Course Name: Analysis and Design of Algorithms

Topics to be covered

- Branch and Bound
  - General Method
  - Travelling Salesman

General search strategies

Backtracking

Explore all alternatives

- Solution constructed by stepwise choices
- Decision tree
- Guarantees optimal solution
- Exponential time (slow)

Depth-first search

- Implement as stack (*push*, *pop*, *isempty*)
- Linear time memory

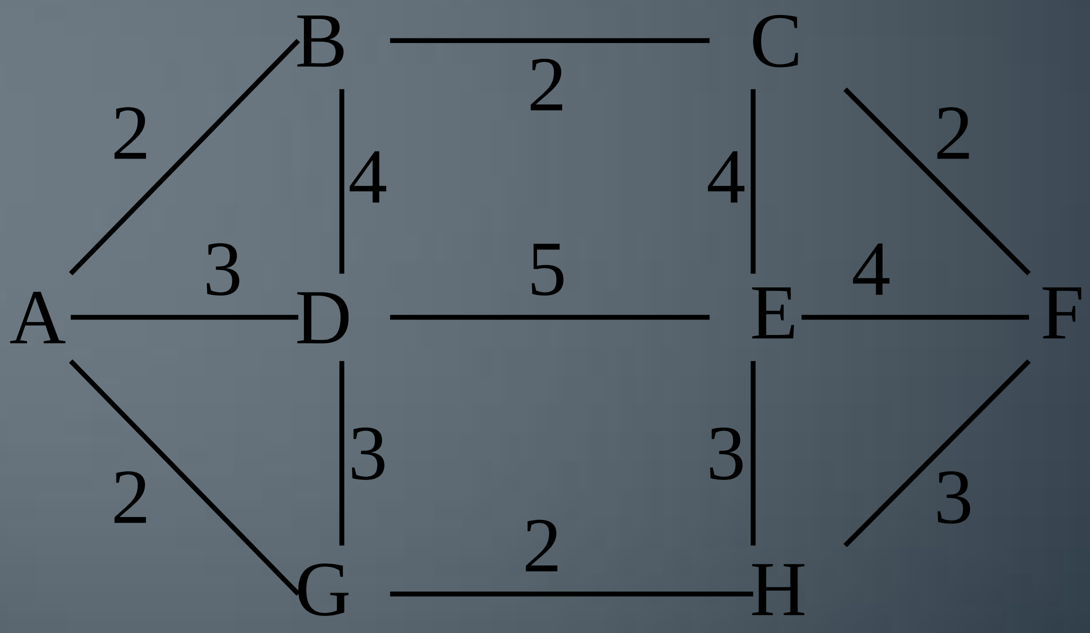
Breadth-first search

- Implemented by queue (*enqueue*, *dequeue*, *isempty*)

Traveling salesman problem

Input: graph (V,E)

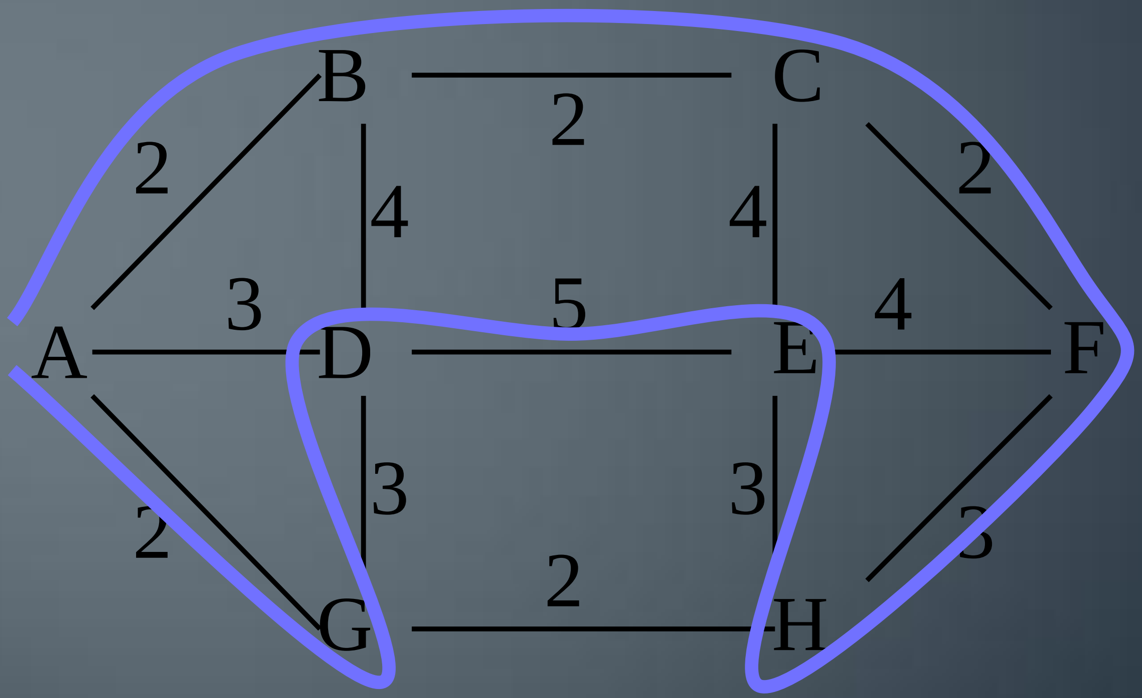
Problem: Find shortest path via all nodes and returning to start node.



