

Efi Arazi School of Computer Science
Reichman University Herzliya

M.Sc. Program in Machine Learning and Data Science

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A great deal of effort has been expended in preparing this handbook, in order to ensure that its content is complete and accurate. However, changes and alterations to the information are possible. The Reichman University Academic Authorities may cancel, alter or add courses and/or specialization programs, and generate changes in the times of lectures or in the assigned lecturer. Such changes will be published over the course of the year by various means, such as the online handbook on the university website, and will apply to all the university students, including students of the Raphael Recanati International School, unless specified otherwise.

Introduction

Reichman University's Efi Arazi School of Computer Science has built an innovative and intensive M.Sc. program aimed at providing deep theoretical and practical understanding of data science, machine learning and big-data technologies to students with a strong quantitative background and education.

The program will endow the students with knowledge, as well as skills and tools, in central fields such as machine learning, algorithms, databases, and statistical inference. Students will attend frontal lectures, seminars, and produce projects of different scales providing them hands-on experience in the data-science and machine learning domains. The conducive learning environment at the Efi Arazi School of Computer Science provides a community and team-up opportunities for students, scientists and researchers from the entire scientific spectrum.

Upon completing our M.Sc. program in data science, our graduates will have gained a strong background in the science and the technology that form the basis to the growing activity in data analysis, data collection and processing and related usage. They will also have acquired expertise in programming for data science using Python, including skills in using programming in statistical analysis and advanced machine learning. Additionally, they will have acquired deeper specialization in data science based on the elective courses of the program: infrastructure courses, big-data and databases, neural networks and deep learning, statistics, optimization, scientific computing, modern bioinformatics and environmental informatics, computer graphics and vision, numerical analysis, and biomedical data science.

The curriculum of the M.Sc. Program in Machine Learning and Data Science includes:

- 4 Mandatory core courses (13 credits)
- 1 advanced mandatory course (3 credits)
- 5 Elective courses (15 credits) out of which:
 - At least 1 Mandatory Applied Data Science Elective (at least 3 credits)
- 1 Mandatory project (5 credits)
- 3 Preparatory CS courses – only for non-CS graduates
- Preparatory math courses – if necessary

Overall, the M.Sc. students are required to complete 36 credits.

Program of Studies

Year 1

Mandatory core courses

Course No.	Course Name	Lecture Hours	Recitation Hours	Total Credit Points	Prerequisites
Fall Semester					
3620	Statistics and Data Analysis	3	1	4	Introduction to Probability
3605	Big Data Platforms	3		3	
Spring Semester					
3141	Machine Learning from Data	3	1	3	Introduction to Probability

Elective courses

Students are required to take **5** elective courses over the course of the degree. One of them must be selected out of the list of Applied Data Science elective courses. The rest of the credits can be taken as **4** elective courses from either the core Applied Data Science course list or the CS elective course list. Student can take **up to 2** elective courses during their first year of study and 2-4 electives during their second year, for a total of **5** elective courses. Only one of the elective courses can be a seminar.

Core Applied Data Science Electives

Course No.	Course Name	Lecture Hours		Total Credit Points	Prerequisites
Fall Semester					
3591	Cognitive Computing	3		3	
3614	Practical Probability Models for Computer Science Seminar ■	3		3	
3604	Data Streaming Algorithms and Online Learning	3		3	
Spring Semester					
3664	Cyber Security and Artificial Intelligence	3		3	
3959	Text Retrieval and Search Engines	3		3	
164	Introduction to Computer Graphics	3	1	4	Algorithms

CS elective courses

Course No.	Course Name	Lecture Hours	Total Credit Points	Prerequisites
Fall Semester				
285	Audio-visual Signals Compression	3	3	
3519	Computational Geometry	3	3	
3558	Algorithms for Planar Graphs	3	3	
3169	Artificial intelligence and Morality ●	3	3	
3626	Blockchains and Cryptocurrencies	3	3	
3795	Ethics in the Digital Age	3	3	
Spring Semester				
3123	Databases Management ●	3	3	
3327	Numerical Optimization with Python	3	3	
3472	High-Performance Parallel Computing Systems ●	3	3	
3593	Combinatorics	3	3	
3595	Resource Allocation Algorithms*	3	3	
3668	HW Design for the Cloud	3	3	
3915	Introduction to Image Processing and Analysis	3	3	
3796	Cryptographic Protocols	3	3	

■ Only one of the elective courses can be a seminar.

● Advanced undergraduate elective course- registration is only possible during the changes period and depending on vacancy.

* Students who take Advanced Algorithm (3501) can't choose this course.

