

ENACloud - Exploiting the dyNamic Adaptation plan space for improving the energy efficiency of CLOUD-based software applications

Denisse Muñante (1) and Sophie Chabridon (2)

(1) [ensIIE](#), [SAMOVAR](#) Lab, Évry, France

(2) [SAMOVAR](#) Lab, [Télécom SudParis](#), [Institut Polytechnique de Paris](#), Évry, France

Contacts: denisse.munante@zapalo [at] ensiie.fr, Sophie.Chabridon [at] telecom-sudparis.eu

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Context. Dynamic adaptation of software is conceived as a way to avoid and correct, at runtime and under certain constraints, the degradation of quality of the software during its execution, which can be due to changes in environmental conditions. A substantial research effort has been done for defining methods and techniques to engineering self-adaptive software systems, SAS for brevity. And notably, research on model-driven approaches [2] and in particular on model@run.time methods have been proposed to specify how SAS should react in dynamically changing run-time environments [1].

Self-Adaptive Cloud Systems (SACS) dynamically adapt Cloud-based Software Applications with a specific adaptation goal, for instance, improving their energy efficiency to consequently reduce their overall greenhouse gas emissions. To do that, SACS are equipped with components that monitor, analyse, plan and execute the adaptation decisions at runtime. In particular, the **Planner** component is one of the cornerstone of SAS whose responsibility is to **decide how** the software system should be adapted **to achieve their adaptation goals**.

Challenges and Internship objectives. The objective of this internship is to **explore, formalise and exploit** the knowledge domain/space of **dynamic adaptation plans** for Cloud Software Applications, or part of them by considering **energy efficiency** as a primary adaptation goal.

To reach the objective of the internship, we should first explore which parts, from now on called variants, of the cloud software application can be adapted at run-time. Next, we should formalise these variants through, for instance the Planning Domain Definition Language (PDDL) [3]. This formalisation should facilitate the reasoning of the planner. Finally, we should build a tool-supported approach that exploits the previous formalisation to plan adaptations.

To reach the objective, we have to take into consideration the following challenges : (1) the first challenge (**Ch1**) is **to conceive variant models that conform to the architectures of cloud applications** or part of them without losing important information, and (2) in order to not impact other QoS criteria, for instance *User Satisfaction*, the second challenge (**Ch2**) is **to consider the management of conflicts** when evaluating variants that can affect energy efficiency and other qualities, so a multi-criteria approach should be studied.

Notice that **Ch1** is related to the exploration and formalisation of the dynamic adaptation plan space, and **Ch2** is related to the exploitation of the previous formalisation for calculating, for instance through a problem solving approach, the new adaptation plans.

In this internship, we plan to validate our proposal on the TeaStore application¹. Benchmarking will be performed using Grid'5000 infrastructure². In addition, the entire process for the experiments must be reproducible, e.g. the benchmarking campaign is based on the construction of Jupyter NoteBooks³.

Terms and conditions

- Production of open source documentation and code (licenses : GFDL and LGPL).
- Preference for using open source software.
- Version control with the GitLab platform of Télécom SudParis.

This subject is part of the research works of the [DisSEM](#) group concerning Distributed Systems, Software Engineering and Middleware, in the [ACMES](#) team of the [SAMOVAR](#) lab.

Références

- [1] Nelly Bencomo, Sebastian Götz, and Hui Song. Models@run.time : a guided tour of the state of the art and research challenges. *Software System Model*, 18(5) :3049–3082, 2019.
- [2] Javier Cámara and et al. Self-aware computing systems : Related concepts and research areas. In Samuel Kounev, Jeffrey O. Kephart, Aleksandar Milenkoski, and Xiaoyun Zhu, editors, *Self-Aware Computing Systems*, pages 17–49. Springer International Publishing, 2017.
- [3] Patrik Haslum, Nir Lipovetzky, Daniele Magazzeni, and Christian Muiße. *An Introduction to the Planning Domain Definition Language*. Synthesis Lectures on Artificial Intelligence and Machine Learning. Morgan & Claypool Publishers, 2019.

1. <https://github.com/DescartesResearch/TeaStore>

2. <https://www.grid5000.fr>

3. <https://www.fun-mooc.fr/en/courses/reproducible-research-methodological-principles-transparent-science/>