

# HPS/PI 124 Space and Time

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**Class Venue/Time:** Beckman Institute 121, Tues/Thurs 1.00p – 2.30p

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Time is a great teacher, but unfortunately  
it kills all its pupils.

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1856 Letter, Louis Hector Berlioz

## Contents

<b>Course Description</b>	2
<b>Prerequisites</b>	2
<b>Required Materials</b>	2
<b>Course Objectives</b>	2
<b>***Assessment***</b>	3
<b>Collaboration</b>	5
<b>Late Submissions</b>	5
<b>Specific Resources</b>	5
<b>Electronics</b>	6
<b>AI Policy</b>	6
<b>Wellness Policy</b>	7
<b>Students with Documented Disabilities</b>	7
<b>Academic Integrity</b>	8
<b>My Status as a “Responsible Employee”</b>	8
<b>***Schedule and Required Readings***</b>	9
<b>General Academic Resources for Students</b>	15
<b>Additional Resources for Students</b>	15

## Course Description

Space and time are probably intuitive concepts to many of us. Clocks tick down, trees grow taller. Things were *here*, now they are *there*. We have memories of the past, of things back *then*, but not of things *in* the future. But despite their familiarity, space and time do not seem to be the same sort of stuff as tables or chairs. So what are they, really? Are they “real”? Is there a sense in which space and time are substantial ‘stuff’ at all? If they are, are they the same kind of stuff? Can we travel through time, like traveling through space? Could we live in a world where space and time are not ‘really’ there, where they are merely emergent? Can we really know the structure of spacetime in our universe?

Some of the greatest thinkers in history have considered these questions, from the Presocratics and Aristotle, to Newton, Leibniz, Kant, Poincare, and Einstein. These are also questions which continues to occupy many philosophers and physicists today. This course will introduce you to some of the ways one can conceptualize, and question, the nature of space and time. The first half of the course will take us through a brief tour of the history of philosophy of space and time, from the Presocratics to Einstein’s theory of relativity. The second half will sample some contemporary topics in the philosophy of space and time.

## Prerequisites

Students must have completed their Freshman Humanities requirement in order to enroll in this course.

## Required Materials

Main textbook: *Space from Zeno to Einstein* (1999), Nick Huggett

Please obtain a copy of the book before the course begins. The first two assigned chapters will be on Canvas, but others will not (for copyright reasons). All other required readings will be on Canvas.

Some recommended readings may not be on Canvas, again, due to copyright reasons. However, all recommended books are placed on course reserves, and should be available through the Library system. **Email me if you are having trouble finding any resources!**

## Course Objectives

Students should:

1. Gain an understanding and appreciation of the historical trajectory of the concepts of space and time, from the Presocratics to Einstein,
2. Gain an ability to grasp, assess, and respond to the views of these thinkers, such as
  - the Heraclitean/Parmenidean picture of the world
  - Zeno’s paradoxes
  - Aristotle’s puzzles about space and time
  - Newton and Clarke’s debate with Leibniz over substantivalism vs relationalism

- Kant's critique of relative space, and his views of space-time and geometry
  - Poincare's conventionalism about geometry
  - Einstein's views of space and time, as it relates to the development of special and general relativity,
3. Have a basic understanding of the arguments occurring in some contemporary debates surrounding the nature of space and time, such as
    - the Hole argument, as it relates to substantivalism and relationalism in relativity
    - the difference between space and time in relativity
    - the (un)reality of time, and the arguments for/against
    - the logical paradoxes of time travel
    - whether there is a thermodynamic arrow of time
    - the motivations for spacetime emergence, and some conceptual problems for it
    - whether there is an underdetermination of spacetime,
  4. Be able to assess and respond to the above arguments,
  5. Gain a big-picture understanding of how physics and philosophy intersect and intertwine in the study of space, time, and spacetime.

### \*\*\*Assessment\*\*\*

Here's a breakdown of how you will be graded:

- **Reading tasks:** 20%
- **Participation:** 20%
- **Essay 1:** 30%
- **Essay 2:** 30%

#### Reading tasks (20%)

There will be a total of 17 reading tasks. Each task will require you to upload **two things** to the respective **discussion forum**, after you are done with the assigned reading:

- One question related to the reading, quoting from the text when necessary,
- An attempt to answer the question you posed, quoting from the text when necessary.

