Electric Generating Capacity Expansion

A shortest-path model

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Capacity Planning for Electric Utility

An electric utility company must schedule the addition of power generation capactiy over the next six years, given

- cumulative number of plants required each year
- fixed cost during year in which plants are constructed
- marginal cost per plant
- discount factor

The fixed cost of adding capacity in a year, independent of the number of generators added, is 1.5 M$.
The marginal cost per generator varies by year, and is

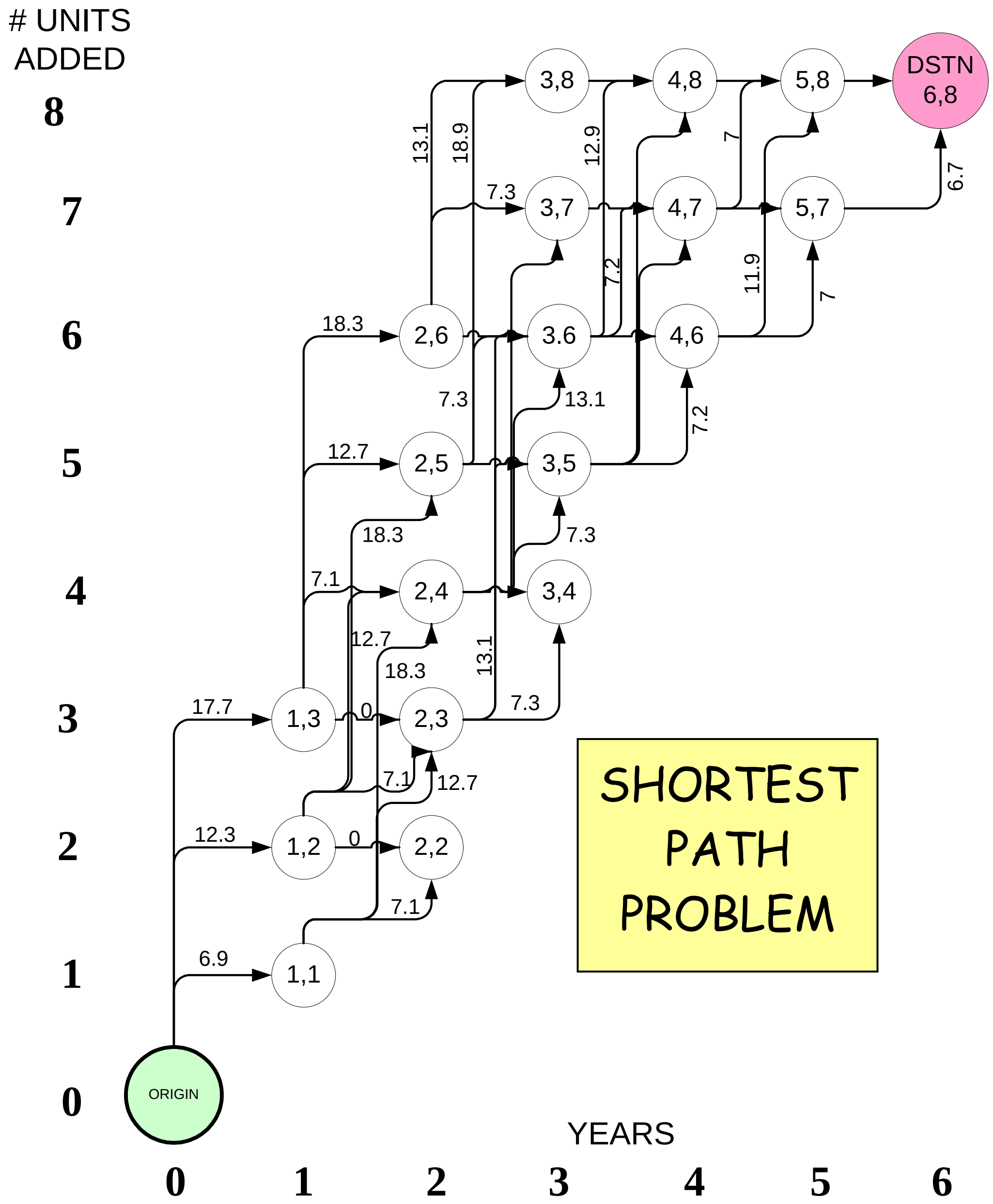
Year	1	2	3	4	5	6
$M/unit	5.4	5.6.	5.8	5.7	5.5	5.2

Based upon forecasts of demand, the company has set the following *goals* to be achieved by the end of any year, i.e., the cumulative number of generators installed:

Year	1	2	3	4	5	6
# units	1	2	4	6	7	8

A total of eight generators will have been installed during the six-year period, then, with a restriction that no more than three may be installed during each one-year period.

