

# Real-Time Networking

Spring 2019

CSC 486

**instructor:** Will Meyers  
**email:** [wmeyers@cdm.depaul.edu](mailto:wmeyers@cdm.depaul.edu)  
**office hours:** M/W 9:30am – 11:30am, 1:30 – 5:00pm in classroom or by email appointment  
**office:** CDM 849  
**website:** Piazza or Discord (Preferred communication)  
**lecture:** Lewis Center 1108, Monday, 5:45-9:00pm  
**Desired to Learn (D2L):** [d2l.depaul.edu](https://d2l.depaul.edu) (Grades, Viewing lectures, Announcements)  
**Version Control:** perforce: **140.192.39.61:1666**

## Description:

Applied real-time networking fundamentals. Topics include low-level TCP/UDP socket programming, serialization of data for network transportation, deterministic data flow and queuing in applications, dynamic configuration and session communications. Students will explore issues related to performance-based networking in different topologies: client/server and peer to peer. Students will create and build real-time applications using different protocols (TCP, UDP, RUDP) with active network simulation of loss, delayed, corrupted and out of order data packets. Architecture of different bandwidth compression and estimation techniques will be investigated. Research of wireless ad hoc networks such as Bluetooth, LTE, WIFI, Zigbee will be explored.

## Prerequisites:

- CSC 461 and (SE 456 or SE 450)
- or instructor consent

## Learning Goals:

- Students should be able to implement TCP/UDP socket programming.
- Students will be able to serialized data structures for network transmission.
- Students will be able to create a deterministic data driven flow in their applications.
- Students should be able to understand the components and communicate with lobby services.
- Students will be able to implement bandwidth compensation techniques for real-time applications such as dead-reckoning and estimation.
- Students will be able to research and comprehend the impact of emerging networking technology trends.

## Grading:

80% - Programming Assignments (7 Assignments READ NOTE BELOW)

- PA1 - Environment (5% - required)
- PA2 - Serialization (12.5%)
- PA3 - Client / Server (12.5%)
- PA4 - Data Driven (12.5%)
- PA5 – Realtime Simulation (12.5%)
- PA6 – Client Side Prediction (12.5%)
- PA7 – Security/Optimization (12.5%)

20% - Final Exam

**NOTE:** You must pass the final exam (60% or higher) to receive a passing grade in the class.  
(It's not an easy exam)

**NOTE:** Grads must complete all assignments.

## Textbooks and printed resources

- **Books**
  - **Computer Networking: A Top-Down Approach (6th Edition)**, 2012, Kurose J., Ross K., Addison Wesley, ISBN-13: 978-0132856201
    - 7th edition is OK as well
- **Material** will be provided by the instructor
  - Lectures, links, SDKs and other corresponding material

## Software

- **Microsoft Visual Studio 2017 Enterprise Edition**
  - [Visual Studio Enterprise 2017](#)
    - C+ and C# install
- **Perforce - Visual Client (p4v)**
  - [www.perforce.com](http://www.perforce.com)
- Download and configuration instructions will be provided in class
  - Server address: **140.192.39.61:1666**

## Programming assignments (PA):

- **5 programming assignments (80%)**
  - PA1 - Environment (5%)
    - C#, C++, Perforce working, Fundamentals
  - PA2 - Serialization (15%)
    - Packing data into continuous small packets for inflation and deflation
  - PA3 - Client / Server (15%)

- TCP/UDP protocols
  - PA4 - Data Driven (15%)
    - Object communication serially driven from a queue
  - PA5 – Realtime Simulation (15%)
    - Realtime (Physics-Based) Simulation using Data Driven Architecture
  - PA6 – Client Side Prediction
    - Simulate Dropped/Corrupt packets on the RealTime Simulation
  - PA7 – Security or Optimization
    - Will add security measures on the RealTime Simulation or Optimize the code for less throughput
    - We will do one or the other
- **Submission of all development projects**
  - Submitted to Perforce

