Distributed Systems

CS425/ECE428

March 20 2023

Instructor: Radhika Mittal

Today's agenda

- Exam Review

Midterm exam: March 22-24

- Detailed instructions shared on CampusWire (post #378).
  - Go over them again.
  - Reserve a slot if you haven't already.
  - Submit your Letters of Accommodations to CBTF, if required.
  - Syllabus: everything covered in class upto and including Paxos.
  - Closed-book exam: cannot refer to any materials / cheat sheets.
  - CBTF will provide calculator and scratch paper.
  - CBTF student office hours tomorrow (March 21st) at 3pm in case you have any questions for them.

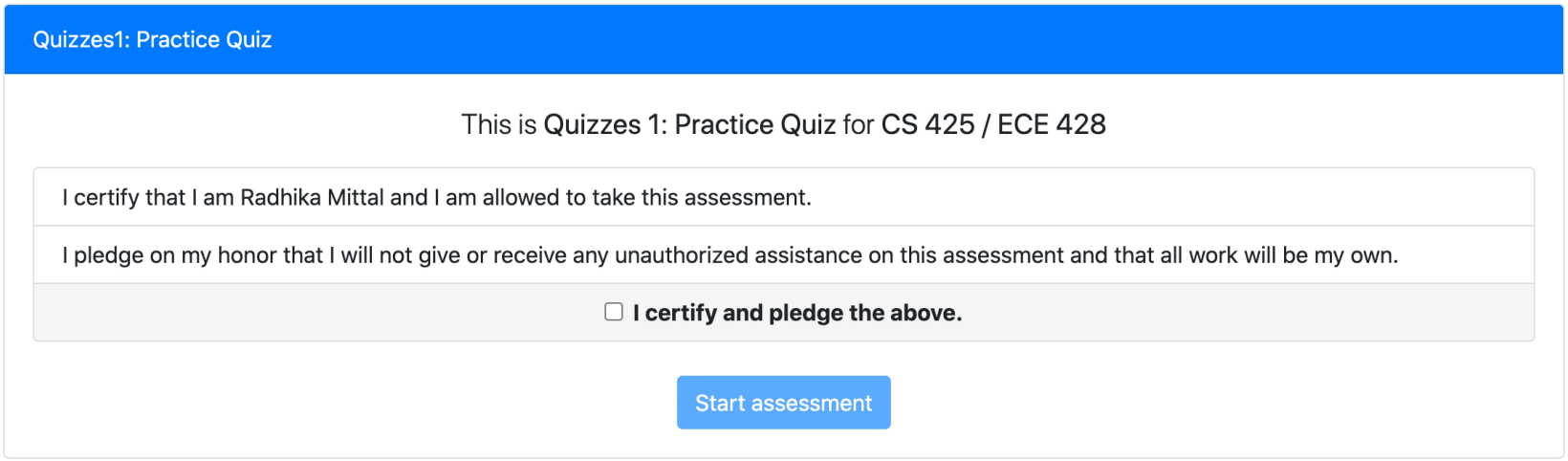
Midterm exam: March 22-24

- Syllabus:
  - everything up to and including Paxos.
- Exam duration: 50mins
  - Extra time to check-in and settle in.

