APIC: A Paper Discussion Club on Advanced Protocols of Internet Communications

Christoph Döpmann, Elias Rohrer, and Florian Tschorsch∗
Technische Universität Berlin, Germany
{christoph.doepmann,elias.rohrer,florian.tschorsch}@tu-berlin.de

1 INTRODUCTION
Gaining an academic degree in computer science requires a series of competencies, which should ideally be acquired during the course of studies. We recognized that one particular skill is often overlooked, that is, the ability to read, understand, and discuss scientific literature.

In this paper, we present a digital seminar concept that is designed as a paper discussion club. More specifically, we present and share our lessons learned of APIC, a seminar on Advanced Protocols of Internet Communications. APIC is comprised of weekly gatherings where a small group of people develop an understanding of a scientific paper. In order to facilitate a discussion, we designate a lead and an expert for each session, who are responsible for running the discussion among participants and providing background information, respectively. The seminar is held online. We rely on virtual conferencing tools to facilitate audio-only conversations, while the lead utilizes screen sharing functionality to provide single point of reference for the discussion.

The teaching goals for APIC are twofold: On the one hand, students become familiar with fundamental and current results in the area of computer networking. In particular, APIC covers the evolution of transport protocols and future Internet architectures. Hence, students gain a deeper understanding of these topics and reflect on a variety of research methods. On the other hand, students acquire the ability to grasp a paper’s contributions quickly and to establish a nuanced perspective on the topic at hand.

We generally found our concept to be compatible with the digital realm, even though additional intervention can become necessary to keep participants engaged. Most notably, we found that having a single visual point of reference can be beneficial for the discussion’s structure. We therefore plan to include similar elements in future offline iterations of our seminar. After successful participation, students gain 3 ECTS credits.

2 CONCEPT AND CONTENT
The main goal of APIC is to get students in close contact with fundamental and current research carried out in the computer networking domain. As such, the seminar strives to teach students two dimensions: knowledge and skill. First, it aims to convey the breadth and depth of computer networking research than is given by typical textbook-based courses. Second, students acquire and practice their skills of working with scientific literature. In particular, this implies reading, understanding, and discussing papers. With these two teaching goals in mind, students should become well-equipped for carrying out their own research in the fields, for example, as part of a thesis or student project. APIC is intended for approximately ten graduate students, enrolled to a Master’s degree program in computer science and similar fields. After successful participation, students gain 3 ECTS credits.

2.1 Concept
Our paradigm is that working with scientific literature can only be learned by—well, exactly that—working with scientific literature. Therefore, APIC follows a hands-on principle of a paper discussion club. For each of the weekly sessions, students are required to read and approach a scientific paper from the research area of computer networking. Each week, this paper is discussed in a synchronous group meeting. By doing so, students have to

• read and work through a variety of different papers,
• grasp the concepts of the scientific work sufficiently for presenting it to others,
• discuss with other students to extend their understanding of the paper

It is our goal to create an open atmosphere for vivid discussions. In order to support and improve the structure of the discussion, we designate three distinct roles: the lead, the expert, the participant. In each session, there is exactly

∗The authors of this paper are ordered alphabetically.
one lead and one expert, while the other attendees are participants.

The lead acts as a moderator. Her task is to guide the group through the discussion, keeping in mind the structure of the paper as well as, for instance, potentially hard-to-understand aspects of the paper that may deserve additional attention. It implies that the lead, as every other participant, may have questions and does not fully understand all the paper’s details. This role is important, though, to help the group come to a well-structured discussion from which everyone can take away the highest possible level of understanding. The lead should thus also keep track of the progress and time of the discussion. We select the lead randomly from the participants at the beginning of each session. Our general expectation is that students are prepared well enough to run the discussion.

