Philosophy and Foundations of Mathematics

Course Description

The goal of this course is two-fold. In the first half of the course, we will introduce students to three common philosophical treatments of mathematics: Logicism, Formalism, and Intuitionism. In the latter half, we will cover the efforts of mathematicians and philosophers throughout the late 19th and early 20th century to reduce mathematics to logic. In many ways, this effort culminated in 1931 with Kurt Gödel's Incompleteness Theorems. Our course will conclude with the philosophical and mathematical implications of the Incompleteness Theorems. Some familiarity with higher-level math and comfort with elementary logic is strongly recommended.

Course Details

- **Course**: TBD
- **Prerequisites**: (Recommended) PHIL170 or CMSC250 or MATH310
- **Credits**: 1
- **Seats**: 20
- **Lecture Time**: TBD
- **Location**: TBD
- **Semester**: Spring 2019
- **Textbook**: Readings will consist of articles from the Stanford Encyclopedia of Philosophy (SEP) and excerpts provided by the Facilitator
- **Course Facilitator(s)**: Conner Gorman
- **Faculty Advisor**: Dr. Roohollah Ebrahimian

Communicating with course staff

For questions regarding the course structure and policy not covered by the syllabus, please contact the Facilitator or the Faculty Adviser. For questions regarding course content, please contact the Facilitator first. While questions regarding content are encouraged and integral to the course, it is often hard to address via email due to the limits of the medium, so they may be best left to class time or office hours.

Instructor(s) Name(s) and Email(s):

- Dr. Roohollah Ebrahimian: ebrahimi@umd.edu

Facilitator Name and Email:

- Conner Gorman: cgorman@umd.edu

Topics Covered

Syllabus may be subject to minor changes, but drastic revisions will require input of students/facilitators, and those involved will be notified immediately

- What is the Philosophy of Math?
    - Metaphysics vs Epistemology (of Math)
- Intuitionism
    - Realism in Math
    - Law of the Excluded Middle

- Formalism
    - Game and Term Formalism
    - Deductivism
        - What are Axioms?
        - Deductivism vs Logicism
- Logicism
    - Frege's Programme
        - Concepts and Extensions
        - Defining the Natural Numbers
    - Russell's Paradox
- Moving Past Frege
    - Russell & Whitehead
    - Peano and his Arithmetic
- Gödel's Theorems: Completeness and Incompleteness
    - Can logic capture all of math?
    - Computability Theory and its connection to logic

Assignments

There are 3 main types of assignments in the course: **Readings**, **Homework**, and a **Final Presentation**.

- **Readings** will be from two sources: *The Stanford Encyclopedia of Philosophy* (SEP) and Stewart Shapiro's, *Thinking about Mathematics*. SEP is an online resource that is free to access. The short excerpts from Shapiro will be provided as scans as necessary. The readings are essential for participating in class discussion. Students should attempt the reading before the class that covers the content (e.g. the first class on intuitionism is week 3, so students should read "SEP Philosophy of Math 2.2" before class on week 3)

- **Homework** will include the logic review packet and 1 worksheet for each of the 4 main topics (Intuitionism, Logicism, Formalism, and Gödel) for a total of 5 assignments. Since logic is a fundamental aspect of this course, students will be asked to provide formal proofs using the deduction rules on some homework assignments.

- The **Final Presentation** is an opportunity for students to research and present on a topic not specifically covered in the course. Students will be required to create a 1 page (possibly 2-sided) handout to accompany their presentation. Students are encouraged to consult the Facilitator about topics, and will be required to submit a proposal for approval. A full set of guidelines will be provided as the semester progresses.

Grading

Grades will be maintained on ELMS. You will be responsible for all material discussed in lecture as well as other standard means of communication (Piazza, email announcements, etc.), including but not limited to deadlines, policies, assignment changes, etc.

Any request for reconsideration of any grading on coursework must be submitted within one week of when it is returned. No requests will be considered afterwards.

Your final course grade will be determined according to the following percentages:

Percentage	Title	Description

40%	Participation	This class (especially the first half) is highly discussion based. Reading the assigned articles and participating in these discussions is vital to understanding the material.
20%	Homework	See “Assignments” section.
40%	Final Presentation	See “Assignments” section

Schedule

Schedule is subject to change and revision. Students will be notified in class and via email of any and all changes.

Week	Topic	Assignment
1 (1/27)	What is the Philosophy of Math?	
2 (2/3)	A Brief Review of Logic	Assigned: Logic Review Packet Read: “Thinking About Mathematics”, pp. 3-16
3 (2/10)	Intuitionism- Brouwer and Realism in Mathematics	Assigned: Intuitionism Worksheet Read: SEP Philosophy of Math 2.2
4 (2/17)	Intuitionism	Due: Logic Review Packet
5 (2/24)	Logicism: Frege’s Programme	Due: Intuitionism worksheet Assigned: Logicism Worksheet Read: SEP Philosophy of Math 2.1

6 (3/2)	Logicism: Russell's Paradox and the End for Frege	
7 (3/9)	Formalism: Game and Term Formalism	Due: Logicism Worksheet Assigned: Formalism Worksheet Read: "Thinking about Mathematics," pp. 140-147
8 (3/16)	SPRING BREAK	
9 (3/23)	Formalism: Deductivism	Read: SEP Philosophy of Math 2.3 Assigned: Proposal for Presentation
10 (3/30)	Formalism: The Hilbert Programme	Read: "Thinking about Mathematics," pp. 158-165 Due: Formalism Worksheet
11 (4/6)	Kurt Gödel and the Limits of Logic	Read: "Thinking about Mathematics," pp. 165-168 Assigned: Gödel Worksheet Due: Proposal for Presentation
12 (4/13)	Gödel (continued)	Due: Gödel Worksheet
13 (4/20)	Student Presentations	
14 (4/27)	Student Presentations	
15 (5/4)	Student Presentations	

Excused Absence and Academic Accommodations

See the section titled "Attendance, Absences, or Missed Assignments" available at Course Related Policies.

Disability Support Accommodations

See the section titled "Accessibility" available at Course Related Policies.

Academic Integrity

Note that academic dishonesty includes not only cheating, fabrication, and plagiarism, but also includes helping other students commit acts of academic dishonesty by allowing them to obtain copies of your work. In short, all submitted work must be your own. Cases of academic dishonesty will be pursued to the fullest extent possible as stipulated by the Office of Student Conduct. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.shc.umd.edu.

Course Evaluations

If you have a suggestion for improving this class, don't hesitate to the facilitator or the faculty adviser. At the end of the semester, please don't forget to provide your feedback using the campus-wide CourseEvalUM system. Your comments will help make this class better.

Thanks to the CS professors at the University of Maryland, College Park for the basic syllabus outline.