Traveling salesman problem

Input: graph (V,E)

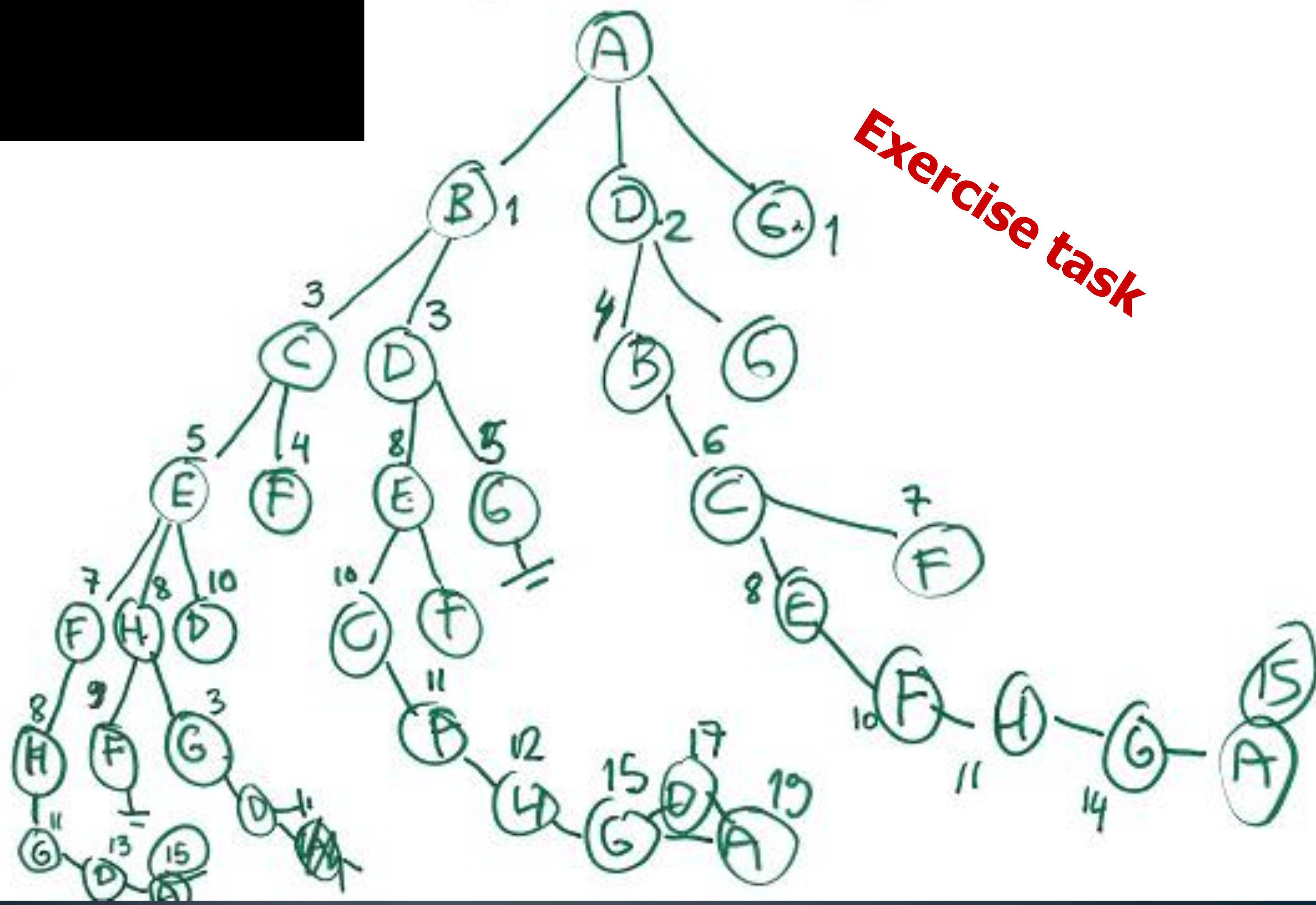
Output: path (p_1, p_2, ..., p_n, p_{n+1})