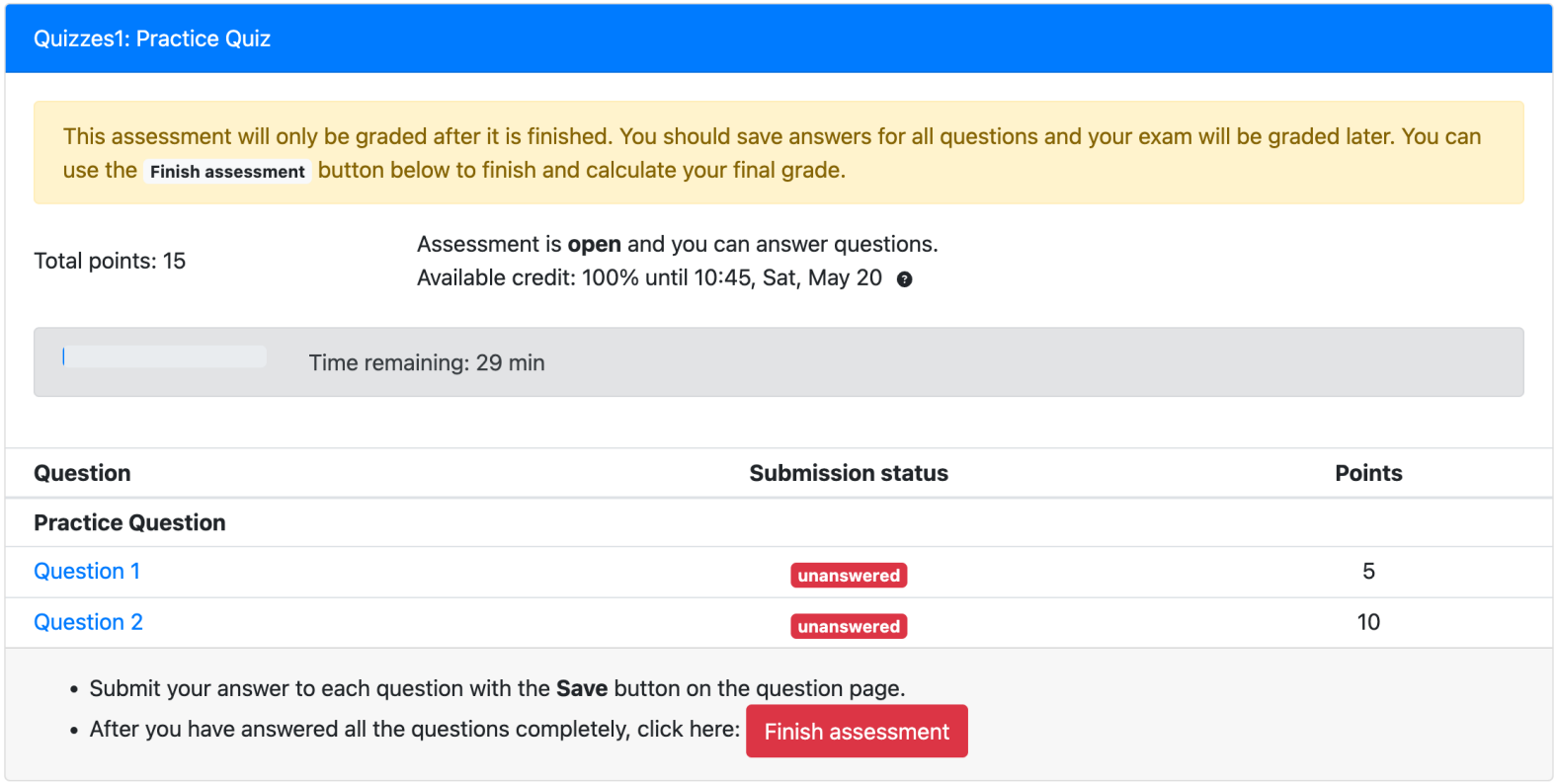
PrairieLearn

- Exam format:
  - Multiple choice questions:
    - Single answer correct; True/False
    - Multiple answers may be correct.
  - Numerical questions
    - No step marking!

