

# TEACHING PORTFOLIO

LINDA FREY

## 1. TEACHING PHILOSOPHY

I started teaching math when I was eleven years old. Ever since then I enjoy teaching math. I deeply believe that the only way to learn math is by doing math. Therefore I always plan my exercise lessons such that the students can present their work and explain it to the other students.

I am always very interested in the ways that other people teach math and talk very much about the topic. I want to develop my teaching skills by learning from other people and extract the best from their techniques.

In advanced lectures I like to treat recent topics in research to show the students the up-to-dateness of math.

## 2. SHORT TEACHING BIOGRAPHY

- 2009, Mainz: I began university teaching in my fourth semester (exercises in Math for computer scientists I)
- 2009 - 2012, Mainz, Zürich: I continued teaching exercise lessons every semester until I started with the PhD
- 2012 - 2018, Frankfurt, Darmstadt, Basel: during the PhD I mainly gave seminars (where the students have to work out a topic and present their work), co-supervised some Bachelor's theses and later on again held exercise lessons
- 2017, Basel: when I held the exercise lessons for Lineare Algebra II in Basel, I produced nine YouTube videos on the topic of eigenvectors and Jordan Normal Form
- 2018, Copenhagen: directly after my PhD I gave a lecture for Master and PhD students
- 2009 - today: experience in all levels from bachelor to PhD students

## 3. TEACHING PRACTICE

In 2017 I gave the exercise lessons for Lineare Algebra II in Basel and produced nine (publicly available) videos for the students to revise the theory of eigenvectors and Jordan Normal Form (see my YouTube channel: [www.youtube.com/c/LindaFrey](http://www.youtube.com/c/LindaFrey)). I also produced (publicly available) a web-browser based program to produce nice exercises for computing Jordan Normal Forms (see [www.lorifan.de](http://www.lorifan.de) and the screenshot in the appendix). The students gave me the feedback that both helped them very much when preparing for the exams. In the same year I also gave the students the possibility to contact me via WhatsApp and voice messages to ask questions that

are not easily put into an e-mail. When one students asked something about the representing matrix for a bilinear form, it was very helpful to answer that question via drawn pictures and voice messages. That way the student and I did not have to meet in real life (which would have wasted some travel time).

When I produced the videos, the director advised me to make the videos at most ten minutes long since the attention span of most people is exceeded by longer videos. The same basically holds for lectures. I want to have more breaks or switches between active and passive parts in my lectures to keep my students' attention.

In the exercise lessons of Elliptische Kurven II, I had a student who could not attend the exercise lessons because her child was not in day care at that time of day. I did the exercise lessons with her exclusively, via Skype.

As a student I was always very happy when the lecturer published their lecture notes. There are different learning types. Most people learn best by experiencing or explaining to others. In a lecture where someone stands in front and explains the topic neither is an option. Some people have to decide whether they want to write down what is on the blackboard or listen to the explanations. By providing sufficient lecture notes I give the students the choice. For my lecture Topics in Number Theory I provided the students with the lectures notes and I plan to do this for all my lectures. As a Bachelor student I teXed the lecture notes for Functional Analysis in one semester (as a paid task given by the lecturer).

One of my tools is a question hour or question day shortly before the exam, held by a teaching assistant. In that session the teaching assistant can recapitulate the most important topics and the students get the chance to ask questions. Since most students advance a lot between the last lecture and the exam, this question session should not be too early. Also, since some students fear asking the professor seemingly stupid questions, the question session should be held by an assistant.

Mathematics is a field that has to be understood, not learned by hard. I am a big fan of giving the students the possibility to take a hand written piece of paper to the lecture. This gives them the chance to not need to learn everything by hard, but to get an overview of what is important and how everything links together.

For the students it is very important to know the criteria of the grading of the exams. For both oral and written exams I want to tell them in advance very transparently what is necessary in order to pass and how the grading scale is made. A good tool for that will be mock exams (written and oral) to give the students a chance of knowing what is expected.

#### 4. TEACHING COMPETENCE DEVELOPMENT

In 2013 I have started the Hochschulzertifikat Lehre at TU Darmstadt. Unfortunately, when my PhD advisor and I moved to Basel, I could not continue the program. I am convinced that academic teaching should be viewed as an evidence-based science and am eager to learn more about psychological foundations of teaching and various

teaching techniques in the future.

The exercise lessons in Basel used to be totally teacher-centered which I did not like. I introduced student-centered teaching in my exercise lessons and convinced some other assistants that this way of teaching is better for the students. The former way was that the teacher presents the results/solutions of the exercise sheet. I changed it like this: In the beginning of the exercise lesson I would write a table on the blackboard with the numbers of the exercises and next to those the names of the students who solved them well. For every exercise one of those students voluntarily came to the blackboard and showed their own solution to the others. I convinced the professor (who is a real fan of teacher-centered exercise lessons) that they can get extra credit (just like they get for solving the exercise sheets and handing them in) for showing their solutions to the others. But I am sure that this method is also possible without any extra credits given as an incentive. This way of having the exercise lessons stimulates peer-to-peer communication which can make the passive learning of lectures more effective. This also allows students to learn from the exercise sheets even if they copied solutions from other students.

