Visiting Singapore University of Technology and Design (SUTD)

Arian Maghazeh

Motivation to Visit

In the summer of 2017, I paid a visit to Singapore University of Technology and Design (SUTD), where I spent a three-month period as a visiting fellow from Jul. 1 to Oct. 1. During this period, I was hosted by the Information Systems Technology and Design research pillar and had the great opportunity to work with prominent SUTD researchers. The visit was financed mainly by SUTD and partially by the national computer science graduate school (CUGS)[1], commissioned by the Swedish government and the board of education. I would like to express my sincere gratitudes to both organizations for their support.

Among several reasons that encouraged me to visit SUTD, perhaps the primary factor was my acquaintance with Dr. Sudipta Chattopadhyay, who was kind enough to offer me a grant to visit SUTD. Dr. Chattopadhyay is an assistant professor at the Information Systems Technology and Design (ISTD) pillar at SUTD. He is a prominent researcher whose research broadly cover the area of program analysis, embedded systems and compiler[2]. Before joining SUTD, Dr. Chattopadhyay spent two years (2013–2014) as a post-doctoral researcher in our lab (Embedded Systems Lab). During this period, I used to have many discussions with him, which would often leave me impressed with his broad range of knowledge across various topics. Surely, this visit would give me the chance to work closely with such a competent researcher, and more importantly a great person, whom I have always admired.

Experiencing another research environment and working in research groups with different research agendas allow any researcher to become exposed to a whole set of new ideas, expand their circle of contacts, and better reflect on their own research activities. This, in particular, holds true for me as a Phd student, who spend most of my time delving into the narrow subject of my thesis. Moreover, SUTD is a young and ambitious university fueled by the highest incentives of an industry leading country, which distinguishes it among other research centers to visit.

Research

My Phd thesis deals with proposing software techniques to optimize the design of GPU-accelerated embedded systems. GPUs (Graphics Processing Units) are

[1] http://www.ida.liu.se/ext/cugs/

[2] https://istd.sutd.edu.sg/people/faculty/sudipta-chattopadhyay

hardware accelerators traditionally designed to handle heavy computation for computer graphics. Since a decade ago, researchers began to use the tremendous computing power of GPUs to accelerate non-graphics applications, and hence a new computing paradigm emerged that is known as GPGPU (General Purpose computing on GPUs). Today, GPGPU is widely deployed in different categories of computing devices from supercomputers to embedded mobile systems. In my thesis, I investigate GPU-based optimization techniques to improve the performance of embedded systems with stringent timing and power requirements.

During the visit, I worked on a project in accordance with my Phd thesis to develop a system-level technique to improve the performance of GPU applications. The goal of the project was to reduce data-access time in GPU applications targeted for GPU-based platforms. Our means to achieve this goal was to exploit the GPU cache (a small fast on-chip memory) to accelerate parameter passing between different data-dependent applications that run successively on the GPU. Two applications are data-dependent if the output generated by one application is used as the input by its successor application. The proposed technique reduces the need to access the system memory, which is typically an order of magnitude slower than the cache.

In addition to the aforementioned project, initially, I was also involved in another project regarding security in cyber-physical systems. The ambition of this project was to create a GPU-accelerated software framework for exposing security vulnerabilities in IoT (the Internet of Things) devices using fuzzing techniques. Fuzzing is an automated software testing technique that seeks to expose several flaws in a computer program by providing random data as inputs to the program. This project was in collaboration with SUTD iTrust research group, which focuses on the development of tools and methodologies to ensure the security and safety of Internet-based computing systems[3]. However, after some early studies and project duration assessment, we came to the conclusion that the project could not be completed within the three-months period and had to be cancelled.

About SUTD

Singapore University of Technology and Design is the fourth autonomous university in Singapore that was established in 2009 in collaboration with the Massachusetts Institute of Technology (MIT). SUTD offers degrees in four areas of focus called "pillars": Architecture and Sustainable Design (ASD), Engineering Product Development (EPD), Engineering Systems and Design (ESD) or Information Systems Technology and Design (ISTD). The campus, which opened in 2015, is located in the eastern part of Singapore. The unique double quadrant organization of the campus provides it a modern view that elegantly reflects university's focus on design – which is perhaps the main strategic factor that sets SUTD apart from other universities in Singapore, and even globally. Below you can see a few photos from the university campus (Figures 1–4). SUTD's emphasis on the design aspect can also be seen in its undergraduate curriculum. For example, in an actual design situation, during their final two semesters, students have to complete a capstone project that spans multiple disciplines.

