

Data Science (Collaborative Program)

This section presents the requirements for programs in:

- **M.Sc. Biology with Specialization in Data Science**
- **M.A.Sc. Biomedical Engineering with Specialization in Data Science**
- **M.Eng. Biomedical Engineering with Specialization in Data Science**
- **Master of Cognitive Science with Specialization in Data Science**
- **M.A. Communication with Specialization in Data Science**
- **M.C.S. Computer Science with Specialization in Data Science**
- **M.A. Economics with Specialization in Data Science**
- **M.A.Sc. Electrical and Computer Engineering with Specialization in Data Science**
- **M.Eng. Electrical and Computer Engineering with Specialization in Data Science**
- **M.Sc. Geography with Specialization in Data Science**
- **M.Sc. Health Sciences with Specialization in Data Science**
- **M.A. History with Specialization in Data Science**
- **Master of Information Technology: Digital Media with Specialization in Data Science**
- **M.A. Psychology with Specialization in Data Science**

Program Requirements

Students enrolled in the Collaborative Program in Data Science must meet the requirements of their respective home units as well as those of the Collaborative Program. The requirements of the Collaborative Program do not, however, add to the number of credits students are required to accumulate by their home unit and the credit value of the degree remains the same. Consult the individual programs for detailed program requirements.

M.Sc. Biology with Specialization in Data Science (5.0 credits)

Requirements:

1. 0.5 credit in approved coursework	0.5
2. 0.5 credit in:	0.5
DATA 5000 [0.5] Data Science Seminar	
3. 4.0 credits in:	4.0
BIOL 5909 [4.0] M.Sc. Thesis	
Total Credits	5.0

M.A.Sc. Biomedical Engineering with Specialization in Data Science (5.0 credits)

Requirements:

1. 0.5 credit in:	0.5
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BIOM 5010 [0.5] Introduction to Biomedical Engineering	
2. 0.5 credit in:	0.5
DATA 5000 [0.5] Data Science Seminar	
3. 1.0 credit in BIOM (BMG) courses	1.0
4. 0.5 credit in elective courses taken either at Carleton University or University of Ottawa with the approval of the OCIBME Director or Associate Director	0.5
5. 2.5 credits in:	2.5
BIOM 5909 [2.5] M.A.Sc. Thesis	
6. 0.0 credit in:	0.0
BIOM 5800 [0.0] Biomedical Engineering Seminar	
Total Credits	5.0

M.Eng. Biomedical Engineering with Specialization in Data Science (5.0 credits)

Requirements - by coursework:

1. 0.5 credit in:	0.5
BIOM 5010 [0.5] Introduction to Biomedical Engineering	
2. 0.5 credit in:	0.5
DATA 5000 [0.5] Data Science Seminar	
3. 2.0 credits in BIOM (BMG) courses	2.0
4. 2.0 credits in elective courses at either Carleton University or University of Ottawa with the approval of the OCIBME Director or Associate Director	2.0
5. 0.0 credit in:	
BIOM 5800 [0.0] Biomedical Engineering Seminar	
Total Credits	5.0

Note: for the course work Item 3 and Item 4 above, three 0.5-credit data science elective courses must be taken (three of BIOM 5400, BIOM 5405, COMP 5100, COMP 5101, COMP 5107, COMP 5108, COMP 5111, COMP 5112, COMP 5204, COMP 5209, COMP 5305, COMP 5306, COMP 5307, COMP 5308, COMP 5401, COMP 5703, COMP 5704, PHYS 5002, SYSC 5001, SYSC 5003, SYSC 5004, SYSC 5007, SYSC 5101, SYSC 5102, SYSC 5103, SYSC 5108, SYSC 5201, SYSC 5207, SYSC 5300, SYSC 5303, SYSC 5306, SYSC 5401, SYSC 5404, SYSC 5405, SYSC 5407, SYSC 5500, SYSC 5703, SYSC 5706)

Requirements - by project:

1. 0.5 credit in:	0.5
BIOM 5010 [0.5] Introduction to Biomedical Engineering	
2. 0.5 credit in:	0.5
DATA 5000 [0.5] Data Science Seminar	
3. 1.5 credits in BIOM (BMG) courses	1.5
4. 1.0 credit in elective courses at either Carleton University or University of Ottawa with the approval of the OCIBME Director or Associate Director	1.0
5. 0.0 credit in:	
BIOM 5800 [0.0] Biomedical Engineering Seminar	
6. 1.5 credit in:	1.5
BIOM 5900 [1.5] Biomedical Engineering Project	
Total Credits	5.0

Note: for the course work Item 3 and Item 4 above, three 0.5-credit data science elective courses

must be taken (three of BIOM 5400, BIOM 5405, COMP 5100, COMP 5101, COMP 5107, COMP 5108, COMP 5111, COMP 5112, COMP 5204, COMP 5209, COMP 5305, COMP 5306, COMP 5307, COMP 5308, COMP 5401, COMP 5703, COMP 5704, PHYS 5002, SYSC 5001, SYSC 5003, SYSC 5004, SYSC 5007, SYSC 5101, SYSC 5102, SYSC 5103, SYSC 5108, SYSC 5201, SYSC 5207, SYSC 5300, SYSC 5303, SYSC 5306, SYSC 5401, SYSC 5404, SYSC 5405, SYSC 5407, SYSC 5500, SYSC 5703, SYSC 5706)

Master of Cognitive Science with Specialization in Data Science (5.0 credits)

Requirements - Thesis Option (5.0 credits)

1. 0.5 credit in:	0.5
DATA 5000 [0.5] Data Science Seminar	
2. 0.5 credit in:	0.5
CGSC 5100 [0.5] Issues in Cognitive Science	
3. 0.5 credit in:	0.5
CGSC 5101 [0.5] Experimental Methods and Statistics	
4. 1.0 credit in CGSC or other approved courses, from two different cognitive disciplines, selected in consultation with the graduate supervisor.	1.0
5. 2.5 credits in:	2.5
CGSC 5909 [2.5] M. Cog. Thesis (The thesis must be approved as fulfilling the data science requirement and be supervised by a faculty member working in a data science related field.)	
6. Preparation of research for presentation at the Carleton Cognitive Science Spring Conference.	
Total Credits	5.0

Requirements - Research Project Option (5.0 credits)

1. 0.5 credit in:	0.5
DATA 5000 [0.5] Data Science Seminar	
2. 0.5 credit in:	0.5
CGSC 5100 [0.5] Issues in Cognitive Science	
3. 0.5 credit in:	0.5
CGSC 5101 [0.5] Experimental Methods and Statistics	
4. 1.5 credits from:	1.5
CGSC 5001 [0.5] Cognition and Artificial Cognitive Systems	
CGSC 5002 [0.5] Experimental Research in Cognition	
CGSC 5003 [0.5] Cognition and Language	
CGSC 5004 [0.5] Cognition and Conceptual Issues	
CGSC 5005 [0.5] Cognition and Neuroscience	
5. 1.0 credit in CGSC or other approved courses selected in consultation with the graduate supervisor.	1.0
6. 1.0 credit in:	1.0
CGSC 5908 [1.0] Research Project (Project must be approved as fulfilling the data science requirement and be supervised by a faculty member working in a data science related field.)	

7. Preparation of research for presentation at the Cognitive Science Spring Conference.

Total Credits 5.0

M.A. Communication with Specialization in Data Science (5.0 credits)

Requirements - Coursework Option (5.0 credits)

1. 0.5 credit in:	0.5
DATA 5000 [0.5] Data Science Seminar	
2. 1.0 credit in:	1.0
COMS 5101 [1.0] Foundations of Communication Studies	
3. 0.5 credit in:	0.5
COMS 5605 [0.5] Approaches to Communication Research	
4. 0.5 credit in:	0.5
COMS 5225 [0.5] Critical Data Studies	
5. 0.5 credit from:	0.5
COMS 5203 [0.5] Communication, Technology, Society	
COMS 5221 [0.5] Science and the Making of Knowledge	
COMS 5224 [0.5] Internet, Infrastructure, Materialities	
6. 2.0 credits in electives	2.0
Total Credits	5.0

