Search-BFS

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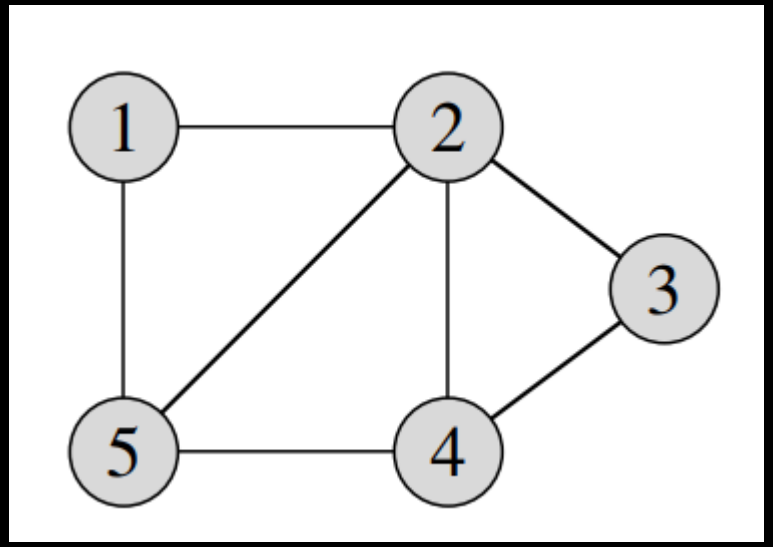
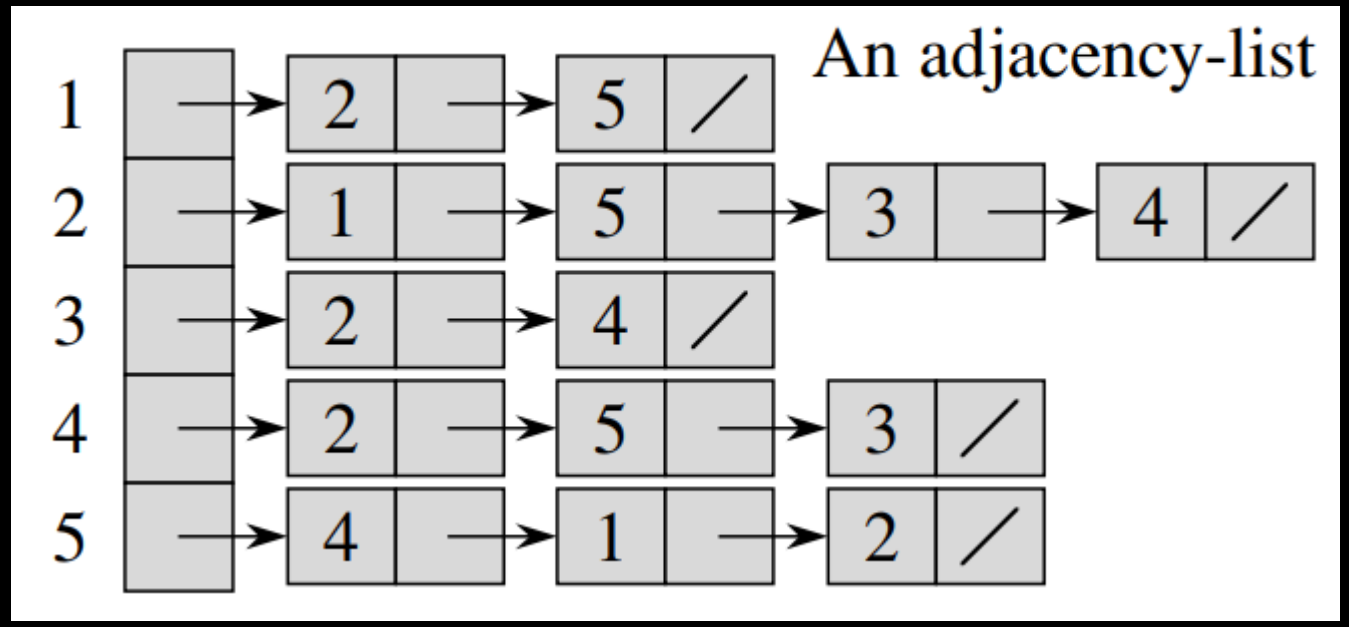
Undirected Graph