The second role is the expert. The expert for each paper is determined at the beginning of the semester. Every student has to be the expert for a paper exactly once. It is the expert’s task to be especially familiar with the details and the background of the paper. If, during the discussion, the group cannot make sense of some aspects of the paper, the expert should be able to help out and answer questions that may arise. Assigning the expert papers in advance allows the expert to devote the appropriate effort to prepare and understand the paper in detail. During the discussion, the expert is indispensable to the group, because, to some degree, she denotes a source of truth if students disagree or need clarification. Handing over this responsibility to one of the students instead of taking on an authoritative role ourselves helps creating an open atmosphere for discussions, because students are less inhibited by fear of saying something wrong and being corrected by the teachers.

All other participants are expected to have approached the paper well enough to contribute to the discussion. To this end, we introduce and recommend the systematic paper-reading method discussed in [1] as a starting point at the beginning of each semester. At least students should have an overview of the paper (being able to take the lead) and being able to articulate questions and difficulties. By giving some responsibility to the expert, we encourage everyone to take part in the discussion, even if not every aspect of the paper has become completely clear. The role of a participant is also the one we assign to ourselves, if there’s no further need for action.

At the end of the semester, the students’ contribution to the course is completed by writing a review about one of the seminar papers. This last component is supposed to introduce the concept of the peer review process as well as used to let students formulate a differentiated and critical view on a piece of scientific work. The course is generally ungraded, that is, there is only pass/fail for active participation. We particularly refrain from grading the discussion part as we want to create an open atmosphere. If, however, a grade is needed, it could be based on the final review written by the students.

### 2.2 Content

An important decision upfront is the list of papers that are covered in the course. Our goal is to extend the students’ knowledge on computer networking research, compared to standard introduction courses, which we assume students have taken before. Going beyond prior knowledge offers two possible directions: breadth and depth. We try to tackle both; the individual papers go rather deep into some aspects of networking research. Offentimes, they introduce a novel piece of technology that can be regarded as significant or groundbreaking from today’s point of view. Understanding those papers thoroughly requires diving into that area of research as well as becoming acquainted with its related work.

We select the papers from a wide range of topics: transport protocols, congestion control, routing, network reliability, distributed hash tables and future internet architectures. By doing so, we make the students get in touch with a broad range of topics.

On the other hand, we also want to demonstrate the diversity of papers as far as their methodological approaches are concerned. Consequently, we have not only included papers that introduce new technological advances, but also for example large measurement studies. Our impression is that the latter genre of scientific papers is one that students do not regularly get in touch with during their studies.

While we do pay attention to the scientific significance of the papers and, for example, source some of them from SIGCOMM’s Test of Time Award¹, we explicitly do not filter all of them based on their quality of writing and presentation. Neither do we only choose very recent bleeding-edge papers. In contrast, we think that by covering papers of varying quality and age, students better attain the set of skills necessary to extract the information required to understand a paper’s concepts, even when some aspects of its presentation is unfamiliar or lacking. To this end, we ask students to reflect not only on the content, but also the presentation and structure of the paper at hand. We furthermore encourage them to put decisions taken by the authors under close scrutiny and to discuss what they would improve methodologically or presentation-wise about the paper. That is, we motivate the students to summarize what they take away from the discussion and to essentially contribute a short oral version of a paper review at the end of each session.

¹[https://www.sigcomm.org/awards/test-of-time-paper-award](https://www.sigcomm.org/awards/test-of-time-paper-award)
3 DIGITAL METHOD

While the concept of the seminar was originally developed with physical meetings in mind, the COVID-19 pandemic forced us to conduct it in a quarantine-friendly manner. To this end, we relocated our weekly meetings to be online-only, making use of video conferencing tools. After investigating feasible tools for our use-case, and initial hesitation because of privacy concerns, we finally settled on the Zoom\(^2\) platform, as we found it to provide the most reliable service out of all alternatives we tested and is furthermore approved by our university.

