Data Structures

Objectives

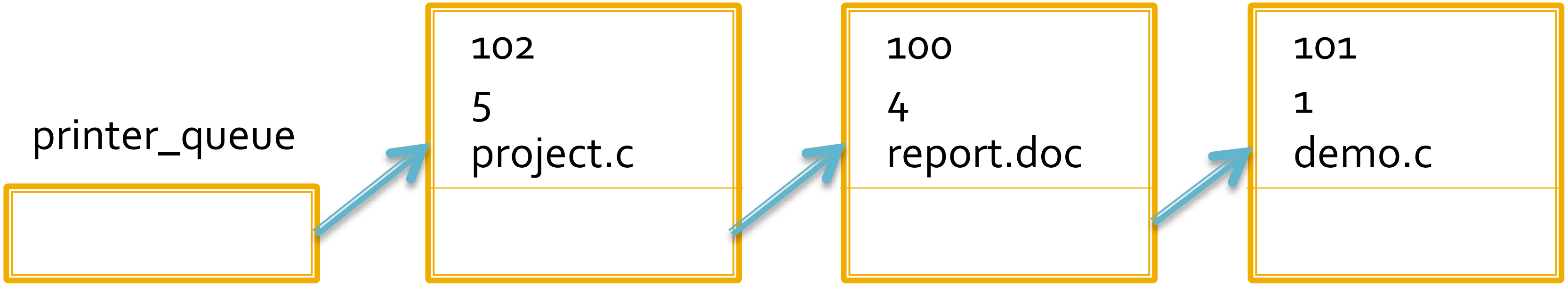
- At the end of the meeting, students should be able to:
  - Enumerate the different types of dynamic linked list;
  - Understand the concept of tree and identify its parts; and
  - Know the different types of graphs and how to represent them.

Dynamic linked lists

- Many queues are really dynamic lists that allow additions/deletions at arbitrary positions
- Examples:
  - a document in a print queue can be prematurely cancelled without being printed
  - a high-priority job can be put near the front of a job queue
  - a text editor allows insertion and deletion of lines anywhere in the text

A linked list

```
struct node { // a recursive data structure
    int job_ID;
    int priority;
    char filename[80];
    struct node * next; // "next" points to an identical structure
};
typedef struct node task;
task * printer_queue;
```



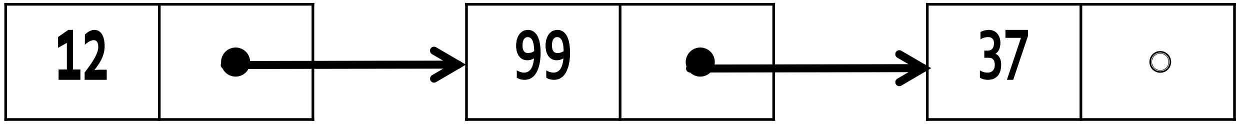
printer_queue

102
5
project.c

100
4
report.doc

101
1
demo.c

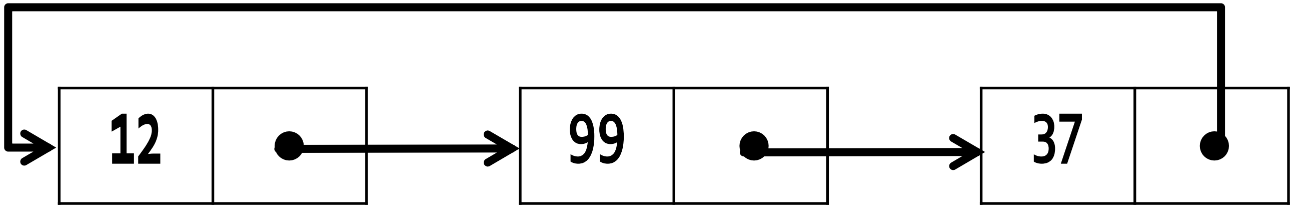
Common types of linked list



Singly-linked:

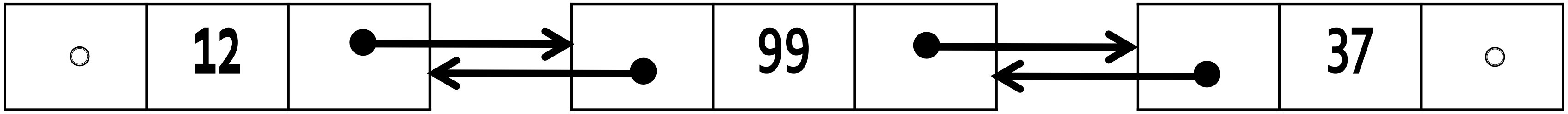
each node points to the NEXT node

Common types of linked list



Circular singly-linked:
last node points back to the first node

Common types of linked list

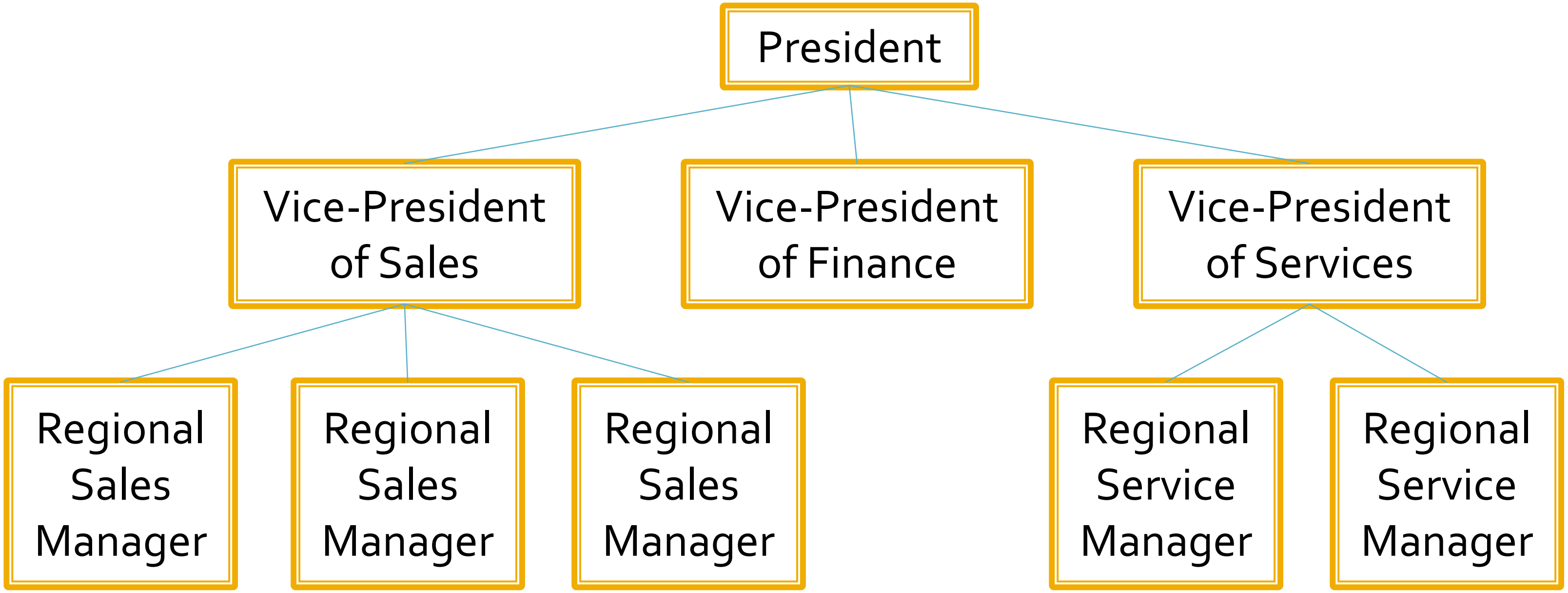


Doubly-linked:

each node points to the NEXT and PREVIOUS nodes

Tree

- is a collection whose entries have a hierarchical organization



President

Vice-President of Sales

Vice-President of Finance

Vice-President of Services

Regional Sales Manager

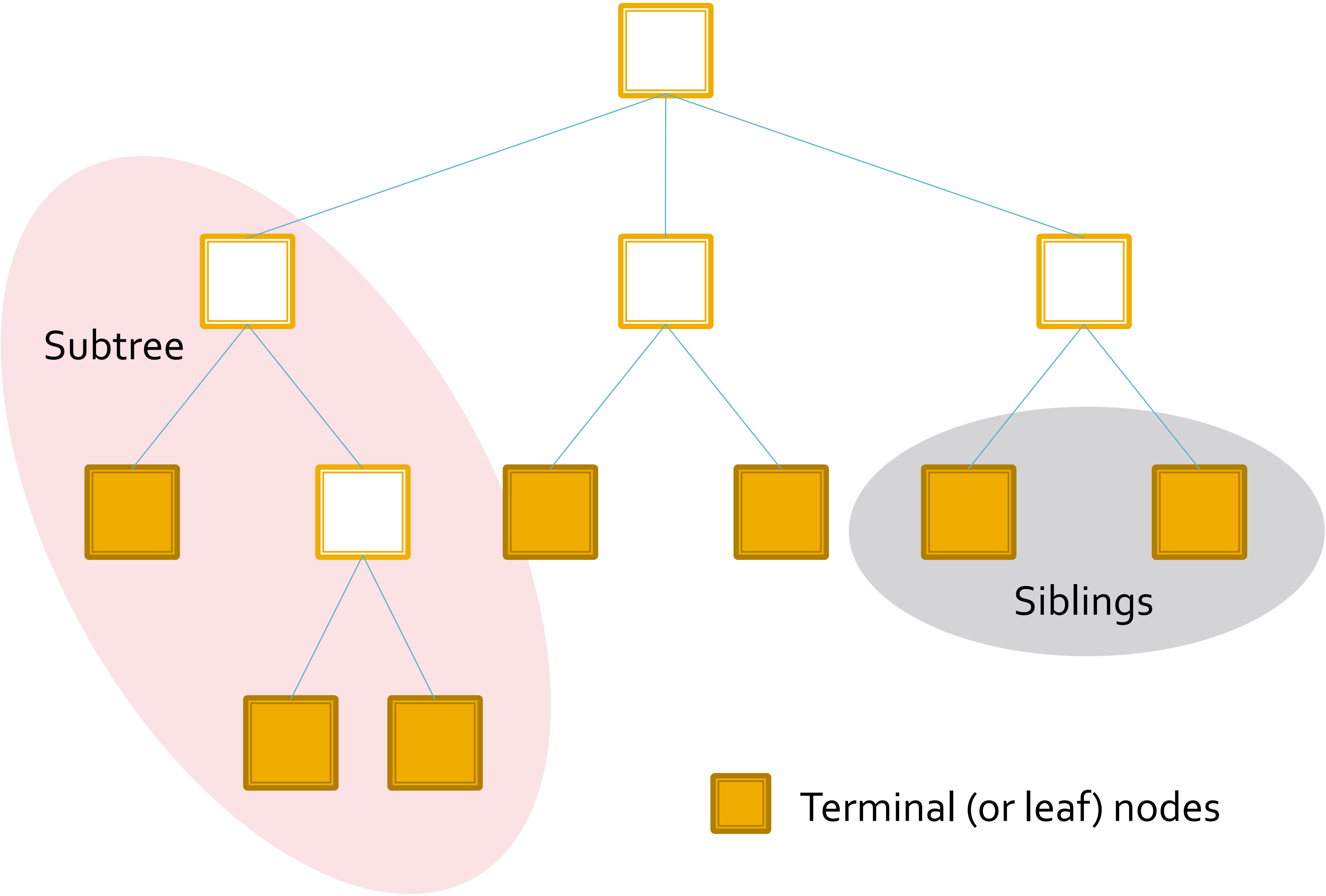
Regional Sales Manager

Regional Sales Manager

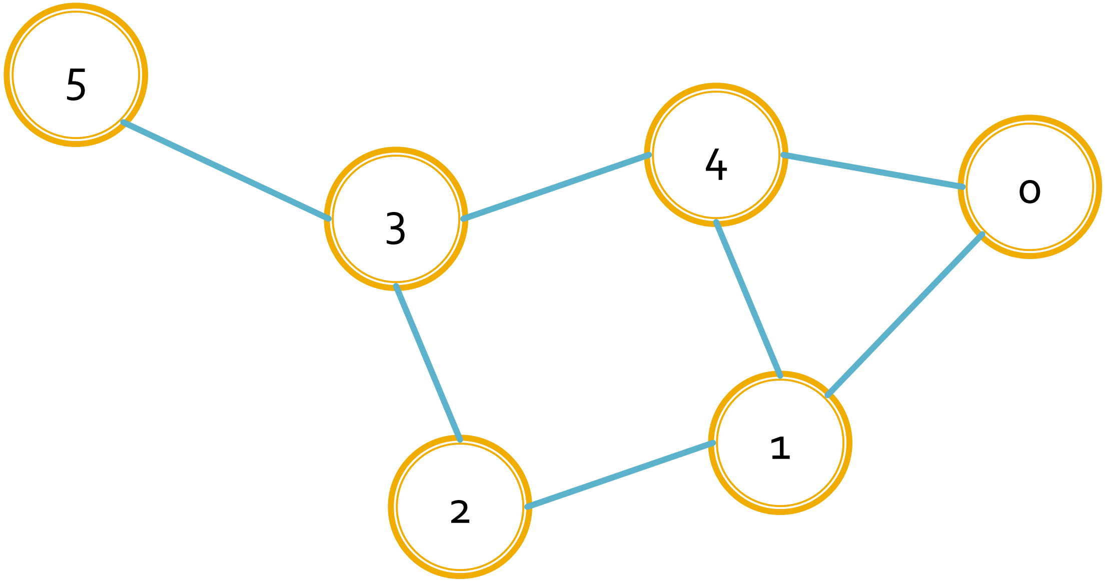
