Ph.D. in Information Technology: Thesis Defense

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Emanuele VITALI – XXXII Cycle

An holistic approach towards future self-tuning applications in homogeneous and heterogeneous architectures

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Abstract:

With the beginning of the dark silicon era, application optimization, even with the exploitation of heterogeneity, has become an important topic of research.

One methodology to obtain optimized applications for different architectures is application autotuning.

Indeed, applications can obtain the same result with different codes.

However, different codes have different extra-functional properties, such as execution time or energy consumption which may change across different architectures.

To obtain the best, application autotuning techniques have been proposed in literature.

It is very difficult for the original application developer to select the best configuration that can enforce the constraints across different machines, with unknown input and varying configurations.

Given this background, I envision future applications not as monolithic code but as a sequence of modules that are capable of autotuning themselves and can exploit platform heterogeneity.

This thesis consists of a collection of methodologies that were developed during my Ph.D. which aim at giving the programmers ways to create these self-tuning modules.

Firstly, we will see general application autotuning techniques, while in a second section we will be focusing on a single application, GeoDock, which has been an industrial use case that I used to develop and validate the proposed techniques.

In the first part of the thesis, we will see the benefit that can be introduced by run-time dynamic autotuning focusing on the condition of the machine, constraints given to the application, or characteristics of the input data.

Then, we will see the developement of GeoDock from a monolithic non tunable application to an heterogeneous and tunable one, and we will see how this has dramatically improved its performances (from tens of ligands per second processed on a single node to thousands).

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