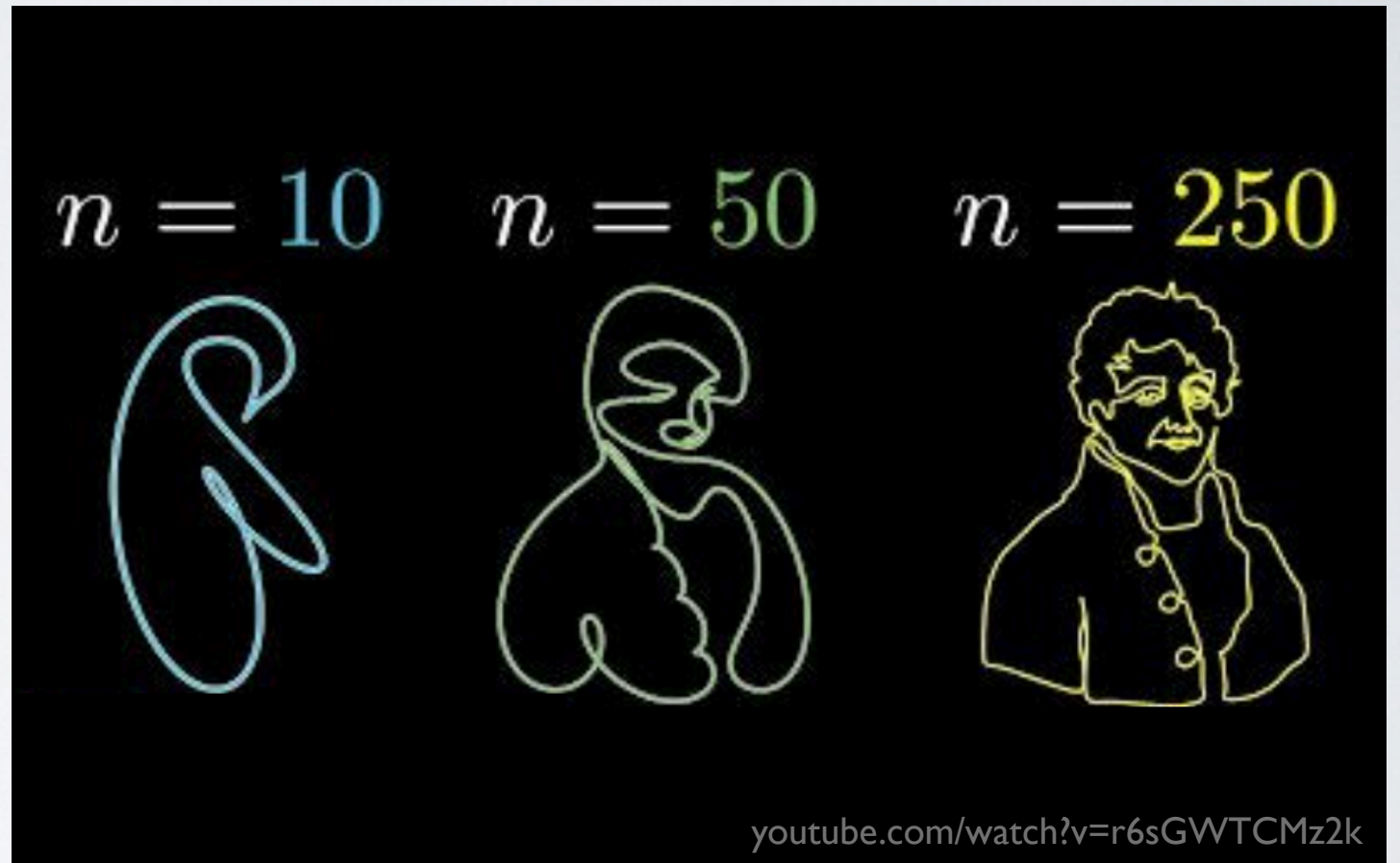


Week 9 - #1

Fourier Series and Transforms (I)



Today: Ch 7

Next Class: Ch 7

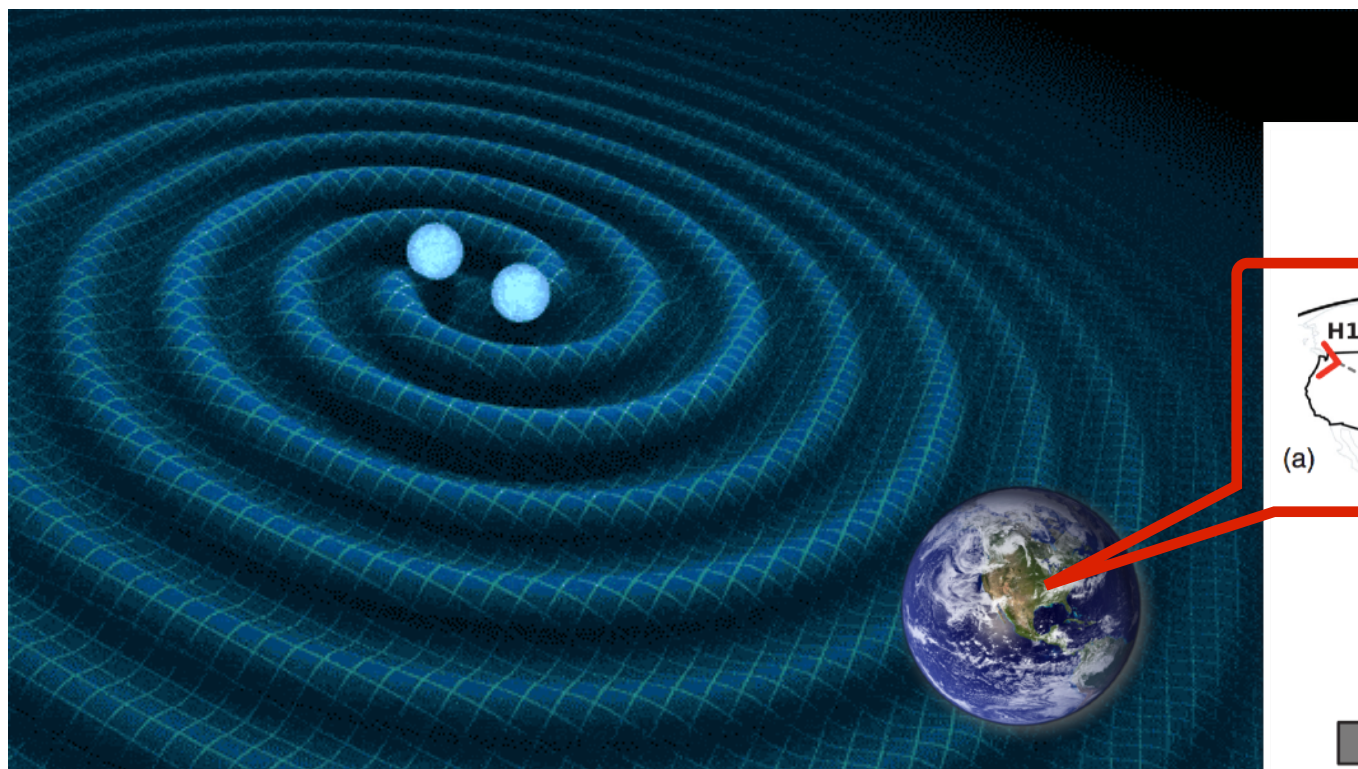
Ji-hoon Kim (Seoul National University)

Rudimentary Mathematical Methods of Physics (Fall 2025): Quiz #12

— [open book and open note, **but** no cellphone or laptop, drop it off as you leave the class] —

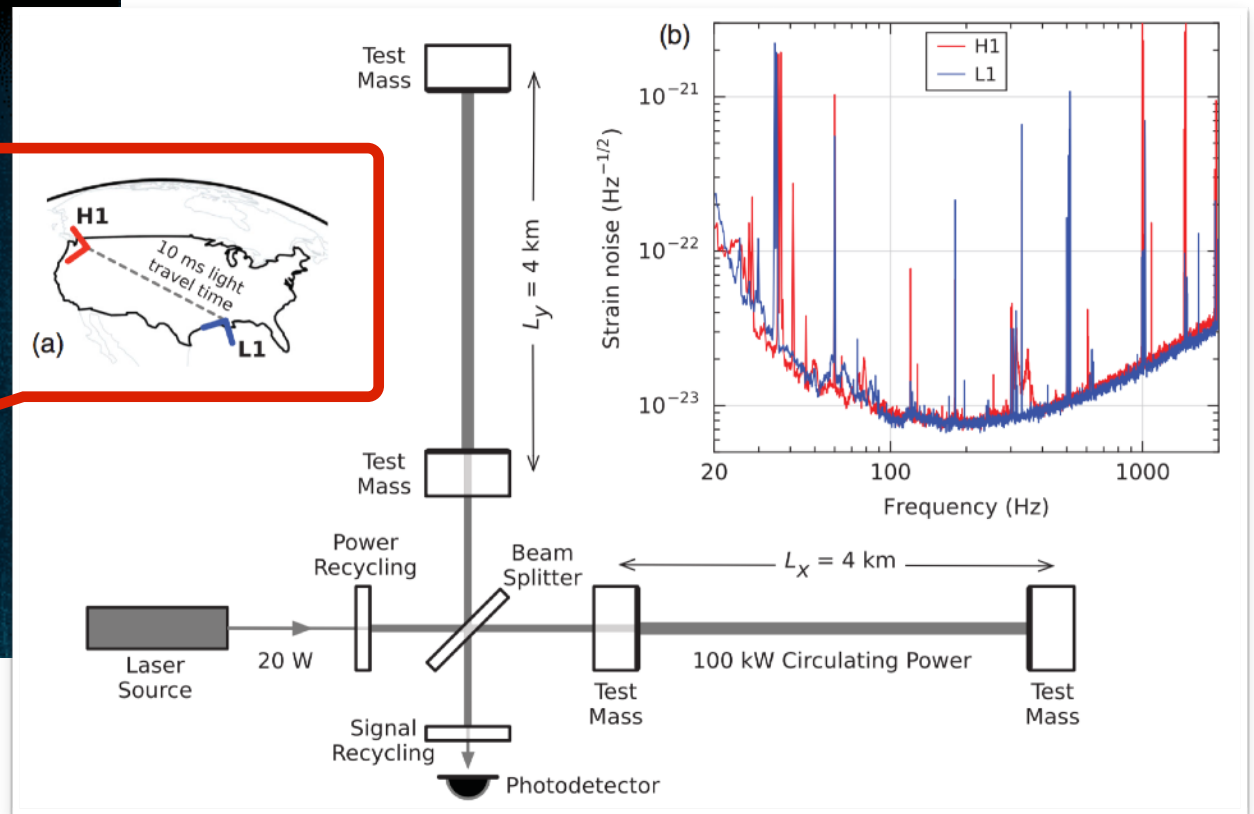
Please write down your name and student ID in the top right corner. (0.0 pt: no paper found with your name / 0.5 pt: paper found with your name and some answers / 1.0 pt: good answers)

1. Boas, Chapter 7, Section 3, Problem 5 (see p.345/373 for definitions of *fundamentals & overtones*)
2. Boas, Chapter 7, Section 4, Problem 2 (which allows us to trivially prove Eq.(4.8) in p.349)



LIGO

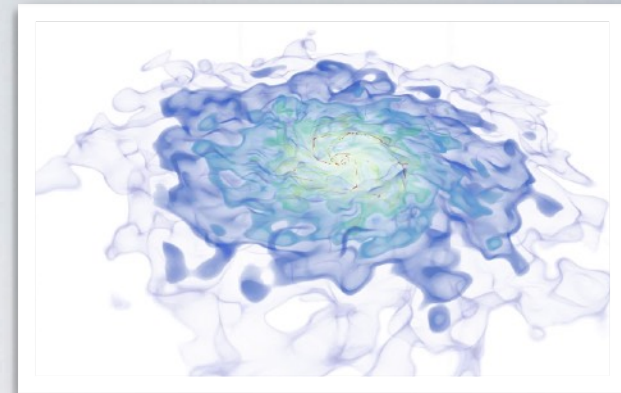
Abbott et al. (2016a)



Rudimentary Mathematical Methods of Physics (Fall 2025): Suggested Problems in Chapter 7, Boas, 3rd ed.

The problems I suggest you to take a deeper look into include, but are not limited to, the following.
The class homework assignments will mainly be from this list.

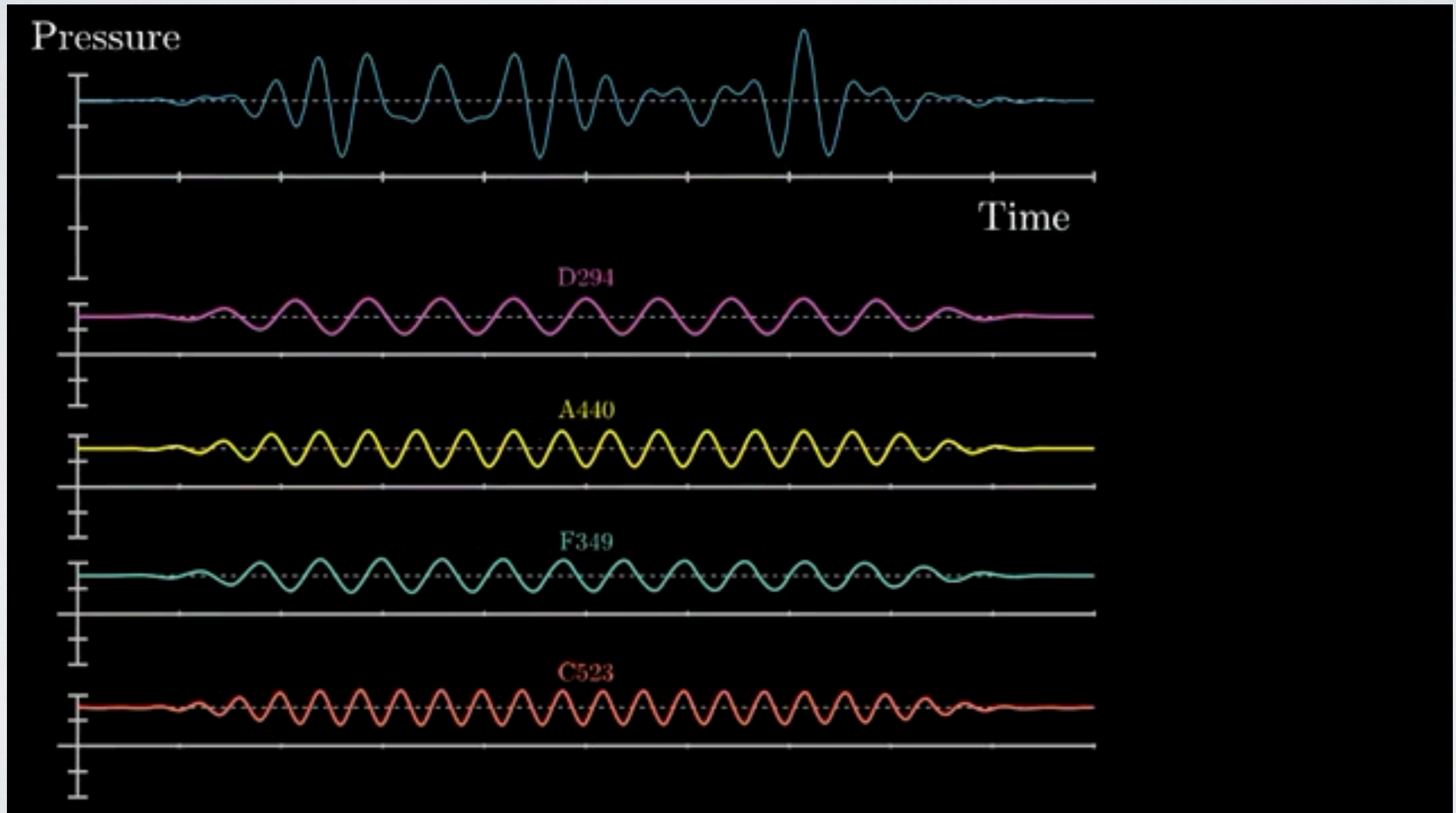
- Section 02: Problems 12, 17
- Section 03: Problems 8
- Section 04: Problems 1, 13, 16
- Section 05: Problems 1, 3, 4, 7, 9, 11
- Section 06: Problems 10, 12 (for Problem 5.7 and 5.9), 14, 15
- Section 07: Problems 7, 9, 11, 13
- Section 08: Problems 2, 14, 15(a)(b), 20
- Section 09: Problems 9, 10, 11, 19, 20, 23
- Section 10: Problems 2
- Section 11: Problems 6, 8
- Section 12: Problems 6, 9, 10, 15, 18, 21, 23, 26, 31, 35
- Section 13: Problems 4, 8, 14, 23



