# Greedy Heuristic Algorithm

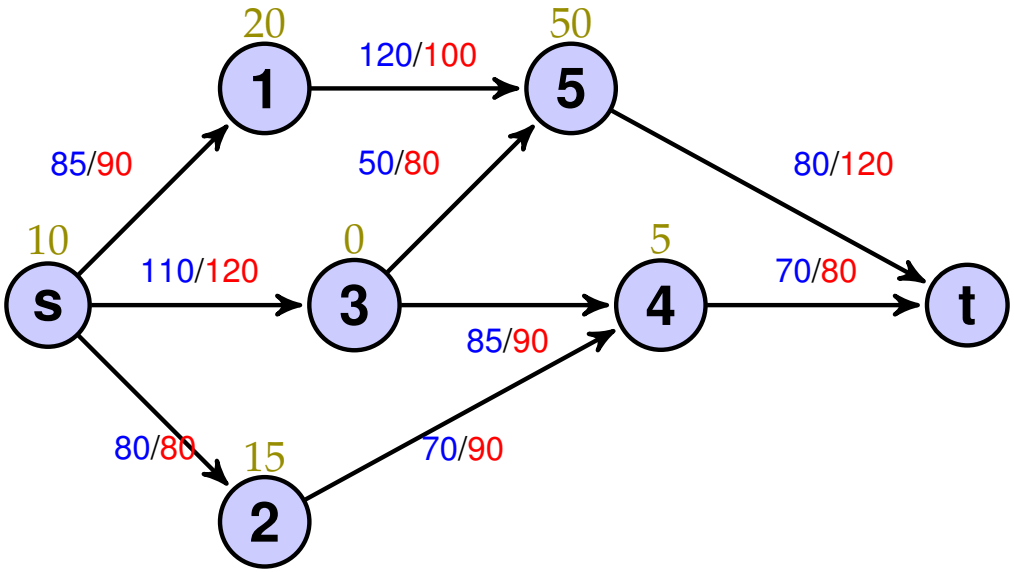
# Consequences of this approach:

- Charging stations are not prioritized
- Choices might get the vehicle "stuck"
- Not optimal

How do we fix this?

- Prioritize vertices with charging stations and lowest time
- Thus we are able to solve more graphs (robustness)
- Not ideal solution

# Example




Edge weights:

- distance (km)
- speed limit(km/hr)

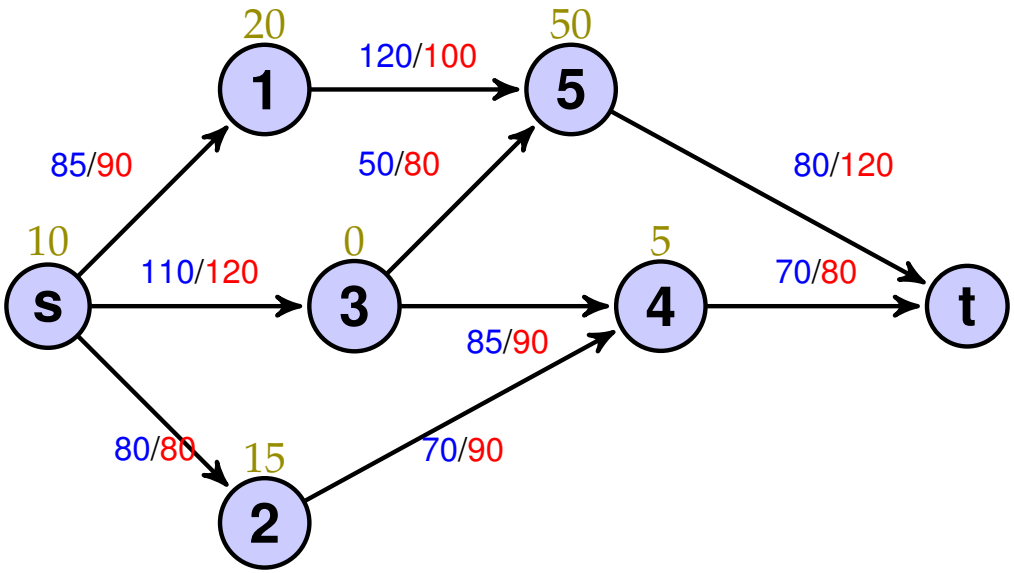
Vertex weights:

- charging speed (kW)

Paths:

$\langle s, 1, 5, t \rangle$: 285km, 2.8hr
$\langle s, 3, 4, t \rangle$: 265km, 2.7hr
$\langle s, 3, 5, t \rangle$: 240km, 2.2hr
$\langle s, 2, 4, t \rangle$: 220km, 2.7hr

