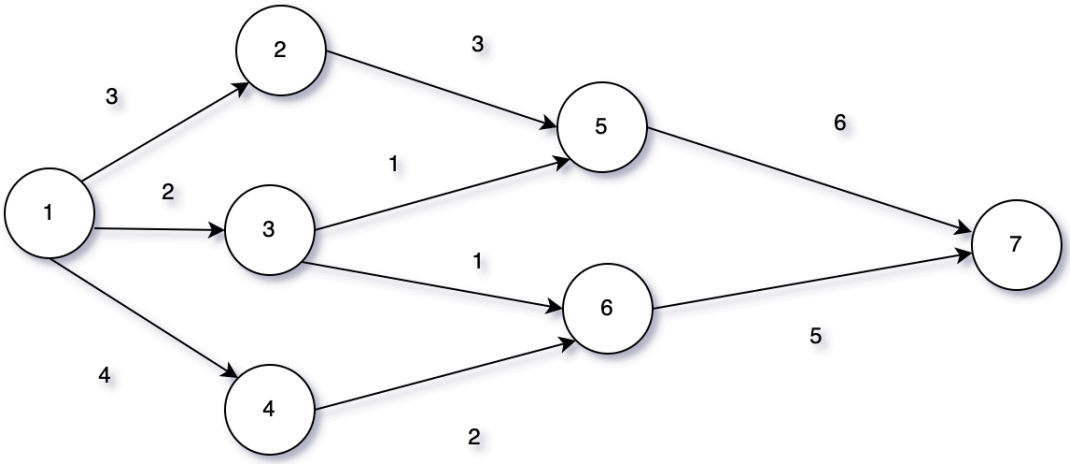
shortestpath

March 21, 2025



$$\min z = 3x_{12} + 2x_{13} + 4x_{14} + 3x_{25} + x_{35} + x_{36} + 2x_{46} + 6x_{57} + 5x_{67}$$

Subject to:

$$x_{12} + x_{13} + x_{14} = 1$$
$$x_{12} - x_{25} = 0$$
$$x_{13} - x_{35} - x_{36} = 0$$
$$x_{14} - x_{46} = 0$$
$$x_{25} + x_{35} - x_{57} = 0$$
$$x_{36} + x_{46} - x_{67} = 0$$
$$x_{57} + x_{67} = 1$$
$$x_{ij} \in \{0, 1\}$$

[58]:
```
using JuMP
```

[59]:
```
using GLPK
```

[60]:
```
m = Model(GLPK.Optimizer)
```

[60]:
```
A JuMP Model
Feasibility problem with:
```

```
Variables: 0
Model mode: AUTOMATIC
CachingOptimizer state: EMPTY_OPTIMIZER
Solver name: GLPK
```

[61]:
```
@variable(m, x12, Bin)
@variable(m, x13, Bin)
@variable(m, x14, Bin)
@variable(m, x25, Bin)
@variable(m, x35, Bin)
@variable(m, x36, Bin)
@variable(m, x46, Bin)
@variable(m, x57, Bin)
@variable(m, x67, Bin);
```

[62]:
```
@objective(m, Min, 3x12 + 2x13 + 4x14 + 3x25 + x35 + x36 + 2x46 + 6x57 + 5x67)
```

[62]:

$$3x12 + 2x13 + 4x14 + 3x25 + x35 + x36 + 2x46 + 6x57 + 5x67$$

[63]:
```
@constraint(m, x12 + x13 + x14 == 1)
```

[63]:

$$x12 + x13 + x14 = 1.0$$

[64]:
```
@constraint(m, x12 - x25 == 0)
```

[64]:

$$x12 - x25 = 0.0$$

[65]:
```
@constraint(m, x13 - x35 - x36 == 0)
```

[65]:

$$x13 - x35 - x36 = 0.0$$

[66]:
```
@constraint(m, x14 - x46 == 0)
```

[66]:

$$x14 - x46 = 0.0$$

[67]:
```
@constraint(m, x25 + x35 - x57 == 0)
```

[67]:

$$x25 + x35 - x57 = 0.0$$

[68]:
```
@constraint(m, x36 + x46 - x67 == 0)
```

[68]:

$$x36 + x46 - x67 = 0.0$$

[69]:
```
@constraint(m, x57 + x67 == 1)
```

[69]:

$$x57 + x67 = 1.0$$

[70]:
```
optimize!(m)
```

[71]:
```
println(m)
```

```
Min 3 x12 + 2 x13 + 4 x14 + 3 x25 + x35 + x36 + 2 x46 + 6 x57 + 5 x67
Subject to
 x12 + x13 + x14 = 1.0
 x12 - x25 = 0.0
 x13 - x35 - x36 = 0.0
 x14 - x46 = 0.0
 x25 + x35 - x57 = 0.0
 x36 + x46 - x67 = 0.0
 x57 + x67 = 1.0
 x12 binary
 x13 binary
 x14 binary
 x25 binary
 x35 binary
 x36 binary
 x46 binary
 x57 binary
 x67 binary
```

[72]:
```
solution_summary(m)
```

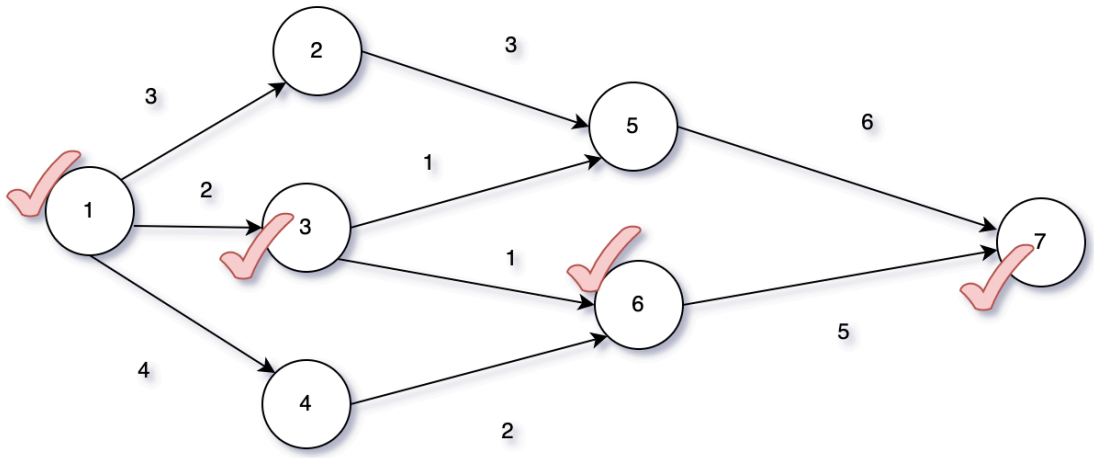
[72]:
```
* Solver : GLPK

* Status
  Termination status : OPTIMAL
  Primal status      : FEASIBLE_POINT
  Dual status        : NO_SOLUTION
  Message from the solver:
  "Solution is optimal"

* Candidate solution
  Objective value      : 8.0
  Objective bound      : 8.0

* Work counters
  Solve time (sec)   : 0.00011
```

[73]:
```
values(m)
```

[73]:
```
A JuMP Model
Minimization problem with:
Variables: 9
Objective function type: AffExpr
`AffExpr`-in-`MathOptInterface.EqualTo{Float64}`: 7 constraints
`VariableRef`-in-`MathOptInterface.ZeroOne`: 9 constraints
Model mode: AUTOMATIC
CachingOptimizer state: ATTACHED_OPTIMIZER
Solver name: GLPK
Names registered in the model: x12, x13, x14, x25, x35, x36, x46, x57, x67
```

[74]:
```
map(x -> (x, value(x)), [x12, x13, x14, x25, x35, x36, x46, x57, x67])
```

[74]:
```
9-element Vector{Tuple{VariableRef, Float64}}:
 (x12, 0.0)
 (x13, 1.0)
 (x14, 0.0)
 (x25, 0.0)
 (x35, 0.0)
 (x36, 1.0)
 (x46, 0.0)
 (x57, 0.0)
 (x67, 1.0)
```



$1 \to 3 \to 6 \to 7$

[ ]: