The following script is intended to illustrate the format of an oral exam. It features two characters: Student Hannah *(maybe with pigtails, 90s-style glasses, and braces? Please oh please oh please don't go looking for pics of me from college)* and TA Hannah *(similar appearance, but minus the terrified look on her face and the pigtails)*.

Student Hannah ("SH") walks in.

***TA Hannah ("TH")*:** Welcome! Please have a seat and make yourself comfortable. As you're doing so, please take a look at the whiteboard and think about which of those topics you'd like to answer a few questions on.

Pan to whiteboard, which has three items written on it:

- *SQL SELECT-FROM-WHERE + Aggregates*
- *SQL Subqueries*
- *ER Diagrams*

***TH*:** While you're thinking it through, could I please see a photo ID? I need it to set up a few things for our grading.

SH sits down, digs out her Husky Card and hands it to TH. TH types a few things on her laptop then returns the card.

***TH*:** Ok, we're all set. Have you picked your topic?

***SH*:** Yes, I'd like to do subqueries.

***TH*:** Excellent choice! For this topic, we've prepared 2 questions. The 2 questions are independent, and they may have multiple parts. The parts are also independent, so you can receive full points in one part of one question even if you've received partial points on a different part.

You are allowed to ask for hints and clarifications, and I may occasionally volunteer hints or clarifications without your prompting. This is not a sign that you're doing poorly! We only have 10 minutes today, so I offer these hints to ensure we have enough time to discuss all the parts of these 2 questions.

Some hints may come with point deductions, but I will always warn you if I'm about to give you one of those. I will also warn you if we need to move on to the next question or the next part. Unfortunately, since we only have 10 minutes, I may have to move us along even if you aren't finished.

Do you have any questions for me before we start?

***SH*:** Nope, we can get started.

TH slides a sheet of paper over to SH.

***TH*:** Please take a look at this query. Can you verbally describe what it is trying to do? Please ignore whether it's successful or not.

Camera pans to the sheet of paper, which has the following query printed on it:

```
SELECT name
FROM Employees
WHERE salary > (SELECT AVG(salary) FROM Employees);
```

***SH*:** It prints the names of employees who earn an above-average salary.

Note from grader: this is a full-points answer. This subquestion might be worth 2 pts.

***TH*:** Excellent! Now, you may have noticed that it has a problem. Can you identify it?

***SH*:** Um, it has a syntax error? I think you are required to have a quantifier if you use a comparison operator with a subquery.

***TH*:** This query doesn't have a syntax error. Are there any other problems you see?

This hint is "free"; the TA didn't mention any deductions.

***SH*:** Ok, then the problem is that it's correlated.

***TH*:** Why is it a problem if a subquery is correlated?

This is a request for clarification, so no deduction.

***SH*:** It's a performance problem. The SQL execution engine is forced to run this query as a pair of nested loops – there's no way at all that it can optimize it into something faster – so its runtime is $O(n^2)$.

***TH*:** I'm going to give you a hint which comes with a small penalty. Think back to some of the decorrelation techniques that we discussed in lecture; are those techniques limited to humans?

Deduction :(

***SH*:** Oh, right, they're not. I guess maybe the query might be fast or it might be slow. The problem is that we don't know what the optimizer will do. I think I might be able to decorrelate it, would you like me to try to do that?

***TH*:** No, thank you. Let's switch to our second question instead.

This question didn't have a coding component, though other questions might.

Note that the student got the remainder of the points for this subquestion! This subquestion might be worth 3 points and the penalty was 1 point, so the student earned a total of 4/5 points for the full question.

***TH*:** We don't have a specific example for this question; instead, please consider a hypothetical query that has a correlated subquery in its SELECT clause. Are we guaranteed that it can be decorrelated? More generally, are we guaranteed that there exists an equivalent query that has a different structure?

***SH*:** Um, maybe? Depending on the query, we might be able to decorrelate it…

… or maybe we can remove the subquery altogether? Hang on, lemme sketch a few things.

SH takes a blank sheet of paper provided by TH and begins drawing a few things on it, eventually sketching a graph that goes up and to the right.

Students will be provided with blank paper, though they can also draw on the provided whiteboard if that is their preference.

***SH*:** Right! We used a graph to illustrate the concept of monotonicity! Thanks to that monotonicity theorem, we know that a query with a subquery cannot be rewritten as a SELECT-FROM-WHERE.

I'm not sure whether we can always decorrelate, though. I think it might depend on the specifics of the query.

Perfect answer! This question might be worth 3 points.

***TH*:** Great, those are all the questions I have for today. Thanks for your time, and good luck on the written midterm!

Note: these two questions are representative of the question style we will use during oral exams. However, both of these were rejected from our question set for the following reasons:

- *Question #1 (multi-part question about average salaries): Length is not representative of the questions students will be asked (too long).*
- *Question #2 (single-part question about monotonicity): Question topic is not representative of topics covered in homework or in section*