## Final Exam - 20%

- A comprehensive final exam, covering the concepts of this class.
- Closed book written exam.
  - Final week of class
- You must pass the final exam (60% or higher) to receive a passing grade in the class.
  - It's not an easy exam

## Perforce Submissions

- Everyone is expected to submit several submissions to perforce a week.
  - Minimum 5 significant (real) submissions on 3 separate days.
  - To promote incremental development and prevent last day rush.
  - Grade deduction will occur if not followed
- The biggest reason students get into trouble with software design:
  - Not starting the project early
  - Not working on the material frequently enough
  - Taking too large of a bite(byte) of the design
- Both are minimized with this Perforce RULE
- Even my simplest programs take 10-20 submissions.
  - For these project assignments my average is 40-400 submissions, so 5 will be no problem.
- Detailed perforce changelist comments are expected

## Piazza Discussion forum (or Discord)

- Statistics show: students who participate more and help other students do better!
  - The correlation is ridiculous!
    - Poor understanding / poor participation.
    - Great understanding / Great participation
  - As you master the material, help others learn!
    - Want to be a Master programmer so master it!
- Everyone is expected and encouraged to participate on the Piazza discussion forum. All class-related discussion here this term.
  - At least one real question or response per week from every student.
- Everyone is expected to keep up with the material on Piazza and are responsible for its content. Critical class updates and directions will be presented there.
  - Not participating or reading the material on Piazza is not an excuse.
- All correspondence that is not personal in nature should be vectored through Piazza
  - Sensitive material, use Piazza private note, not email.
- The quicker you begin asking questions on Piazza (rather than via emails), the quicker you'll benefit from the collective knowledge of your classmates and instructors. I encourage you to ask questions when you are struggling to understand a concept.
- Keep the forum professional and positive, help each other out.
  - Karma really pays off here.
  - Help each other whenever you can.
    - There will be a section where you'll need help (trust me).

NOTE: Do **NOT** post until you have watched the entire lecture **FIRST** (in class or online)

This will prevent frustration on all sides (members asking or answering questions)

## Collaborating together on programming assignments

- You are encouraged to work together
  - Use the Piazza forums heavy
  - Even share your material with others in the common directory
    - Obviously not the answers
- Everyone is 100% responsible for the work they do.
  - If you get help with a section of code,
  - Please refactor the code the **not out of it**
    - Comment and understand that material
    - Transform the code to **make it yours**
  - Be able to answer **any** question regarding the code you commit
- System for Detecting Software Plagiarism
  - We will be using MOSS - Measure of Software Similarity (Stanford University)
    - Indicates possible code infringements (plagiarism)
    - MOSS - will detect the similarity independent of naming convention, indentation style or formatting, it compares abstract syntax tree of your code.
  - I will pursue any plagiarism/integrity violations aggressively, arguing for full expulsion from the university for the offenders.
    - Don't put me or you in this scenario
- If you gain significant support / help from another student
  - Fully disclose the support / help you had in a Readme.txt file submitted with your assignments.
    - Disclosing the help, is **not permission** for copying the code.
    - Only there to clarify and acknowledge help you were given from a fellow student.
- Modifying any Unit Test to alter the outcome results is also an **Academic Integrity Violation**
- If you are stuck and find yourself even tempted to plagiarize
  - Ask for help !!!!
    - Use on Piazza -> Visit during offices hours, make an appointment
    - **Don't ever compromise your integrity!**
- Material was uniquely created for this Class.
  - You indirectly by the process of tuition, "paid" for the contents and material of this class.
    - Do not share this **copyrighted** material in any form
    - It is design for your personal use, while enrolled in the Class.
  - Do **NOT** post any content or revealing material to any external website or forum outside of this class.
    - The Class Piazza forum is provided for this service, ask questions there, not on the internet (i.e. StackOverflow and other software forums)
- After you leave this class
  - You are expressly **FORBIDDEN** to provide or share the content with others.
  - Academic Integrity Violations can still be applied to students who provide material support to other students even after completion of the class.
- Just follow the golden rule:
  - **"I have neither given, nor received, nor have I tolerated others' use of unauthorized aid."**

