Programmes and their Project Requirements

This comprehensive document outlines each of our master's programmes and what their thesis requires/entails. This document will provide a description of the thesis, areas of research, examples of past project titles and the requirements of the thesis for each of the programmes. We hope that this document will answer any questions you may have, as well as allow you to submit project proposals more easily and correctly. If you have any questions, please do not hesitate to contact us at thesisfair-lvl@uva.nl.

Table of Contents

Time/duration

- Duration of project: depends on the programme and ranges from 3 months to 8 months

Language

- Project submission language: the project proposal submission needs to be **in English**, but you can indicate that the language of the project will be Dutch. Please make sure to clearly indicate this with the project proposal submission.

Supervision

- Every student will require a dedicated daily supervisor/mentor at your organisation.

Workspace

- Throughout the project, you will need to give the student will time and space to be able to conduct their research
- Students will be required to attend meetings with their UvA supervisor and other MSc thesis meetings. Please give the student the flexibility to attend these meetings.

Compensation

- Compensation is not required but some students may exclusively choose a project that offers renumeration.

UNL Internship Requirements

The UNL (Universities of the Netherlands) internship agreement provides guidance for universities, students, and companies using the national model agreement for internships in academic (WO) education. This model was developed to streamline the creation of internship agreements by offering a legally sound, consensus-based framework, eliminating the frequent need for legal consultation. Its development involved extensive input from businesses, universities, and student representatives. The agreement helps universities fulfill their statutory duty of care toward students, including maintaining academic integrity and ensuring internship-related documents, are auditable and transparent.

The agreement is grounded in Dutch law and tailored to domestic internships, though it can be used by non-European students interning in the Netherlands. It allows room for customized clauses through a "Particulars" section, though deviations from core conditions are limited. Intellectual property (IP) generated during the internship typically belongs to the host company unless the university or student contributes substantially outside the internship scope. Copyright of the final report remains with the student, but sensitive content can be embargoed for 2 to 5 years (or longer in specific sectors) to protect trade secrets.

Careful language has been used to avoid blurring the lines between internship and employment, particularly for tax reasons. Company rules may apply during the internship but must align with the agreement terms, particularly concerning confidentiality. Interns and university staff are held to the same confidentiality standards as company employees. Interns must be adequately supervised, and health insurance requirements are clarified, especially for international students. Lastly, universities, as publicly funded bodies, must ensure that any transfer of knowledge or resources to the private sector adheres to state aid regulations, charging at least cost price for any services rendered.

Please note that the following organisations are exempt from this UNL Internship policy:

- Internal UvA departments and Research Groups.
- (Academische) ziekenhuizen, zoals het AUMC
- De Nationale Politie
- Het Nederlands Forensisch Instituut
- Het Ministerie van Defensie

Here are important links:

- The official document with all stipulations listed.
- An addendum.
- The official contract.
    - Please note that on page 3, Article 16.4 is ticked as “applicable” as per UvA policy.
- The UNL website with all documentation, including Dutch versions.

For any questions, please contact internshipagreement-science@uva.nl

MSc Artificial Intelligence

Project requirements
The submitted project must be written in English. If the project requires a Dutch speaker please state that in the project description.

Thesis projects for the AI Master should focus on research. Hence, the main project requirement is a clear research question the student can answer during the six months of the thesis.

The goal of the thesis
The high-level goal of the thesis is for the student to demonstrate that they are capable to formulate a clear research question; make a plan to answer it within a given timeframe; and answer it convincingly: a good thesis is actionable and could be used as a base for future research. As such, both "positive" and "negative" results are valued, granted they are motivated and come from a clear and unambiguous protocol.

The final grade of the thesis project is mostly determined by the final manuscript: its scientific content, but also presentation, readability are all assessed. Adherence to deadlines and student attitude is also taken into account.

