Gödel's Incompleteness Theorem and an Introduction to Modern Mathematics

Honors Minicourse, Spring 2009

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Office: Math Tower 3-103
Office Hours: Wed 3:30-4:30 in 3-103
Fri 10:00am-11:00am in the Math Learning Center
Fri 1:00pm-2:00pm in the Math Learning Center
Class Time: 2:20-3:15 Wednesdays in the Library W3502 (The Honors Lounge).

This course will serve as an introduction to the famous incompleteness theorem of Kurt Gödel, and in doing so will (hopefully) provide an introduction to mathematics as a field of study. In other words, figuring out Gödel's theorem will help tell us a little bit about the types of things that professional mathematicians do. There is no textbook for this course, but if there were, it would be the following classic work, the reading of which will greatly help you to understand this course:

- *Gödel's Proof.* Nagel, Ernest and Newman, James R.

The following are other good books on the subject. I own all of them, and you are welcome to drop by my office and look at them.

- *Gödel's Theorem: An Incomplete Guide to Its Use and Abuse.* Franzén, Torkel. This is also an introduction for "non-specialists," but there is more mathematics than in Nagel and Newman's book, so it is a bit harder to get through.
- *Gödel, Escher, Bach: An Eternal Golden Braid.* Hofstadter, Douglas. This book is written for a general audience, is not a math book, and covers a broader philosophical topic, but it is a great read is very inspiring. It won the 1980 pulitzer prize for general nonfiction.
- *On Formally Undecidable Propositions of Principia Mathematica and Related Systems.* Gödel, Kurt. Translation by B. Meltzer. This is an english translation of the original paper. The introduction by R. B. Braithwaite is excellent. Be aware that this is the original paper, and is intended to be read by specialists in the field. Nevertheless, if you are brave and really interested, I will be more than happy to discuss this paper with you.

Grading: The grading is pass/fail, and there will be no homework or exams. You will receive a passing grade by simply attending class. If you find yourself interested in learning more, feel free to talk to me and I can offer you more information, exercises, or more challenging things to do.
Prerequisites: There are none, other than being in the Honors program. No prior knowledge of mathematics is assumed other than a good high school education and a willingness to learn.
Syllabus: Because the focus is on student understanding, the schedule of topics is flexible and may change. The topics that we will try to cover include the liar paradox and Russell's Paradox, formal systems and euclidean geometry, a brief introduction to non-euclidean geometry, consistency and completeness of formal systems, and of course the statement of Gödel's Theorem. If there is time then we may cover a rough outline of the proof, by introducing Gödel numbering and observing the striking relationship to the liar paradox. I also welcome suggestions from students on topics they would like to see or specific questions, and encourage group discussions.