USC Viterbi School of Engineering

Multiplayer Game Programming

ITP 484x (3 Units)

Objective	This course provides students with an in-depth exploration of networked multiplayer game architecture. Students will develop an understanding of networked games from the lowest Internet protocol level all the way up to network-friendly game logic. Technologies for back-ends as well as large-scale MMOs will also be covered, though the primary focus of this course is on more traditional smaller-scale multiplayer games. Students will participate in hands-on lab exercises which reinforce these concepts.
Concepts	Internet protocols. Sockets. Network topology. Latency. Reliability. Data streams. Generalized Object replication. Data Compression. Client Side Prediction. Networked game logic. Zoning. Quake, Tribes ,Unreal Networking. Back-ends.
Prerequisites	ITP 380
Instructor	Joshua Glazer jglazer@usc.edu
Lecture	M 7-8:20PM in KAP 267
Lab	W 7-8:20PM in KAP 267. Each lab will begin with a simple quiz.
Course Structure	The topics covered during lecture will be applied to the programming assignments spread out through the semester. Throughout the semester, students will be working by themselves on the five different lab assignments. Each assignment will present a problem at a specific layer of a networked multiplayer game. The assignments are: 1. A set of refresher exercises in C++ concepts 2. A basic client-server chat program using TCP/IP. 3. Adding multiplayer support to Trojan Blast, a simple single player game. 4. Adding a reliability layer and bandwidth optimization to Trojan Blast 5. Adding client side prediction and combat to Trojan Blast. There are two exams that are comprehensive of all topics covered.
Textbook	*Networked Graphics: Building Networked Games and Virtual Environments*. Anthony Steed and Manuel Oliveira. ISBN-10: 0123744237.
Grading	The course is graded with the following weights:

Quizzes	15%
Labs (9% Each)	45%
Midterm Exam	20%
Final Exam	20%
TOTAL POSSIBLE	100%

Grading Scale

Letter grades will be assigned according to the following scale:

93%+	A
90-92%	A-
87-89%	B+
83-86%	B
80-82%	B-
77-79%	C+
73-76%	C
70-72%	C-
69	D+
67-68	D
66	D-
65 and below	F

Half percentage points will be rounded up to the next whole percentage. So for instance, 89.5% is an A-, but 89.4% is a B+.

There is no curving. Students will receive the grade they earn. Extra credit is generally not offered.

Policies

Make-up policy for exams: To make up for a missed exam, the student must provide a satisfactory reason (as determined by the instructor) along with proper documentation. Make-up exams are only allowed under extraordinary circumstances.

Late Assignments: Late assignments will only be accepted by the same documented extraordinary circumstances policy for make-up exams.

Before logging off a computer, students must ensure that they have emailed or saved projects created during the class or lab session. Any work saved to the computer will be erased after restarting the computer.

ITP is not responsible for any work lost.

ITP offers Open Lab use for all students enrolled in ITP classes. These open labs are held beginning the second week of classes through the last week of classes. Please contact your instructor for specific times and days for the current semester.

Academic Integrity	USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *SCampus*, the Student Guidebook, (www.usc.edu/scampus or http://scampus.usc.edu) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/. Information on intellectual property at USC is available at: http://usc.edu/academe/acsen/issues/ipr/index.html. In this class, all code submissions will be ran against current, previous, and future students using MOSS, which is a code plagiarism identification tool. If your code significantly matches another student's submission, you will be reported to SJACS. Generally, the rule of thumb is that it is acceptable to discuss solutions to problems with other students, but once you are looking at someone else's code, it crosses over into the realm of cheating. It does not matter if this code is online or from a student you know, it is cheating in all situations. Do not share your code with anyone else in this or a future section of the course, as allowing someone else to copy off your code carries the same penalty as you copying the code yourself.
Students with Disabilities	Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.
Emergency Preparedness	In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies. Please activate your course in Blackboard with access to the course syllabus. Whether or not you use Blackboard regularly, these preparations will be crucial in an emergency. USC's Blackboard learning management system and support information is available at blackboard.usc.edu.

