ECE4122/6122 - Advanced Programming Techniques

Instructor

Dr. George F. Riley
Office: Klaus 3360
Office hours: TBD other times by email
Email: riley@ece.gatech.edu

Course Summary

The "Advanced Programming Techniques" course will cover a number of advanced topics in programming methods, data management, distributed computing, and advanced algorithms used in typical engineering applications. All class projects and in--class examples will use the C++ programming language. It is designed to be a 4000 level course cross listed with a 6000/8000 level course, taken by both advanced undergraduate and beginning graduate students. The undergraduate and graduate versions will meet in the same room at the same time, and graduate students will be expected to complete two or three additional assignments as compared to the undergraduate students. The format of the class is two 1-hour classroom lectures per week, where the new topic is introduced, and suggestions of how to go about implementing the topic in C++ is discussed. The students will have unsupervised lab to work on the programming projects and complete the assignments. The topics are diverse, and each could merit its own course. Instead, this course will cover each topic from a conceptual standpoint, and discuss in some detail a small number of specific instances of the programming techniques used to implement programs using that topic. One programming assignment for each topic will be provided to give students practical experience in each topic, and to improve the students overall programming skill via substantial practice in coding and debugging.

Tentative Topics

The list of topics to be discussed is tentative, but likely to include:

- Distributed programming with MPI (2 or3 lectures)
- Parallel programming with pthreads (3 lectures)
- Introduction to graphics programming using OpenGL (3 lectures)
- Object--Oriented code templates (2 lectures)
- Event--based Programming (2 lectures)
- Using non--blocking system I/O (2 lectures)
- Discrete Event Simulation (2 lectures)

Teaching Philosophy

Teaching is interactive! Students are strongly encouraged to participate in class and offer opinions on the issues being discussed. I encourage (and expect) you to participate actively in the learning process. In particular, I welcome your comments and questions as we cover material in class. One-way lectures quickly becoming

boring, both for you and for me. Also, I have found that students often learn more from other students comments than from the instructor! By asking lots of questions, your understanding of the material will be deepened significantly, and the course will be much more fun! From time to time there will be readings for a class session; these will be posted on the class web page below in a downloadable format. Students are expected to download and read the assigned readings before class.

Policy for Completing Out-of-Class Assignments

We will have programming assignments every week or two weeks, excepting weeks when there is an examination. The policy of completing these assignments is clear and simple. **All students must personally and with their own two hands design, implement (type in) and debug their programs.** Two or more students " Working Together " and turning in one program (or copies of the program) is **not acceptable.** However, students are very much encouraged to seek help when it is needed. You can get help from anyone, including the instructor, teaching assistants, and fellow students. You can ask for help with debugging, help with how to formulate a solution, and help with the syntax of the C/C++ program. However, to be clear, each student must personally type in, compile and debug their own program. Cutting and pasting from other solutions is **not acceptable.**

Computing Resources

We will use the Deep Thought computing cluster. Details to follow.

Textbook

There is no textbook for this class. We will use research papers and handouts as required for our reading and discussion.

Getting Help

Students are encouraged to get help from either their fellow students or the instructor. However, when getting help from students be sure to adhere to the policy for completing out-of-class work as above.

- TA Office hours across from Klaus 3360
- Teaching Assistant: Paloma Casteleiro Costa casteleiro@gatech.edu

Office Hours, Tue/Thu 09:30 - 12:30 and Wed 10:30 - 11:30

- Teaching Assistant: Hemin Yang hyang350@gatech.edu

Office Hours,Mon/Wed 09:00-10:00 and Mon/Wed 1pm - 4pm and Fri 09:00am to 12 noon

- Teaching Assistant: Jenny Zhang Jenny_Zhang@gatech.edu

Office Hours, Tue/Thu 1:00 to 3:00, and Thu 09:00 to 12:noon and Fri09:00am - 12 Noon

