Automated Fine-Grained Resource Management on Serverless Computing Architectures

Serverless computing represents the next frontier in the evolution of cloud computing being an emerging paradigm that greatly simplifies the usage of cloud resources and suits well to many tasks. Today several public cloud vendors already support serverless. Examples include AWS Lambda (Amazon), Azure Functions (Microsoft), Google Cloud Functions and IBM Cloud Functions. A recent report from Markets and Markets reported that the serverless market is expected to reach USD 14.93B by 2023.

Serverless removes the burden of configuration and management issues (resource allocation, fault-tolerance, load balancing, availability, scalability and others) from the developers. On the other side, from the cloud provider’s perspective, employing an "efficient" consolidation strategy to pack as many applications of different users as possible is challenging. Higher resource sharing leads to decreased performance predictability in serverless frameworks.

Additionally, the fine-granularity nature of serverless computing and the heterogeneity of platforms offered (GPUs, FPGAs, etc)

Figure 1: Serverless growth

Figure 2: An overview of the evolution of virtualization technologies
In this thesis, we will explore different techniques in order to achieve high utilization of resources and high performance at the same time. First we will study the serverless paradigm, and then we will configure a state-of-the-art serverless open-sourced framework.

**Keywords:**
Cloud computing, Serverless Computing, Resource management, Kubernetes, High Performance Computing (HPC)

![Figure 3: Microservice-architecture adopted by leading organizations](image)

**Figure 3: Microservice-architecture adopted by leading organizations**

**Related Work:**
- OpenWhisk
- [Serverless introductory video by AWS Lambda](https://www.youtube.com/watch?v=dQw4w9WgXcQ)

**Prerequisites:**
- Linux, Bash/Shell scripting, eager to learn new things
- Experience on other programming languages (Golang/Python/Java) would be a plus

**Knowledge & Experience the student will acquire:**
- A broader understanding of cloud computing architectures
- Research experience
- Research various state-of-the-art, open-source frameworks (Kubernetes, Knative OpenLambda)

**Contact:**
Achilleas Tzenetopoulos Ph.D. student: [atzenetopoulos@microlab.ntua.gr](mailto:atzenetopoulos@microlab.ntua.gr)
Dimosthenis Masouros Ph.D. student: [dmasouros@microlab.ntua.gr](mailto:dmasouros@microlab.ntua.gr)
Sotirios Xydis Ass. Prof.: [sxydis@microlab.ntua.gr](mailto:sxydis@microlab.ntua.gr)
Dimitrios Soudris Prof.: [dsoudris@microlab.ntua.gr](mailto:dsoudris@microlab.ntua.gr)