Regional Service Manager

Regional Service Manager

Tree terminology

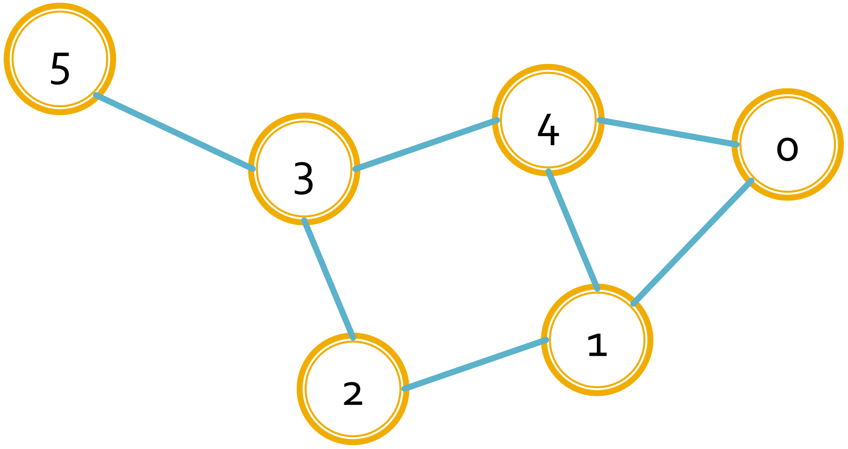


Graph



A labeled graph of 6 vertices and 7 edges

Types of Graphs

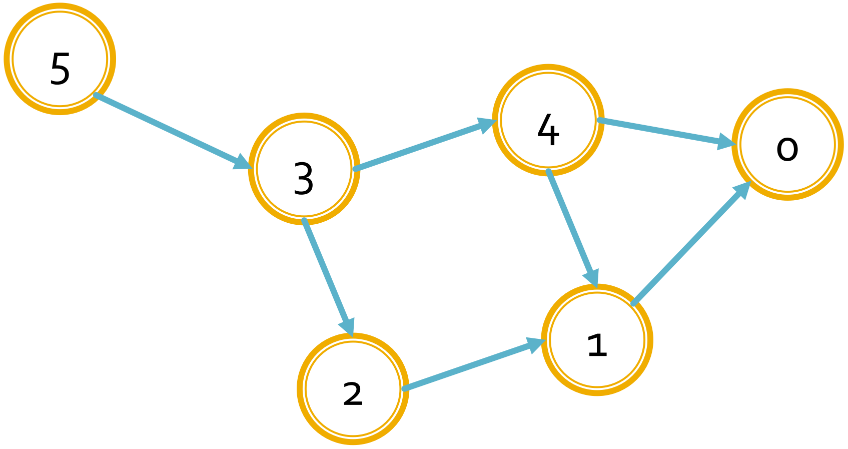


Unweighted Undirected Graph

```
int graph[6][6];
```

	0	1	2	3	4	5
0	0	1	0	0	1	0
1	1	0	1	0	1	0
2	0	1	0	1	0	0
3	0	0	1	0	1	1
4	1	1	0	1	0	0
5	0	0	0	1	0	0

