CS442: High Productivity and Performance with Domain-specific Languages in Scala
Information Sheet
http://www.stanford.edu/class/cs442

Time & Location:
Tuesday & Thursday 11:00 AM-12:15 PM Gates 359

Instructor:
E-Mail: kunle at stanford dot edu
Location: Gates 302
Telephone: 650-725-3713
Office Hours: Monday & Wednesday: 11 AM-Noon or by appointment

Teaching Assistants: Hassan Chafi, Arvind Sujeeth, Kevin Brown
E-Mail: cs442-spr1011-staff at lists dot stanford dot edu

Course Support: Darlene Hadding
E-Mail: darleneh at stanford dot edu
Location: Gates 408
Telephone: 650-723-1430
Office Hours: M-F 10:00 AM-3:00 PM

Handouts are available on the web

Mailing List: The class mailing list that will be used for important or late-breaking announcements. Enrolling in the class in Axess should put you on the mailing list automatically.

Grading: Final grades will be computed approximately as follows:

Class participation	10%
Final Project	90%

Units: 3 units

Course Description: This course is an advanced undergraduate/graduate level introduction to developing domain specific languages (DSLs) for productivity and performance using the Scala programming language. The goal of this course is to equip students with the knowledge and tools to develop DSLs that can dramatically improve the experience of using high performance computation in important scientific and engineering domains. The course is aimed at two sorts of students: domain experts who can define key domain specific language elements that capture domain knowledge and computer scientists who can implement these DSLs using a new DSL framework in Scala. In the first half of the class we will focus on understanding the infrastructure for implementing DSLs in Scala and developing techniques for defining good DSLs. In the second half of the course we will focus on example DSLs that provide both high-productivity and performance. During the second half of the course groups of students will develop and implement their own DSLs using the Delite DSL infrastructure. Delite is a Scala infrastructure that simplifies the process of implementing DSLs for parallel computation.

Prerequisites: CS background: CS108, and a systems course (CS143, CS140), preferably CS 149. Non CS background: Expertise in a particular domain and desire to improve productivity and performance of computation.

Participation: You are expected to participate in the class discussion; in fact, 10% of your grade depends on it. To facilitate discussion, I will call upon you at any time during a lecture to answer questions.

Website: The class website is located at:

http://www.stanford.edu/class/cs442

All important class information including lecture notes, and information about the programming assignments will be posted to this site. Any major updates or corrections will also be sent to the class mailing list.

Programming Assignments: Students are responsible for two programming assignments and a final project. The programming assignments will be completed in two weeks. The first programming assignment will serve as an introduction to programming in Scala. The second programming assignment will introduce techniques for embedding DSLs in Scala using Delite.

Final Project: The Final Project is an open-ended research project. The final project will be completed by groups of two to three students. The project will consist of defining a new DSL or adapting an existing DSL and implementing the DSL using Delite. The goal will be to demonstrate that using the DSL improves both productivity and performance.

Tentative Course Schedule

Date	Lecture	Lecturer	Assigned	Due
Tue Mar 29	1. Intro to DSLs	Kunle		
Thu Mar 31	2. Intro to Scala	Hassan	Scala PA, Final Project	
Tue Apr 5	3. Scala II (OO, functional)	Hassan		
Thu Apr 7	4. Scala III	Hassan		
Tue Apr 12	5. Delite	Kevin		
Thu Apr 14	6. OptiML	Arvind		Scala PA
Tue Apr 19	7. Domain knowledge and modeling / DSL design	Zach DeVito		
Thu Apr 21	8. DSL implementation strategies	Kunle	Delite PA	
Tue Apr 26	9. Embedded DSLs in Scala (LMS)	Arvind	FP proposal	
Thu Apr 28	10. DSLs for parallelism	Pat Hanrahan		
Tue May 3	11. Phantom Midterm			Delite PA
Thu May 5	12. Scala STM	Nathan Bronson		FP proposal
Tue May 10	12. Liszt	Niels Joubert		PA2
Thu May 12	13. DSLs for visualization	Jeff Heer		
Tue May 17	14. DSLs for graphs	Sungpack		
Thu May 19	15. DSLs for data querying	Hassan		
Tue May 24	16. Future topics in DSLs	Martin Odersky/ Jorge Ortiz		
Thu May 26	17. Presentations			
Tue May 31	18. Presentations/ Wrap up			Final project