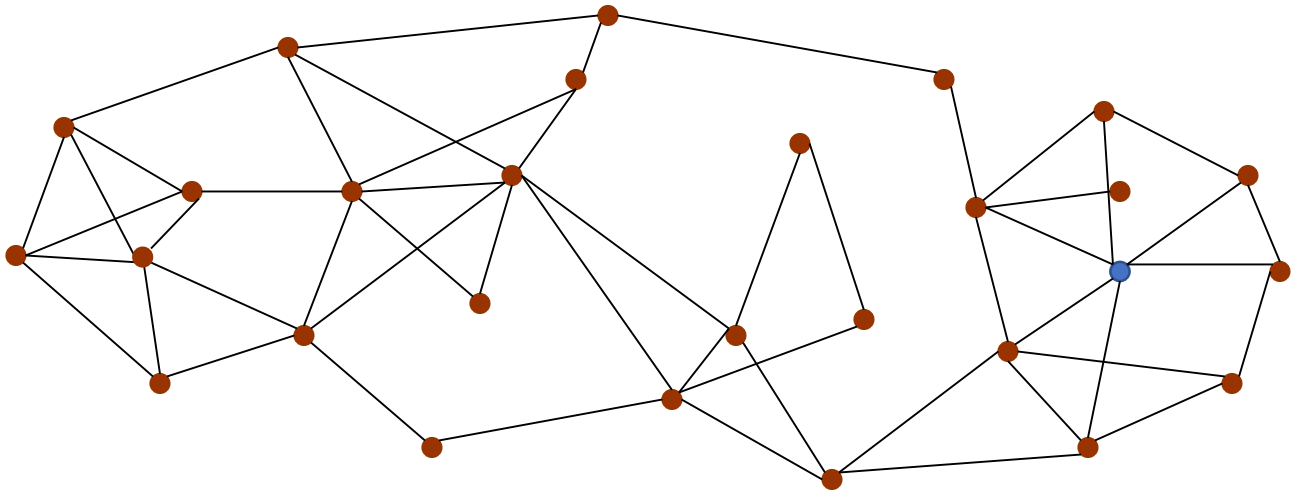
Data Structures
Programming Project #2

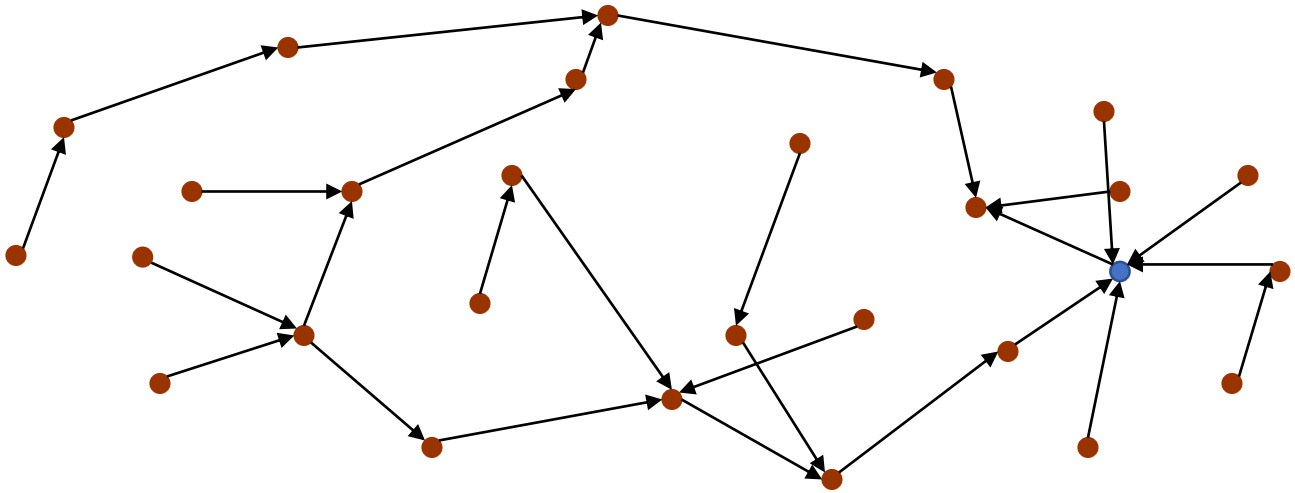
Background

- Large-scale sensor networks
- Every node senses the environment
- How to collect all the data to the sink?
  Such as temperature



