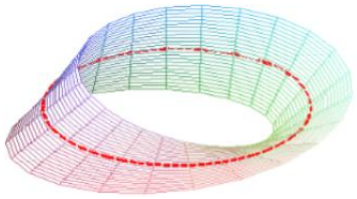
Logic & Critical Thinking[1]
Version 3.6—Villanova University, Fall 2009, PHI 2010.002/.003
002: MW 1:30-2:45 JBarry 208; CRN #22335
003: MW 4:30-5:45 Bartley 023A; CRN #22336



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Office hours: MW 3-4pm, and by appointment, SAC 69

Official Course Description: "The study of logic and critical thinking. Topics include: argument identification and analysis; formal and informal logic; fallacies; inductive argument; the role of argumentative structures in various philosophical traditions. 3.0 Credits." (*VU Course Catalog*)

Introduction

Logic, uniquely, is a branch of philosophy beside metaphysics, ethics, *etc.,* and at the same time a branch of mathematics on equal footing with algebra, analysis, *etc.* This double classification does not signal uncertainty, confusion or redundancy[2] but expresses an essential two-sidedness. Further, that logic is not *one* field provides a first clue toward surpassing our presumption that logic forms a "field" at all.

In this course, we shall try to do justice to logic's dual citizenship by setting up a conversation between philosophy and mathematics, weaving back and forth between 1) formal *proofs* and 2) *elucidations* expressed in the less formal but more searching language of a thought which orients itself according to philosophy's fundamental questions, as these reveal themselves in our own reflection and in our reading of key texts in the history of philosophy. (These are never simply "historical"; the part of the history of philosophy worth pursuing for our purposes is the part that is also immediately contemporary to thought.) If we avoid conflating philosophy with mathematics or pushing them toward a superficial unity (a temptation to be actively resisted) our conversation will hopefully shed light on both philosophical and mathematical discourses, each through its *tension* with—and *need* for—the other. We shall try to elucidate the principle of this need—*Why* is it the case that, as someone puts it [3]

> *Without mathematics, one cannot penetrate deeply into philosophy.*
> *Without philosophy, one cannot penetrate deeply into mathematics.*
> *Without the two, one cannot penetrate deeply into anything.*

Thus logic will be put into motion, no longer as something reified and static (a field, a discipline, the so-called "science of arguments") but as the conversation between philosophy and mathematics.

Now, the interest in formal structures (proofs, theorems, deductive systems *etc.*) which is proper to logic might at first give the impression that the study of logic has nothing to do with everyday life and practical concerns. I suggest that this impression is misleading for two reasons. The first of these reasons puts logic together with existence in an ordinary or normal way, the second in an extraordinary or exceptional way. Please consider first the normal way.

1. A traditional but thoughtless definition makes logic "the science of arguments". We will show that this traditional definition cannot possibly be right, and that it is even the case that the one thing we can be sure logic *isn't* is a science of arguments. Nevertheless, it remains true that a major part of logic, coming before its reflection on itself, does consist in the study of the logical form of arguments, and *argument*—discourse that claims to give *reasons*—is a familiar and ubiquitous part of our legal, scientific, economic, political,

[1] Image credit: http://www.atsweb.neu.edu/math/cp/blog/mobius.gif
[2] It does, though, provide for *endless* library trouble, especially at those universities where math and philosophy collections are housed in different buildings.
[3] But who? Gregory Chaitin attributes the lines to Leibniz - and it captures a side of Leibniz's thought which we could wish to find expressed so decisively - but so far I have not succeeded in identifying a source text, despite locating tantalizing references, older than Chaitin, to the *Nouveaux Essais*, in which, Uqbarishly, these lines do not appear. Nonetheless, the errant or dissembling scribe writes truely!

and moral life. Without arguments—that is, without giving each other reasons for holding certain claims as true and others as false—a democratic society perhaps could not be held together, unless one supposes that force, shared opinion, or habit could do the job for a short time. (Is this alarming?) But this would mean that a person who pays attention to the structure and justification of arguments is potentially not only a better thinker but a more critical user of "information" supplied by the media or other institutions, a stronger and more authentic advocate, a less manipulable consumer, a more responsible citizen, a better person. This ideal describes what I'm calling the "ordinary" relation of logic to existence: that of grounding or giving reasons in the discourses that play a central role in our lives. (Though of course, serious progress toward the realization of this ordinary and widely acknowledged norm is far from "normal" in the sense of being widespread; it's the ideal and not its realization that's familiar.) I take it that everyone who believes in and is pursuing a liberal education accepts this ideal to some degree.

2. The second (call it "extraordinary" or "anomalous") relation lies in the fact that *metalogical* reflection gives us philosophical tools for reflecting rationally about the limits, possibilities, and crises of rationality. (Or so I claim, and I hasten to admit that this is even my signature claim, not anyone's accepted doctrine.) If we live, as has been suggested with increasing frequency since the mid-nineteenth century, in the wake of a crisis of rationality, then this exception may be, ironically, widespread; it may even be the very medium or norm of contemporary existence. To get to the point where we can see how this would be, to determine whether and how it is possible to think reasonably about the limits of reason, to be thoughtful about the limits of thought, and what kind of orientations or attitudes—theoretical, ethical, existential—it might make sense to have about these "limits" is a second major goal of the course, on par with the more ordinary goal of gaining insight into logical form. What happens or should happen at "the limits of thought"? Is there a leap into some other attitude, *e.g.* a leap of faith or a sovereign decision? *Or is undergoing its own limit actually what is most proper to thought?*

In the second half of the course, we will explore philosophical interpretations of the phenomenon known as "incompleteness" as a way of asking this second group of questions more precisely and deeply. We will seek to understand the implications—not just for certain technical logical systems, but for our individual and historical existence—of what is arguably the major event of logical history since Plato: the discovery and proof of the First and Second Incompleteness Theorems by Kurt Gödel (then 25 years old) in 1930-31.

