Distributed Systems

CS425/ECE428

March 8 2022

Instructor: Radhika Mittal

Logistics

- HW3 was due yesterday.
 - If you are using grace period for late submissions, today is the last day to submit the homework.
- HW4 will be released later this week (after your midterm).

Today's agenda

Exam Review

Midterm on Thursday, March 10, I Iam-noon

- Detailed instructions shared on CampusWire (post #292).
 - Go over them again.
- Syllabus:
 - everything up to and including Paxos.
 - Until ~first half of March 1st lecture.

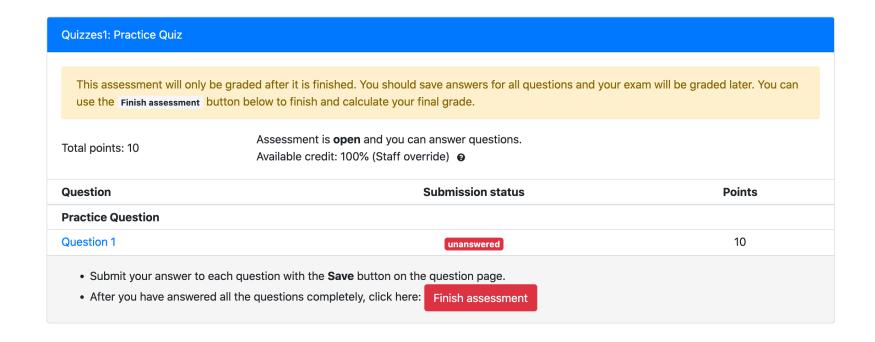
Prairie Test

- Check your reservation time slot.
 - All conflicts and accommodations have been accounted for.
- Zoom link will be made available on your PrairieTest homepage 5-10mins before the start of your exam.
- PrairieLearn link will also be made available on your PrairieTest homepage at start time.
 - Unless you have special accommodations, you have Ihr to complete the exam (irrespective of your session duration).
- Detailed instructions linked at CampusWire post #292.

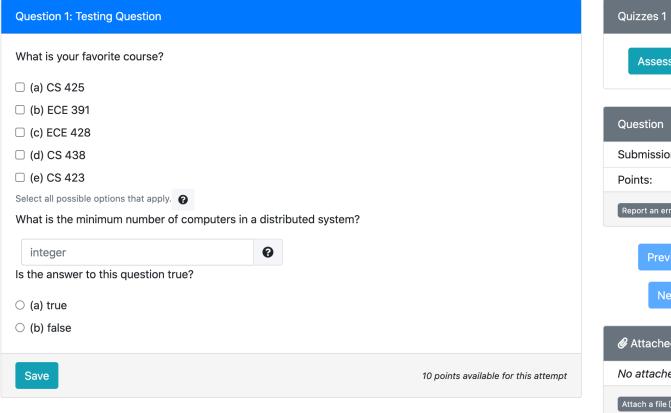
PrairieLearn

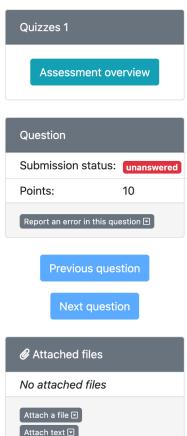
- Exam format:
 - Multiple choice questions and True/False
 - For questions with multiple choices correct, there is negative marking for selecting incorrect choices to discourage guesswork (the minimum score per question is capped at zero).
 - Numerical questions
 - No step marking!

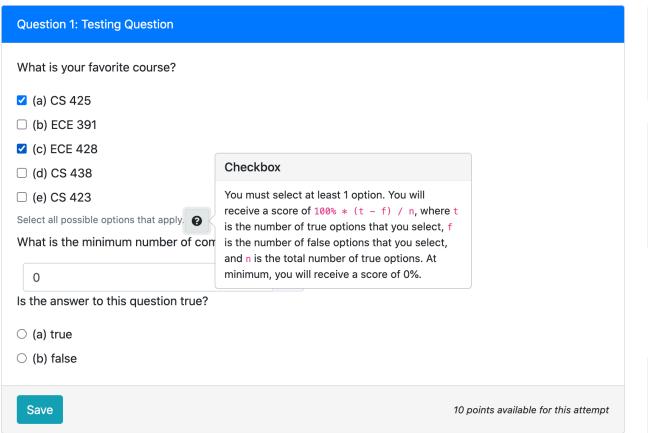
Quizzes1: Practice Quiz
This is Quizzes 1: Practice Quiz for CS 425 / ECE 428
I certify that I am Radhika Mittal and I am allowed to take this assessment.
I pledge on my honor that I will not give or receive any unauthorized assistance on this assessment and that all work will be my own.
☐ I certify and pledge the above.
Start assessment

