

Probabilistic analysis of heap fragmentation in Java-programs

M.Sc. Thesis project (Ex-jobb) proposal

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Background

If a heap is occupied by a spatially scattered large number of small live objects the heap is said to be fragmented. Heap fragmentation is a result of a large number of allocations / deallocations and can cause unexpected delays when allocating memory for new objects.

The main counter-measurement is called *defragmentation* or *compaction* of the heap. Since Java hides the actual memory addresses for objects, the JVM is allowed to implement facilities to compact the heap at will. However, this obviously comes with a performance penalty.

Objective

In this project you will develop a tool to *foresee* heap fragmentation. That is, given some initial knowledge of the program, the tool shall predict the state of fragmentation in the long run by simulating a coarse model of the program using a stochastic memory model.

The tool would roughly work as follows:

1. The user selects a program to analyze.
2. The tool statically analyzes the program
3. (Optional step) The tool rewrites the program to log branching probabilities during execution and runs for a relatively short period of time.
4. A model is built based on the analysis and logged branching probabilities.
5. The model is simulated, or “executed”, and statistical data is collected.
6. A report is generated, with useful information about where the worst memory fragmentation occurs.

Upon successful completion of the project, you are welcome to participate in writing and submitting a scientific paper to a suitable conference.

The project includes:

- A reading part to deepen knowledge of the Java memory model, Java garbage collection and heap fragmentation.
- A tool development part.
- Case study part; Dig up about two or three real world Java applications and analyze them with the tool.
- A writing part in which a formal report is written.

Competence:

- Profound programming skills, preferably with a background in Java.
- Essential knowledge of probability and statistics.

Further reading

<http://java.dzone.com/articles/ghost-java-virtual-machine>
<http://www.artima.com/insidejvm/ed2/gc.html>
[http://en.wikipedia.org/wiki/Fragmentation_\(computer\)](http://en.wikipedia.org/wiki/Fragmentation_(computer))

Contact

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