Examples of successful past thesis projects
Successful examples:

1. Greedy InfoMax for Self-Supervised Representation Learning
2. Deep Learning Methods for Deconvolution in Radio Astronomy
3. Deep Reinforcement Learning for Coordination in Traffic Light Control

What does a good project proposal look like?
A good proposal includes a clear and sufficiently novel research question, an interesting research problem, and relevant context (which includes motivation for the research question and optional references). Notably, the question should be able to be answered with a 'yes'/'no'/'how much'. Simply attempting to solve a given problem is too broad and not clear enough. But testing if given method can perform well for some task is a better framing of the question. Negative results should be a possible outcome, provided they help to build knowledge and understanding of the task and problem.

What does an MSc student from your programme look like?
An AI MSc student undertaking their thesis will be a 2nd year master's student. The student has a solid foundation in machine learning theory and application, with specialties ranging from computer vision and natural language processing to reinforcement learning and traditional AI.

By completing the project, a student will be able to:

- Analyse the scientific literature most relevant to the thesis topic, and develop a clear research plan based on said literature and own knowledge.
- Demonstrate the ability select and apply a broad range of methods and techniques relevant to the task.

- Assess the results quantitatively and/or qualitatively (whichever is applicable), thoroughly and unambiguously.
- Summarise the work performed and its findings, while remaining accessible to a broader, non-expert audience.
- Discuss the high-level impact of the work, both within its own field, and with respect to the larger societal context.

Main areas of research

- Machine learning
- Computer vision
- Natural language processing
- Reinforcement learning
- AI
- Information retrieval

Timeline of the thesis

The typical student will start their thesis in January and last typically for 6 months:

- 1 month: developing and understanding
- 2-3 months for developing method
- 2-1 months: finalising
- 1 month: polishing the writing

Scope of the project

A thesis manuscript should contain relevant analyses, methods, and experiments to support the research question.

MSc Computational Science

Project requirements
The submitted project must be written in English. If the project requires a Dutch speaker please state that in the project description.

The graduate in Computational Science has a thorough knowledge of modelling and simulation of complex systems, computational methods and techniques, and the application of computational methodologies in application fields (ranging from e.g. physics or biology to medical sciences or engineered systems to complex social systems).

The computational science thesis should include one or more of the following broad aspects:

- Developing computational models, that implement causal mechanisms to understand and predict the behaviour of any system. This could be any system such as social, technical, engineered, biological, physical etc. or
- Computational or mathematical techniques to analyze the behaviour of such models. These include strategies for sensitivity analysis, calibration and validation of models. or
- Developing computing techniques (e.g. distributed algorithms) to enable large scale, computational models.

The goal of the thesis
The thesis aims to enable the student to develop more in-depth knowledge, understanding, capabilities, and attitudes in the study programme. A Master of Computational Science thesis should emphasize the scientific and modelling (computational) aspects of the specific system under investigation. The thesis's overall goal is to display the knowledge and capability required for independent work as a computational scientist.

Computational models are intended to implement causal processes in a single mechanism, which sets them apart from traditional data analysis techniques (such as machine learning) which are applied directly to available data. Without incorporating the same causal mechanisms either explicitly or implicitly (on which research indeed is taking place), in general, data analysis should be restricted to make inferences or predictions 'within the data (e.g., clustering, regression, interpolation) or perhaps 'near extrapolation' (hypothetical scenarios which are still close to that of the data). The outcome of 'far extrapolation', however, requires incorporating the relevant causal processes (since their validity extends beyond any data set), which is by definition the goal of computational modelling.

This distinction can also be seen by comparing the 'inductive capability' of the learning algorithms (from past data, one can identify patterns) with the deductive capability of computational (mechanistic) models.

Examples of successful past thesis projects

1. Understanding biomass dynamics in semi-arid ecosystems A computational means to an organic end.
2. Causal Discovery from Spontaneous Targeted Interventions
3. Effects of internal viscosity contrasts in a blood flow model based on immersed boundary lattice Boltzmann methods
4. Optimizing Resource Allocation in Socio-economic Systems with the Minority Game: A Case Study on Electric Cars
5. Rethinking Global Sensitivity Analysis for Agent-Based Models: from Scalar Outputs to Stochastic Trajectories
6. Complex Systems Analysis of Multi-Level Poverty Traps
7. Modelling Interstellar Conflict

What does a good project proposal look like?