# EXAMPLE

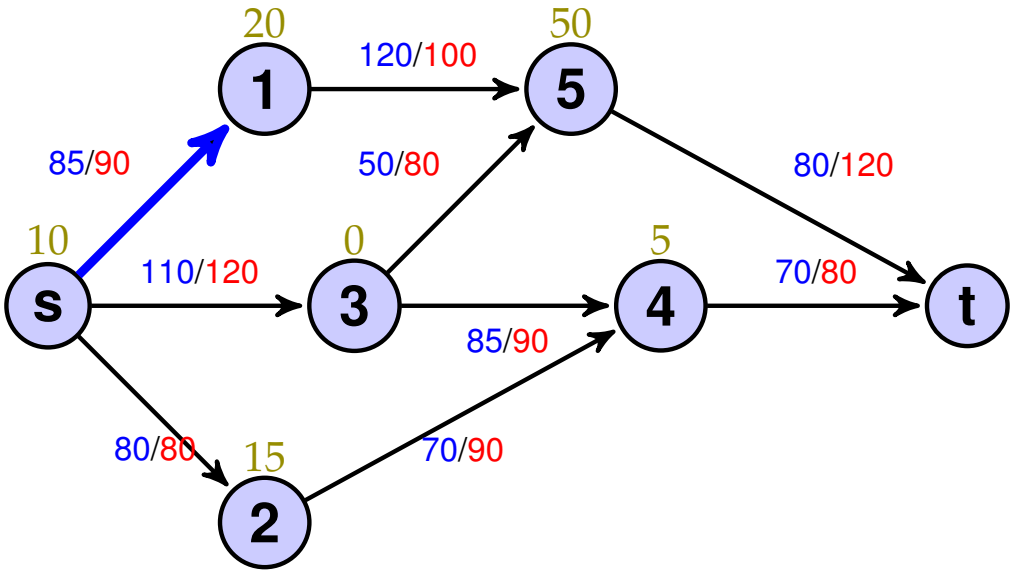



$Q = \{s\}$

Best: s

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| t | | | |
| | | | |

# EXAMPLE

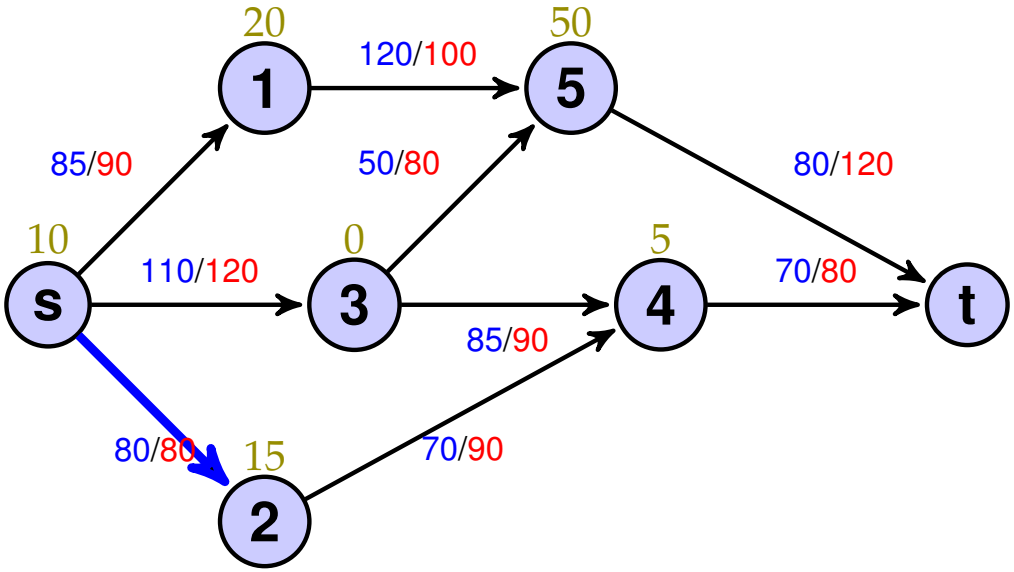



Driving: 90km/hr: 0.94 hr

Charge and drive: Same

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| t | | | |

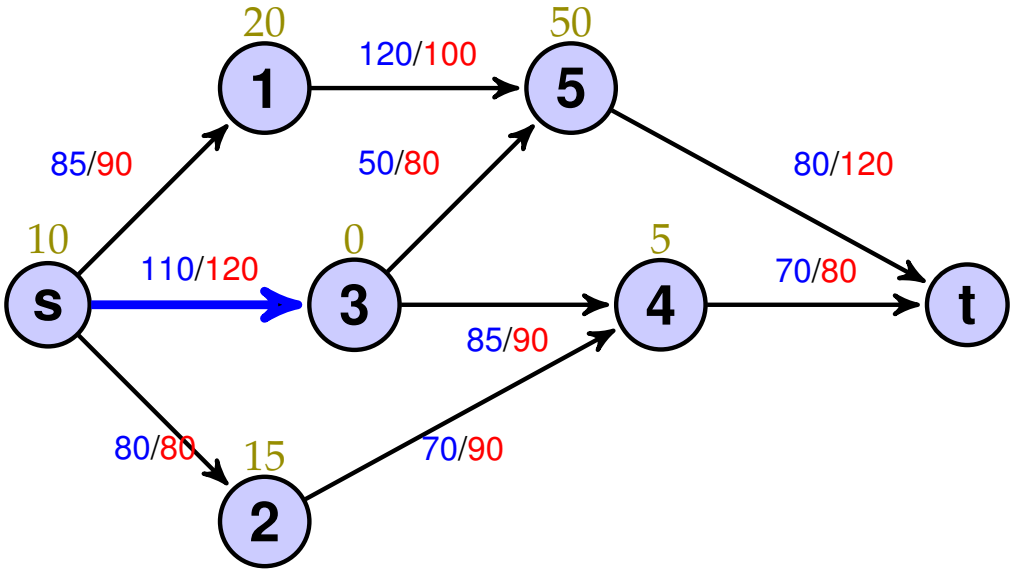
# EXAMPLE




Driving: 80km/hr: 1hr
Charge and drive: Same

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| t | | | |
| | | | |

# EXAMPLE

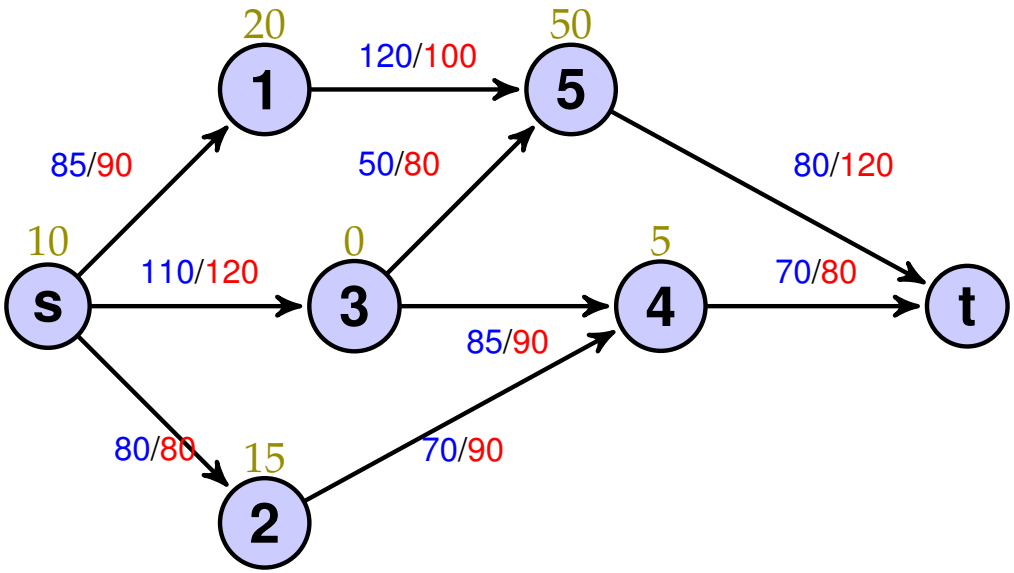



Driving: 120km/hr: 0.92hr

Charge and drive: Same

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | | | |
| 5 | | | |
| t | | | |