Fourier Series

Fourier Series

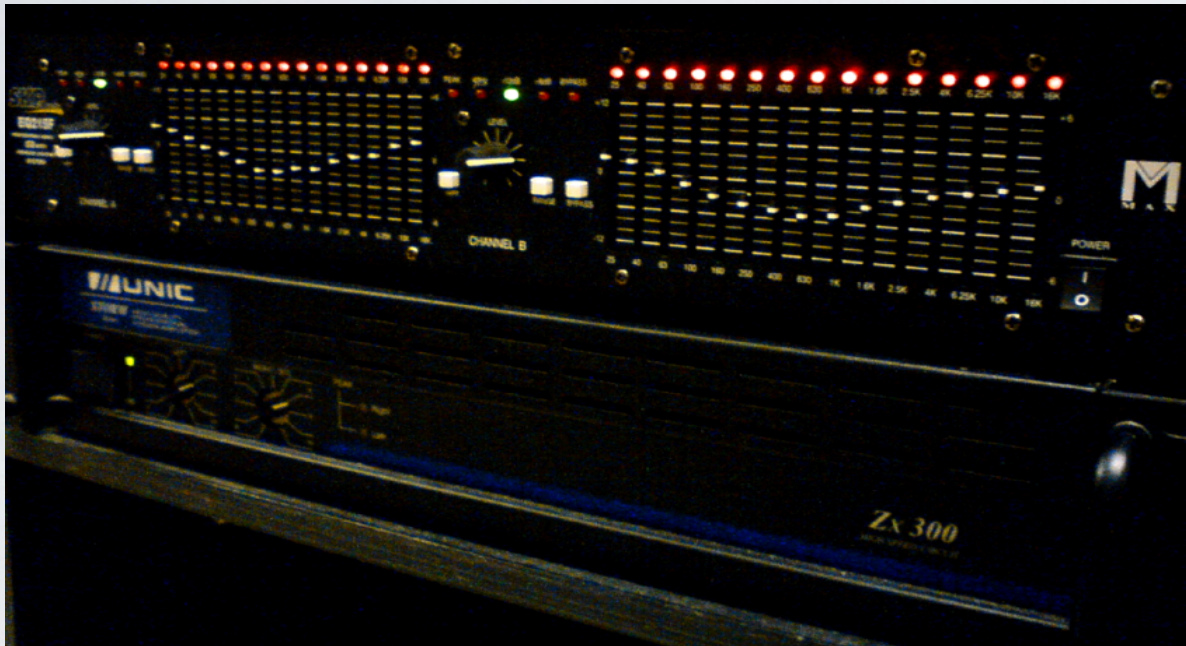
- A visualization of Fourier series.



youtube.com/watch?v=spUNpyF58BY

Applications of Fourier Analysis

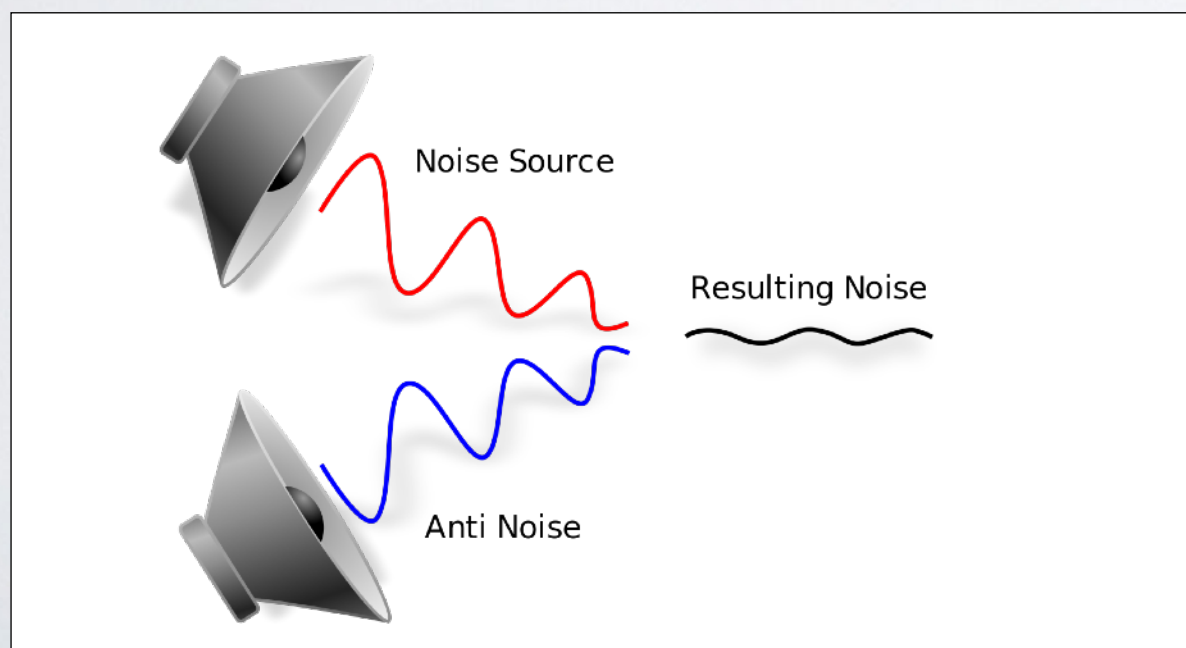
- Whenever there are wave patterns.



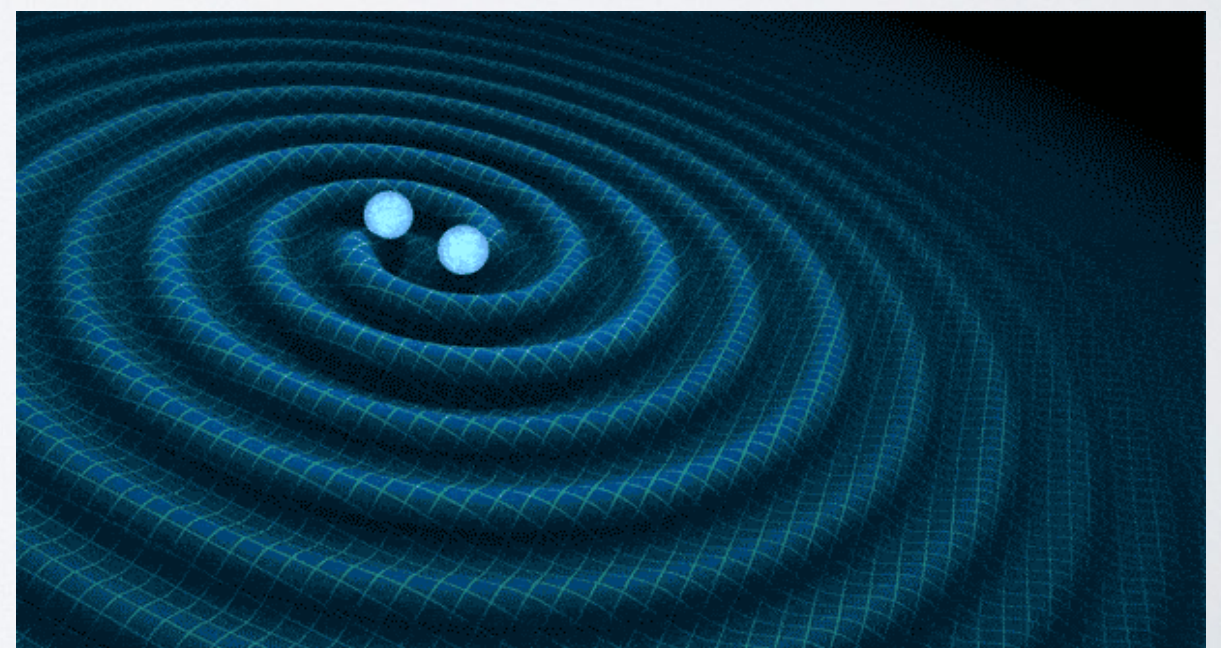
Sound equalizer, Wikipedia commons



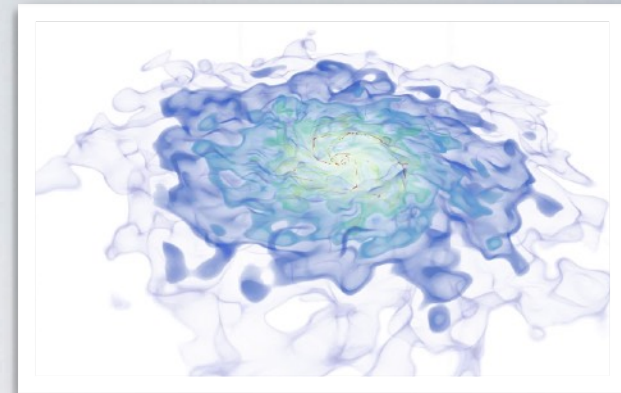
Electroencephalography (EEG), abcnews.go.com



Active noise cancelling, Wikipedia commons



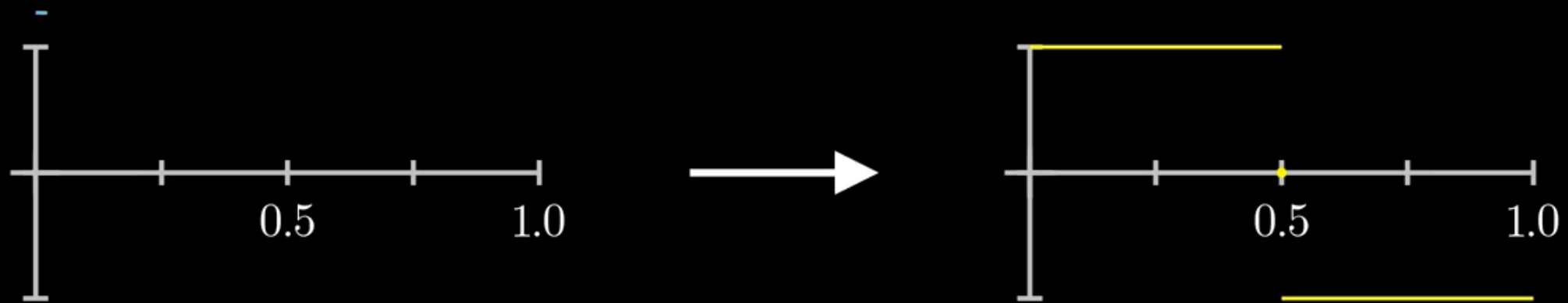
LIGO



Sine-Cosine Fourier Series

Fourier Cosine Series

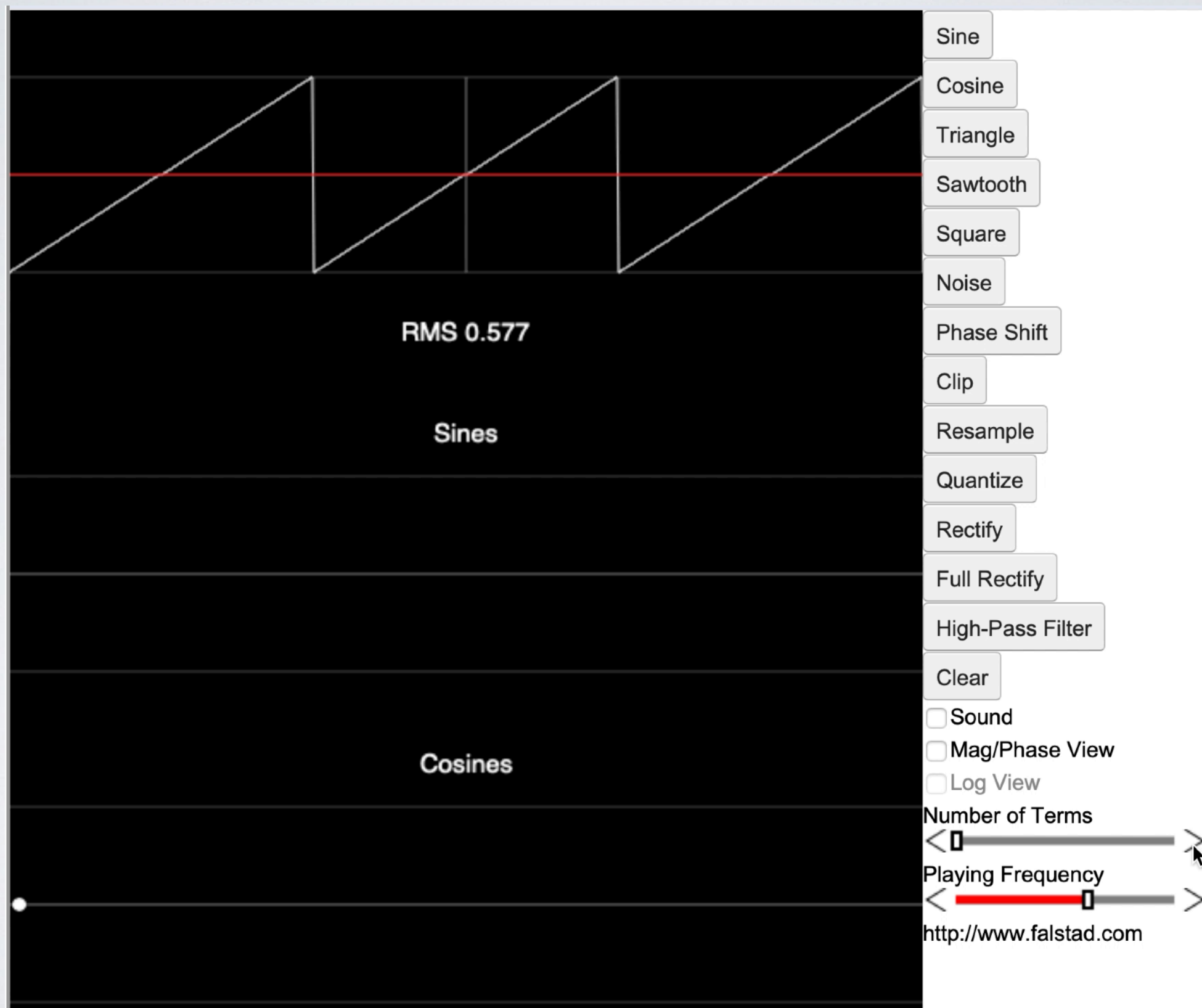
- A visualization of Fourier cosine series.



$$\frac{4}{\pi} \left(\frac{\cos(\pi x)}{1} - \frac{\cos(3\pi x)}{3} + \frac{\cos(5\pi x)}{5} - \dots \right) = \begin{cases} 1 & \text{if } x < 0.5 \\ 0 & \text{if } x = 0.5 \\ -1 & \text{if } x > 0.5 \end{cases}$$