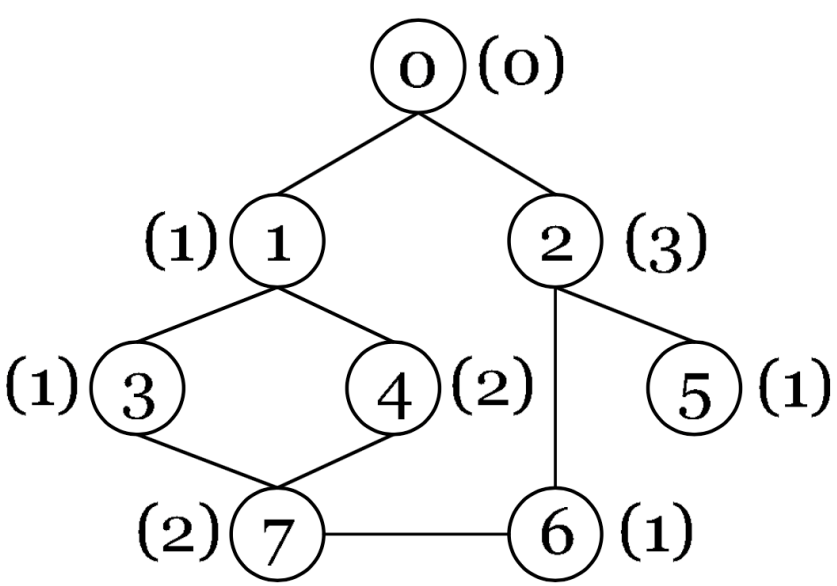
Why Aggregation Tree?

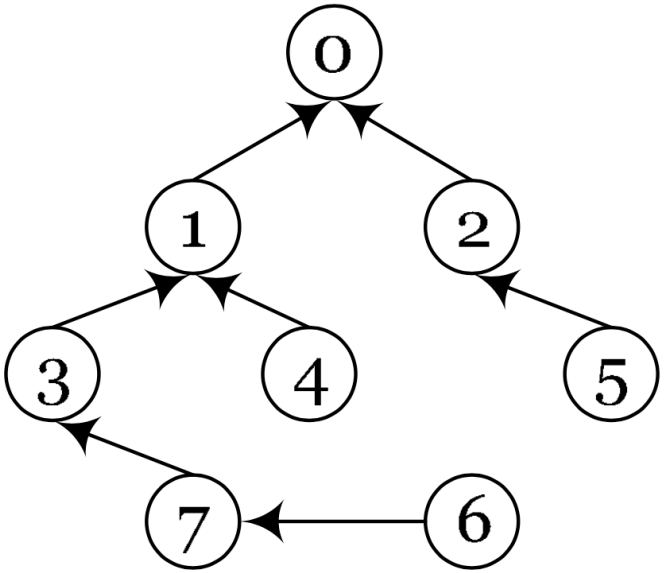
- Collect all the data to the sink?
- Limited storage and computation capability
- Routing on a tree → Simple to maintain
- Data aggregation → Save transmission energy