At the point of Incompleteness, I suggest, the whole landscape of logical space changes in a way that there's no point trying to describe too closely in advance of the experience. At this point, the conversation between philosophy and mathematics becomes internal to the participants; there, it's no longer a matter of exchanges between two fixed languages, but of a mutation of language and thought which calls for new thinking, and leads us rapidly to the edge of established lexicons, both philosophical and mathematical. The primary goal of the second half of the course, in my intention, is for each of us to have this experience for her/himself, the experience of an "eidetic intuition", as Husserl would say, of Incompleteness—or as a Platonist might say: no longer just talking about it secondhand, but seeing the form itself, for oneself, as one's own...

Course Outline: Pre-Theory → Theory → Metatheory

The course will attempt to follow two *movements* of thought, two *transitions*, therefore three *points* or signposts: "informal logic", "formal logic", and "metalogic". The first transition that interests us is from informal logic to formal logic, the second from formal logic to metalogic. This second transition opens onto ways of thinking that could be called "post-formal", so the course follows the arc of the destiny of formal thought. The three points taken together are intended not only to present a series of topics, but also to enact and observe a philosophical drama about the 1) emergence, 2) development, and 3) destiny of formal thinking, a destiny that you must decide for yourself whether to interpret as tragedy or fulfillment. You *could* understand some key metalogical results as bringing us around in a circle to the point we were at before formalization. If this were the right interpretation, formal rigor would be futility itself, a mad detour, as some contemporary thinkers suggest. But perhaps this apparent circularity is misleading, and there is instead something utterly central about using a formalism (or being used by one) in order to glimpse the limits of formalisms.

In the first movement of the course, then, we will learn how to build and use some typical logical-mathematical systems—categorical, sentential, and predicate logics—while reflecting upon their philosophical motivation (why build them?) and their particular components (do they work?). At this stage, the drive is toward greater formalization, while at the same time we will remark upon the challenge to formalization that persists in the form—or formlessness—of ordinary content-rich language. By the midterm, you ought to be able to read and use some basic logical systems to assist your thinking about an endless variety of issues, and also to think about the limits of such systems from the outside.[4]

The second movement will introduce you to the techniques and deep concepts of metalogic—the philosophical and mathematical reflection on logical systems and their limitations, which made it possible to think about the very *idea* of a logical system, about the implications and limitations of this idea, *from the inside*. The results studied in this section form a key part of the intellectual inheritance of the nineteenth, twentieth, and twenty-first centuries, as well as directly recovering problems raised by Plato, Leibniz, Kant, and Hegel. They are vital for understanding contemporary developments in philosophy, mathematics, physics, computer science, and information theory which impact the shape and direction of contemporary life. Moreover, they are often surprising and beautiful, even moving.

The leading idea of this part of the course is "Incompleteness", referring in the first instance to two results first proven by Kurt Gödel in 1930/31 and subsequently known as his "First and Second Incompleteness Theorems". A related key term here is "diagonalization", which refers to the "technique" by which the proofs of these theorems—and many others—can be accomplished. These theorems forever changed (or ought to have changed) our philosophical picture of logic and its powers, and of the relation of logical systems to philosophy and mathematics. Their consequences are still being thought through at the cutting edge of our civilization. You might say that in 1930/1, mathematics started *talking about itself,* and we are still processing the logical shock of its speaking and still (perhaps forever) interpreting what it had to say.[5]

But, one might object, why push our introductory study of logic into metatheory, a supposedly "advanced" topic?

1. Ordinary logical theory has the power to *express* a picture of the world in language. Metalogic has the ability to change one's picture of the world, and even one's picture of *what it is to have a picture of the world!* It can change what we think the world is like, and what we think *thinking* is like. It can change our view, and at the same time, change our view *of views*. It can shift our paradigm, as well as shifting our paradigm *of a paradigm.* This, then, is not merely an "advanced" technical extension which should be reserved for specialists; it's a qualitatively different way of apprehending the structure of the logical field and its relation to existence. It would be wrong—ethically wrong, I think—to pretend that it's not out there in setting out our work for ourselves.

2. This is why, in my experience, incompleteness is the most direct path to opening formal logic up to deeper philosophical themes. One wonders in a typical logic course what logic has to do with *existence* in the physical, spatiotemporal, social, ethical world. Logic's mode of operation (that is, its initial investment in the form/content distinction) seems for the most part to ignore/repress/exclude space, time, individuals, value, performativity, *etc.* (*Cf.* our selection from Russell's "Logic and Mathematics".) Once we take Incompleteness on board, however, rich (or: *thick*) philosophical concepts like infinity, paradox, self-reference, historicity, contingency, the role of information/computing technology, and the limits of thought leap unavoidably into our mathematical exercises! Philosophy shows up at the heart of technical mathematics here in a completely surprising way. At the same time, the mathematical rigor of the metalogical theorems begins to inform our reflections on metaphysics, cosmology, philosophy of mind, and even (I will argue) ethics or existential philosophy—the side of philosophy from which mathematical logic seems (indeed, is) at first, far-

[4] *Read and use:* a logical system always occupies an uncanny middleground between *text* and *machine.*

[5] Incidentally, mathematics said the opposite of what everyone assumed that it would say, if it ever spoke, which wasn't supposed to happen. It said "no" to its own perfection, that is, consistency + completeness, separating itself forever from the epochal vision of a perfect system, which henceforth has the status only of a logic of illusion. (The question that drives my personal philosophical work, by the way, is "Was this loss of the Perfect perhaps *good*? Was it even perhaps the appearance of *the* Good, the *form* of the Good in and for our time?" It's totally ok if you think that's crazy.)

thest removed. Questions about the role of thought in the physical universe, the possibility or impossibility of various metaphysical perfections, the structure of mind/cognition/consciousness, language, society, and the anxieties that lie at the foundation of a political or legal regime frequently can be given surprisingly clear and compelling elucidations in metalogical terms.

At the point of metalogic, then, a more intimate relation develops between philosophical logic and mathematical logic; once we reach this point, we have a chance of really understanding why some philosophers have thought that the philosophy of *logic* and the philosophy of *existence* are inseparable without being reducible one to another. (Interpenetration without identity between a theory of logical form and existence.)