# EXAMPLE

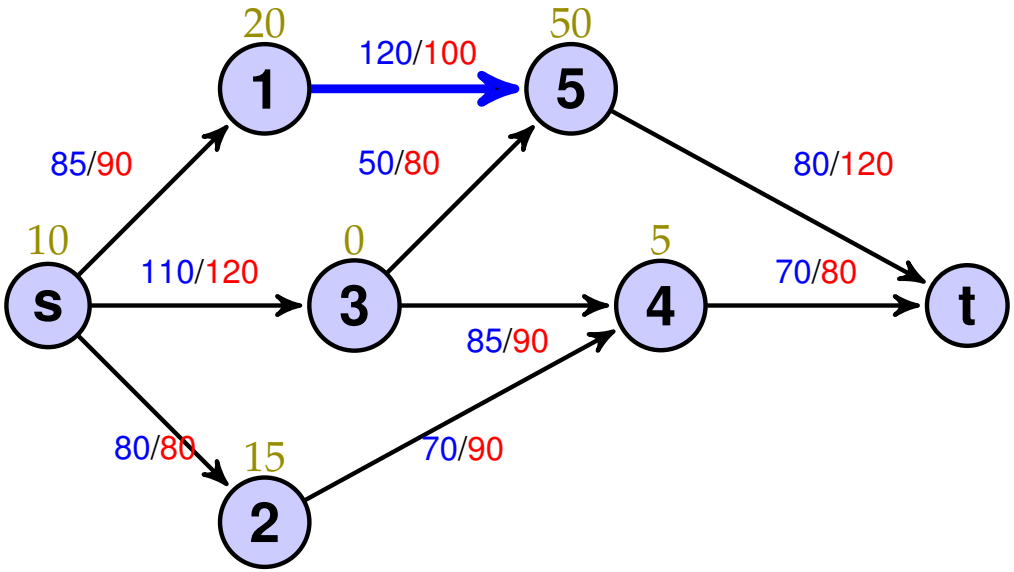



$Q = \{1, 3, 2\}$

Best: 1

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | | | |
| 5 | | | |
| t | | | |

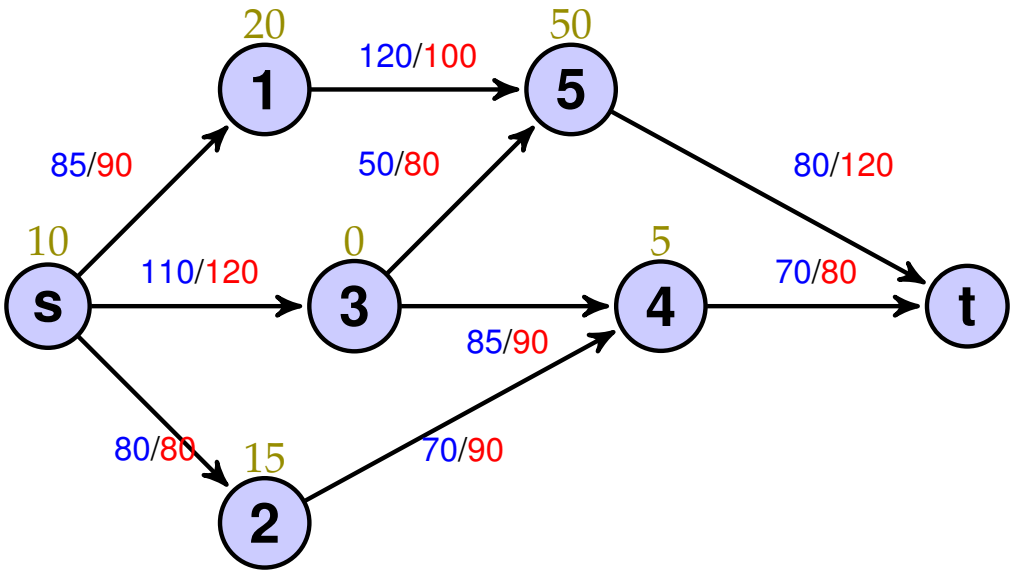
# EXAMPLE




| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | | | |
| 5 | 1 | 2.5 | 0 |
| t | | | |
| | | | |