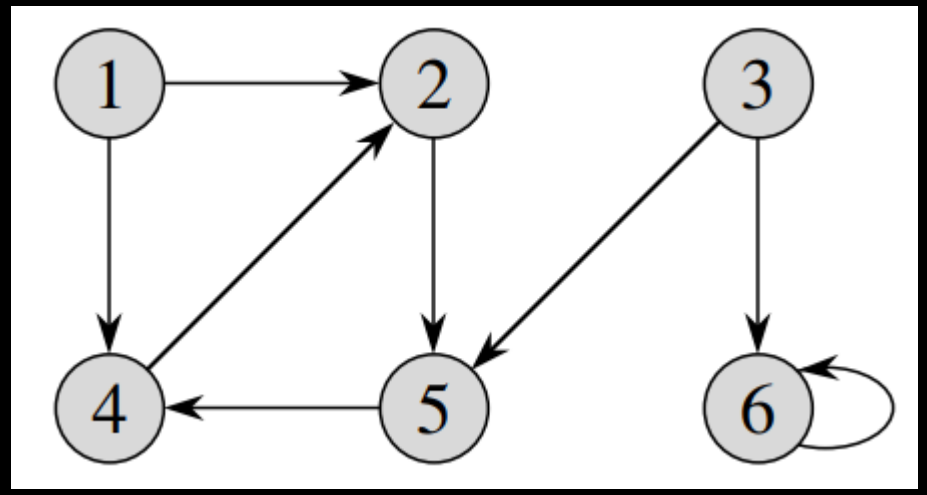


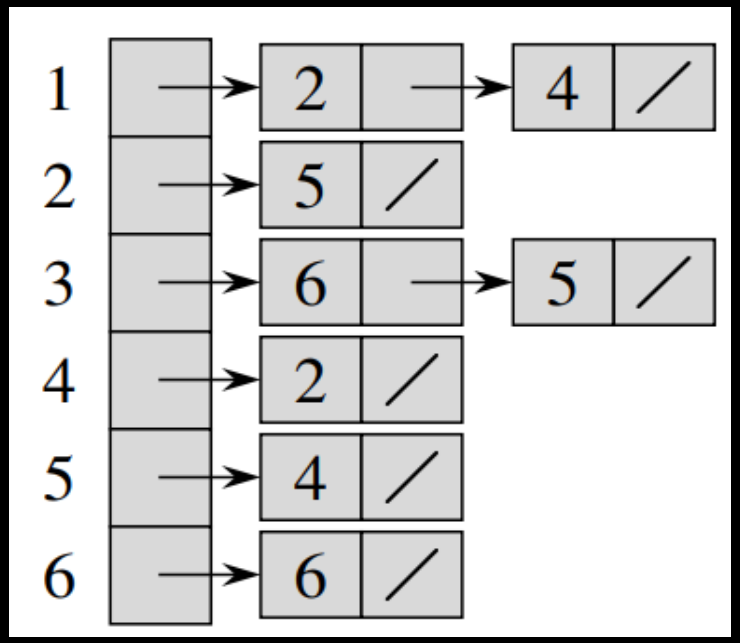


The adjacency-matrix

	1	2	3	4	5
1	0	1	0	0	1
2	1	0	1	1	1
3	0	1	0	1	0
4	0	1	1	0	1
5	1	1	0	1	0

Directed Graph

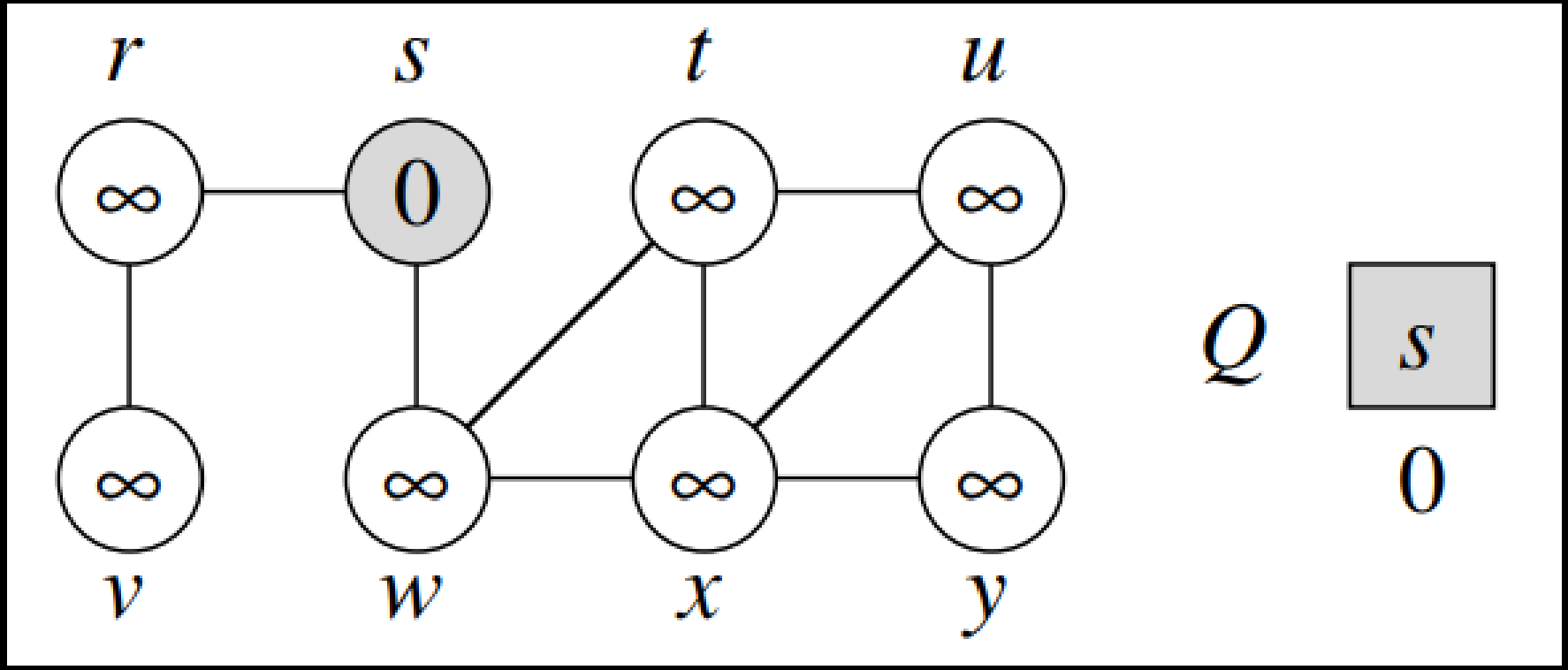




	1	2	3	4	5	6
1	0	1	0	1	0	0
2	0	0	0	0	1	0
3	0	0	0	0	1	1
4	0	1	0	0	0	0
5	0	0	0	1	0	0
6	0	0	0	0	0	1

Breadth-first search

Breadth-first search



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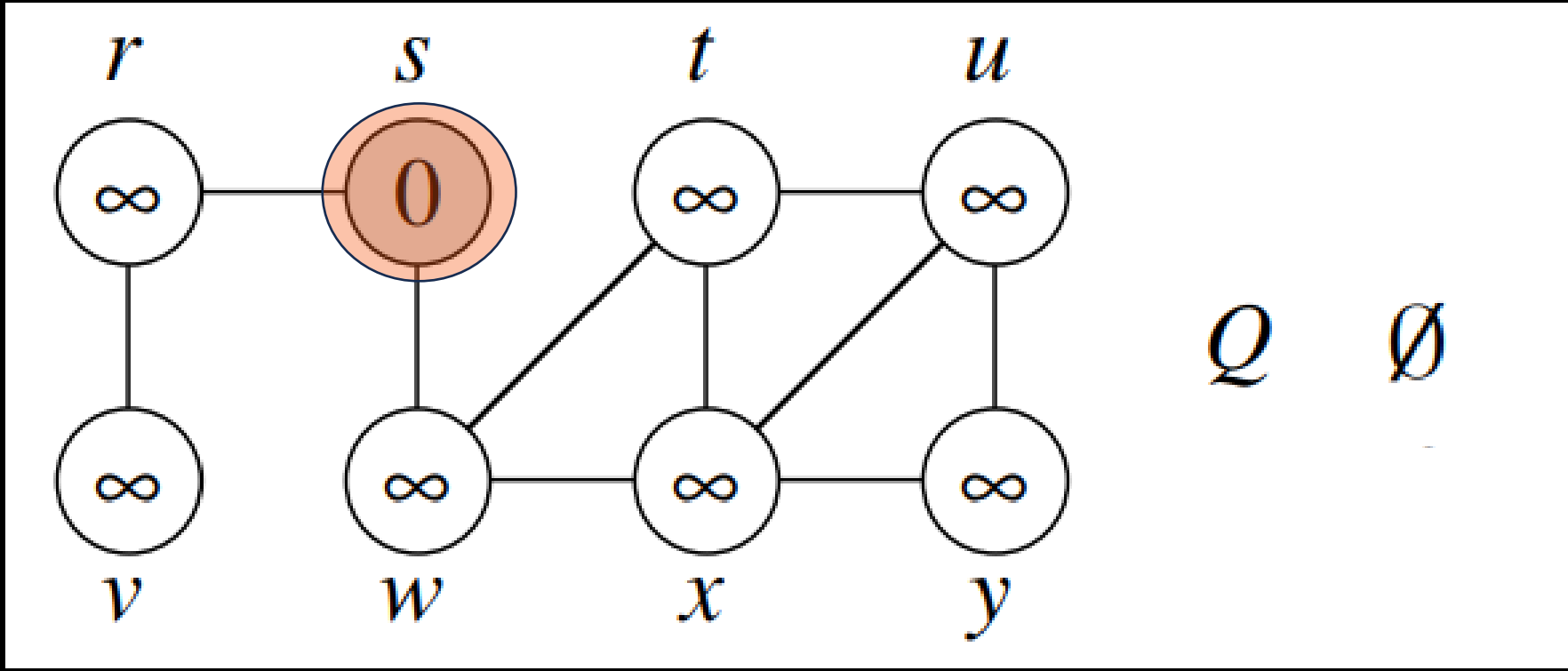

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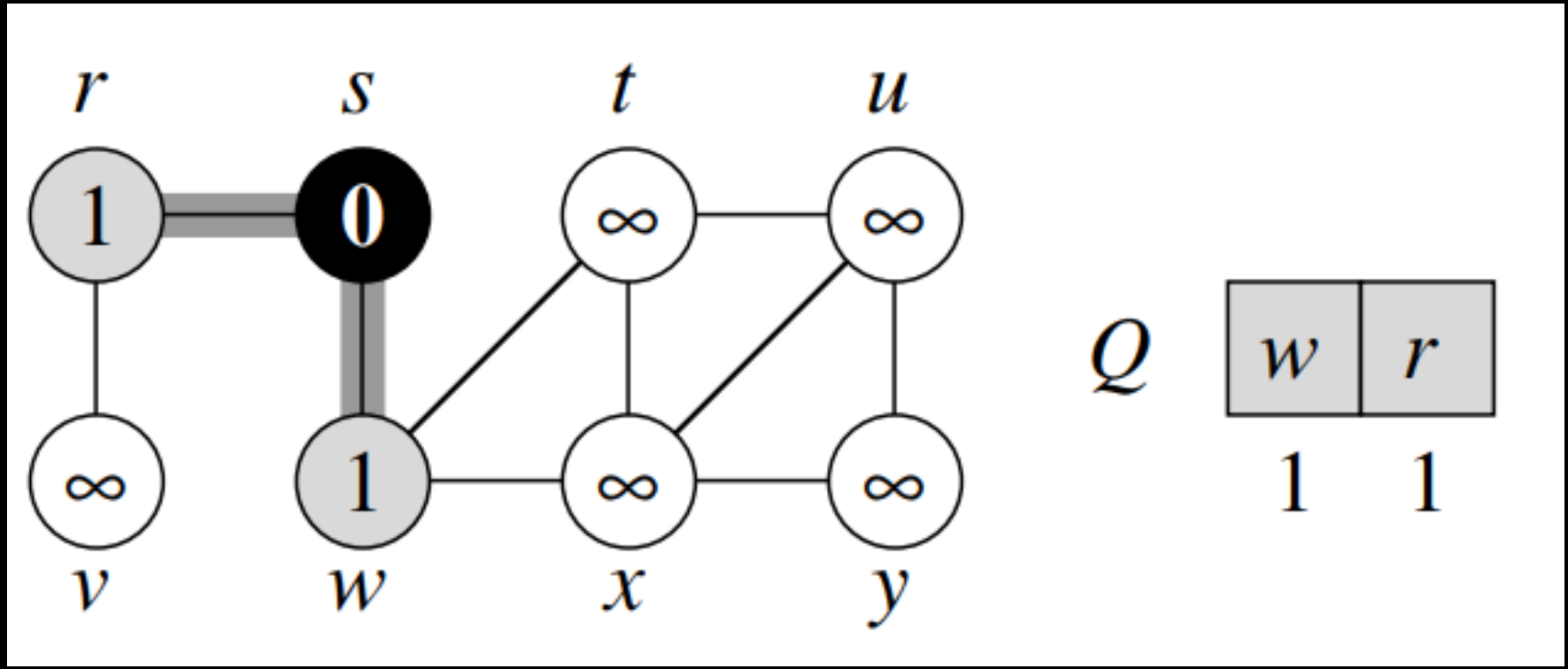