PrairieLearn: interface example

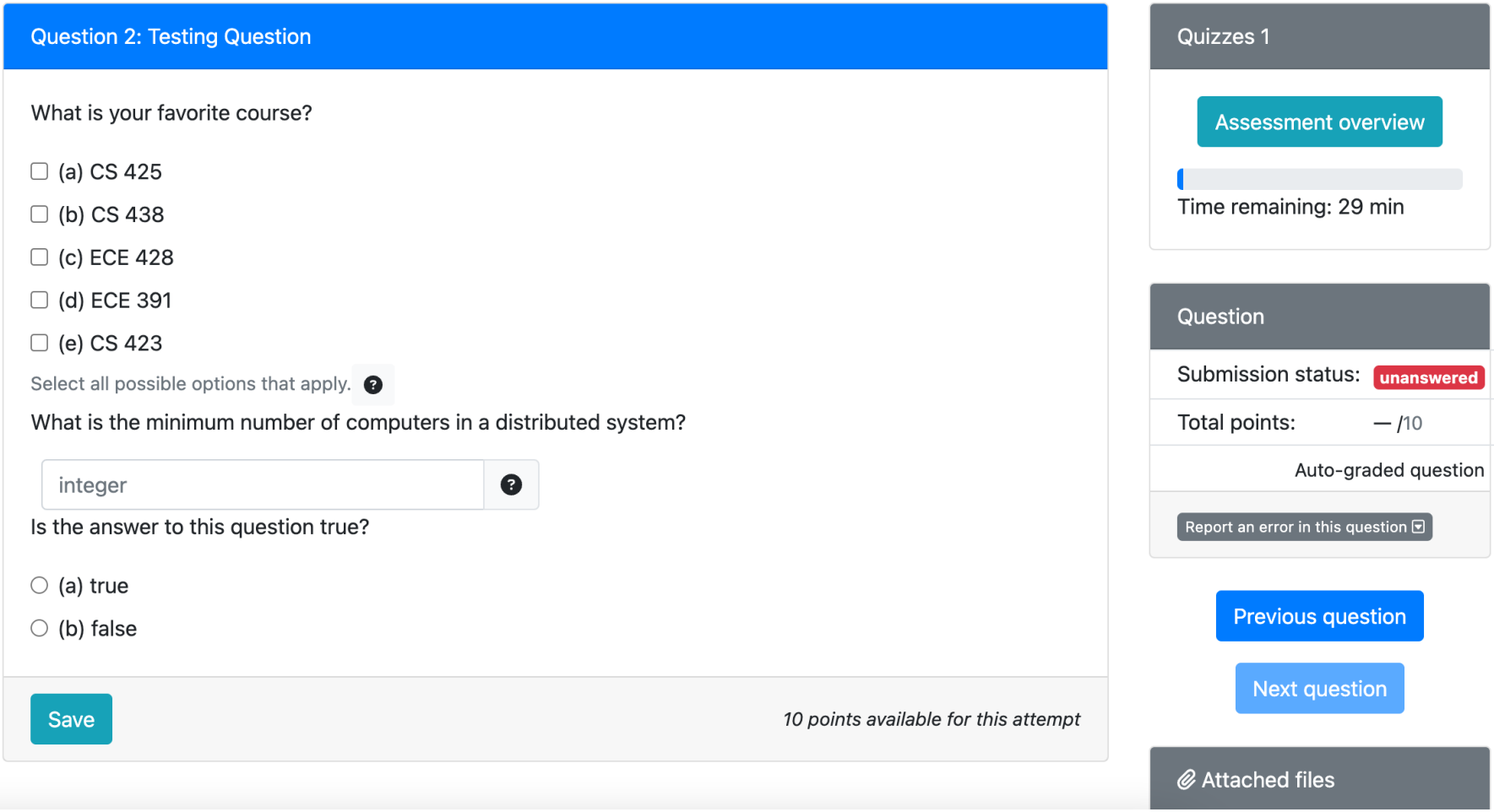


PrairieLearn: interface example