Try to make the question as narrow as possible, so that you can answer your own question **in under 200 words**.

Each task is **due at midnight, 2359 hrs, before each class** for which the reading is assigned. Each task is **graded on completion**, and will be worth **1% each**. However, if you are found asking low-effort questions, you may not receive the point for that task. A quick example:

- Good:

– Q: I didn't get the distinction between absolute and relative space in the Leibniz-Clarke correspondence, and why Leibniz argued for relative space over absolute space. What does it have to do with Leibniz's principle of sufficient reason?

– A: If I had to hazard a guess, one major difference would be in terms of how they view...

- Bad:

– Q: Is Newton still alive?

– A: No.

In general, any good-faith attempt to ask a question / answer the question will receive the mark. If you successfully complete all 17 tasks on time, you will receive a completion bonus, for a **total of 20%**.

### Participation (20%)

**You are permitted two absences from class without excuse**, though you must email me to let me know I shouldn't be expecting you for the class. (No need to provide any reason or excuse)

Otherwise, **you will be expected to attend each class, unless you have an excused absence**. Failure to attend class without excuse, past the two-class allowance, will result in a **1 point deduction (out of 20) from your participation grade for each missed class**.

Attendance is a necessary but insufficient condition for participation. If you attend class but do not participate in class discussions, you may not receive the full participation grade. Again, in general, any good-faith attempt to participate in class activities will be acknowledged.

### Essays (30% each)

- **Essay 1 – The History of Philosophy of Space and Time** (~2000–2500 words): due **Sunday, Feb 4, 2359 hrs** on Canvas
- **Essay 2 – Contemporary Topics on Space and Time** (~2000–2500 words): due **Friday, March 15, 2359 hrs** on Canvas

### Grade scale:

<b>A+</b> : $\geq 97$	<b>A</b> : $\geq 93$	<b>A-</b> : $\geq 90$
<b>B+</b> : $\geq 87$	<b>B</b> : $\geq 83$	<b>B-</b> : $\geq 80$
<b>C+</b> : $\geq 77$	<b>C</b> : $\geq 73$	<b>C-</b> : $\geq 70$
<b>D</b> : $\geq 65$	<b>F</b> : $< 65$	

All aspects of evaluation come under the provenance of the university's honor code. In addition to passing overall, a student must also **receive a passing grade on each of these components in order to pass the course**.

## Collaboration

For the reading tasks, you may work with other students to think about good questions to ask, or how to answer your own questions. Each student must write up their own answer to the reading question.

For the midterm and final essays, you are also encouraged to discuss ideas and share drafts with one another to get feedback.

## Late Submissions

This course has a strict policy on late assignments. Late reading tasks will not receive credit (unless an extension has been granted in advance). Late essays will receive a one letter-grade deduction if they are submitted within 48 hours of the original deadline and no credit if they are submitted later than that (unless an extension has been granted in advance). Late essays may also not receive comments (on time, or at all, depending on how late the submission is).

In general, extensions on assignments will only be granted for unpredictable circumstances, such as illness or family emergency.

## Specific Resources

Here are some resources you can and should use, throughout the course:

- Me! I am here to help you to the best of my abilities. Make an appointment, and come for my office hours!
- The required readings should contain the content you'll need to answer the essay questions. The recommended readings often offer more depth, context, or background for the required readings.
- The Stanford Encyclopedia of Philosophy is an excellent, rigorous, online, and (!) free resource for almost every philosophical topic you can think of. For any philosophical topic X, search for "X sep" on your favorite search engine and you should find an appropriate entry. Here are some relevant ones:
  - \* [Parmenides](#)
  - \* [Heraclitus](#)
  - \* [Absolute and Relational Theories of Space and Motion: Classical Theories](#)
  - \* [Absolute and Relational Theories of Space and Motion: Post-Newtonian Theories](#)
  - \* [Aristotle's Natural Philosophy](#)
  - \* [Samuel Clarke](#)
  - \* [The Conventionality of Simultaneity](#)
  - \* [Early Philosophical Interpretations of General Relativity](#)
  - \* [Einstein's Philosophy of Science](#)
  - \* [Galileo](#)
  - \* [Inertial Frames](#)
  - \* [Poincare](#)
  - \* [Leibniz's Philosophy of Physics](#)