Solution = A-B-C-F-H-E-D-G-A
Length = 22

Traveling salesman problem

[redacted]



Exercise task

Knapsack problem

Problem definition

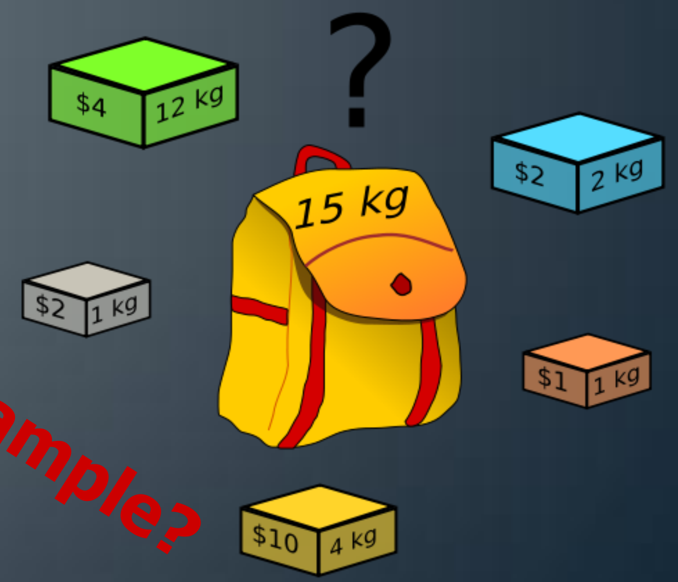
Input: Weight of N items $\{w_1, w_2, \ldots, w_n\}$
Cost of N items $\{c_1, c_2, \ldots, c_n\}$
Knapsack limit S

Output: Selection for knapsack: $\{x_1, x_2, \ldots x_n\}$
where $x_i \in \{0,1\}$.

Sample input:

$w_i = \{1,1,2,4,12\}$
$c_i = \{1,2,2,10,4\}$
$S=15$

Real example?



Knapsack problem

Simplified

Input: Weight of N items $\{w_1, w_2, \ldots, w_n\}$
Knapsack limit S

Output: Selection for knapsack: $\{x_1, x_2, \ldots x_n\}$
where $x_i \in \{0,1\}$.

