Teaching Portfolio

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September 2024

"To teach is to learn twice." - Joseph Joubert

Contents

1 Teaching Philosophy

In academic teaching, I see *self-motivation* as a key factor of the learning process. I strongly believe that motivation should be fostered and rewarded, as deep learning can only be achieved intrinsically rather than extrinsically (e.g., grades). My teaching philosophy is guided by the **self-determination theory** [16]. Hence, teachers should foster the three psychological needs of autonomy, competence, and relatedness in their students. Here, I briefly present my interpretation of how these needs relate to teaching.

Autonomy requires enough *freedom* for students to flourish. For instance, when developing strategies for problem-solving, individual students or student groups should have the opportunity to choose their own problems in order to tackle and/or develop their own solutions to the problem at hand. Knowledge acquisition is a process that can only happen on the side of the learner rather than happening purely through mediation or instruction. Hence, the teacher takes on the role of a **guide** who should strive to empower their students by providing *direction*. Teachers, thus, have a responsibility to provide necessary resources, e.g., in the form of their own time, while students have the responsibility to use these resources wisely.

Competence is acquired by striving toward *mastery*. Here, the removal of unnecessary barriers, e.g., by properly introducing the necessary tools and processes, is essential for fostering a setting wherein deep knowledge in a particular subject is gained. The teacher needs to be an **expert** within the task to *assess* the outcome by providing feedback and grades. As mastery is the goal, the assessment should at least aim at the highest level of the learning taxonomy [4] to create original work whenever applicable. For example, students could design and develop their own systems within projects, which they should be able to defend. By adhering to a constructive alignment with careful consideration of the assessment forms, students are forced to learn such that they achieve the learning outcome, thus aligning their mutual interests.

Relatedness needs to be established by *connecting* to the course matter. Students are often hesitant to learn if the concepts being covered seem foreign to them. Therefore, the relevance and the benefits of learning the materials being covered in class need to be outlined clearly. The teacher acts as a **role model**, one who is passionate about the subject and who also provides *personal* experiences, insights, and values. Consequently, a teacher must adhere to the same principles as they expect from their students to follow. For instance, when requiring transparency regarding source code, then the teacher should also release their code for teaching and research outcomes.

Additionally, I want to briefly demarcate my philosophy from traditional lecture-style teaching. I am not a fan of presenting facts for the purpose of students parroting them back. If this were sufficient, in my opinion, textbooks would solely be enough without need for a teacher. Nevertheless, some course formats still require that a teacher presents mainly in a plenum. However, the way that the course content is organized, through consideration of the three functions (guidance rather than instructing, constructively aligned assessment, and personal touch), allows for a more dynamic way of teaching and learning.

My teaching style is also heavily inspired by Jeremy Howard, especially his excellent "Practical Deep Learning for Coders" course (and book [9]). Most notably, my love for Jupyter as a teaching medium and its top-down approach is derived from his teaching style. His courses encourage students to find novel approaches to cutting-edge technologies, which is something I strive for as well.

2 Teaching Experience and Responsibilities

So far, my two main teaching responsibilities consist of the Advanced Information Retrieval (AIR) course and advising students on projects and theses. For the full list of teaching activities, refer to Appendix A.

The AIR course is the successor of the Web Technology course of which I was already involved, but with a greater focus on web search and other advanced retrieval topics. I was involved in the design of the AIR course led by Assoc. Prof. Dr. Elisabeth Lex. My main responsibilities within the course are the development of the two homework assignments, which are supported by the student assistants, and the practical project. Regarding the latter, I am directly responsible for providing support on student questions, whereas regarding the former, the student assistants are the first line of defense against student questions, I only get involved on the more challenging questions. I am also involved in the grading process of all assignments. Besides these more behind-the-scenes responsibilities, I also teach the more practically oriented lecture units, i.e., a tutorial on deep learning with PyTorch and two classes on Transformers for a more hands-on style of information retrieval. The Transformer classes are designed to be similarly structured to an IR experiment, which they should follow in their project.

Another important teaching area is the advisement of students in several projects, which typically result in subsequent theses. Here, I am responsible for the organization of the bi-weekly research meetings of the Social Computing and Recommender Systems lab, which all supervised students need to attend.

3 Teaching Approach

3.1 Teaching Principles

I have several teaching principles that support my stated teaching philosophy:

Top-down allows for quickly grasping the relevance of concepts and their application before knowing every detail. Subsequently, the granularity of detail increases to better understand concepts. This type of teaching is especially feasible nowadays, where the current models often depend on many small details but are still easy to understand on their own. Consider the Transformer architecture [18], which is easy to use on its own thanks to Huggingface [19], while the implementation details in PyTorch [13] are better preserved for more advanced users.

Personal Touch as a good presentation not only considers the content but also the audience and the presenter itself. This includes incorporating the experiences and opinions of students, as well as providing your own perspective and values.

Practice-oriented learning is best established by conducting projects as coursework. On the teaching side, it depends on the context. For academia, research-led teaching is effective, while for applied areas, industry insights might be more relevant. Students should be given objectives to strive for rather than closed-form questions or solutions. Like machine learning, the optimal solution is typically difficult or impossible to reach but can be iteratively approximated.

Research-informed Teaching as research and teaching should go hand in hand. Ideally, the lecture materials should be informed by the current state of the art in research.