- \* Kant's Views on Space and Time
- \* John M.E. McTaggart
- \* Newton's Views on Space, Time, and Motion
- \* Plato's Timaeus
- \* Time Machines
- \* Time Travel
- \* Zeno's Paradoxes
- \* Emergent Properties
- \* Thermodynamic Asymmetry in Time
- \* Time
- \* Consciousness (c.f. Hard Problem)

## Electronics

Students may have laptop computers, tablets, or other portable electronic devices for the purpose of taking notes, consulting readings, and occasionally looking up material relevant to class discussion. However, there will be no internet-surfing, texting, e-mailing, gaming, tweeting, or other use of electronic devices not directly related to class. Any abuse of electronic devices during class time will result in the use of such devices being disallowed. Also, please silence phones before class starts.

## AI Policy

You are allowed to use generative AI tools, such as ChatGPT, Bard, Bing Chat, Grammarly, etc. in your research, brainstorming, and copyediting. Just as one might use Wikipedia, however, I would recommend these tools as the **first stop, not the last stop**, for research.

Here are some recommended ways of using generative AI:

- **Idea generation and brainstorming:** Use them for exploring initial ideas, topics, or angles for research.
- **Understanding complex concepts:** They can be amazing at explaining complex theories or concepts in simpler terms. Remember to check the veracity of this explanation by doing some research elsewhere.
- **Citation suggestions:** They can be helpful in suggesting potential sources (especially GPT-4), but always verify the credibility and relevance of these sources independently. They are still statistical in nature, and can 'hallucinate' sources.

Here are some uses of generative AI which I don't allow. In general, these are ways in which ChatGPT is doing the heavy-lifting in your work. Don't let them replace you!

- **Submission of AI-generated work:** Directly submitting work generated by generative AI as your own is strictly prohibited. This includes both essays and reading tasks. Note that papers generated without further revision are typically at best a C+/B-.
- **Plagiarism and academic dishonesty:** Using them to circumvent plagiarism detection software or to otherwise engage in academic dishonesty is not permitted.

- **Replacing critical thinking – and you!:** Do not use them as a substitute for your own critical thinking, analysis, and synthesis of information.
- **Sole source for research:** They should not be the sole source of information for research projects. Always consult primary and peer-reviewed academic sources.

If you use generative AI in your research or writing, disclose this usage in your work and cite how it helped you. Always critically evaluate and fact-check the quality of the information generated! If I have reason to believe that you have violated this AI policy, I may report the case to the Board of Control.

## Wellness Policy

- I want to clearly state that taking care of your health and well-being should be your number one priority. You cannot learn if you are unwell or under extreme duress.
- The course work should feel challenging in a positive way, but I do not want you to be overwhelmed by your work for this course.
- If you find yourself overwhelmed or encountering other personal challenges during the term, please reach out to me so we can develop a plan for you to pursue success in this course in a healthy way. In addition, I encourage you to utilize Caltech's resources.
- Diversity, inclusion, and belonging are all core values of this course. All participants in this course must be treated with respect by others in accordance with the honor code. If you feel unwelcome or unsafe in any way, no matter how minor, I encourage you to talk to me or one of the Deans.
- If you would like to ask about flexibility with coursework for a temporary or minor wellness issue, please contact me.

The Deans' Office, Student Wellness Services (SWS) and Caltech Accessibility Services for Students (CASS) are available to help you with illness and health conditions that may impact your coursework:

- Student Wellness Services will assess and treat illnesses and medical conditions and communicate (with student's permission) with the Deans' Office if needed. CASS, part of SWS, can recommend and provide for accommodations needed due to temporary or long-term disabilities. Policies about academic extensions for medical reasons can be found [here](#).
- The Deans' Office may recommend academic exceptions in cases of significant family or personal emergencies, or moderate to severe illness or medical conditions that make it difficult to keep up with coursework. Please reach out to a dean as soon as possible if you experience these conditions.

## Students with Documented Disabilities

Students who may need an academic accommodation based on the impact of a disability must initiate the request with Caltech Accessibility Services for Students (CASS). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and

prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact CASS as soon as possible, since timely notice is needed to coordinate accommodations. For more information:

<https://cass.caltech.edu/>

or email:

[cass@caltech.edu](mailto:cass@caltech.edu)

If you are having difficulties with access or other challenges in the class you think might be related to a disability, but do not yet have a diagnosis, please feel free to reach out to CASS to learn more about resources.