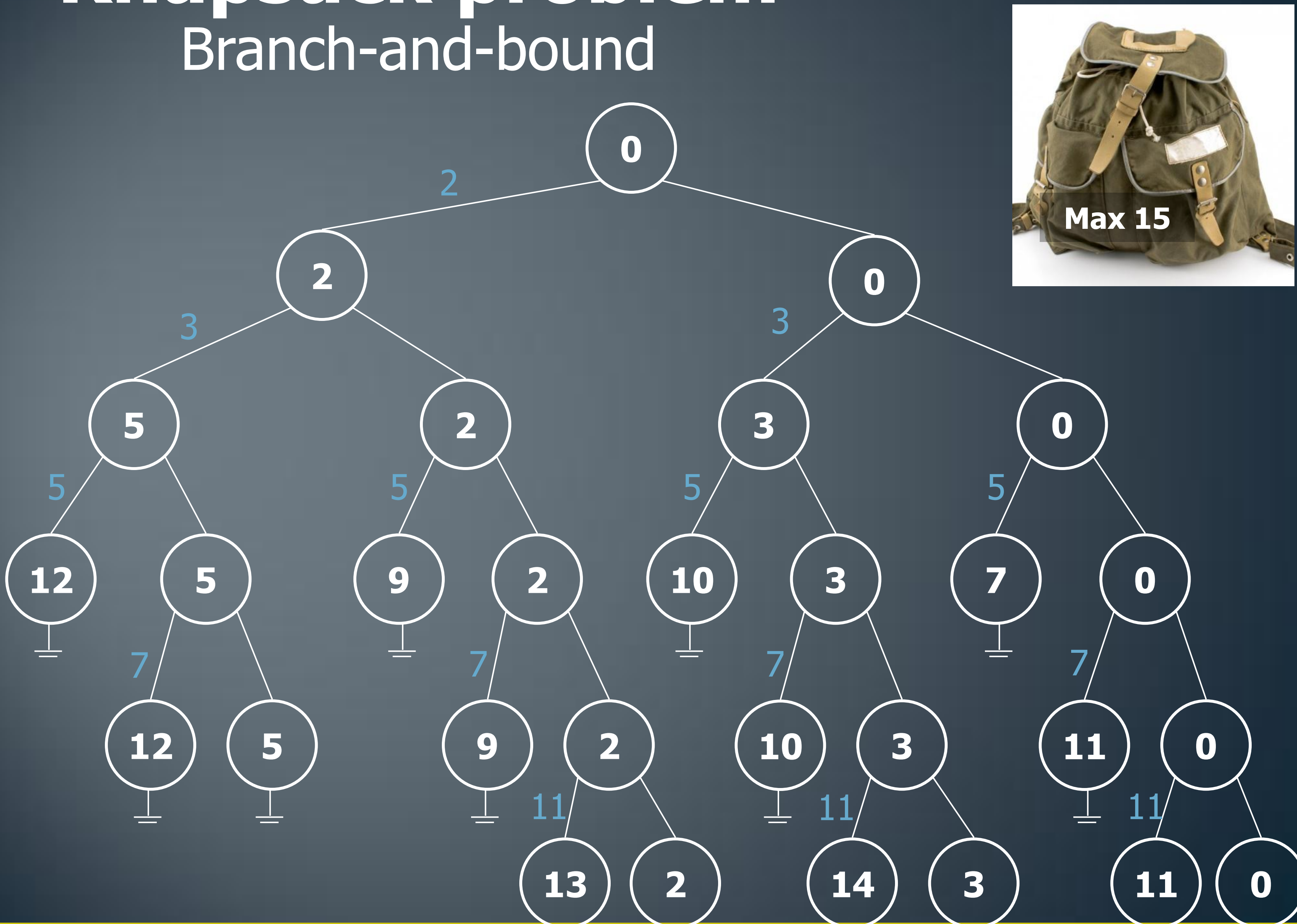
Sample input:

$w_i=\{2,3,5,7,11\}$
$S=15$

Knapsack problem

Branch-and-bound

$w_i = \{2,3,5,7,11\}$



Something here

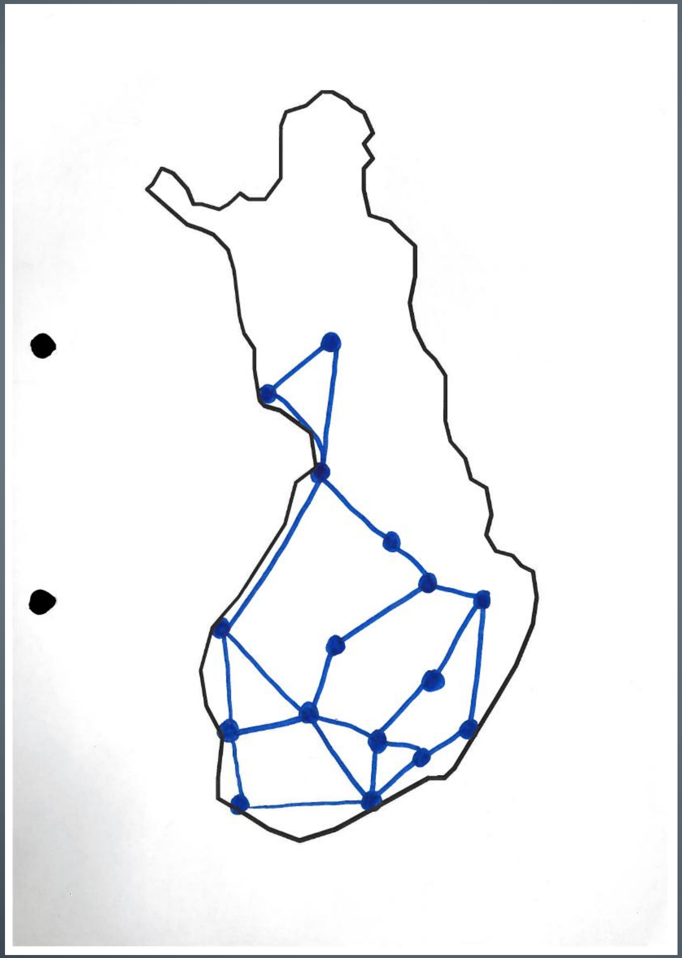
When time

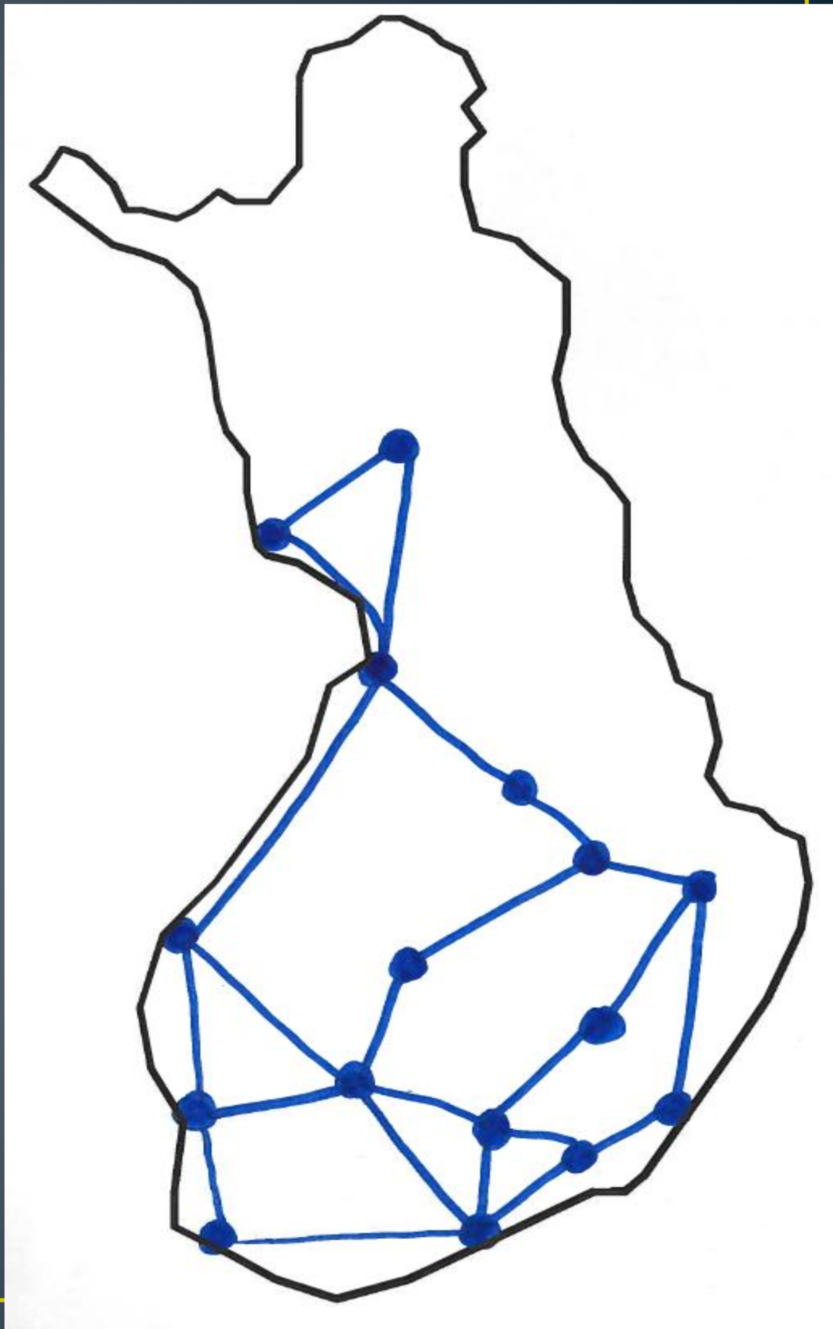
To be done...

