

Essay Assignment (Optional)

Instructions: Choose one of the following topics and respond to it in a paper of no less than 5 pages and no more than 7 pages. You may choose a topic that does not appear below, but you should first clear it with the instructor. Your paper should be typed, 10- or 12-point, double-spaced and spell-checked. It should conform to the guidelines for writing essay papers handed out in class. In particular: (a) *Your paper must be divided into sections, each with a subtitle*; and (b) *Your paper must include a bibliography that lists at least one reference.*

1. Gödel showed that the formal system \mathcal{N} that is intended to describe the natural numbers \mathbb{N} is not complete. Show that this is a non-trivial result by describing how the following number systems can be derived from the properties of \mathbb{N} : (*Sample Refs:* For \mathbb{Z} , \mathbb{Q} , \mathbb{R} , see [4]. For \mathbb{C} , \mathbb{H} , \mathbb{O} , see [1].)

- (a) The integers $\mathbb{Z} = \{ \dots -2, -1, 0, 1, 2, \dots \}$
- (b) The rational numbers $\mathbb{Q} = \{ p/q : p \text{ and } q \text{ are integers, } q \neq 0 \}$
- (c) The real numbers $\mathbb{R} = \{ \text{rationals \& irrationals} \}$

Intrepid essayists may wish (but are not compelled) to continue on to explain how the following number systems can then be constructed:

- (d) The complex numbers \mathbb{C}
- (e) The quaternions \mathbb{H}
- (f) The octonions \mathbb{O}

2. *The Incompleteness Theorem and the Strong Program in artificial intelligence:* Does Gödel's Theorem entail that the human brain cannot be a computer? What is the explicit form of the argument, and what are its flaws, if any? (*Sample Refs:* [3], [6], [8].)

3. ZF formal set theory encompasses formal arithmetic \mathcal{N} . Explain the details. Also explain how the natural numbers \mathbb{N} can be extended to form the system of *ordinal numbers*, how the ordinal numbers differ from the *cardinal numbers*, and the significance of both to set theory and the concept of infinity. (*Sample Refs:* [2], [4], [5], [7].)

4. *The Continuum Hypothesis.* What is it? What claims does it rely on and how are they proved? What is its significance to formal set theory and the concept of infinity? How can it be interpreted as the claim that "The infinity of the very small is larger than the infinity of the very large"? (*Sample Refs:* [2], [5]. For the last claim, see [7].)

Sample References

- [1] Baez, J. (2001) "The Octonions", *Bulletin of the American Mathematical Society*, **39**, pp. 145-205.
- [2] Bell, J., and M. Machover (1977) *A Course in Mathematical Logic*, North Holland.
- [3] Franzén, T. (2005) *Gödel's Theorem: An Incomplete Guide to Its Use and Abuse*, AK Peters.
- [4] George, A. and D. Velleman (2001) *Philosophies of Mathematics*, Blackwell Publishers.
- [5] Hamilton, A. (1988), *Logic for Mathematicians*, Cambridge Univ Press.
- [6] Lucas, (1961) "Minds, Machines and Godel", *Philosophy*, **36**, pp. 112-127. Reprinted at <http://users.ox.ac.uk/~%7Ejrlucas/Godel/mmg.html> >.
- [7] Moore, A. W. (2001) *The Infinite*, Routledge.
- [8] Various articles in *Psyche* Vol. 2, online at <http://psyche.cs.monash.edu.au/psyche-index-v2.html#som> >.

Guidelines For Writing a Philosophical Essay

All submitted papers **must** follow these guidelines. If a submitted paper does not follow them, it will be returned to the author for revision. A late-paper penalty may subsequently be charged.

I. Presentation

1. Begin with a title page containing the following information:

The title of your paper.

Your name.

The paper's due date.

The name of the course.

Your instructor's name.

This should be the **only** page on which your name appears, so that your paper may be graded anonymously.

2. Choose a title that refers to the theme or content of your paper fairly specifically - not something like "First Paper" or "Philosophy Paper #1".
3. Print your paper in 10- or 12-point type, double-spaced, with margins of about 1 inch each. Do not hand-write your paper. Number your pages. Spell-check your finished product!
4. Staple the pages of your paper together; do not use a paper clip, a folder, or a binder.
5. Keep an extra copy (either on paper or on disk) of your paper.

