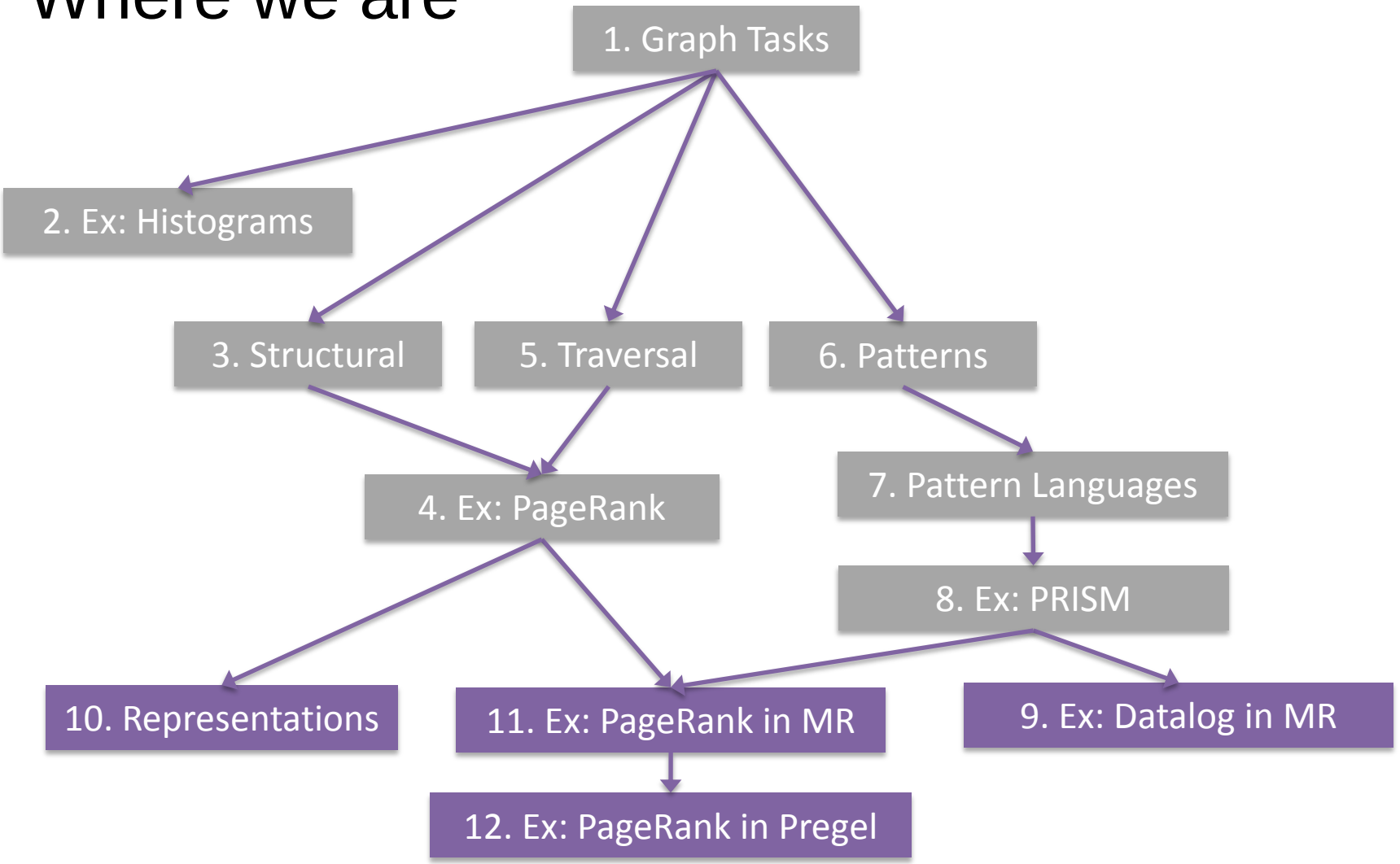
Where we are


1. Graph Tasks
2. Ex: Histograms
3. Structural
5. Traversal
6. Patterns
4. Ex: PageRank
7. Pattern Languages
8. Ex: PRISM
10. Representations
11. Ex: PageRank in MR
9. Ex: Datalog in MR
12. Ex: PageRank in Pregel

