

Things you can not do with usual chalk

Online teaching with Zoom, iPad & YouTube

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These slides and all the videos/lecture materials can be found on my homepage:

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Some context

Who am I?

Since October 2019 Associate Professor in the G30 Program.

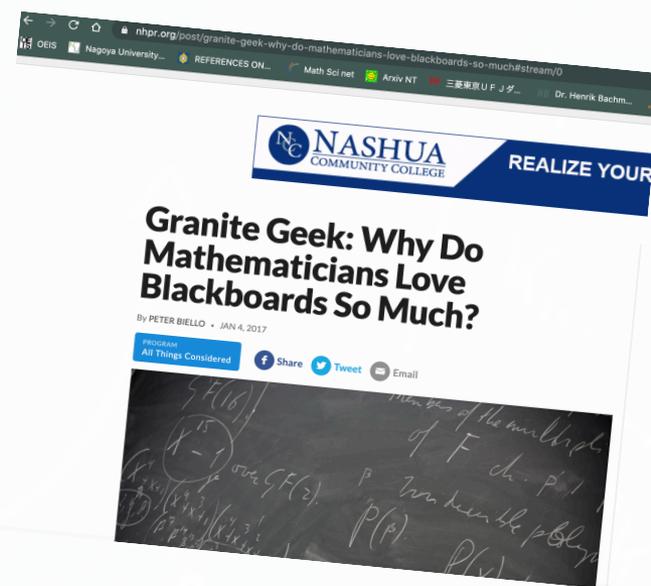
What were my teaching duties? (Spring 2020)

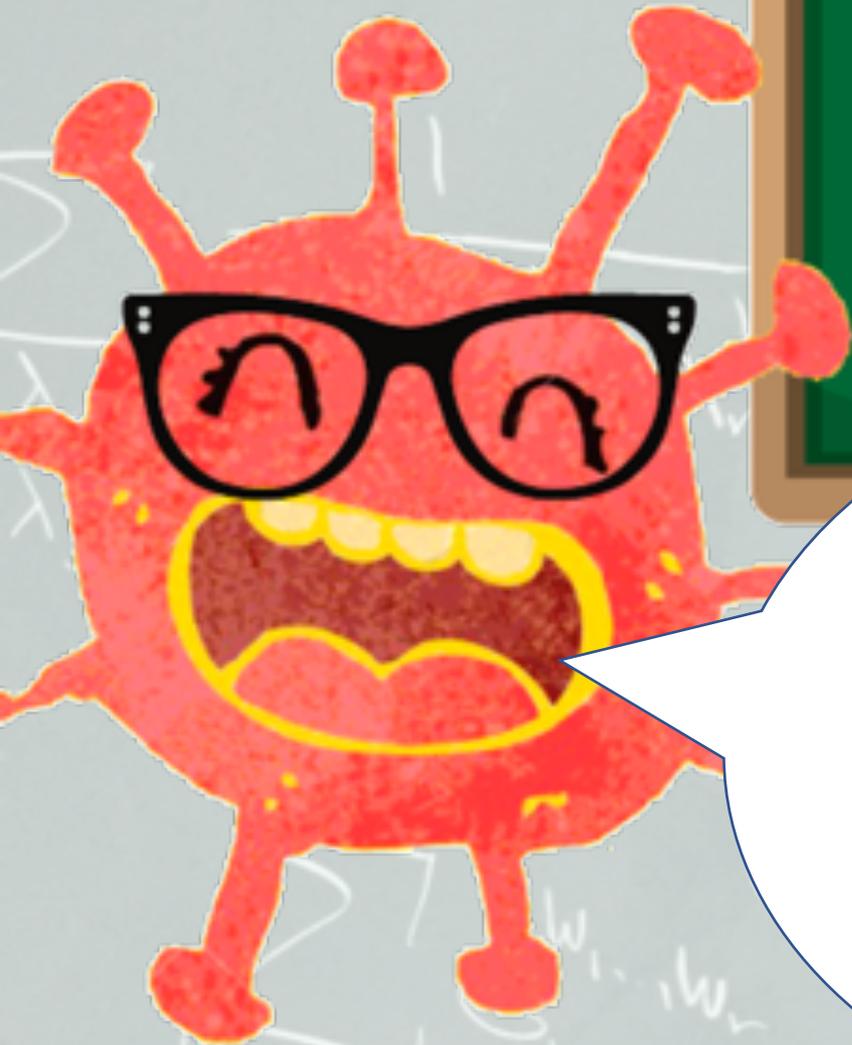
1. Teaching undergraduate mathematics courses in the G30 Program
(Linear Algebra II + Tutorial)
2. Graduate course in the Graduate school of Mathematics
(My first graduate course ever)

What would have been the “classical” teaching method?