## Academic Integrity

“No member of the Caltech community shall take unfair advantage of any other member of the Caltech community.”

Plagiarism is the appropriation of another person’s ideas, processes, results, or words without giving appropriate credit, and it violates the honor code in a fundamental way. You can find more information at:

<https://writing.caltech.edu/resources/plagiarism>

All instances of plagiarism or other academic misconduct will be referred to the Board of Control for undergraduates.

You are encouraged to discuss your work with other students and to share drafts with each other to get feedback. However, the work you submit must be your own. If you incorporate the ideas of others, cite those sources. Do not copy language too closely. Even when summarizing and paraphrasing cited sources, you must use your own language and present the ideas in an original way. I will be happy to answer any questions you may have. A detailed explanation of the plagiarism policy for humanities courses at Caltech is available at:

<http://www.hss.caltech.edu/academics/avoiding-plagiarism>

## My Status as a “Responsible Employee”

As a faculty member, I am required to notify the Institute’s Equity and Title IX Office when I become aware of discrimination, sexual harassment, or sex- or gender-based misconduct involving our community members. If one of my students shares such an experience with me, I can help connect them to support resources but will not be able to keep that information confidential as part of fulfilling my responsibility to make sure my students are offered the opportunity to access information and support by the Institute. For more information, you can email [equity@caltech.edu](mailto:equity@caltech.edu), go to <http://equity.caltech.edu>, or review the Institute’s Sex- and Gender-Based Misconduct Policy.

If you have experienced such prohibited conduct and want to report it or speak to a confidential resource, consult the Equity and Title IX Office’s webpage on reporting for guidance.



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### \*\*\*Schedule and Required Readings\*\*\*

The readings are separated into *required* and *recommended* readings. You will *only ever be expected to read the required readings*, and you *should* read the required readings first before venturing into the recommended readings. However, the recommended readings are, well, recommended.

Note that readings may be subject to change. You will be notified in advance of any such changes.

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#### Week 1, 01/01 - 01/05: The beginning of space and time

- *Assignments:*
    - Nil
  - *Readings:*
    - **Thurs 01/04: Introductions**
      - \* *Required:* Syllabus
      - \* *Required:* Nick Huggett (1999), Ch. 1: "Plato", *Space from Zeno to Einstein*, pp. 1–14
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#### Week 2, 01/08 - 01/12: The Presocratics on the nature of time and space

- *Assignments:*
    - Reading task #1: Heraclitus & Parmenides
    - Reading task #2: Zeno
  - *Readings:*
    - **Tues 01/09: Heraclitus and Parmenides on time**
      - \* *Required:* Ronald Hoy (2013), Ch. 1: "Heraclitus and Parmenides", in *A Companion to the Philosophy of Time*, pp. 9–29
    - **Thurs 01/11: Zeno and the paradoxes of space**
      - \* *Required:* Nick Huggett (1999), Ch. 3: "Zeno", in *Space from Zeno to Einstein*, pp. 29–51
      - \* *Recommended:* Niko Strobach (2013), Ch. 2, "Zeno's Paradoxes", in *A Companion to the Philosophy of Time*, pp. 30–46
      - \* *Recommended:* Nick Huggett (2018), "Zeno's Paradoxes", in *Stanford Encyclopedia of Philosophy*, <https://plato.stanford.edu/entries/paradox-zeno/>
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**Week 3, 01/15 - 01/19: Aristotle and Newton on Absolute Space and Time**

- *Assignments:*
    - Reading task #3: Aristotle
    - Reading task #4: Newton
  - *Readings:*
    - **Tues 01/16: Aristotle's absolute space and time**
      - \* *Required:* Nick Huggett (1999), Ch. 4: "Aristotle", in *Space from Zeno to Einstein*, pp. 53–82
      - \* *Required:* Andrea Falcon (2013), Ch. 3: "Aristotle on Time and Change", in *A Companion to the Philosophy of Time*, pp. 47–56
    - **Thurs 01/18: Newton's absolute space and time**
      - \* *Required:* Nick Huggett (1999), Ch. 7: "Newton", in *Space from Zeno to Einstein*, pp. 107–141
      - \* *Recommended:* Robert DiSalle (2006), Ch. 2: "Absolute motion and the emergence of classical mechanics", in *Understanding Space-Time*, pp. 13–53
      - \* *Recommended:* Tim Maudlin (2012), Ch. 1: "Classical Accounts of Space and Time", in *Philosophy of Physics: Space and Time*, pp. 1–16
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**Week 4, 01/22 - 01/26: Newton vs Leibniz, and Kant, on Substantivalism vs Relationalism**