Driving: 71.1km/hr: 1.7 hr
Charge and drive: 88.1km/hr: 1.6 hr

# EXAMPLE

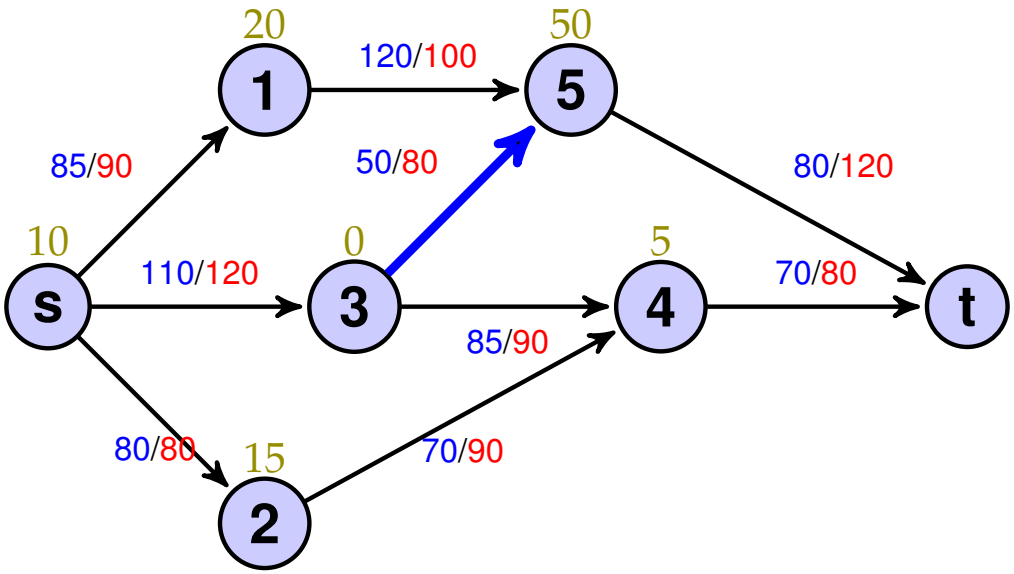



$Q = \{3, 2, 5\}$

Best: 3

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | | | |
| 5 | 1 | 2.5 | 0 |
| t | | | |

# EXAMPLE

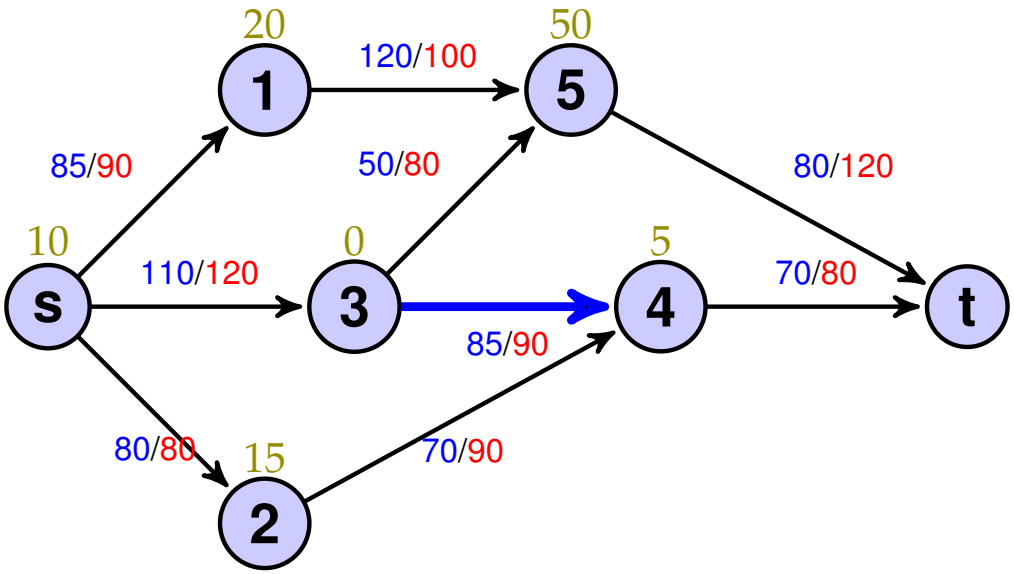



Driving: Not possible!

Charge and drive: Not possible!

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | | | |
| 5 | 1 | 2.5 | 0 |
| t | | | |
| | | | |

# EXAMPLE

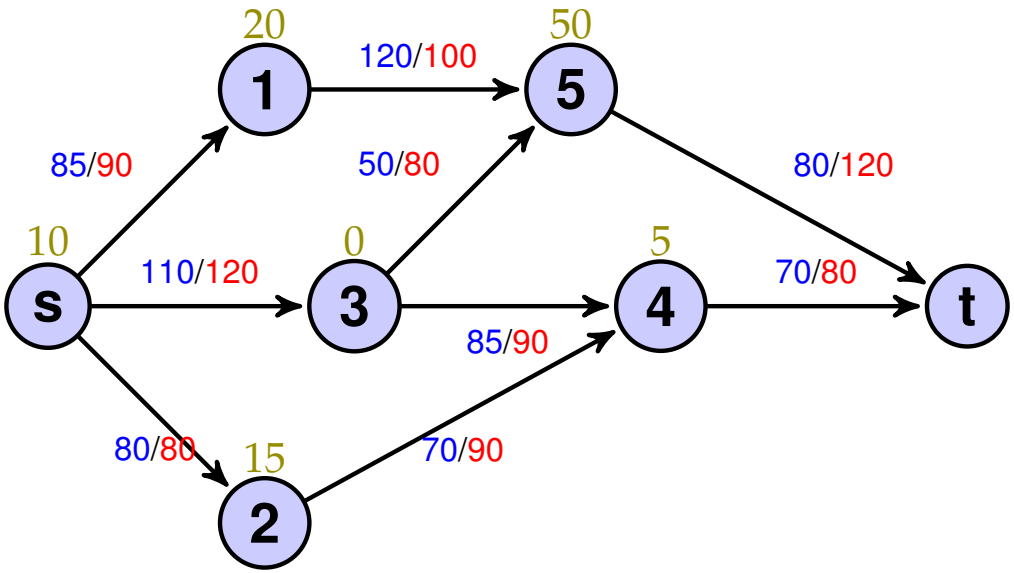



Driving: Not possible

Charge and drive: Not possible!