For $0 \leq x \leq 1$

Fourier Sine Series



Sine-Cosine Fourier Series

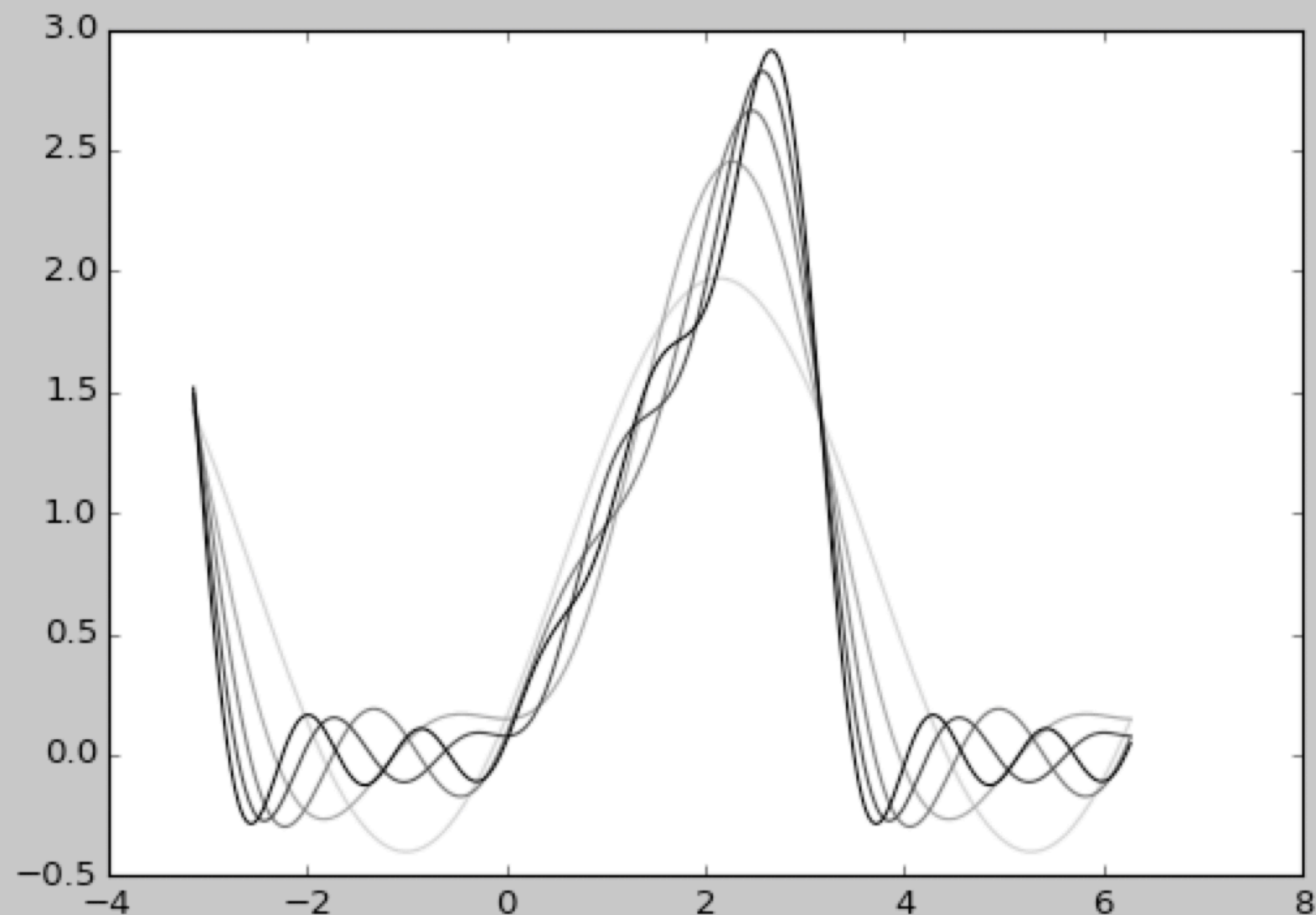
- A visualization of sine-cosine Fourier series (Ch 7.5, Prob 5.7).

```
import numpy as np
import matplotlib.pyplot as plt

N = 50 # partial sums up to the N-
t = np.arange(-np.pi, 2*np.pi, 0.6)

def my_fourier(n, t):
    partial_sum = [np.pi/4] * len(t)
    for nn in range(1, n+1):
        if nn%2==1:
            partial_sum += np.sin(
            partial_sum -= (2./np.
        else:
            partial_sum -= np.sin(
    return partial_sum

for n in range(N, N+1):
    col = 1. - float(n)/float(N)
    plt.plot(t, my_fourier(n, t),
plt.show()
```



Sine-Cosine Fourier Series

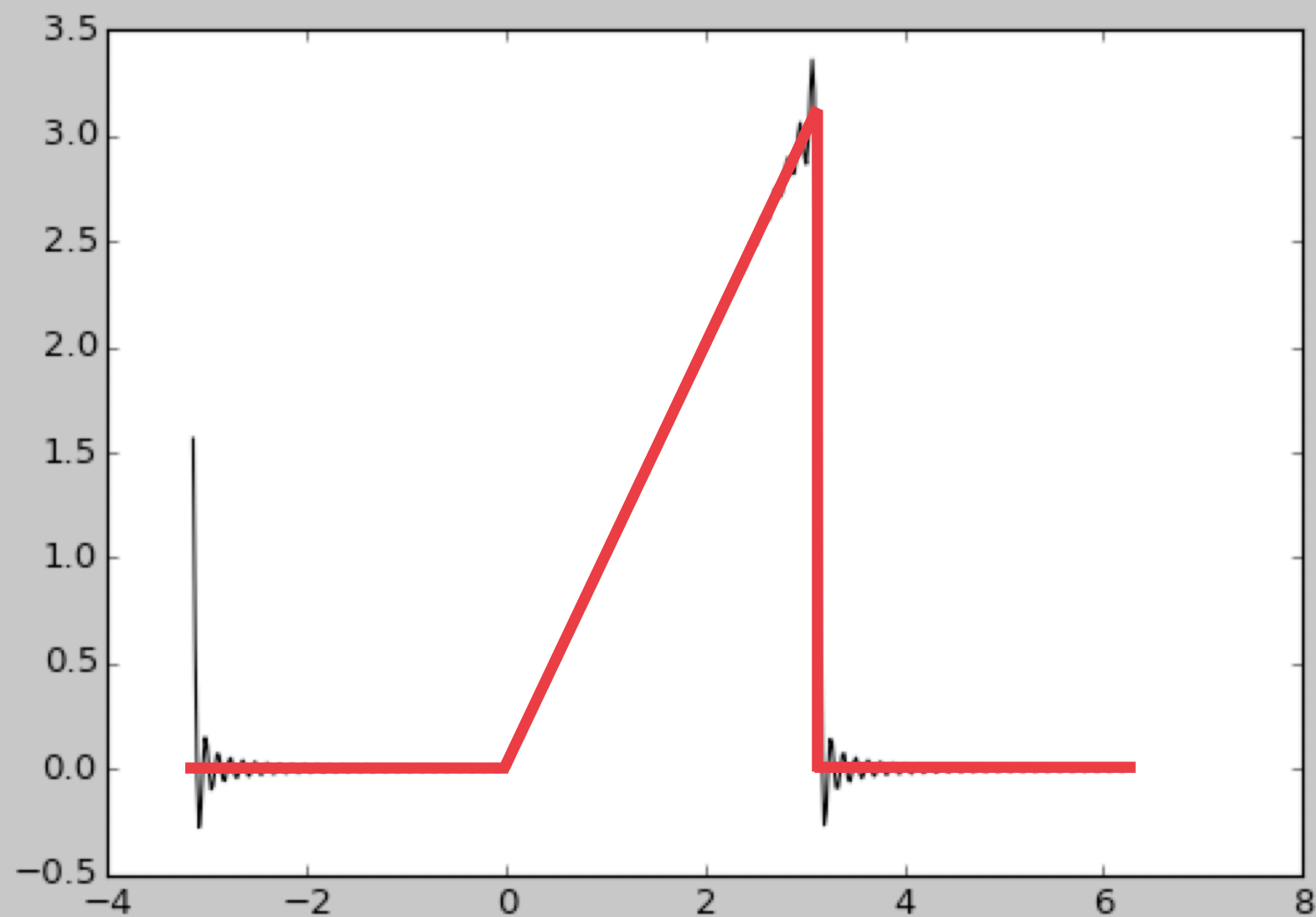
- A visualization of sine-cosine Fourier series (Ch 7.5, Prob 5.7).

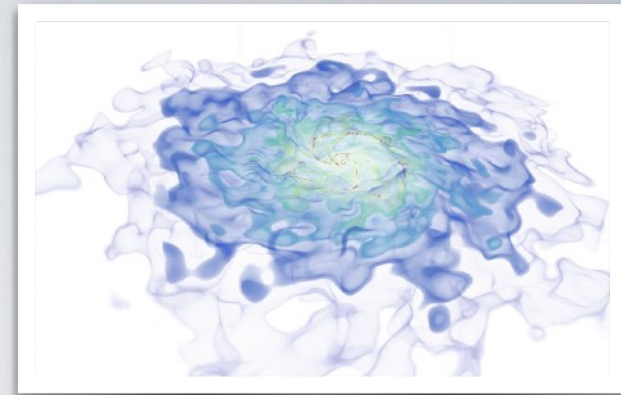
```
import numpy as np
import matplotlib.pyplot as plt

N = 50 # partial sums up to the N-
t = np.arange(-np.pi, 2*np.pi, 0.01)

def my_fourier(n, t):
    partial_sum = [np.pi/4] * len(t)
    for nn in range(1, n+1):
        if nn%2==1:
            partial_sum += np.sin(
            partial_sum -= (2./np.
        else:
            partial_sum -= np.sin(
    return partial_sum

for n in range(N, N+1):
    col = 1. - float(n)/float(N)
    plt.plot(t, my_fourier(n, t),
plt.show()
```

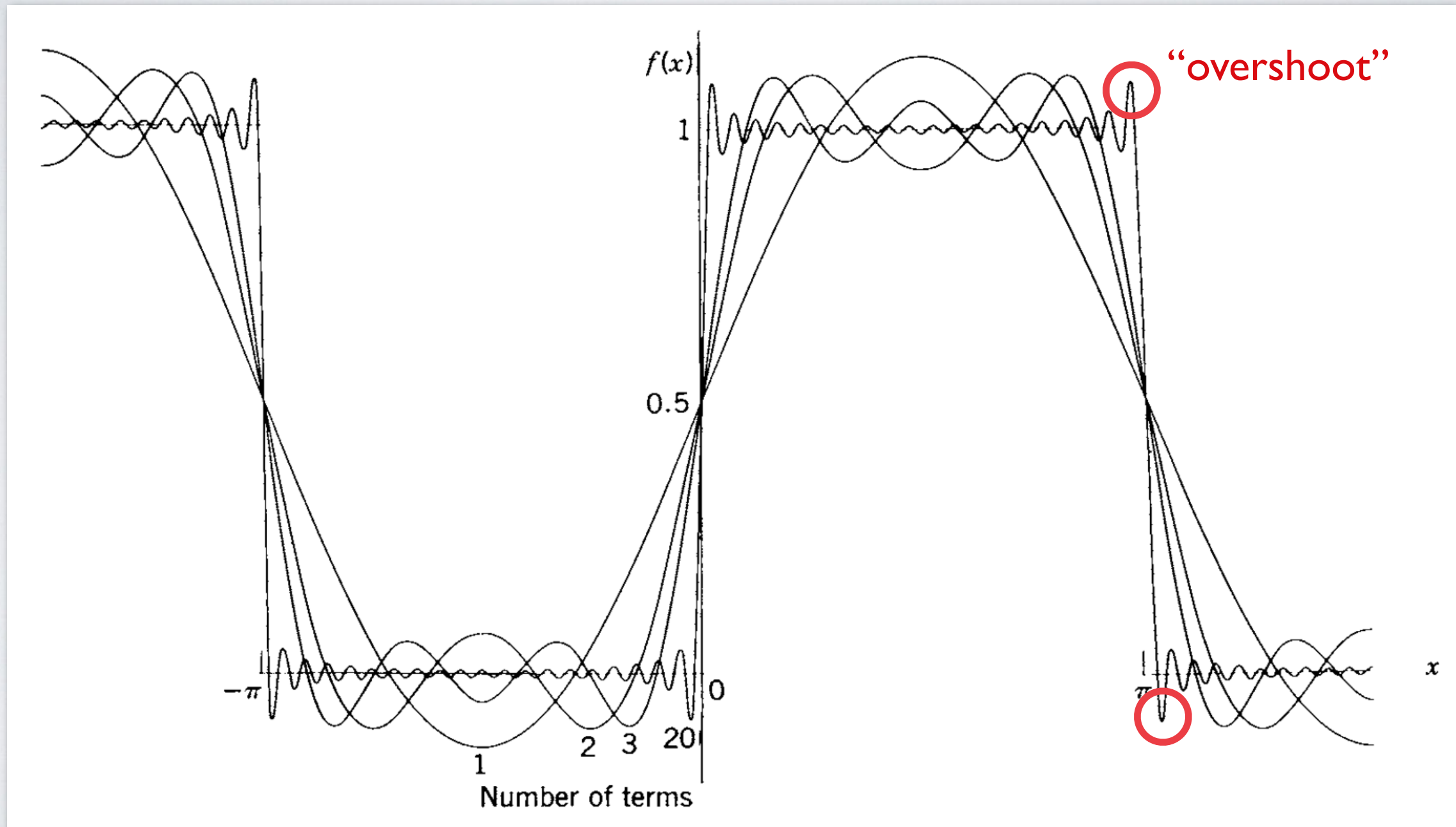




Gibbs Phenomenon

Fourier Sine Series

- A visualization of Fourier sine series (Ch 7.6, Figure 6.2).



Sine-Cosine Fourier Series

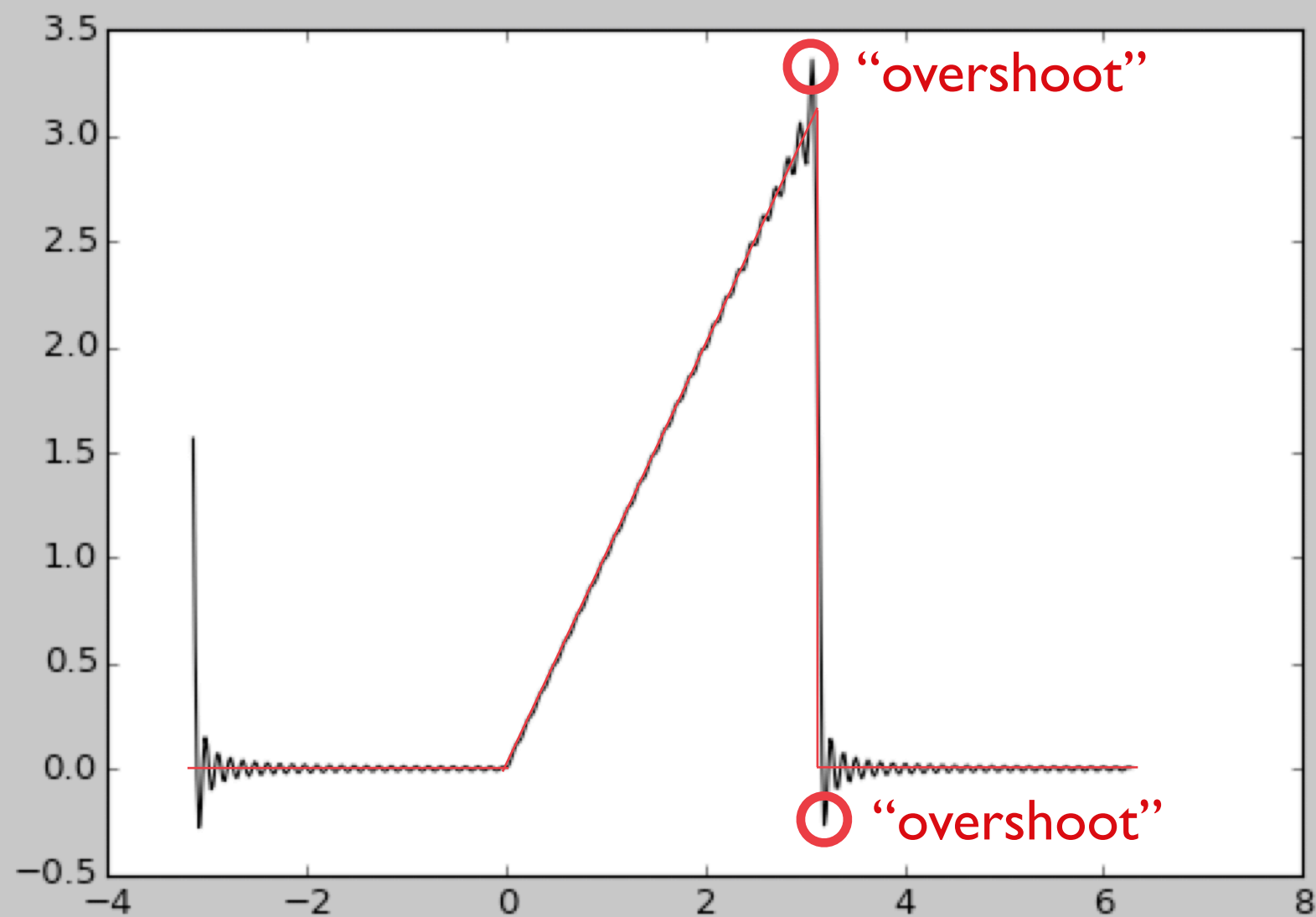
- A visualization of sine-cosine Fourier series (Ch 7.5, Prob 5.7).

