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. Object replication. Client Prediction. Networked game logic. Back-ends.
Prerequisites	ITP 380
Instructor	Joshua Glazer
Lecture	M 7-8:20PM in KAP 267
Lab	W 7-8:20PM in KAP 267
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 four different lab assignments. Each assignment will present a problem at a specific layer of a networked multiplayer game. The assignments are: 1. A basic peer-to-peer chat program using TCP/IP. 2. Adding a serialization/reliability layer to Trojan Blast, a single player top down shooter. 3. Adding a client server model, client side prediction, etc. to Trojan Blast 4. Adding matchmaking and leaderboards 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: Labs (15% Each) 60% 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 (8/26 and 8/28) – Introduction and Internet Protocols

- Course overview and history of networked games
- Network Layer (NAT, IP, DHCP, ICMP)
- Transport Layer (UDP, TCP/IP)

Reading: *Steed*: Chapter 1; §3.3 – §3.4

Lab: Using Wireshark (not graded, but very important)

Week 2 (9/4) – Internet Data Transmission

- Application layer
- Sockets
- Basic data transmission

Reading: *Steed*: §3.1 – §3.2; Chapter 6

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

No class 9/2 due to Labor Day.

Week 3 (9/9 and 9/11) – Network Topology

- Data sharing methodologies
- Peer-to-Peer
- Server/Client

Reading: *Steed*: Chapter 2; §4.1 – §4.5

Lab: Continue Lab 1.

Week 4 (9/16 and 9/18) – Adding Reliability to UDP

- Connection management and reliability
- Data streams

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

Lab: Finish Lab 1.

Lab 1 DUE Sunday, 9/22 @ 11:59PM

Week 5 (9/23 and 9/25) – Object Replication

- General object sharing
- RakNet

Reading: *Steed*: Chapter 8.

Lab: Begin work on Lab 2: Adding a serialization/reliability layer to Trojan Blast.

Week 6 (9/30 and 10/2) – Messaging

- Remote Procedure Calls
- Message-Based Systems

Reading: *Steed*: Chapter 9

Lab: Continue Lab 2.

Week 7 (10/7 and 10/9) – Network Requirements

- Latency and jitter
- Bandwidth
- Connectivity

Reading: *Steed*: Chapter 10

Lab: Continue Lab 2.

Week 8 (10/14 and 10/16) – **Midterm Exam during lecture hours on 10/14**

Lab: Finish Lab 2.

Lab 2 DUE Sunday, 10/20 @ 11:59PM

Week 9 (10/21 and 10/23) – Game Logic for Multiplayer Games

- Implementing multiplayer-friendly game logic
- Converting code from authoritative to client/server
- UDK and Unity networking comparisons

Reading: Unreal networking whitepaper (blackboard)

Lab: Begin work on Lab 3: Implementing a client/server model with client prediction.

Week 10 (10/28 and 10/30) – Game State Consistency

- Lockstep approach
- Optimistic algorithms
- Client prediction

Reading: *Steed*: Chapter 11

Lab: Continue Lab 3.

Week 11 (11/4 and 11/6) – Scalability Issues

- Spatial Models
- Network Architecture changes

Reading: *Steed*: §12.1 – §12.5

Lab: Continue Lab 3.

Week 12 (11/11 and 11/13) – Security and Cheating

- Client-side attacks
- Man-in-the-middle
- Encryption

Reading: *Steed*: §13.1

Lab 3 DUE Sunday, 11/17 @ 11:59PM

Week 13 (11/18 and 11/20) – Gamer Services

- Matchmaking
- Voice communication
- Leaderboards and Achievements

Reading: *Steed*: §13.3 – §13.8

Lab: Begin work on Lab 4: Adding matchmaking and leaderboards to Trojan Blast.

Week 14 (11/25) – Back-end Services

- Back-end system design
- Communication methods
- Performance issues

Reading: N/A

Lab: Continue Lab 4.

No class 11/27 due to Thanksgiving.

Week 15 (12/2 and 12/4) – Networking for MMOs

- Database approaches
- Login server communication
- Server Partitioning

Reading: N/A

Lab: Finish Lab 4.

Lab 4 DUE Friday, 12/6 @ 11:59PM

Final Exam on 12/11 @ 7PM