For mathematics: Blackboard!

- Blackboards are terrific
- **The best tool to develop a thought to a class**
- They always work
- **They slow down the speaker enough to get the ideas across clearly**





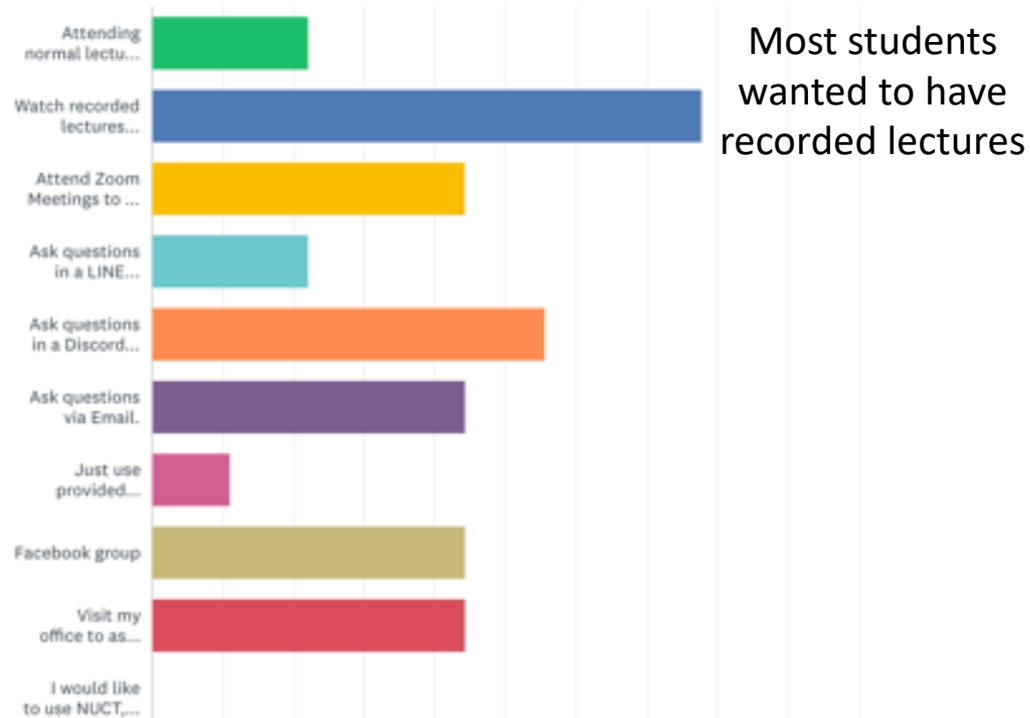
But what if a
classical face-to-face
blackboard lecture is
not possible ?!

What did the students want?

SurveyMonkey (<https://www.surveymonkey.com/>)

Which of the following options would you use if offered? (multiple choices are possible)

Answered: 9 Skipped: 0



But of course there should also be the possibility of asking questions and have live interactions!

What I did (there are probably a lot of other good/better ways!)

Linear Algebra II + Tutorial (G30 undergraduate course)

- Record one lecture (~60min) each week (YouTube)
- Have a 45min Zoom meeting (Tutorial) each week
- Provide lecture notes & overview notes
- Homework assignments via NUCT
- Exam via Zoom

Multiple zeta values & modular forms (graduate course)

- Give a 90min Zoom lecture each week
- Record one lecture (~60min) each week (YouTube)
- Write lecture notes
- Grades were based on one written homework assignment

Share materials via homepage

Course schedule:

The following gives a tentative overview of the topics we will cover each week.