1. Clearly highlight the novelty of the proposed research and how it builds on the current state-of-art?
2. Clearly highlights the significance of the research. Why now?
3. Clearly highlight the data availability (if applicable) and how data will be accessed.
4. Computational techniques that will be applied in the research with a focus on mechanistic understanding and interventions.
5. Planned research outcome.

What does an MSc student from your programme look like?

The programme is oriented to prepare students for entry into a PhD programme in Computational Science or related disciplines, or into research positions outside academia. This is mainly triggered by the strong need in science and society for computationally trained researchers, in academia, industry and business.

A number of core and constrained courses (in the first year) help develop students with an independent and scientific mindset.

1. A CLS student is an expert in modelling and simulation as the third pillar of science and is capable of applying abstract models to understand societal questions. Courses such as Agent-Based Modelling and Complex System Simulation (in addition to teaching knowledge and skills) ask students to develop their own research questions and models by themselves on a diverse set of topics.
2. Students can apply models to Implement and study interventions and what-if scenarios to improve/optimize with respect to a practical application.
3. The student has basic knowledge about different techniques for modelling biochemical reactions, metabolic pathways, regulatory networks and cells (Boolean networks, coupled with

ordinary differential equations, examples of partial differential equations, optimization techniques, and cell- based models)

4. Students obtain insight into distributed algorithms - concurrency concepts and are offered a bird's-eye view of a wide range of algorithms for basic and important challenges in distributed systems

By completing the project, a student will be able to:

1. Develop a robust understanding of modeling and simulation as the third pillar of science.
2. Independently formulate and analyze abstract models to tackle societal, scientific, and industrial challenges.
3. Design and conduct research projects that involve defining research questions and creating models.
4. Develop an independent and scientific mindset to pursue further academic or industrial research.
5. Build skills for creating novel models, designing interventions, and contributing to fields like computational science, data science, systems biology, and distributed computing.

These competencies will prepare students for advanced research roles in academia, industry, or government organizations and enable them to effectively contribute to solving complex computational and societal challenges.

Main areas of research

- Complex adaptive systems
- Computational Biology
- Computational Finance
- Computational Economics
- Computational Engineering
- Theory of complex systems

A rough timeline of the thesis

7 to 8 months, typically starting in November.

Scope of the project

The projects are not limited to any systems and context as long as they adhere to the requirements.

MSc Computer Science

Project requirements
The submitted project must be written in English. If the project requires a Dutch speaker please state that in the project description. The project has the required academic level and content. The project must enable the student to learn to conduct independent research under supervision, on a research question that has been clearly defined in advance. A student on a placement may not carry out simply routine work. The project should be feasible.

The proposal must include: the problem statement, the research question(s), a short description of the proposed method, and a planning that also states the frequency the student will meet with the daily supervisor/main supervisor.

Goal of the thesis
A thesis and/or placement assignment is an important part of the Master programmes and involves many different aspects, such as theoretical preparation, practical execution, literature survey, report and thesis writing, oral presentation, and participation in the scientific activities of a research department. The Master Project is the programme component where scientific and professional skills are trained most extensively. The Master Project always involves an element of originality or creativity. A student will use all the knowledge acquired during the studies to perform a design task or to contribute to solving a scientific problem in the computer science field.

Example of successful past thesis projects
- Enhancing and Assessing a Prefetching Technique for Android apps
- Android Time Machine: A Graph-based Dataset of Commit History of Real-World Android Apps
- Parallel Detection of Strongly Connected Components with Prioritised Vertices
- A Scalable and Hybrid Cloud Framework for Evaluating Streams of Sensor Data in Real-Time
- Dangless MAlloc: Safe Dangling Pointer Errors
- Detecting information leaks using kernel-level multi-variant execution
- A Learning-based Approach for Stream Scheduling in Multipath-QUIC
- Adaptive Latency Control for Edge Video Stream Analytics
- Automatic test case generation based on properties as scenarios for Axini Modeling Language

By completing the project, a student will be able to:
- Identify a scientific problem in a computer science-related field
- Formulate one or more research questions to guide the project
- Design a solution to answer the research question(s) in a limited period of time, implement the solution and critically analyze the results
- Collaborate with supervisors and other students and communicate (both orally and in writing) about their progress, the results, and the lessons learned.

