Høyskolen Kristiania

Programme description

Bachelor in Data Science

180 credits

2020-2023

The study programme was accredited: 31.10.19 (HK-case no. 34.7/19)
The study programme was approved: 06.11.19 (UU/EIT-case no. 32/19)
The programme description has been approved by the Education Committee 06.11.19 (UU/EIT-case no. 32/19)

Innhold

1. Introduction

The Bachelor in Data Science is a research-based full-time undergraduate level program covering the academic disciplines of computer science, information science, statistics, computational linguistics, and data ethics. Throughout the studies, a close collaboration with the (inter)national industry is applied. Guest lectures are organized on a frequently basis and courses are given by a combination of national and international staff from partners in academia and business. The content of the courses is aligned with industry needs, and real-world cases are applied in assignments and exams. After completing the degree, the candidates can be recruited to several different positions in private and public sector, as well as pursue a master's degree nationally or internationally. Some examples of job opportunities are data analyst, data scientist, business developer, project manager, big data specialist and several more.

1.1 Formal requirements

Higher Education Entrance Qualification is required for admission. In addition, sufficient formal mathematic skills need to be documented (equal to Norwegian Mathematics R1 or S1+S2).

For applicants with foreign education a satisfactory English language test is required.

2. Learning outcomes

All study programmes at Kristiania University College have adopted overarching learning outcomes that each student is expected to have achieved having completed the course. The learning outcomes describe what the student is expected to be able to do as a result of the learning acquired throughout the course. The academic outcome is divided into three categories: Knowledge, Skills and General competence.

Knowledge

The student…

- has a broad knowledge of data science fundamentals such as linear algebra, probability & statistics, data structures, data science algorithms, architectures and infrastructures of data science, visual analytics, text analytics, predictive analytics, machine learning, deep learning, data regulation, data security, data privacy, and data ethics
- can understand knowledge on theories, frameworks, algorithms, methods, techniques, and tools to analyze, describe, and solve complex and interdisciplinary challenges within design, development, adoption, implementation, and exploitation of both internal and external data pipelines for organizations
- has a broad knowledge of analyses of various data pipelines (such as text, prediction and visual) with an analytical focus on deriving meaningful facts, actionable insights valuable outcomes, and sustainable impacts to support domain-specific processes and functions
- has a broad understanding of and ability to aid technical aspects of data science applications in organizations and society.
- has knowledge about research, methods, techniques and tools to support data-driven organizational decision making
- has knowledge of frameworks for integrating data-driven decision making into organizational practices
- has a good understanding of global and local perspective on data pipelines and data science applications.

Skills

The student…

- can acquire, produce, apply and update new knowledge in data science using visual, text or predictive analytics and to apply results within new application domain areas
- has a deep insight into use of, comprehensive technical skills in Data Science, in addition to academic skills and the ability to reflect over own practice
- can conceptualize, implement, evaluate and reflect over data-driven architectures and data-driven decision making
- has the ability and capacity to innovative and independently reflect, and take action using the taught methods, techniques and tools

- has achieved writing skills for academic and technical documentation and oral communication and presentation skills

General competence

The student…

- can work independently and in teams including interdisciplinary groups, diverse professional and academic competences
- can understand and reflect upon ethical considerations of the domain of data science in relation to both work and professional scenarios
- can critically reflect upon cases from local, national, and international environments using written, oral and other related forms of expression
- can box-in complex problems and take forward actions in situations with uncertainty of outcome or data in-completeness in order to provide innovative solutions

3. Programme structure

Bachelor in Data Science is a three-year study with a total of 180 ECTS credits, of which 150 is comprised of compulsory courses, and 30 credits comprised of optional (elective courses). The study programme is structured with four courses with 7.5 credits each per semester. The fifth semester there are elective courses and possible exchange visits, and in the sixth semester the student writes the Bachelor's Thesis.

The study programme consists of three components: core modules, shared modules with *Bachelor of IT*, elective courses visits and a compulsory Bachelor's Thesis.