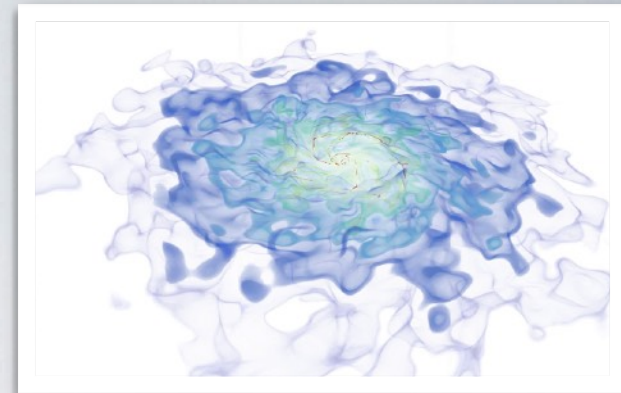
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import matplotlib.pyplot as plt

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t = np.arange(-np.pi, 2*np.pi, 0.01)

def my_fourier(n, t):
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            partial_sum -= (2./np.
        else:
            partial_sum -= np.sin(
    return partial_sum

for n in range(N, N+1):
    col = 1. - float(n)/float(N)
    plt.plot(t, my_fourier(n, t),
plt.show()
```

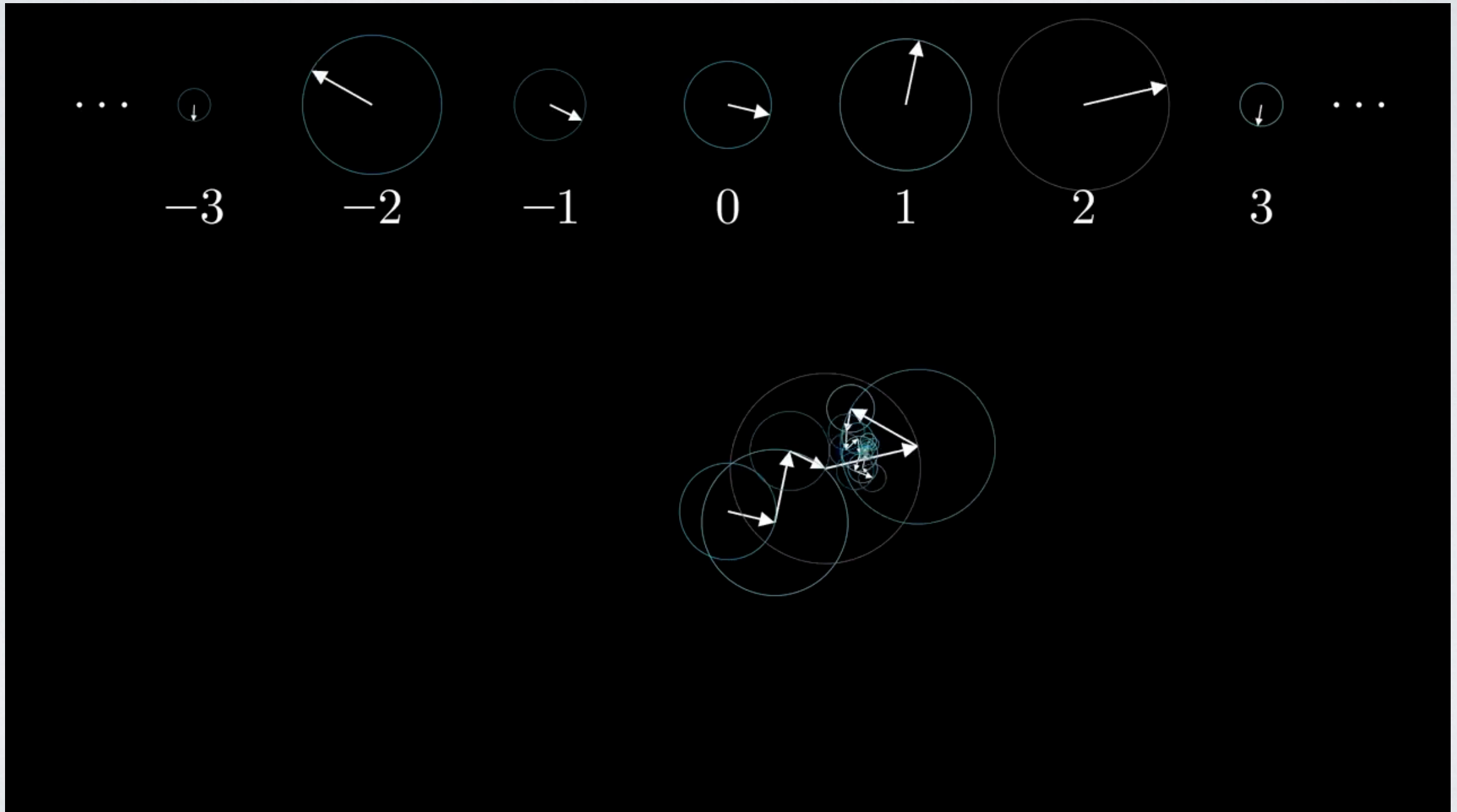




Complex Fourier Series

Complex Fourier Series

- A visualization of complex Fourier series.

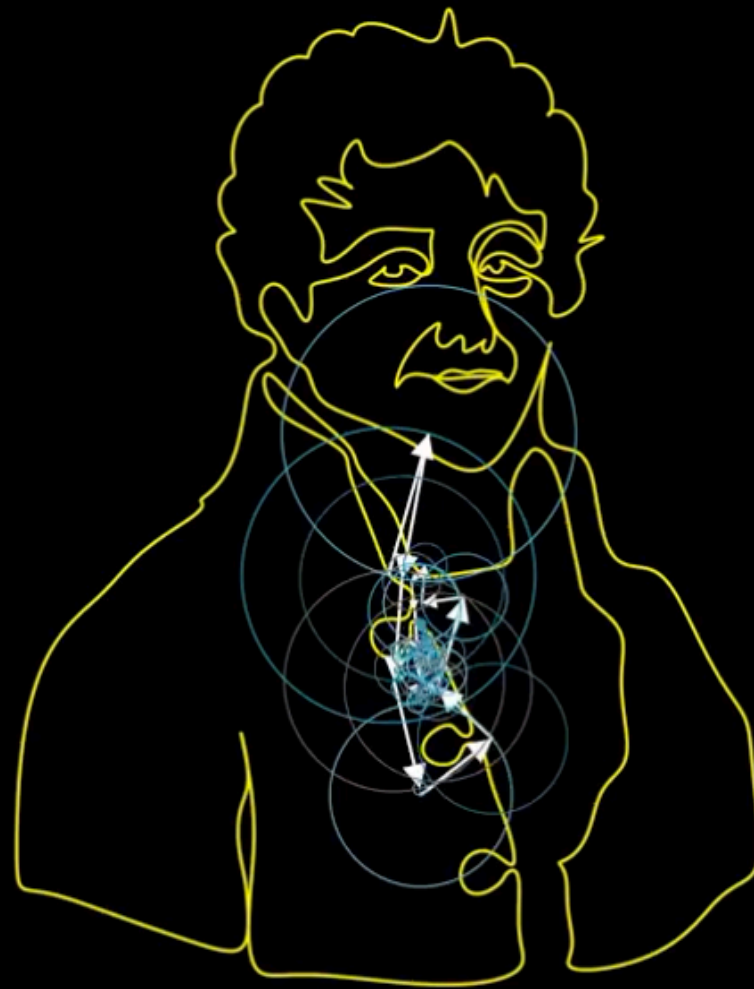


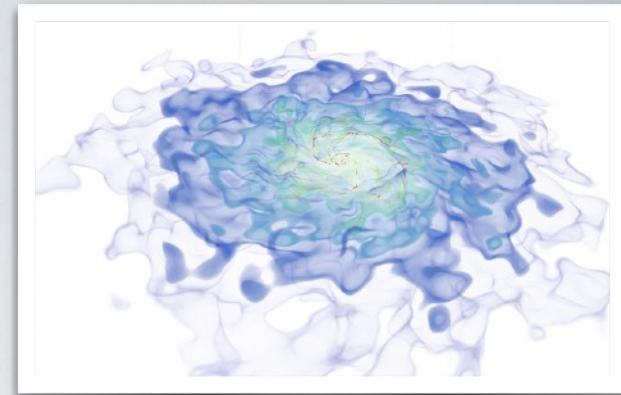
youtube.com/watch?v=r6sGWTCMz2k

Complex Fourier Series

- A visualization of complex Fourier series.

Approximation using 250 vectors





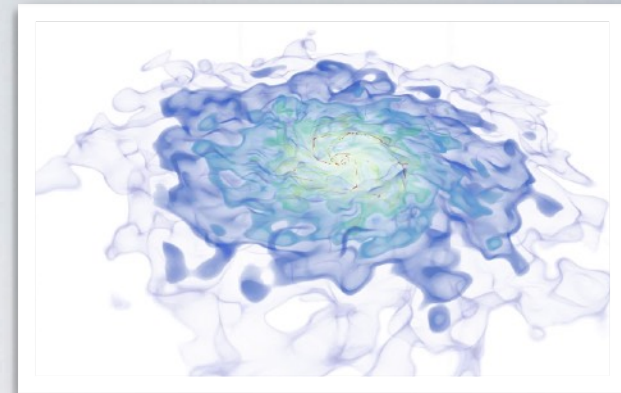
Term Project Paper

Grading Scheme

- Grade policy in the course syllabus.

* 3. 평가방법	구분	출석	과제	중간	기말	수시평가	태도	기타	합계
	비율	5	35	20	20	15	5	0	100
	비고			지필고사	지필고사				
	출석 규정 : 수업일수의 1/3을 초과하여 결석하면 성적은 "F" 또는 "U"가 됨(학칙 85조) (담당교수가 불가피한 결석으로 인정하는 경우는 예외로 할 수 있음)								

- 6 HW assignments - Scheduled in 3, 5, 7, 10, 12, 14th week
 - Due in <1 weeks on eTL or in the classroom
 - Only handwritten answers accepted (except numerical problems)
- Term project paper - Due near the end of the semester
 - To be discussed in detail later

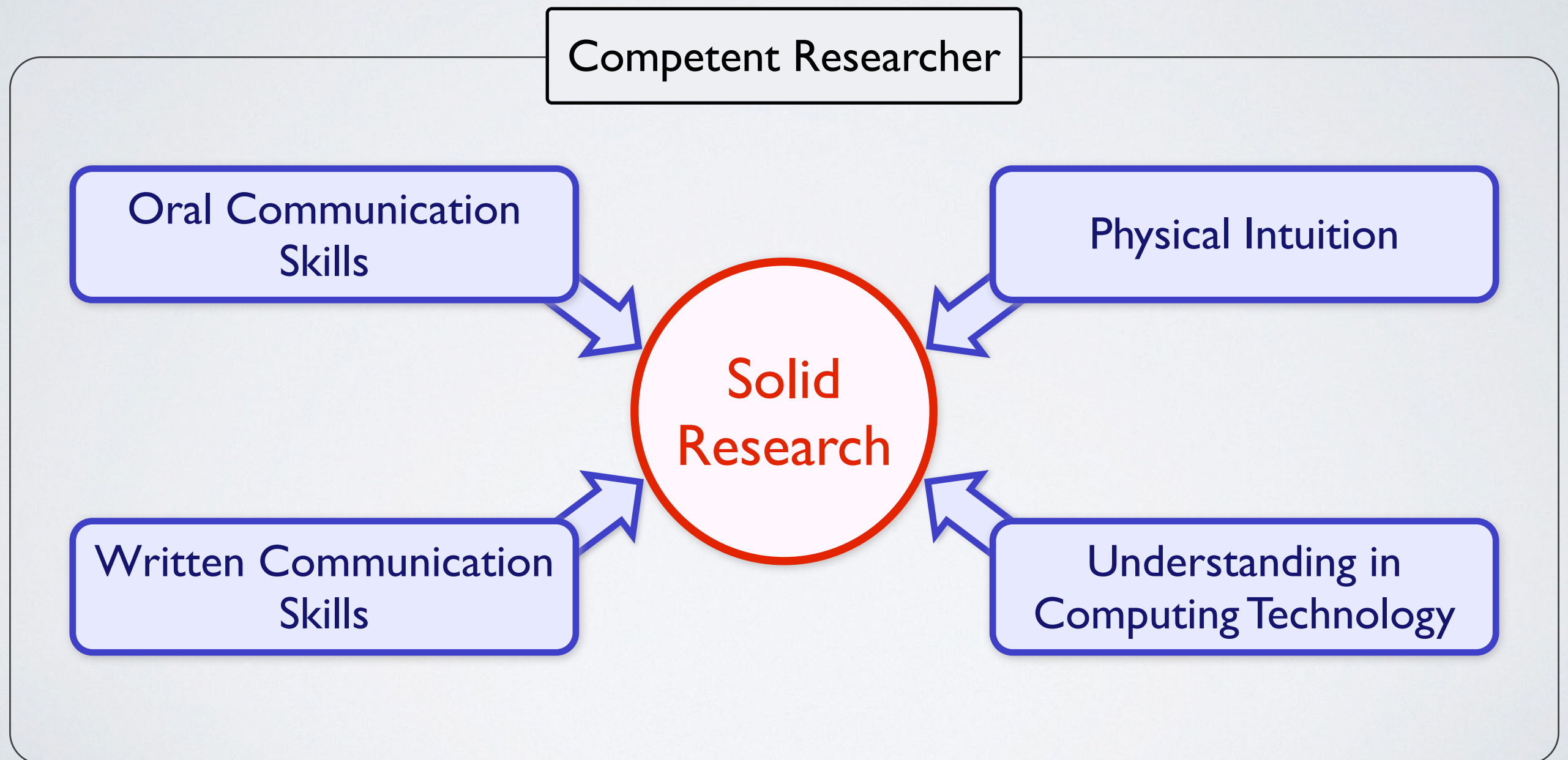


Essential Skillsets For Future Physicists & Astrophysicists

(on top of the strong physics/math background you will build)

Essential Skillsets For (Astro)Physicists

- To become proficient and effective researchers while **relying less on guesswork as you navigate through the academia**



Essential Skillsets For (Astro)Physicists

Competent Researcher

Oral Communication Skills

- How to present long and short talks
- How to answer questions
- How to make an elevator pitch

Written Communication Skills

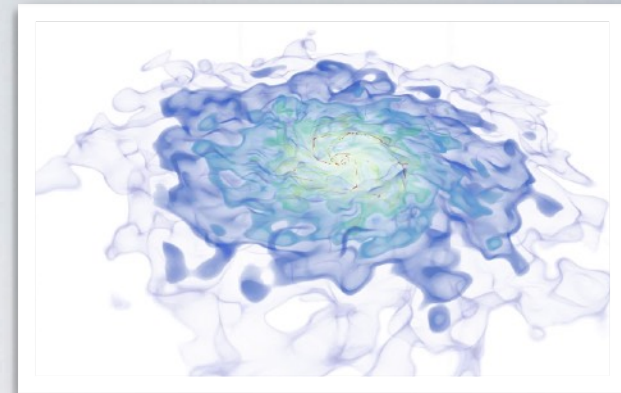
- How to write papers and proceedings
- How to write referee reports
- How to respond to referee reports

**Solid
Research**

Physical Intuition

Understanding in
Computing Technology

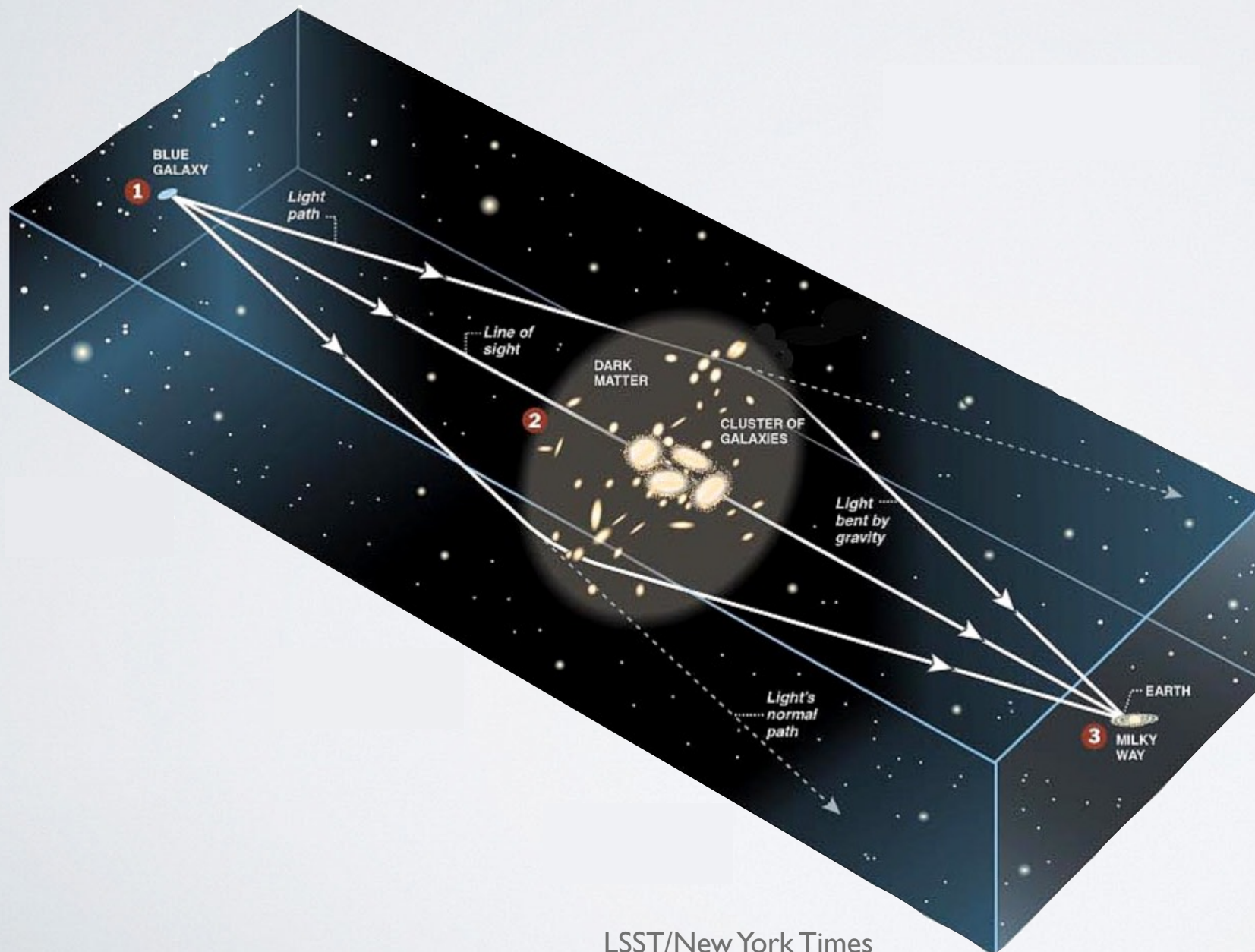




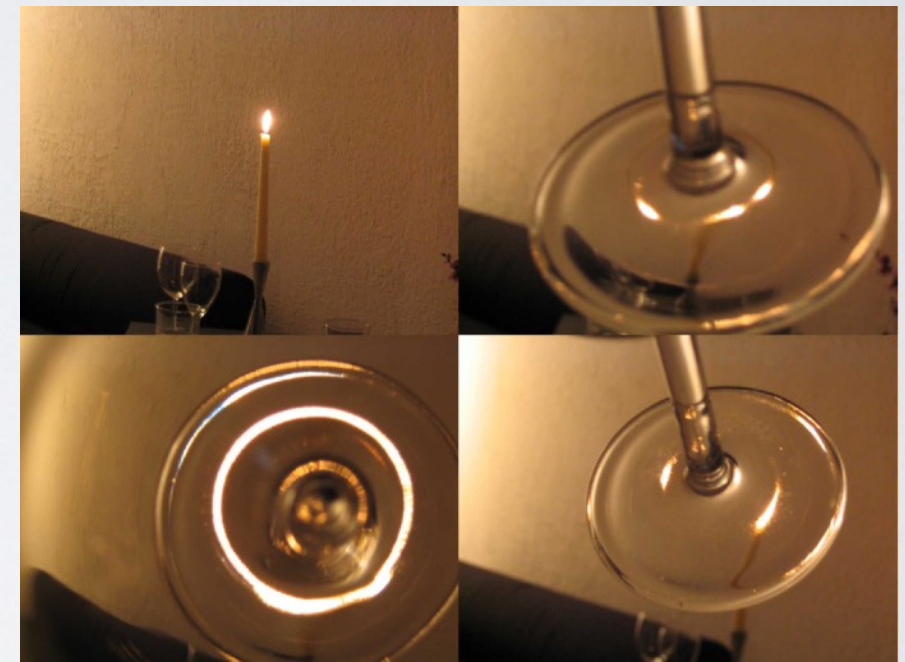
My Examples This Semester

Gravitational Lens As A Telescope

- Galaxy clusters act as **nature-made cosmic telescopes** allowing us to observe the young Universe (~ 10 to 10^3 times magnified).



LSST/New York Times



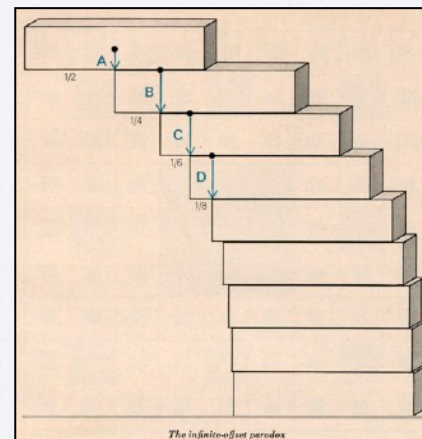
Marshall

Fun with Stacking Blocks

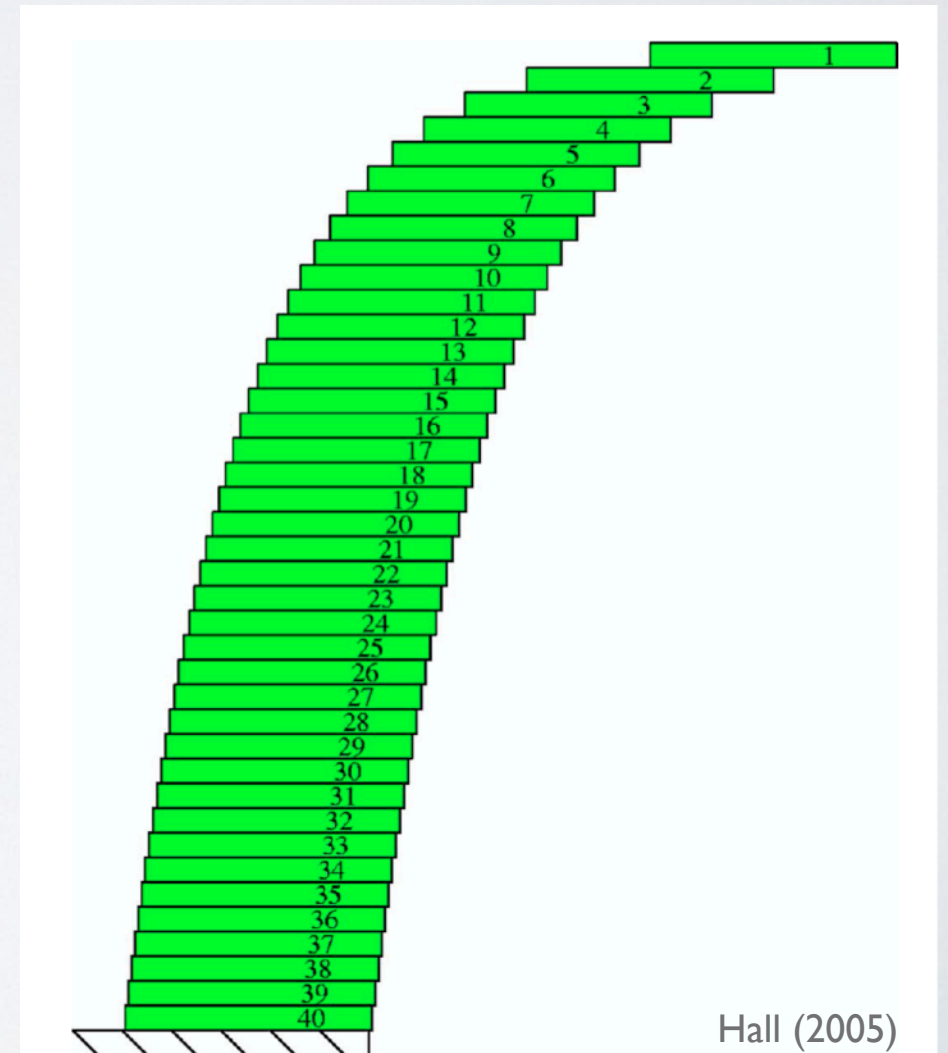
- See: Problem 16.1 + “Fun with Stacking Blocks” (Hall, 2005), etc.



N=13



bit-player.org



Rudimentary Mathematical Methods of Physics (Fall 2025): Quiz #2

— [open book and open note, “and” cellphone or laptop, drop it off as you leave the class] —

Please write down your name and student ID in the top right corner. (0.0 pt: no paper found with your name / 0.5 pt: paper found with your name and some answers / 1.0 pt: good answers)

1. Define “complex plane” from your textbook; then, Boas, Chapter 2, Section 5, Problem 59
2. Briefly explain the so-called Mandelbrot set demonstrated in the following movie — in particular, how this one of the most famous images in the fractal/chaos theory is plotted on a “complex plane”.



youtube.com/watch?v=G_GBwuYuOOs,