Show not Tell whenever possible. Instead of telling students how to conduct a scientific experiment, incorporate it directly into the class itself.

Interactive classes, which can also occur in large settings. One way is to have interactive media, which does not need to consist of animations or videos. Instead, Jupyter is an interactive format that applies well to teaching and learning settings [5]. Jupyter is also closely related to the literate programming that was envisioned many years ago [12].

Bidirectional Learning as not only the students should benefit from teaching but the teacher as well, e.g., through encouraging critical questions, prompts for personal experiences, and letting students present their own solutions. Moreover, teachers should also learn from students and their experiences.

Open education is important for society. However, this does not end with open resources but also applies to the choice of tools and media. Therefore, open formats (especially simple text-based ones) such as Markdown are preferable to proprietary formats such as Word documents (to clarify, the file format is open; however, the standard requires a fee compared to a truly open format).

3.2 Teaching Practice

My teaching methods are tailored toward teaching computer and data science. Therefore, code is an integral part of problem solving. First, we consider computer science, where, traditionally, coding is initially taught theoretically, which then must be applied in practice by students. Even if code snippets are provided, the context is typically missing, which hinders proper learning. Instead, in my teaching design, the lectures revolve around code. This allows students to follow the steps in a more realistic way and allows them to directly run the code and adapt it at their own discretion.

Similarly, in machine learning or data science, courses often start with mathematical theory. However, the challenges that arise in practice are often very different (e.g., regarding the scaling of data, feedback loops, and data leaks). Therefore, rather than starting off with lots of theory, which is then hard put into practice, I want my students to get early hands-on experience.

Here, I briefly illustrate my teaching practice on the use of Jupyter Notebooks [11], which is my media of choice, followed by an example lecture unit that I designed as an executable presentation. In line with open education, the discussed materials along resources are openly available (see Appendix B). Also, in Appendix C, I provide a brief sample exam that I designed, including parts of the thought process.

3.2.1 Teaching Media: Jupyter 4 Teaching

Literate programming [12] was already envisioned by Knuth in 1984. I also believe that code interwoven with natural language fits perfect into a teaching setting — more so since artificial intelligence (AI) assistant tools blur the line between the two types of languages (i.e., programming and natural languages). Presently, I see Jupyter Notebooks as the most advanced medium in this regard. You can tell an easy-to-grasp story by sequentially presenting either Markdown (i.e., formatted text) or code cells directly out of the Jupyter Notebook itself. This fact is already well known, as it is supported by a complete handbook that discusses Jupyter's teaching and learning applications [5]. The handbook discusses the various ways and formats that Jupyter Notebooks can be used for educational purposes, such as textbooks and worksheets. However, my experience has shown that this plain mode of "Shift-Enter for the win" is subpar for presenting in class. Therefore, one has to make use of the vast ecosystem surrounding Jupyter and other executable notebooks (e.g., R Markdown [3]).

One tool that supports presenting from Jupyter is the RISE (derived from Reveal.js - Jupyter/IPython Slideshow Extension)[1]. RISE allows one to present the cells as slides, while allowing the customization of the role a cell serves via its metadata. In RISE, a cell can serve as a slide, subslide, or fragment on a slide; however, it can also be skipped or act as speaker notes. The cells are still executable (although I would not recommend relying on this fact due to Murphy's law). Additional features, such as a virtual chalkboard from reveal.js (i.e., the underlying presentation framework[2]), allow for an exceptionally interactive presentation style. In case anything goes wrong, you can export the slides to PDF in advance as a backup.

We know it is advantageous to have static slides to avoid unexpected issues during presentations. Therefore, another alternative is Quarto [2], which allows the conversion from executable notebooks to various other formats. Like RISE, Quarto allows the creation of reveal.js slides but without the live coding capabilities. We likely do not need the live code execution in most cases anyway. Furthermore, unlike RISE, Quarto is so flexible in its conversion functionalities that it can adapt to basically any need. The same notebook can serve as a handout (e.g., as PDF) or an online demo (via HTML), but it can also serve as a plain old PowerPoint presentation (not that I would endorse this). Even complex libraries can now be built entirely in Jupyter Notebooks, with the documentation being automatically generated from the alternating code and descriptive cells (see Fast.AI [10] as an example).

In sum, Jupyter Notebooks and its ecosystem enable what both teachers and practitioners have envisioned for quite some time. It serves as an optimal medium to tackle various differing tasks without much overhead. Before, documentation and libraries were often two separate documents. Likewise, when it came to teaching, handouts and slides typically did not either have much in common or the handouts were just the slides without adaptation. This is even worse for programming courses, where the code snippets in and of themselves were often inexecutable due to missing parts. Now, the presentation itself can be a fully functioning program, while only the relevant bits are shown during the lecture. The students can then play around and adapt the provided code (i.e., notebooks) to their own liking.

[1] `https://rise.readthedocs.io/en/latest/index.html`
[2] `https://revealjs.com/`

3.2.2 Example Lecture: Transformers 4 IR (WS22)

The code of the lecture that I want to highlight is available online[3]. The slides were directly presented using RISE (see Subsection 3.2.1). Additional details on the thinking that went into the planning and improving of my lectures are provided in the Appendix D.