So building on a sketch of Gödel's Theorems, we will use metalogic to begin to forge links between formal mathematical logic and a wide variety of philosophical concerns. At this stage, the drive is toward an awareness of the role and limits of formalization itself as revealed *from the inside*. By the end of this second movement, you ought to be able (such is my goal) *to recognize the metalogical dimension in discourse*—which, we shall see, is frequently the dimension of any field of thought that is richest in problems and in creative concepts; further I wager that this reflection on the limits of logic can be rediscovered at the limit of each "field" or "subject" of the University, possibly constituting their unexpected return to philosophy. The option to pursue an individual project, described below, is for the sake of carrying through this localization in particular cases. If you like, our course can be in part an experiment in using metalogic to open a bridge between formal logic and your own intellectual projects/interests /loves.

Throughout, my hope is not only that your thinking becomes better (again in a twofold sense: more formally rigorous *and* more involved in awareness of the limits of formal rigor) but also that you find that participating in philosophy's discussion with mathematical forms warms you a little to philosophy's claim that the joy of thinking makes life more worthwhile, even and especially if philosophy turns out not to be a form of knowledge-production.

At the inauguration of a new level of philosophizing in the West, Socrates famously claimed that "the unexamined life is not a really *lived* or *livable* life (*bios biotos*)." The provocative structure of this claim is hidden by its overfamiliarity to us; it's worth thinking about what very different picture he might have drawn of thought's value just by changing a word or two... Socrates didn't claim that examination (philosophical reflection) succeeds on its own terms, that it produces a master knowledge, directing life from a position of sovereignty, that it discovers some unequivocal truth about life, or even that it adds to our knowledge at all. Doesn't the claim instead suggest an *essential indirectness* in the relation between reflection and life? Isn't the Socratic claim that *thinking about thinking*—which seems to enact a suspension of living, a potentially alienating *step back* from our actual existentially gripping concerns, a detour from engaged care into logical play—in fact, if carried out correctly, is the means of getting closer to existence, reaching the heart of life? *How would the topological configuration of thought and existence have to be repictured if this were to be the case?*

Requests: Think. Don't stress out. Enjoy.

Requirements:

Participation (1/3 of grade) Dimensions of participation include (but are not necessarily limited to) the following:

In-class participation:

- To the extent possible, try to think of yourself as a co-creator of the course, not as a consumer.
- Do all reading and practice problems recommended (a.k.a. "assigned").
- Come prepared to contribute your thoughts about concepts and problems, and your solutions or attempts at exercises, and your questions. Ask questions that arise in your preparation, and about my lectures either as they're going on, or at the beginning of the next meeting.

- Be willing to make mistakes! No one can improve at a mathematical or philosophical discipline without making loads of mistakes. As logic is both, we get to make twice (four times?) as many mistakes.
- Courteously challenge each other's philosophical assumptions and claims, including mine.

Précis:

- At least once (probably twice) during the semester, each participant will be asked to take especially detailed notes during a meeting, organize, systematize, and then present a recapitulation of the main issues raised at the beginning of the next meeting, along with any additional points that arise in reflection on them. Please email me the *précis* by the night before you present it, so that I have time to look over it. I will use them as a basis for blog posts to benefit the entire seminar, to jumpstart long-term reflection on the issues raised, and facilitate review throughout the semester. Please do not, however, make the mistake of thinking that the collective précis effort is a substitute for taking your own detailed notes in your own way; access to a *précis* can improve your recall and reflection but can not stand on its own as a substitute for your thinking.

Discussion Blog:

- Regularly share your ideas on the class discussion blog, responding to my threads, and introducing threads of your own. Use the comment section and sign your response with some means of identification. You may abbreviate initials, use your first name, etc., to provide whatever level of web anonymity makes you comfortable.
- The exemplary student would make it a goal (not always fulfilled, of course) to respond in some way to each meeting, and to respond not only to my prompts, but to the responses of other students.
- Check out the list in progress of links relevant to logic and the border between philosophy and mathematics. Contribute anything you find. Explore intellectual space.

Attendance Policy:

- The crucial reason to attend each class session is that the course as a whole comprises an organic/emergent discussion, and each meeting involves experiments in communication and thought whose direction and outcome cannot fully be determined in advance. (I do not have determined in advance exactly what is going to happen; you determine it by your collective involvement as much as I do.) Thus, at each meeting, I will be making decisions about what we need to stay with, and where we need to go next. If you miss class except on very rare occasions, as much as anyone may do their best to help you, *you are not likely to know what is going on.*
- I will take attendance regularly for information's sake; you are responsible for signing in on an attendance sheet at the beginning of class when there is one.
- Villanova has an attendance policy; more than 6 unexcused absences are grounds for failure.
- If at times you cannot attend your section, but can attend the other, please do so. It's best not to make a habit of this; since the two groups may be in different places, continuity and nuance can be lost when switching from section to section.
- If you miss a class, you are responsible first for obtaining lecture notes and assignments from a study partner. Once you have done so, please consult me to talk about issues you are intrigued by or don't understand. Please don't email me first asking for a recapitulation. If you think about it, you'll realize that I can't reteach the entire lesson for every student who misses a meeting. Instead, get notes, read, think, and then come to office hours to talk.

Midterm (1/3) Will consist of technical problems and short essays on the philosophical dimensions and history of logic. A take-home portion may be added if the group expresses interest in removing some of the stakes/stress of the in-class test.

Final (1/3). Will resemble the midterm, but cover topics from the second half of the course. (Note that there is an implicit cumulativity to the final, even if we don't bother repeating the same question-types from the midterm. Even though metalogic surpasses first-order logic, it can't be understood without the latter.)