The study programme is implemented over six semesters, and the structure is as follows:

<table>
<tr><th colspan="6">Bachelor in Data Science</th></tr>
<tr><td>1st term (autumn)</td><td>Databases 1
7.5 credits</td><td>Data Ethics and Regulations
7.5 credits</td><td>Linear Algebra
7.5 credits</td><td>Python Programming
7.5 credits</td></tr>
<tr><td>2nd term (spring)</td><td>Information Risk and Security
7.5 credits</td><td>Big Data and Cloud Computing
7.5 credits</td><td>Probability and Statistics
7.5 credits</td><td>Visual Analytics
7.5 credits</td></tr>
<tr><td>3rd term (autumn)</td><td rowspan="2">Agile Project
15 credits</td><td>Machine Learning
7.5 credits</td><td>Data Structures and Algorithms
7.5 credits</td><td>Software Design
7.5 credits</td></tr>
<tr><td>4th term (spring)</td><td>Deep Learning
7.5 credits</td><td>Elective
7.5 credits</td><td>Elective
7.5 credits</td></tr>
<tr><td>5th term (autumn)</td><td>Text Analytics
7.5 credits</td><td>Predictive Analytics
7.5 credits</td><td>Elective
7.5 credits</td><td>Elective
7.5 credits</td></tr>
<tr><td>6th term (spring)</td><td>Research Methods
7.5 credits</td><td colspan="3">Bachelor Thesis
22.5 credits</td></tr>
</table>

Shared module with Bachelor of IT	**Elective modules**	**Core modules**

3.1 Academic progression

The Bachelor in Data Science curriculum consists of mandatory core curriculum courses and elective courses on emerging topics of academic interest and industry relevance. The courses are designed to engage students in a diversity of learning activities in the traditional classroom and blended learning format (lectures, in-class exercises, mandatory assignments, tool-training workshops, individual and group projects, internships, etc.). The program emphasizes socio-technical interactions with other students, real-world datasets, and cutting-edge research prototypes and best-of-breed commercial tools throughout the program.

A foundational first year introduces the underlying concepts of algebra and programming, as well as ethical aspects and important laws and regulations in relation to working with data analyses. Through the second year the students gain in depth knowledge of the first fundaments of data science from a machine learning and software perspective. Through the first part of year three state of the art analysis paradigms are investigated and will allow the students to solve real world business problems and provide substantial decision support material. The electives in semester 4 and 5 will allow the students to influence the character of their degree, either focusing on breadth or depth. The study finishes with a bachelor project in a company, in which the students get to use all the competence acquired through the study in order to solve a problem or assignment for an external employer.

3.2 Modules 1st academic year

Subjects, each accounting for 7.5 credits	**Description**
Databases 1	Following the completion of Databases 1, you will be able to explain what a relational database is, what it can be used for and how it differs from other forms of persistent storage. You will be able to model and structure data for a domain. You will be able to create tables, enter different types of data into them, link them together and extract reports using SQL queries. You will also be able to explain and apply the principles of good design (normalisation, key usage).
Data Ethics and Regulations	The first half of the course introduces the fundamental principles of moral philosophy and ethics and their applications to data science processes and outcomes. The second half of the course discusses the various data regulations at the local, regional, national and international levels that students and provides frameworks for incorporating them into data science projects to evaluate ethical implications as well as to ensure legal compliance.
Linear Algebra	This course teaches Linear algebra and other mathematical/statistical foundations of data science. Linear algebra is the mathematical foundations of data science that deals with planes, vectors and vector spaces matrices and linear transformation of vectors and matrices, which provides basic foundations for many supervised and unsupervised algorithms in machine learning. The course consists of lectures and hands-on training with open source libraries (such as NumPy and SciPy) in Python. Finally, students will