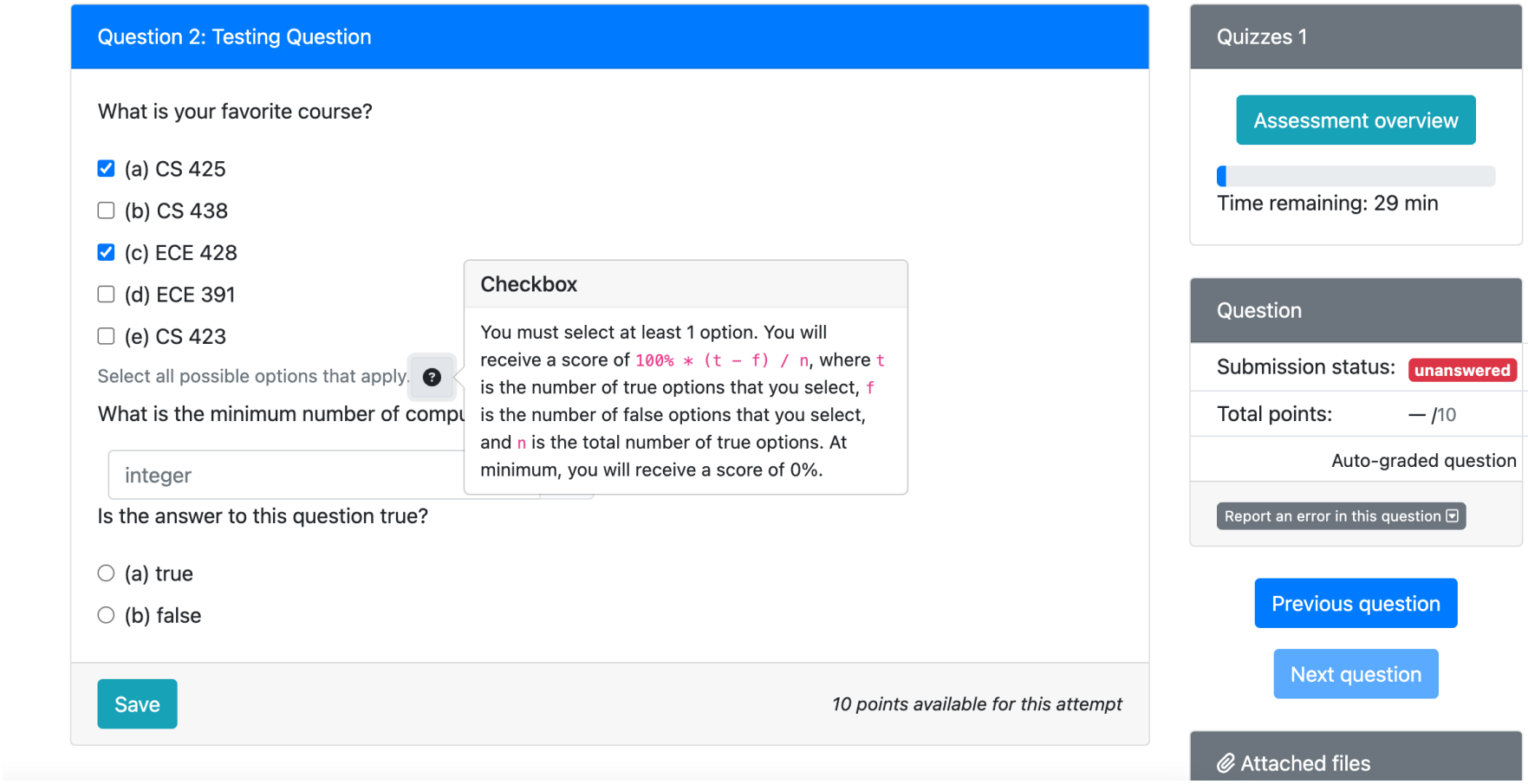


This demo has only two questions. Your midterm will display more questions.