Evaluation of Recursive Programs

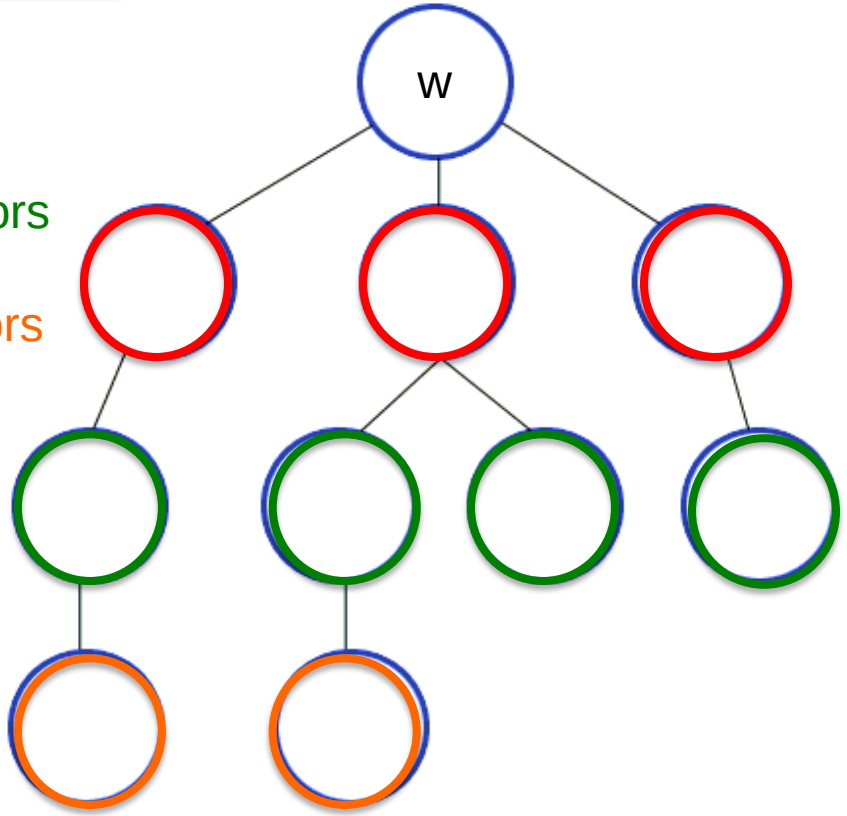
Reachability from a given node

```
A(y) :- Edge('w', y)
A(y) :- A(x), Edge(x,y)
```

step 0: A0 = all nodes connected to 'w'

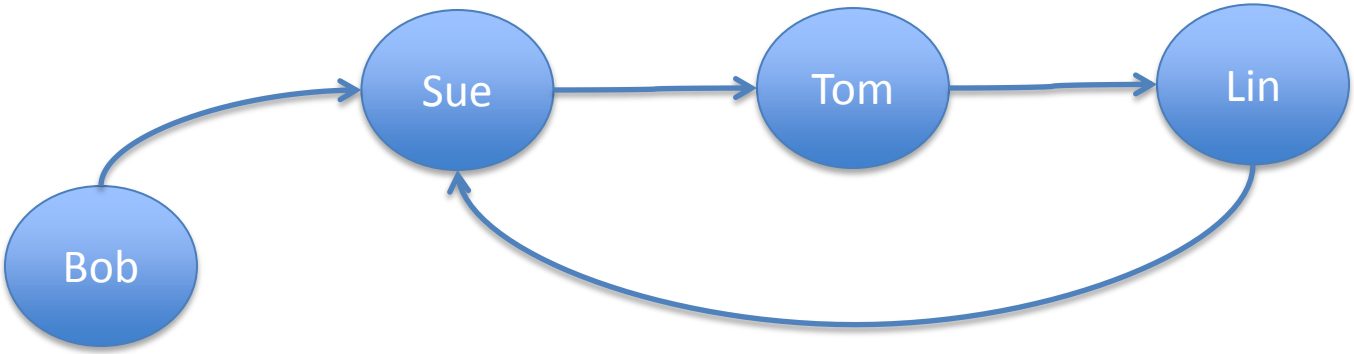
step 1: for each node in A0, find neighbors

step 2: for each node in A1, find neighbors



Evaluating Recursive Queries

- Problems with this approach
  - What if there are cycles in the graph?



Example of Semi-Naïve Evaluation

Reachability from 'a' in datalog

```
A(y) :- R('a', y)
A(y) :- A(x), R(x,y)
```

$$\Delta A^0 = R', i = 1$$

while ΔA^{i-1} is not empty:

$$A^i = (\Delta A^0 \cup \cdots \cup \Delta A^{i-1})$$

$$\Delta A^i = (\Delta A^{i-1} \bowtie R) - A^i$$

$$i = i + 1$$

Join

Dupe-elim

In MapReduce