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | | | |
| 5 | 1 | 2.5 | 0 |
| t | | | |
| | | | |

# EXAMPLE

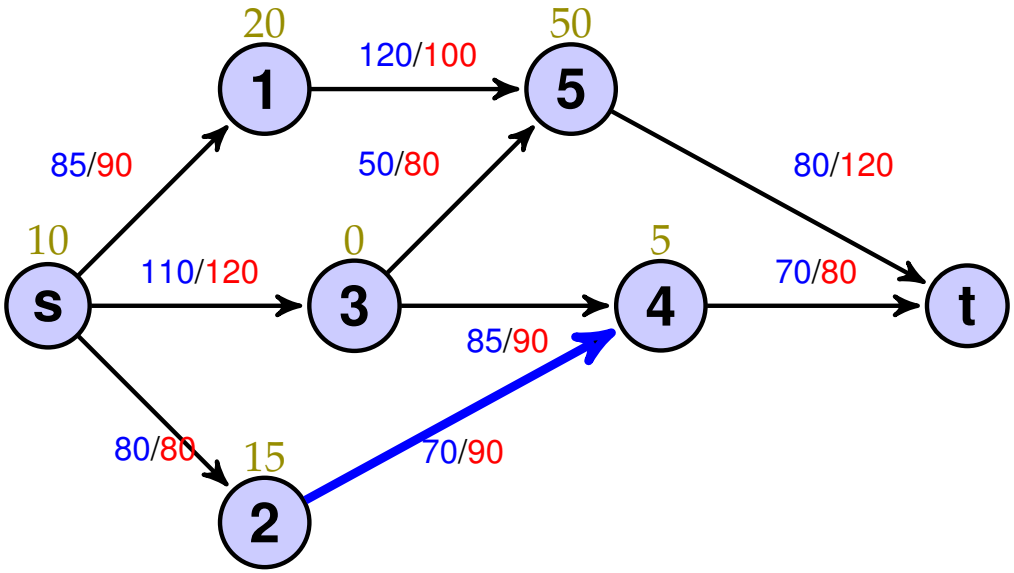



$Q = \{2, 5\}$

Best: 2

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | | | |
| 5 | 1 | 2.5 | 0 |
| t | | | |

# EXAMPLE

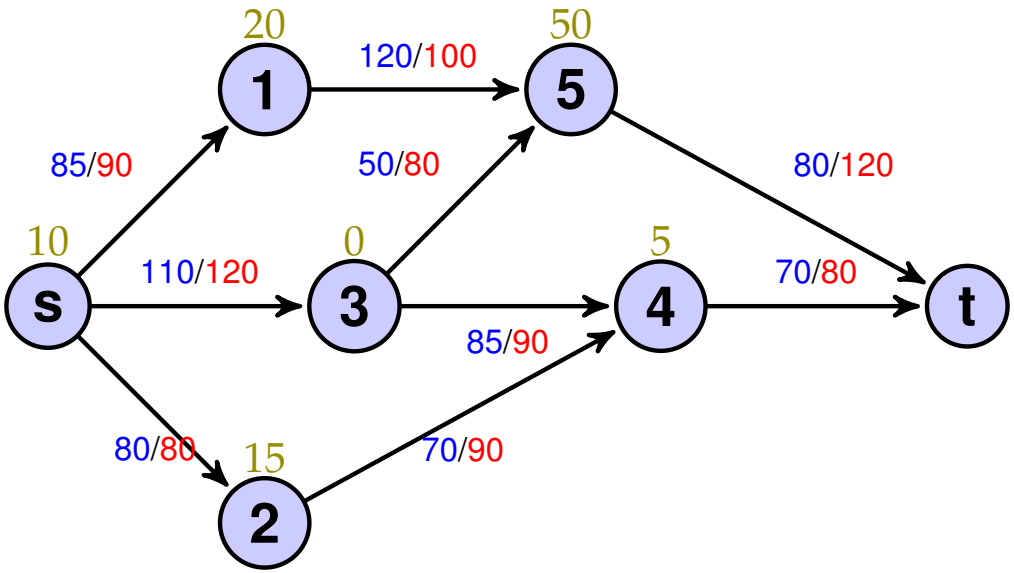



Driving: 90km/hr: 0.8hr

Charge and drive: Same

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | 2 | 1.8 | 11.6 |
| 5 | 1 | 2.5 | 0 |
| t | | | |

# EXAMPLE

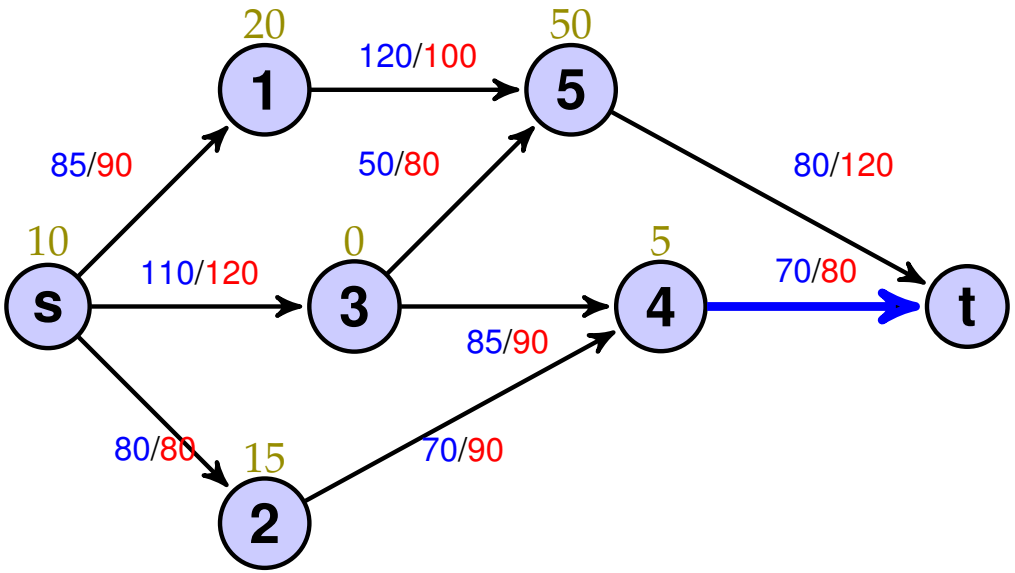



$Q = \{5, 4\}$

Best: 4

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | 2 | 1.8 | 11.6 |
| 5 | 1 | 2.5 | 0 |
| t | | | |

# EXAMPLE



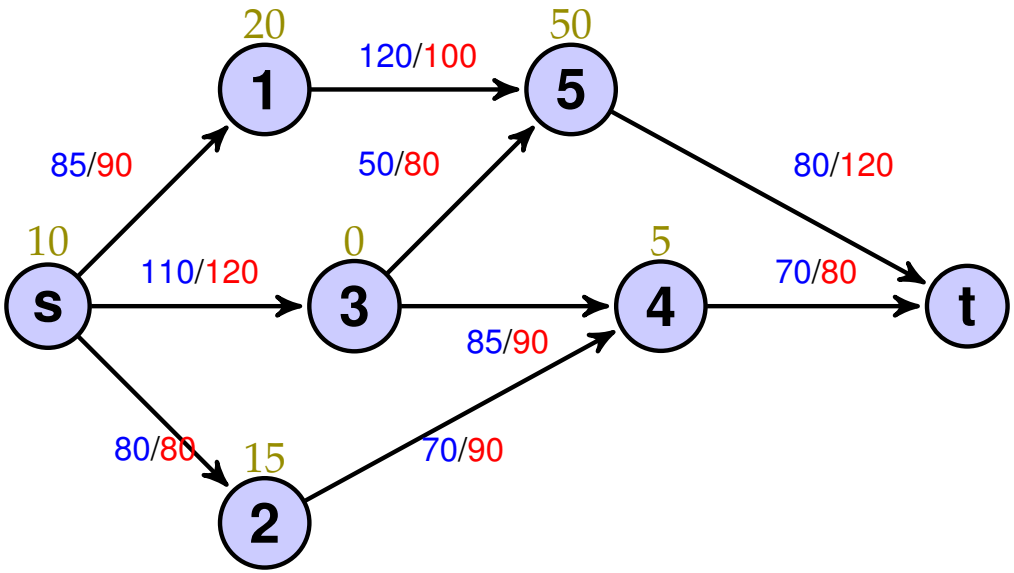

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | 2 | 1.8 | 11.6 |
| 5 | 1 | 2.5 | 0 |
| t | 4 | 3 | 0 |

Driving: Not possible

Charge and drive: 58.6km/hr: 1.2hr

Uses previous charging station of 15kW!

