# Master's Project

# Inferring Universe Annotations on the Presence of Ownership Transfer

Annetta Schaad

May 2007

**Introduction**   The Universe type system [1] allows the programmer to structure the object store by an ownership relation to control aliasing and dependencies in object-oriented programs. To be practical, ownership systems must allow objects to migrate from one owner to another. UTT [2] is an extension of Universe Types that supports such ownership transfer. It guarantees statically that a cluster of objects is externally-unique when it is transferred. An externally-unique variable or reference contains either the only reference from outside into the object or is null.

In his Master's Thesis [3] Yoshimi Takano implements uniqueness and ownership transfer in the MultiJava/JML Compiler as extension to the Universe Type System.

**Goal of this master's project**   is to extend the Universe Type System on the presents of ownership transfer and to implement it in the MultiJava/JML Compiler.

**The main parts**   of this project are:

1. Design and implementation of type inference for local variables such that they do not need to be annotated with a Universe modifier anymore.

2. Design and implementation of an extension to the type system to check the subclass separation property.

3. Design and implementation for the support of arrays.

**Possible extensions**   of this project are:

1. Addition of a more flexible solution for array coverage.

2. More precise handling of exceptions.

3. Addition of the support to pass multiple references on a cluster via method invocation.

**This project is supervised by:**

Prof. Peter Müller
Arsenii Rudich arsenii.rudich@inf.ethz.ch
ETH Zurich

# References

[1] Werner Dietl and Peter Müller. Universes: Lightweight Ownership for JML. *Journal of Object Technology (JOT)*, vol. 4, no. 8, 2005, pages 5–32.

[2] Peter Müller and Arsenii Rudich. Ownership Transfer in Universe Types.

[3] Yoshimi Takano. Implementing Uniqueness and Ownership Transfer in the Universe Type System. Master's Theses. March 2007.
http://www.sct.ethz.ch/projects/student_docs/Yoshimi_Takano