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Master's Thesis

Graal Support for Valhalla

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Co-Advisors:	Doug Simon, Dr. David Leopoldseder (Oracle Labs)
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Graal [1] is a just-in-time compiler for the JVM platform that is itself written in Java.

Project Valhalla [2] is bringing *value objects* to the Java object model. These objects aim to combine the abstractions of object-oriented programming with the performance characteristics of simple primitives.

The goal of this Master's project is to add support to Graal for Valhalla. This entails:

- Updating the Graal implementation of the bytecode instructions whose semantics are modified by Valhalla-specific JVM specification changes [3]. When compiled by Graal, the new semantics must be implemented for correctness. The implementation will be tested by the existing Valhalla-specific tests in the Valhalla repository [4].
- Adding optimizations in Graal that leverage value objects to obtain better performance. The main optimization will be to scalarize such object whenever possible. This means decomposing the fields of such objects such that their values are stored in registers or stack slots and heap allocation can be avoided. This work will be highly driven by considering the Valhalla-specific optimizations that have been added to C2, the existing top-tier JIT compiler in the HotSpot VM.
- Run Valhalla-specific benchmarks to demonstrate the optimizations added by the previous step have the same or better score when run on Graal versus C2.

The progress of the project should be discussed at least every two weeks with the advisors. A time schedule and a milestone plan must be set up within the first 3 weeks. It should be continuously refined and monitored to make sure that the thesis will be completed in time. The final version of the thesis should be submitted not later than 30.09.2025.

[1] http://openjdk.java.net/projects/graal

[2] https://openjdk.org/projects/valhalla

[3] https://cr.openjdk.org/~dlsmith/jep401/jep401-20240624/specs/value-objects-jvms.html#jvms-6.5

[4] https://github.com/openjdk/valhalla

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