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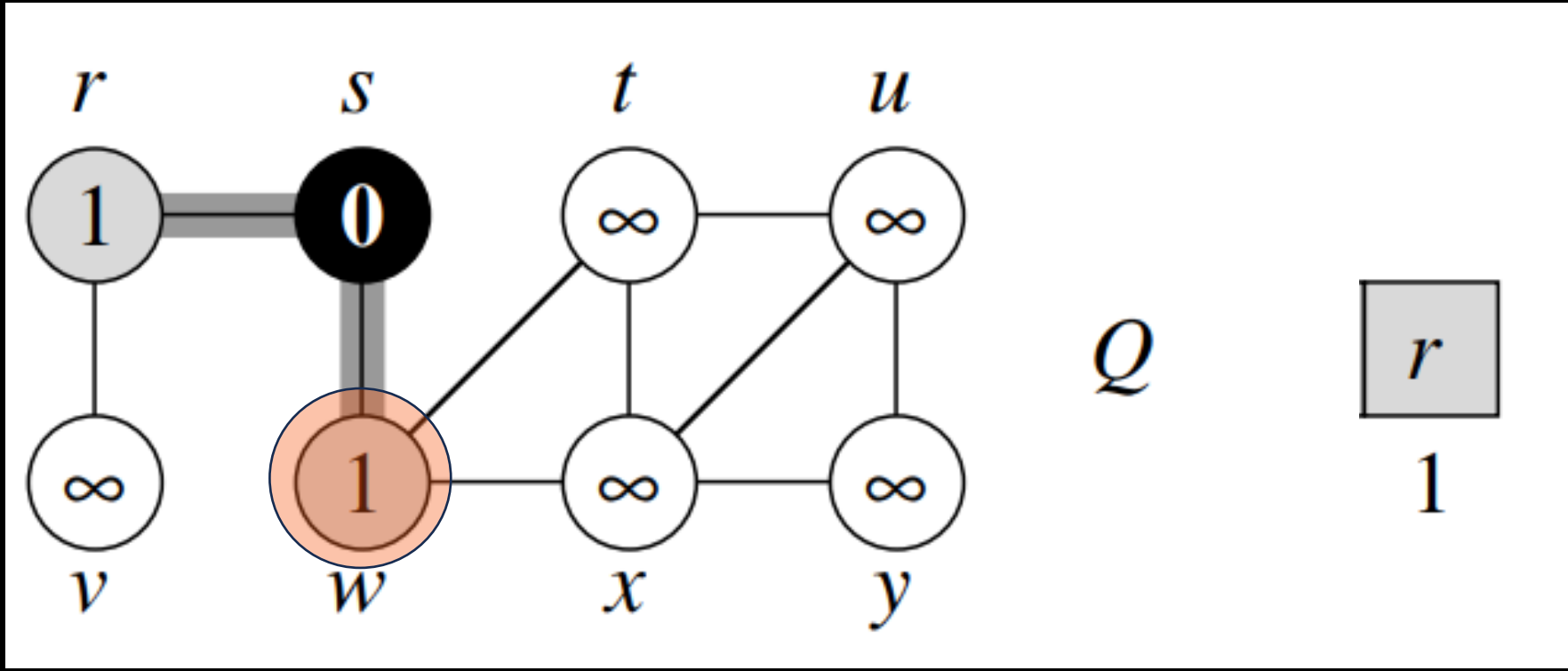

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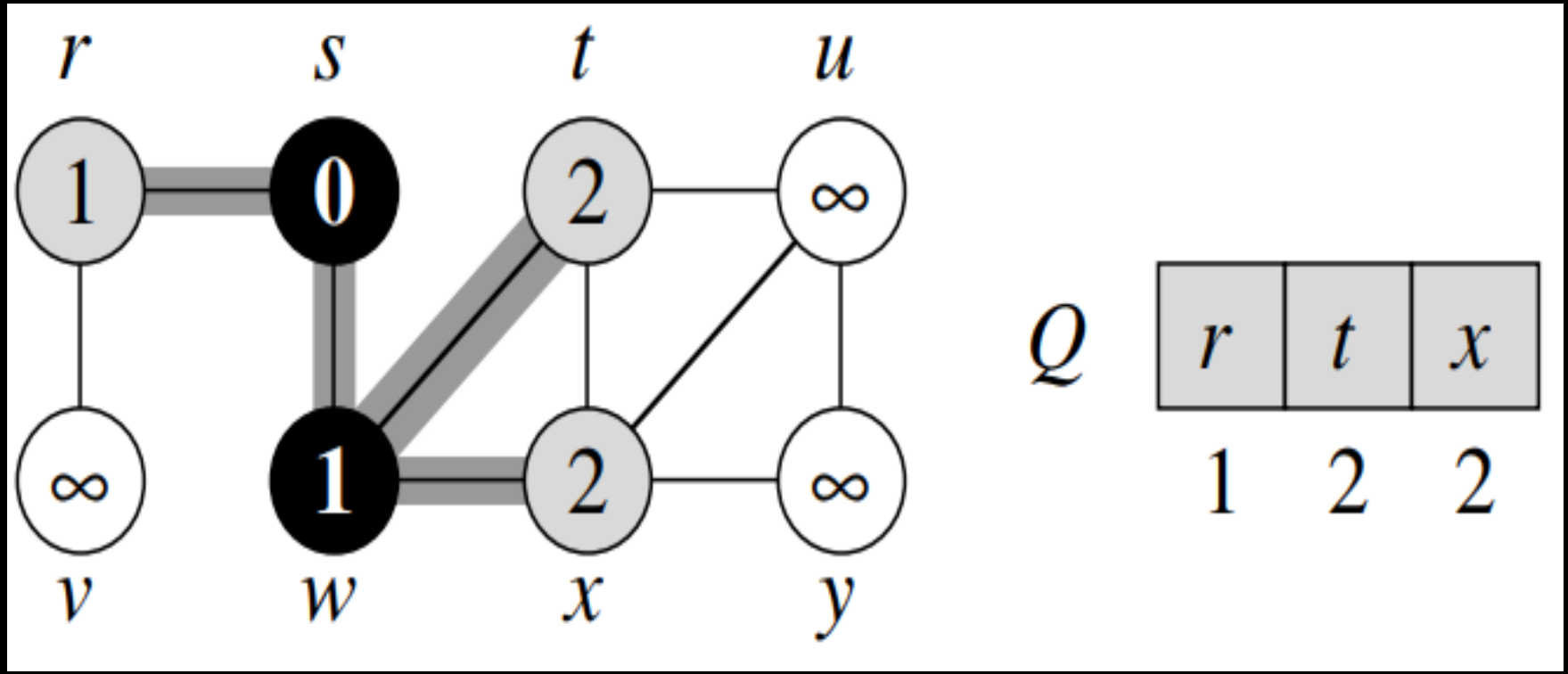