Mandelbrot set on complex plane

Rudimentary Mathematical Methods of Physics (Fall 2025): Quiz #6

— [open book and open note, “and” cellphone or laptop, drop it off as you leave the class] —

Please write down your name and student ID in the top right corner. (0.0 pt: no paper found with your name / 0.5 pt: paper found with your name and some answers / 1.0 pt: good answers)

1. Boas, Chapter 3, Section 11, Problem 22
2. Study and briefly explain how matrix operations are used in 3-dimensional rendering in various fields such as game design, immersive visualization, augmented reality, and others.



Rudimentary Mathematical Methods of Physics (Fall 2025): Quiz #11

— [open book and open note, “and” cellphone or laptop, drop it off as you leave the class] —

Please write down your name and student ID in the top right corner. (0.0 pt: no paper found with your name / 0.5 pt: paper found with your name and some answers / 1.0 pt: good answers)

1. Explain in layman’s terms — as if you do to your friend in the College of Humanities — what a tensor is. Study and briefly explain how the “tensors” are used in machine learning. For example, the popular open source deep neural network platform by Google is called TensorFlow.

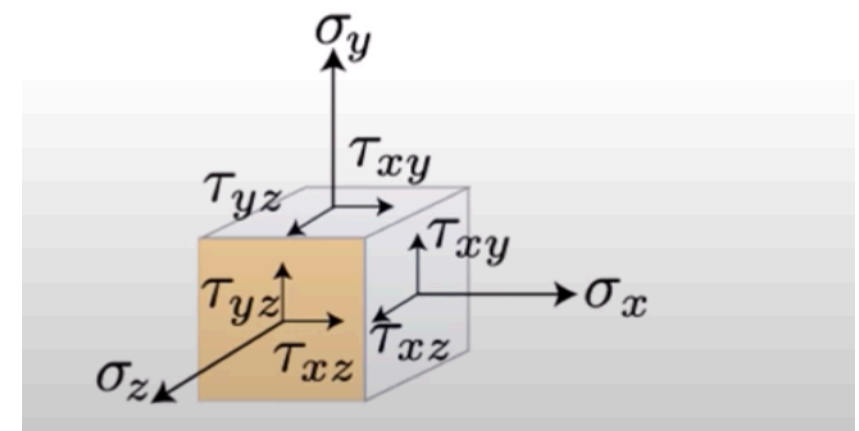
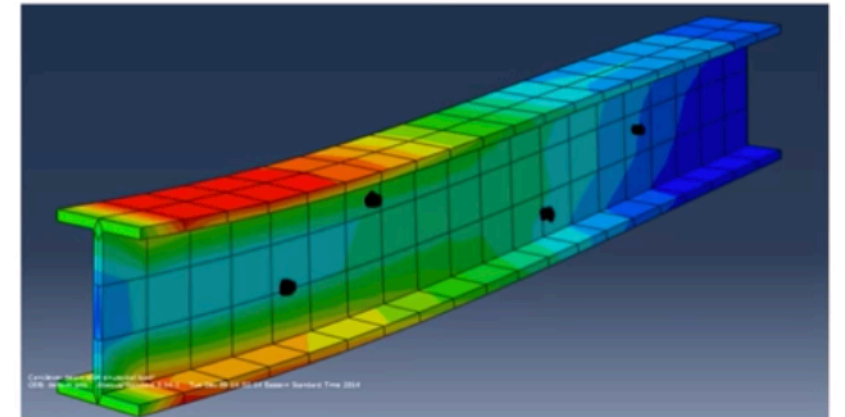
2. Boas, Chapter 10, Section 5, Problem 11



tensorflow.org



stress tensor, [youtube.com/watch?v=kGXrISF3WmA](https://www.youtube.com/watch?v=kGXrISF3WmA)



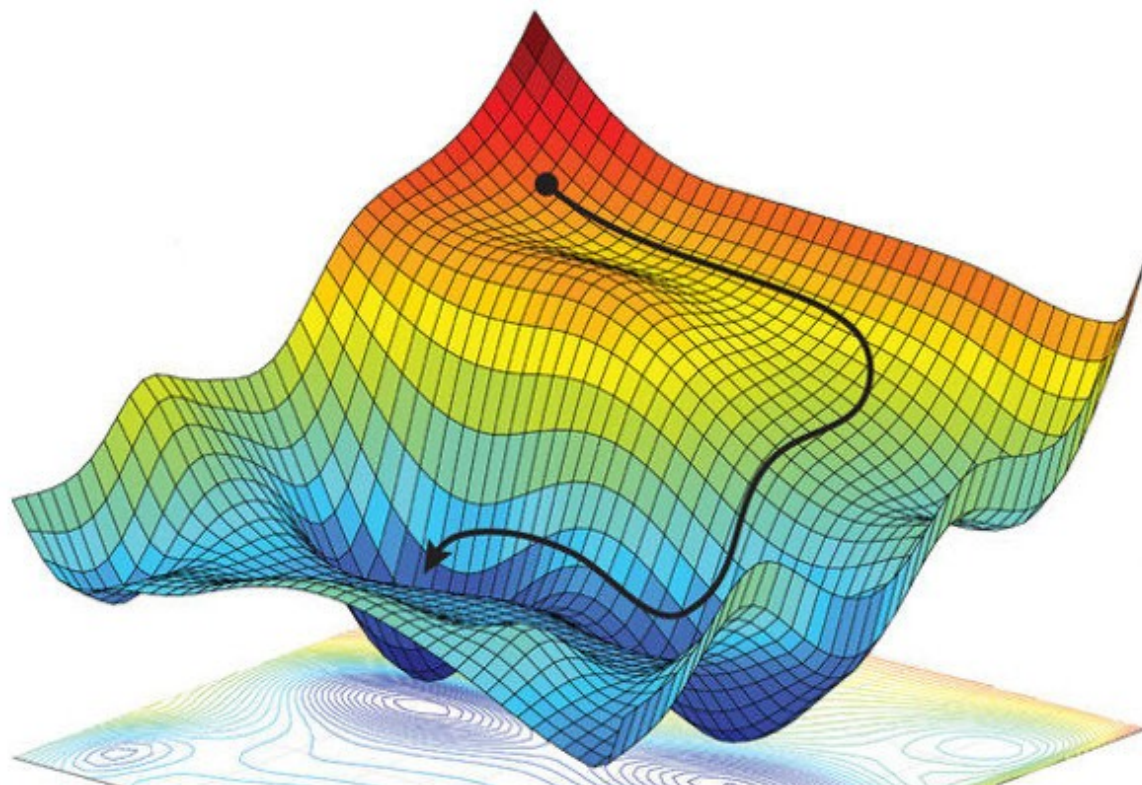
Rudimentary Mathematical Methods of Physics (Fall 2025): Quiz #9

— [open book and open note, “and” cellphone or laptop, drop it off as you leave the class] —

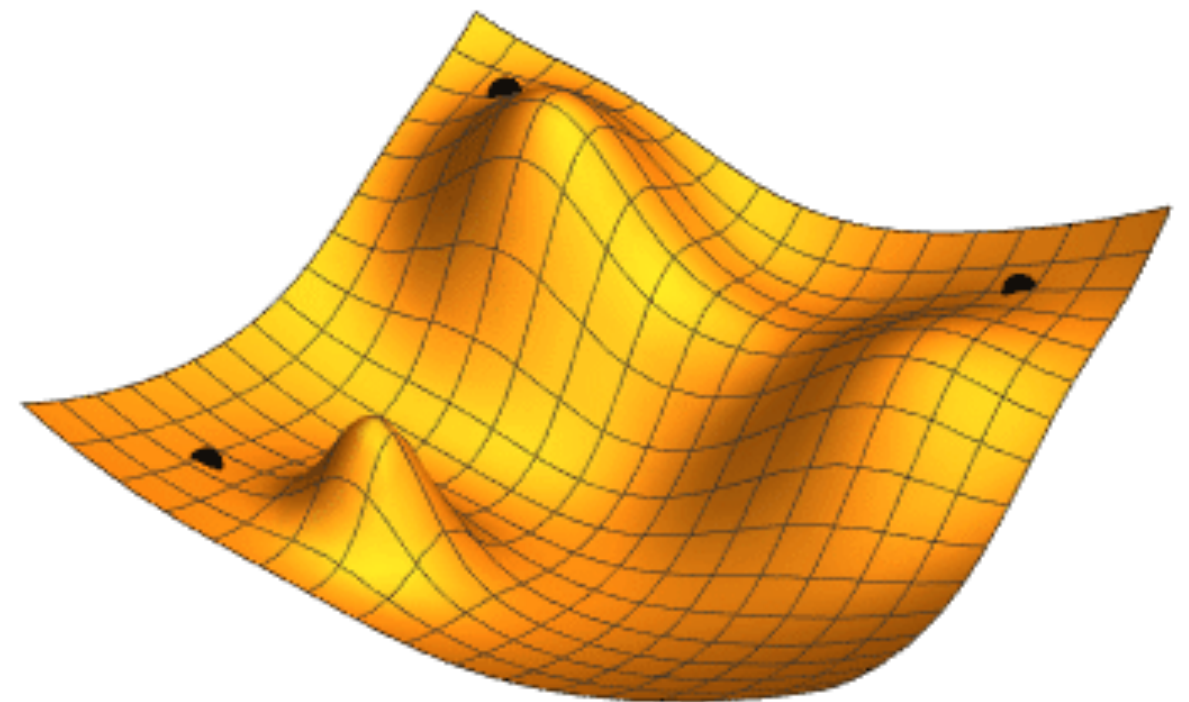
Please write down your name and student ID in the top right corner. (0.0 pt: no paper found with your name / 0.5 pt: paper found with your name and some answers / 1.0 pt: good answers)

1. Boas, Chapter 5, Section 3, Problem 24

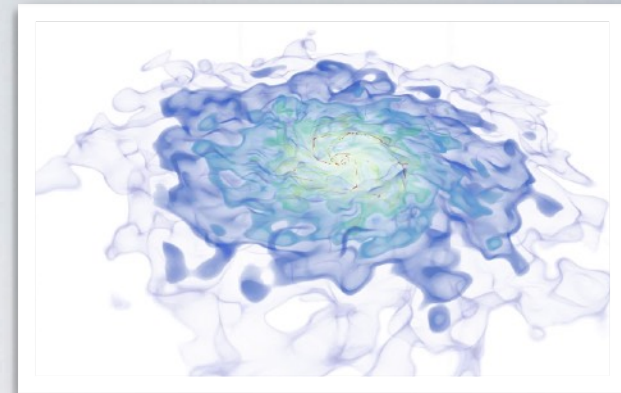
2. Explain in layman’s terms what the figure/movie below are trying to visualize — by using the term “gradient”. On a related note, study and explain briefly how the concept of “gradient” is used in machine learning and artificial intelligence.



Amini et al. (2018)



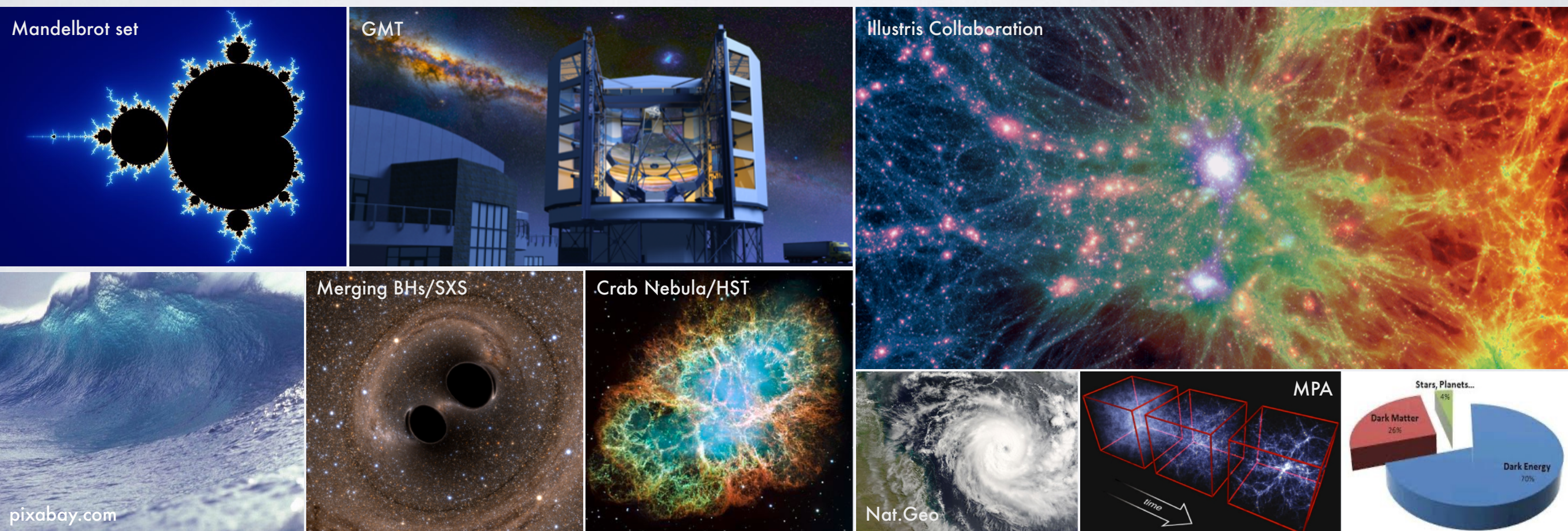
gradient descent, Wikipedia commons



Project Ideas

Term Project Paper

- Report about mathematical physics ideas or methodology being used in contemporary physics research or in daily applications.
- Due: Beginning of the class on **Dec. 1st**
(**10 page-limit** including cover/reference; typewritten report okay)



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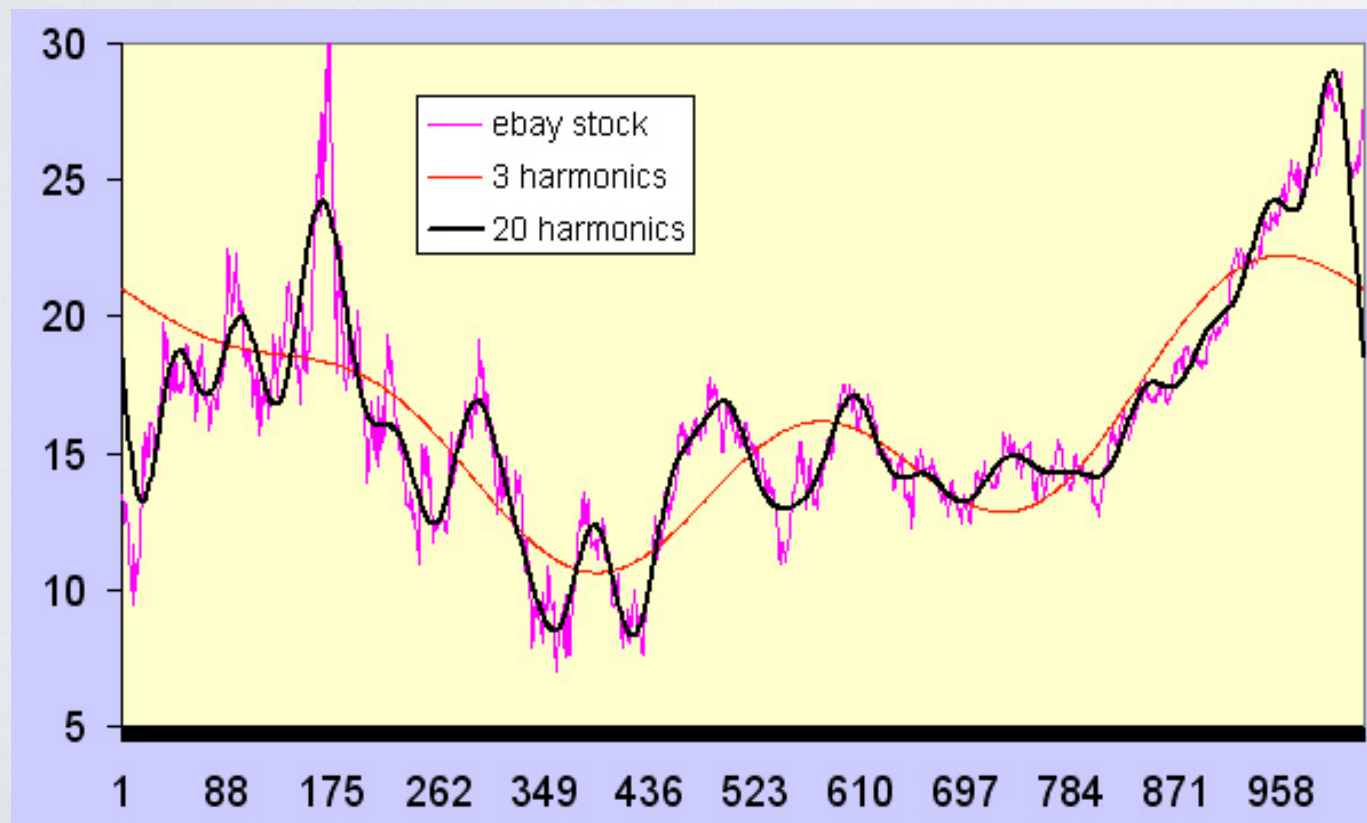
Sound equalizer, Wikipedia commons

Grading guideline

- 0: no paper found with your name on it
- 1: paper found with your name on it
- 2: some scribbles
- 3: reasonable problem & solution
- 4: unique, interesting problem & solution
- 5: reserved for those exceptional

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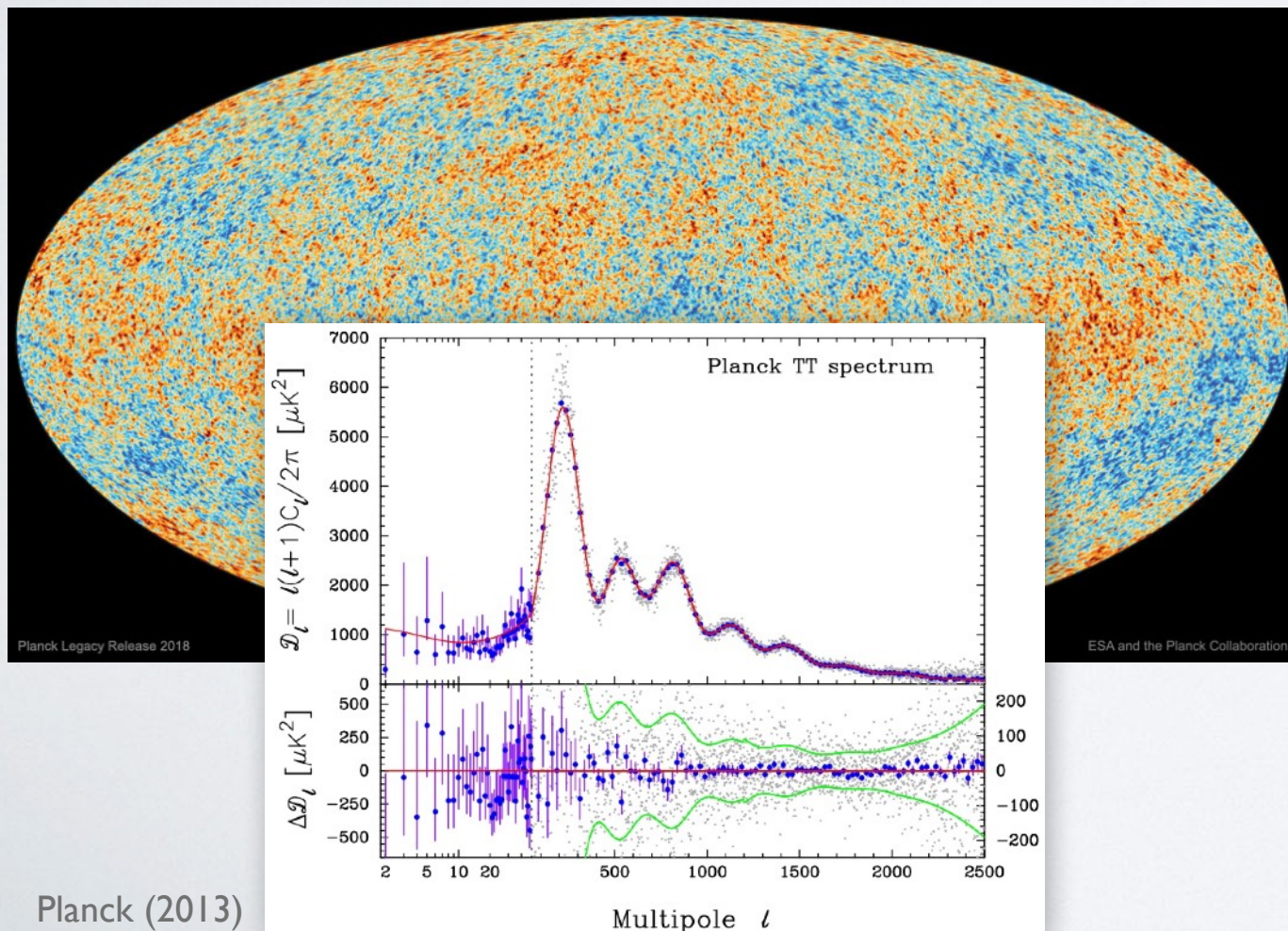
intelligenttradingtech.blogspot.com

Grading guideline

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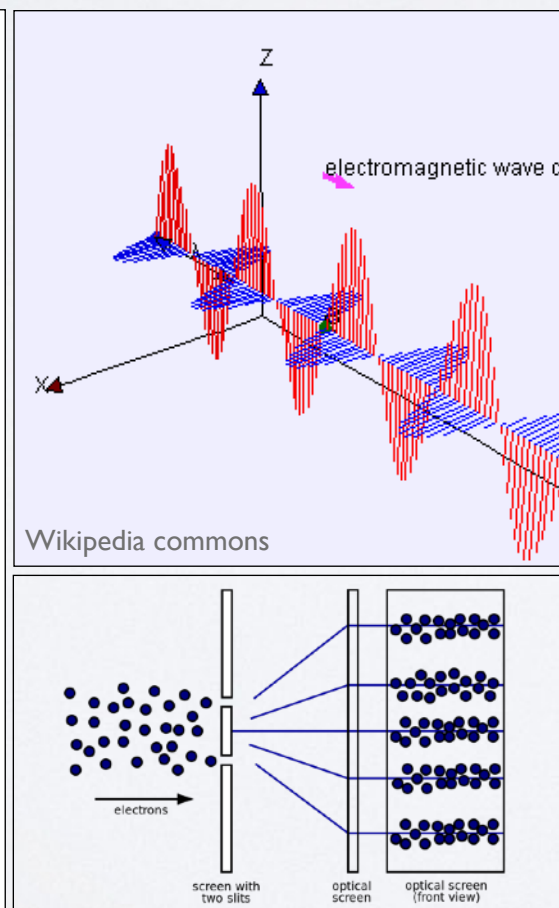
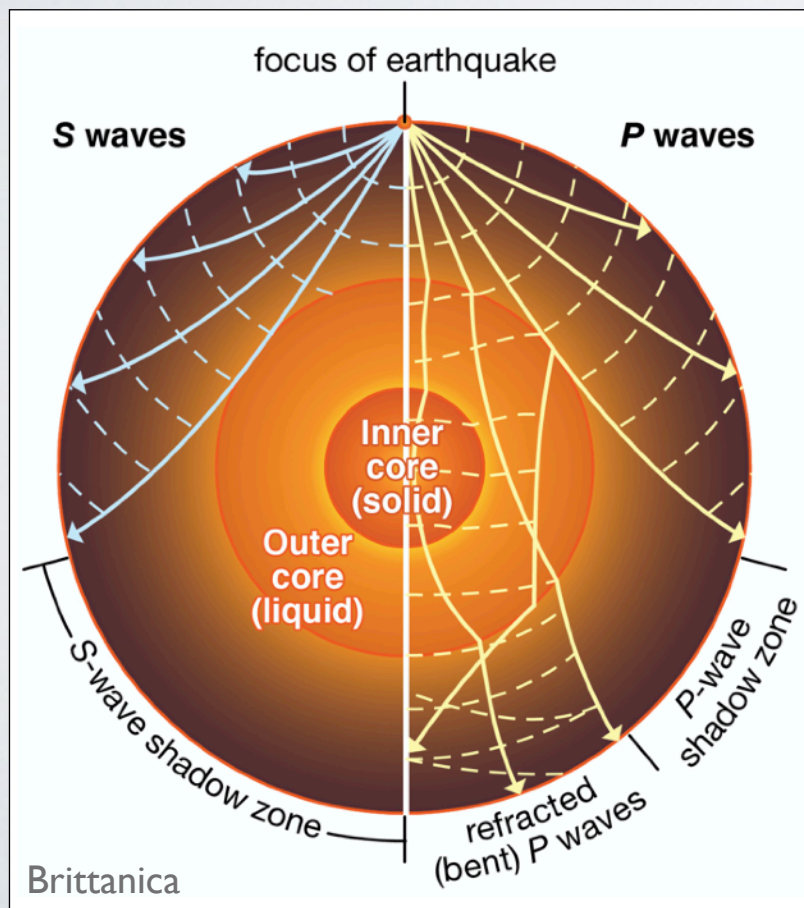
theatlantic.com

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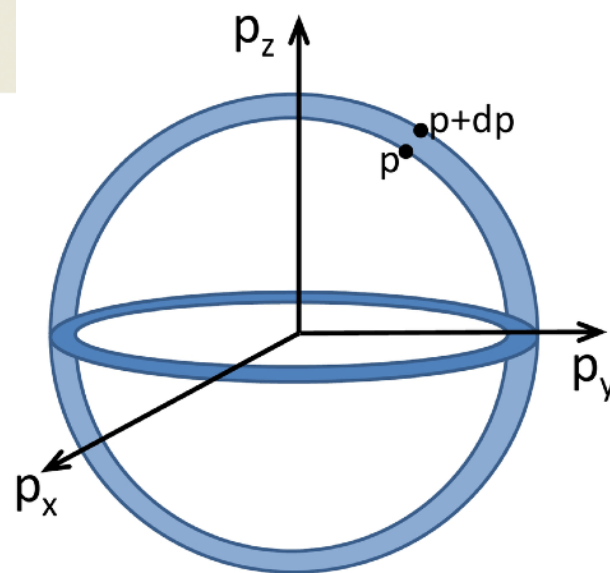
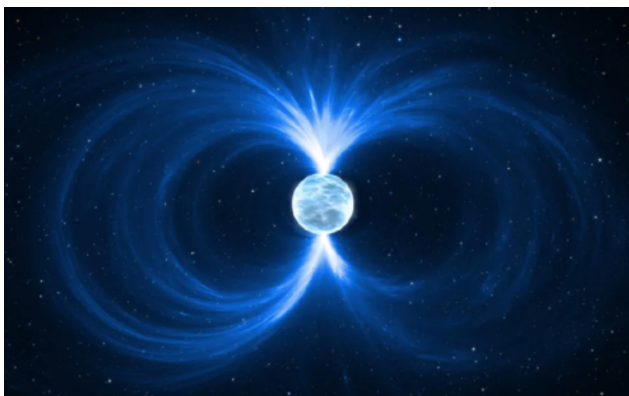