Example 1

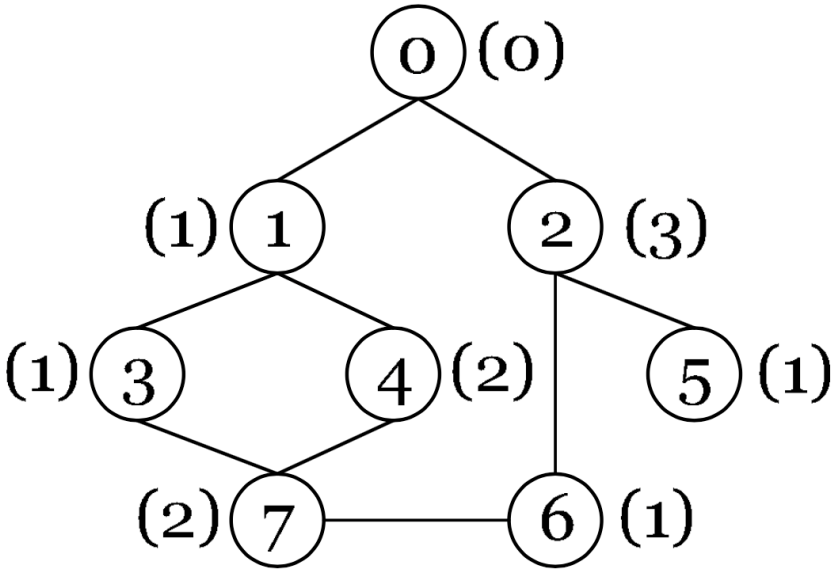
- Routing on a tree → Simple to maintain
- Data aggregation → Save transmission energy
- Nodes' distinct data size (e.g., 1-5)
- Fixed packet size (e.g., 3)



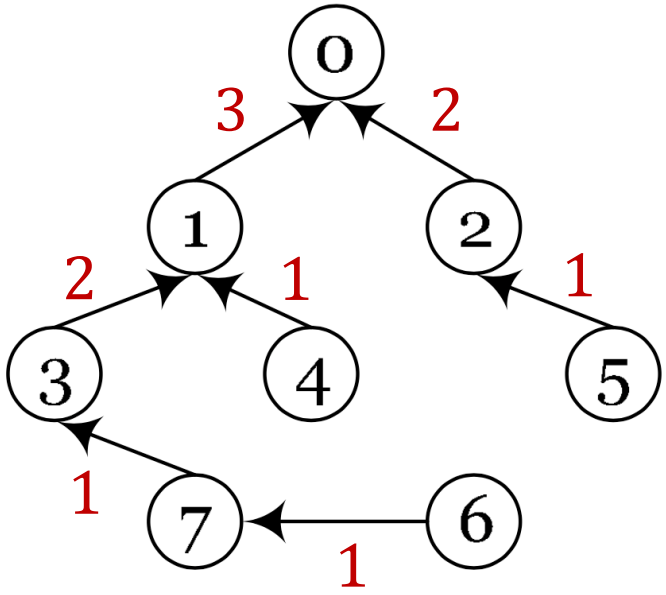


Example 1

- Routing on a tree → Simple to maintain
- Data aggregation → Save transmission energy
- Nodes' distinct data size (e.g., 1-5)
- Fixed packet size (e.g., 3)