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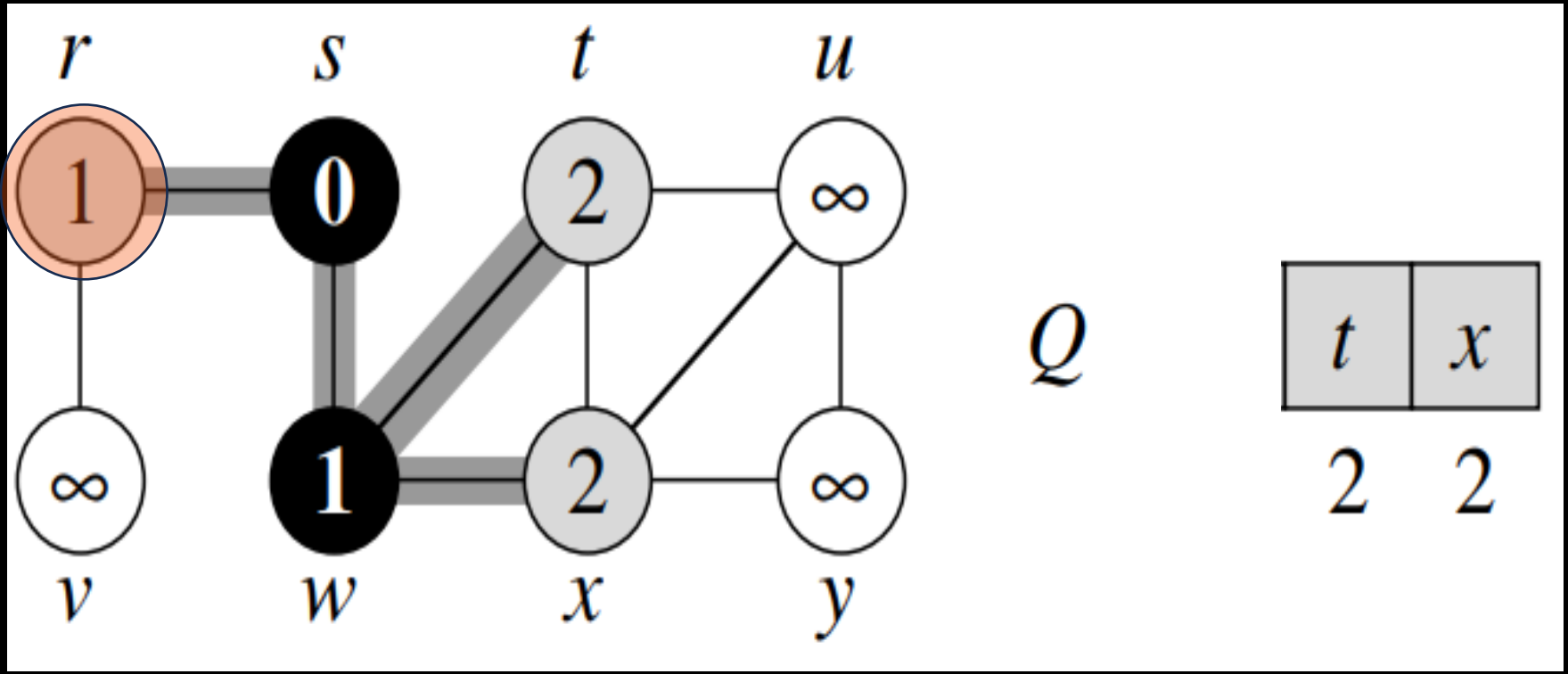

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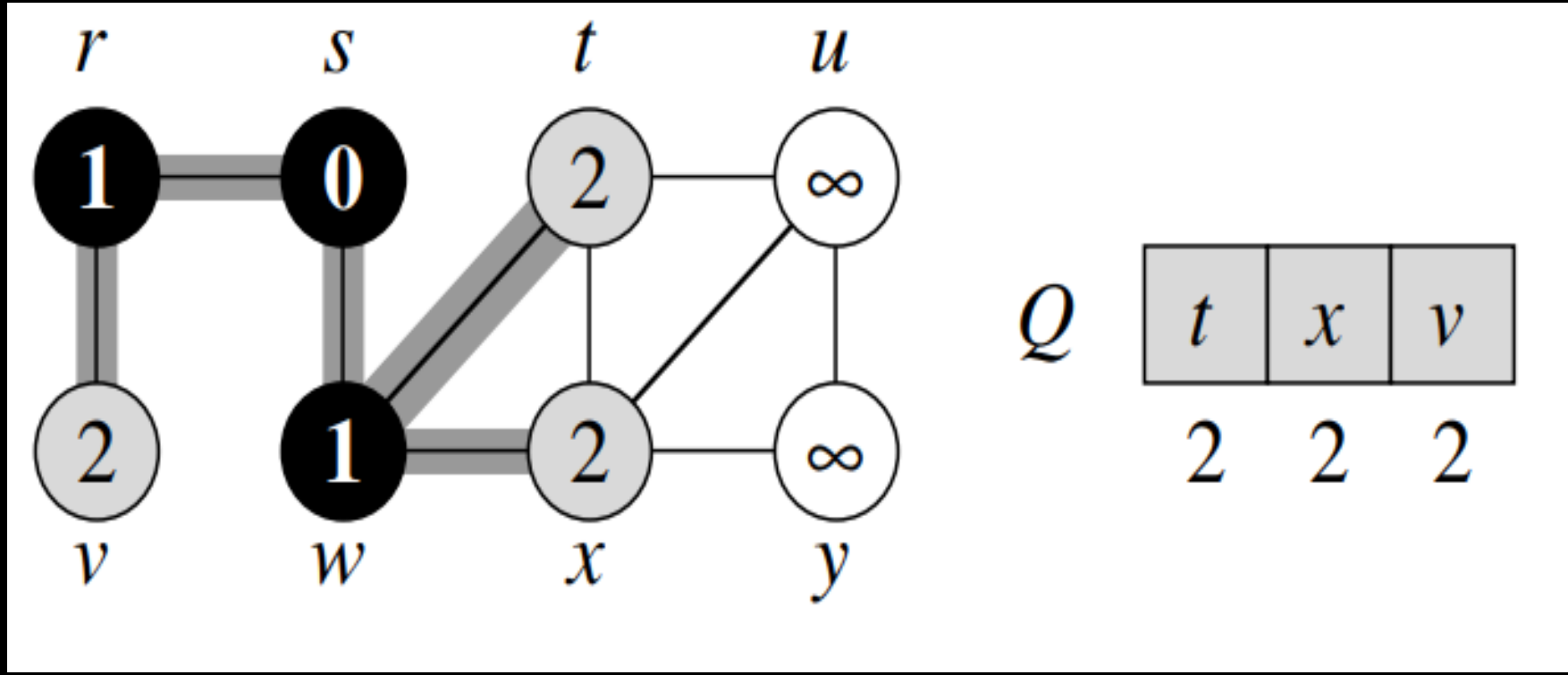