Elective semester project: For the ambitious, intellectually curious, and independent thinker... Instructions: Work with me over the semester to develop *writing* (not "a piece of writing", certainly not that awful commodity "a paper") that explores philosophical dimensions of a metalogical form (such as incompleteness, reflexivity/self-reference, the idea of the infinite or the role of paradoxes) as it appears in a context that you personally *care* about, *i.e.*, that is related to your broader intellectual project. You might choose to work out a connection with your major or a field that you've already done some work in, so that you're not trying to learn about a completely new set of issues at the same time that you're trying to learn/find the metalogical connections. In addition to philosophy and mathematics (obviously), I'm aware of potential connections in law, politics, psychology, cognitive science, physics, linguistics, economics, computer programming, literature, the fine arts, and more—not all of which can I even touch on in the main narrative of our course, both for reasons of time and the fact that one can't assume multidisciplinary familiarity in the large group. I will assist you throughout the semester in developing your investigation, and will encourage you to share your progress on the blog. Please do not pursue this option for the sake of "extra credit" or "doing well in the course"; it won't work if it's not a real exploration, and it will work if it is.

Texts: Please bring whatever texts we're currently working on to class with you, including books, articles, and any commentary that I've emailed or distributed. You will probably find that the ability to follow along in these texts during discussion is essential, and that annotating them with notes from the lectures and your own thoughts is valuable.

"Required" (Strongly Recommended): Are there any required texts? Yes and no. There is required reading in the sense that in order to do well in the course, you'll need to have access to a number of texts to read and discuss. In my experience it's also *extremely* helpful that you be able to reread them at will & annotate them extensively with your thoughts. Of course, for these purposes you'll need copies of your own, but it would be odd if I insisted that you purchased them. (Who am I to tell you that you have to spend money in a certain way in order to take this course?) So I won't *insist*—you could share, borrow from the library, etc.—but I do strongly *recommend* acquiring the works listed below. I'm confident that they have the power to assist a committed student immensely in learning and appreciating philosophical logic both at the introductory level and (far) beyond. I know people for whom these texts have been the occasion of their first initiation into philosophy; on the other hand, I refer to them frequently in my own philosophical work; they *stretch* in a curious way to match the level of experience from which a reader interrogates them.

Graham Priest. ***Beyond the Limits of Thought.*** Oxford U. Press. (My edition is the paperback 2003, ISBN-10: 0199244219, ISBN-13: 978-0199244218). A fascinating rereading of the history of philosophy through the lens of the "Inclosure Schema". Ultimately too reductive but an excellent lesson in patiently teasing out the metalogical dimensions of real philosophical problems, and thus building bridges between formal logical problematics and fundamental philosophical issues. Available at the VU store and online.

Douglas Hofstadter. ***Gödel, Escher, Bach: An Eternal Golden Braid.*** Basic Books. (My edition is the paperback 20th Anniversary Edition, 1999. ISBN-10: 0465026567 ISBN-13: 978-0465026562). I've ordered this for VU as well, and it's in stock, new and used. (*GEB* is also particularly inexpensive and plentiful online, a side-effect of its cult-classic status in the recent past.) I do find the new Preface in the 1999 edition to be good reading, but it's not strictly necessary for you to worry about this if you have access to an earlier edition. Both of these are extraordinary texts, real works of philosophy, rather than "textbooks". There are a surprising number of thinkers in the world who love these books... not quite like siblings, but let's say, like pets. The Hurley, on the other hand, is just a standard textbook. I'll explain why and in what capacity we'll be using that too when we meet. When you're able to get hold of all of them together, you'll see that they make quite an interesting contrast...

For reasons I'll elaborate in person, I haven't gone through the bookstore for the third text:

Patrick Hurley: ***A Concise Introduction to Logic.*** Wadsworth. I have the ninth edition (2006). Order any reasonably recent version of this necessary evil. We'll use it because the software is convenient, and because it's useful to philosophically diagnose what goes wrong in a textbook presentation of logic like this. (If you like, you could substitute or supplement with a better logic text such as Kleene's or Goldfarb's; these are written at a slightly higher level, and some students don't find them as user-friendly.)

Initial suggestions for reading Hurley: 1) First complete the CD tutorial. 2) Then read the chapter over. 3) Take notes on discussion questions. 4) Then complete selected exercises.

Initial suggestions for reading real books: 1) Read carefully. 2) Take notes in the margins. 3) Underline / mark important claims. 4) Develop ideas & questions for discussion in your notes and on the blog.

Potentially Useful Links:

- *Stanford Encyclopedia of Philosophy* (*plato.stanford.edu*). This, not (alas!) Wikipedia is your best first stop for getting reliable introductory information about an unfamiliar philosophical topic. The articles are detailed, the authors are scholars in their fields, and new articles, especially on logic, appear at a remarkable rate. You can access a feed of new *SEP* articles from the 'friends' page of our discussion blog.
- Greek and Roman texts at The Perseus Project (including old but serviceable translations of Plato's dialogues). (*perseus.tufts.edu/cache/perscoll_Greco-Roman.html*)
- *PhilPapers* is a rapidly-growing repository of contemporary professional articles in many areas of philosophy (*philpapers.org*).

A more extensive list of links is maintained on the blog.

Supplementary Readings: TBA. Will typically be provided via electronic reserve, over email, or on the course page on WebCT. Please print hard copies of the supplementary reading to annotate and bring to our meetings.

Itinerary of Reading Assignments and Topics: TBA. Our schedule should and will be flexible in response to the needs and interests of the class. Reading assignments and specific exercises will be filled in as we go, keeping in mind Hofstadter's Law: "Things always take longer than you think they will, even when you take into account Hofstadter's Law." To state the obvious, this means that you need to attend class, or at minimum get detailed feedback from someone, in order to know what to do next.

Grades Defined: These official Villanova grade definition guidelines are reproduced for your convenient reference. They are also available at *http://www.villanova.edu/enroll/registrar/_grades/policy/defined.htm.*

- A / A- The highest academic grade possible; an honor grade which is not automatically given to a student who ranks highest in the course, but is reserved for accomplishment that is truly distinctive and demonstrably outstanding. It represents a superior mastery of course material and is a grade that demands a very high degree of understanding as well as originality or creativity as appropriate to the nature of the course. The grade indicated that the student works independently with unusual effectiveness and often takes the initiative in seeking new knowledge outside the formal confines of the course.
- B+/B/B- A grade that denotes achievement considerably above acceptable standards. Good mastery of course materials evident and student performance demonstrates a high degree of originality, creativity, or both. The grade indicates that the student works well independently and often demonstrates initiative. Analysis, synthesis, and critical expression, oral or written, are considerably above average.
- C+/C/C- Indicates a satisfactory degree of attainment and is the acceptable standard for graduation from college. It is the grade that may be expected of a student of average ability who gives to the work a reasonable amount of time and effort. This grade implies familiarity with the content of the course and

acceptable mastery of course material; it implies that the student displays some evidence of originality and/or creativity, and works independently at an acceptable level and completes all requirements.