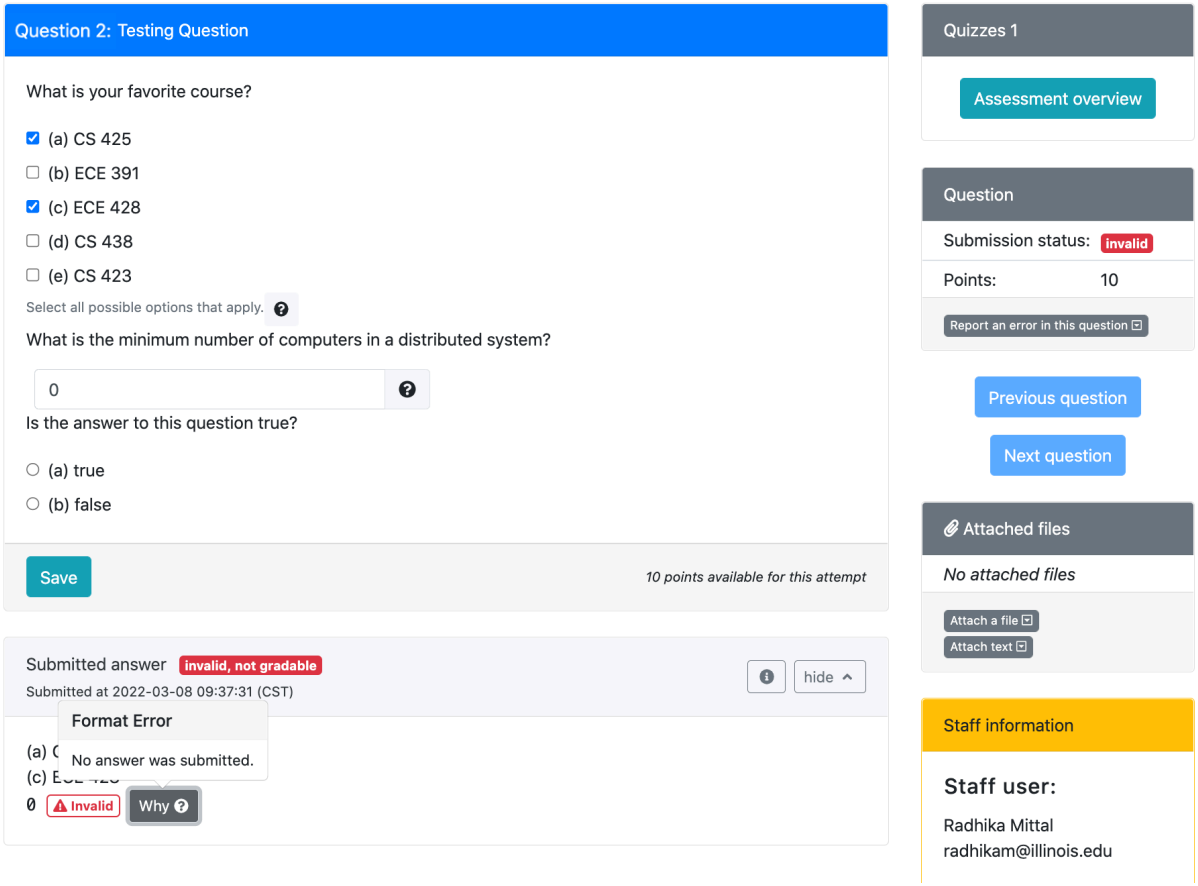
PrairieLearn: interface example



PrairieLearn: interface example