Why Transformers? Transformers [18] have fundamentally changed the world that we know forever, as they comprise virtually all AI assistance tools such as ChatGPT. Even before public awareness, the Transformer architecture had permeated many areas, such as information retrieval. Therefore, it was fitting to include a Transformer lecture for the advanced information retrieval course. The lecture was held on two subsequent course dates (the 29TH of November and the 6TH of December 2022), with two units consisting of 45 minutes each (therefore, 3 hours in total).

As a fun fact, ChatGPT was released between those two dates on the 30TH of November 2022 and supported the relevance of the lecture. I even included a brief discussion of ChatGPT in the lecture, but believed as I did that it might fail to hold up to its promises — as had basically all previous language models at the time.

Lecture Design as Real Experiment. Regarding the lecture structure, I basically designed it from scratch, as teaching materials were still limited in this particular area. Nevertheless, I relied on several solid sources to support the lecture design. The biggest structural influence came from the book "Pre-trained Transformers for Text Ranking: BERT and Beyond" [20]. From the book, I picked bi-encoders and cross-encoders as the main points on which to focus and contrast, as these are, for practical purposes, the most fundamental concepts to understand. Moreover, I designed the lecture to be similar to an information retrieval experiment, starting with the use of a small benchmark dataset [17, 6].

As a first step in an experiment, you start with an analysis of the data. I used that opportunity to showcase BERTopic [8], which highlights the then novel but popular (due to its ease of use) library and shows how versatile Transformers can be applied to problems. Note that the notebook structure mirrors the steps as described.

After it has been established that Transformers can be used rather easily, the students are ready to question the inner workings and theory behind Transformers (i.e., top-down). At this point, I refer to the well-known visual depictions of "The Illustrated Transformer" [1].

At the pinnacle of the lecture, the two specific architectures are investigated and contrasted. In both cases, I use the SentenceTransformers [15] and directly incorporate the important diagrams of the documentation of the library into the code (and thus into the presentation itself). Both approaches are evaluated on common metrics that are visualized by using common plotting functions. The last step is very atypical in presentations, as it requires real data to work properly, but it is easily done if the presentation reflects real circumstances.

Finally, I conclude the lecture by discussing the bigger picture and possible future directions. Note that, while the extent of the presentation differs from the real experiment that students must conduct in their practical project, the basic steps are the same. Therefore, by attending the lecture, students not only learn about Transformers but also implicitly learn through information retrieval experiments while getting a tutorial on the libraries at the same time. Moreover, practical tips and pitfalls relevant to the student projects, such as scaling regarding CUDA memory, can be directly shown and addressed.

Student Responses: During the lecture, I incorporated students by actively prompting them for input. Anecdotally speaking, this boosted engagement in the lecture. Additionally, I argue that students who attended the lecture were aided in their practicals. As an example, I would refer back to the teaching highlight in Subsection 3.3.1, where the group similarly compared a bi-encoder to other models.

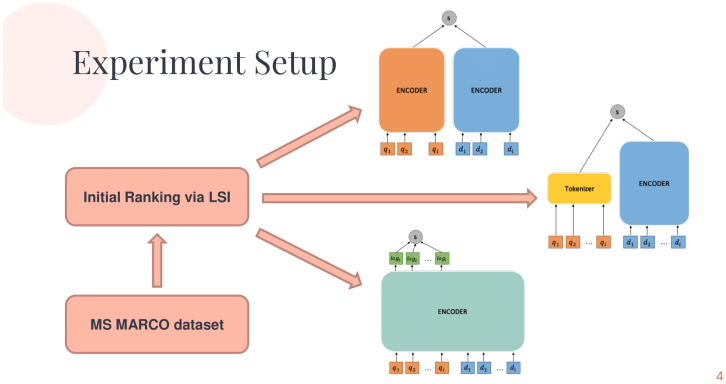
Furthermore, the course evaluation also shows that the lecture was well received. I want to present one particular written response verbatim:

> Loved his presentation. I like that he showed a lot of code in his presentation (for me this helped back up the information he was saying), also seems very involved in the course, which is always a good sign. Also congratulations for being such a patient novice lecturer, that ain't easy :))

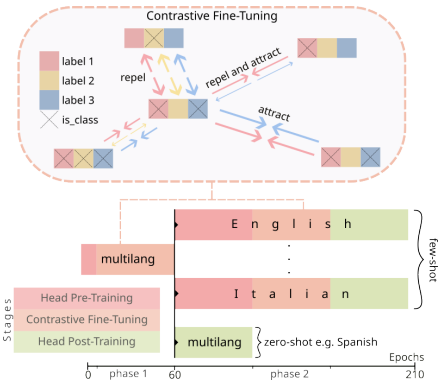
Here, I want to thank the anonymous student, as your kind words are very much appreciated.

[3] `https://www.kaggle.com/code/markusreiterhaas/advanced-information-retrieval-7-transformers4ir`

3.3 Teaching Highlights



(a) Notable project in advanced information retrieval (winter term 2022) beyond the scope of the course.



(b) Notable student group results in the SemEval 2023.

Figure 1: Two Examples of Teaching Highlights. Both examples show that with proper guidance, students achieve amazing results. The two examples are different in their context, as (a) is the outcome of a regular course, whereas (b) is the results of student supervision as part of their projects and theses.