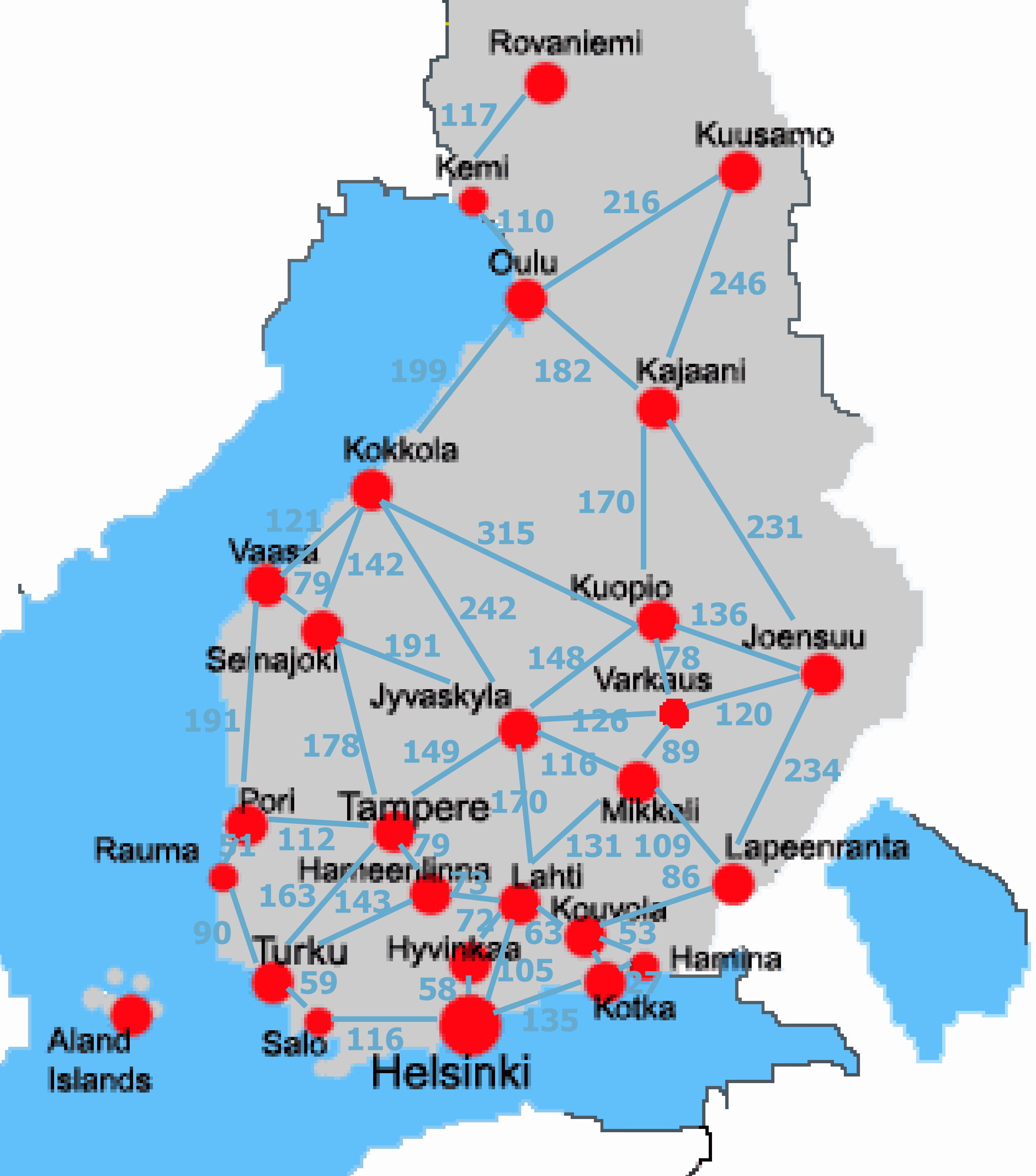
Plus the same for sorting decreasing order