- D+/D/D- Denotes a limited understanding of the subject matter, meeting only the minimum requirement for passing the course. It signifies work which in quality and/or quantity falls below the average acceptable standard for passing the course. Performance is deficient in analysis, synthesis, and critical expression; there is little evidence of originality, creativity, or both.
- F Indicates inadequate or unsatisfactory attainment, serious deficiency in understanding of course material, and/or failure to complete requirements of the course.

Thoughts on Academic Integrity: Violations of the University policy on academic integrity will result in failure for the course. Please review the policy at your leisure. It can be found here: *http://www.vpaa.villanova.edu/academicintegrity/code.html*. Please pay special attention to the "Statement of Purpose", which explains the importance of the Academic Integrity Policy, and Section D, which contains information on plagiarism which may be new to you.

Sometimes plagiarism is a function of pure indifference, laziness, or hostility, but I think that more often students plagiarize out of ignorance or when they feel helpless / out of control. This, however, is not an excuse but an explanation. So rather than letting things get to the point where dishonesty could be an issue, it would be wise to approach me 1) with any questions about how to acknowledge influences on your work or 2) if you feel the sort of distress or frustration about your work that would tempt you to cut corners.

That said, it's also important to acknowledge that the notion of intellectual property, its role in the academy and in a global society, is very much in flux in 2009, and is a topic of contentious philosophical and legal debate. (Think of the rise of Wikis and blogs, the open-source movement, the travails of the music industry...) This is surely one of the most exciting issues of our time, forced on us by the potential for radically new degrees of knowledge-sharing through the Web. One positive side of these problems is that a tertiary but nontrivial goal of a college course today ought to be to explore the place of our subject on the Web. (Please join with me in this effort!) The task of finding meaningful ways to assign credit where credit is due in a world of freely-flowing information is something for all of us to think about actively and honestly, without indulging in oversimplification. I don't pretend to have all or most of the answers to these issues, but the stakes are high when a well-meaning mistake can seriously jeopardize your academic future.[6] For the moment, use the following rule of thumb: When in doubt, cite everything!

Statement on Dis/ability: Villanova seeks to make reasonable academic accommodations for students with disabilities. If you are a person with a disability, please contact me outside of class, and consider contacting the Learning Support Office (x9 5636; *nancy.mott@villanova.edu*)

What skills will I learn? Will this get me into law school? I'm curious about that myself! I'm not even going to try going to try to list all of the skills (better: moves in the game of thought) that you will be introduced to in this course. I'll instead try to point them out as we meet with them. The process of philosophical learning can't be summarized up-front, because thinking is not like an economic transaction. *Exchange* works like that, but not *production*. In a well-functioning market you know exactly what you're going to get, you get exactly what you pay for, so you have equality of payment and goods received—but you also have a sort of sterility: nothing is uncertain, therefore nothing (nontrivial) can really *happen*. Education is not like that, at least not in philosophy, which is kind of the last refuge of a certain classical ideal of education as the activity of a free person. As an awkward first approximation, I would suggest thinking about it on the metaphor of gardening—it's about growth rather than the exchange of commodities.

[6] This problem is less pressing on the mathematical side of our investigations than on the philosophical, which is itself something worth reflecting on philosophically... Even if you hear about a mathematical concept or theorem fourteenth-hand, the act of understanding it is acknowledged to make it just as much your own as the discoverer's, even if you were to repeat it in exactly the same terms, as long as you don't claim to have discovered it first. In mathematics, every act of understanding is a re-creation... But with respect to everything else, we have to be very careful indeed. Quoting Shakespeare is not the same as re-writing Hamlet. This difference between quotation and repetition is itself actually something philosophically interesting, especially if logic mixes aspects of mathematics with aspects of philosophical prose. What does intellectual property mean in logic? In philosophy generally? Can one own an argument? These are nontrivial questions.

When it comes to growing things, there is always a necessarily indirect (that motif again!) and somewhat unpredictable relationship between what you put in and what you get out. Never in a complex system do you find a linear transformation of inputs into outputs—*essential* indirectness is a characteristic of complex phenomena (like brains, organisms, careers, economies as wholes (as opposed to the individual transactions), and good conversations). Some students find the unpredictable nature of philosophical work frustrating and anxiety-provoking, but my hope is that if we can acknowledge up front that that's the way it works, rather than being a sign of something going wrong, then some of that anxiety can be saved. And fortunately, in logic there's a special opportunity for defusing that anxiety: when our reflections get too far afield, we can return to our anchor in the formalisms—the mathematics. Imo, this doesn't mean that some grim formalisms constrain our philosophizing. To the contrary, the ability to hang on to logical/mathematical form where it's possible *frees up* what's legitimately extraformal in our thinking for more daring acrobatics.

Extended Remarks 1: Questions

Here are some questions that could fall under logic, broadly construed. (I suggest that it is in our interest as thinkers to construe it broadly!) We're going to spend a good deal of our time, appropriately, learning how to use the technical apparatus of first-order predicate logic and its associated metatheory. This is proper, because logic is a technical discipline. (The Greeks first called it *he logike tekhne*, the technical apparatus (or, more loosely, "art/science") having to do with *logoi* (sentences, propositions, concepts, thoughts), before this adjectival phrase got shortened—and institutionalized—to "logic". But I want to make the case at the outset that logic, like any genuine way into philosophy, is made of open, probing questions, questions that are in some way enchanting or commanding, *more* than it's made of techniques. So here are just a few hopefully stimulating questions, intended to illustrate something of the wide scope of what can fall under "logic" philosophically. As you can see, when you approach logic in this way, it becomes meaningless to speak of a strict distinction between logic and other "branches" or philosophy, such as metaphysics, epistemology, philosophy of mind, philosophy of language, semiotics, philosophy of mathematics, philosophy of science. . . . and perhaps finally even ethics / existential philosophy. (Or perhaps ethics covers all of the same topics, but starting from the opposite shore from logic, so to speak. . .) We will not get to talk about all of these questions, and we certainly won't address all of them at once. We may even find that the questions that really do it for us do not resemble the ones I've set out here. I offer them to indicate that there's already a great deal to think about, and that we will not lack for provocations to reflection.[7]

1. Is logic one or many? What are we to make of the fact that professional logicians these days for the most part refer to "logics" in the plural? What would this mean for a philosophical ideal of rationality?