Week 01 (04/20-04/26): Vector spaces (Notes: Lecture 1, Videos: Lecture 1-1, Lecture 1-2, Homework: HW1)

Week 02 (04/27-05/01): Linear maps (Notes: Lecture 2, Video: Lecture 2, Homework: HW2)

Golden week

Week 03 (05/11-05/17): The matrix of a linear map (Notes: Lecture 3, Video: Lecture 3, Homework: HW3)

Week 04 (05/18-05/24): Determinants & Mathematical induction (Notes: Lecture 4, Video: Lecture 4, Homework: HW4)

Week 05 (05/25-05/31): Properties of the determinant I (Notes: Lecture 5, Video: Lecture 5, Homework: HW5)

Week 06 (06/01-06/07): Properties of the determinant II (Notes: Lecture 6, Video: Lecture 6, Homework: Recall Week 1-6)

Week 07 (06/08-06/14): Eigenvalues and eigenvectors I (Notes: Lecture 7, Video: Lecture 7, Homework: HW6)

Week 08 (06/15-06/21): Eigenvalues and eigenvectors II (Notes: Lecture 8, Video: Lecture 8, Homework: HW7)

Week 09 (06/22-06/28): Eigenvalues and eigenvectors III (Notes: Lecture 9, Video: Lecture 9, Homework: HW8)

Week 10 (06/29-07/05): Applications (Notes: Lecture 10, Video: Lecture 10, Homework: Play around in python)

Week 11 (07/06-07/12): Continuous dynamical systems (Notes: Lecture 11, Video: Lecture 11, Homework: Recall Week 7-10)

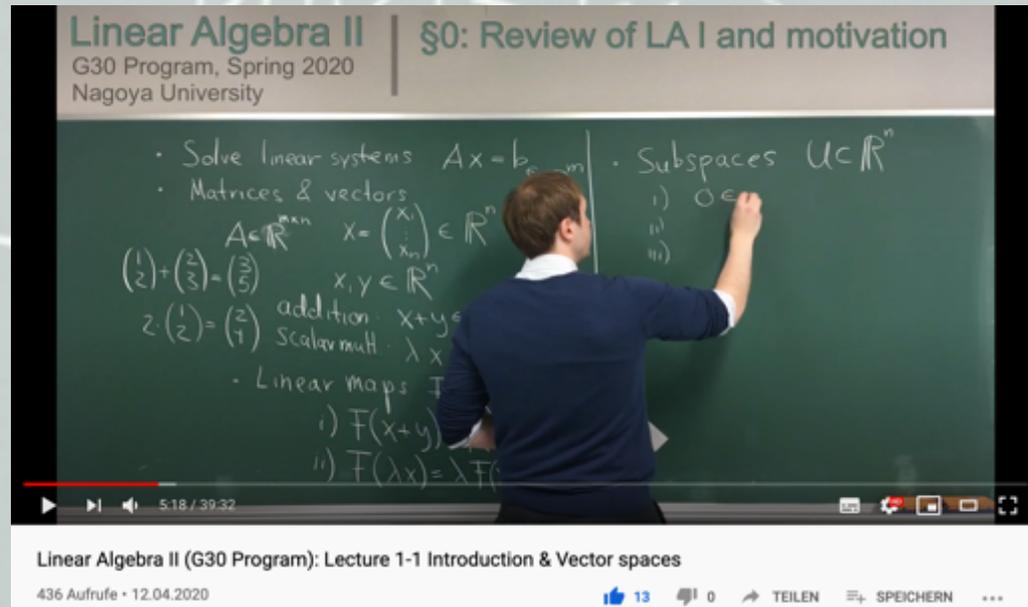
Week 12 (07/13-07/19): Linear differential equations I (Notes: Lecture 12, Video: Lecture 12, Homework: HW9)

Week 13 (07/20-07/26): Linear differential equations II (Notes: Lecture 13, Video: Lecture 13, Homework: Prepare for the exam)

Week 14 (07/27-08/02): Review (Review exercises, Video: Lecture 14)

Final Exam: 7th August: 17:45 - 19:00 Online via Zoom.

