Honoursprogramme: Research track, option B (9 ECTS)

A core language with row-based effects for optimised compilation

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1 Reflection

1.1 General reflection

An important, if not the most important, aspect that I learned, is that there is no shame in asking for help. This is a competency I didn't think I would learn, it is also not a competency I thought was a problem. More specifically, during the honoursproject I realised that it was better to ask a lot of questions and timely tell someone when I'm having issues then to wait.

In the proposal, I said that the honoursprogramme provided an excellent opportunity to get involved with research. Looking back, this has become the most important reason for me. Without the honoursprogramme, I would have a different view of what research is like. I also said that I liked the challenge.

In the end, the honoursproject was even more challenging than I expected it to be. Instead of doing the honoursprogramme over a period of the entire academic year, I completed it in nearly one semester. Because I really enjoyed the challenge that the honoursprogramme provided me, I decided to take the second honoursproject this year aswell. This means that I will complete the entire honoursprogramme in a single year.

1.2 Relation between honoursprogramme and degree

The honoursproject is linked to my master degree. The honoursproject helped me decide what I want to do for my masterthesis. My second honoursproject goes further in the effect handlers project. Both honoursprojects build up towards my masterthesis. This is an interesting result from doing the honoursprojects within the computer science departement. If I didn't do my honoursproject within the computer science departement, I wouldn't be able to use the honourprojects as a build up for the masterthesis. This is also something that wasn't planned in advance.

During my bachelors, I had a course on functional and logical programming. This course was useful since it provided me with knowledge about the functional programming paradigm. Though it wasn't a course, I have done several research internships. The content of these internships were not related to programming languages. However, these internships did prepare me for the honoursproject. It taught me how to work independently.

There is also a course on Formal Systems and their Applications (H04H8BE) which revolves around the typical structure and composition of a formal system such as the lambda calculus. It is taught during the second semester. I was planning to take this course at first, since the content seemed relevant to my honoursproject. However, since my honoursproject occured throughout the first semester, I wasn't able to take the course and possibly take advantage of the content.

Other than these courses, there weren't any courses which directly link to the honoursproject. However there was a synergy between the honoursproject and the courses I followed. This synergy came from the fact that my specialisation, Artificial Intelligence, is linked to the research group where I'm doing my honoursproject.

1.3 Workload of the honoursprogramme

In the proposal of the honoursproject, it was also discussed that doing the entire honoursprogramme during the masters would be difficult. To make my second year more bearable, I chose to spend 70 ECTS credits on courses during my first year instead of the usual 60 ECTS credits. This has to consequence that my first year would be even more difficult compared to the honoursproject added to the usual 60 ECTS credits.

My academic year hasn't ended yet, but I can say that it wasn't a mistake to take the 70 ECTS credits. It was a huge workload, but it also had another unintended effect. My time management skills improved significantly. The fact that I'm also taking my second honoursproject this year tells that I'm motivated and able to handle the workload.

In general, I found the workload of the honoursprogramme to be comparable to the workload of 9 ECTS credits.

1.4 Social relevance

In the initial proposal, it was said that the honoursproject is socially relevant for multiple reasons. Society continuously demands more, faster and more reliable software. If better tools for programming languages are developed, this demand can be satisfied faster. A type-&-effect system makes it easier

to implement backtracking, non-determinism and more. It also makes it easier to detect bugs within a program. Optimizing a type-&-effect system makes it more viable to use such a system in commercial software.

2 Conclusions

2.1 Looking back

I was able to accomplish more than I expected in the honoursproject. I expected that I could only implement one optimization and that by then I would be done. Multiple optimizations were implemented. In this regard, I underestimated the amount of work I could do in the honoursproject.

However, It took longer to orientate myself in the landscape of algebraic effect handlers than I expected. I found that there is a big difference between getting familiar enough with algebraic effects and handlers so I could use them within programs and getting familiar enough with algebraic effects and handlers so I could do research within that field. More specifically, I could write small programs that use algebraic effects and handlers quite fast, but it took a lot longer to be able to do the optimizations.

2.2 Where the goals reached

In the motivation letter, multiple steps were given that needed to be accomplished.

1. Literature study of Eff and existing optimizations
2. Designing new optimizations
3. implementation
4. evaluation through benchmarks
5. formal proof of the optimizations

These steps, with the exclusion of step 5, were accomplished. In the group, it was decided that it was best for me to continue working on the benchmarks and writing the paper instead of writing formal proofs.

Step 1 was the first task that was accomplished. This was essential for me to be able to contribute to the research project. Afterwards step 2 and step 3 were done in parallel. Finally step 4 and working on the paper were done.