Requirements - Research Essay Option (5.0 credits)

1. 0.5 credit in:	0.5
DATA 5000 [0.5] Data Science Seminar	
2. 1.0 credit in:	1.0
COMS 5101 [1.0] Foundations of Communication Studies	
3. 0.5 credit in:	0.5
COMS 5605 [0.5] Approaches to Communication Research	
4. 0.5 credit in:	0.5
COMS 5225 [0.5] Critical Data Studies	
5. 1.0 credit in:	1.0
COMS 5908 [1.0] Research Essay	
Research Essay on a Data Science topic approved by the Advisory Board representative from Communication in consultation with the graduate Committee of the Institute of Data Science.	
6. 1.5 credits in electives.	1.5
Total Credits	5.0

Requirements - Thesis Option (5.0 credits)

1. 0.5 credit in:	0.5
DATA 5000 [0.5] Data Science Seminar	
2. 1.0 credit in:	1.0
COMS 5101 [1.0] Foundations of Communication Studies	
3. 0.5 credit in:	0.5
COMS 5605 [0.5] Approaches to Communication Research	
4. 0.5 credit in:	0.5
COMS 5225 [0.5] Critical Data Studies	
5. 2.0 credits in:	2.0
COMS 5909 [2.0] M.A. Thesis	

M.A. Thesis on a Data Science topic approved by the Advisory Board representative from Communication in consultation with the Graduate Committee of the Institute of Data Science.

6. 0.5 credit in electives 0.5

Total Credits 5.0

M.C.S. Computer Science with Specialization in Data Science (5.0 credits)

Requirements - Thesis Option (5.0 credits)

1. 0.5 credit in: 0.5

DATA 5000 [0.5] Data Science Seminar

2. 1.0 credit from: 1.0

COMP 5100 [0.5] Topics in Artificial Intelligence

COMP 5101 [0.5] Distributed Databases and Transaction Processing Systems

COMP 5107 [0.5] Statistical and Syntactic Pattern Recognition

COMP 5108 [0.5] Algorithms in Bioinformatics

COMP 5111 [0.5] Data Management for Business Intelligence

COMP 5112 [0.5] Algorithms for Data Science

COMP 5204 [0.5] Computational Aspects of Geographic Information Systems

COMP 5209 [0.5] Visual Analytics

COMP 5305 [0.5] Advanced Database Systems

COMP 5306 [0.5] Data Integration

COMP 5307 [0.5] Knowledge Representation

COMP 5308 [0.5] Topics in Medical Computing

COMP 5401 [0.5] Electronic Commerce Technologies

COMP 5703 [0.5] Algorithm Analysis and Design

COMP 5704 [0.5] Parallel Algorithms and Applications in Data Science

3. 1.0 credit in course work 1.0

4. 2.5 credits in: 2.5

COMP 5905 [2.5] M.C.S. Thesis

Total Credits 5.0

Notes:

1. Course work must include a minimum of 1.5 credits of OCICS courses in three different research areas (see OCICS course listing by research areas).
2. M.C.S. Thesis must be in an area of Data Science and requires approval from the Institute of Data Science. Each candidate submitting a thesis will be required to undertake an oral defence of the thesis.