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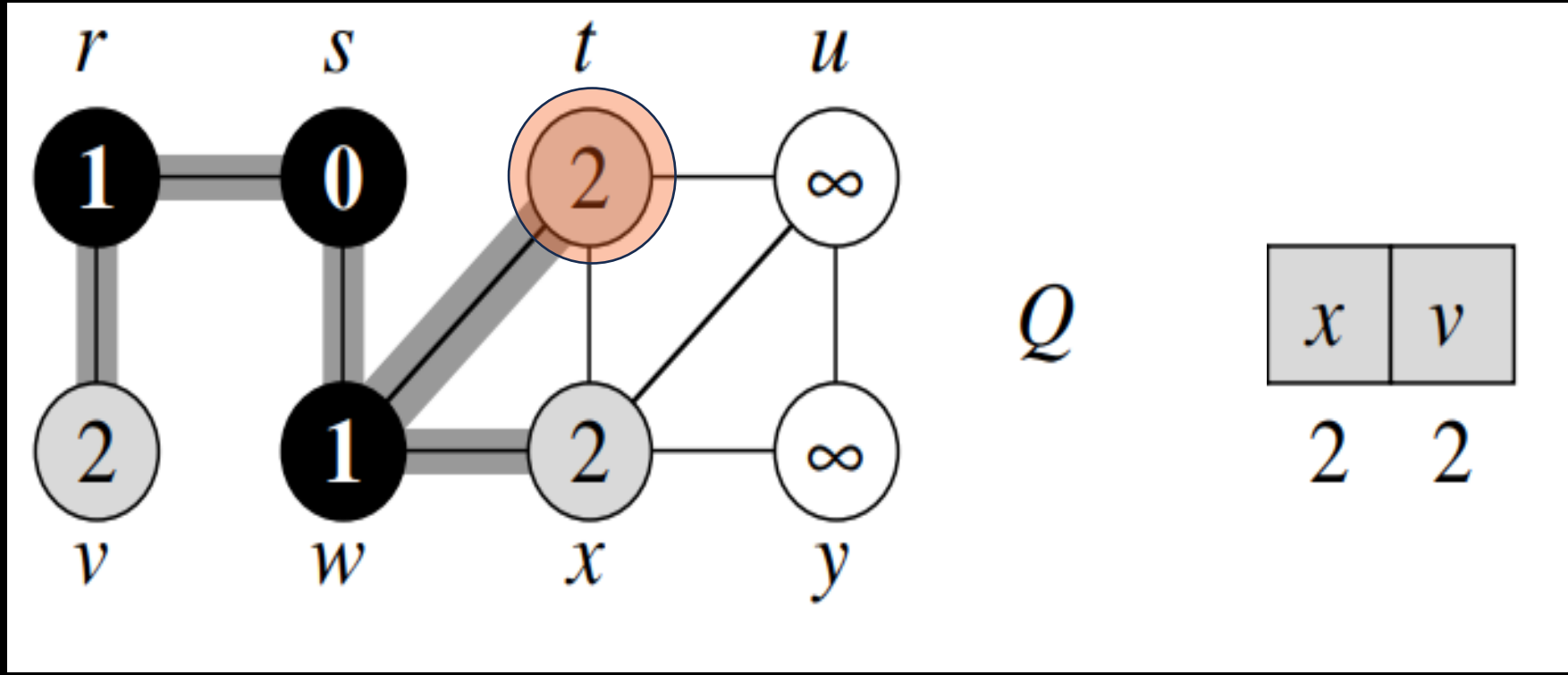

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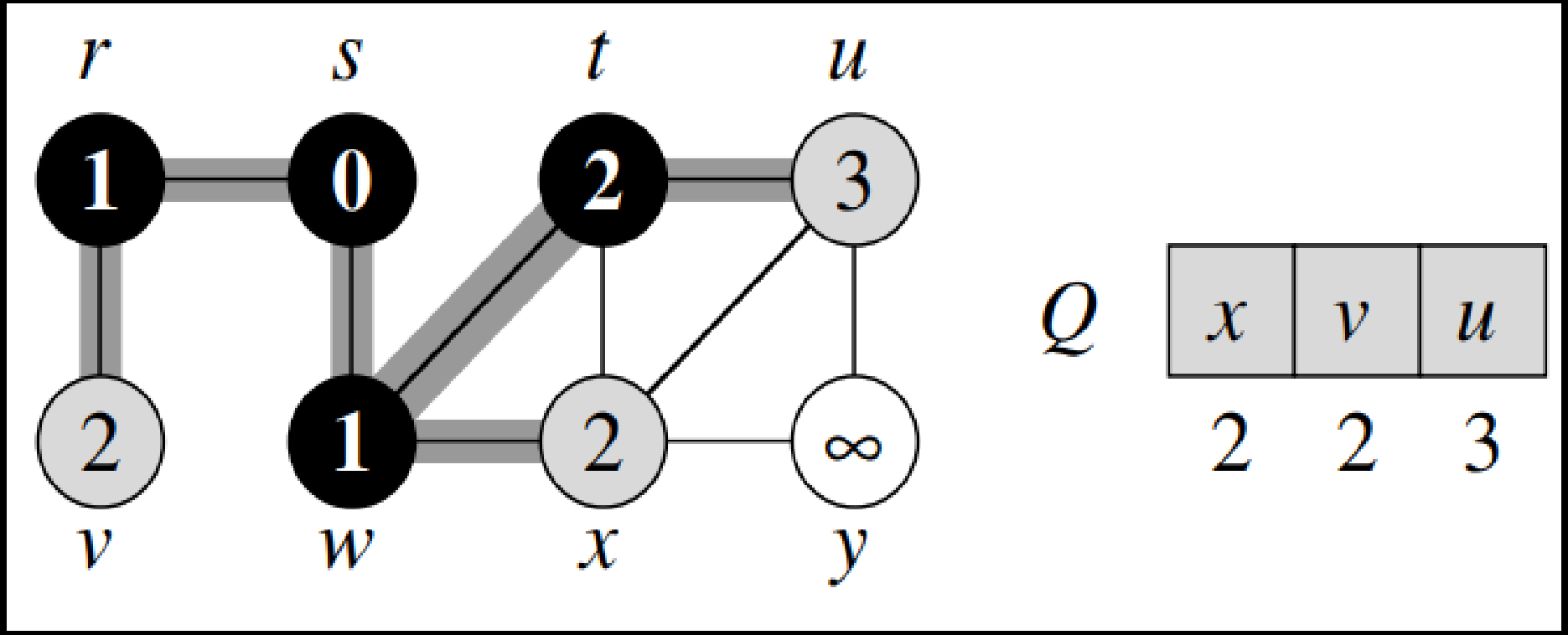

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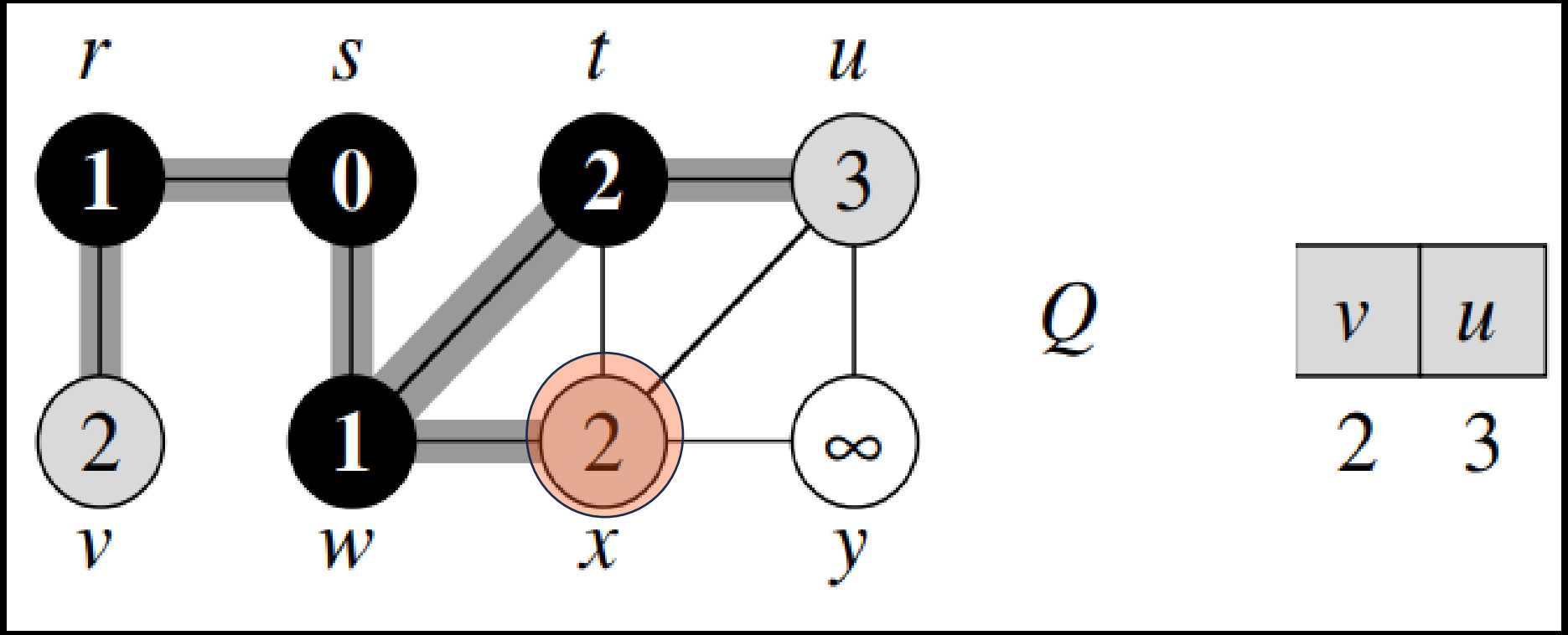