2.3 Value of the Honoursprogramme

Other goals that are important for the honoursprogramme concern my own contributions and the knowledge and experience that were gained. During the honoursproject, I was partly treated as an honoursstudent and partly as a researcher. I was partly treated as an honourstudent since I did have regular meetings with professor Schrijvers. But I was also treated as a researcher as I did have a voice during meetings for the project. This meant that I was able to make contributions and state my opinion about decisions before they are made. Ofcourse this came with the responsibility that I carried my own weight.

I would say there were a lot of values to the honoursproject. Some I have already mentioned. I got introduced to being a researcher. The honoursproject was quite a challenge, which I definitely found a value of the honoursproject. I believe that because of these values, my thirst for more knowledge also increased. I want to delve deeper into type-&-effect systems, learn more about the theoretical foundations.

2.4 Conclusion

To conclude, something that definitely needs to be said is that I'm proud of what I've accomplished during this honoursproject. Choosing to participate in the honoursprogramme and doing my honoursproject with professor Schrijvers were the best choices I could have made. The honoursproject taught me a lot about research, programming language theory and myself.

A Competencies

Theoretical and mathematical foundations of computer science: I wanted to expand my knowledge of the theoretical and mathematical foundations of computer science. I found that I have improved this competency. More specifically, I learned about algebraic effect handlers and formal type systems. However, my thirst for more knowledge has only increased since starting the honoursproject. I want to learn more about type systems and algebraic effect handlers, especially about the theoretical foundations.

Oral communication: I learned a lot about this competency. I was able to discuss decisions to be made in the project with other researchers. In the weekly meetings, each researcher had to talk about the progress made and the issues encountered during the previous week. I feel like I was more shy towards the beginning of the honoursproject. This has gotten a lot better during the honoursproject. However, I feel like I cannot always express my thoughts in the correct scientific terms. That is definitly a working point for the future. Most communication happened in English. It was really interesting and fun to communicate professionally in English. I didn't think that improving my English communication skills was a competency I was going to learn. However, my communication skills did improve during the honoursproject. A skill that I wanted to improve was given presentations for a larger audience. However, this is something that does not really occur during the honoursproject.

Written communication: I improved this competency less than I expected. It also improved in a different way than I expected. I expected to improve my competency in writing reports. However, I didn't write many reports for this honoursproject. I did write portions of the paper, which improved my academic writing competency. This is a competency that still needs to be improved a lot. More specifically, my academic writing skills need to be improved.

Asking for help: As explained before, this is one of the most important competencies that I learned. I didn't think I would learn this competency, since I never realised that this was something that needed improvement. In a research project, it is important to understand the material, but there is also a deadline. That means that without asking for help, things are bound to go awry. This is something I learned during the honoursproject. However, I do think that this is something that can and needs improvement. Sometimes it occurs that people explain a new concept to me, but I don't fully understand it yet. In those circumstances, I would like to ask for more explanations, however I'm not always sure how to ask for help. I also think that sometimes I assume too quickly that I understand something when it would have been better to ask more questions. These are definitely issues that have a high priority for improvement.

Time management: In my reflection I explained that I improved my time management skills. I find this to be an important competency to be learned. Due to the huge workload that I took, which wasn't solely due to the honoursproject, I learned how to efficiently manage my time. I do think that there are still many improvements possible. More specifically, I'm not good at estimating how long a task will take me to execute. I often underestimate or overestimate the amount of time required for certain tasks. This happens mostly with tasks that take less than a week to complete.

Interdisciplinary interest: This competency is not directly linked to my honoursproject, but is more a consequence of the honoursprogramme. Nevertheless, I still find this to be important enough to include in this report. My honoursproject is focused on research and also happens to be within my own discipline. Due to this, the interdisciplinary character of my honoursproject is small. Due to being part of the honoursprogramme, I also attended intervision moments and honourscommunity meetings.

In these meetings I met a lot of new people. Due to these events I learned how different people look towards honoursprogrammes and interdisciplinary work. This is something that broadened my view and is definitely an aspect which I find important.

Finding my limit: As explained above, I improved my time management skills. Another related competency that I improved is how to find my own limits, what I can and cannot do. This is another competency I learned due to the high workload I had. Using the honoursproject I found the bounderies of the amount of work I can do. However, I do think I'm sometimes still overzealous.

Creating a hypothesis: This is a competency I wanted to learn. I feel like this is something that improved over the course of the honoursproject. However I still find it difficult to create a hypothesis. An illustration of this is my masterthesis topic. I knew several aspects about my topic. I wanted it to be research related and it should be related to my honoursproject, type systems. However, it was quite difficult to get concrete ideas myself. Partly I believe this comes from not being knowledgeable enough about the field, which is normal since I'm a masterstudent. But partly I also believe that I also need to learn how to look for potential research ideas.