Learning Objectives

- After this segment, students will be able to
  - Describe CONNECT clause in SQL SELECT
  - Use it to query Directed Acyclic Graphs
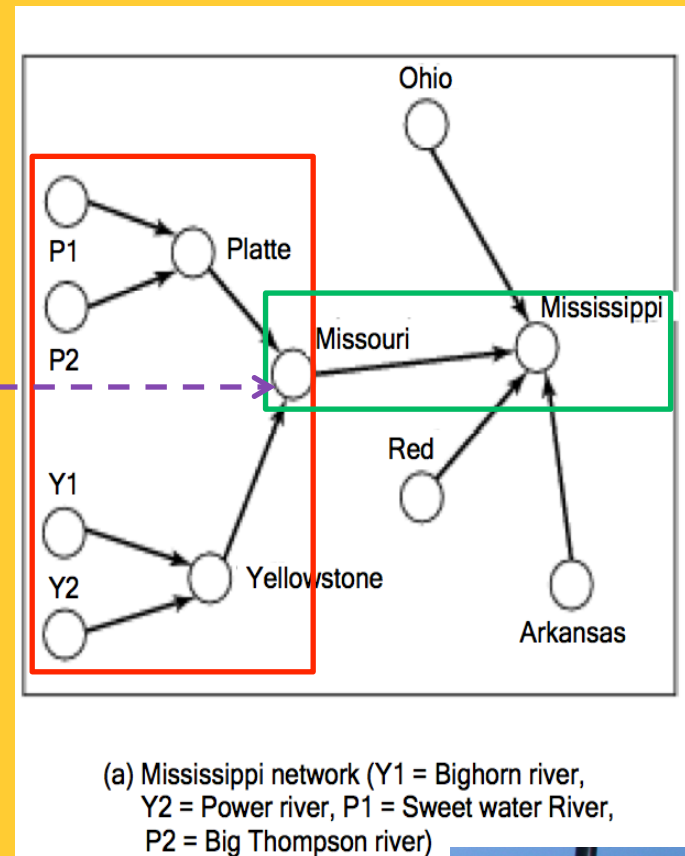
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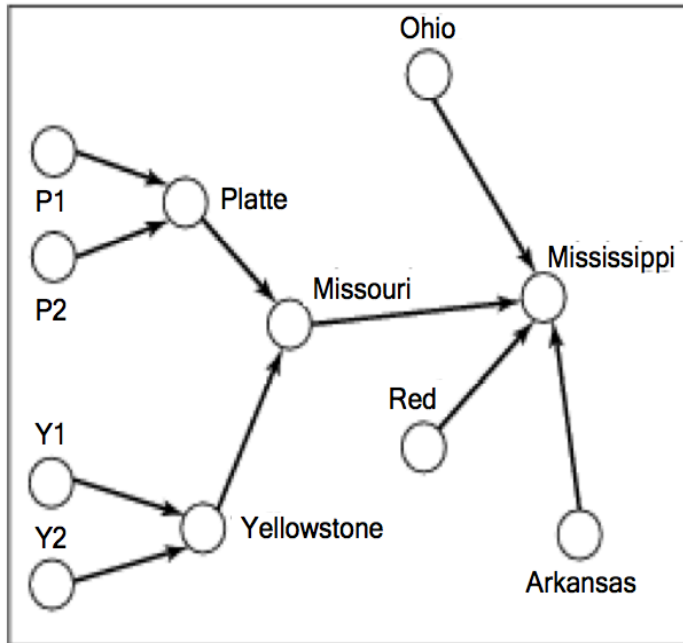Research Group

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

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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 (Y1 = Bighorn river,
Y2 = Power river, P1 = Sweet water River,
P2 = Big Thompson river)
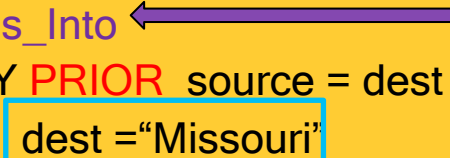
Directed Edges: Tabular Representation

(a) Mississippi network (Y1 = Bighorn river,
Y2 = Power river, P1 = Sweet water River,
P2 = Big Thompson river)

Table: Falls_Into

Source	Dest
P1	Platte
P2	Platte
Y1	Yellowstone
Y2	Yellowstone
Platte	Missouri
Yellowstone	Missouri
Missouri	Mississippi
Ohio	Mississippi
Red	Mississippi
Arkansas	Mississippi

CONNECT BY- PRIOR - START WITH

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

Q? What does CONNECT BY ... PRIOR specify?
- Direction of travel
- Example: From Dest to Source
- Alternative: From Source to Dest

Table: Falls_Into

Source	Dest
P1	Platte
P2	Platte
Y1	Yellowstone
Y2	Yellowstone
Platte	Missouri
Yellowstone	Missouri
Missouri	Mississippi
Ohio	Mississippi
Red	Mississippi
Arkansas	Mississippi

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CONNECT BY- PRIOR - START WITH

Choice 1: Travel from Dest to Source
Ex. List direct & indirect tributaries of Missouri.

    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?

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

Table: Falls_Into

Source	Dest
P1	Platte
P2	Platte
Y1	Yellowstone
Y2	Yellowstone
Platte	Missouri
Yellowstone	Missouri
Missouri	Mississippi
Ohio	Mississippi
Red	Mississippi
Arkansas	Mississippi

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Execution Trace – Step 1

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

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

Table: "Prior "

Source	Dest
Platte	Missouri
Yellowstone	Missouri

Table: Falls_Into

Source	Dest
P1	Platte
P2	Platte
Y1	Yellowstone
Y2	Yellowstone
Platte	Missouri
Yellowstone	Missouri
Missouri	Mississippi
Ohio	Mississippi
Red	Mississippi
Arkansas	Mississippi