In addition to the evaluations that are usually realized by the university, I usually let the students evaluate me with my own questions. Often the university's questions are no help for me - I don't need to know whether a first year student thinks I have enough knowledge in Lineare Algebra I. I need to know whether the students hesitate to ask questions or if they liked my way of explaining the topics. I use the evaluation to continuously improve my teaching.

## 5. TEACHING PERSPECTIVES

One of my main goals in teaching has always been pushing e-learning techniques. Even before the pandemic I have been convinced that we need to take advantage of e-learning techniques in addition to presence learning techniques. I am convinced that a good e-learning offer will never substitute teaching staff but it will definitely improve the students' learning experience.

## 6. APPENDIX A: TEACHING EXPERIENCE IN A TABLE

10/2018 onwards University of Copenhagen Denmark	Topics in Number Theory (4+2 lecture; approx. 8 master and PhD students, contact Fabien Pazuki for details)
09/2015 to 06/2018 Universität Basel Switzerland	Elliptische Kurven II (exercise lessons and sometimes substitution of the lecturer; approx. 5 master students) Schülerseminar (twice; approx. 10 high school students) Lineare Algebra II (exercise lessons; approx. 20 bachelor students)
04/2013 to 07/2014 TU Darmstadt Germany	Seminar Kategorientheorie (approx. 10 bachelor and master students) Co-supervised Bachelor theses

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10/2012 to 02/2013 Goethe Universität Frankfurt Germany	Seminar Höhentheorie (approx. 10 bachelor students)
09/2011 to 06/2012 ETH Zürich Switzerland	Linear Algebra I (exercise lessons; approx. 20 bachelor students) Grundlagen der Mathematik II (exercise lessons; approx. 20 bachelor students)
10/2009 to 08/2011 Universität Mainz Germany	Mathematik für Informatiker I (exercise lessons; approx. 20 bachelor students) Lineare Algebra I (twice) (exercise lessons; approx. 20 bachelor students) Lineare Algebra II (exercise lessons; approx. 20 bachelor students)

## 7. APPENDIX B: JORDAN NORMAL FORM EXERCISE GENERATOR (SCREENSHOT)

### Jordan Normal Form Exercise Generator

The following program gives you an integral  $n$  by  $n$  matrix with eigenvalues in the Gaussian integers (that is  $Z[i]$ ) where the real and imaginary part are in the interval  $[-m, m]$ . You can change  $n$  and  $m$  by editing the code below. You can make the eigenvalues non-complex by replacing the  $1/2$  in the first if-query by one or force them all to be complex by replacing it by zero.

```

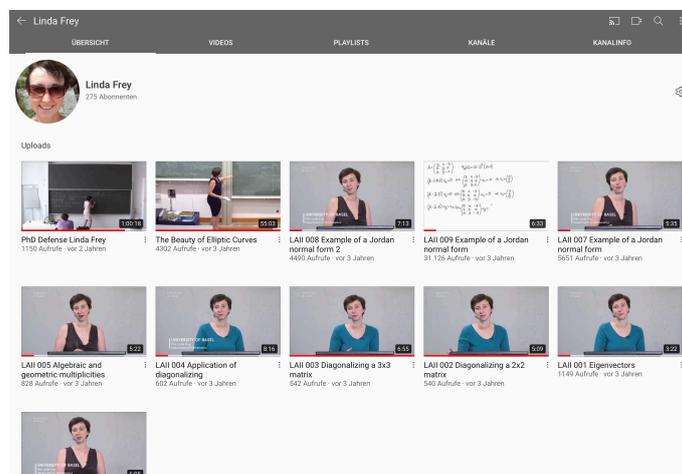
1 n = 5 #number of rows of the matrix
2 m = 6 #the eigenvalues are in the interval [-m,m]
3 R.<I> = QuotientRing(QQ[I], QQ[I].ideal(I^2 + 1));
4 M = MatrixSpace(R, n,n)
5 i = 0
6 A = M(zero_matrix(R,n,n))
7 while i < n:
8     p = random()
9     if (p > 1/2 and (n-i>=2)):

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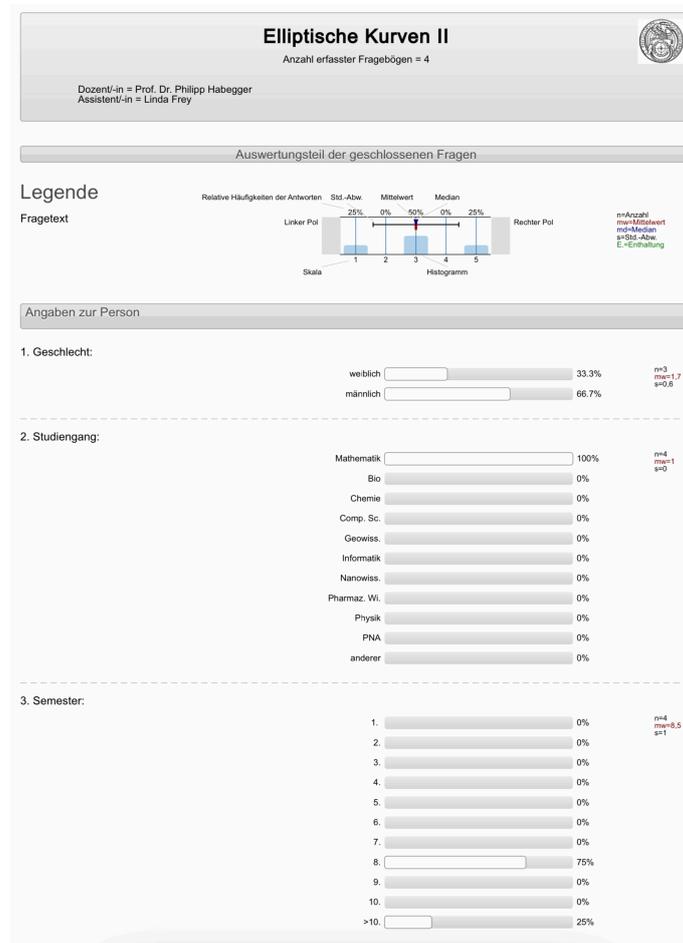
Give me a beautiful matrix

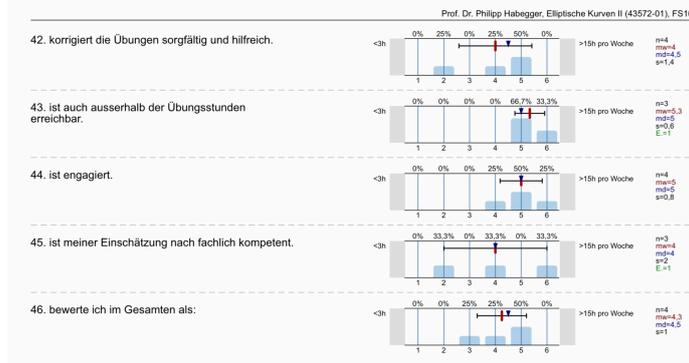
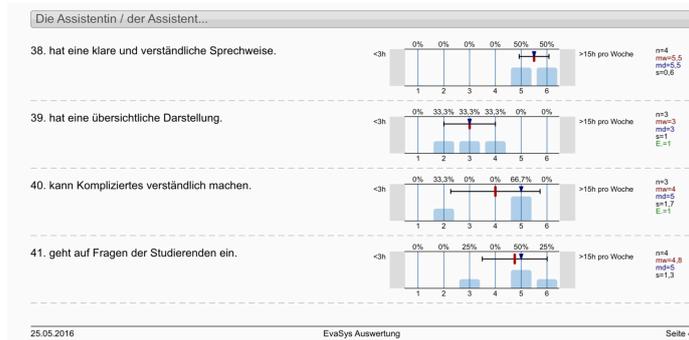
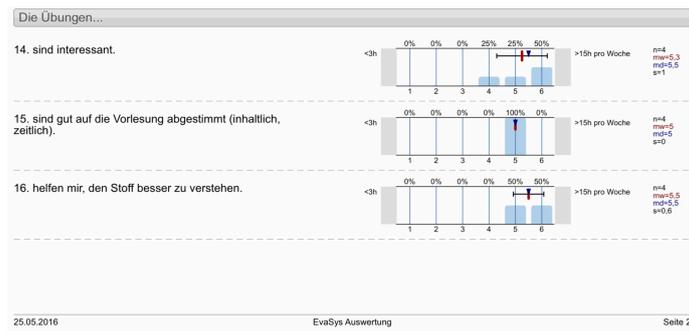
Since I had problems with the comments in this [SageMathCell](#), I deleted them. You can find the commented sourcecode [here](#) as a public project in the SageMathCloud.

## 8. APPENDIX C: YOUTUBE CHANNEL



## 9. APPENDIX D: EVALUATION ELLIPTISCHE KURVEN II (EXERCISE LESSON)





49. Ich finde an den Übungen besonders gut:

Musterlösungen

- sind alle "lösbar"
- gut passen zur Vorlesung
- Musterlösungen

- Musterlösungen
- grundsätzlich Videos (für wenn man nicht da ist)

- 1 selbst vorlesen

50. Ich finde, an den Übungen könnte verbessert werden (Erläuterungen/Verbesserungsvorschläge):

25.05.2016

EvaSys Auswertung

Seite 9

50. Ich finde, an den Übungen könnte verbessert werden (Erläuterungen/Verbesserungsvorschläge):

25.05.2016

EvaSys Auswertung

Seite 1

Prof. Dr. Philipp Habegger, Elliptische Kurven II (43572-01), FS11

~~Zeitpunkt~~

- Zeitpunkt

- kontinuierlich Videos (nicht einmal ja, einmal nein als ich einmal nicht da war gabs da plötzlich keines)
- Nicht alles nur von Studierenden vorlesen lassen, sondern auch mal schön andere Ansätze zu sehen
- 8-10 zu früh
- alternative Lösungswege sehen (bei Aufgaben die alle richtig lösen)