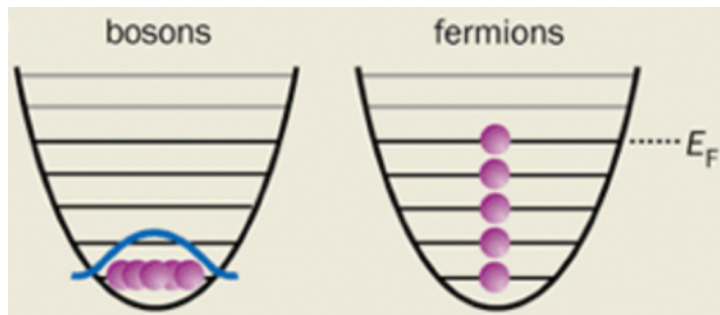


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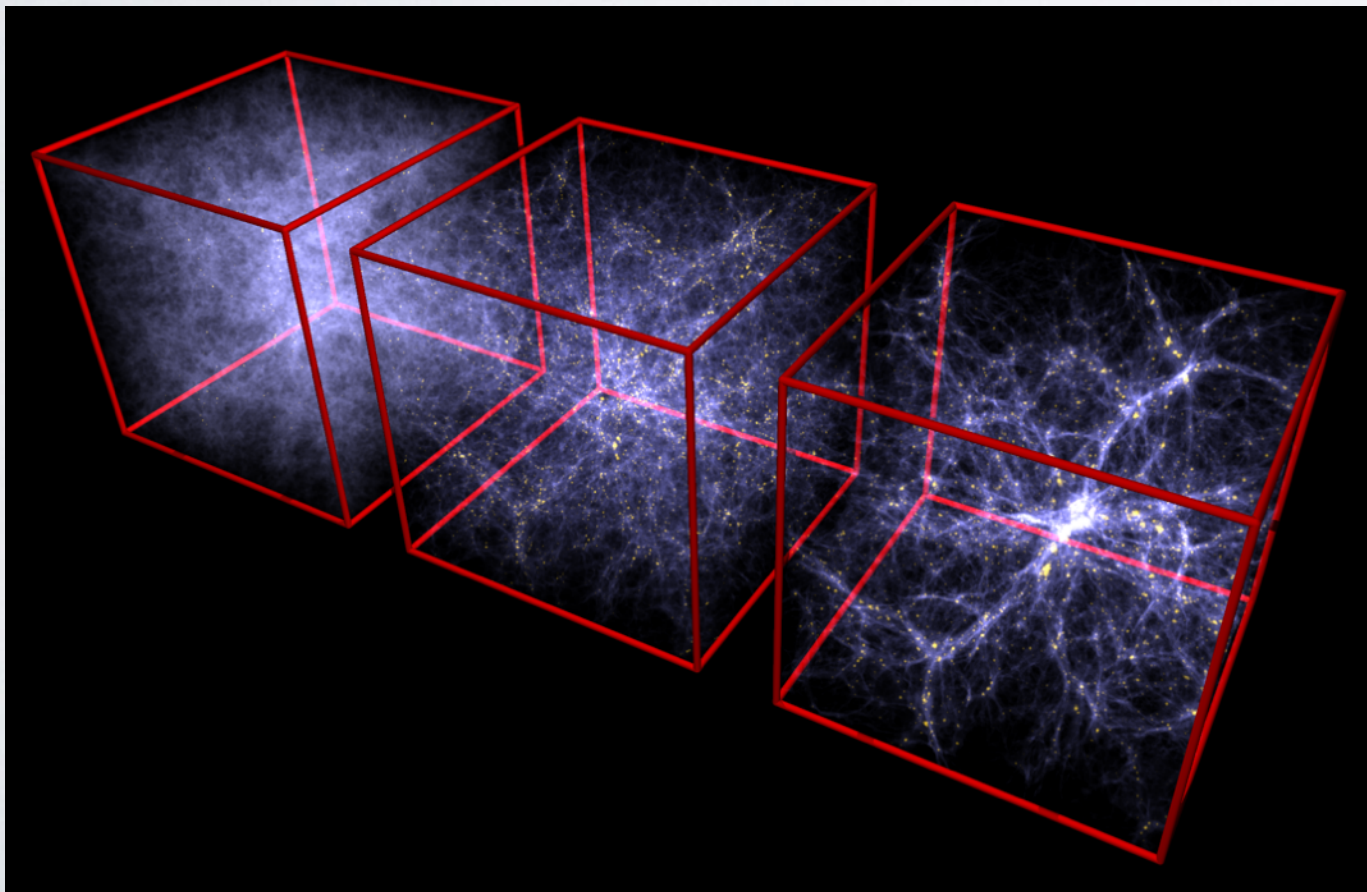


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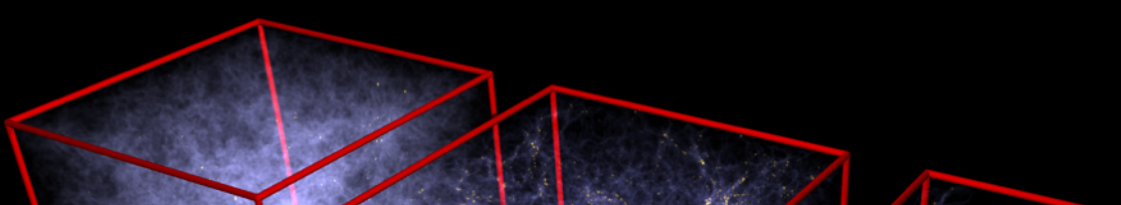
Structure Formation, MPA

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Poisson's equation can be solved in real-space by a convolution of the density field with a Green's function.

$$\Phi(\mathbf{x}) = \int g(\mathbf{x} - \mathbf{x}') \rho(\mathbf{x}) d\mathbf{x}'$$

Example for vacuum boundaries:

$$\Phi(\mathbf{x}) = -G \int \frac{\rho(\mathbf{x})}{|\mathbf{x} - \mathbf{x}'|} d\mathbf{x}' \quad g(\mathbf{x}) = -\frac{G}{|\mathbf{x}|}$$

In Fourier-space, the convolution becomes a simple multiplication!

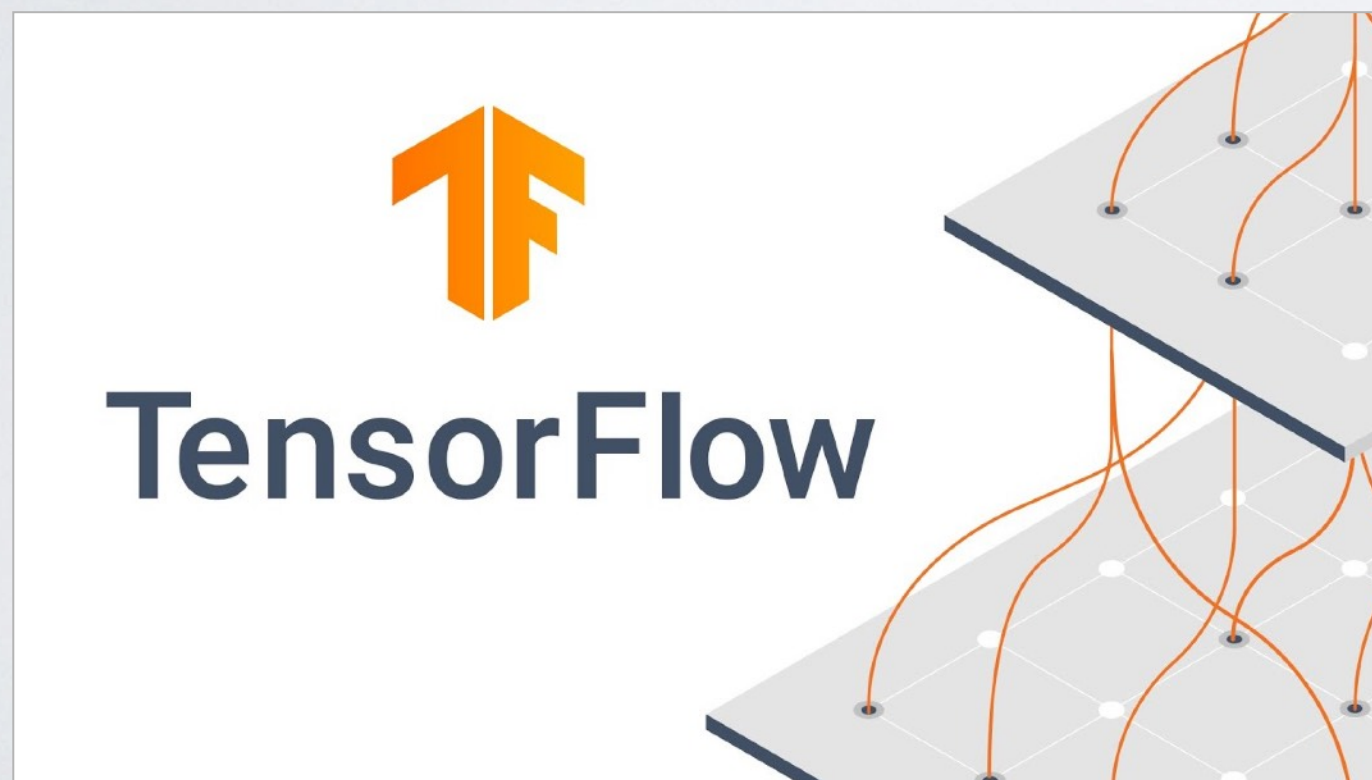
$$\hat{\Phi}(\mathbf{k}) = \hat{g}(\mathbf{k}) \cdot \hat{\rho}(\mathbf{k})$$

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Research

Discovering novel algorithms with AlphaTensor

October 5, 2022

Article

Discovering faster matrix multiplication algorithms with reinforcement learning

<https://doi.org/10.1038/s41586-022-05172-4>

Received: 2 October 2021

Accepted: 2 August 2022

Published online: 5 October 2022

Open access

Check for updates

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Improving the efficiency of algorithms for fundamental computations can have a widespread impact, as it can affect the overall speed of a large amount of computations. Matrix multiplication is one such primitive task, occurring in many systems—from neural networks to scientific computing routines. The automatic discovery of algorithms using machine learning offers the prospect of reaching beyond human

Grading guideline

- 0: no paper found with your name on it
- 1: paper found with your name on it
- 2: some scribbles
- 3: reasonable problem & solution
- 4: unique, interesting problem & solution
- 5: reserved for those exceptional

Term Project Paper

- Report about mathematical physics ideas or methodology being used in contemporary physics research or in daily applications.
- Due: Beginning of the class on **Dec. 1st**
(**10 page-limit** including cover/reference; typewritten report okay)



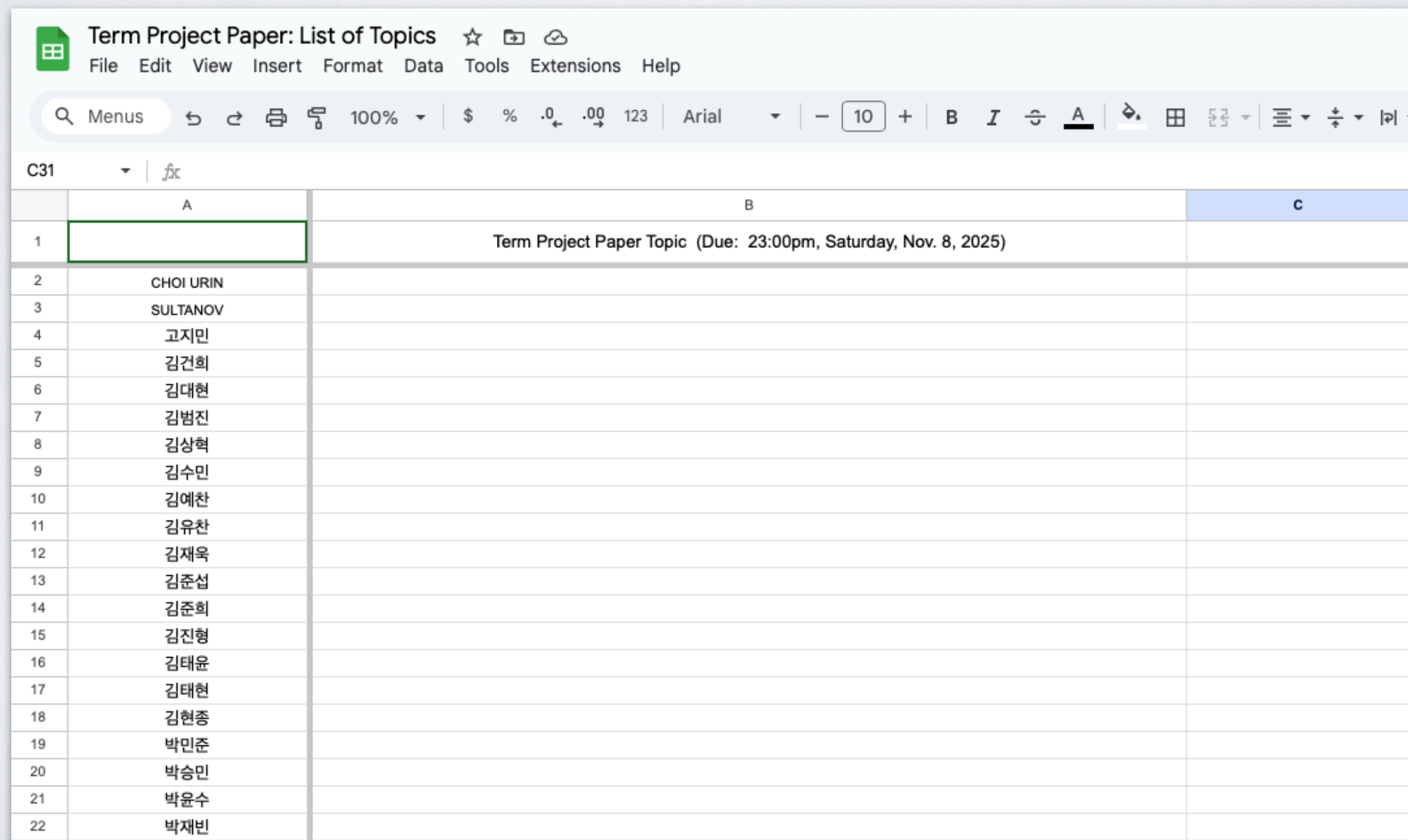
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Term Project Paper

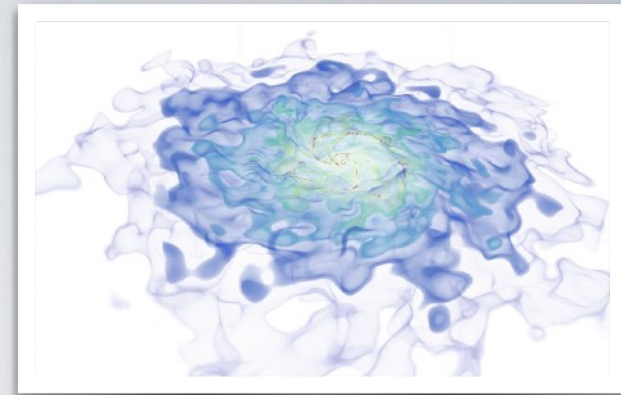
- **Post your topic by 23:00 pm, Nov. 8 (Sat)** on a shared Google document below (expect late penalty of -0.5 pt/day):

<https://docs.google.com/spreadsheets/d/1I7yyzo6Zp6dISAU5C7gyoNI03kjj8IM90b2MImP86yE>



The screenshot shows a Google Sheet interface. The title bar reads 'Term Project Paper: List of Topics'. The menu bar includes 'File', 'Edit', 'View', 'Insert', 'Format', 'Data', 'Tools', 'Extensions', and 'Help'. The toolbar shows various icons for undo, redo, copy, paste, and formatting. The spreadsheet has three columns: A, B, and C. Column A contains a list of names, and column B contains the topic title. Column C is empty. The first row (row 1) is highlighted in blue and contains the text 'Term Project Paper Topic (Due: 23:00pm, Saturday, Nov. 8, 2025)'. The subsequent rows (rows 2-22) contain names in column A and are empty in column B.

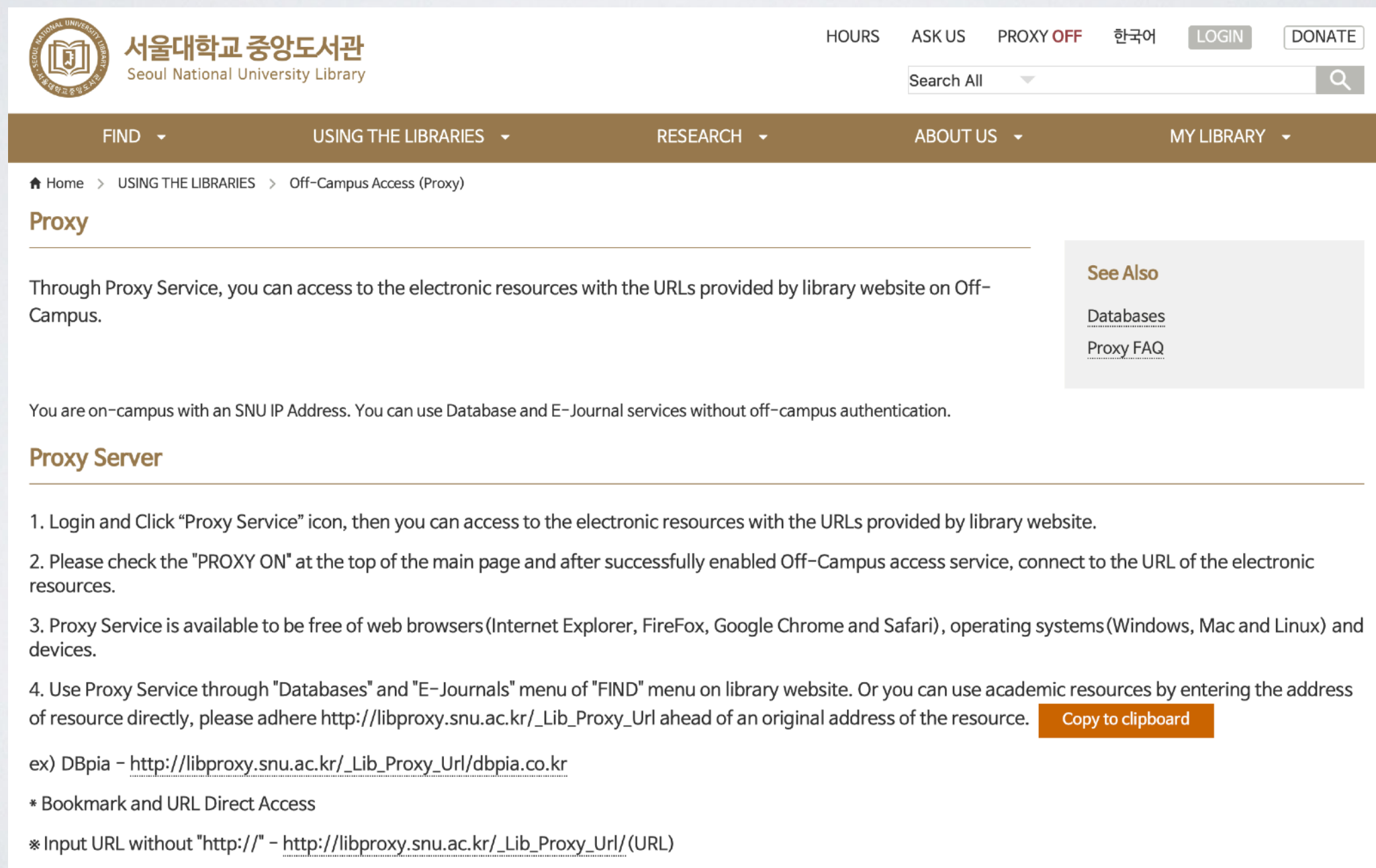
	A	B	C
1		Term Project Paper Topic (Due: 23:00pm, Saturday, Nov. 8, 2025)	
2	CHOI URIN		
3	SULTANOV		
4	고지민		
5	김건희		
6	김대현		
7	김범진		
8	김상혁		
9	김수민		
10	김예찬		
11	김유찬		
12	김재욱		
13	김준섭		
14	김준희		
15	김진형		
16	김태윤		
17	김태현		
18	김현종		
19	박민준		
20	박승민		
21	박윤수		
22	박재빈		



Quantity Doesn't Guarantee Quality!

Electronic Resources via SNU Library

- To access e.g., academic journals off-campus via SNU library's proxy service, visit library.snu.ac.kr/using/proxy.



The screenshot shows the Seoul National University Library website. The header includes the library logo, name in Korean and English, and navigation links for HOURS, ASK US, PROXY OFF, 한국어, LOGIN, and DONATE. A search bar is also present. The main navigation menu includes FIND, USING THE LIBRARIES, RESEARCH, ABOUT US, and MY LIBRARY. The breadcrumb trail indicates the current location: Home > USING THE LIBRARIES > Off-Campus Access (Proxy). The page title is "Proxy". The main content explains that the Proxy Service allows access to electronic resources with library-provided URLs on off-campus. It notes that on-campus users with SNU IP addresses can use database and e-journal services without authentication. A "See Also" sidebar lists "Databases" and "Proxy FAQ". The "Proxy Server" section provides a four-step guide: 1. Login and click "Proxy Service". 2. Check "PROXY ON" and connect to the resource URL. 3. Note that the service is available on various browsers and operating systems. 4. Use the service through "Databases" and "E-Journals" or directly by adding the proxy URL to the resource address. An example is given for DBpia. A "Copy to clipboard" button is provided for the example URL. Additional instructions include bookmarking the proxy URL and inputting it without "http://".

서울대학교 중앙도서관
Seoul National University Library

HOURS ASK US PROXY OFF 한국어 LOGIN DONATE

Search All

FIND USING THE LIBRARIES RESEARCH ABOUT US MY LIBRARY

Home > USING THE LIBRARIES > Off-Campus Access (Proxy)

Proxy

Through Proxy Service, you can access to the electronic resources with the URLs provided by library website on Off-Campus.

You are on-campus with an SNU IP Address. You can use Database and E-Journal services without off-campus authentication.

Proxy Server

1. Login and Click "Proxy Service" icon, then you can access to the electronic resources with the URLs provided by library website.
2. Please check the "PROXY ON" at the top of the main page and after successfully enabled Off-Campus access service, connect to the URL of the electronic resources.
3. Proxy Service is available to be free of web browsers (Internet Explorer, FireFox, Google Chrome and Safari), operating systems (Windows, Mac and Linux) and devices.
4. Use Proxy Service through "Databases" and "E-Journals" menu of "FIND" menu on library website. Or you can use academic resources by entering the address of resource directly, please adhere http://libproxy.snu.ac.kr/_Lib_Proxy_Url ahead of an original address of the resource. [Copy to clipboard](#)

ex) DBpia - http://libproxy.snu.ac.kr/_Lib_Proxy_Url/dbpia.co.kr

* Bookmark and URL Direct Access

※ Input URL without "http://" - [http://libproxy.snu.ac.kr/_Lib_Proxy_Url/\(URL\)](http://libproxy.snu.ac.kr/_Lib_Proxy_Url/(URL))

See Also

- Databases
- Proxy FAQ

Resources via SNU Liberal Education

- To access e.g., academic journals off-campus via SNU library's proxy service, visit library.snu.ac.kr/using/proxy.

The image displays two overlapping browser windows showing SNU Liberal Education resources.