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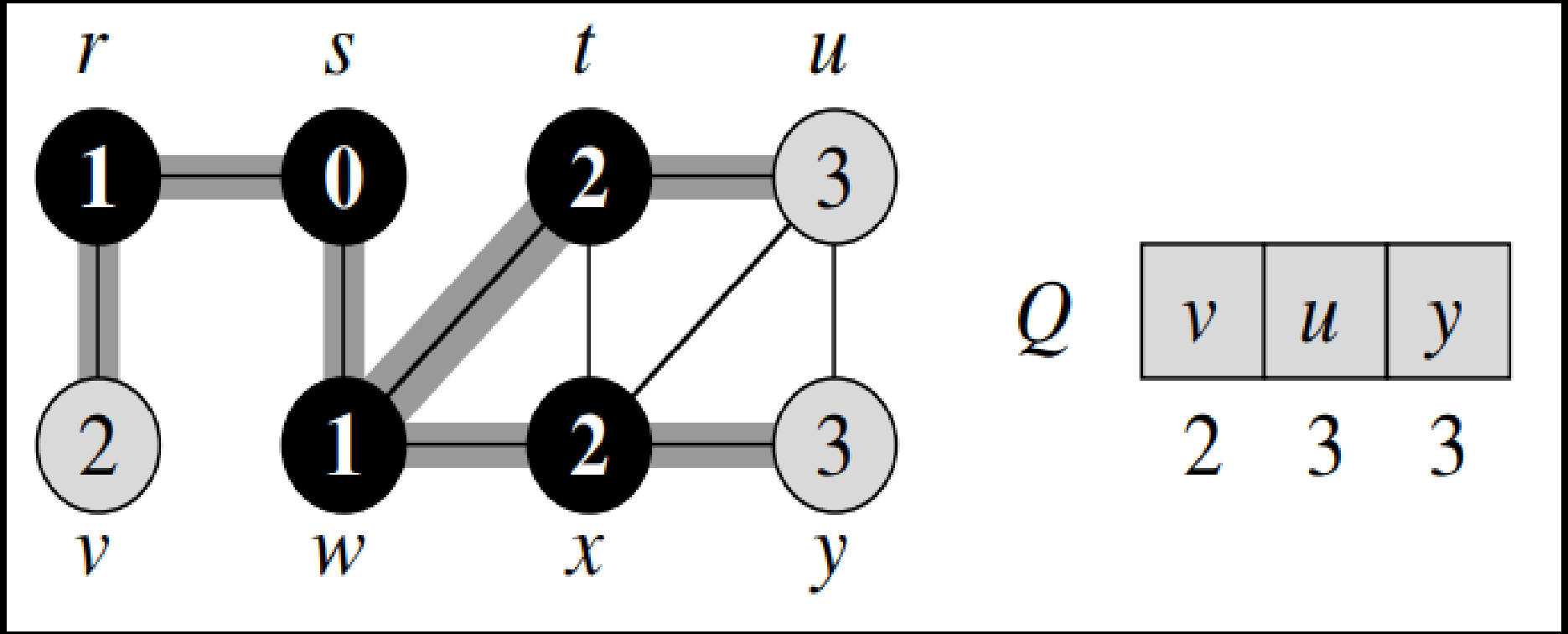

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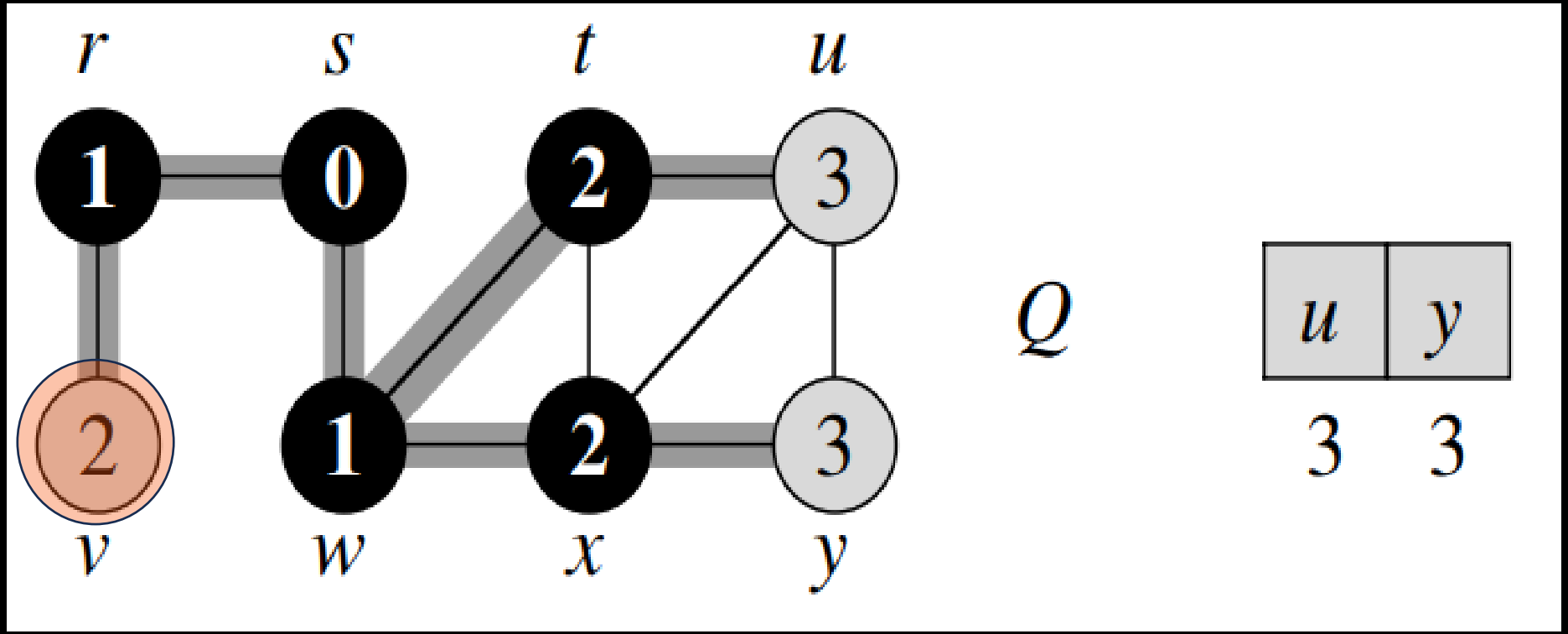