2. What are the relations between mathematical, computational, and philosophical thinking?

3. What is the relation between computation and our ordinary experience (such as perception)? How should we think about the relationship between thought and life?

4. What is *form*? Of what use to us is the form/content distinction? If form can be thought as pattern, then what is pattern? How should we think about the relation *pattern/patterned*?

5. What is a theory? For much of the twentieth century, a theory has been thought of as first-order predicate logic supplemented with some axioms (derived perhaps from empirical observation). What are the strengths and limitations of this view?

6. Are there truths? What is a truth? Is it the same as a proof? Is it the same as an experience? Is it a thing, or a property, or an event? Or something completely different?

7. Are there "logical truths" that are different in kind from "empirical truths"? Or is this difference a matter of degree, or relative to some cognitive setting? Is there a division between "analytic" and "synthetic" knowledge, or between "knowledge of relations of ideas" and "knowledge of matters of fact", or between "a priori" and "a posteriori" knowledge? Or is all knowledge part of a single "web of belief" and always open to revision, alike at the core and the periphery?

[7] The numbering is arbitrary, but it seems useful to have it, in case we want to refer back to any of these questions.

8. Is it possible to change your mind? How? Does a fundamental change of mind / paradigm shift / epistemic break happen for rational or nonrational reasons? How do we avoid paradoxical conclusions either way?

9. What to think about a classical definition of the human being as *rational animal*? Is it suggestive? Is it a mistake? Both?

10. How to think about the relation of (as Plato might say) logic and ethics / (as Heidegger might say) thought and care / (as Augustine might say) knowledge and love?

11. What are "critical" and (capital-c) "Critical" thought/thinking/theory? Is there a difference between "dogmatic" belief and "critical" or "self-critical" belief? Is *self*-critical belief critical enough, or do we need the touch of something or someone more radically Other to be truly self-critical?

12. Is there such a thing as "informal reasoning" or "inductive logic" (or what used to be called "material" logic)? What could this be? Would it be better to preserve the tension between logic as strictly formal/mathematical on the one hand and nonmathematical experience on the other, rather than filling in this hypothetical middle ground? But then what is *approximation*? And what is *probability*? And ordinary reasonableness? And how do form and life hold together? Do we have to choose between form-content dualism and the problematic monism of a material logic?

13. What's the difference between the "logical" point of view on language and other points of view? From rhetoric? From the figurative or metaphorical use of language? From the standpoint of hermeneutics (understanding, relevance, interpretation, *etc.*)? Must logic ignore/repress these dimensions? If it does, is there something intrinsically repressive about logic itself? Is logic an ethically dangerous form of ideology, as some contemporary philosophers and feminist theorists have suggested? What about other criticisms of the entire logical project?

14. What role does language play in reality? What place does thinking have in reality? *How can we have a picture of reality that takes into account our activity of picturing?* (If "activity" is even the right word here.) Can we think of thinking as a *fold* in reality? As a *break*? As a separate *sphere*? And how do we think of our specifically philosophical activity, our thinking of thinking (*etc. ad inf.*)

15. How are formal logical systems and living minds/bodies/societies alike and different? How should we think about their interaction in the idea of concrete "rationality"?

16. What is belief? Is it something discrete or fuzzy/continuous/a matter of degree? Can I ever be mistaken about whether I believe something? Can I ever know all the relations among my beliefs? Do I have the right to believe anything that pleases me / "works" for me, or is there an ethics of belief? Is there a difference between having knowledge and holding an opinion?

17. Can beliefs be justified? Can beliefs be justified by other beliefs? Can they be justified by anything else? There seem to be instructive problems either way...

18. Is there a technological attitude built into the logical project? If so is this helpful or harmful? If not, can logic transcend a technological attitude on its own resources? Does our answer to this question change once we make it to the point of metalogic?

19. What does it mean for a situation or event to be "possible", "impossible", "actual" etc.? Is modality a part of reality? Is reality a part of modality? Is possibility prior to actuality? Is actuality prior to possibility?

20. What is the infinite? Is it one or many? Is it possible to think about it rigorously? For that matter, what is finitude? Are infinity or the infinitesimal "real" or are they "conceptual fictions"? For that matter, what about zero, imaginaries, and points? And what is a number anyway?

21. What is identity? What kinds of things can be identical? Can something be identical to itself? Can something be identical to something else? Is it a good idea to distinguish between *identity, equality, isomorphism,* and still other forms of relation (*equivalence, adjunction....*)? What are the philosophical stakes of doing so?

22. A fundamental logical/computational concept is that of *information*. This concept is typically understood in terms of effective *difference*. But what is difference? What is it to be *other*? What is the relation between difference and multiplicity? What is the relation between these and the "what is—?" question? What are the implications of the hypothesis that difference is at the origin of meaning or information?

23. What is a sign? What kinds of signs are there? How do we use them? If signs haven't preceded us into existence then how does something *become* a sign? How does logic account for the *genesis* (becoming) of its own concepts?

24. How do signs get interpreted? Can we have a rigorous idea of what an interpretation of a formal system is?

25. What is meaning? Is it something fixed and determinate? Something flowing and variable? Under what conditions might we give either of these answers? Do we have the option of dispensing with the notion of meaning or concepts altogether and speaking directly about the relations of words and the world? How would our view of things change if we did away with meaning?

26. What is a world? Are there more than one world? Is a world relative to linguistic description? Is "world" a logical idea? Is there a universe?

27. Do we think in language? Are language and thought the same or different? Do the properties of language determine somehow the possibilities of thought?