Course Outline

Week 1 (1/13 and 1/15) – Introduction and C++

- Course overview
- Expectations
- C++ refresher
- SVN refresher

Reading: *http:// http://www.parashift.com/c++-faq/*

Lab: C++ refresher

Week 2 (1/22) – The Internet

- The layer cake
- Transport layer: UDP

Reading: *Steed*: Chapter 1

No class 1/19 due to MLK Day.

Lab 1 DUE Sunday, 1/26 @ 11:59PM

Week 3 (1/27 and 1/29) – Internet Data Transmission

- Transport layer: TCP
- The Socket Library

Reading: *Steed*: Chapter 3

Lab: Begin work on Lab 1: Simple chat program with TCP/IP.

Week 4 (2/3 and 2/5) – Network Topology

- NAT
- Peer-to-Peer
- Server/Client
- Wireshark Demo

Reading: §4.1 – §4.5

Lab: Continue Lab 2.

Week 5 (2/10 and 2/12) – Distributing Data Model & Tribes

- Connection management and reliability
- Data streams

Reading: *Steed*: §5.1 – §5.2; "The TRIBES Network Engine Model" (blackboard)

Lab: Continue Lab 2.

Lab 2 DUE Sunday, 2/16 @ 11:59PM

Week 6 (2/19) – Object Replication

- General object sharing
- Intro to Lab 3

Reading: *Steed*: Chapter 8.

No class 2/17 due to President's Day.

Lab: Begin work on Lab 3: Adding Multiplayer to Trojan Blast

Week 7 (2/24 and 2/26) – Continued Object Replication

- Bandwidth Conservation
- Client / Server Modularization

Reading: N/A

Lab: Continue Lab 3

Lab 3 Part 1 DUE Sunday, 3/2 @ 11:59PM

Week 8 (3/3 and 3/5) – Message Architectures

- Remote Procedure Calls
- Message-Based Systems

Reading: *Steed*: Chapter 9

Lab: Continue Lab 3.

Week 9 (3/10 and 3/12) – **Midterm Exam during lecture hours on 3/10**

Lab: Continue Lab 3.

Lab 3 Part 2 DUE Sunday, 3/16 @ 11:59PM

Week 9.1 (3/17 and 3/19) – Spring Break WOOOOH!

Week 10 (3/24 and 3/25) – Real World Problems

- Latency and jitter
- Bandwidth
- Connectivity

Reading: *Steed:* Chapter 10

Lab: Begin work on Lab 4: Delivery Notification Manager and Replication Manager

Week 11 (3/31 and 4/2) – Real World Case Study

- UDK Networking Model
- More Optimizations

Reading: Unreal networking whitepaper (blackboard)

Lab: Continue Lab 4.

Lab 4 Part 1 DUE Sunday, 4/6 @ 11:59PM

Week 12(4/7 and 4/9) – Game State Consistency

- Lockstep approach
- Optimistic algorithms
- Client prediction

Reading: *Steed*: Chapter 11

Lab: Continue Lab 4.

Lab 4 Part 2 DUE Sunday, 4/13 @ 11:59PM

Week 13 (4/14 and 4/16) – Scalability and Security

- Spatial Models
- Network Architecture changes
- Attack Vectors and Security Best Practices
- Case Studies

Reading: *Steed*: §12.1 – §12.5, *Steed*: §13.1

Lab: Begin work on Lab 5: Client Side Predication and Combat!

Week 14 (4/21 and 4/23) – Gamer Services!

- Node.js
- Mongodb
- Heroku

Reading: There is no reading. Only Zuul

Lab: Continue work on Lab 5.

Week 15 (4/28 AND 4/30) – Gamer Services Continued

- TBD
- Review
- **Lab**: Continue work on Lab 5.

Reading: N/A

Lab 5 DUE 5/4 @ 11:59PM.

Final Exam on Monday 5/12 7-9PM KAP 267