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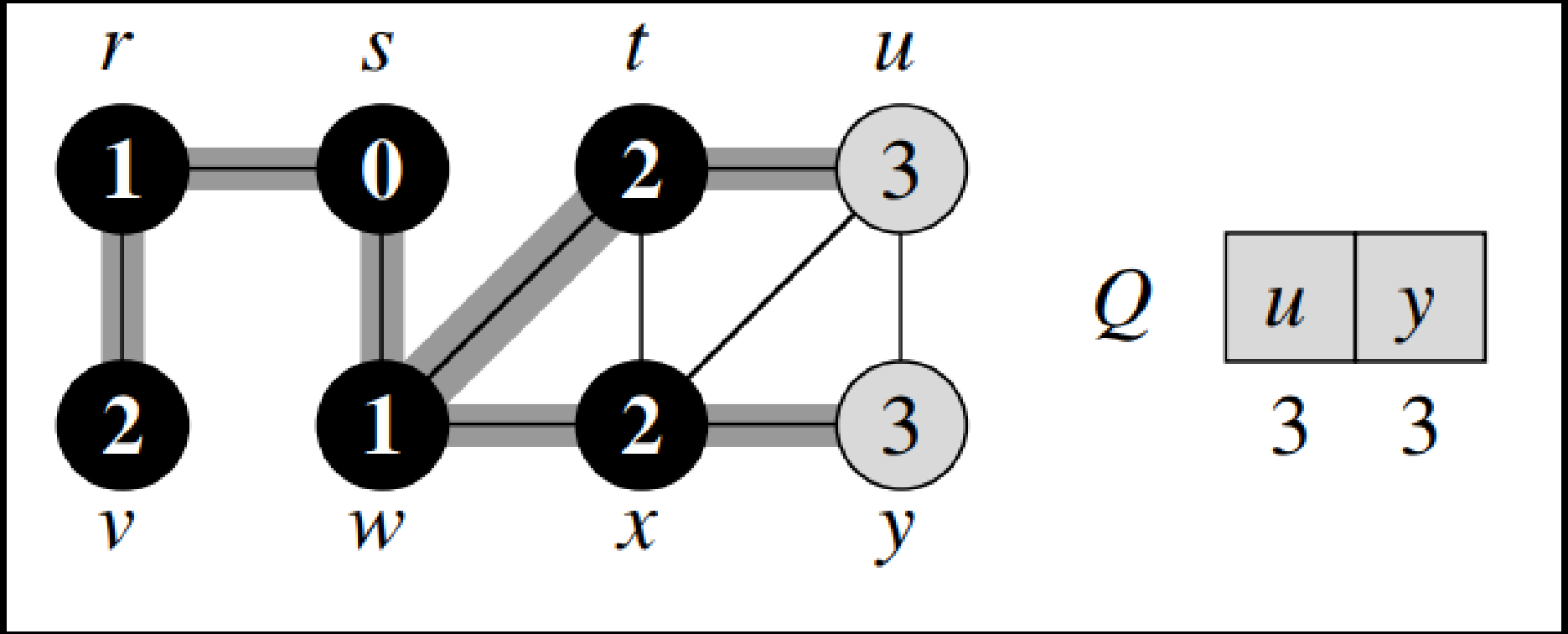

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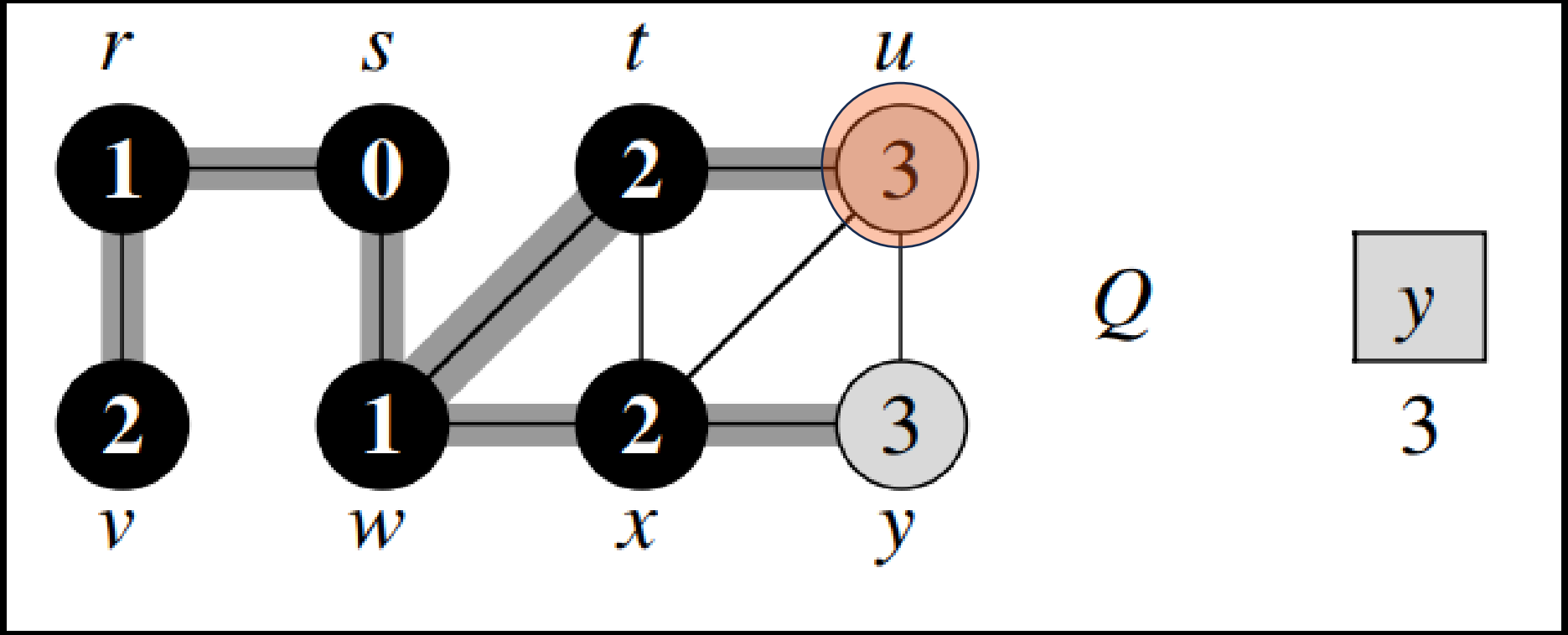

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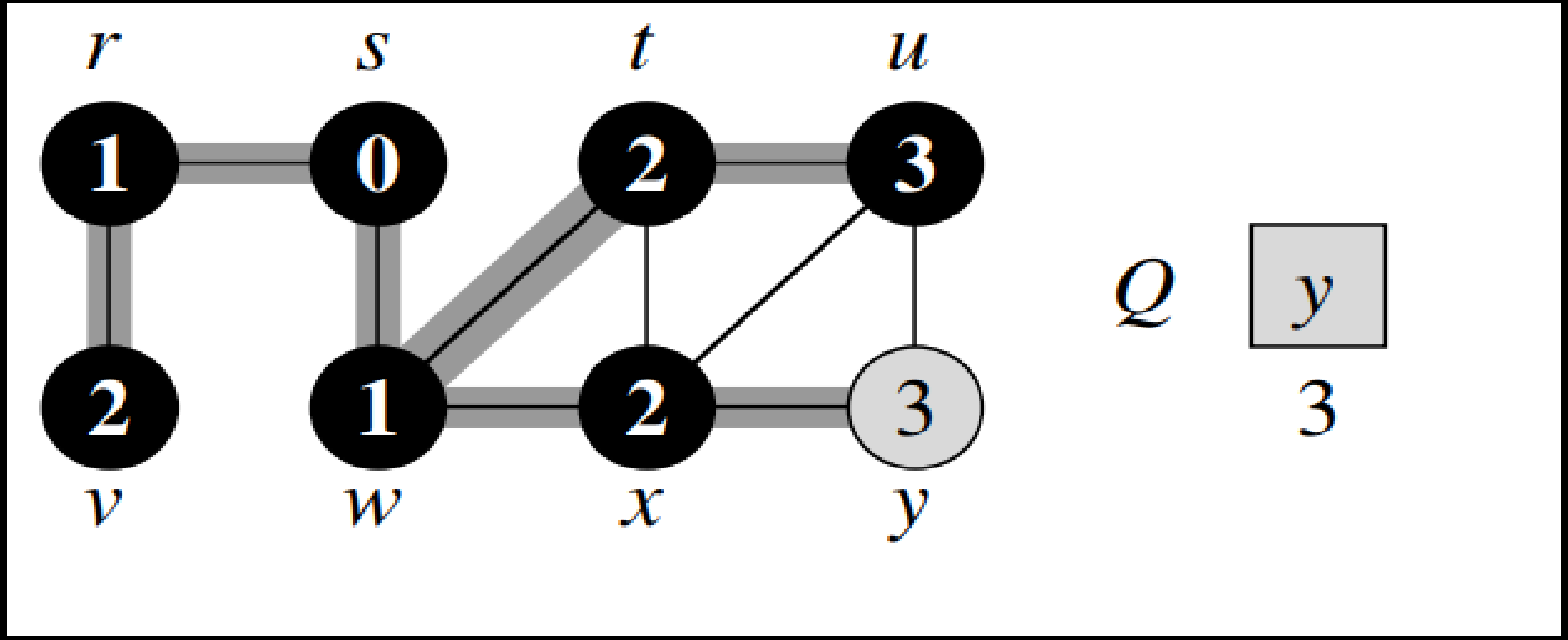