# EXAMPLE

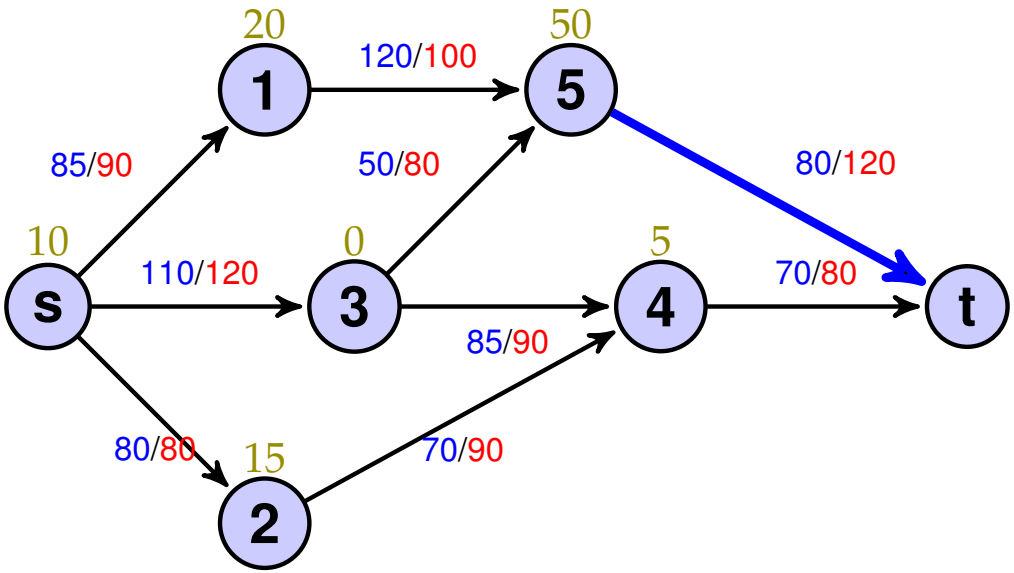



$Q = \{5\}$

Best: 5

| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | 2 | 1.8 | 11.6 |
| 5 | 1 | 2.5 | 0 |
| t | 4 | 3 | 0 |

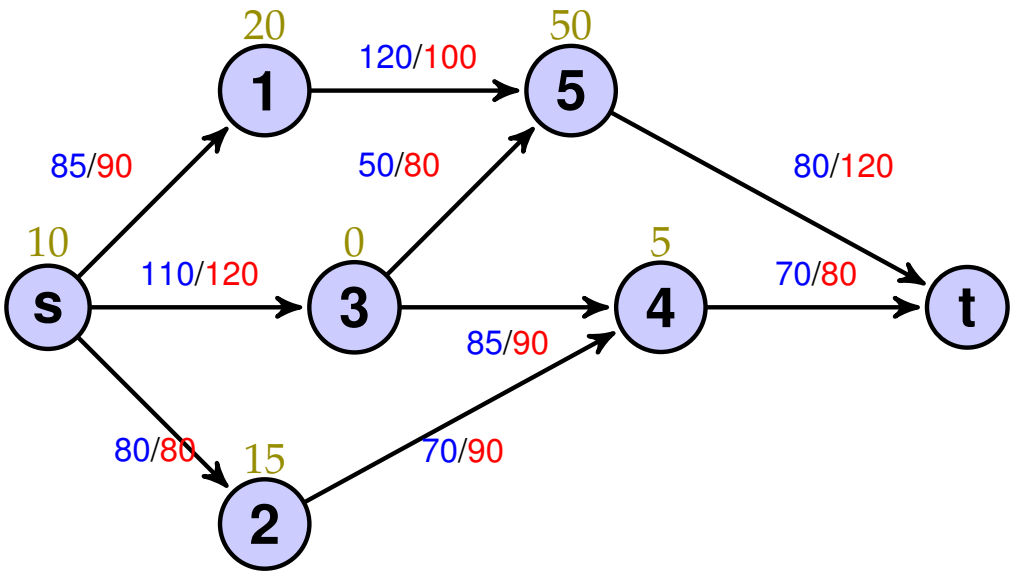
# EXAMPLE




| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | 2 | 1.8 | 11.6 |
| 5 | 1 | 2.5 | 0 |
| t | 4 | 3 | 0 |

Driving: Not possible
Charge and drive: 120km/hr: 1.2hr

# EXAMPLE




| | $\pi$ | time | bat |
|---|---|---|---|
| s | | 0 | 50 |
| 1 | s | 0.9 | 27.1 |
| 2 | s | 1 | 30.4 |
| 3 | s | 0.9 | 9.8 |
| 4 | 2 | 1.8 | 11.6 |
| 5 | 1 | 2.5 | 0 |
| t | 4 | 3 | 0 |

Conclusion

- Greedy path: $\langle s, 2, 4, t \rangle$, 3 hours
- Optimal path: $\langle s, 3, 5, t \rangle$, 2.8 hours