---

Grading

Programming Projects	60%
Final Project	40%
Total	**100%**

Syllabus

Day	Month	Date	Description	Handout	Due Date
Tue	Aug	23	MPI Tutorial	https://computing.llnl.gov/tutorials/mpi/	
			Simple Blocking MPI Program	testMPI.cc	
			Simple Non-Blocking MPI Program	testMPI2.cc	
			MPI Programs(pdf)	mpi-examples.pdf	
			2D Fourier Transform Assignment	fft2d.pdf	
Thu	Aug	25	MPI Continued		
Tue	Aug	30	MPI Continued		
			MPI non-blocking receive with tags	testMPI4.cc	
Thu	Sep	1	MPI Barrier and Collectives	testMPI3.cc	
			rsync tutorial	http://www.tecmint.com/rsync-local-remote-file-synchronization-commands/	
Tue	Sep	6	Barriers	Barriers-handout.pdf	
Thu	Sep	8	PThreads Example	PthreadsExample.pdf	
			ThreadedCount.cc	ThreadedCount.cc	
			ThreadedCount-Again.cc	ThreadedCount-Again.cc	
			simpleThread.cc	simpleThread.cc	
			simpleThread-Again.cc	simpleThread-Again.cc	
Tue	Sep	13	Leslie Lamport's Bakery Algorithm	Bakery-handout.pdf	
Thu	Sep	15	Threaded 2D FFT Assignment	dft2d-PThreads.pdf	
Tue	Sep	20	Mid-Term Review		
Thu	Sep	22	Mid-Term Exam		
Tue	Sep	27	Discussion of threaded FFT.		
Thu	Sep	29	Templates	TemplateIntroduction-handout.pdf	
			templateintroduction.cc	templateintroduction.cc	
			Vectors-handout	Vectors-handout.pdf	
			vector.cc	vector.cc	

Tue	Oct	4	Vector discussion continued		
			Vector Assignment	TemplatedVector.pdf	
Thu	Oct	6	Continued discussion of Vector assignment		
Tue	Oct	11	NO CLASS SCHOOL HOLIDAY		
Thu	Oct	13	COntinued discussion of Vector assignment		
Tue	Oct	18	Guest Lecture by Brian Swenson		
Thu	Oct	20	Guest Lecture by Brian Swenson CUDA	http://www.nvidia.com/content/gtc-2010/pdfs/2131_gtc2010.pdf	
Tue	Oct	25	Multi-precision arithmetic	gmp-man-5.0.2.pdf	
			RSA Encryption	RSA-handout.pdf	
Thu	Oct	27	RSA Lab Assigned	RSA.pdf	
Tue	Oct	31	RSA Lab Discussion		
Thu	Nov	3	OpenGL Documentation	http://www.opengl.org/sdk/docs/man2/	
			circle.cc	circle.cc	
			circle-complete.cc	circle-complete.cc	
			Makefile for above	Makefile-OpenGL-deepthought	
Tue	Nov	8	Discussion of Icosahedron Assignment		
			ICosahedron Assignment	Icos.pdf	
Thu	Nov	10	Non-Blocking Input Output with select	ChatExample.pdf	
			Chat client	chat.cc	
			Chat server	chatserv.cc	
Tue	Nov	15	More discussion of Mandelbrot set assignment		
			Interesting Mandelbrot Set Video	http://vimeo.com/12185093	
			Mandelbrot Set Assignment	MBSet.pdf	
Thu	Nov	17	Interprocess Communication with Shared memory	ShmFork-handout.pdf	
Tue	Nov	22	The STL Sorted Containers	MapSet-handout.pdf	
			map-set.cc	map-set.cc	
			Day before THanksgiving	no class	
Thu	Nov	24	Thanksgiving Holiday	no class	
Tue	Nov	29	Model/View/Controller Design Pattern	MVC-handout.pdf	
			TicTacToe Class Declarations	ttt.h	
			TicTacToe Class Implementations	ttt.cc	
			TicTacToe main program	TicTacToe.cc	

			Eight Queens	queens-recursive.cc	
Thu	Dec	1	Using Makefiles		
			Makefile1	Makefile1	
			Makefile2	Makefile2	
			Makefile3	Makefile3	
			Makefile4	Makefile4	
			Makefile5	Makefile5	
Tue	Dec	6		Discrete Event Simulation	
			Typesafe Callvbacks	TypesafeCallbacks-handout.pdf	
Thu	Dec	8	Final Exams		
Tue	Dec	13	Final Exams		
Thu	Dec	15	Final Project Due	08:00AM	

Contact Information:

riley@ece.gatech.edu
School of Electrical and Computer Computing
Georgia Institute of Technology
Atlanta, GA 30332-0250

Last Modified: 05:39PM, 14 March 2017.