- *Assignments:*
  - Reading task #5: Newton, Leibniz & Clarke
  - Reading task #6: Kant
- *Readings:*
  - **Tues 01/23: Classical relationalism vs substantivalism about space**
    - \* *Required:* Nick Huggett (1999), Ch. 8: "Leibniz-Clarke", in *Space from Zeno to Einstein*, pp. 143–168
    - \* *Recommended:* Tim Maudlin (2012), Ch. 2: "Evidence for Spatial and Temporal Structure", in *Philosophy of Physics: Space and Time*, pp. 17–46
    - \* *Recommended:* Tim Maudlin (2012), Ch. 3: "Eliminating Unobservable Structure", in *Philosophy of Physics: Space and Time*, pp. 47–66
  - **Thurs 01/25: Kant on space and geometry**
    - \* *Required:* Nick Huggett (1999), Ch. 11: "Kant and Handedness", in *Space from Zeno to Einstein*, pp. 197–212
    - \* *Required:* Nick Huggett (1999), Ch. 12: "Kant and Geometry", in *Space from Zeno to Einstein*, pp. 213–234
  - *Recommended:* Robert DiSalle (2006), Ch. 3: "Empiricism and A Priorism from Kant to Poincaré", in *Understanding Space-Time*, §3.1–§3.4, pp. 55–72

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- *Recommended*: Michael Friedman (1985), "Kant's Theory of Geometry", *Philosophical Review*

Others:

- **01/24**: last day to add class!
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### Week 5, 01/29 - 02/02: Poincaré and Conventionalism about Space-Time, Special Relativity

- *Assignments*:
    - Reading task #7: Poincaré and Conventionalism
    - Essay #1: due on **Sunday, Feb 4, 2359 hrs**, to be uploaded on Canvas
  - *Readings*:
    - **Tues 01/30: Non-Euclidean geometries & conventionalism**
      - \* *Required*: Nick Huggett (1999), Ch. 13: "Poincaré", in *Space from Zeno to Einstein*, pp. 235–252
      - \* *Recommended*: Robert DiSalle (2006), Ch. 3: "Empiricism and A Priorism from Kant to Poincaré", in *Understanding Space-Time*, §3.4 – §3.8, pp. 72–97
      - \* *Recommended*: Hilary Putnam (1974), "The Refutation of Conventionalism", *Nous*
    - **Thursday 02/01: Special relativity**
      - \* *Required*: Robert DiSalle (2006), Ch. 4: "The origins and significance of relativity theory", in *Understanding Space-Time*, §4.1–§4.3, pp. 98–120
      - \* *Recommended*: Maudlin (2012), Ch. 4: "Special Relativity", in *Philosophy of Physics: Space and Time*, pp. 67–105
      - \* *Recommended*: Maudlin (2012), Ch. 5: "The Physics of Measurement", in *Philosophy of Physics: Space and Time*, pp. 106–125
      - \* *Recommended*: John Norton, *Einstein for Everyone*, Chs. 1–17  
[https://sites.pitt.edu/~jdnorton/teaching/HPS\\_0410/chapters/](https://sites.pitt.edu/~jdnorton/teaching/HPS_0410/chapters/)
      - \* *Recommended*: Nick Huggett (1999), Ch. 10: "Space-Time", in *Space from Zeno to Einstein*, pp. 189–196
      - \* *Recommended*: Nick Huggett (1999), Ch. 14: "Einstein", in *Space from Zeno to Einstein*, pp.253–265
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### Week 6, 02/05 - 02/09: General Relativity, Time and Space after Relativity

- *Assignments*:
  - Reading task #8: Relativity, Special and General
  - Reading task #9: The Hole Argument
- *Readings*:

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– **Tues 02/06: General relativity – a sketch**

- \* *Required*: Tim Maudlin (2012), Ch. 6: “General Relativity”, in *Philosophy of Physics: Space and Time*, pp. 126–140
- \* *Required*: Robert DiSalle (2006), Ch. 4: “The origins and significance of relativity theory”, in *Understanding Space-Time*, §4.4–§4.7, pp. 120–151
- \* *Recommended*: John Norton, *Einstein for Everyone*, Chs. 18–26, 34–38  
[https://sites.pitt.edu/~jdnorton/teaching/HPS\\_0410/chapters/](https://sites.pitt.edu/~jdnorton/teaching/HPS_0410/chapters/)
- \* *Recommended*: Robert Geroch (1981), *General Relativity A to B*, p. 159–185

– **Thurs 02/08: Substantivalism and relationalism revisited: The hole argument**

- \* *Required*: John D. Norton, Oliver Pooley, James Read, “The Hole Argument” in *Stanford Encyclopedia of Philosophy*
  - \* *Required*: Visualizing Leibniz Equivalence Through Map Projections, <https://plato.stanford.edu/entries/holearg/leibniz-equivalence.html>
  - \* *Recommended*: John Earman (1992), *World Enough and Space-Time*
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**Week 7, 02/12 - 02/16: The reality of time, the direction of time**

• *Assignments*:

- Reading task #10: Is Time Spatialized?
- Reading task #11: Is Time Real? McTaggart’s Argument

• *Readings*:

– **Tues 02/13: Is time ‘spatialized’ in relativity?**

- \* *Required*: Craig Callender (2017), Ch. 6: “The Difference Between Space and Time”, in *What Makes Time Special?*, pp. 119–137
- \* *Recommended*: Craig Callender (2017), Ch. 7: “Laws, Systems and Time”, in *What Makes Time Special?*, pp. 138–156

– **Thursday 02/15: The reality of time, before relativity**

- \* *Required*: John M. E. McTaggart (1908), “The Unreality of Time”, *Mind*
  - \* *Recommended*: Jeff Speaks, Notes on “McTaggart’s Proof of the Unreality of Time”: <https://www3.nd.edu/~jspeaks/courses/mcgill/370/mctaggart-time.html>
  - \* *Recommended*: Smith and Oaklander (1994), Dialogue 6: The passage of time, in *Time, Change and Freedom*, pp. 60–87
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**Week 8, 02/19 - 02/23: The reality of time, cont’d, time travel and paradoxes**

• *Assignments*:

- Reading task #12: Is Time Real? Putnam’s Argument
- Reading task #13: The Paradoxes of Time Travel

- *Readings:*
  - **Tues 02/20: The reality of time, after relativity**
    - \* *Required:* Hilary Putnam (1967), "Time and Physical Geometry", *The Journal of Philosophy*
    - \* *Recommended:* Pieter Thyssen, "The Rietdijk–Putnam–Maxwell Argument", <https://philarchive.org/rec/THYTRA>
    - \* *Recommended:* Pieter Thyssen, "Conventionality and Reality", <https://philarchive.org/rec/THYCAR>
  - **Thursday 02/22: Time travel**
    - \* *Required:* David Lewis (1976), "The Paradoxes of Time Travel", in *American Philosophical Quarterly*
    - \* *Required:* Kurt Gödel (1949), "Remarks on the Relationship Between Relativity Theory and Idealistic Philosophy"
    - \* *Recommended:* David Malament (1984), "'Time Travel' in the Gödel Universe", in the *Proceedings of the Biennial Meeting of the Philosophy of Science Association*
    - \* *Recommended:* Frank Arntzenius (2006), "Time Travel: Double Your Fun", in *Philosophy Compass*

*Others:*

- **02/21:** last day to drop class!