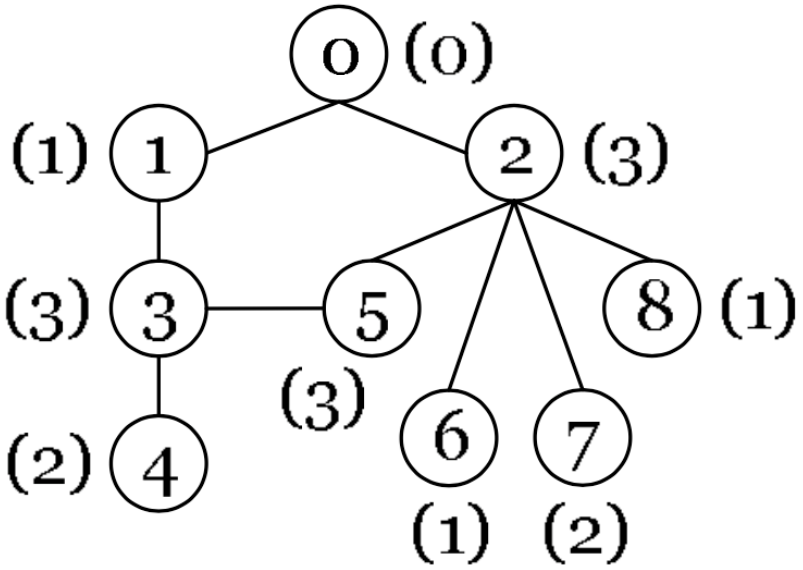


Total cost = 11

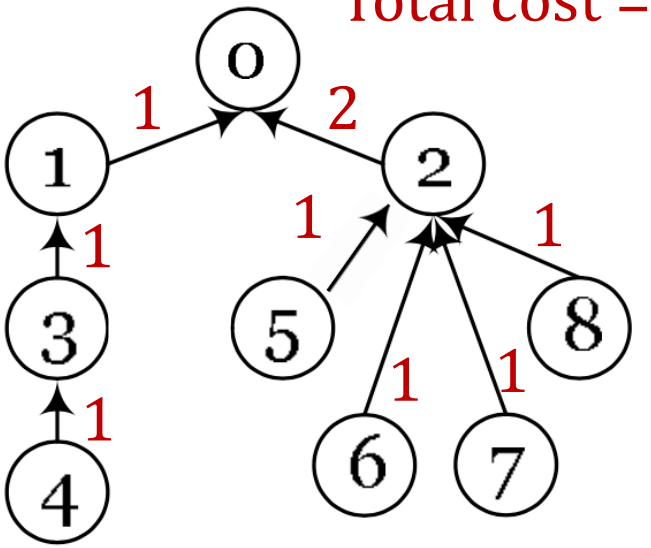


Example 2

- Routing on a tree → Simple to maintain
- Data aggregation → Save transmission energy
- Nodes' distinct data size (e.g., 1-5)
- Fixed packet size (e.g., 9)

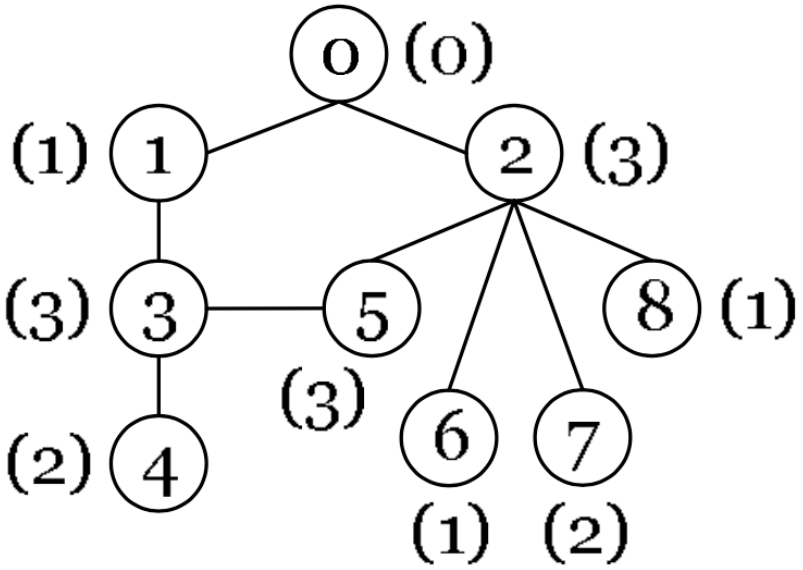


Total cost = 9

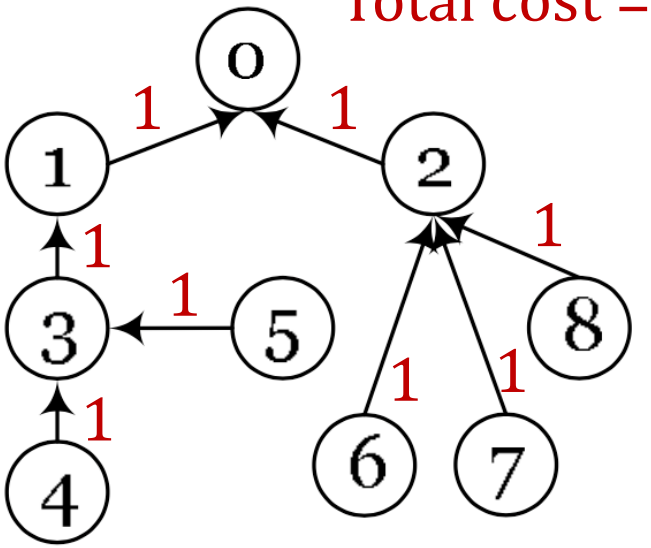


Example 2

- Routing on a tree → Simple to maintain
- Data aggregation → Save transmission energy
- Nodes' distinct data size (e.g., 1-5)
- Fixed packet size (e.g., 9)