3.3.1 Teaching Highlight: AIR Projects

One highlight of my teaching career is when students show that they can successfully transfer the acquired knowledge to their own projects. For this reason, I like to highlight such achievements, as it makes both the students and teachers proud. In AIR winter term 2022, we featured five projects at the end of the course on the lab website[4]. One of the most notable examples was the "Comparison of Rerankers" by Julian Rakuschek and Matthias Hülser. As shown in Figure 1a, they compared bi-encoders (which were covered in class) with two advanced models: the Deep Query Likelihood [21] and the Term Independent Likelihood moDEl (TILDE) [22]. Hence, they have demonstrated that they can conduct their own experiments that included recent research results. Moreover, their final presentation was very informative, even for course's teachers, due to the presentation's relatedness to current research. It was so well conducted that some unassuming visitors of the presentation might have thought that the students were the class lecturers. Therefore, this example shows how teachers can learn from their students.

3.3.2 Teaching Highlight: SemEval Placement

Another highlight of my teaching career was when I created a group to participate in the SemEval 2023 Task 3 challenge [14]. The shared task was concerned with multilingual framing detection in few- and zero-shot settings. I was able to motivate two students willing to participate, i.e., Kevin Innerebner and Alexander Ertl. As the students worked predominantly on their own, I mainly provided guidance in frequent but brief meetings. The constant exchanges strengthened the team's collaboration, which then led to their discovery of a suitable contrastive loss function for multi-label classification and training procedure for the task at hand (see Figure 1b). In the evaluation, we achieved notable placements among all languages, especially Spanish, where our group was ranked number one. As a result, the research led to a publication [7] (joint first authorship went to Alexander Ertl and co-authorship went to Kevin Innerebner). Although the results were already more than sufficient for the project, both students agreed to conduct additional experiments with me to further strengthen the paper's arguments. Subsequently, Alexander Ertl further expanded the experiments and wrote his master's thesis on the topic, which I co-supervised. Additionally, we discussed several outcomes in the research meetings of the lab. Alexander Ertl successfully defended his thesis and achieved his academic degree with distinction. He also worked as a project assistant in another study relating to my research topic that took place during the time interval between the thesis writing and defense. Hence, this example shows how proper guidance of students can motivate them and lead to successful projects that might result in fruitful collaborations.

[4] `https://socialcomplab.github.io/advancedIR-2022-showcase/`

4 Teaching Improvement Activities

Evaluating and critically reflecting on your own work (i.e., teaching), is another important hallmark of a good teacher. For this reason, I strive to improve my teaching competencies by gaining appropriate teaching qualifications. I aim to improve my skills in a diverse set of topics but with a greater focus on technology-enhanced presentation skills and assessment concerning constructive alignment while regarding openness as another important concern. Therefore, my improvement activities adhere to my teaching philosophy and principles (see Section 1).

To that end, I have partaken in several didactic qualifications while at TU Graz. Specifically, these qualifications are grouped into 5 modules:

2024S Didaktik-Werkstatt
Total effort: 3 courses with 4 work units 1 hour each (= 12h) and a subsequent online phase (0.5 ECTS = 12.5h) with reflection and networking.

2023W - 2024S Teaching Academy Module Expert
Total effort: at least 76 work units, 45 minutes each
comprising the workshop "Teaching Expert" (16 work units), a teaching portfolio — which is the current document (30 work units), and contributions to the Teaching Community at TU Graz (30 work units), the goal being to make your teaching competence visible.

2023S OER Practitioner
Total effort: 1 ECTS (= 25h)
comprising an introduction to OER lecture (4h), the OER MOOC (8h), the creation of 3 OERs (4h per OER), and an oral discussion (1-2h).

2022W-2023S Teaching Academy Module Advanced
Total effort: 77 work units (with at least 72 work units required), 45 minutes each
comprising a flexible selection of courses from a diverse set of topics, the goal being to deepen your didactic knowledge in specific areas.

2021W Teaching Academy Module Basic
Total effort: 40 work units, 45 minutes each
which is the qualification for independent teaching at TU Graz.

Refer to Appendix E for the full list of individual courses and Appendix F for or the acquired certificates.

5 Teaching Prospects

If the opportunity arises, I would like to create a "Web Mining and Content Analysis" course, where I could incorporate the knowledge I acquired for my research/dissertation. The topic list of the course would be inspired by the Web Conference track of the same name[5]. Especially nowadays, between web content playing such a big role in people's lives and artificial intelligence allowing for a much richer analysis, such a course would be very beneficial for future generations.

Besides, I want to further explore the direction of executable notebooks in teaching (and also other areas). Ideally, research should be similarly conducted, which is possible with Quarto. If research were based on executable notebooks, the entry barrier would be lower, and it would support incorporating examples from recent research results into teaching. Such research-informed teaching would further bridge the gap between research and teaching, therefore benefitting student researchers.

Finally, I want to strengthen my focus on the learning process, especially in group settings. The work conducted in groups can sometimes appear as a black box and hinders timely corrections when progress is stalling. Hence, I want to improve that aspect even further, as it is especially important to my teaching style.

[5]Link to 2024 call: `https://www2024.thewebconf.org/calls/research-tracks/`

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A Teaching Career Summary

The following is the complete list of teaching activities:

2022W-2023W Advanced Information Retrieval course
5 ECTS, VU, mixed master/bachelor, CS + CSS, 107 registered (WS23), 131 registered (WS22)

2022W-2024S Research Meetings within the Recommender Systems and Social Computing Lab
Bi-weekly, Organization, 1 unit on academic publishing, Diploma Seminar/Introduction to Scientific Working

2022W Master project: SemEval challenge Team
2 students, team leader, first place in Spanish framing detection subtasks, subsequent paper publication, and master thesis.

2021W Web Technology course
5 ECTS, VU, 1 lecture = 2 work units, mixed master/bachelor, CS

2021S Lecture Unit in Social Media Course @ Uni Graz
External, 1 lecture = 2 work units, SM (Twitter) with Python/Jupyter

2020S Know-Center Summer School
Presentation on polarization

2013W-2017W Tutor: Foundations of Computer Science
Homework correction with delivery talks and a weekly question time

I also co-supervised the following thesis:

2023S Alexander Ertl - Master Thesis
Contrastive Pre-Training of Transformer Models for Computational Framing Analysis[6]

2022W Lukas Preitler - Bachelor Thesis
Topic Description: Word Embedding Association Test to Reveal Gender Bias in Austrian Teaching Literature

B Teaching Resources

Several of my teaching resources are available online:

OERs - At my personal website under section teaching:
`https://iseratho.github.io/#teaching`
For instance, on the difference between Google and ChatGPT:`https://iseratho.github.io/teaching/ChatGPT_vs_Google_Search.pdf`

Kaggle - Public Notebooks for Teaching at:
`https://www.kaggle.com/markusreiterhaas/code`

AIR project highlights - At the research group website under teaching:
`https://socialcomplab.github.io/#teaching`
For WS22: `https://socialcomplab.github.io/advancedIR-2022-showcase/`

Blog - A few blog posts that might help to better understand (large) language models: `https://iseratho.github.io/posts`

[6] Links to Thesis: `https://online.tugraz.at/tug_online/wbAbs.showThesis?pThesisNr=85966&pOrgNr=14250` and GitHub Repo: `https://github.com/lambdasonly/mCPT`

C Example Test

The following provides an example of a test I designed for the Advanced Information Retrieval course. I want to emphasize that the test allows one to determine knowledge on a wide range of levels, especially in an oral setting. By considering the steps students do (or do not) perform or know, the test shows their competence with the topics. Hence, it enables to swiftly gauge the expertise of students.

The following page shows the test's two assignments. Afterwards, the solutions are listed in detail and are accompanied by the grading scale, which can be adapted to the specific points required.

TF-IDF Retrieval

Your are given the following the query;

$$q: \text{ One dark rule}$$

and the corpus (i.e., document collection):

$d1$: One for the dark lord on his dark throne
$d2$: One Ring to rule them all
$d3$: One Ring to find them
$d4$: One Ring to bring them all

and the stopword list: *to, for, on, the, them, his.*

Task: Retrieve the **top-3** most similar documents and provide their ranking score. Specifically, use the vector-space model with the **Dot Similarity**, the documents weighted by **TF-IDF**, and the unweighted query (i.e., a one-hot encoded vector). Also, provide the most important steps of the calculation (data sparsity can still be exploited).

Equations for TF-IDF:

$$\begin{aligned} tf(t,d) &= f_{t,d} \\ idf(t) &= log_2(|D|/df_t) \\ w_{t,d} &= tf(t,d) \cdot idf(t) \end{aligned}$$

Transformers 4 IR

You plan to rank online posts based on their sentiment score.
What Transformer model would you select, and how would train it? Provide reasons for your choices.

TF-IDF Retrieval Solution

Short Answer: No real calculation needed. We only consider the three words from the query (none of which are stopwords), as the remaining ones will be zero. *One* is part of every query, hence, its IDF is 0, i.e., log(1). The word *dark* appears twice in *d1* and nowhere else. Hence, its TF-IDF is 4 (i.e., $2 * 2$, as the IDF is $\log_2(4/1) = \log_2(4) = 2$). Finally, *rule* only appears in *d2*, thus having a TF-IDF of 2 (same IDF as *dark*). Thus, the retrieved documents and their scores are: $d1 = 4; d2 = 2; d3 = 0; d4 = 0$ with d3 or d4 being arbitrarily cut off. Hence, the ranking is *d1*, followed by *d2*, and then either *d3* or *d4* (or neither).

Longer Answer: Use the document-term matrix, i.e., the upper part of the Table:

	One	Ring	rule	find	bring	all	dark	lord	throne	
d1	1	0	0	0	0	0	2	1	1	5
d2	1	1	1	0	0	1	0	0	0	4
d3	1	1	0	1	0	0	0	0	0	3
d4	1	1	0	0	1	1	0	0	0	4
df	4	3	1	1	1	2	1	1	1	15/16†
idf	0	0.41	2	2	2	1	2	2	2	
q	1	0	1	0	0	0	1	0	0	
qd1	0	0	0	0	0	0	4	0	0	**4**
qd2	0	0	2	0	0	0	0	0	0	**2**
qd3	0	0	0	0	0	0	0	0	0	**0**
qd4	0	0	0	0	0	0	0	0	0	**0**

Results in **bold**. † shows difference in counting between TF and IDF.

Transformers 4 IR Solution

Most important parts for the solutions.

