

Bachelor's Thesis

In-Place Allocation into Free Space into Old Generation Regions

Student: Tobias Kern (k12215555)
Supervisor: Prof. Dr. Hanspeter Mössenböck
Co-Supervisor: Dipl. Ing. Thomas Schatzl (Oracle)
Start: April 1, 2024

Linz, March 21, 2024

The G1 garbage collector is high-performance incremental garbage collector in the OpenJDK Hotspot VM. Currently, G1 reclaims space in regions with live objects by completely evacuating the respective regions, i.e. moving these live objects into different areas. In some situations evacuation is not very cost-effective: evacuation can require significant effort for comparatively little gain in actually freed memory.

An alternative to reclaiming space by evacuation is the re-use of areas of known free space between live objects in the old generation.

The goal of this bachelor's thesis is to

1. investigate which changes are required to make G1 a *hybrid* collector: keep using evacuation for the young generation, but partial in-place allocation into free space into the old generation for promoted objects.
2. based on that, implement a prototype demonstrating the viability of the idea and
3. measure the impact of the changes on garbage collection behavior on a set of benchmarks.

In more detail, since JDK 20, existing concurrent liveness analysis already explicitly recognizes the free areas between objects, but does not use them for allocation. G1 should be extended to collect information about "holes" in the old generation, used to create a heuristic whether a given old generation region should be evacuated, its space used for in-place allocation or left alone, and if applicable prepared to use at allocation time.

At allocation time G1 should then use this information about "holes" to allocate space for promoting objects into.

o.Univ.-Prof. Dr. Dr.h.c.
Hanspeter Mössenböck
Institut für Systemsoftware

P +43 732 2468 4340
F +43 732 2468 4345
hanspeter.moessenboeck@jku.at

Sekretariat:
Karin Gusenbauer
Ext. 4342
karin.gusenbauer@jku.at

The progress of the thesis should be discussed every two or three weeks with the supervisor or the co-supervisor. The normal duration of a bachelor's thesis is 6 months. The mark "sehr gut" is only possible if the software and the written thesis are submitted not later than September 31, 2024. Within the first few weeks of the work a rough time schedule should be developed and discussed with the supervisor.