# Carleton University

# Collaborative Master's Program

# in Data Science

School of Computer Science (lead unit)

Department of Biology

Department of Systems and Computer Engineering

Department of Geography and Environmental Studies

Department of Economics

Biomedical Engineering

Sprott School of Business (Data Analytics)

Data Science, also known as Big Data, is a rapidly evolving field. It studies how to make use of the massive amounts of data relevant to research, to strategy and operations in industry, and to policy development in government. Many of the technical foundations arise from Computer Science and Mathematics, but the area is fundamentally both multi- and interdisciplinary. Indeed, data science is often performed in collaborations spanning many disciplines to bring together the needed expertise and proficiencies. Data science not only seeks methods and strategies to find and organize data associated with the problem at hand, it has as a goal making it simpler for people to access data and conduct research.

The purpose of the Collaborative Master's Program in Data Science at Carleton University is to provide training in the analysis of Big Data and the skills to successfully undertake a piece of state-of-the-art research. Working in this area requires a special set of multi- and interdisciplinary skills. Those with a technical background related to big data need an understanding of the methodologies and problems related to using it in particular application areas. Those with expertise in application areas need technical knowledge in order to effectively make use of big data tools and methodologies.

The Harvard Business Review gives the following description of what it takes to be an effective data scientist:

"Data scientists make discoveries while swimming in data. It's their preferred method of navigating the world around them. At ease in the digital realm, they are able to bring structure to large quantities of formless data and make analysis possible. They identify rich data sources, join them with other, potentially incomplete data sources, and clean the resulting set. The dominant trait among data scientists is an intense curiosity: a desire to go beneath the surface of a problem, find the questions at its heart. Often they are creative in displaying information visually and

making the patterns they find clear and compelling. They communicate in language that all their stakeholders understand and demonstrate the special skills involved in storytelling with data whether verbally, visually, or ideally both."

The collaborative Master's program aims to educate Data Scientists in a multi- and interdisciplinary setting. The program includes the following units spanning all five Faculties at Carleton University:

- School of Computer Science (lead unit)

- Department of Biology

- Department of Systems and Computer Engineering

- Department of Economics

- Department of Geography and Environmental Studies

- Master's program in Biomedical Engineering

- Sprott School of Business (Data Analytics)

The Collaborative Master's Program in Data Science is structured as a collection of specializations added to existing Master's programs. The degree designation is that of the admitting program, with "specialization in Data Science" appended.

Students must fulfill all requirements of the Master's degree program through which they enter – their "home" program.  Additional requirements flow from the following three structuring principles:

1. Students in all programs must complete the Data Science Seminar (DATA 5000), a shared 0.5 credit course that is unique to the Data Science specialization.
2. When the specific requirements of the Data Science specialization for a given program include a thesis, the thesis must be in the area of data science and must be supervised by a faculty member working in a data science related field. The Data Science Institute will form a committee to evaluate and approve thesis topics.
3. Specific course requirements the Specialization in Data Science as outlined below.

**M.C.S. Computer Science with Specialization in Data Science**

- 0.5 credit in DATA 5000 [0.5] Data Science Seminar
- Two 0.5-credit data science elective courses chosen from the following list: COMP 5009, 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 5704.
- Two 0.5-credit electives (not necessarily in data science)
- Fulfilment of the graduate seminar requirement
- 2.5 credits in COMP 5905 [2.5] M.C.S. Thesis. Thesis must be in the area of Data Science. Each candidate submitting a thesis will be required to undertake an oral defence of the thesis.

**M.Sc. Biology with Specialization in Data Science**

- 0.5 credit in DATA 5000 [0.5] Data Science Seminar
- 0.5 credit elective (not necessarily in data science)
- 4.0 credits in BIOL 5905 [4.0] M.Sc. Thesis.  Thesis must be in the area of Data Science. Each candidate submitting a thesis will be required to undertake an oral defence of the thesis.

**M.A.Sc. Electrical and Computer Engineering with Specialization in Data Science**—thesis option

- 0.5 credit in DATA 5000 [0.5] Data Science Seminar
- 0.5 credit in a data science elective course chosen from the following list (SYSC5001, SYSC5003, SY-SC5004, SYSC5101, SYSC5103, SYSC5104, SYSC5201, SYSC5207, SYSC5300, SYSC5303, SY-SC5306, SYSC5401, SYSC5404, SYSC5405, SYSC5407, SYSC5500, SYSC5703, SYSC5706)
- 1.5 credits in electives (not necessarily in data science)
- 2.5 credits in SYSC 5909 [2.5] M.A.Sc. Thesis. Thesis must be in the area of Data Science.

**M.Eng. Electrical and Computer Engineering with Specialization in Data Science**—project option

- 0.5 credit in DATA 5000 [0.5] Data Science Seminar
- 1.0 credit in data science elective courses chosen from the following list (SYSC5001, SYSC5003, SY-SC5004, SYSC5101, SYSC5103, SYSC5104, SYSC5201, SYSC5207, SYSC5300, SYSC5303, SY-SC5306, SYSC5401, SYSC5404, SYSC5405, SYSC5407, SYSC5500, SYSC5703, SYSC5706)
- 3.0 credits in course work (not necessarily in data science)
- 0.5 credit in SYSC 5900 [0.5] M.Eng. Project. Project must be in the area of Data Science.

**M.Eng. Electrical and Computer Engineering with Specialization in Data Science**—coursework option

- 0.5 credit in DATA 5000 [0.5] Data Science Seminar
- 1.5 credit in data science elective courses chosen from the following list (SYSC5001, SYSC5003, SY-SC5004, SYSC5101, SYSC5103, SYSC5104, SYSC5201, SYSC5207, SYSC5300, SYSC5303, SY-SC5306, SYSC5401, SYSC5404, SYSC5405, SYSC5407, SYSC5500, SYSC5703, SYSC5706)
- 3.0 credits in course work (not necessarily in data science)

**M.A.Sc. Biomedical Engineering with Specialization in Data Science**—thesis option

- 0.5 credit in DATA 5000 [0.5] Data Science Seminar
- 0.5 credit in BIOM 5010 Introduction to Biomedical Engineering
- 1.5 credits in coursework
  - 1.0 credit in graduate-level BIOM (BMG) courses (or equivalent)
  - 0.5 credits from graduate-level courses offered at either Carleton University or the University of Ottawa
  - 1.0 credit from the two previous lines must be in data science, chosen from the following list (BIOM 5400, BIOM5405, COMP 5111, COMP 5112, COMP 5009, COMP 5100, COMP 5101, COMP 5107, COMP 5108, COMP 5204, COMP 5209, COMP 5305, COMP 5306, COMP 5307, COMP 5308, COMP 5401, COMP 5704, PHYS,5002, SYSC 5001, SYSC 5003, SYSC 5004, SYSC 5101, SYSC 5103, SYSC 5104, SYSC 5201, SYSC 5207, SYSC 5300, SYSC 5303, SYSC 5306, SYSC 5401, SYSC 5404, SYSC 5405, SYSC 5407, SYSC 5500, SYSC 5703, SYSC 5706)
- 2.5 credits in BIOM 5909 M.A.Sc. Thesis. Thesis must be in the area of data science.
- 0.0 credit in BIOM 5800 Biomedical Engineering Seminar

**M.Sc. Geography and Environmental Studies with Specialization in Data Science**

- 0.5 credit in DATA 5000 [0.5] Data Science Seminar
- 2 credits in electives (not necessarily in data science).

- 2.5 credits in: GEOG 5906 [2.5] Thesis. Thesis must be in the area 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** – Coursework Option

- 0.5 credit in DATA 5000 [0.5] Data Science Seminar
- 1.5 credits in:
  - ECON 5020 [0.5] Microeconomic Theory,
  - ECON 5021 [0.5] Macroeconomic Theory,
  - ECON 5027 [0.5] Econometrics
- 0.5 credit in: ECON 5029 [0.5] Methods of Economic Research.  Research paper must be on a data science-related topic.
- 0.5 credit from data science-related ECON courses: ECON 5055, ECON 5361, ECON 5362, ECON 5700, ECON 5712, ECON 5713. Must be approved by the M.A. Supervisor of the Department of Economics.
- 0.5 credit in Data Science elective (may be an additional course from the list above). Must be approved by the M.A. Supervisor of the Department of Economics.
- 0.5 credit in ECON approved by the M.A. Supervisor of the Department of Economics. Must be approved by the M.A. Supervisor of the Department of Economics.

**M.A. Economics with Specialization in Data Science** – Thesis Option

- 0.5 credit in DATA 5000 [0.5] Data Science Seminar
- 1.5 credits in:
  - ECON 5020 [0.5] Microeconomic Theory,
  - ECON 5021 [0.5] Macroeconomic Theory,
  - ECON 5027 [0.5] Econometrics
- 1.5 credits in: ECON 5909 [1.5] M.A. Thesis on a Data Science topic approved by the Graduate Committee of the Institute of Data Science
- 0.5 credit from ECON 5055 [0.5], ECON 5361 [0.5], ECON 5362 [0.5], ECON 5700 [0.5], ECON 5712 [0.5], ECON 5713 [0.5]