Total cost = 8



Bad News

- The problem is NP-hard
- We may not always find the optimal solution in polynomial time
- Alternatively, we aim at a near-optimal solution

Programming Project #2: Construct an aggregation tree

- Input:
  - A node-weighted network $G = (V, E)$
  - Packet size
- Procedure:
  - Determine a set of links to construct a tree rooted at 0
  - Calculate the total cost
- Output:
  - Every node's parent in the constructed tree
  - Total cost
- The grade is inversely proportional to the total cost

Programming Project #2: Construct an aggregation tree

- Input:
  - A node-weighted network $G = (V, E)$
  - Packet size
- Procedure:
  - Determine a set of links to construct a tree
  - Calculate the total cost
- Output:
  - Every node's parent in the constructed tree
  - Total cost
- The grade is inversely proportional to the total cost

Programming Project #2: Construct an aggregation tree

- Input:
  - A node-weighted network $G = (V, E)$
  - Packet size
- Procedure:
  - Determine a set of links to construct a tree
  - Calculate the total cost
- Output:
  - Every node's parent in the constructed tree
  - Total cost
- The grade is inversely proportional to the total cost

Programming Project #2: Construct an aggregation tree

- Input:
  - A node-weighted network $G = (V, E)$
  - Packet size
- Procedure:
  - Determine a set of links to construct a tree
  - Calculate the total cost
- Output:
  - Every node's parent in the constructed tree
  - Total cost
- The grade is inversely proportional to the total cost

Programming Project #2: Construct an aggregation tree

- Input:
  - A node-we
  - Packet size
- Procedure:
  - Determine
  - Calculate t
- Output:
  - Every nod
  - Total cost
- The grade i

rooted at 0

he total cost

Programming Project #2: Construct an aggregation tree

- Input:
  - A nod
  - Packe
- Proced
  - Deter
  - Calcul
- Output
  - Every
  - Total

oted at 0

- The grade is inversely proportional to the total cost

Programming P
Construct an ag e

- Input:
  - A node-weighted E)
  - Packet size
- Procedure:
  - Determine a set t a tree rooted at 0
  - Calculate the tot
- Output:
  - Every node's par cted tree
  - Total cost
- The grade is inve nal to the total cost

Programming Project #2: Construct an aggregation tree

- Input:
  - A node-weighted network $G = (V, E)$
  - Packet size
- Procedure:
  - Determine a set of links to construct a tree rooted at 0
  - Calculate the total cost
- Output:
  - Every node's parent in the constructed tree
  - Total cost
- We have a competition
- The grade is… (see next page)

The Competition

- The grade is inversely proportional to the total cost
- Basic: 75 (deadline)
  - A feasible aggregation tree
  - The correct total cost of the feasible one
- Performance ranking (decided after the deadline)
  - [0%, 50%) (bottom): +0
  - [50%, 75%): + 5
  - [75%, 90%): + 9
  - [90%, 95%): + 12
  - [95%, 100%] (top): + 15
- Homework assistant (superb deadline)
  - +10

The Competition

- The grade … he total cost
- Basic: 75
  - A feasibl
  - The corr
- Performa … e deadline)
  - [0%, 50
  - [50%, 7
  - [75%, 9
  - [90%, 9
  - [95%, 1
- Homework assistant (superb deadline)
  - +10