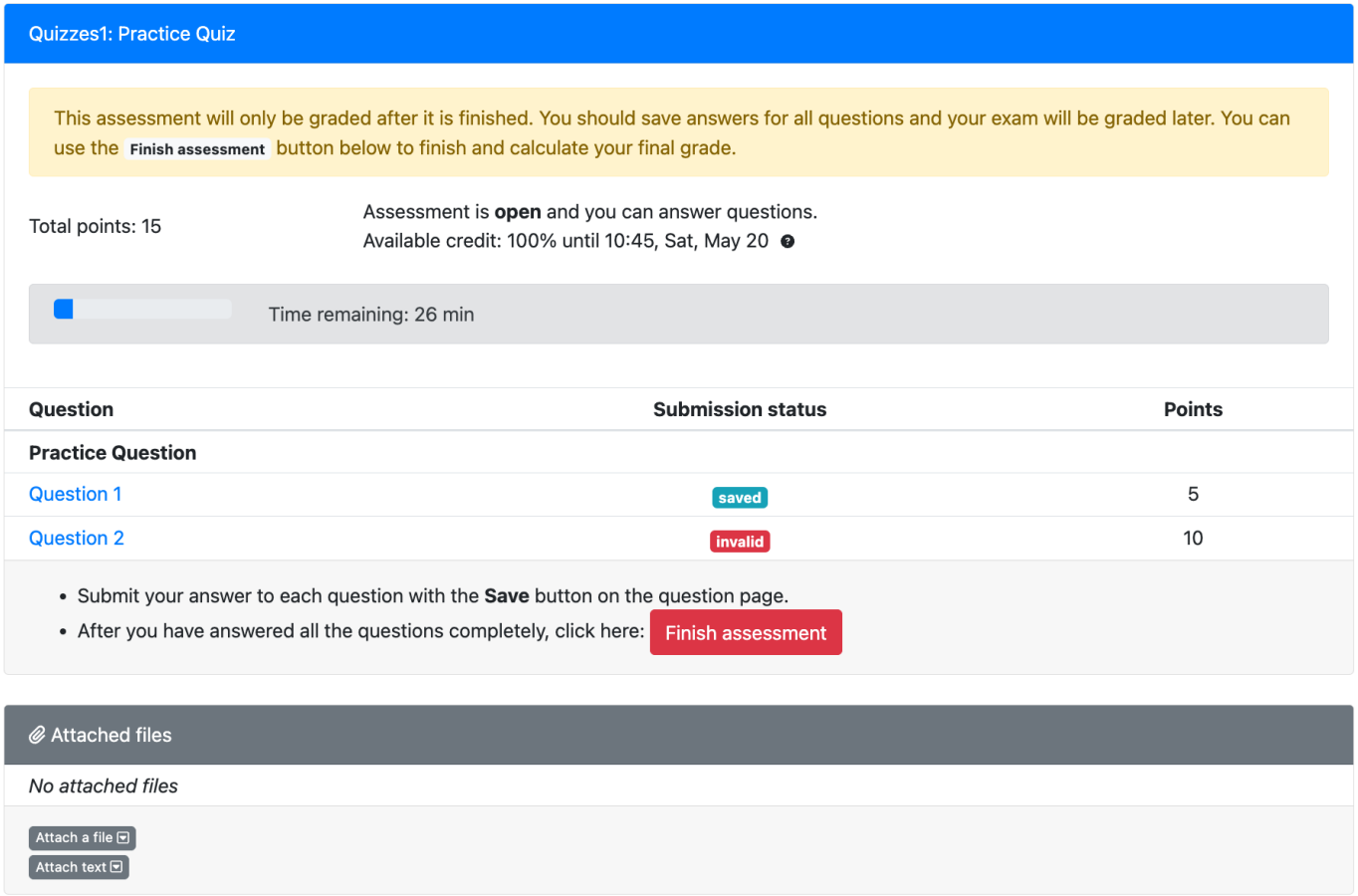


PrairieLearn: interface example



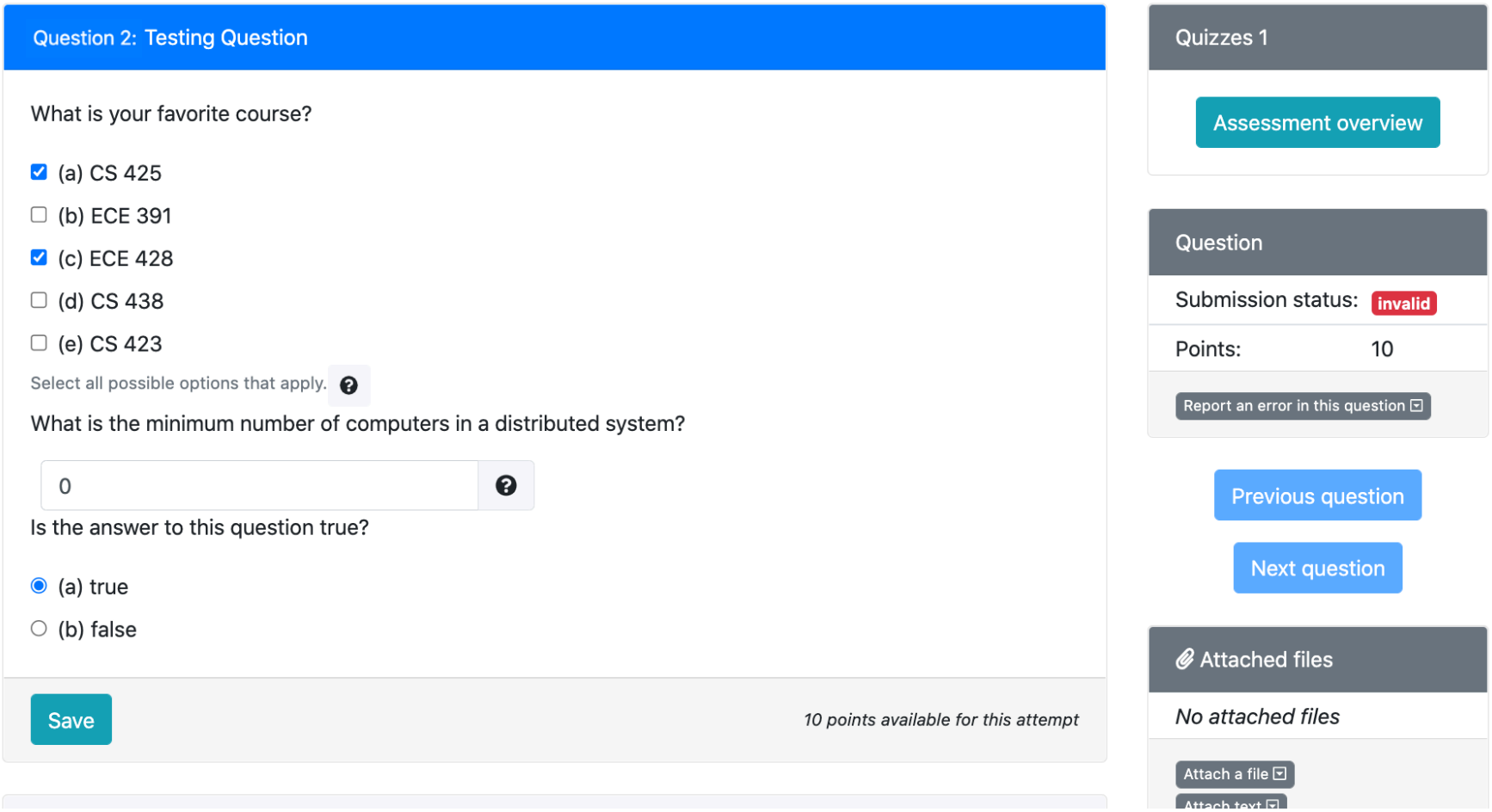
You must attempt all subparts of a given question for the question to be gradable.