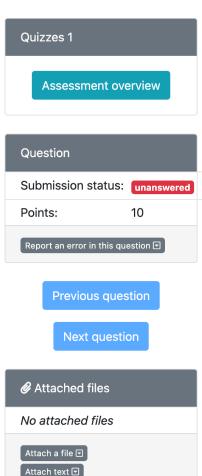


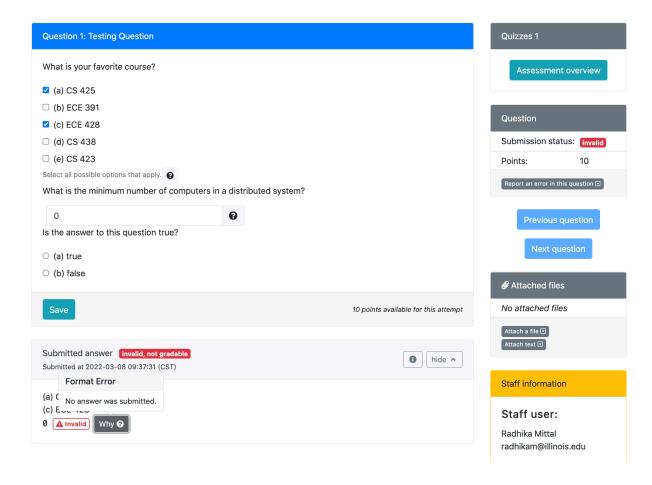
This demo has only one question. Your midterm will display more than one questions.