We recognize that in the current situation in which students participate in virtual meetings from home, the separation of the public and private sphere may get blurred. In particular, if enabling video is mandatory, students may feel forced to grant their fellow students a view into their homes, they otherwise would be uncomfortable to share. We therefore abstain from requiring students to enable their webcams and opt for audio-only sessions. By utilizing an audio-only format instead of making video optional, we avoid the peer pressure that may lead students to reveal their private environment even if they do not actually feel comfortable doing so. From a technical perspective, the decision also ensures a better overall experience for participants with poor connection quality.

During the virtual meetings, the video conferencing tool is therefore utilized to facilitate the audio-only discussion, while the session’s lead presents the discussed material via screen sharing. Because of this, her task of structuring the ongoing discussion is augmented to entail the navigation through the paper. The screen sharing also allows the lead to annotate and highlight the document in real time, incorporating elements from the ongoing discussion. As this visual presentation allows every participant to closely follow what part of the paper is currently discussed, we found this to be an advantage over our usual offline setting, in which everyone would not have access to such a shared virtual document. Furthermore, we found that the online setting increases the responsibility of the lead and expert to structure the discussion and include other participants in the discussion.

This is especially the case since we found that online discussions are generally less vivid, as it takes more patience and resistance to communicate without interrupting others. While in the offline variant of the course it was most often possible to grasp which participants are (quietly) following the ongoing discussion, this capability is lost in translation to the online format. As a result, it became harder to assess who is still involved (actively or passively) and who we lost. There is a variety of other situations that may require our involvement. For example, consider the lead role: It is a natural circumstance that people differ in personality, which can obviously influence the vividness of the discussion. Our impression was that such effects become more visible in an online meeting, because there is less non-verbal communication that improve group interactions. The same is, for example, true for situations in which the discussion tends to become a dialog between the expert and the lead, with little engagement of the other participants.

We therefore found that additional interventions from our side can become necessary more frequently in order to keep the discussion going and to keep more participants engaged. In particular, we found that preparing and raising questions was helpful. Apart from individual, paper-related questions, we compiled a collection of recurring discussion points, including validity of the methodology, hidden assumptions, completeness, feasibility, and comprehensibility.

4 LESSONS LEARNED

We found that the seminar’s concept of a paper discussion club worked very well in the digital realm. Even when issues arise, these may be counteracted by the intervention of the teaching staff. On the contrary, we found that having a single visual reference to the current focus can help to align the discussion without having to communicate which part of the paper one currently references. We therefore plan to include the augmented lead role also in our offline variant, in which the lead then may use a projector to navigate through the paper enabling such single point of reference.

This is furthermore supported by the positive feedback we received personally from students, as well as from the anonymized course evaluation forms at the end of the semester. While students generally found that the required reading for the seminar was initially challenging and very time-consuming, they state that it became easier (and hence less time-consuming) as they gained practice on how to work

\(^2\)https://zoom.us

![Average workload reported by students.](Figure 1: Average workload reported by students.)
with literature. We are very satisfied to hear this, as it indicates that—while participation in the seminar entails a certain workload—our concept succeeds to meet the central teaching goal of increasing students’ competency for working with scientific literature. Figure 1 shows the average workload reported by the students as part of the end-of-semester course evaluation. We observe that the majority of students find the average workload to be 2–4 or 4–6 hours per week, which varied over the years, likely due to a varying list of papers.

For the future, we consider a few modifications that could generally improve the seminar and/or make it suitable for other settings. First, while a group size of 10–15 participants works, the seminar could scale by introducing a panel discussion format, where more students join as participants and a subset (including lead and expert) constitute a panel. The panel’s role is to shape the discussion accordingly. However, special care would have to be taken to maintain active engagement of the other participants. Second, although the audio-only sessions were appreciated by the students, using video conferencing instead could maybe help with interactivity, at the expense of some of the students’ privacy. Features such as background blurs might pose a compromise. Third, one might consider a relatively strict set of questions that should be discussed for every paper. While this could lead to a more structured and streamlined discussion, our setting allowed more open discussion instead, where we could take advantage of this flexibility.

REFERENCES