	develop mathematical and statistical skills that are needed to understand the foundations of various algorithms in the data science.
Python Programming	This course teaches Python programming for data science on how to collect, transform, model, analyze and visualizes broad range of datasets. Students will learn on how to use the Python programming language to work with numerical, string, and more complex data formats, and to perform data analysis with basic data mining and machine algorithms using both supervised and unsupervised approaches. The course will focus on open source technologies and consists of lectures and hands-on training with open source libraries in Python for data mining, machine learning and data visualizations. Finally, students will develop practical programming skills in problem solving by working on real-world datasets as part of their course project.
Information Risk and Security	The aim of this course is to give the students knowledge of business models, ecosystems and technologies used in intelligent systems. Students will acquire knowledge about sensors, steering behavior, networks, infrastructure and applications. The course aims to give skills in evaluation and selection of appropriate technologies/sensors. The students will discuss ethical considerations within the field.
Big Data and Cloud Computing	The goals of this course are two-folds: First it provides knowledge of key concepts, methods, techniques, and tools of big data. Second, it provides an overview of cloud Computing, its enabling technologies, main building blocks and architectures and hands-on experience through projects utilizing public cloud infrastructures (Amazon Web Services (AWS) and Microsoft Azure). As part of these goals, the course will also introduce and cover the topics of cloud infrastructures, virtualization, software defined networks and storage, cloud storage, and distributed programming models such as map-reduce, parallel programming models like Dryad, dockers and containers and so on. The course will focus on open source technologies to the extent possible and consists of lectures and hands-on training with open source libraries and public cloud infrastructures such as AWS and Azure. Finally, students will develop practical programming skills in cloud storage systems and learn to develop different applications in several distributed programming paradigms.
Probability and Statistics	This course introduces theoretical principles of probability and statistics with a focus on practical applications in data science. Topics include but are not limited to: permutations and combinations, frequentist vs. subjectivist probability, parametric vs. non-parametric statistics, probability distributions, Bayesian inference, null hypothesis significance testing, confidence intervals, effect sizes, point estimation, linear regression, multiple regression and logistic regression.
Visual Analytics	This course teaches theoretical principles of and computational techniques for visual analytics of large datasets. The course will enable students to design, develop, and evaluate information dashboards for applications in various domains. The students will be able to reflect upon the different models, theories, and frameworks for visual analytics from a data science perspective.

Table 1. Modules 1. academic year

3.3 Modules 2nd academic year

Subjects, each accounting for 7.5 credits	Description
Agile Project	The course aims to give students a deeper experience in handling a complete systems development project, with a focus on how to use an agile methodology, Scrum. The students are to carry out an extensive project case and will be experienced in using modern techniques and tools.
Machine Learning	The course provides knowledge of the key concepts, techniques and methods related to machine learning. Topics include an understanding of the mathematical basics of data mining and machine learning, linear models for regression such as maximum likelihood, sequential learning, regularized least squares and classification models such as probabilistic generative models, probabilistic discriminative models. Furthermore, the course provides the students with practical hands-on experience on machine learning using open source machine learning libraries such as scikit-learn in Python programming language. After completing the course, the students will be able to apply and use appropriate machine learning techniques in various data science domains.
Data Structures and Algorithms	This course aims to teach the mathematical foundations and computational applications of data structures and algorithms. The first half of the course will cover the topics in and aspects of data structures while he second half of the course will cover the design and analysis of algorithms. The course will focus on the predominant distributed and parallel computing algorithms and how their computing time and memory usage complexity will impact different data science use cases.
Software Design	The course will enable the students to design and further develop larger software systems in line with known techniques for modeling, testing and implementation.
Deep Learning	The course provides knowledge of the key concepts, techniques and methods related to deep learning. The candidate gains in depth knowledge of mathematical foundations of deep learning, neural networks and has advanced skills in applying the appropriate tools, techniques and development of these respective areas. Furthermore, the course provides the students with practical hands-on experience on deep learning using open source deep learning libraries in Python programming language. After completing the course, the students will be able to apply and use appropriate deep learning techniques in various data science domains.
Electives	Will be announced on KUC website and LMS.

Table 2. Modules 2. academic year

3.4 Modules 3rd academic year

Subjects, each accounting for 7.5 credits	Description
Text Analytics	The course provides knowledge of the key concepts, techniques and methods in natural language processing to text analytics. The students gain in depth knowledge of natural language processing and will further apply this to practical scenarios with acquired skills in text classification methods. The course provides students with hands-on

	experience on text analytics using open source machine learning libraries such as scikit-learn, Natural Language Toolkit (NLTK) in Python programming language. After completing the course, students will be able to apply and use various NLP techniques such as sentiment/emotion analysis opinion mining etc. on text documents/ corpora.
Predictive Analytics	The course provides knowledge of the key concepts, techniques and methods in predictive analytics. This course will cover methods and tools for data pre-processing for forecasting tasks in data science, techniques for selecting well-suited models for analysis, model performance evaluation tools. The course provides students with hands-on experience on predictive analytics using open source statistics tools such as R. After completing the course, students will be able to apply and use various predictive analytics techniques such as regression, time series on numerical datasets.
Research Methods	The course aims to introduce research methods with a focus on methods that are especially relevant for the IT business. The course supports the bachelor's degree project.
Bachelor Thesis	The students will get practical, real-life experience by carrying out a project in a company, establish their own business, or participate in a research project. They will be able to demonstrate broad knowledge of central topics and theories and to show skills in using methods, tools and technology.
Electives	Will be announced on KUC website and LMS.