- Encoder Model (Type): auto-encoding is good for NLU
- BERT or RoBERTa as prominent examples.
- monoBERT (i.e., Cross-Encoder) for with classifier head for fine-tuning
- Idea: simply concatenate pairs of statements (S1, S2) and predict whether S1 has a higher score than S2: reranking. Computationally intensive.
- Alternative just try to predict score, as regression problem.
- Alternative 2 bi-enoder with similarity of score reflected. Better for computational efficiency.
- Alternative 3 just use a pretrained sentiment model.

standard	TF-IDF Retrieval	Transformers4IR
MAX	Correct result with calculation steps.	Good choice of model and training with coherent reasoning for IR task.
AVG	Small calculation mistakes, but roughly correct retrieval; some steps could be unclear, but overall procedure is valid.	Imperfect selection and reasoning but still could be applied in practice.
MIN	Basic components for retrieval are present (e.g., term-document matrix, query vector, stop word removal) but no complete solution.	Transformer architecture and fine-tuning known.

Table 1: The grading scale considers three levels: (i) the maximum for which full points will be awarded, (ii) the average case that a typical student should be able to reach, and (iii) the minimum required for a passing grade.

D Teaching Project: Jupyter Experiment in Transformers4IR

The goal of the teaching project is to introduce, in a meaningful way, code showing the discussed concepts. Specifically, Jupyter notebooks are used to present code in a teaching environment. Here, we target the Transformers lecture units, as these models are easy to employ while comprising many concepts under the hood. Besides using Jupyter, the intent is to similarly structure the lecture to a small scientific experiment to support the students' understanding of their own design and development of the final course project.

From a didactic standpoint, the aim is to achieve a higher taxonomy level (i.e., apply) within the lecture. Typically, such data science lectures explain concepts (i.e., for understanding) but not the applicability. The expectation is for students to more easily apply the concepts to the project and thus target the highest didactic level without too much friction. Hence, students should be able to create their own experiments within their projects which are structured similarly to the lecture mini experiment. The evaluation will be based on the quality of the project results and students' feedback.

Planning

We conducted the project twice with slightly different setups. The second-year project is informed by the students' feedback and the observed results of the first year. The course had no direct predecessor from which data could be taken. Nevertheless, in other courses like Web Technology, the results suggested that students often could not apply the concepts that were discussed, even when code snippets were present. Hence, the full code should be used for presentation and provided to students as well.

As the lecture is more code-heavy than typical lectures, it will require more time for presentation. Hence, four lecture units in total (i.e., two dates with two units each) will be required. This was not initially accounted for in the 2022 syllabus but was adapted during the semester (as other adaptions also needed to be made due to external factors).

The suggested project will require additional preparation and tooling for code presentation during the lecture. In the following, I will go into detail on the required preparation and tooling.

AIR 2022

In 2022, the project was developed from scratch. It aimed to teach the concept of Transformers by considering cross-encoders and bi-encoders, as well as contrast between the two approaches. First, it started with the basics of neural networks, and it then followed the rough structure of a handbook (i.e., "Pretrained Transformers for Text Ranking: BERT and Beyond") for applying Transformers to text ranking problems. Specifically, the monoBERT and representation-based models were selected. The code was developed on Kaggle to ensure the students had the resources to run the code. For presentation, RISE (Reveal.js — Jupyter/IPython Slideshow Extension) was used, which allows presenting of the Jupyter code as slides while also keeping it fully interactive. Hence, code could be run during the lecture. However, as the models took a significant training time, training during the lecture itself was not feasible. As a consequence, it needed to be decided which cells should be used to show the execution during the lecture and which should be left for students to explore on their own. Additionally, a script was created to convert all cells to slide cells (as only slide cells are shown); the presentation was then gone over a couple of times, wherein code cells were adjusted accordingly (e.g., to slide fragments instead).

AIR 2023

A few adaptions were made in 2023, with three notable changes. First, a prior lecture which was on deep learning with PyTorch was presented beforehand. This effectively tackled two critiques from the prior year: that not everyone is well versed with deep learning in general and that the used library was not properly introduced beforehand. Also, it freed time in the Transformer presentation, as no quick introduction of PyTorch needed to be done at the start. Second, Quarto was used instead of RISE. Quarto, rather than presenting live code, converts the code in advance. This preserves the core idea of using real-code without the hassle of a live code presentation. Hence, the interactive presentation is still executable, but it can be tuned toward more traditional slides beforehand. Finally, feedback on project ideas was given on the newly introduced design document submission. While not entirely in the scope of the lecture, it was observed that the lack of prior feedback was troublesome and needed to be improved.

E Teaching Improvement Courses

Table 2: **Didactic Courses**: Individual didactic courses in reverse chronological order. The courses are referred to by their original titles, which could be in German.

Title	Program	Term	Effort
Onlinephase: Reflexion und Vernetzung	Didaktik-WS	24S	$\sim$ 16 WU
Coaching Skills für die Lehre	Didaktik-WS	24S	4 WU
Professionelle Beziehungsarbeit in der Lehre	Didaktik-WS	24S	4 WU
Leistungsbeurteilung: vom Produkt zum Prozess	Didaktik-WS	24S	4 WU
Teaching Community Contribution	Expert	24S	30 WU
Teaching Project and Portfolio	Expert	24S	30 WU
Teaching Expert Workshop	Expert	23W	16 WU
Teaching in English: Presenting in Class	Advanced	23S	16 WU
iMooX - Using and Creating OER	OER	23S	10 WU
Digitalisierung in der Lehre: Wie Technologie Ihre Lehre bereichern kann	Advanced, OER (4h)	23S	16 WU
Didaktik-Werkstatt - Mit wenig Aufwand gute Prüfungsaufgaben erstellen	Advanced	23S	4 WU
Didaktik-Werkstatt - Blended Learning: Flipped Classroom, Zopfstruktur & Co.	Advanced	23S	4 WU
Kompetent prüfen	Advanced	22W	16 WU
Hochschuldidaktik 3: Lehrverhaltenstraining	Advanced	22W	16 WU
Barrierefreie PowerPoint Präsentationen - Barrierearmes PDF	Advanced	22W	16 WU
Hochschuldidaktik 2: Durchführen von Lehrveranstaltungen	Basic	21W	16 WU
Hochschuldidaktik 1: Grundlagen des Lehrens und Lernens	Basic	21W	16 WU
Lehre an der TU Graz	Basic	21W	8 WU

