala courses

Description: We look for course assignment developers to assist the teachers for the academic year 2020-2021 courses. Course developers are responsible of tools for course specific needs or needs for specific language for multiple courses. Please note that this is different from being a teaching assistant; there will be a separate call for that later in the spring. Developing Scala exercise testing framework and tools. These tools support automated assessment on many of our courses including Programming 1 and 2, Studio 1 and 2 and maybe others in the future.

- Special requirements:
  - Working knowledge in Scala and basic knowledge about JSON
  - Experience with unit testing and test frameworks

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and A+ lead developer Jaakko Kantojärvi jaakko.kantojarvi@aalto.fi

59. Academic contact person for further information on topic: Jaakko Kantojärvi
(jaakko.kantojarvi@aalto.fi)

Title of topic: Course developer for Python courses

Description: We look for course assignment developers to assist the teachers for the academic year 2020-2021 courses. Course developers are responsible of tools for course specific needs or needs for specific language for multiple courses. Please note that this is different from being a teaching assistant; there will be a separate call for that later in the spring.
Developing Python exercise testing framework and tools. These tools support automated assessment on many of our courses including ohjelmoinnin peruskurssi Y1 and Y2, Tietorakenteet ja algoritmit Y and hopefully others in the future.

- Special requirements:
  - Working knowledge in Python and basic knowledge about JSON
  - Experience with unit testing and test frameworks

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and A+ lead developer Jaakko Kantojärvi jaakko.kantojarvi@aalto.fi

60. Academic contact person for further information on topic: Juha Sorva (juha.sorva@aalto.fi)

Title of topic: Course developer for Programming 1 (Scala)

Description: We look for course assignment developers to assist the teachers for the academic year 2020-2021 courses. Course developers are responsible of tools for course specific needs or needs for specific language for multiple courses. Please note that this is different from being a teaching assistant; there will be a separate call for that later in the spring.

O1 a.k.a. Programming 1 (https://plus.cs.aalto.fi/o1/) has a number of development projects. Join the O1 teachers and head TAs in developing this popular introductory course!

- Special requirements:
  - Working knowledge in Scala

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and Juha Sorva juha.sorva@aalto.fi

61. Academic contact person for further information on topic: Jan-Mikael Rybicki/Language centre (jan-mikael.rybicki@aalto.fi)

Title of topic: Course developer for language courses

Description: We look for course assignment developers to assist the teachers for the academic year 2020-2021 courses. Course developers are responsible of tools for course specific needs or needs for specific language for multiple courses. Please note that this is different from being a teaching assistant; there will be a separate call for that later in the spring.

Assignments for language studies: the teachers at the Language Centre want to provide students with more versatile assignments with rich feedback. Come and help teachers in creating the assignments and course contents! In addition to the salary, you have an opportunity to earn some language credits, depending on the languages used during the summer.

- Special requirements:
  - Basic knowledge in Javascript, JSON and CSS

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 and Jan-Mikael Rybicki/Language centre, jan-mikael.rybicki@aalto.fi
62. Professor in charge of topic: Lauri Malmi (lauri.malmi@aalto.fi)

Academic contact person for further information on topic: Otto Seppälä (otto.seppala@aalto.fi)

Title of topic: Course developer for Studio 2 (Scala)

Description: We look for course assignment developers to assist the teachers for the academic year 2020-2021 courses. Course developers are responsible of tools for course specific needs or needs for specific language for multiple courses. Please note that this is different from being a teaching assistant; there will be a separate call for that later in the spring. We need people for creating new learning resources for Programming studio 2 (https://plus.cs.aalto.fi/studio_2/k2020/). These include building new programming exercises and improving current ones, as well as developing new resources for learning how to build graphical user interfaces.

- Special requirements:
  - Working knowledge in Scala programming

Additional information with further requirements, positions and instructions for the applications: https://wiki.aalto.fi/display/EDIT/Internships+2020 Lauri Malmi lauri.malmi@aalto.fi and Otto Seppälä otto.seppala@aalto.fi

63. Professor in charge of topic: Mikko Kivelä (mikko.kivela@aalto.fi)

Title of topic: Course developer Programming 2

Description: We look for a developer for the Programming 2 course. There are projects related both to the backend of the course and new exercises. An ideal candidate would have taken the course with grade 5 and be enthusiastic about developing it further and knowing what is happening in the background. Most of the codebase for the course is in Scala, but some of the backend implemented with Python. Please note that this is different from being a teaching assistant.

Special requirements: Working knowledge in Scala and Python

64. Professor in charge of topic: Mikko Kivelä (mikko.kivela@aalto.fi)

Title of topic: Analysing social networks and human behaviour data and models

Description: I am looking for an enthusiastic summer student to join my research group. Our research is within the field of complex systems and spans a range of topics from human behaviour to analysis of large-scale networks. The methods we use vary between data analysis and theoretical work on random networks. We have several ongoing and upcoming projects that the student could join: analysing social networks and human behaviour in games, analysing attention patterns from large-scale data, modelling and analysing polarisation in social networks, theoretical models in temporal networks and multilayer networks, etc. An ideal candidate will have a background in computer science, mathematics or statistics and have programming skills in Python (or C/C++ for simulations studies) or mathematical skills related to network science.