28. Are we machines? Are bodies machines operating according to physical laws? Are minds machines operating according to logical laws? What is a machine, anyway? Do we have any idea what a machine is or what it is capable of?

29. How should we think about the relation between *levels* of description (physical, chemical, biological, psychological, linguistic, sociological, computational) of the same phenomenon, especially when that phenomenon is a human being? In what sense does reality have levels? In what sense is reality "flat"? How are these senses related?

30. Is there such a thing as a metalanguage? If we have reason to doubt this, then what is going on when we talk *about* a language that we also *use*?

31. Is there something special about mathematical truths? Are they absolutely true, where other truths are matters of approximation? If so, then how do we know them, and how do they apply to the spatiotemporal world? Are there realities (perhaps like "mathematical objects") that do not exist in the world of spacetime and matter-energy?

32. Can we have an idea of "that about which we can't have an idea" or "the unknowable"? Can we think about the limits of thought? How? How do we think about the *outside* of thought? Incoherent, you say? But isn't thought's fundamental purpose to think about something other than itself, something *else*—not *just* itself, but what is really *outside*? Isn't that what we call 'reality'? Then doesn't every true statement somehow involve this outside?

33. Some of the lines I've just typed sound paradoxical. But what makes a statement paradoxical? Are paradoxes bad? Are paradoxes always bad? Are all paradoxes bad? (Note that these questions aren't exactly identical...)

34. What is self-reference? Is it ever real? (Can something actual ever affect itself, talk about itself, be about itself, *etc.*...) If so, exactly what does this involve? What role does reflexivity play in our concepts—and our desires?

35. Perhaps the most unarguably central part of logic is the theory of implication. But there's little agreement about what implication is or how it functions! What does it mean for one idea to follow from another or be a consequence of another? What if anything lets us move from point to point in thought in a way that's better than random psychological association?

36. *Why* be rational? Of what value is logic? Is there a responsibility to be rational? Is there a responsibility to be consistent? Is there a responsibility to be open-minded?

37. Is there such a thing as a "performative contradiction" between our beliefs and our actions? How should this be understood, logico-ethically?

38. Why is "Reason" such a contentious word in the University—and the broader culture—today? What can be kept from Enlightenment-era accounts of Reason and what must be discarded?

39. What is information? What is a computer? Are these concepts good models for minds? For science? For the universe? How did the computer emerge from logical investigation, and what does this mean for our civilization?

40. What is a scientific or mathematical *model*? What should count as actual knowledge and what should be critiqued as ideology in a scientific model?

41. And what about ideology? What is the relation, if any, between what gets counted as good reasoning in some context and who/what holds power in that context?

42. Are there limits to logic? Metaphysical? Ethical? Political? Logical? If so, what is their significance? Should they make us less or *more* interested in logic? How should one respond to someone blanketly indifferent to or skeptical about logical investigation?

43. Does logic have metaphysical presuppositions? If so, what are they? Can they be varied?

44. Is first-order logic—the kind that most people know about if they know any logic at all—a powerful enough tool to think about anything interesting with? If not, then how should it be extended?

45. What if anything does the study of logic teach us about existence, the physical world, personal identity, ethics, the body, desire, theology, history & time, creativity and meaningful living? How should we think about the relation between logic and existence?

46. How does the mathematical tension between the *discrete* and the *continuous* play out in language, thought, and reality?

47. How can we think about unity and multiplicity ('the one and the many')?

48. Context is often said to be essential to understanding meaning. But what is context and *how* can we take it into account? What happens when we try to think about context, turning the background into a foreground figure?

49. What is a rule? What is a law? How does one follow a rule? How does one apply a law? How do we think the combination of continuity and gap here? If rules aren't self-applying or self-interpreting, then what should a theory of application or interpretation look like?

50. Logic appears to leave to one side whatever belongs to time and chance. Is this appearance accurate or illusory? What role do time and chance play in logic?

51. What is incompleteness? Is it a source of meaninglessness or a source of meaning? Or both...?

Extended Remarks 2: Experimenting With the Form of Thought

We often give preliminary definitions of a discipline by identifying its subject matter. So we define biology offhandedly by saying that it is the study of life, or geology by saying that it's the study of the earth. What then, is logic? We begin by assuming that logic is a discipline, though this assumption does not settle the question, but to the contrary can only carry us to the point where thinking begins. What then is the subject matter of this hypothetical discipline, 'logic'?

If the essence of logic can be expressed at all in the usual form "the study of X", we would have to say that it is the study of the *form* (or *formal* properties) of thought. (An alternative name for "form" here is *structure*,

and we might also speak of the formal *dimension* of thought if we don't want to rush to the conclusion that there are logical *properties*.) *Logic undertakes the experiment of drawing a distinction between form and content in thought.* In thought—or perhaps we want to say 'in *language*'; already it's an important puzzle whether to think/speak of these as the same. A succinct statement of all this is found in "Mathematics and Logic," the final chapter of Bertrand Russell's *Introduction to Mathematical Philosophy* (1919), where Russell characterizes logic (and mathematics) in terms of the abstraction of form from content.

> To begin with, we do not in this subject [mathematics or logic] deal with particular things or particular properties: we deal formally with what can be said about any thing or any property: We are prepared to say that one and one are two, but not that Socrates and Plato are two, because, in our capacity of logicians or pure mathematicians, we have never heard of Socrates and Plato. A world in which there were no such individuals would still be a world in which one and one are two. It is not open to us, as pure mathematicians or logicians, to mention anything at all, because if we do so, we introduce something irrelevant and not formal.

The main difference between Russell's approach and mine is that in this early text, Russell writes as though the distinction between form and content could—actually, and completely—be accomplished. In fact, he writes here as if it were accomplished *at the beginning* of our logical inquiry, and in such a way that it *stays* accomplished, as if logic took off from the form/content dichotomy, and never looked back. We'll discuss in detail the motivations for making this assumption; for the moment, suffice it to say that, at least at first, it looks that *if* the distinction could be made unambiguously, then a number of important theoretical and practical problems in organizing our thoughts and organizing our lives could be solved.

