CARLETON UNIVERSITY
SCHOOL OF COMPUTER SCIENCE

COMP 5307: Knowledge Representation

Winter Term 2018

Instructor: Dr. Leopoldo Bertossi. **Email:** `bertossi@scs.carleton.ca`

Course web page: `http://www.scs.carleton.ca/~bertossi/KR`

Lectures: Tu and Th 16:00-17:30. Room: SA 313

Office hour: Room 5125A. Th. 14:30-15:30.

Prerequisite: A first course on discrete mathematics, e.g. equivalent to COMP 1805. A first course on databases is strongly recommended.

Objectives and Contents: Knowledge representation (KR), traditionally a main area of artificial intelligence, deals the problem of representing knowledge in computers and using it in computer systems. Symbolic logic provides formal languages with a clear syntax and semantics for representing knowledge, and deductive systems that can be used to automate reasoning and decision making.

Knowledge representation has regained the interest and attention from the computer science and computer engineering communities due to the emergence of new and important areas that are based on or applying KR tools and concepts. Some of them are: semantic web, ontologies, logic-based agents technology, databases and information systems, and logic programming.

This course presents the fundamentals and applications of logic-based knowledge representation and reasoning. It will not only benefit the students who wish to learn KR, but also those who need to learn the fundamentals of computational logic, a fundamental discipline for many areas of computer science. Automated reasoning tools will be used throughout the course. Specific topics will be taken from the following list:

1. Introduction: Different forms and applications of KR.
2. Review of propositional logic. Introduction to First-Order Logics (FOL).
3. Automated reasoning in FOL. Resolution. Logic programming. Tableaux.
4. Commonsense and non-monotonic reasoning. Non-Monotonic logics.
5. Extensions of logic programming and Datalog. Answer set programming for KR.
6. Specification of dynamic systems. Reasoning about action and change. Situation calculus, epistemic actions.

7. Diagnostic Reasoning, automated diagnosis.
8. Formal ontologies: Description Logic and Datalog$^{\pm}$.

Assessment:

- 2 midterm tests, in class: %40
- Individual written assignments (conceptual and applications of automated reasoning systems): % 60

Lecture notes (slides) prepared by the instructor will be posted right after every lecture on the course web page. Reading them carefully (i.e. understanding everything, filling in details, and solving the proposed exercises) is crucial to get good marks in the tests. Posted slides should read right after every lecture and before attending the next lecture.

Also active class attendance and participation is strongly recommended. What is said or discussed in class (and possibly not directly reflected in the lecture slides) may be asked in a test.

Reading and Bibliography:

- Instructor's lecture slides. Posted after every lecture.
- Papers and documents posted by the instructor on the course web page. Unless otherwise stated, they are mandatory reading.

Books:

- Michael Genesereth and Eric Kao. "Introduction to Logic". Third Edition, Synthesis Lectures on Computer Science #6, Morgan & Claypool Publishers, 2017. (E-edition accessible through CU Library)
- Martin Gebser, Roland Kaminski, Benjamin Kaufmann, and Torsten Schaub. "Answer Set Solving in Practice". Synthesis Lectures on Artificial Intelligence And Machine Learning #19. Morgan & Claypool Publishers, 2013.
- Ronald Brachman and Hector Levesque. "Knowledge Representation and Reasoning". Morgan Kauffmann Publishers, 2004.
- F. van Harmelen et al. "Handbook of Knowledge Representation". Elsevier, 2008.
- M. Gelfond and Y. Kahl. "Knowledge Representation, Reasoning, and the Design of Intelligent Agents". Cambridge Univ. Press, 2014.
- C. Baral. "Knowledge Representation, Reasoning and Declarative Problem Solving". Cambridge University Press, 2003.