M.A. Economics with Specialization in Data Science (4.0 credits)

Requirements - Coursework option (4.0 credits)

1. 1.5 credits in: 1.5

ECON 5020 [0.5] Microeconomic Theory

ECON 5021 [0.5] Macroeconomic Theory

ECON 5027 [0.5] Econometrics I

2. 0.5 credit in: 0.5

DATA 5000 [0.5] Data Science Seminar

3. 0.5 credit in: 0.5

ECON 5029 [0.5] Methods of Economic Research

including a research paper on a data science related topic

4. 1.0 credit in ECON approved by the M.A. Supervisor of the Department of Economics, including at least 0.5 credit from ECON 5055, ECON 5361, ECON 5362, ECON 5700, ECON 5712, ECON 5713 1.0

5. 0.5 credit in Data Science elective (which may be an additional course from the preceding list) approved by the M.A. Supervisor of the Department of Economics 0.5

Total Credits 4.0

Requirements - Thesis option (4.0 credits)

1. 1.5 credits in: 1.5

ECON 5020 [0.5] Microeconomic Theory

ECON 5021 [0.5] Macroeconomic Theory

ECON 5027 [0.5] Econometrics I

2. 0.5 credit in: 0.5

DATA 5000 [0.5] Data Science Seminar

3. 1.5 credit in: 1.5

ECON 5909 [1.5] M.A. Thesis

on a data science topic approved by the Data Science governance committee

4. 0.5 credit from: 0.5

ECON 5055 [0.5] Financial Econometrics

ECON 5361 [0.5] Labour Economics I

ECON 5362 [0.5] Labour Economics II

ECON 5700 [0.5] Social and Economic Measurement

ECON 5712 [0.5] Micro-Econometrics

ECON 5713 [0.5] Time-Series Econometrics

Total Credits 4.0

M.A.Sc. Electrical and Computer Engineering with Specialization in Data Science (5.0 credits)

Requirements - by Thesis (5.0 credits)

1. 0.5 credit in: 0.5

DATA 5000 [0.5] Data Science Seminar

2. 0.5 credit from data science elective courses: 0.5

SYSC 5001 [0.5] Simulation and Modeling

SYSC 5003 [0.5] Discrete Stochastic Models

SYSC 5004 [0.5] Optimization for Engineering Applications

SYSC 5101 [0.5] Design of High Performance Software

SYSC 5103 [0.5] Software Agents

SYSC 5104 [0.5] Methodologies For Discrete-Event Modeling And Simulation

SYSC 5201 [0.5] Computer Communication

SYSC 5207 [0.5] Distributed Systems Engineering

SYSC 5300 [0.5] Advanced Health Care Engineering

SYSC 5303 [0.5] Interactive Networked Systems and Telemedicine

SYSC 5306 [0.5] Mobile Computing Systems

SYSC 5401 [0.5] Adaptive and Learning Systems

SYSC 5404 [0.5] Multimedia Compression, Scalability, and Adaptation

SYSC 5405 [0.5] Pattern Classification and Experiment Design

SYSC 5407 [0.5] Planning and Design of Computer Networks

SYSC 5500 [0.5] Designing Secure Networking and Computer Systems

SYSC 5703 [0.5] Integrated Database Systems

SYSC 5706 [0.5]	Analytical Performance Models of Computer Systems	
3. 1.5 credits in courses		1.5
4. 2.5 credits in:		2.5
SYSC 5909 [2.5]	M.A.Sc. Thesis	
in the area of data science (each candidate submitting a thesis will be required to undertake an oral defence of the thesis)		
Total Credits		5.0

M.Eng. Electrical and Computer Engineering with Specialization in Data Science (5.0 credits)

Requirements - by Project (5.0 credits)

1. 0.5 credit in:		0.5
DATA 5000 [0.5]	Data Science Seminar	
2. 1.0 credit from data science elective courses:		1.0
SYSC 5001 [0.5]	Simulation and Modeling	
SYSC 5003 [0.5]	Discrete Stochastic Models	
SYSC 5004 [0.5]	Optimization for Engineering Applications	
SYSC 5101 [0.5]	Design of High Performance Software	
SYSC 5103 [0.5]	Software Agents	
SYSC 5104 [0.5]	Methodologies For Discrete-Event Modeling And Simulation	
SYSC 5201 [0.5]	Computer Communication	
SYSC 5207 [0.5]	Distributed Systems Engineering	
SYSC 5300 [0.5]	Advanced Health Care Engineering	
SYSC 5303 [0.5]	Interactive Networked Systems and Telemedicine	
SYSC 5306 [0.5]	Mobile Computing Systems	
SYSC 5401 [0.5]	Adaptive and Learning Systems	
SYSC 5404 [0.5]	Multimedia Compression, Scalability, and Adaptation	
SYSC 5405 [0.5]	Pattern Classification and Experiment Design	
SYSC 5407 [0.5]	Planning and Design of Computer Networks	
SYSC 5500 [0.5]	Designing Secure Networking and Computer Systems	
SYSC 5703 [0.5]	Integrated Database Systems	
SYSC 5706 [0.5]	Analytical Performance Models of Computer Systems	
3. 3.0 credits in courses		3.0
4. 0.5 credit in:		0.5
SYSC 5900 [0.5]	Systems Engineering Project	
in the area of data science		
Total Credits		5.0

