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Undergraduate Internship Program

This report sums the developed work and goals achieved during my internship at the *School of Computer Science* (SCS) of *Carnegie Mellon University* (CMU). My sponsor at CMU was Professor Umut Acar, while my portuguese sponsor was Professor Hervé Paulino. The internship took place between September and December 2015. During it I attended weekly meetings, and also worked close with Stefan Muller, a SCS Graduate student, advised by Professor Umut. Fortunately, I was given the opportunity to work on a fun, challenging and cutting-edge research problem. None of the internship outcomes would have been possible without the discussions and feedback both Stefan and Umut gave me during the meetings.

The internship's objectives aimed to work on the design of a scheduling algorithm, and further proving some properties regarding its efficiency. The developed algorithm has a novel property that, for the best of my knowledge, has not been mentioned nor solved yet in any related work. This new property leads to great changes in the previous solutions, as the new one has now to deal with requests that must be served as soon as possible after their arrival. For this reason, the work aimed towards designing a provably efficient scheduling algorithm which not only scheduled a computation's execution, but also took into account incoming requests, scheduling them in such a way that they could be served as fast as possible. So, in order to serve a request as fast as possible, the algorithm also had to minimize the time starting between a request's arrival and until some processor started serving the request (ideally this time would be constant). In the first few weeks, I discussed several possible approaches to solve the problem with both Umut and Stefan. After having a sketch of an algorithm, it was time to start working towards proving some of its basic efficiency properties, such as expected execution time and its space bounds. Two distinct versions of the algorithm were developed, but only one had its efficiency properties proved. Even though the second version was not proved due to time constraints, we are aware that by simply using the proofs for the first version of the scheduling algorithm together with some already existing proofs, presented on the field's literature, it would be straightforward to finish the proofs for this unproved version. At the end of the internship, two algorithms were designed, and one had its base properties proved. As for the novel property, a proof was also created for the proved scheduler's version, meaning the developed algorithm possesses all the desired theoretical properties. Furthermore, also during the internship I learned a new programming language, *Standard ML*, in which I helped developing some simple benchmarks to test the efficiency of these scheduling algorithms.

The environment at CMU is phenomenal, both for work and leisure. In what regards to work, some of the numerous interesting events taking place during my stay got my attention. For instance, I have attended some distinguished lectures, which are very interesting as they give an insight on a whole research field, not to mention the career of these distinguished lecturers, their lessons and tips. Another event I attended was a NASA's event regarding how to design robots that could move in environments with almost no gravity (such as meteorites). The director of NSA also gave a talk in which he discussed current security problems of USA engaging in a full debate with the audience. Numerous *hackathons* also took place, as well as seminars towards presenting the latest tendencies of programming languages, IDE's, and so on. During my stay at CMU, I frequently went to its cinema, played tennis, squash and many other sports together with Pedro Neves, who was also at CMU for the same internship program.

To conclude, I have to strongly recommend this internship to any student like me, as it allowed me to grow up so much in so many ways. And so, I have to thank *CMU Portugal* program for this unique opportunity to learn and work on an encouraging environment and in such fun and challenging problems, as the one I was assigned.