In a project of this magnitude and duration, consideration of the *time value of money* is important. The company policy is to use a discount rate of **0.86956**, that is, the *present value* of a cost of $1 incurred one year into the future is $0.86956.



The optimal sequence of units added corresponds to a path from **source** node (0,0), *time 0,0 units added.* to the **destination** node (6,8), *time 6, 8 units added.*

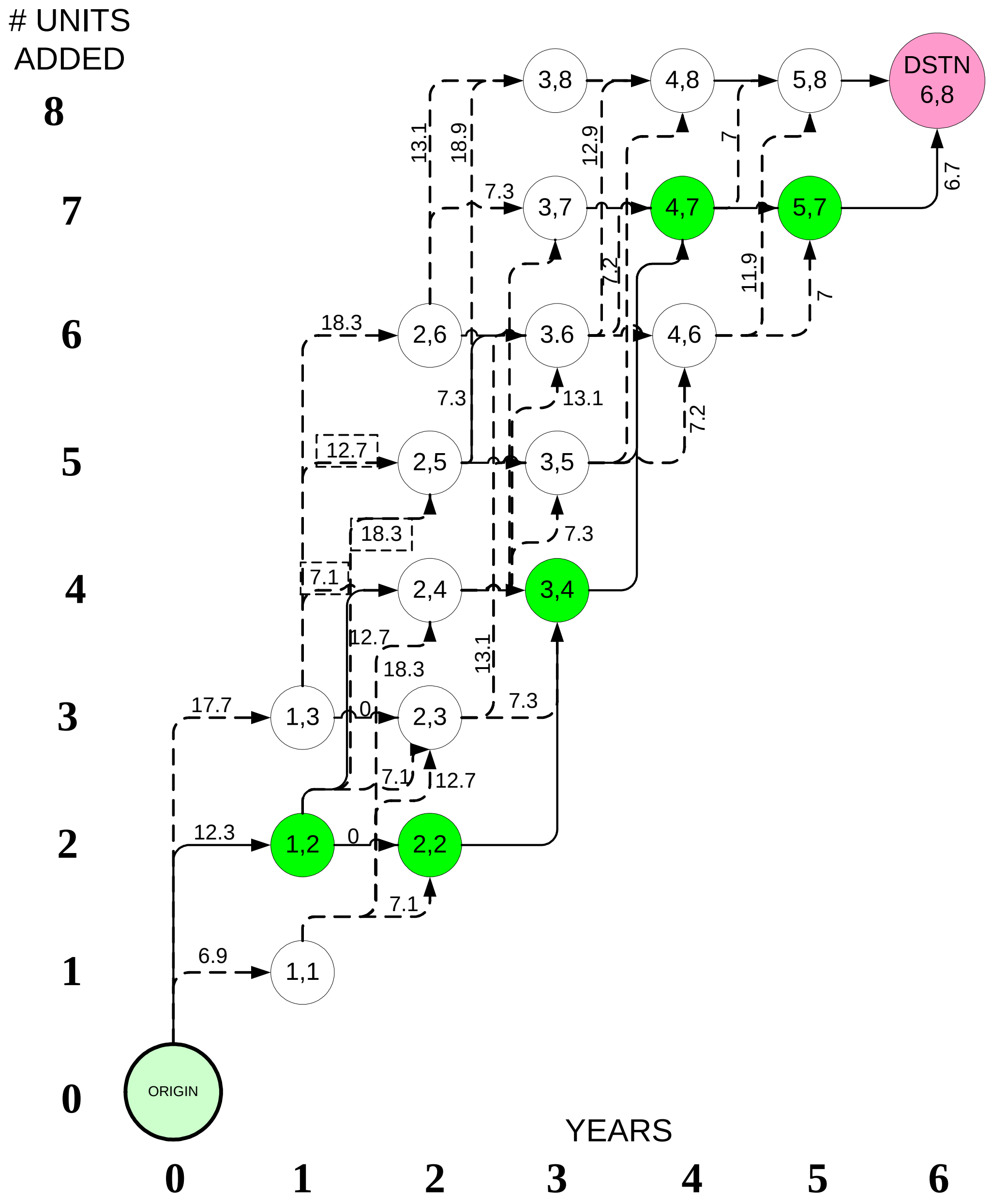
The cost of a link between two nodes is the cost of adding the corresponding capacity--

for example, the cost of the link

$$(2,3) \rightarrow (3,6)$$

is the cost of adding 3 generators in period 2, namely

$$1.5 + 3\times 5.6 = 18.3$$



Shown on the left is the **shortest path**

from the initial node

to the destination, node (6,8).

The length of this shortest path

(discounted for present value) is

37.7664