

ENGAGE - ENerGy efficiency through softwAre GENetic improvement

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Context. Energy efficiency has already been considered for many years at the hardware level. However, powerful and cheaper computing resources have led to less resource optimization in software. Considering the planet resource limits and the increasing role of software in the distributed systems, there is an urgent need to design software with energy-efficiency as a requirement.

On the other hand, Genetic Improvement (GI) aims to improve the quality of existing software by using search-based techniques. Gin is a GI toolbox for Java that was used for software repair and run-time performance. Gin was recently extended to improve software according to multiple objectives, *e.g.*, execution time and memory usage.

Internship objectives. In the context of this internship, we would like to introduce a tool-supported approach that takes advantage of GI to improve software energy efficiency. To do that, we plan to extend the Gin toolbox by integrating three main concepts: **i) Energy consumption profiler:** we integrate an energy profiling tool, *e.g.*, JoularJX, to identify the most energy-hungry methods in software, which will be the target of GI. The profiler is also needed to evaluate the fitness function of search-based algorithms. **ii) Energy efficiency tactics:** we add other mutation operators to Gin, they refer to code tactics that were proven to save energy consumption, *e.g.*, code refactoring and changes to data structure. **iii) Energy efficiency fitness function:** the search-based algorithms of Gin are adapted to support the following fitness function: “minimise energy consumed by software”.

Concretely the tasks that will be carried by the selected candidate:

1. Study energy-aware refactoring approaches, *e.g.*, [1].
2. Study the Genetic Improvement approach [3, 4].
3. Understand the Gin toolbox [2].
4. Extend the Gin toolbox for software energy efficiency.

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.

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