II. Content

1. The most important aspect of a paper is its structure. This is **extremely important**: A paper may make several good points, but if it is not well-organized, these points will be obscured and overlooked. A good paper is divided into an introduction, several sections constituting the body of the paper, and a conclusion. **Number these divisions and give the section headings names.** *Example:*

1. Introduction
2. Why Quantum Mechanics Needs an Interpretation
3. Bohm's Theory
4. Problems with Bohm's Theory
5. Conclusion

2. **Always begin your paper with an introduction.** A good introduction is short and accomplishes two things. First, it **explicitly** tells the reader what the author's claims are; this should take only a sentence or two. Second, it tells the reader, in brief, what is going to be said in the rest of the paper to support these claims. This should take only a few more sentences so that the reader doesn't get bogged down in details. **The best way to do this is to explicitly state what will be said in each section of the paper to follow.** *Example:*

1. Introduction

This essay is about Bohm's theory as an interpretation of quantum mechanics. I will claim that Bohm's theory provides an adequate way of describing what quantum mechanics is about. This will require addressing standard problems associated with Bohm's theory. In Section 2, I indicate why quantum mechanics needs an interpretation in the first place. In Section 3, I explain the details of Bohm's theory. Finally, in Section 4, I discuss the problems associated with Bohm's theory and possible responses.

It often happens that you are not sure exactly what your claims are going to be, or the best way to organize and present them, until *after* you've written the paper. For this reason, it often makes sense to write the introduction last.

3. The remaining paragraphs of your paper (except the conclusion) should each make one clear point; it should be obvious, from the structure of your paper, how that point supports the thesis of your paper. Details belong in these paragraphs, not in the introduction.

4. Use a conclusion only to provide a brief summary of what you have accomplished in your paper. It should be a reminder of what you have proved and how you have proved it.
5. Be sure that you address all parts of the assigned topic. This often requires both explaining an author's argument clearly and critically evaluating it. To do this well, you need to be very familiar with the text that you are discussing and will need to cite parts of it that support your claims.

III. Plagiarism and the Use of Sources

Plagiarism is the act of presenting another person's written work as your own. It is the most serious offense a writer can commit. ***If you engage in this act, you will receive an F for your essay and possibly an F for the course.*** Beware of copying essays or text directly from the web. It is *extremely* easy to catch this: It is HuSS Departmental policy to scan all submitted papers using turnitin.com.

To avoid plagiarizing, simply follow the steps below:

1. All sources (books, journal articles, web pages, *etc.*) you make use of must be included in a bibliography.
2. When writing your paper, do the writing yourself. Any language not your own -- whether a sentence from a source or just a clever phrase or metaphor suggested by another person in conversation -- must be attributed to its source. You will not be penalized for borrowing good ways of expressing ideas, unless you borrow so much that the paper ceases to be legitimately yours. But as long as the paper is not flooded with quotations (*i.e.*, as long as it is plainly a piece of your writing), the writing will be judged on its quality and clarity, and not on whether it's original with you.
3. To cite a source of ideas or language you are borrowing, use a system of citations, such as footnotes, endnotes, or parenthetical references (see, for instance, *MLA Handbook for Writers of Research Papers*, or *A Manual for Writers of Term Papers, Theses, and Dissertations*, by Kate Turibian). You may use whatever system you are comfortable with. Below are examples of the method of parenthetical reference:

Ex. 1. The essay text reads:

Rynasiewicz (1996, pg. 305) contends that the hole argument is a version of Quine- and Putnam-style inscrutability of reference arguments.

The bibliography would include the following reference:

Rynasiewicz, R. (1996) 'Absolute versus Relational Space-Time: An Outmoded Debate?', *Journal of Philosophy* **93**, 279-306.

Ex. 2. The essay text reads:

For Hobbes, "war" means more than just physical conflict: "For War consisteth not in battle only, or the act of fighting, but in a tract of time wherein the will to contend in battle is sufficiently known" (Hobbes 1668, pg. 76).

The bibliography would include the following reference:

Hobbes, T. (1668), *Leviathan*, Hackett Publishing Co. edition (1994), Edwin Curley (ed.).