In dissent, I want to suggest that *today* we can only approach this division as an investigation-inaugurating *experiment*—not as a discipline-defining *assumption*.

In one sense this is only a small difference. We should continue to acknowledge that *abstraction* names a crucial experiment, perhaps even a name for the one great experiment that characterizes a philosophy that arises under the influence of mathematics (as Western philosophy surely did among the Greeks). But for us today, after Cantor, Gödel and Turing, it must still be an experiment, not a *fait accompli* or even an axiom.[8]

This difference will make a difference. For one thing, we will eventually have to ask whether the idea of a "thing in general" or a "property in general" still makes sense today, that is, whether a thought that tries to grasp contemporary life can still be founded on the notions of "thing" and "property"—as so much of metaphysics was between Aristotle and the twentieth century. *Are things and properties still ways of understanding what is most real today?* Can the question "What is a thing?" still be regarded as another way of asking the question "What is real?" Try this in your own reflections: Do you really believe that the real things are, well, *things*? Real compared to networks? Real compared to technology? Real compared to information? Real compared to events? Real compared to market relations, relations of forces, relations of ideas, and so forth, which may not be thinglike and whose properties may be obscure? Do you feel a faint anxiety when you witness something very thinglike—let's say a toaster—that's brand-new, made in 2009? Do you have the sense that it's a *false* thing, false to the extent that it is thinglike, a traditional and reassuring but unreal surface simplification and dissimulation of the real processes and relations that produced it and which determine what it means apart from its apparent thinghood—as if every new commodity were also a halfhearted attempt to convince us that we still lived in the world, in the time, of *things*? If you feel any of this, then you also feel the need to move past a logic (like first-order predicate logic (FOL), I'll argue) whose basic metaphysical model is that of things and properties, in order to search for a logic adequate to contemporary life.

One watershed separating us from Russell is that in undertaking to learn logic in 2009 we're obviously approaching the subject *after* the events of 1930/1, when Kurt Gödel's two Incompleteness Theorems forever

[8] Interestingly, (surprisingly?) I find that Plato himself often expresses himself in this way, writing of the separation of form (the ideas) from content (the spatiotemporal causal world) as an experiment of thought, or a hypothesis, rather than as an unshakeable first principle. (However one can admittedly also find texts of Plato's that lean the other way.)

changed our views of logic and its possibilities. It's incumbent upon us, I think, to acknowledge this event,[9] and to try to think through its consequences, even in an "introductory" course, in the same way (the analogy is actually surprisingly apt) that one ought to acknowledge that the earth is round instead of flat, even in an "introductory" course on geography. *Getting the sense of the curvature* might not make an immediate difference to you in navigating small distances... but then again, it might! Having the right sense of *the shape of the whole* (different from *covering* or technically *mastering* the whole) of the logical/metalogical scene can impact how one thinks of the everyday application of even the most simple applications of notions like truth and implication. Further, I will want to raise the possibility that given the current state of technological acceleration, we twenty-first century thinkers neglect metalogic at the risk of losing any way to understand the crucial dimensions of contemporary life rationally. Do we say that "advanced" issues are those at or over the horizon? Fine. Let it be so. But is the logical horizon today really far away, waiting for us to take an advanced logic/mathematics course (or more likely *not* to take one) in order to get a glimpse of it, or is the logical/technological horizon rushing *toward* us, or even already here? Does the horizon not already impinge on our moment of presence? Are we not already living in a time in which the sovereignty of the form/content distinction in thought has been displaced?

In offering these suggestions, and in the philosophical practice that follows from them, I want to walk a fine line between two mistakes:

1. thinking that the form/content distinction is easy to make, unproblematic, a fact or a safe assumption, or a simple instrumental protocol

2. thinking that if the form/content distinction is never stable, that fact renders it superfluous, disqualifies it as an important move to make in thought, makes the time for pursuing philosophy as logic or rational reflection over and done with, and shows that it's time to do something else, a philosophy that is no longer entwined with mathematics.

The first mistake (if I'm right that it's a mistake) would lead us to ignore all sorts of open questions, new insights, and points of vulnerability regarding the form/content distinction. By going this way, we would lose nearly everything interesting in logic, which is found in these cracks in the edifice. It would make our thought dogmatic in its application, and finally drag the level of our reasoning down from a *logic* worthy of the name to *ideology*. Then we would be in need of critiques of logic (or Critical Theory with two capital letters) to expose what passes for logic in our thinking as mere ideology.

But the second mistake (if I'm right that it's a mistake) would lead us to the view that we can or should turn away from the project of logic if we find that the logical experiment always involves an element of *failure*, if the "logical view of the world" instead of defining a fixed way of looking at things, were always temporary and unstable, the opening of a parenthesis, subject to sudden transformations and collapses, though always also renewable in a very different way than can be described according to the first-draft Enlightenment notion of "progress" in rationality. I want to suggest that it is precisely the interval between making the assumption that abstraction is possible, and having this abstraction overturned by its own consequences that characterizes not only the interesting history of logic, but also nearly every attempt to deal thoughtfully with life. Perhaps indeed, it is in part the point of failure in abstraction that finally enables the experiment of abstraction to be so *fruitful* for us, bringing thought down to earth in an unexpected way that's neither application nor abdication. And perhaps the great merit in building logical systems would lie in provoking, hastening, inviting these transformations and collapses by the very attempt at systematization. Perhaps these moments of *failure* are also, at least potentially, legible as moments of *discovery*.

A more ordinary way of putting this point might be this: perhaps it is the attempt to systematize and formalize thinking that, *in its failure*, brings about the moments when we fundamentally, radically, have to change our mind. But *to change one's mind for principled reasons* is surely also what we mean by *learning* in the most essential sense, and to learn is surely the success of thinking. All of this, of course, will need to be filled out, clarified, and tested over the course of a semester's discussion. But I also invite you to look

[9] My opinion is admittedly a minority one. The author of your textbook, Hurley, is an example of someone who does not share it!

for this entwining of failure and success of systematic thought and abstraction at the very place that we are going to begin: Plato's *Meno*.

Let's begin.