

CIS/CSE 607
Mathematical Logic for Computing
Fall Semester, 2011
Prof. Howard Blair

Introduction

The mathematical basis of computing really involves all areas of mathematics, but there is a particular focus on so-called *discrete mathematics*, theory of computability, computational complexity, algorithmic complexity, and underlying all of this, *mathematical logic*. This course focuses on mathematical logic in a way appropriate both for applications to various areas of computing, and for deepening the understanding of various areas of computer science such as the design of programming languages, artificial intelligence, knowledge engineering, data mining, and software and hardware verification.

Course Objective and Purpose

- The objective of this course is to equip participants with a *way of seeing and reasoning* based upon mathematical logic, and to understand the limitations of this way of seeing and reasoning.
- The purpose of this way of seeing is to empower one to engineer anything in the design space that is the mathematical universe, the only limits being those imposed by logical consistency.

Course Rationale

- The mathematical universe displays extreme consilience; in particular, the structure and function of any part of it impacts the structure and function of every other part.
- Artifacts of technology as well as the the virtual worlds of computing are realizations of structures in the mathematical universe.
- Therefore, the greater one's powers to roam at will through the design space that is the mathematical universe, the greater will be one's powers to create and to wield artefacts of technology and the virtual worlds of computing.

Course Outcomes

To realize the course's purpose, upon completion of the course participants will be able to:

- Begin to read mathematical research papers in computer science and engineering.
- Recognize rigorous logical reasoning.
- To use mathematics and rigorous logical reasoning to facilitate deep learning of new technical concepts on one's own.
- To formalize rigorous reasoning and appreciate the issues involved in formally modeling natural reasoning.
- To apply mathematical logic to showing that hardware and software conform to desired specifications.

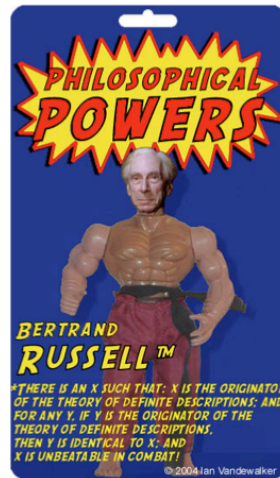
Grading

$$\max(\text{AVG}(\text{Exam1}, \text{Exam2}, \text{Labs}, \text{FinalExam}), \text{FinalExam})$$

Bibliography

- Richard L. Epstein and Walter A. Carnielli: *Computability* (2nd edition). Wadsworth Pub Co. 1999. ISBN 0534546447.
- (Recommended - Older Edition 2 or 3): George S. Boolos, (John P. Burgess) and Richard C. Jeffrey: *Computability and Logic* (2nd or 3rd edition, Paperback). Cambridge University Press. These editions are out of print, but if you can find edition 3, buy it! Avoid edition 4.
- (A freeware text on mathematical logic. There is much more here than needed for the present course and it is easy to get bogged down in this material. Still, it's a useful companion): S. Bilaniuk, *A Problem Course in Mathematical Logic*
- (Helpful review of undergraduate discrete mathematics for computer science. An edition is currently used in CIS 275. Consult the SU Bookstore. Earlier editions are OK. **Strongly recommended**): Rosen, Kenneth H.: *Discrete Mathematics and Its Applications with MathZone*, McGraw-Hill Science/Engineering/Math; 6 edition (July 27, 2006) Other editions are OK. ISBN 0073312711. 910 pages!!

Our Founder



Bertrand Russell

1872-1970

Nationality: British

Group Alliances:

"Antagonistic" Analytic Philosophers
"Loathsome" Logicians
"Noisome" Nobel Laureates

AKA: Hurtin' Bertrand

Russell the Logic Muscle
Russell "Wanna Tussle?"
The Principal of Mathematics
The Third Earl Russell

Powers: comprehension of sets

Weaknesses: radical political views about war and nuclear weapons being bad

Notes: Mail in a proof of purchase for this toy (plus \$4.95 S & H) and receive either a Present King of France® action figure with removable toupee or a copy of Waverly by Scott!

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University Academic Calendar

SPRING 2012	
Registration for new and returning graduate students who did not previously register, and new & readmitted undergraduate students	Sunday, January 15
First day of classes	Tuesday, January 17
First day of Extended Campus classes	Tuesday, January 17
Late registration & Schedule adjustment	Tuesday, January 17 - Tuesday, January 24
Martin Luther King Day (no classes, University offices closed)	Monday, January 16
Add deadline *	Tuesday, January 24
Grading option deadline to elect or rescind pass/fail or audit	Tuesday, January 31
Financial deadline to drop class*	Tuesday, February 7
Mid-semester progress reports due from faculty	Monday, February 27
Mid-term	Monday, March 5
Academic drop deadline*	Tuesday, March 20
Registration for Summer begins	Wednesday, March 21
Spring Break (no classes, University offices open)	Sunday, March 11 - Sunday, March 18
Registration for Fall semester	Monday, April 9 - Wednesday, May 9
Withdrawal deadline*	Tuesday, April 17
Final grades due from faculty	Tuesday, May 15
Last day of classes	Tuesday, May 1
Reading days	Wednesday, May 2; Saturday, May 5; Sunday, May 6
Final examinations	Thursday, May 3; Friday, May 4; Monday, May 7 - Wednesday, May 9
Last day of Extended Campus classes	Thursday, May 10
Commencement Weekend	Saturday, May 12; Sunday, May 13

See: <http://www.syr.edu/registrar/students/index.html>

Topics (Approx. Week by Week) (Assumes 15 weeks and includes self-assessment exam plus 3 exams.) Final exam to be given during final exam week on the evening of December 14th at 6:30pm. Mid-semester exam dates are approximate.

1. **Week 1, Tuesday January 17:** Introduction.
2. **Week 1, Thursday January 19:** Assessment exam.

(To be continued.)