## Tentative Schedule:

Week	Lecture	Assign	Due
1	Syllabus, Class Overview Network Introduction	PA1 - Environment	
2	Data Alignment and Padding Serialization Networking IP DNS	PA2 - Serialization	PA1
3	Sockets Socket Programming Networking NAT	PA3 - TCP/UDP	
4	C# Basics Protocol Internals		PA2
5	Data Driven Networking Debugging	PA4 – Data Driven Queue	PA3
6	Architecture	PA5 – RealTime Simulation	PA4
7	Latency		
8	Prediction Concurrent Networking	PA 6 – Client Side Predition	PA 5
9	Consistency Replication	PA 7 – Security Optimization	PA6
10	Cheating / Security Review		
11	Final Exam		PA7

April 5, 2019  
 April 12, 2019  
 April 12, 2019  
 April 22, 2019  
 May 17, 2019

Last day to add classes to SQ2019 schedule  
 Last day to drop classes with no penalty, Last day to select pass/fail option  
 Grades of "W" assigned for SQ2019 classes dropped on or after this day  
 Last day to select auditor status  
 Last day to withdraw from SQ2019 classes

## Course Policies

### Changes to Syllabus

This syllabus is subject to change as necessary during the quarter. If a change occurs, it will be thoroughly addressed during class, posted under Announcements in D2L and sent via email.

### Online Course Evaluations

Evaluations are a way for students to provide valuable feedback regarding their instructor and the course. Detailed feedback will enable the instructor to continuously tailor teaching methods and course content to meet the learning goals of the course and the academic needs of the students. They are a requirement of the course and are key to continue to provide you with the highest quality of teaching. The evaluations are anonymous; the instructor and administration do not track who entered what responses. A program is used to check if the student completed the evaluations, but the evaluation is completely separate from the student's identity. Since 100% participation is our goal, students are sent periodic reminders over three weeks. Students do not receive reminders once they complete the evaluation. Students complete the evaluation online in [CampusConnect](#).

### Academic Integrity and Plagiarism

This course will be subject to the university's academic integrity policy. More information can be found at <http://academicintegrity.depaul.edu/>. If you have any questions be sure to consult with your professor.

### Academic Policies

All students are required to manage their class schedules each term in accordance with the deadlines for enrolling and withdrawing as indicated in the [University Academic Calendar](#). Information on enrollment, withdrawal, grading and incompletes can be found at: [cdm.depaul.edu/enrollment](http://cdm.depaul.edu/enrollment).

### Students with Disabilities

Students who feel they may need an accommodation based on the impact of a disability should contact the instructor privately to discuss their specific needs. All discussions will remain confidential.

To ensure that you receive the most appropriate accommodation based on your needs, contact the instructor as early as possible in the quarter (preferably within the first week of class), and make sure that you have contacted the Center for Students with Disabilities (CSD) at: [csd@depaul.edu](mailto:csd@depaul.edu).

Lewis Center 1420, 25 East Jackson Blvd.

Phone number: (312)362-8002

Fax: (312)362-6544

TTY: (773)325.7296

### Retroactive withdrawal

This policy exists to assist students for whom extenuating circumstances prevented them from meeting the withdrawal deadline. During their college career students may be allowed one medical/personal administrative withdrawal and one college office administrative withdrawal, each for one or more courses in a single term. Repeated requests will not be considered. Submitting an appeal for retroactive withdrawal does not guarantee approval. Information on enrollment, withdrawal, grading and incompletes can be found at:

<http://www.cdm.depaul.edu/Enrollment-Policies.aspx>