The Competition

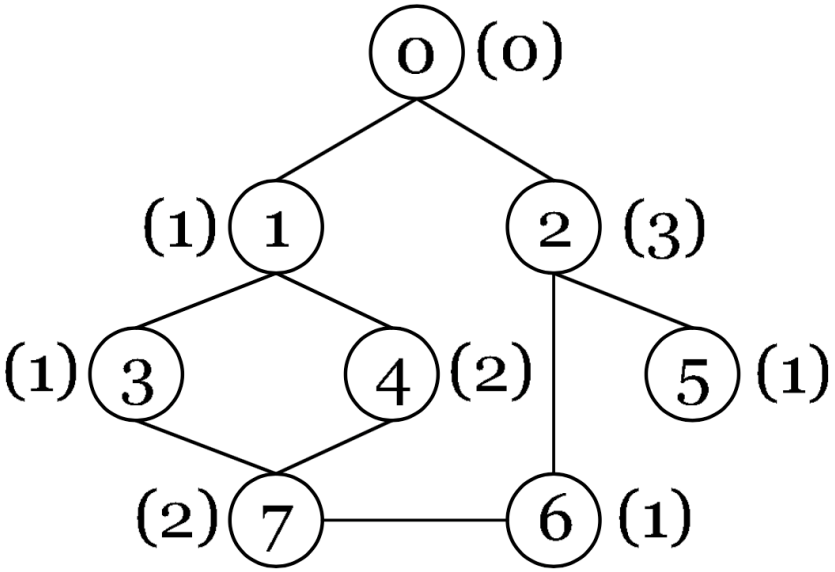
- The grade … he total cost
- Basic: 75
  - A feasibl
  - The corr
- Performa … deadline)
  - [0%, 50
  - [50%, 75
  - [75%, 90
  - [90%, 95
  - [95%, 10
- Homework assistant (superb deadline)
  - +10

相信你們在做完作業以後

Input Sample: use scanf

Format:

#Nodes #Links Packet_Size
Node_ID Node_Weight
…
Link_ID Link_End1 Link_End2
…



Example:

```
8       9       3
0       0
1       1
2       3
3       1
4       2
5       1
6       1
7       2
0       0       1
1       0       2
2       1       3
3       1       4
4       2       5
5       2       6
6       3       7
7       4       7
8       6       7
```

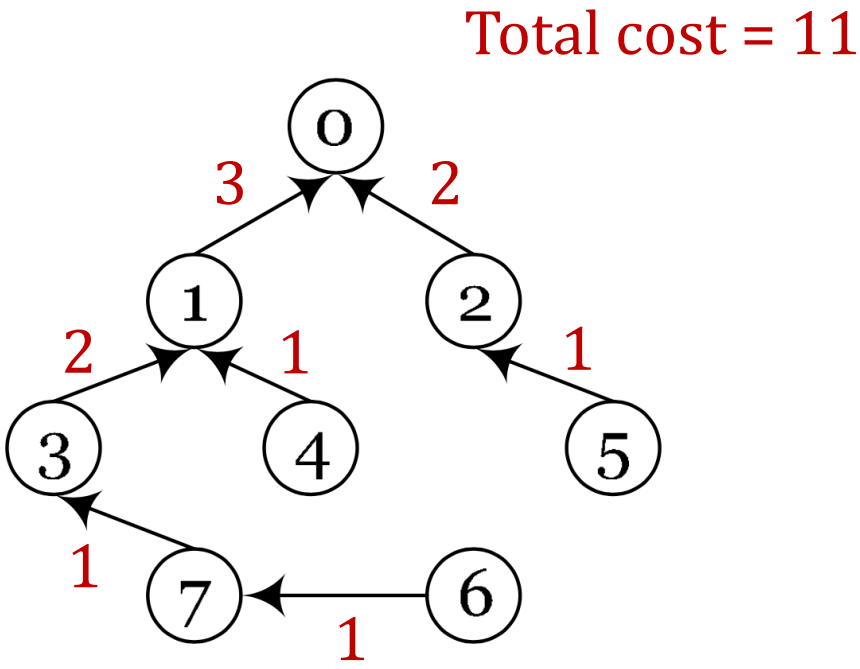
Output Sample: use printf

Format:

#Nodes Total_Cost

Node_ID Parent_ID

…



Example:

8	11
0	0
1	0
2	0
3	1
4	1
5	2
6	7
7	3

Note

- Superb deadline: 11/16 Tue
- Deadline: 11/23 Tue
- Pass the test of our online judge platform
- Submit your code to E-course2
- Demonstrate your code remotely with TA
- **C Source code (i.e., only .c)**
- Show a good programming style

Yesterday!!!

- Taiwanese Computer Science Day
- 1101101