Beginning: Recording lecture in office

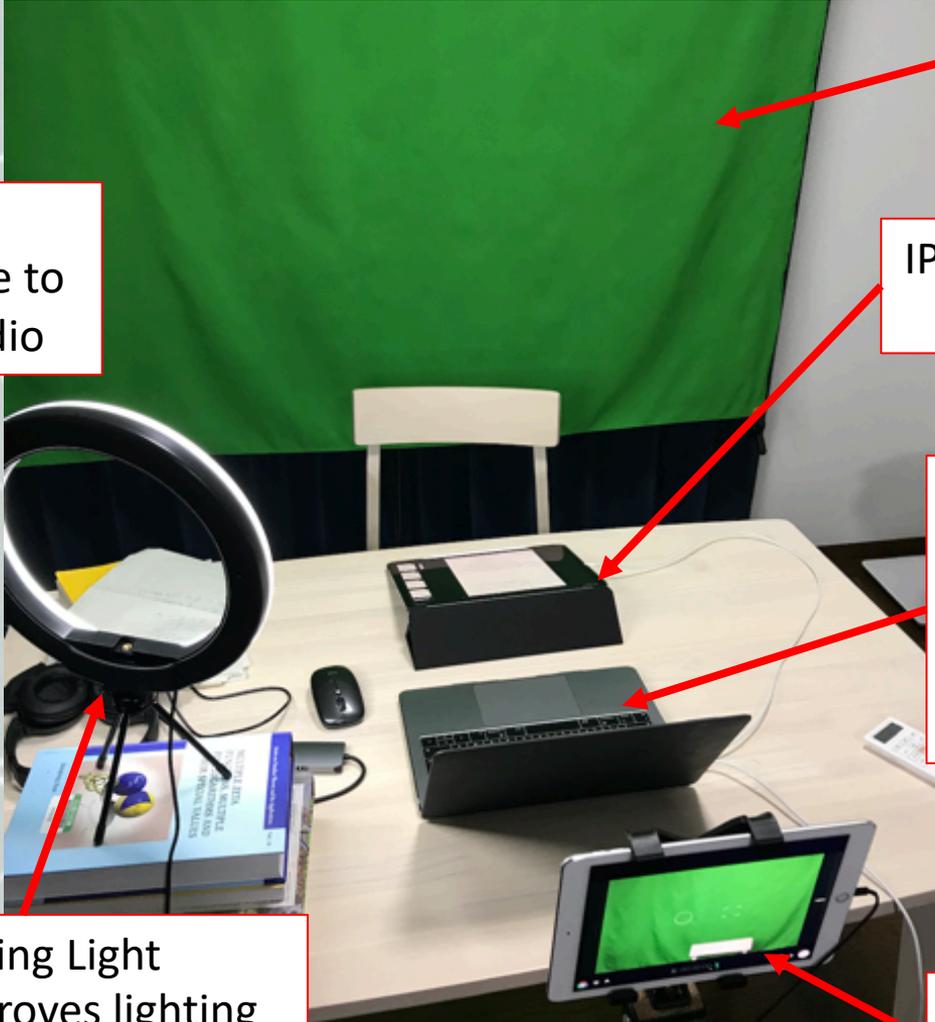


This did not bring any good new features and therefore I switched after two lectures to a home recording. (Also at this time we were not allowed to come to NU)

Record lecture from home: Hardware



Lavalier
microphone to
record audio



LED Ring Light
(really improves lighting
for videos/zoom)

Greenscreen
(~3000 yen at Amazon.jp)

IPad Pro + Apple Pencil 2 + Paperlike
(Feels natural to write!)

Macbook
(Used for Zoom & Doing
additional things on the laptop
during video recording, e.g.
screen recording)

Older iPad used as a camera
(any phone/camera would work)

Record lecture from home: **Software**

After recording:

Combine everything in **LumaFusion** on iPad
(Video editing software. Can remove
greenscreen by one click)

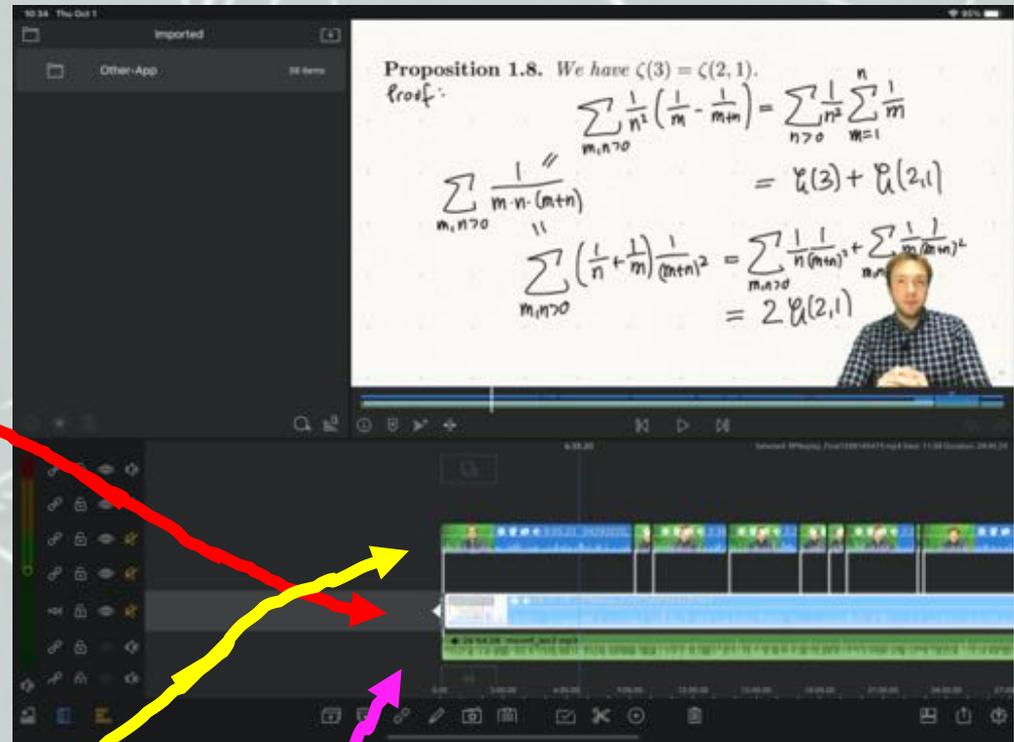
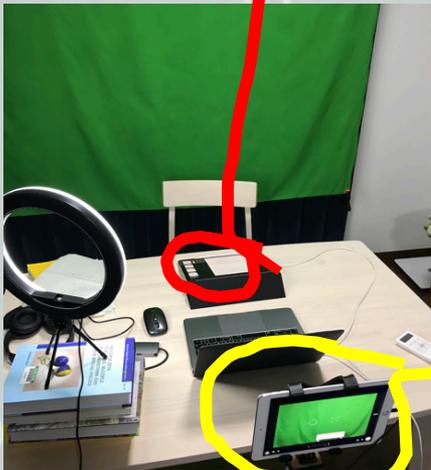
Linear Algebra II Lecture 5: Properties of Determinants I
- 630 Program - Spring 2020

$$A = (a_{i,j}) \in \mathbb{R}^{n \times n}$$
$$\det(A) = \sum_{\sigma \in S_n} \text{sign}(\sigma) \prod_{i=1}^n a_{i,\sigma(i)}$$
$$A = \begin{pmatrix} 1 & 2 & 3 \\ 8 & 7 & 9 \\ 11 & 10 & 1 \end{pmatrix}$$
$$P = \{(1,1), (2,2), (3,3)\}$$
$$= \{(1, \sigma(1)), (2, \sigma(2)), (3, \sigma(3))\}$$

Goal: A invertible $\Leftrightarrow \det(A) \neq 0$

$\text{sign}(\sigma) = \text{sign}(\sigma')$

iPad Notes taking: **Notability**
(also good: **Goodnotes**)



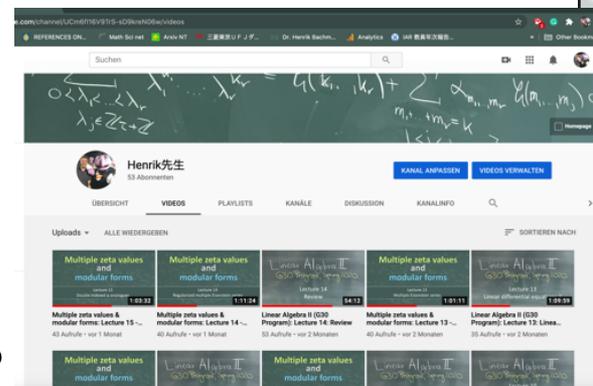
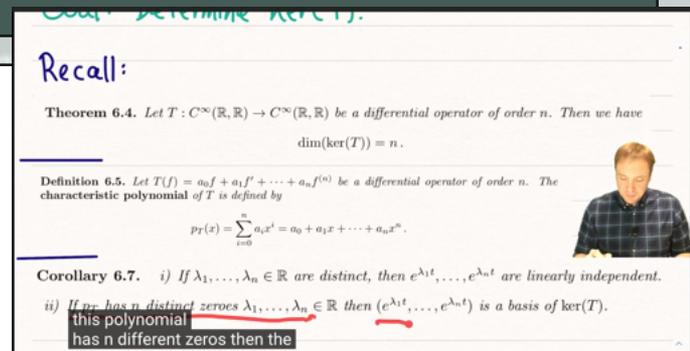
Audio recording: Noise cancellation
in **Audacity** (Macbook)

Why YouTube and not NUSS?