Left Window (liberaledu.snu.ac.kr/글쓰기-클리닉/):

- Header: 서울대학교 기초교육원 (Faculty of Liberal Education)
- Navigation: 교양교육과정, 자율연구, 교육·학생지원, 교수학습센터, 글쓰기센터, 정보
- Section: 글쓰기 프로그램 (Writing Program)
- Sub-section: 글쓰기 클리닉 (Writing Clinic)
- Content: 글쓰기 능력 향상 프로그램 (Writing Ability Improvement Program)
- Text: 방학 기간 중 튜터와의 일대일 대면 지도를 통해 자신의 글쓰기 능력을 향상시킬 수 있도록 마련된 프로그램입니다. 튜터로부터 자신의 글쓰기 습관에 맞는 글쓰기 과제를 부여 받아 작성하는 과정을 통해 글쓰기에 대한 자신감을 키울 수 있습니다.
- Text: ※ 이 프로그램을 성실하게 이수한 학생에게는 이수증이 발급됩니다.
- Text: · 신청 대상: 학부 및 대학원생(외국인 학생은 '외국인 글쓰기 지도 프로그램'을 이용해 주세요.)
- Text: · 신청 방법: 서울대학교 포털 홈페이지(<https://my.snu.ac.kr>) → 상단의 '비교과'(<https://extra.snu.ac.kr>) → '글쓰기 능력향상 프로그램' 검색

Right Window (owl.snu.ac.kr/글쓰기-길잡이/):

- Header: 온라인 글쓰기교실 (ONLINE WRITING LAB)
- Navigation: 글쓰기 길잡이, 아카이브, 블로그, 공지사항, 추천 링크, 글쓰기 FAQ
- Section: 글쓰기 길잡이 (Writing Guide)
- Text: 서울대학교 온라인 글쓰기교실 글쓰기 길잡이 코너입니다
- Text: 글쓰기가 막막할 때 글쓰기의 시작부터 마무리까지 도움이 되는 길잡이로 참고하실 수 있습니다
- Grid of Topics:

글쓰기 시작하기	글쓰기 전개하기	글쓰기 마무리하기	종류별 글쓰기
→ 대학에서의 글쓰기	→ 논증하기	→ 인용하기와 인용 출처 표기하기	→ 논문 쓰기
→ 과제 이해하기	→ 설명하기	→ 수정하기	→ 서평 쓰기
→ 주제 찾기	→ 문제해결하기	→ 마무리하기	→ 학술 에세이 쓰기
→ 주제문과 개요 작성하기			→ 비평적 글쓰기

Footer: <https://liberaledu.snu.ac.kr>

Student Honor Code

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HOME > NEWS > ALL NEWS > AS SCIENTISTS EXPLORE AI-WRITTEN TEXT, JOURNALS HAMMER OUT POLICIES

NEWS | SCIENTIFIC COMMUNITY

As scientists explore AI-written text, journals hammer out policies

Many ask authors to disclose use of ChatGPT and other generative artificial intelligence

22 FEB 2023 • 1:35 PM • BY [JEFFREY BRAINARD](#)

SHARE:

One concern for journal managers is accuracy. If the software hasn't been exposed to enough training data to generate a correct response, it will often fabricate an answer, computer scientists have found. In November, Meta took down the public interface for Galactica, its scientist-specific large language model, just days after it was unveiled—users had identified myriad factual errors in the generated text. And a [2022 preprint study of Sparrow, an information-seeking chatbot developed by a Google subsidiary, found that up to 20% of its responses contained errors](#). AI text may also be biased toward established scientific ideas and hypotheses contained in the content on which the algorithms were trained. Journal editors also worry about ethics, suggesting authors who use text generators are sometimes presenting the outputs as if they wrote them—a transgression others have dubbed “aigiarism.”

Many journals' new policies require that authors disclose use of text-generating tools and ban listing a large language model such as ChatGPT as a co-author, to underscore the human author's responsibility for ensuring the text's accuracy. That is the case for [Nature and all Springer Nature journals, the JAMA Network](#), and groups that advise on best practices in publishing, such as the [Committee on Publication Ethics](#) and the [World Association of Medical Editors](#). But at least one publisher has taken a tougher line: [The Science family of journals announced a complete ban on generated text last month](#). The journals may loosen the policy in the future depending on what the scientific community decides is acceptable use of the text generators, Editor-in-Chief Holden Thorp says. “It's a lot easier to loosen our criteria than it is to tighten them.”

www.science.org

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