What does it mean to explain something? We will study different answers to this question by means of a close examination of examples drawn from ancient, early modern, and contemporary mathematics, science, and philosophy. Minimal specific technical background will be required. We begin by considering classical views of the nature of explanation in Plato and Aristotle, with some attention to the work of later thinkers such as Hume and Kant. We will then explore â€“ via accessible examples â€“ the various types of explanation in mathematics that go along with, or precede, proof: conjecture, hypothesis, heuristic, plausible reasoning, analogy, illuminating definition, visual proof, indirect proof, and computer proof. We will consider explanations in medicine, with specific emphasis on the concepts of â€œcauseâ€ and of â€œpowerâ€ or â€œcapacityâ€ (X occurs because Y has a specific power to bring about X). And we will try to understand the contemporary discussion about "Correlation and Causation" in the debate about the significance of Big Data.

Open to graduate students and qualified undergraduates with permission of the instructors. The first meeting of the course will be on Tuesday, September 6, 2016 in Science Center 359.

Course Bibliography

Readings for Tuesday, Nov. 29:
(1) Jaffe and Quinn, Theoretical Mathematics: Toward a Cultural Synthesis of Mathematics and Physics, https://arxiv.org/pdf/math/9307227v1.pdf (Links to an external site.).
(2) Thurston, On Proof and Progress in Mathematics, https://arxiv.org/pdf/math/9404236v1.pdf (Links to an external site.).
(3) Atiyah et al., Responses to "Theoretical Mathematics: Toward a Cultural Synthesis of Mathematics and Physics", By A. Jaffe and F. Quinn, https://arxiv.org/pdf/math/9404229v1.pdf (Links to an external site.)

Readings for Tuesday, Nov. 22:

Tasha Schoenstein will offer a presentation at the above date. Readings for her presentation include Borwein.et.al in the files page and this (David Epstein, Silvio Levy and Rafael de la Llave's discussion about the nature of their journal 'Experimental Mathematics'). See also Doron Zeilberger'a short discussion pieces doron and doron2 in the files page.

Readings for Tuesday, Nov. 15:

Kemen Linsuain and Clare Kim will offer presentations this coming Tuesday.

Kemen's presentation will have the same readings as last week.

For Clare's presentation, please read this which is in reference to this.

Readings for Tuesday, Nov. 8:

Kemen Linsuain and Sam Liu will offer presentations this coming Tuesday.

For Kemen's presentation, please read:

Proofs Without Words and Beyond - PWWs and Mathematical Proof

W.W. Tait, 1986, "Truth and Proof: The Platonism of Mathematics", Synthese, 69: 341

For specific excerpts from"Truth and Proof..." see the recent 'announcement'. Also, here is useful background reference:

Giaquinto, Marcus, 1983, â€œHilbert's philosophy of mathematicsâ€, British Journal for Philosophy of Science, 34: 119â€“132.

And the following excepts from Plato's dialogues may be relevant:
Meno
71â€“81, 85â€“86: The discovery (or "recollection") of knowledge as latent in the soul, pointing forward to the theory of Forms
Phaedo
73â€“80: The theory of recollection restated as knowledge of the Forms in soul before birth in the body.
100c: The theory of absolute beauty
Republic
Book III

402â€“403: Education is the pursuit of the Forms.
Book V
472â€“483: Philosophy is the love of the Forms.
Books VIâ€“VII
500â€“517: Philosopher-guardians as students of the Beautiful.
Metaphor of the Sun
Allegory of the Cave

For Sam's presentation:

Sam writes:

"The main idea from my readings was to present a sample of ideas from current experts on elegance/explanation, rather than inform any one particular view. This is in contrast to the readings we have done up to this point, where one person thought deeply about the issue; the perspective I'm trying to offer is a more general approach."

Please read the first 6-7 pieces in Edge.pdf.

As background, see this file.

Readings for Tuesday, Nov. 1:

1. For Hans's presentation: The Introduction, sections 1, 2, 5, and 12 of Frege's *Foundations of Arithmetic.* Please also review Aristotle, *Posterior Analytics,* book 1, chapters 2 and 13.

