

CSci 8980 - Domain Specific Languages and Analyses

Contact information, office hours:

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Office hours: Monday and Wednesday from 10:00am - 11:00am in EE/CSci 6-203, or by appointment.
- Seminar meets on Monday and Wednesday from 4:00pm until 5:15pm in Amundson Hall, room 124.

Course Description

Domain specific languages (DSLs) are designed to be used in specifying solutions to problems in particular areas or domains. Their primary advantage comes from their attempt to raise the level of abstraction of the language to that of the problem domain. This allows programmers to directly specify solutions using concepts and notations from the problem domain as opposed to encoding their solutions in the relatively low-level of abstraction of a general purpose programming language. Examples of DSLs include *SQL*, *Kairos* for programming sensor networks *HTML*, *Yacc*, and *LN* for efficient unbounded-precision integers for computational geometry problems. Besides high-level notations, DSLs often perform static analyses that are impossible (or very difficult) to perform on the programs written in a general purpose language. For example, LN takes advantage of certain characteristics of geometric problems to optimize its unbounded-precision integers for significant increase in efficiency. Security concerns have given rise to languages that track the flow of data through programs to determine if (to over simplify somewhat) data classified as “secret” leaks into variables classified as “public”. Such domain specific analyses are also of interest in this seminar.

This seminar course will be of interest to a wide range of students. Besides the expected audience of students studying programming languages and software engineering, a goal of this seminar is to attract students from various domains such as sensor networks, HPC, DBMS, security, robotics, and others.

In this seminar we will investigate various various domains, domain-specific languages, and implementation techniques. The particular DSLs studied and DSL papers read will be influenced by the interests of the participants. The seminar will include a student-selected and designed project to study a domain (such as those listed above) and implement some aspects of a domain-specific language or analysis. To prepare for this we will also study various implementation techniques for DSLs. These include traditional compiler-generator tools based on attribute grammars or term-rewriting as well as the Microsoft Visual Studio Domain Specific Language Tools (<http://msdn.microsoft.com/vstudio/DSLTools/>). We will also look study tools and techniques for embedding domains specific languages and analyses in general purpose languages. These include lightweight approaches that embed DSLs into languages like Haskell and Ruby. More sophisticated approaches leverage language specification and implementation tools such as the locally grown extensible C and Java language tools (<http://www.melt.cs.umn.edu>), Stratego/JavaBorg, and ASF+SDF.

Prerequisites:

There are no formal prerequisites for this seminar, but if you have taken CSci 5106 or 5161 (ideally both) you will be very well prepared for this seminar. If you've taken neither of these courses, please speak to me; depending on your programming experience, you may still be prepared for this seminar. Some of the fundamentals of compilers and programming languages that are necessary to make effective use of the tools will be reviewed in class.

Required Work and Grading

There will be no exams or homework assignments. Students are expected to lead the class discussion on a topic and appropriate papers selected by the student and instructor. A list of possible papers will be put up on the course web page. This list is meant only to suggest topic areas and possible papers - students are encouraged to search out additional research on a chosen topic.

Students are also expected to complete a project that investigates some aspect of implementing domain specific languages or language features. Students will write a short proposal to be turned into the instructor. Students will also be required to provide a written report of their project.

Projects can be done in small groups or individually.

Questions? If you have questions about what we will be covering or the background you need, please do not hesitate to stop by my office (EE/CSci 6-203) or email me (evw@cs.umn.edu). Additional details will also be posted on the course web page

(<http://www-users.itlabs.umn.edu/classes/Spring-2007/csci8980-DSL/>).