Table 3. Modules 3. academic year

3.5 Elective modules

For the study programme in Bachelor Data Science, students are presented with optional modules in the fourth and fifth term that total 30 credits. The electives in semester 4 and 5 will allow the students to influence the character of their degree, either focusing on breadth or depth. Up-to-date information on elective modules can be found on Kristiania University College's website and through the learning platform.

3.6 Bachelor's project

In this final assignment, students will demonstrate that they can immerse themselves in, and apply their knowledge to, key areas of the bachelor's degree, and lie within its field of study. Students will gain professional experience by conducting a project within a business, establishing their own company or participating in a research project. Students will demonstrate a broad knowledge of the discipline's key topics and theories, and skills in applying its methods, tools and technology.

4. Internationalisation and international student exchange

The course has schemes for internationalisation and international student exchanges, according to the Regulations on the Supervision and Control of the Quality of Norwegian Higher Education (Studietilsynsforskriften) of February 2017 (§ 2-2, sections 7 and 8)

The schemes for internationalisation are adapted to the level, scope and uniqueness of the course. The content of schemes for international student exchanges is academically relevant.

4.1 Internationalisation schemes

In this context, internationalisation means that the education offered has an international context and that the students are exposed to a diverse range of perspectives.

The education offered has an international context and exposes the student to a varied perspective on Service Management This is achieved through the use of international literature and international cases during classes.

The whole program is conducted in English and the teaching staff is a combination of national and international staff. The many cases used in the courses during teaching and exercises are all based in an international context.

For specific internationalisation arrangements, please see the course descriptions for the study programme.

4.2 Schemes for international student exchange

With regard to schemes for international student exchanges, the university college offers the following mobility programmes;

- Nordplus in the Nordic and Baltic countries
- ERASMUS+ in Europa
- 'Study Abroad', for students within and outside Europe

Exchanges are arranged in the fifth term for the Bachelor in Data Science.

Exchange modules from current partner institutions are approved by academic course leaders, for entry into the applicable bachelor's degrees, with a scope of *30 credits*. Information on places of study and exchange modules abroad, for the current course offer and year group, is published on the University College's website and learning platform.

For nomination to a student exchange, certain grades and an application of motivation are required. Other requirements for documentation of creative work/portfolios may be demanded and Kristiania University College may conduct interviews of the applicants for exchanges.

Kristiania University College aims to send well qualified and motivated students to reputable foreign institutions.

Kristiania University College wishes to have a small number of active agreements within prioritised academic and research areas. The International Office is responsible for organising Kristiania University College's exchange programmes.

Exchange schemes are open to students who are studying a degree-awarding course and have completed a minimum of 60 credits at Kristiania University College.

5. Teaching and assessment forms

5.1 Learning platform and teaching in practice

The program is characterised by the use of lectures, exercises and active- and problem-based learning. Problem-based learning means that students are faced with practical and professional challenges. Students must, on their own initiative, acquire necessary information and discuss this together with fellow students and supervisors. The use of lectures and exercises will help provide students with individual professional expertise in all modules. Project-organised teaching means that all terms have interdisciplinary projects. Through the project work, students are also provided with more individual, professional expertise experience in collaboration with others, project management and project organisation. Through the course of study, active learning is also employed as an important part of the didactics model and put emphasis on an environment which blends student activity, with self-study, workshop and instructor led exercises.

5.2 Examination and assessment methods

Throughout the course, several different exam and assessment forms are utilised. The assessment forms are adapted to the learning outcomes of each individual module, whilst simultaneously striving for an appropriate distribution of different exam forms through each term of the course. The assessment forms reflect the desire to promote accountability amongst students. Therefore, several possible assessment forms exist that are adapted to the uniqueness of each module and provide students with different forms of challenges both individually and in groups. Throughout the study program hand ins, written exams, oral exams and group-based projects are just examples of what the students will meet.

Some modules may involve mandatory work requirements. Work requirements are requirements the student must fulfil in order to be allowed to take the exam. The right to take the exam requires approved work requirements. The scope and plan for work requirements are specified in the module descriptions. (The assessment expression for work requirements is Approved/Not approved).

For more information about the exam, see Kristiania University College’s website.