Types of Graphs

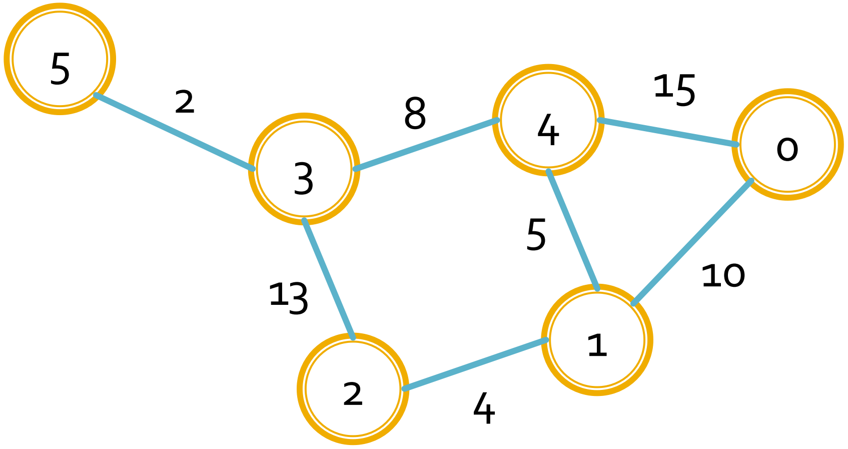


Unweighted Directed Graph

int graph[6][6];

	0	1	2	3	4	5
0	0	0	0	0	0	0
1	1	0	0	0	0	0
2	0	1	0	0	0	0
3	0	0	1	0	1	0
4	1	1	0	0	0	0
5	0	0	0	1	0	0

Types of Graphs

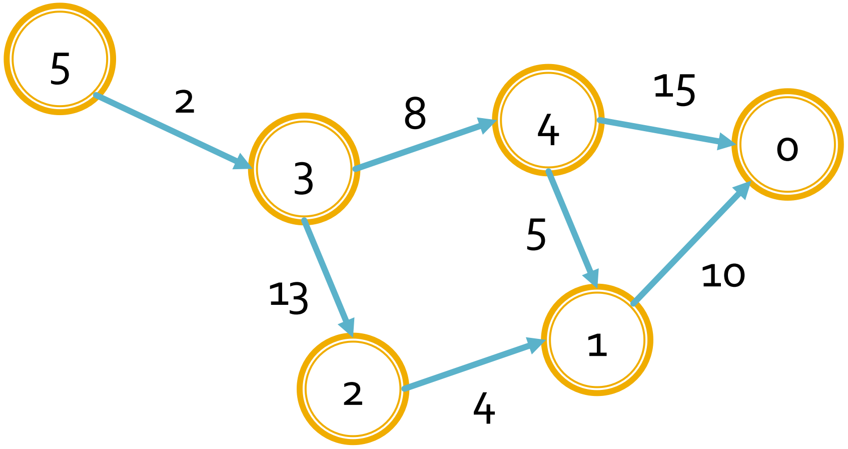


Weighted Undirected Graph

int graph[6][6];

	0	1	2	3	4	5
0	0	10	0	0	15	0
1	10	0	4	0	5	0
2	0	4	0	13	0	0
3	0	0	13	0	8	2
4	15	5	0	8	0	0
5	0	0	0	2	0	0