- YouTube is fast and scalable (quality gets adjusted to the internet speed)
- It supports automated subtitles and much more features
- It is just much better in every way when it comes to streaming

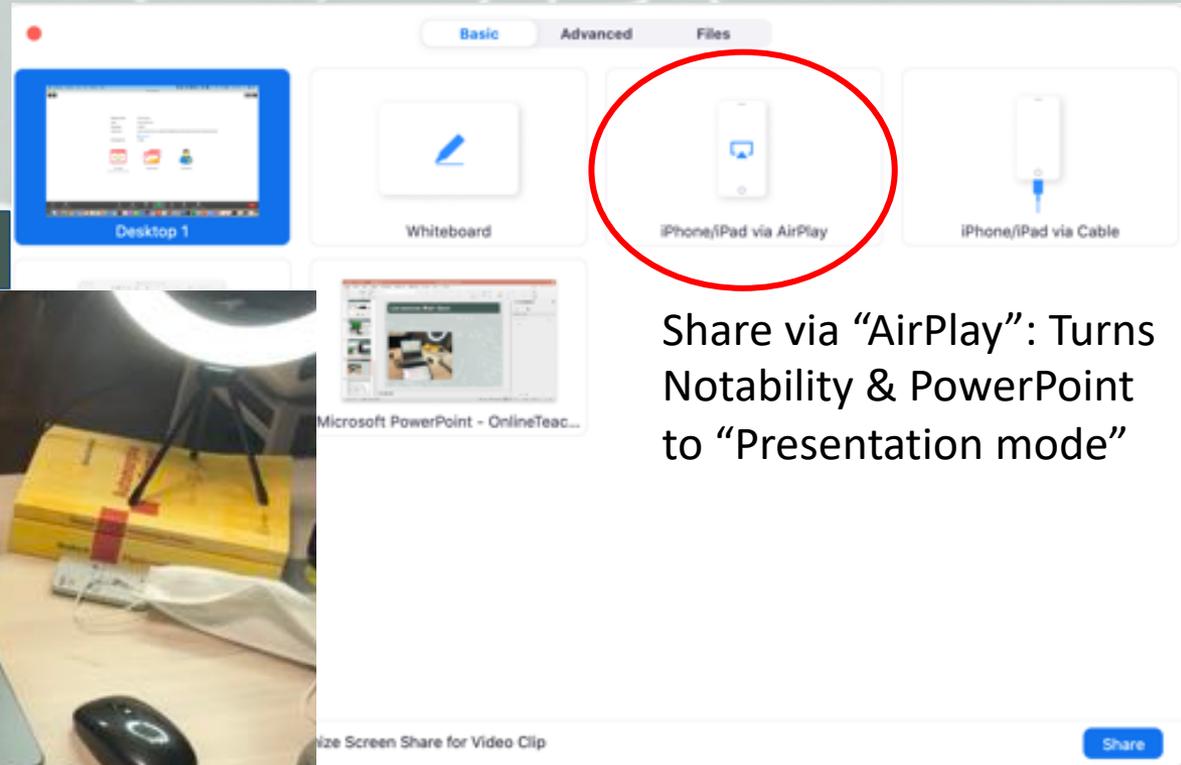
But then everyone can see my lectures??

It offers the option to put your videos “unlisted”. Then just people who have the link can watch the video.