PrairieLearn: interface example

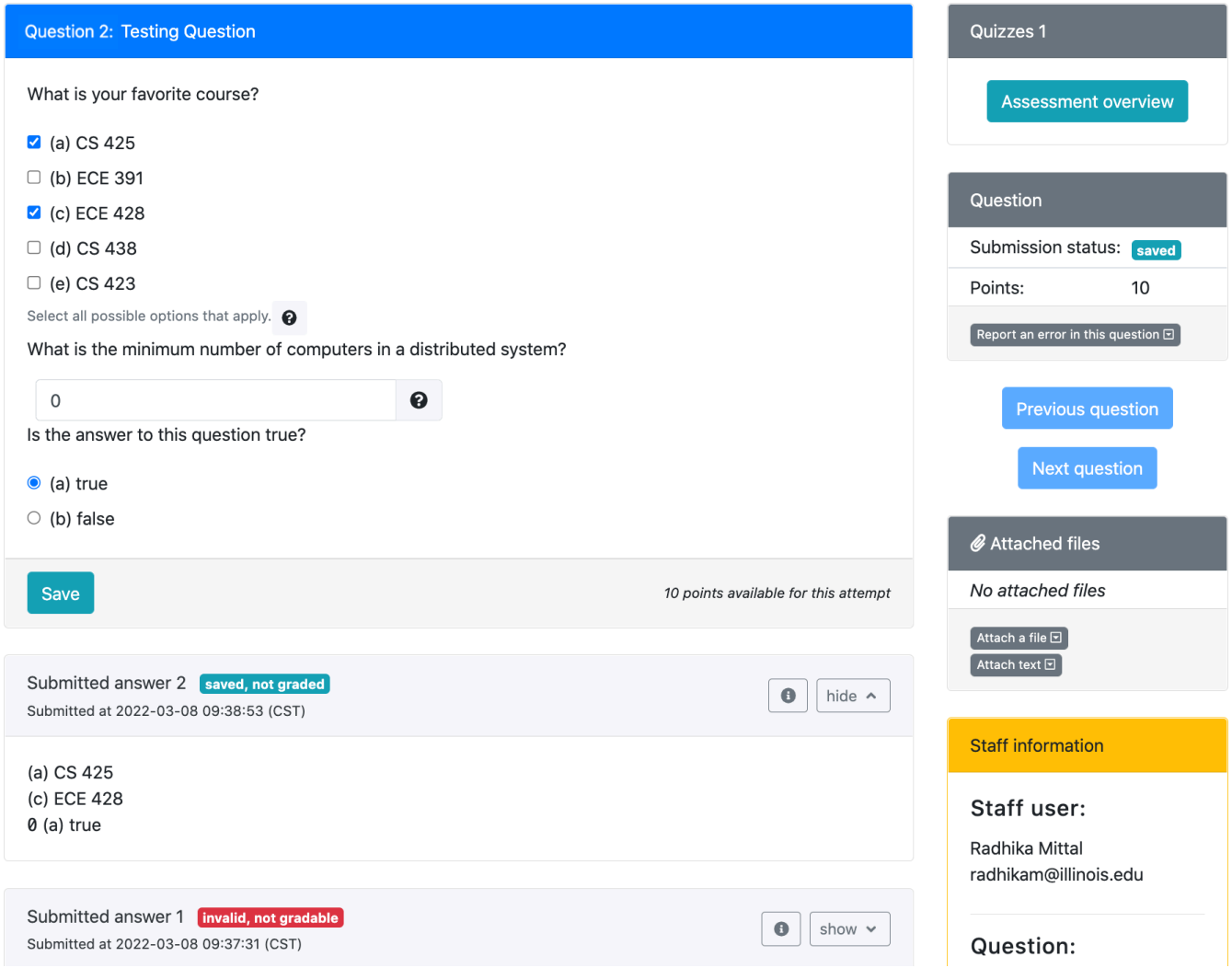


Valid responses saved for other questions will not be affected.

PrairieLearn: interface example



PrairieLearn: interface example



PrairieLearn: interface example

Quizzes1: Practice Quiz

This assessment will only be graded after it is finished. You should save answers for all questions and your exam will be graded later. You can use the **Finish assessment** button below to finish and calculate your final grade.

Total points: 15

Assessment is **open** and you can answer questions.
Available credit: 100% until 10:45, Sat, May 20

Time remaining: 22 min

Question	Submission status	Points
Practice Question		
Question 1	saved	5
Question 2	saved	10

- Submit your answer to each question with the **Save** button on the question page.
- After you have answered all the questions completely, click here: Finish assessment

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.

Topics for your midterm

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

Topics for your midterm

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

Topics for your midterm

- 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.

Topics for your midterm

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

Topics for your midterm

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

Topics for your midterm

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

Topics for your midterm

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

Topics for your midterm

- 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.

Topics for your midterm

- 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

Topics for your midterm

- 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 1: *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?

Topics for your midterm

- System model and Failures
- Failure Detection
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- Multicast
- Mutual Exclusion
- Leader Election
- Synchronous Consensus and Paxos

Good luck!