Readings for Tuesday, Oct. 25:

1. Notes for Macey's presentation.

2. 'Hippocrates' *Prognostic* (sections 13 and 16-20)

3. Galen, *On Prognosis* (selections; see notes)

4. Galen, *On the Natural Faculties,* Book 1, sections 12, 13, and 14.

Readings for Tuesday, Oct. 18:

1. For Marco's presentation:

a) Plato, *Meno* 86b-d

b) Plato, *Theaetetus* 150d-151a (Socratesâ€™ account of *maieutikÃ©*)

c) Plato, *Phaedo* 96a-102a (Socratesâ€™ intellectual autobiography)

2. *For Katie's presentation:*

a) Galen: *On Sects for Beginners* (translated by M. Frede)

b) R. J. Hankinson, "The Growth of Medical Empiricism"

3. For Macey's presentation:

a) Section 13 of Galen's "On the Natural Faculties," Book 1.
(http://classics.mit.edu/Galen/natfac.1.one.html)
b) Sections 13 and 16-20 of Hippocrates' "Book of Prognostics"
(http://classics.mit.edu/Hippocrates/prognost.html)

Readings for Tuesday, Oct. 11:

1. Aaron Slipper's notes (See announcement)

2. For Marco's presentation:

Meno 86b-d

Theaetetus 150d-151a (Socratesâ€™ account of *maieutikÃ©*)

Phaedo 96a-102a (Socratesâ€™ intellectual autobiography)

Readings for Tuesday, Oct. 4:

We will discuss teleological explanation in Aristotle and Kant.

1. Aristotle, *Physics* II, 7-9.

2. Kant, selections from the *Critique of the Power of Judgment.*

3. (Optional background): Ginsborg, Hannah, "Kant's Aesthetics and Teleology", in *The Stanford Encyclopedia of Philosophy.*

Readings for Tuesday, Sept. 27:

1. Hume, *An Enquiry Concerning Human Understanding,* Sections 1-7 (online). We will focus especially on section 7, "Of the Idea of Necessary Connexion."

2. Kant, *Prolegomena to Any Future Metaphysics,* Introduction and (optionally) sections 27-30 (online). We will give an exposition of sections 27-30 in class.

3. G. De Pierris and M. Friedman, "Kant and Hume on Causality," in the *Stanford Encyclopedia of Philosophy*

4. (Optional background reading): F. Wilson, "Explanation in Aristotle, Newton, and Toulmin," pp. 291-297. This follows up on our discussion of Aristotle vs. Newton from last time.

Readings for Tuesday, Sept. 20:

1. Aristotle on the four causes: *Physics* II 2 and *Metaphysics* V 2 (translation by J. Barnes online)

2. B. van Fraassen, "A Re-examination of Aristotle's Philosophy of Science"

3. L. Filep, "Pythagorean Side and Diagonal Numbers" (with special attention to the method presented on pp. 1-4, and fig. 1)

4. Further optional reading: O. Harari-Eshel, "Knowledge and Explanation in Aristotle's *Posterior Analytics.*" This addresses in particular Aristotle's distinction between "knowledge of the fact" and "knowledge of the reason why" *(Post. An.* I 13), which we will return to next Tuesday.

Initial Readings
We will introduce these at the first meeting on Tuesday, Sept. 6, 2016, then consider them in further detail on Sept. 13.
Plato:
Meno: 80d-85c and 97e-98a
Theaetetus: 144d-148e (with the specific issues starting at 147d)
Aristotle: *Posterior Analytics* I.1-2 and I.13. Online.
Euclid: Proposition I.47 and VI.31. Online.
For comparison: See http://www.cut-the-knot.org/pythagoras/ for a discussion of 367 proofs, etc.
Part I of BM's essay 'On the word 'because' in mathematics, and elsewhere'

The entry by P. Mancosu on "Explanation in Mathematics" in the Stanford Encyclopedia of Philosophy provides an orientation to the issues we will discuss in this seminar, and a very useful bibliography.

Outline of Topics (subject to modification):

I. Introduction:. Explanation versus Proof in Mathematics [Sept. 6, 13]

II. Causality: Aristotle, Hume, Kant [Sept. 20, 27; Oct. 4]

III. Cause and Explanation in Galen [Oct. 11]

IV. Explanation by "powers"; "constitutive" explanations [Oct. 18, 25]

V. Correlation and Causation; current discussion about â€˜Big Dataâ€™ [Nov. 1, 8]

VI. Explanation in Mathematics [Nov. 15, 22]

VII. Concluding discussion/Overflow [Nov. 29]