Main areas of research

- Artificial Intelligence
- Bioinformatics
- Computer Systems
- High Performance Distributed Computing
- Systems and Network Security
- Massivizing Computer Systems
- Foundational and Experimental Security
- Sustainable Digital Society
- Software and Sustainability
- User Centric Data Science
- Decentralized Information Society Engineering
- Theoretical Computer Science

Duration

The thesis should be concluded within 5 months with the majority of the students starting in February.

Scope of the project

The projects are not limited to any systems and context as long as they adhere to the requirements. A thesis manuscript should contain relevant analyses, methods, and experiments to support the research question.

What does an MSc student from your programme look like?

The MSc student undertaking the master project will be a second year master's student. Student should ideally have completed the 90% of the course work in order to have a solid foundation of the theory, practical and application skills of computer science field.

Course Content

The Master Project is the programme component where scientific and professional skills are trained most extensively. The Master Project always involves an element of originality or creativity. A student will use all the knowledge acquired during the studies to perform a design task or to contribute to solving a scientific problem in the computer science field.
The project can take place either inside the Department of Computer Science of the VU or the Informatics Institute of the University of Amsterdam or as an internship in a company. In the case of an internship, supervision will be in cooperation with a daily supervisor at the company. In both cases, a detailed project proposal must be written and approved in advance by a staff member, who in this way agrees to act as project's main supervisor. The proposal must include: the problem statement, the research question(s), a short description of the proposed method, and a planning that also states the frequency the student will meet with the daily supervisor/main supervisor. The main supervisor needs to find a second reader for the thesis, who must also be a staff member.

Additional Information Teaching Methods
The project can take place either inside the Department of Computer Science of the VU or the Informatics Institute of the University of Amsterdam or as an internship in a company. In the case of an internship, supervision will be in cooperation with a daily supervisor at the company. In both cases, a detailed project proposal must be written and approved in advance by a staff member, who in this way agrees to act as project's main supervisor.

In most cases, the Master project is performed as an individual project, under close and regular supervision by the main supervisor and the daily supervisor. In exceptional and well-argued cases, students may execute projects in small groups, when the project lends itself for. The project starts when the project proposal has been signed by both students and supervisors. The student plans regular meetings with the daily supervisor and the main supervisor to discuss the progress. Towards the end of the project, the student gives a presentation in the research group of the supervisor or at the company where the internship took place. The student submits their thesis which will be evaluated by the main supervisor and the second reader.

MSc Information Studies:
Data Science (DS) and Human-Computer Interaction (HCI)

The MSc Information Studies has two tracks, namely Data Science (DS) and Human Computer Interaction. Students in the DS track focus on data, related structures and their algorithmic processing, for the generation of information, and the maintenance of data and information, mainly using machine learning approaches. Students in the HCI track focus on the ways in which people, organisations and societies interact with data-driven technologies, and investigate how we can design such technologies in ways that are effective, ethical and inclusive.

Project requirements

The submitted thesis must be written in English. If the project requires a Dutch speaker, please state that in the project description. Students must have completed all courses from the previous four teaching blocks before starting the project.

1. A typical Data Science thesis requires hand-labelled data, sufficient complexity going beyond simple approaches such as linear regression and a proper evaluation setup (cross-validation, using more than 1 dataset, train/test, et cetera).
2. A Human Computer Interaction thesis typically involves original research at the intersection of human behaviour, technology and interaction design. Acceptable projects include empirical user studies, and/or the design and evaluation of novel interactive systems. Projects are grounded in a clear research question, a systematic methodology, and a critical reflection on implications for both theory and practice.

A Master's thesis is an individually written record of original research or design of a scientific nature. It is an original, independent, creative work composed specifically for this purpose. All claims, hypotheses, policy recommendations and design choices must be supported by existing theory and/or empirical evidence. The thesis must be the student's own work: sources such as the internet, books and journals must be properly cited and referenced. The thesis content cannot include material already submitted elsewhere (e.g. other courses, study programmes, universities). It may, however, build on prior work, provided the student's contributions in the context of the thesis project are clearly distinguished from any such prior work.