Most of the courses in Table 2 are part of the Teaching Academy at TU Graz[7] and are structured in three modules. In the advanced module, the selected topics list spans the areas: "Teaching and Learning", "Assessment", "Technology-Enhanced Learning", "Teaching in English", "Communication and Presentation", and "Diversity in Teaching".

Teaching Community Contributions I also contributed to the teaching community through the following activities. First, I participated in an exchange on the role of artificial intelligence in teaching at TU Graz. Second, I presented on the use of Jupyter as an educational tool at the "In love with teaching" conference at TU Graz. And finally, I authored a report on how to present code in the classroom for the eCampus system of the Science Space Styria.

F Teaching Certificates

In the following, I provide the teaching certificates for the three modules (expert, advanced, and basic), the eCampus Use Case, the didactic workshop, and the OER certificate, in that order. The OER certificate ID can be verified online[8].

[7] https://www.tugraz.at/en/studying-and-teaching/teaching-at-tu-graz/services-for-teaching-staff/higher-education-didactics

[8] https://www.oer-zertifikat.at/oer/de/zertifikate/personenzertifikat

TEACHING ACADEMY

TU Graz

Zertifikat

Dipl.-Ing. Markus Reiter-Haas, BSc

hat das

Modul „Expert“
der Teaching Academy

an der Technischen Universität Graz
erfolgreich abgeschlossen.

Graz, 08. Juli 2024

Dr. phil. Verena Schwägerl-Melchior
Teaching Academy

Univ.-Prof. Dipl.-Ing. Dr.techn. Stefan Vorbach
Vizerektor für Lehre

Teaching Academy
Modul „Expert“

Absolvierte Veranstaltungen und erbrachte Leistungen

Titel	Semester	Arbeitseinheiten*
Workshop „Teaching Expert“	23W	16
Lehrportfolio	24S	30
Beitrag zur Teaching Community	23W-24S	30
Gesamtumfang erbrachte Leistungen		**76**

*1 Arbeitseinheit entspricht 45 min

TEACHING
ACADEMY
TU Graz

Die Teaching Academy ist das hochschuldidaktische Qualifizierungsprogramm der Technischen Universität Graz. Die drei Module „Basic“, „Advanced“ und „Expert” können jeweils mit einem Modulzertifikat abgeschlossen werden.

TEACHING ACADEMY

Module "Expert"

The module "Expert" represents the highest level of the Higher Education Didactics programme of the TU Graz Teaching Academy.

Building on their previously acquired competencies, the participants document their teaching skills and present them to fellow lecturers.

The module consists of the following elements:

- A two-day "Teaching Expert" workshop (equivalent to a workload of 16 units of 45 minutes)
- The compilation of a teaching portfolio and/or the implementation and documentation of a teaching project (equivalent to a workload of 30 work units)
- A documented contribution to the Teaching Community where the participants share their expertise with fellow teaching staff (equivalent to a workload of 30 work units)

TEACHING ACADEMY

TU Graz

Zertifikat

Dipl.-Ing. Markus Reiter-Haas, BSc

hat das

Modul „Advanced“ der Teaching Academy

an der Technischen Universität Graz erfolgreich abgeschlossen.

Graz, 14. Juli 2023

Dr. phil. Verena Schwägerl-Melchior
Teaching Academy

Univ.-Prof. Dipl.-Ing. Dr.techn. Stefan Vorbach
Vizerektor für Lehre

Teaching Academy
Modul „Advanced“

Absolvierte Veranstaltungen

Titel	Semester	Arbeitseinheiten*
Kompetent prüfen	22W	16
Digitalisierung in der Lehre: Wie Technologie Ihre Lehre bereichern kann	23S	16
Hochschuldidaktik 3: Lehrverhaltenstraining	22W	16
Barrierefreie Powerpoint – Barrierearmes PDF	22W	5
Teaching in English: Presenting in Class	23S	16
Blended Learning: Flipped Classroom, Zopfstruktur & Co**	22W	4
Mit wenig Aufwand gute Prüfungsaufgaben erstellen**	23S	4
Gesamtumfang erbrachte Leistungen* **		**77**

*1 Arbeitseinheit entspricht 45 min.

** Diese Kurse wurden im Rahmen der Didaktik-Werkstatt 2023 des Science Space Styria absolviert und als gleichwertig zu Weiterbildungsleistungen im Modul „Advanced“ der Teaching Academy anerkannt.

