Learning Objectives

• After this segment, students will be able to
  • Describe CONNECT clause in SQL SELECT
  • Use it to query Directed Acyclic Graphs
Querying Graphs: Overview

- Relational Algebra
  - Can not express transitive closure queries

- Two ways to extend SQL to support graphs
  1. Abstract Data Types
  2. Custom Statements
    - SQL2 - CONNECT BY clause(s) in SELECT statement
    - SQL3 - WITH RECURSIVE statement
CONNECT BY: Input, Output

- **Input:**
  - (a) Edges of a directed acyclic graph $G$
  - (b) Start Node $S$, e.g., Missouri
  - (c) Travel Direction

- **Output:** Transitive closure of $G$
  - Ex. Predecessors of $S =$ Missouri
  - Ex. Successors of $S =$ Missouri

(a) Mississippi network ($Y_1 =$ Bighorn river, $Y_2 =$ Power river, $P_1 =$ Sweet water River, $P_2 =$ Big Thompson river)
Directed Edges: Tabular Representation

Table: Falls_Into

<table>
<thead>
<tr>
<th>Source</th>
<th>Dest</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Platte</td>
</tr>
<tr>
<td>P2</td>
<td>Platte</td>
</tr>
<tr>
<td>Y1</td>
<td>Yellowstone</td>
</tr>
<tr>
<td>Y2</td>
<td>Yellowstone</td>
</tr>
<tr>
<td>Platte</td>
<td>Missouri</td>
</tr>
<tr>
<td>Yellowstone</td>
<td>Missouri</td>
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<tr>
<td>Missouri</td>
<td>Mississippi</td>
</tr>
<tr>
<td>Ohio</td>
<td>Mississippi</td>
</tr>
<tr>
<td>Red</td>
<td>Mississippi</td>
</tr>
<tr>
<td>Arkansas</td>
<td>Mississippi</td>
</tr>
</tbody>
</table>

(a) Mississippi network (Y1 = Bighorn river, Y2 = Power river, P1 = Sweet water River, P2 = Big Thompson river)
CONNECT BY- PRIOR - START WITH

SELECT source
FROM Falls_Into
CONNECT BY PRIOR source = dest
START WITH dest = “Missouri”

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Q? What does CONNECT BY ... PRIOR specify?
• Direction of travel
• Example: From Dest to Source
• Alternative: From Source to Dest
Choice 1: Travel from Dest to Source
Ex. List direct & indirect tributaries of Missouri.

```sql
SELECT source
FROM Falls_Into
CONNECT BY PRIOR source = dest
START WITH dest = “Missouri”
```

Choice 2: Travel from Source to Dest
Ex. Which rivers are affected by spill in Missouri?

```sql
SELECT dest
FROM Falls_Into
CONNECT BY source = PRIOR dest
START WITH source = “Missouri”
```
SELECT source
FROM   Falls_Into
CONNECT BY PRIOR source = dest
START WITH dest = Missouri

1. Prior Result = SELECT * FROM Falls_Into
   WHERE (dest = Missouri )