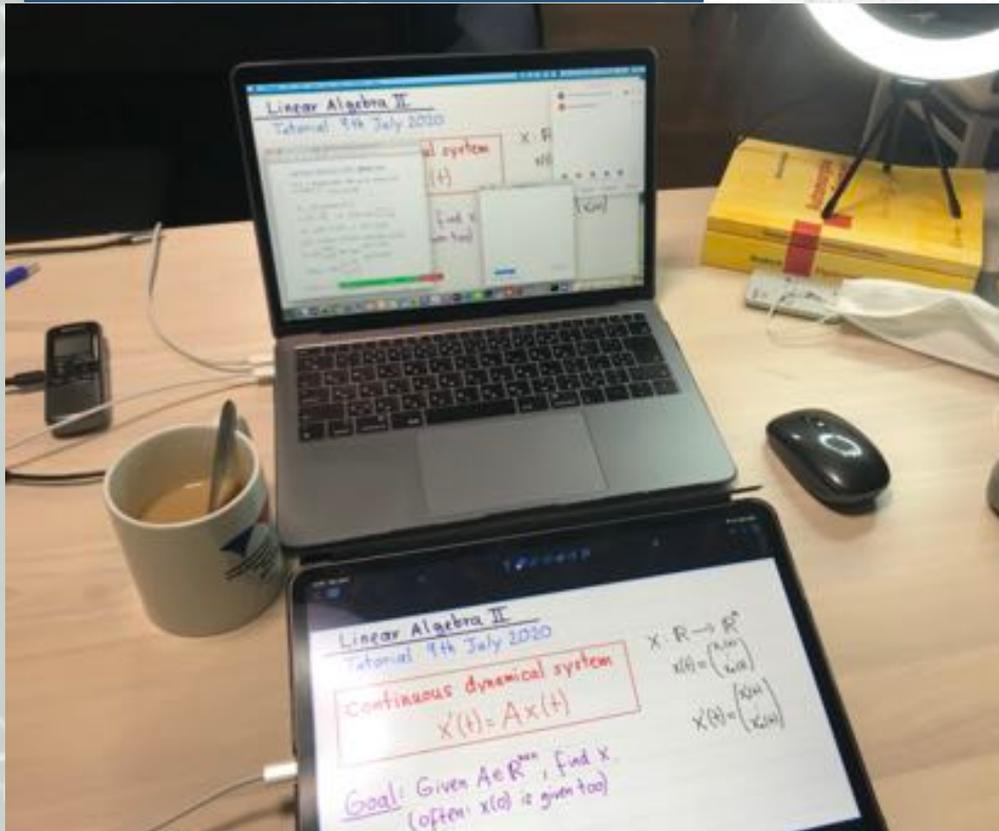


Live sessions: iPad + Zoom

On Macbook: **Zoom**



Share via “AirPlay”: Turns Notability & PowerPoint to “Presentation mode”



IPad Notes taking: **Notability**

Live sessions: iPad + Zoom

- Did quizzes during Zoom session.
Multiple choice questions & Answer via private chat from the students

Linear Algebra II
Tutorial 4th June 2020

Today: **Who wants to be a Linear Algebraist**

Rules:

- There will be up to 10 questions (if we have enough time)
- Roughly 3 minutes for each question.
- Each question has 4 possible answers (A,B,C,D) of which **multiple/all answers can be correct.**
- Write the solution to each question in the **private(!!)** chat to me like this: "Q5: A, B", if you think A and B is correct for **Question 5.**
- You might need to do small calculations. So be prepared to write down something.
- This is just for fun and it will not influence your grade. I want to get an honest overview of the current knowledge. No need to cheat!



Question 2 Let V be a vector space and $U, W \subset V$ subspaces of V .

Which statements are true?

(A) $U \cup W$ is a subspace (B) $U \cap W$ is a subspace

(C) $\{u+w \mid u \in U, w \in W\}$ is a subspace (D) $V \setminus U = \{v \in V \mid v \notin U\}$ is a subspace.

- From week to week the students got more relaxed and participated (and showed their faces) more and more.

Positive things about online teaching

Of course, I missed it a lot to see my students sitting in the same room....

But there are also some positive aspects:

- Possibility to include different media (webpages, doing a bit programming, showing pictures/videos).
- The students could decide the time when watching the lecture.
- Students could pause the lecture at certain points.

Online lectures are international: Anyone can attend!

- NU Students registered for my graduate course: 4
- Student attending my lecture: 15 (coming from China, Europe, Africa, Taiwan and several places around Japan) + several people watching my lectures on YouTube and contacting me by mail.
- I am now supervising two students in Germany who are writing a Bachelor & Master thesis on a topic related to my lecture.

(teaching from the well cooled living room during the hot summer was also nice)

Conclusion

- Online lectures should not just be an “offline lecture” put online.
- Try to use the new possibilities!
(e.g. allow anonymous questions by using for example <https://www.menti.com/>).
- Open your lecture to students outside of Nagoya! Your local students will benefit when discussing with other students around the world/Japan.
- Getting used to the online setup also helped me to work on my joint research projects with my collaborators outside of Nagoya.

Thank you very much for your attention!