Year 2

Mandatory core courses

Course No.	Course Name	Lecture Hours	Recitation Hours	Total Credit Points	Prerequisites
Annual Courses					
3624	Final Project *			5	
Spring Semester					
3600	Deep Learning ▲	3	1	3	
3945	Advanced Machine Learning **	3	1	3	Machine Learning from Data

* Individual meetings that will be scheduled directly with the project team (from Academia or Industry).

** Can be substituted by either Advanced Statistics (3696) or Advanced Algorithms (3501). Substitution requires approval from the Program Director.

▲ The course Deep learning is taught in Hebrew and can be replaced by course 3598 (which is taught In English in the Fall semester)

*** **Students studying in the Thesis track** must learn two of the three following courses:

- 3945 - Advanced Machine Learning (second year mandatory course)
- 3676 - Advanced Statistics
- 3501 - Advanced Algorithms

Elective courses

Students are required to take **5** elective courses over the course of the degree. One of them must be selected out of the list of Applied Data Science elective courses. The rest of the credits can be taken as **4** elective courses from either the core Applied Data Science course list or the CS elective course list. Student can take **up to 2** elective courses during their first year of study and 2-4 electives during their second year, for a total of **5** elective courses. Only one of the elective courses can be a seminar.

Core Applied Data Science Elective

Course No.	Course Name	Lecture Hours	Total Credit Points	Prerequisites
Fall Semester				
3591	Cognitive Computing	3	3	
3604	Data Streaming Algorithms and Online Learning	3	3	
3639	Recommendation Systems	3	3	Machine Learning from Data

3640	Reinforcement Learning	3	3	Machine Learning from Data
3674	Advanced Topics in Data Analysis – Seminar ■	3	3	Machine Learning from Data
3614	Practical Probability Models for Computer Science Seminar ■	3	3	
3690	Machine Learning Operations (MLOps)	3	3	Machine Learning from Data
3890	Information-Theoretic Analysis of Neural Language Models Seminar ■	3	3	Machine Learning from Data

Spring Semester

3523	Natural Language Processing	3	3	Machine Learning from Data
3959	Text Retrieval and Search Engines	3	3	
3676	Advanced Statistics	3	3	Statistics and Data Analysis
3946	Theoretical and Practical Aspects of Machine Learning	3	1	3 Machine Learning from Data This course as recitation
3664	Cyber Security and Artificial Intelligence	3	3	
3697	AI for Healthcare	3	3	Machine Learning from Data Deep Learning (3600 or 3598)
3655	Unsupervised Learning Methods	3	3	Machine Learning from Data Deep Learning
164	Introduction to Computer Graphics	3	1	4 Algorithms

CS elective courses

Course No.	Course Name	Lecture Hours	Total Credit Points	Prerequisites
Fall Semester				
285	Audio-visual Signals Compression	3	3	
3169	Artificial Intelligence and Morality ●	3	3	

3519	Computational Geometry	3	3	
3558	Algorithms for Planar Graphs	3	3	
3626	Blockchains and Cryptocurrencies	3	3	
3795	Ethics in the Digital Age	3	3	
3894	Sublinear and Streaming-Seminar ■ ♦	3	3	
3960	DNA Sequencing, Bioinformatics and Functional Genomics	3	3	
Spring Semester				
3031	Cloud Computing ●	3	3	
3123	Databases Management ●	3	3	
3327	Numerical Optimization with Python	3	3	
3472	High-Performance Parallel Computing Systems ●	3	3	
3593	Combinatorics	3	3	
3541	Seminar in Concurrent and Distributed Computing ■ ♦	3	3	
3595	Resource Allocation Algorithms*	3	3	
3622	Advanced Topics in Deep Learning Seminar ■ ♦	3	3	Machine Learning from Data
3668	HW Design for the Cloud	3	3	
3796	Cryptographic Protocols	3	3	
3915	Introduction to Image Processing and Analysis	3	3	
3958	Learning and Graphics Seminar: the Computer as a Content Creator ■ ♦	3	3	
3961	Cloud Computing and Software Engineering	3	3	

■ Only one of the elective courses can be a seminar.

♦ Registration for these seminars will be open on the second day of the registration period.

● Advanced undergraduate elective course- registration is only possible during the changes period and depending on vacancy.

* Students who take Advanced Algorithm (3501) can't choose course Resource Allocation Algorithms.

Exam Schedule the dates of the examinations can be found on the University website under Students > Student Information > Course Catalog, Student Regulations and Syllabus > Search Exams A personal examinations schedule is published at the Student's Information website (My IDC).