## **Week 9, 02/26 - 03/01: The Arrow of Time, and the Emergence of Spacetime**

- *Assignments:*
  - Reading task #14: The arrow of time
  - Reading task #15: Why spacetime emergence?
- *Readings:*
  - **Tues 02/27: Is there an arrow of time?**
    - \* *Required:* Huw Price (1996), Ch. 1: "The Stock Philosophical Debates..." – "The puzzle of origins", in *Time's Arrow and Archimedes' Point*, pp. 12–21
    - \* *Required:* Huw Price (1996), Ch. 2: "'More Apt to Be Lost than Got': The Lessons of the Second Law", in *Time's Arrow and Archimedes' Point*, pp. 22–48
    - \* *Recommended:* David Z Albert (2000), Ch. 4: "The Reversibility Objections and the Past Hypothesis", in *Time and Chance*, pp. 71–96
    - \* *Recommended:* David Wallace (2013), "The Arrow of Time in Physics"
  - **Thursday 02/29: Could the world be non-spatiotemporal?**
    - \* *Required:* Nick Huggett, "Spacetime 'Emergence'", in *The Routledge Companion to Philosophy of Physics*
    - \* *Recommended:* Nick Huggett and Chris Wuthrich, "Chapter 1: Introduction: The emergence of spacetime"

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**Week 10, 03/04 - 03/08: Spacetime emergence: problems**

- *Assignments:*
  - Reading task #16: Problems with spacetime emergence
  - Reading task #17: Discovering space-time
- *Readings:*
  - **Tues 03/05: Spacetime emergence and the ‘hard problem’**
    - \* *Required:* Sam Baron, Kristie Miller, and Jonathan Tallant (2022), Chapter 6: “Metaphysical Emergence”, in *Out of Time – A Philosophical Study of Timelessness*, pp. 118–152
    - \* *Recommended:* Baptiste Le Bihan (2019), “Spacetime emergence in quantum gravity functionalism and the hard problem”, *Synthese*
    - \* *Recommended:* Richard Healey (2002), “Can Physics Coherently Deny the Reality of Time?”
  - **Thurs 03/07: Can we know spacetime?**
    - \* *Required:* P. D. Magnus (2004), “Reckoning the Shape of Everything: Underdetermination and Cosmotopology”, *British Journal for the Philosophy of Science*
    - \* *Recommended:* David Malament (1977), “Observationally Indistinguishable Spacetimes”
    - \* *Recommended:* Baron and Le Bihan (forthcoming), “Spacetime Quietism”, in *The Foundations of Spacetime Physics: Philosophical Perspectives*

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**Week 11, 03/11 - 03/15: Exam week**

- *Assignments:*
  - Essay #2: due on **Friday, March 15, 2359 hrs**, to be uploaded on Canvas

## General Academic Resources for Students

- **Tutoring:** The undergraduate dean's office provides a free peer tutoring service. If the course isn't listed, students can talk with the dean's office to arrange for a tutor. [Dean's Office Website](#)
- **Writing:** The Hixon Writing Center provides professional writing tutors as well as peer tutors, individual and group writing space, and additional resources. [Hixon Writing Center Website](#)
- **Registrar & FERPA:** The registrar can answer questions about degree progress, privacy of student records, and course enrollment procedures. [Registrar's Office Website](#) The website also lists Option Representatives for option-specific advising, policies, and information.
- **Library:** Borrow books, retrieve journal articles, receive guidance about research. [Caltech Library Website](#)
- **Dean of Undergraduate Students:** Wide-ranging assistance addressing issues (academic and other) for undergraduates. [Dean of Undergraduate Students Website](#)

## Additional Resources for Students

- **Student Wellness Center:** Wide variety of health and wellbeing services. [Student Wellness Center Website](#)
- **Counseling Services:** Free for all students, regardless of insurance plan. [Counseling Services Website](#)
- **Occupational Therapy:** Individual sessions and consultations on building healthy habits and routines, time management, planning and organization, and more. Free for all students. [Occupational Therapy Website](#)
- **Center for Inclusion and Diversity:** Resources concerning navigating diversity and inclusion, including staff who can speak with students about challenges of harassment and discrimination. [Center for Inclusion and Diversity Website](#)
- **Title IX:** Caltech's Title IX Coordinator (titleix@caltech.edu) works with students on issues related to sexual harassment, sexual misconduct, and sex discrimination. [Title IX Office Website](#)
- **Caltech Accessibility Services for Students:** The Accessibility Services Specialist works with students with temporary medical conditions, or mental, physical or learning disabilities on accommodation requests and services. [CASS Website](#)
- **Career Advising and Experiential Learning:** Provides resources to help students make career decisions and implement career plans. [Career Advising and Experiential Learning Website](#)