Requirements - by Coursework (5.0 credits)

1. 0.5 credit in:		0.5
DATA 5000 [0.5]	Data Science Seminar	
2. 1.5 credits from data science elective courses:		1.5
SYSC 5001 [0.5]	Simulation and Modeling	
SYSC 5003 [0.5]	Discrete Stochastic Models	
SYSC 5004 [0.5]	Optimization for Engineering Applications	
SYSC 5101 [0.5]	Design of High Performance Software	
SYSC 5103 [0.5]	Software Agents	

SYSC 5104 [0.5]	Methodologies For Discrete-Event Modeling And Simulation	
SYSC 5201 [0.5]	Computer Communication	
SYSC 5207 [0.5]	Distributed Systems Engineering	
SYSC 5300 [0.5]	Advanced Health Care Engineering	
SYSC 5303 [0.5]	Interactive Networked Systems and Telemedicine	
SYSC 5306 [0.5]	Mobile Computing Systems	
SYSC 5401 [0.5]	Adaptive and Learning Systems	
SYSC 5404 [0.5]	Multimedia Compression, Scalability, and Adaptation	
SYSC 5405 [0.5]	Pattern Classification and Experiment Design	
SYSC 5407 [0.5]	Planning and Design of Computer Networks	
SYSC 5500 [0.5]	Designing Secure Networking and Computer Systems	
SYSC 5703 [0.5]	Integrated Database Systems	
SYSC 5706 [0.5]	Analytical Performance Models of Computer Systems	
3. 3.0 credits in courses		3.0
Total Credits		5.0

M.Sc. Geography with Specialization in Data Science (5.0 credits)

Requirements

1. 0.5 credit in:		0.5
DATA 5000 [0.5]	Data Science Seminar	
2. 0.5 credit in:		0.5
GEOG 5001 [0.5]	Modeling Environmental Systems	
3. 0.5 credit in:		0.5
GEOG 5905 [0.5]	Masters Research Workshop	
4. 1.0 credit in Physical Geography selected from:		1.0
GEOG 5002 [0.5]	Quantitative Analysis for Geographical Research	
GEOG 5103 [0.5]	Hydrologic Principles and Methods	
GEOG 5104 [0.5]	Advanced Biogeography	
GEOG 5107 [0.5]	Field Study and Methodological Research	
GEOG 5303 [0.5]	Geocryology	
GEOG 5307 [0.5]	Soil Resources	
GEOG 5803 [0.5]	Seminar in Geomatics	
GEOG 5804 [0.5]	Geographic Information Systems	
GEOG 5900 [0.5]	Graduate Tutorial	
up to 0.5 credit in GEOG or GEOM at the 4000 level, with departmental approval		
5. 2.5 credits in:		2.5
GEOG 5906 [2.5]	M.Sc. Thesis (in the specialization and including oral examination of the thesis)	
6. In addition to the formal requirements, M.Sc. students are required to attend the DGES Departmental Seminar series, and the Graduate Field Camp.		
Total Credits		5.0

M.Sc. Health Sciences with Specialization in Data Science (5.5 credits)

Requirements (5.5 credits)