w_i={2,3,5,7,11}
S=15

Graph algorithms







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Oulu
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Vaasa
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Kuopio
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Joensuu
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Seinajoki
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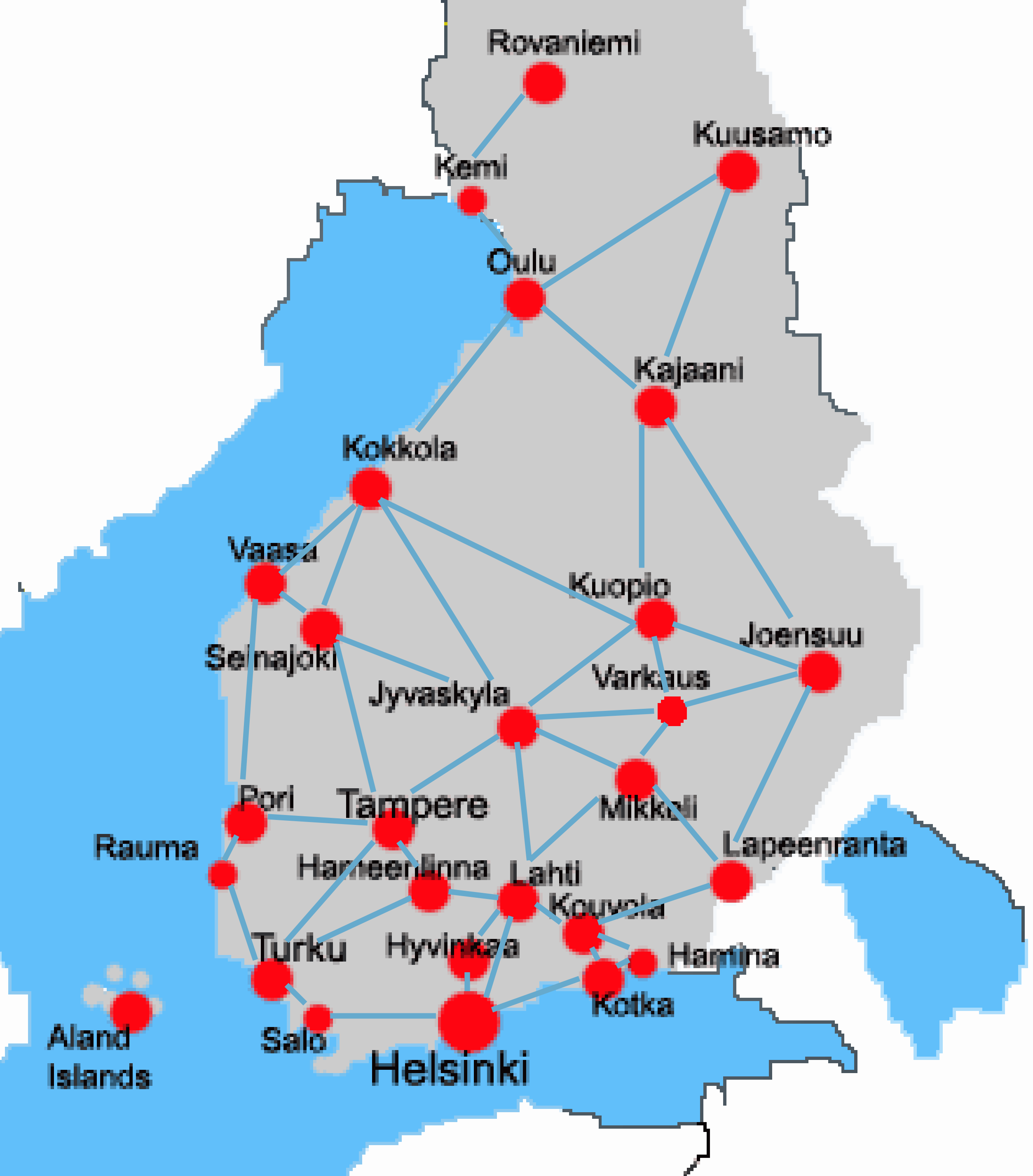
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C

A

B