

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 with 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
Spring Semester					
3667	ML and Data Analysis	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. Students can take **up to 3** elective courses during their first year of study and 3-4 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					
3604	Data Streaming Algorithms and Online Learning	3		3	
3959	Text Retrieval and Search Engines	3		3	
Spring Semester					
164	Introduction to Computer Graphics	3	1	3	Algorithms
3613	Introduction to Bioinformatics	3		3	

CS elective courses

Course No.	Course Name	Lecture Hours		Total Credit Points	Prerequisites
Fall Semester					
3169	Artificial intelligence and Morality (E)	3		3	
3569	Applied Cryptography Workshop	3		3	
3589	Automata and Games	3		3	
3669	Introduction to Speech Recognition	3		3	
3671	The Art of Rhetoric in the Hi-Tech World- Workshop	3		3	
3682	Attacks on Secure Implementations	3		3	
3983	Introduction to Quantum Computation	3		3	
Spring Semester					
3123	Databases Management •	3		3	
3488	AI for Mathematics	3		3	
3508	Introduction to Robotics and Autonomous Systems	3		3	
3510	Distributed Algorithms	3		3	
3613	Introduction to Bioinformatics	3		3	

3626	Blockchains and Cryptocurrencies	3	3
3643	Advanced Topics in Computer Systems Security	3	3
3664	Cyber Security and Artificial Intelligence	3	3
3796	Cryptographic Protocols	3	3
3477	Chip Design and Verification	3	3
3502	AI-Driven Android Application Development ●	3	3
3917	Using AI for Malware and Intrusion Detection ●	3	3
13001●●	Bioinformatic Approaches to Understand the Role of the Human Microbiome	3	3
13002●●	AI and Synthetic Biology Seminar■	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.
- A course in the M.Sc. program in Synthetic Biology.
Students who choose course code: 13001 will not be able to choose Seminar code: 13002 and vice versa.

Year 2

Mandatory core courses

Course No.	Course Name	Lecture Hours	Recitation Hours	Total Credit Points	Prerequisites
Annual Course					
3624	Final Project *			5	
Fall Semester					
3797	Advanced Statistical Analysis and Model Based Learning ** ►	3		3	Machine Learning from Data
3994	Deep Learning and Image Understanding ▲	3	1	3	Machine Learning from Data
Spring Semester					
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 Advanced Algorithms (3501). Substitution requires approval from the Program Director.

▲ Deep Learning and Image Understanding can be taught In Hebrew in the Spring semester.

► **Students studying in the Thesis track** must learn all three courses:

3797 - Advanced Statistical Analysis and Model Based Learning or Information Theory (3798)

3501 - Advanced Algorithms

3945 - Advanced Machine Learning

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. Students can take **up to 3** elective courses during their first year of study and 3-4 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					
3575	Probabilistic Models for Data Analysis	3		3	Machine Learning from Data
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
3959	Text Retrieval and Search Engines	3		3	Machine Learning from Data
3530	Data analysis and applications of synthetic DNA	3		3	Machine Learning from Data
Spring Semester					
164	Introduction to Computer Graphics	3	1	3	Algorithms
3475	AI in finance	3		3	Machine Learning from Data
3523	Natural Language Processing	3		3	Machine Learning from Data
3640	Reinforcement Learning	3		3	Machine Learning from Data
3960	DNA Sequencing, Bioinformatics and Functional Genomics	3		3	
3613	Introduction to Bioinformatics	3		3	
3670	Advanced seminar in natural language processing ■◆	3		3	Machine Learning from Data

CS elective courses

Course No.	Course Name	Lecture Hours	Total Credit Points	Prerequisites
Fall Semester				
3169	Artificial intelligence and Morality (E)	3	3	
3569	Applied Cryptography Workshop	3	3	
3589	Automata and Games	3	3	
3476	Computational Models of Cognition	3	3	
3485	NeuroAI : Bridging Brain Science and AI	3	3	Deep Learning
3671	The Art of Rhetoric in the Hi-Tech World	3	3	
3669	Introduction to Speech Recognition	3	3	
3682	Attacks on Secure Implementations	3	3	
3801	Data Science Workshop 1	3	3	
3916	Introduction to Generative Models and Computational Creativity	3	3	Deep Learning
3966	Computation and Randomness	3	3	
3924	Advanced Systems Development Using AI • (E)	3	3	
3983	Introduction to Quantum Computation •	3	3	
Spring Semester				
217	Computer Vision	3	3	
3123	Databases Management •	3	3	
3483	From Complex Networks to Graph Learning	3	3	Machine Learning from Data
3488	AI for Mathematics	3	3	

3508	Introduction to Robotics and Autonomous Systems	3	3	
3502	AI-Driven Android Application Development ●	3	3	
3510	Distributed Algorithms	3	3	
3626	Blockchains and Cryptocurrencies	3	3	
3643	Advanced Topics in Computer Systems Security	3	3	Machine Learning from Data
3664	Cyber Security and Artificial Intelligence	3	3	
3796	Cryptographic Protocols	3	3	
3834	Seminar- Distributed Algorithms ■	3	3	
3670	Seminar in Natural Language Processing ■ ♦	3	3	
3527	The Brain and AI – Seminar ■ ♦	3	3	
3883	Computational Methods in RNA Expression Analysis	3	3	
3917	Using AI for Malware and Intrusion Detection ●	3	3	
3799	Advanced Complexity	3	3	
3477	Chip Design and Verification	3	3	
3906	Data Science Workshop 2	3	3	
13001●●	Bioinformatic Approaches to Understand the Role of the Human Microbiome	3	3	
13002●●	AI and Synthetic Biology Seminar ■	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.

- A course in the M.Sc. program in Synthetic Biology.
Students who choose course code: 13001 will not be able to choose Seminar code: 13002 and vice versa.

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 Runi).