Types of Graphs



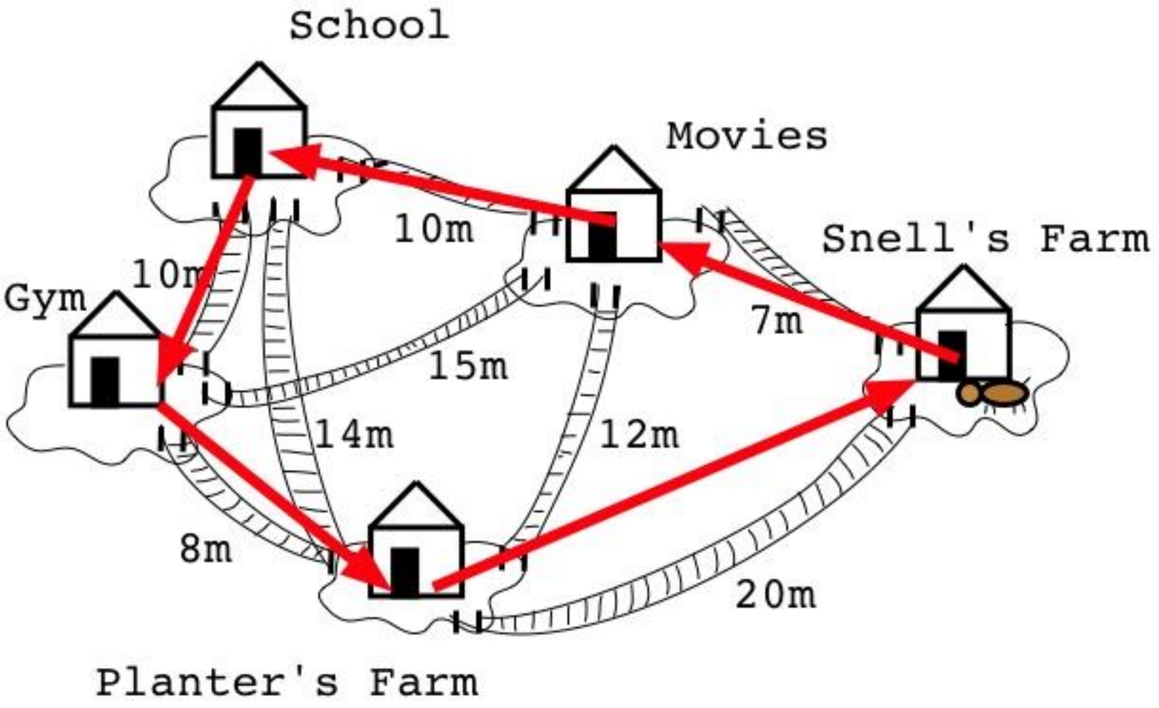
Weighted Directed Graph

int graph[6][6];

	0	1	2	3	4	5
0	0	0	0	0	0	0
1	10	0	0	0	0	0
2	0	4	0	0	0	0
3	0	0	13	0	8	0
4	15	5	0	0	0	0
5	0	0	0	2	0	0

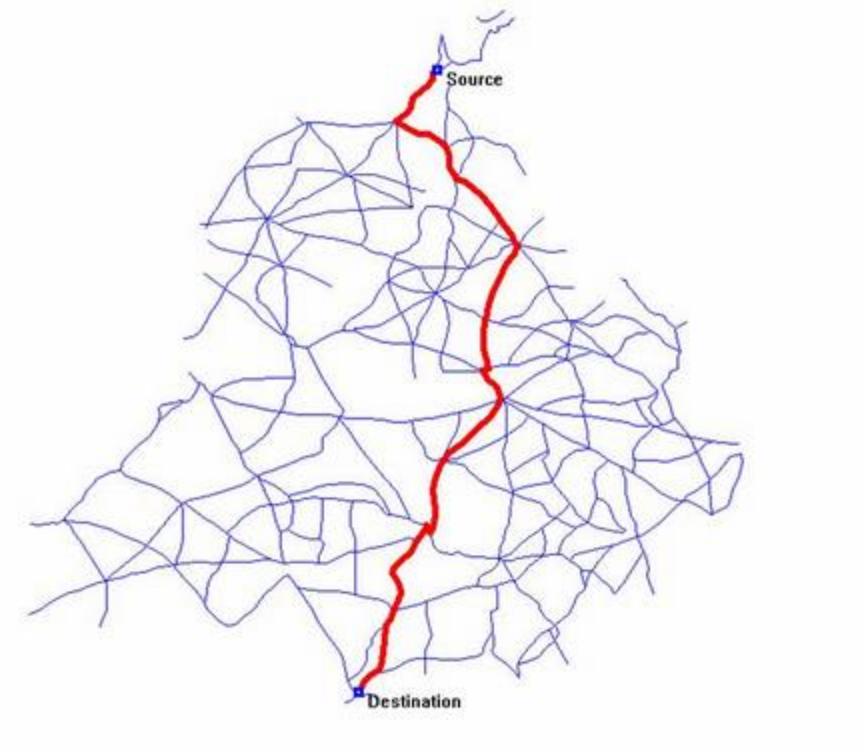
The Traveling Salesman's Problem

The goal is to find the shortest path through a graph that visits each node exactly once and returns to the starting node.



http://computationaltales.blogspot.com/2011/08/traveling-salesmans-problem-part-6-of.html

The Shortest Path Problem



http://www.bhugolgis.com/gram++/shortestpath.html

Dijkstra's Algorithm

What’s the shortest way to travel from Rotterdam to Groningen, in general: from given city to given city. It is the algorithm for the shortest path, which I designed in about twenty minutes.
One morning I was shopping in Amsterdam with my young fiancée, and tired, we sat down on the café terrace to drink a cup of coffee and I was just thinking about whether I could do this, and I then designed the algorithm for the shortest path.(Dijkstra E.W.,2001)