Announcements

- Midterm is **next class** from 6pm - 7:30pm
- Midterm location: Zoom
- Review session: Friday from 6:30pm - 7:30pm on Zoom
- Milestone 8 due this Sunday
1) Does Q1 contain a subquery?

Q1: SELECT * FROM Lineup
    WHERE band = (SELECT id FROM Band
                  WHERE name = 'Asleep at the Wheel')

A. Yes
B. No
2) There can be at most one subquery per SQL statement.

A. True
B. False
3) What is the output from this query?

```sql
SELECT COUNT(*) FROM Lineup WHERE band IN (SELECT id FROM Band WHERE genre != 'Swing')
```

<table>
<thead>
<tr>
<th>Lineup</th>
<th>Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>id</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

A. 6     B. 5     C. 4
4) What is the output from this query?

```
SELECT COUNT(*) FROM Lineup WHERE length >
(SELECT MIN(length) FROM Lineup)
```

<table>
<thead>
<tr>
<th>id</th>
<th>date</th>
<th>time</th>
<th>length</th>
<th>venue</th>
<th>band</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2020-06-05</td>
<td>00:15</td>
<td>30</td>
<td>vegas</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2020-06-04</td>
<td>00:45</td>
<td>60</td>
<td>pclub</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2020-06-11</td>
<td>00:00</td>
<td>40</td>
<td>coopers</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2020-06-09</td>
<td>23:50</td>
<td>15</td>
<td>barra</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>2020-06-05</td>
<td>00:00</td>
<td>40</td>
<td>cclub</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>2020-06-04</td>
<td>12:45</td>
<td>45</td>
<td>honda</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>id</th>
<th>name</th>
<th>genre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Borzoi</td>
<td>Punk</td>
</tr>
<tr>
<td>2</td>
<td>Black Pumas</td>
<td>Soul</td>
</tr>
<tr>
<td>3</td>
<td>Western Youth</td>
<td>Rock</td>
</tr>
<tr>
<td>4</td>
<td>Deezie Brown</td>
<td>Hip-Hop</td>
</tr>
<tr>
<td>5</td>
<td>Asleep at the Wheel</td>
<td>Swing</td>
</tr>
</tbody>
</table>
5) A subquery can appear only in the **WHERE** clause of a SQL statement.

A. True  
B. False
Filtering Subqueries: \texttt{WHERE} clause

\begin{verbatim}
SELECT a, b, c
FROM T1
WHERE a =
    (SELECT x FROM T2 ...)
\end{verbatim}

Comparison Operators: $=, \neq, >, <, \leq, \geq$
Practice Question 1

Who are the oldest students?

Student_Beam(sid, fname, lname, dob, status)
Class(cid, cno, cname, credits)
Teacher_Beam(tid, fname, lname, dept)
Takes_Beam(sid, cid, grade)
Teaches(tid, cid)
Filtering Subqueries: WHERE clause

```
SELECT a, b, c
FROM T1
WHERE d IN
      (SELECT x FROM T2 ...
```

List Membership Operators:

IN
NOT IN
Practice Question 2

Who does not take CS327E?

Is this a correct implementation?

```sql
SELECT sid
FROM Takes
WHERE cno != 'CS327E'
```
Filtering Subqueries: **HAVING** clause

SELECT a, b, c <aggregate functions>
FROM T1
[WHERE <boolean condition>]
GROUP BY a, b, c
HAVING <aggregate function> = (SELECT x
FROM T2 ...)

Comparison Operators:  =  !=  >  <  <=  >=
Practice Question 3

Which classes have a higher enrollment than the overall average enrollment per class?

Student Beam \((\text{sid, fname, lname, dob, status})\)

Class \((\text{cid, cno, cname, credits})\)

Teacher Beam \((\text{tid, fname, lname, dept})\)

Takes Beam \((\text{sid, cid, grade})\)

Teaches \((\text{tid, cid})\)
iClicker Question

Which classes have a higher enrollment than the overall average enrollment per class?

Student_Beam(sid, fname, lname, dob, status)
Class(cid, cno, cname, credits)
Teacher_Beam(tid, fname, lname, dept)
Takes_Beam(sid, cid, grade)
Teaches(tid, cid)

How many subqueries does the answer require?

A. 0  B. 1  C. 2  D. 3
Correlated Subqueries

```
SELECT a, b, c
FROM T1
WHERE d > (SELECT x FROM T2 WHERE T2.y = T1.a)
```

**Comparison Operators:** =, !=, >, <, <=, >=

**List Membership Operators:** IN, NOT IN
Correlated Subqueries: \texttt{EXISTS}

\begin{verbatim}
SELECT a, b, c 
FROM T1 
WHERE \texttt{EXISTS}
    (SELECT * FROM T2 WHERE T2.x = T1.a)
\end{verbatim}

Existential Quantifiers:
\texttt{EXISTS}
\texttt{NOT EXISTS}
Practice Question 4

Who does not take CS327E?

Using EXISTS this time.
iClicker Question

Who does not take CS327E?

Using EXISTS this time.

Student_Beam(sid, fname, lname, dob, status)
Class(cid, cno, cname, credits)
Teacher_Beam(tid, fname, lname, dept)
Takes_Beam(sid, cid, grade)
Teaches(tid, cid)

Which field is used to correlate the outer query with the subquery?

A. sid  B. cid  C. cno
Virtual Table Subqueries: FROM and JOIN clauses

SELECT a, b, c
FROM (SELECT a, b, c FROM ...)
[WHERE]
[ORDER BY]

SELECT a, b, c
FROM T1 JOIN (SELECT a, b, c FROM T2)
[WHERE]
[ORDER BY]
Practice Question 5

Out of the students who don’t take CS327E, which ones are Seniors?

Student_Beam(sid, fname, lname, dob, status)
Class(cid, cno, cname, credits)
Teacher_Beam(tid, fname, lname, dept)
Takes_Beam(sid, cid, grade)
Teaches(tid, cid)
Practice Question 6

Which teachers earn a higher salary than the average salary of their department?

Student_Beam(sid, fname, lname, dob, status)
Class(cid, cno, cname, credits)
Teacher_Sal(tid, fname, lname, dept, sal)
Takes_Beam(sid, cid, grade)
Teaches(tid, cid)
iClicker Question

Which teachers earn a higher salary than the average salary of their department?

- Student_Beam(sid, fname, lname, dob, status)
- Class(cid, cno, cname, credits)
- Teacher_Sal(tid, fname, lname, dept, sal)
- Takes_Beam(sid, cid, grade)
- Teaches(tid, cid)

Does the answer contain a correlated subquery?

A. Yes  B. No
Milestone 8