The goal of the thesis

The focus of the thesis research is the scientific study of a problem relevant to current research themes in academia and society. It aims to give students an opportunity to acquire practical experience in quantitative and/or qualitative research methods and to learn to work independently. It also provides students with first-hand experience of working with established scientists or industry experts over an extended period of time.

Learning objectives

After completion of the research project, the student is able to:

- formulate a clear research question in the field of information studies (i.e. human computer interaction or data science) and design a plan to address that question

- demonstrate knowledge of the state-of-the-art in the relevant research area (as evidenced in the scientific literature) and apply it in a practical context
- process and analyse research data and critically evaluate the results in relation to the broader research goals
- present all of the above in a well-structured written report, justifying the methodology and substantiating original arguments
- present and discuss findings with both scientific and non-scientific audiences
- function effectively in a professional environment.

Examples of successful past thesis projects

1. Efficient Image Similarity Clustering within Apple Orchards on Edge Devices
2. Echocardiographic Clustering by Machine Learning in Children with Early Surgically Corrected Congenital Heart Disease
3. End-to-End Learning on Multi-Edge Graphs with Graph Convolutional Networks
4. Improving the Precision of the HyperLogLog Algorithm by Introducing a Bias
5. "Swipe, watch, scroll, repeat: Assessing temporal costs of Endless Short-Format Video Scrolling on Social Media"
6. "Exploring the Impact of Soundscapes in Headspace on User Focus: A Mixed-Methods Study Using Thematic Analysis and Behavioral Experimentation"

What does an MSc student from your programme look like?

The students have good analytical skills regarding problem identification. They can identify potential solutions to the problem and then find in this solution space the answer that best addresses the problem.

Main areas of research

- machine Learning
- natural language processing (NLP)
- media analysis
- data analytics
- HCI

Given the programme's interdisciplinary nature, students bring knowledge from a broad range of domains.

TImeline

The project runs in two parts: a 3-month design phase (part-time), followed by a 3-month full-time project phase. The project typically runs from 1 April to 30 June.

Scope of the project

Students address a feasible research question using quantitative and/or qualitation methods. Given the fixed 3-month timeframe, the problem should be well-defined and manageable in scale (for example, comparing two machine learning approaches to determine which performs better in a given context).

MSc Logic

Project requirements
The submitted project must be written in English. If the project requires a Dutch speaker please state that in the project description.

30EC of work, including the writing of the thesis.

The goal of the thesis
The thesis is a report on a substantial piece of scientific work, usually including a significant amount of original research that clearly demonstrates the student's capacity to independently conduct research in an interdisciplinary environment.

Examples of successful past thesis projects
1. Communicate and Vote: Collective Truth-tracking in Networks
2. The Classicality of Epistemic Multilateral Logic
3. A Compositional Analysis of Dependence Statements
4. Hyperintensional Logics for Evidence, Knowledge and Belief
5. Algebraic models of type theory

What does a good project proposal look like? What do you want to see included?
To be decided case by case.

What does an MSc student from your programme look like?
Mainly formal-theoretical research skills, background in the theoretical sciences like, e.g., Theoretical Computer Science, Theoretical Linguistics, Mathematics and Philosophy.

Main areas of research
Theoretical sciences such as:
- Theoretical Computer Science
- Theoretical Linguistics
- Mathematics
- Philosophy

A rough timeline of the thesis
The whole thesis amounts to roughly 5 months of work.

Scope of the project
Depends on the project.

MSc Software Engineering

Project requirements
The submitted project must be written in English. If the project requires a Dutch speaker please state that in the project description.

The project requires scientific research contributions. The project should be a mix of theory and practice.

The goal of the thesis
The student should aim to master the scientific research process.

Examples of successful past thesis projects

1. Measuring the degree of library dependency (available at: https://zenodo.org/record/4280883#.YqiXvexBzPY)

What does a good project proposal look like? What do you want to see included?
A clear description of the dataset/infrastructure/lab-like environment/real-life case/application that the company can provide the student access to.

What does an MSc student from your programme look like?
The students from MSc SE are quite heterogenous: different countries, and different previous education; one thing they have in common: software is their second nature.