**mindestens 72 Arbeitseinheiten.

TEACHING
ACADEMY
TU Graz

Die Teaching Academy ist das hochschuldidaktische Qualifizierungsprogramm der Technischen Universität Graz. Die drei Module „Basic“, „Advanced“ und „Expert” können jeweils mit einem Modulzertifikat abgeschlossen werden.

TEACHING ACADEMY

Module "Advanced"

The module "Advanced" represents the second of three levels of the Higher Education Didactics programme of the TU Graz Teaching Academy.

This module is designed for teaching staff who are already teaching independently at TU Graz or who have completed the module "Basic". In this module, teaching staff can refresh, expand, and improve their didactic skills in areas relevant to their specific needs and interests.

The module comprises a minimum workload of 9 days (= 72 units, 45 minutes each) and consists of the following elements:

- two compulsory workshops on the topics "assessment" and "technology-enhanced learning" (16 units each)
- 40 more units comprising workshops on different topics of teaching and learning and individual consulting offers.

TEACHING ACADEMY

TU Graz

Zertifikat

Dipl.-Ing. Markus Reiter-Haas, BSc

hat das

Modul „Basic“
der Teaching Academy

an der Technischen Universität Graz
erfolgreich abgeschlossen.

Graz, 02. März 2022

Dr. phil. Verena Schwägerl-Melchior
Teaching Academy

Univ.-Prof. Dipl.-Ing. Dr.techn. Stefan Vorbach
Vizerektor für Lehre

Teaching Academy
Modul „Basic“

Absolvierte Veranstaltungen

Titel	Semester	Arbeitseinheiten*
Online-Kurs: Lehre an der TU Graz	WS2021/22	8
Online-Kurs: Hochschuldidaktik 1: Grundlagen des Lehrens und Lernens	WS2021/22	16
Online-Kurs: Hochschuldidaktik 2: Durchführen von Lehrveranstaltungen	WS2021/22	16
Gesamtumfang erbrachte Leistungen		**40**

*1 Arbeitseinheit entspricht 45 min

TEACHING
ACADEMY
TU Graz

Die Teaching Academy ist das hochschuldidaktische Qualifizierungsprogramm der Technischen Universität Graz. Die drei Module „Basic“, „Advanced“ und „Expert” können jeweils mit einem Modulzertifikat abgeschlossen werden.

Science Space Styria

Der Steirische Hochschulraum

Zertifikat

Erstellung eines hochschuldidaktischen Use Cases für die Plattform eCampus

Herr Dipl.-Ing. Markus Reiter-Haas, BSc

hat im Sommersemester 2024 den Use Case
Programmcode präsentieren

in Abstimmung mit der AG eCampus erstellt
(Arbeitsaufwand: 1 ECTS)

Graz, 31.07.2024

MONTANUNIVERSITÄT LEOBEN * REKTOR *

Univ.-Prof. Dipl.-Ing. Dr.mont. Dr.-Ing. E.h. Peter Moser
Rektor der Montanuniversität Leoben
für die Steirische Hochschulkonferenz

ZERTIFIKAT

Herr

Dipl.-Ing. Markus Reiter-Haas, BSc

hat das Fortbildungsprogramm

Didaktik-Werkstatt

im Ausmaß von

3 ECTS-Punkten

im Zeitraum vom 04.03.2024 bis 21.06.2024 absolviert

Graz, Juli 2024

MONTANUNIVERSITÄT LEOBEN * REKTOR *

Univ.-Prof. Dipl.-Ing. Dr.mont. Dr.-Ing. E.h. Peter Moser
Rektor der Montanuniversität Leoben
für die Steirische Hochschulkonferenz

Didaktik-Werkstatt
Ein Fortbildungsprogramm der Steirischen Hochschulkonferenz zur Hochschuldidaktik

Absolvierte Workshops

Leistungsbeurteilung: vom Produkt zum Prozess	Online
Professionelle Beziehungsarbeit in der Lehre	Universität Graz
Coaching-Skills für die Lehre	Technische Universität Graz
Onlinephase: Reflexion und Vernetzung	FH JOANNEUM

ZERTIFIKAT

open educational resources

practitioner | praktiker:in
verliehen von <fnma>
ID: P-2023-060

Forum Neue Medien in der Lehre Austria (fnma) verleiht

Markus Reiter-Haas

Technische Universität Graz

das Zertifikat „OER Practitioner | OER-Praktiker:in“

Markus Reiter-Haas hat an einer von fnma akkreditierten Weiterbildung zu offenen Bildungsressourcen (engl. Open Educational Resources, kurz OER) im Umfang von 1 EC (25 Stunden) teilgenommen, dabei mindestens drei OER veröffentlicht sowie nachgewiesen, selbstständig, eigenverantwortlich und unter Berücksichtigung des professionellen disziplinären und didaktischen Fachwissens offen lizenzierte Bildungsressourcen (OER) finden, erstellen, überarbeiten, neu zusammenstellen und veröffentlichen zu können.

Die dazu nachgewiesene Weiterbildung der Technischen Universität Graz trägt den Namen „OER-Zertifikat von fnma bei der TU Graz“ und wurde im Jahr 2023 abgeschlossen. Das Konzept der Weiterbildung wurde vom Beirat zur OER-Zertifizierung im Jahr 2023 akkreditiert (W-2023-02).

Dieser Nachweis erhält die ID P-2023-060.

Graz, 30. Juni 2023

Ortrun Gröblinger für das Präsidium von <fnma>