Teaching Statement Kiwan Maeng

Teaching Philosophy When it comes to teaching, I keep it my top priority to *provide a learning experience that is fun, interactive, and not too overwhelming.* Learning can often be frustrating for students if they lose motivation or lack proper background knowledge, which can deteriorate their academic achievement. Based on my prior experience, I will work hard to keep students engaged and motivated throughout the learning process. I have developed three guiding principles in teaching to achieve this goal from my past teaching experiences. First, the learning materials **must be motivating and interesting**. Second, the class **must be tiered to target students of different levels**. Third, the learning experience **must provide means for different students to participate comfortably**. The guiding principles are exemplified throughout my teaching experiences, including (1) *my educational science graphic novel publication*, (2) *academic teaching experiences as a teaching assistant, tutorial organizer, and hackathon mentor*, and (3) *voluntary teaching experiences for the local community.*

Experience 1. Educational Science Book Publication I am the author of a best-selling educational science book in Korea [1], which honed my skills to effectively deliver scientific knowledge. The book [1], which aims to explain scientific concepts to the general audience without much scientific background, received several awards and is being distributed by the government to military bases to educate the Korean army.

When conveying information to others, I always try hard to be *interesting and accessible*, which I found to be often the most effective strategy for successful learning. Although there had been many science books targeting the general public before mine, I found that they were mostly read only by those who were already knowledgeable and enthusiastic about science. I felt a need for a learning experience fun and accessible enough to attract even the non-science enthusiasts. The key was to put myself in the reader's shoes. *What would motivate them? What concept would they find confusing, and why?* I motivated topics with examples the readers can attach to, used analogies to trending cultural references, or even referenced internet memes to keep the readers engaged. I carefully chose each wording, often spending days on a single sentence, to ensure that the information is easy to comprehend. The friendliness and accessibility of the way my book delivered scientific concepts made my book successful. I received several compliments from readers saying that my book was the first science book that they would voluntarily read.

Even in universities where students are already eager to learn, I often find interesting and motivating lectures much more effective to students' success. I will use my skills as a successful book writer to keep students motivated and engaged throughout the class. I will connect to students' thoughts and feelings to understand what makes them struggle during classes. *Is the class hard to follow? Is it boring? Do they understand the importance of the concept?* I will not hesitate to use motivating examples, various multimedia over text-based lectures, and sometimes refer to trending cultural references as a refresher, which were all highly successful strategies when writing my book.

Experience 2. Academic Teaching Experiences I also have experiences as an instructor in academic settings, which taught me the importance of tiered lectures. I organized a tutorial on programming battery-less, energy-harvesting devices at the IEEE/ACM International Symposium on Microarchitecture (MICRO) in 2018. I also organized and ran an embedded systems hackathon for undergraduate women as part of the CMU's educational outreach program (OurCS).

For both experiences, making participants with different backgrounds actively participate was my biggest concern. For the MICRO tutorial, participants had different prior knowledge of batteryless devices and embedded system programming. To embrace all participants, I designed a series of hands-on activities, where the participants built a batteryless ML application running with harvested energy. I decomposed the end-to-end application building experience into a series of small steps so that participants can accomplish each task at their own pace. Most participants ended up with some version of a working system, which made them satisfactory. For example, most participants could run a toy application with tethered power, while a few participants succeeded in running the ML application with harvested energy. The MICRO tutorial was a big success, with more than 60 people actively participating.

Similarly, the 6 participants for the OurCS hackathon did not have much programming experience and had different backgrounds, making it hard for me to set the right level of difficulty for the hackathon. Again,

designing tiered goals was helpful. I designed an open-ended project for the participants, where they built a batteryless board game using an accelerometer and a color sensor. The project was guided by a set of tiered goals. For example, they started from only using a color sensor and were advised to additionally add an accelerometer to the system for additional features. The students could not accomplish all the goals that we initially set; however, they could still end up with an end-to-end board game that was functional.

I plan to use a similar tiered lecture strategy to embrace students with different levels and learning speeds. I will carefully design lower-level materials not to be overwhelming and design optional, higher-level goals for additional achievements, as I did for the tutorial and the hackathon.

Experience 3. Community Teaching Experiences I have consistently participated in voluntary teaching activities for local communities, where I learned how to make an inclusive classroom environment. In Korea, I served as a teacher in children's centers for low-income housing and multiracial families for three years each. I have also organized and taught at English summer camps for rural areas three times. After coming to the U.S., I have been teaching Korean to the local community in a public library for four years.

Because students in these classes often had different cultural, academic, and personal backgrounds, promoting in-class participation was a challenge. For example, in children's centers in Korea, students felt uncomfortable speaking out loud in front of their seniors because of cultural reasons. In the public library, students had widely different levels of background knowledge, which made many students reluctant to ask questions. To solve the problem, I paired the students to do in-class activities, where they discussed and compared the answers. I found that the discussion was much more active in pairs of two than in a larger group because many students became friends with their pair and felt more comfortable discussing their thoughts. Instead of only enforcing face-to-face participation, I also promoted other forms of participation. For example, many students who were silent during the in-class discussion were able to participate more in the form of text, e.g., when asked to write down their thoughts.

Similarly, in university lectures, students come from different cultural backgrounds, and some students find it hard to participate in class actively. Using my experiences, I will make an inclusive classroom where everyone can participate through diverse communication channels, e.g., using online chat or polls during class. I will also pair the students based on their background knowledge to expedite one-on-one discussions, which I found very useful.

Future Courses I am excited to teach introductory computer systems/architecture courses, both introductory and advanced level compiler courses, and embedded system courses.

On top of existing courses, I am eager to design new undergraduate- and graduate-level courses, including:

- A graduate-level course for **modern compiler optimizations**, similar to CMU's 15-745 that I TA'ed. The course will cover extensive hands-on experiences on LLVM-based compiler implementation, in-depth optimization theory, and paper reading and discussion to cover cutting-edge technologies and emerging new topics, such as compilers for machine learning.
- A course for **machine learning for low-power embedded devices (TinyML)**, which will introduce a new field of TinyML and its challenges, including efficient kernel synthesis, model compression, and neural architecture search. The class will include hands-on experiences to implement ML applications on a resource-constrained embedded device with widely-used frameworks, followed by discussions of the limitation and an open-ended project.
- A course for **intermittent, batteryless energy-harvesting devices**, which will consist of a set of paper reading and hands-on projects implementing useful applications on batteryless devices.

My research background in designing compilers for batteryless devices and TinyML systems will make me suitable for teaching these new courses, which will be a nice addition to the existing curriculum.

References

[1] Kiwan Maeng. 야밤의공대생만화 *[The Midnight Engineer]*. Seoul: 뿌리와이파리, 2017.