Main areas of research

- Software engineering
- Software testing
- Software evolution
- Model-based design
- DevOps
- Requirements engineering
- Software process
- Microservices
- Programmeming languages
- Cyber-physical systems
- MLOps
- DataOps
- DApps
- Data engineering

A rough timeline of the thesis
1 month thesis proposal, 3-5 months thesis implementation.

Scope of the project
Ideally, publishable research, at least at a workshop level

Important information
We work a lot of time on co-designing the research proposals. We do not expect companies to be able to formulate scientific research questions, but we always find very interesting scientific research problems that could be solved by our students and the solutions validated in the context of these companies. So, for SE, the companies are lab-like environments where our students conduct real-life experiments. This is extremely valuable and makes our programme attractive and high standard. This means however a lot of work in the weeks after the Thesis Fair when the thesis coordinator sits down with students and helps them identify the research gap in these industry projects.

Of course, this is mostly not the case with projects proposed by our former students that are now working in various companies. They already know what we look for in a project and how to formulate scientific research questions.

MSc Security and Network Engineering

Project requirements
The project requires novel scientific research contributions. The project should combine theory and practice. The submitted project must be written in English. If the project requires a Dutch speaker please state that in the project description. The thesis amounts to 18EC of work, including the writing of the thesis, i.e. the rough equivalent of 3-month full-time work.

The goal of the thesis
Through the thesis, the student should aim to master the scientific research process. They should formulate clear research questions, understand and improve the state-of-the-art in a particular field and critically reflect upon their results. During the thesis, the student should demonstrate independence and the ability to function in a professional setting. The thesis culminates in a manuscript and a scientific presentation. By completing the project, the student will be able to produce an innovative manuscript in the academic field of Computer Networks and/or Cybersecurity and present their findings to a specialized audience.

Examples of successful past thesis projects

- Exploring Programmable Network Techniques for Data Plane Optimization
- Automated Machine Learning for power-based Side-Channel Analysis
- Elastic data services for time critical distributed workflows
- Ethereum Smart Contract Fuzz Testing
- High-performance implementations of cryptographic primitives in RISC-V
- Building an open-source, flexible, large-scale static code analyzer
- Security of IoT communication protocols on the AWS platform
- Assessing data remnants in modern smartphones after factory reset
- TCP-Prague evaluation and enhancement
- Persistent Fault Analysis: attacks and countermeasures
- Future tooling and cyber defense strategy for ICS

What does a good project proposal look like? What do you want to see included?
The proposal must include a solid and new research question, and a relevant context and motivation, coupled with existing academic references. The proposal should have clear description of the dataset/infrastructure/lab-like environment/real-life case/application that the company or organization can provide to the student.

What does an MSc student from your programme look like?
All SNE students (Dutch and international) have been accepted into the MSc programme after an intake exam, to ensure that they are proficient with standard networking protocols (TCP/IP stack), Linux console/environments, Python coding, basic mathematics as well as reading/writing/reasoning skills. Their past education is often a BSc in Computer Science (or related degree) from either University (WO) or from University of Applied Sciences (HBO). Several SNE students have past work

experience in the ICT field. All SNE students are very keen on delving deep into the technical details of a particular problem/topic and deploying/testing it in real-world infrastructure.

Main areas of research

- Network/protocol security
- Software security, exploits, secure coding
- Penetration testing
- Digital forensics
- Intrusion/anomaly detection systems
- Applied cryptography, implementations, physical attacks
- Any other related cybersecurity topics
- Sustainable Cloud Computing
- Cloud FinOps: Cost-Optimization in Cloud DevOps
- Virtualization and Resource Provisioning
- Intelligent Network Resource Allocation
- Machine Learning -based Network Optimization & Management
- 6G Networks
- Any other related computer network topics

A rough timeline of the thesis

3 months of full-time work

Scope of the project

A thesis manuscript should contain relevant analyses, methods, and experiments to support the research question. The work should, ideally, lead to publishable research.

Important information

Every SNE thesis is carried out in collaboration with an academic supervisor (UvA staff member) that co-designs the research proposals/questions and assists the student in solving the real-world problems posed by the industry.