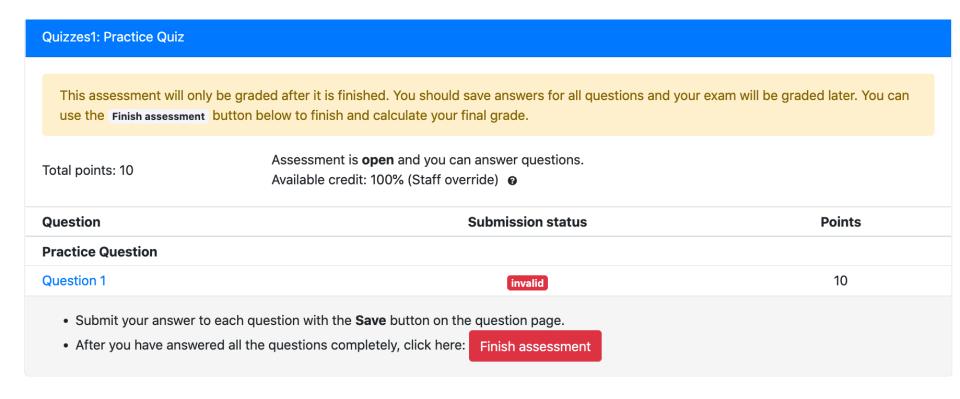




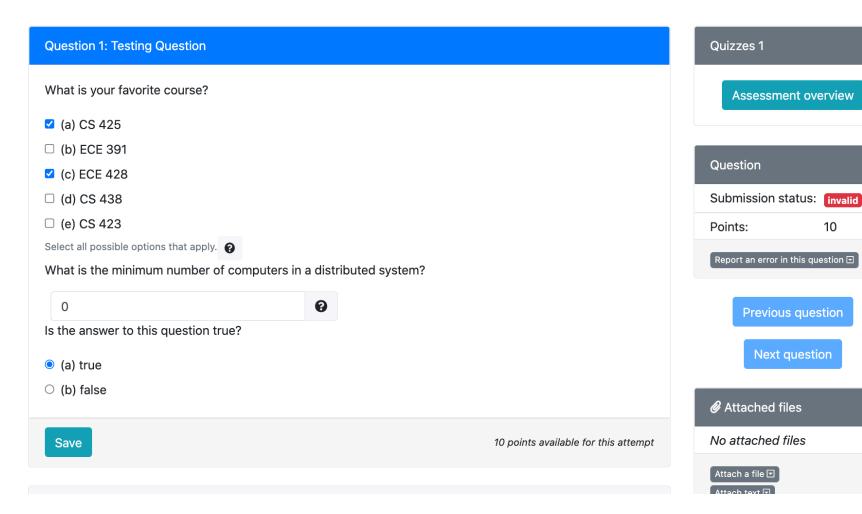


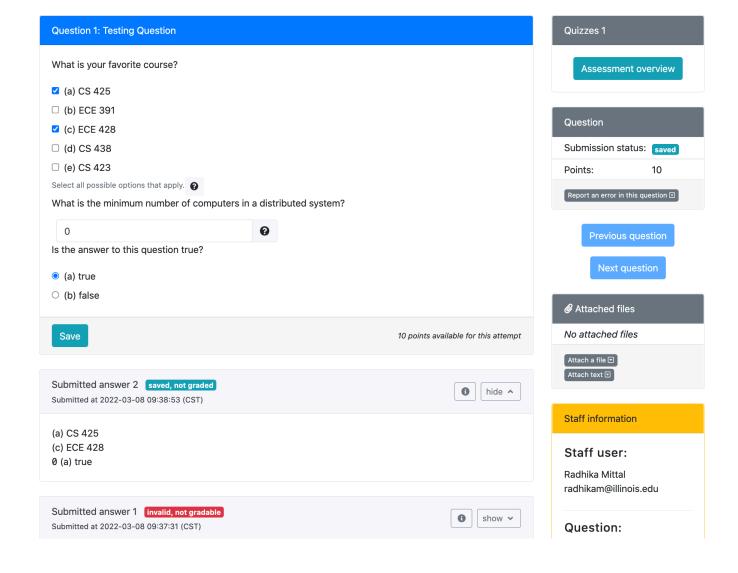


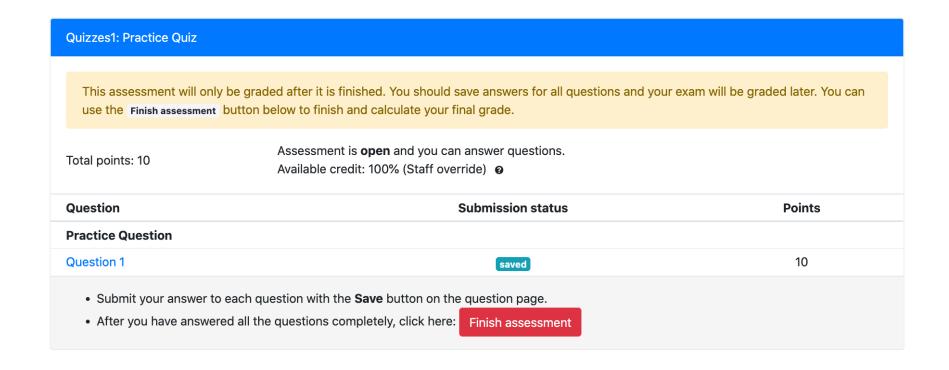
You must attempt all subparts of a given question for the question to be gradable.



Valid responses saved for other questions will not be affected.







Policies

- It is a closed-book exam (no websites, no textbooks).
 - You are allowed one physical double-sided cheat sheet (could be typed or hand-written).
- You cannot print your exam.
- You cannot use your iPad as scratch-pad.
- You must finish your PrairieLearn assessment before you end your Zoom proctoring session.
- Checkout post#292 for other instructions.

Disclaimer for our agenda today

- Quick reminder of the relevant topics we covered in class, that are included in your midterm.
- Not meant to be an exhaustive review!
- Go over the slides for each class.
 - Refer to lecture videos and textbook to fill in gaps in understanding.

- System model and Failures
- Failure Detection
- Clock Synchronization
- Event ordering and Logical Timestamps
- Global Snapshot
- Multicast
- Mutual Exclusion
- Leader Election
- Synchronous Consensus and Paxos

- System model and Failures
 - What is a distributed system?
 - Relationship between processes
 - Synchronous and Asynchronous Systems
 - Types of failures

- Failure Detection
 - Ping-ack and Heartbeats: what are appropriate timeout values?
 - Correctness of failure detection algorithms (accuracy and completeness).
 - Performance of failure detection algorithms (bandwidth usage and worst-case failure detection times).
 - Extending to a system of N processes.

- Clock Synchronization
 - Clock skew and drift rates
 - External vs Internal Synchronization
 - Clock synchronization in synchronous systems
 - Cristian Algorithm
 - Berkeley Algorithm
 - NTP Symmetric mode synchronization

- Event ordering and Logical Timestamps
 - Happened before relationship
 - Lamport Clocks
 - Vector Clocks

- Global Snapshots
 - Process and channel states
 - Consistent cuts
 - Chandy-Lamport algorithm
 - Runs and Linearizations
 - Safety and liveness properties, stable global predicates

- Multicast
 - Basic multicast
 - Reliable multicast
 - Ordered multicast: FIFO, Causal, Total
 - How to implement these?

- Mutual Exclusion
 - Central server algorithm
 - Ring-based algorithm
 - Ricart Agrawala algorithm
 - Maekawa algorithm (breaking deadlock not in your syllabus)
 - Analyzing these algorithms:
 - Safety, liveness, and ordering
 - Client delay, Synchronization delay, and Bandwidth.

- Leader Election
 - Ring election algorithm (Chang and Roberts algorithm)
 - Bully algorithm
 - Analyzing these algorithms:
 - Safety and liveness for synchronous and asynchronous systems
 - Turnaround time and bandwidth

- Synchronous Consensus and Paxos
 - Round-based algorithm for synchronous consensus
 - Impossibility of consensus in asynchronous systems (proof not in your syllabus).
 - Paxos algorithm
 - Three roles: proposer, acceptor, learner.
 - Phase I: prepare request and response.
 - When will an acceptor respond?
 - Phase 2: accept request (if applicable)
 - When will an accept request be sent?
 - What will be the proposed value?
 - When is a value implicitly decided? How is the value shared with the learners? What is required to guarantee safety?

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Good luck!