[3]https://itrust.sutd.edu.sg

Visiting Singapore

Singapore is an attractive candidate for spending an internship. Being a leading country in modern technology and innovation, its universities are among the top universities in the world with National University of Singapore (NUS) and Nanyang Technological University (NTU) consistently being ranked among the global top 15. Moreover, it is a tourist friendly country with great number of attractions, making it a pleasant place to stay. Following, I have gathered some miscellaneous remarks that hopefully can be of use for anyone who plans to visit Singapore in the future.

- The cost of living in Singapore is comparable to that in Sweden, with the exception of the accommodation cost which is more expensive in Singapore. You can find detailed information about cost of living in Singapore in this link. The average cost of living for a single person is about 2000–2500 SGD (approx. 12000–15000 SEK) including rent.
- Singapore is situated near equator and has a tropical climate with high humidity and uniform temperature, which typically ranges between 26 °C and 31 °C throughout the year. Therefore, consider taking extra clothes and abundant of water if you plan on long distance walking. Also, do not forget to carry an umbrella with you as heavy rain might catch you by surprise.
- I suggest to find an accommodation that is located within a ten-minute walking distance from the campus/work place. This way you can save yourself from getting soaked in sweat at the start of the day and also skip the heavy traffic jams in the morning.
- Singapore has very strict urban regulations. It is forbidden to eat or drink in public transport, chew gum, spit or litter – you can be heavily fined if you do so!
- Singapore has a very rich multicultural food culture offering cuisines from India, China, the Middle East, etc. Make sure you visit the famous food centres (aka. hawker centres), where you can find a great variety of high quality food as cheap as 20 SEK. Also, if you are looking for a local food with unique and sophisticated taste, do not miss the 328 Katong Laksa (Figure 5).
- To run away from the crowd and enjoy a beautiful panoramic view of the city, you can visit the less known Singapore Pinnacle.
- If you are a coffee drinker, get yourself familiarized with different types of local coffee drinks in Singapore (Figure 6) and make sure you try them.
- Like any other crowded city, it can get noisy at times. Therefore, having simple earplugs or active noise-cancellers can be very handy.

Figure 1: A view of the campus

Figure 2: SUTD library

Figure 3: SUTD library

Figure 4: University food court

Figure 5: Laksa (on the left) with Otah

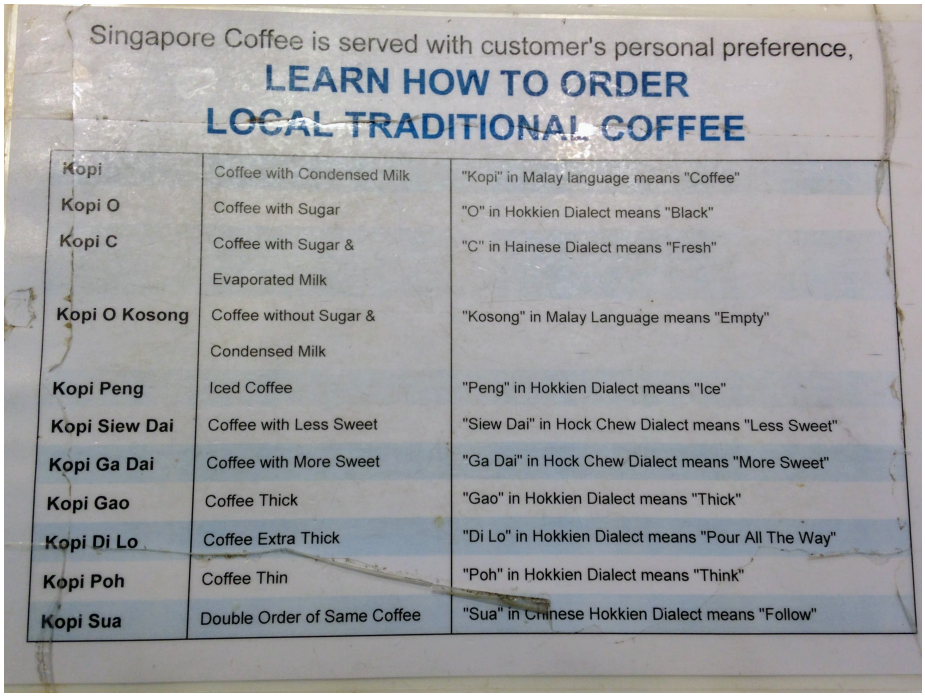

Figure 6: Local coffee drinks