1. 1.0 credits in:		1.0
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HLTH 5901 [0.5]	Advanced Topics in Interdisciplinary Health Sciences	
HLTH 5902 [0.5]	Seminars in Interdisciplinary Health Sciences for MSc	
2. 0.5 credits in:		0.5
DATA 5000 [0.5]	Data Science Seminar	
3. Completion of:		
HLTH 5905 [0.0]	Final Research Seminar Presentation for MSc	
4. 4.0 credits in:		4.0
HLTH 5909 [4.0]	MSc Thesis	
5. Twice-yearly meetings with the thesis Graduate Advisory Committee, with students meeting a level of progress as determined by the Committee.		
Total Credits		5.5

Note: The final research seminar presentation must be completed within one month of the thesis defence.

M.A. History with Specialization in Data Science (4.5 credits)

Requirements:

1. 0.5 credit in:		0.5
HIST 5003 [0.5]	Historical Theory and Method	
2. 1.5 credits in HIST	at the graduate level of which only 0.5 credit may be taken in a designated public history course; with departmental permission, up to 0.5 credit from courses with historical content may be taken from another unit at Carleton University, at the University of Ottawa, or at another accredited institution.	1.5
3. 0.5 credit in:		0.5
HIST 5706 [0.5]	Digital History	
4. 0.5 credit in:		0.5
DATA 5000 [0.5]	Data Science Seminar	
5. 0.5 credit in:		0.5
HIST 5900 [0.5]	Directed Research	
6. 1.0 credit in:		1.0
HIST 5908 [1.0]	M.A. Research Essay (in the specialization)	
Total Credits		4.5

Master of Information Technology: Digital Media with Specialization in Data Science (5.0 credits)

Requirements:

1. 0.5 credit in:		0.5
DATA 5000 [0.5]	Data Science Seminar	
2. 0.5 credit in:		0.5
ITEC 5000 [0.5]	Analytical Methods for Information Technology	
3. 1.0 credit from core courses:		1.0
ITEC 5200 [0.5]	Entertainment Technologies	
ITEC 5201 [0.5]	Computer Animation Technologies	
ITEC 5202 [0.5]	Visual Effects Technologies	
ITEC 5203 [0.5]	Game Design and Development Technologies	
ITEC 5204 [0.5]	Emerging Interaction Techniques	
4. 0.5 credit in	electives, which may include ITEC courses or any other 5000- or 4000-level courses from other departments or programs selected in consultation with the supervisor.	0.5

5. 2.5 credits in:		2.5
ITEC 5909 [2.5]	Master's Thesis (in the specialization)	
Total Credits		5.0

Note: No additional IT seminar requirements for this stream.

M.A. Psychology with Specialization in Data Science (5.0 credits)

Requirements:

1. 1.0 credit in:		1.0
PSYC 5410 [0.5]	Advanced Analysis of Variance	
PSYC 5411 [0.5]	Advanced Regression	
2. 0.5 credit in:		0.5
DATA 5000 [0.5]	Data Science Seminar	
3. Completion of:		0.0
PSYC 5906 [0.0]	Pro-Seminar in Psychology	
4. 1.0 credit in PSYC	courses at the 5000 level or higher	1.0
5. 2.5 credits in:		2.5
PSYC 5909 [2.5]	M.A. Thesis (in the area of Data Science, which must be defended at an oral examination)	
Total Credits		5.0

Regulations

See the General Regulations section of this Calendar, as well as regulations pertaining to the specific collaborative programs offering the data science specialization.

Admission

Students who are enrolled in a master's program in one of the participating units may apply to the Data Science governance committee for admission to the Collaborative Program. Admission to the program is determined by the governance committee and will normally take place before the end of October the year of admittance in one of the participating master's programs.

Admission requirements to the Collaborative Master's with Specialization in Data Science are:

- Registration in the master's program of one of the participating units
- Approval of a student's program of study by the Data Science governance committee and the student's home department. Students in a thesis program will be expected to choose a thesis topic that is directly related to Data Science. Students in an approved course work program will be required to take some elective courses in designated or approved courses with significant Data Science content.