The Traveling Salesman Problem
Nearest-Neighbor Algorithm

Lecture 31
Sections 6.4

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Fri, Apr 6, 2018

1. Greedy and Approximate Algorithms

2. The Nearest-Neighbor Algorithm

3. The Repetitive Nearest-Neighbor Algorithm

4. Assignment

Outline

1. Greedy and Approximate Algorithms
2. The Nearest-Neighbor Algorithm
3. The Repetitive Nearest-Neighbor Algorithm
4. Assignment

Greedy Algorithms

Definition (Greedy Algorithms)

A greedy algorithm is an algorithm that, like greedy people, grabs what looks best in the short run, whether or not it is best in the long run.

- Greedy algorithms optimize locally, but not necessarily globally.
- The benefit of greedy algorithms is that they are simple and fast.
- They may or may not produce the optimal solution.

Approximate Algorithms

Definition (Approximate Algorithm)

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- The benefit of approximate algorithms is that they can produce a good solution very quickly.

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- Also known as “The perfect is the enemy of the good.”

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- The benefit of approximate algorithms is that they can produce a good solution very quickly.
- They operate under the principle “Good is good enough.”
- Also known as “The perfect is the enemy of the good.”
- “Striving to be better, oft we mar what’s well.” (Shakespeare)

Approximate Algorithms

- We will look at three greedy, approximate algorithms to handle the Traveling Salesman Problem.
  - The Nearest-Neighbor Algorithm
  - The Repetitive Nearest-Neighbor Algorithm
  - The Cheapest-Link Algorithm

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The Nearest-Neighbor Algorithm

Definition (Nearest-Neighbor Algorithm)

The Nearest-Neighbor Algorithm begins at any vertex and follows the edge of least weight from that vertex. At every subsequent vertex, it follows the edge of least weight that leads to a city not yet visited, until it returns to the starting point.

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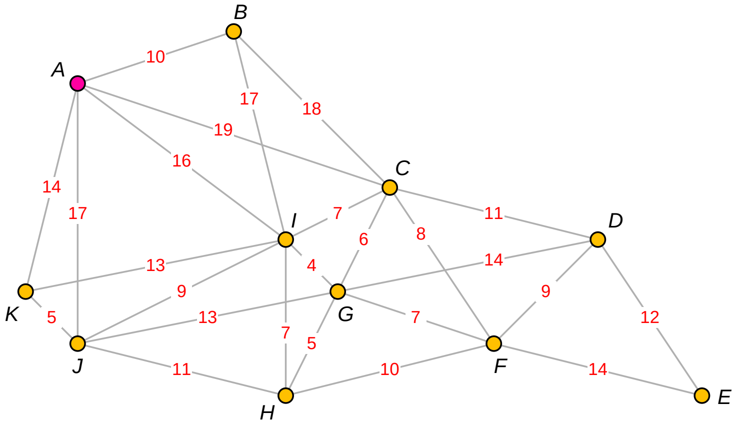
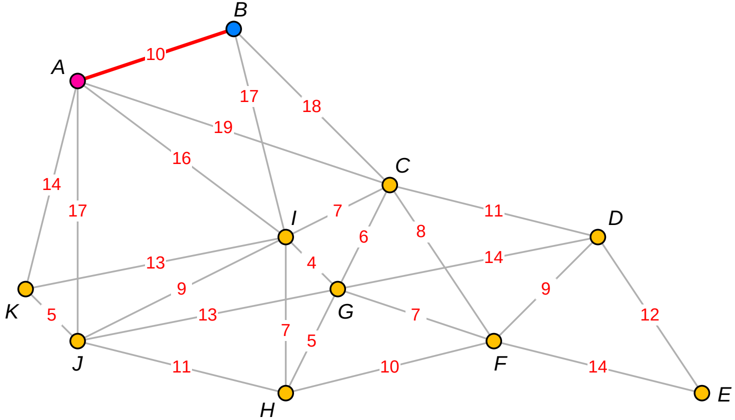
- The result typically depends on the chosen starting point.

Example



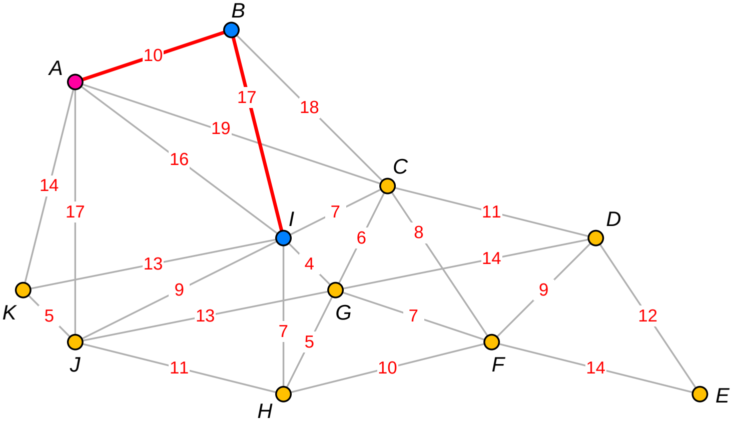
Start at *A*

Example



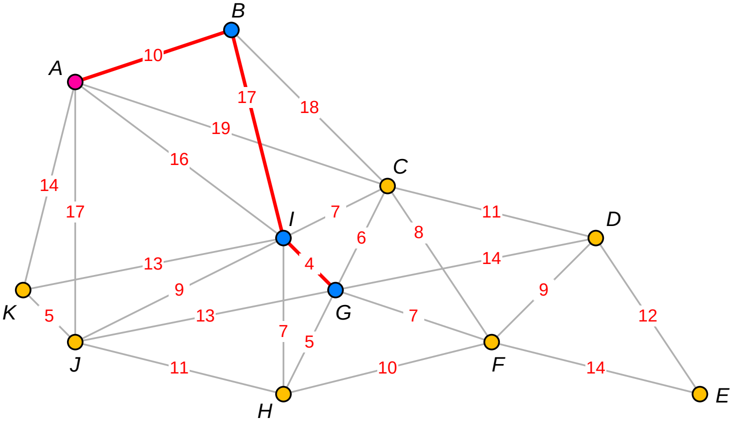
Distance = 10

Example



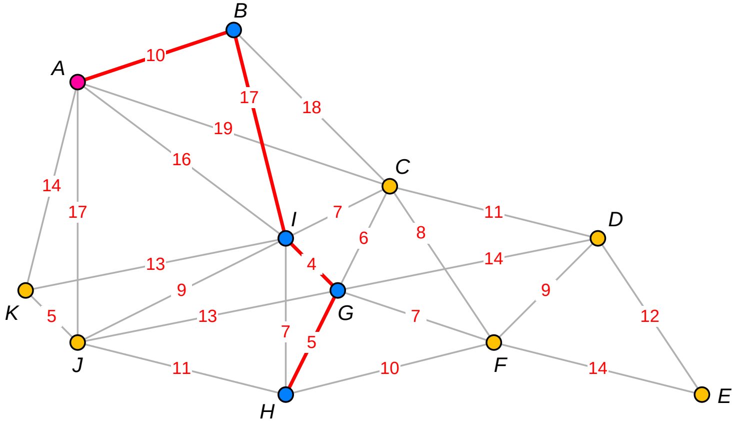
Distance = 27

Example



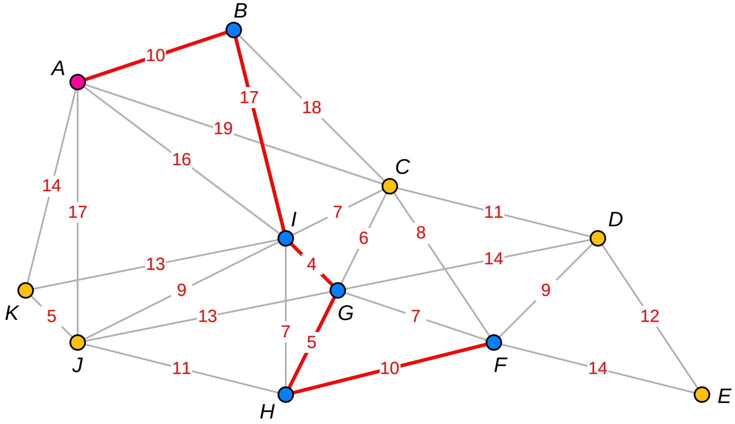
Distance = 31

Example



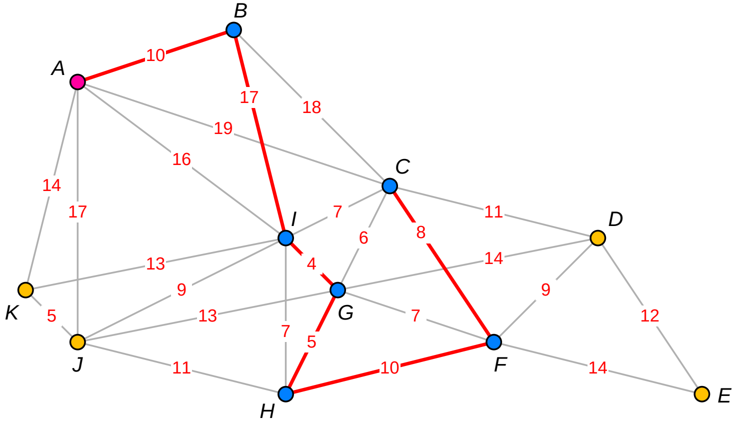
Distance = 36

Example



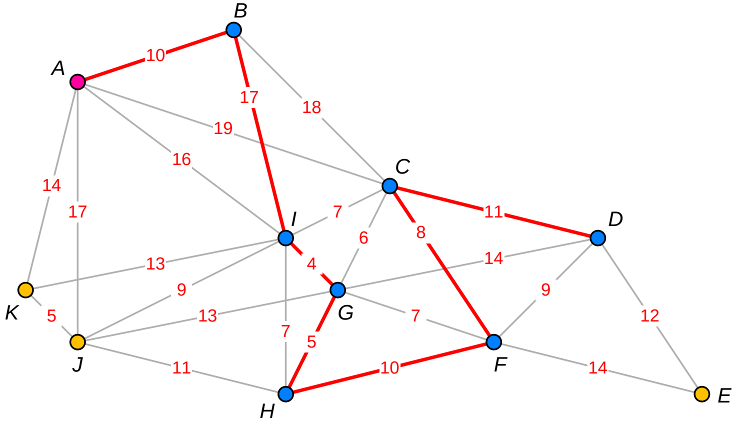
Distance = 46

Example



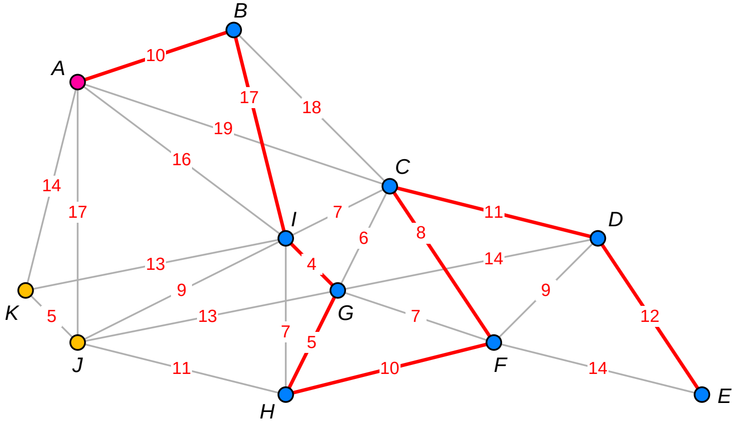
Distance = 54

Example



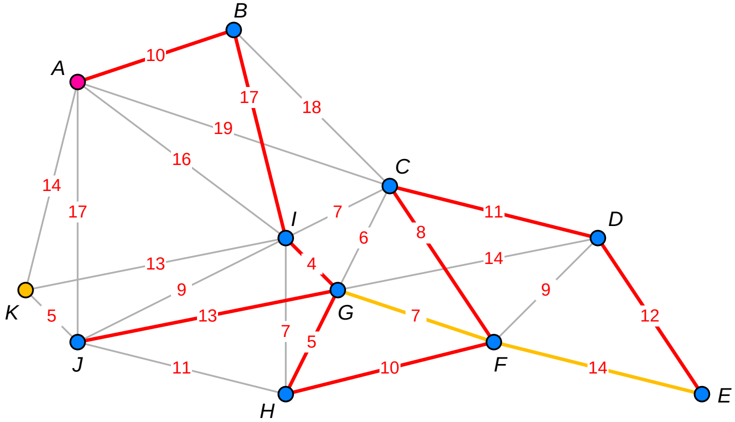
Distance = 65

Example



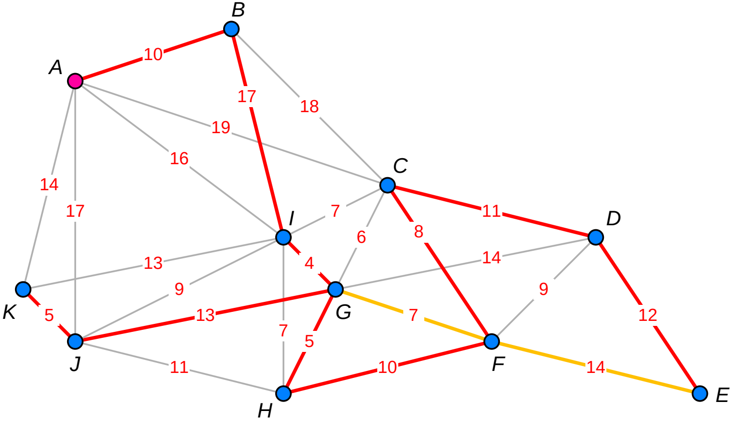
Distance = 77

Example



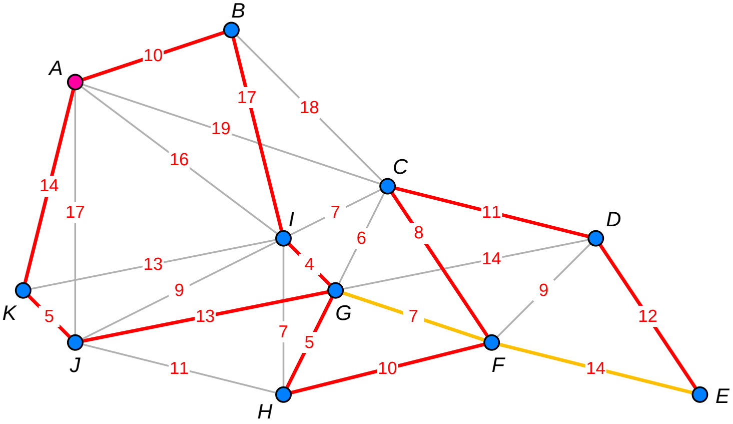
Distance = 111

Example



Distance = 116

Example



Distance = 130

The Nearest-Neighbor Algorithm

Example (Nearest-Neighbor Algorithm)

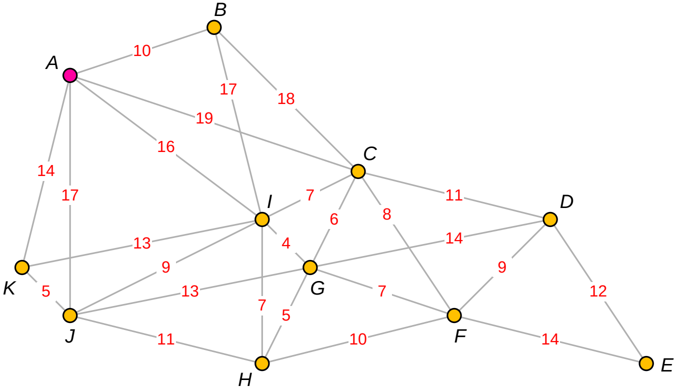
- We ended up with the circuit *ABIGHFCDEJKA*.
- The length is 130 miles.
- Is it possible to do better?

The Nearest-Neighbor Algorithm

Example (Nearest-Neighbor Algorithm)

- We ended up with the circuit *ABIGHFCDEJKA*.
- The length is 130 miles.
- Is it possible to do better?
- Yes.

The Nearest-Neighbor Algorithm



- Re-do the previous example, starting at city *B*.
- Re-do the previous example, starting at city *C*.

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The Repetitive Nearest-Neighbor Algorithm

Definition (Repetitive Nearest-Neighbor Algorithm)

The Repetitive Nearest-Neighbor Algorithm applies the nearest-neighbor algorithm repeatedly, using each of the vertices as a starting point. It selects the starting point that produced the shortest circuit.

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- Chapter 6: Exercises 35, 36, 37, 41, 45.