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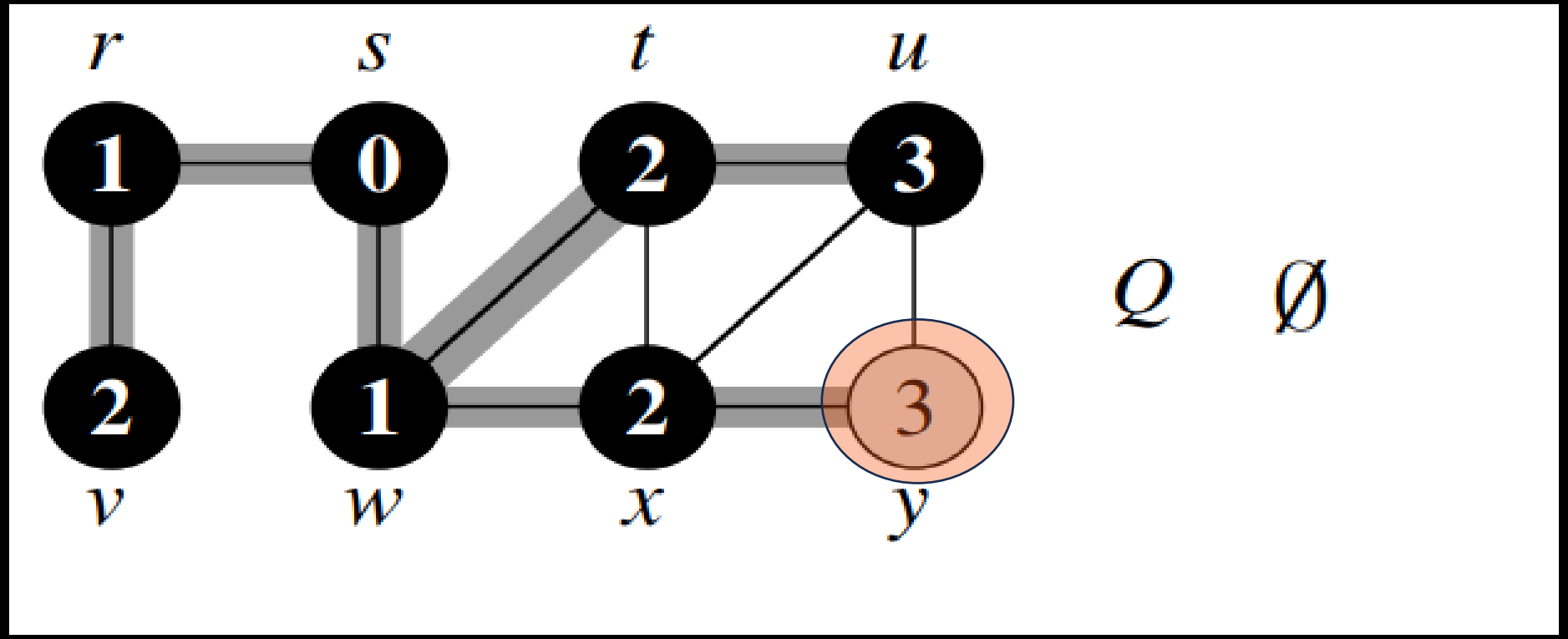

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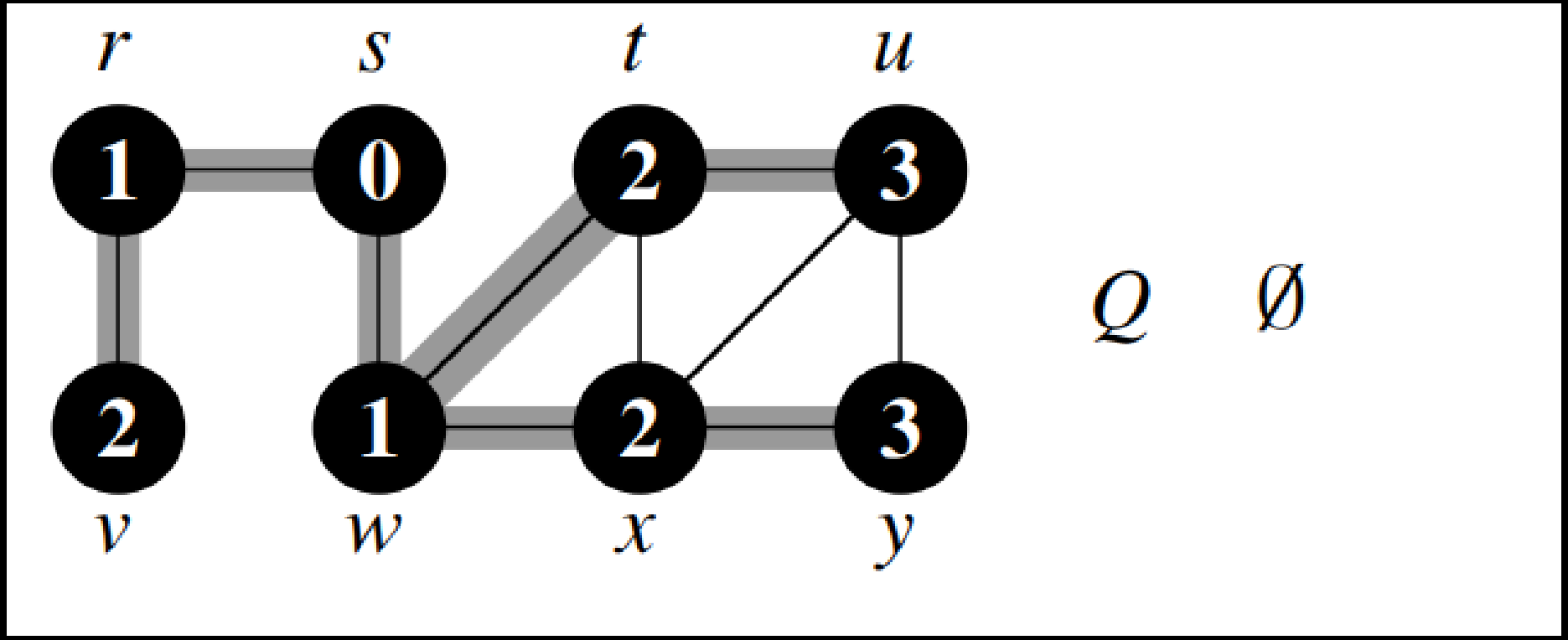

Breadth-first search

```
BFS(G, s)
 1   for each vertex u ∈ V[G] − {s}
 2         do color[u] ← WHITE
 3            d[u] ← ∞
 4            π[u] ← NIL
 5   color[s] ← GRAY
 6   d[s] ← 0
 7   π[s] ← NIL
10   while Q ≠ ∅
11         do u ← DEQUEUE(Q)
12            for each v ∈ Adj[u]
13                do if color[v] = WHITE
14                      then color[v] ← GRAY
15                           d[v] ← d[u] + 1
16                           π[v] ← u
17                           ENQUEUE(Q, v)
18            color[u] ← BLACK
```

Analysis of BSF

```
BFS(G, s)
 1  for each vertex u ∈ V[G] − {s}
 2       do color[u] ← WHITE
 3          d[u] ← ∞
 4          π[u] ← NIL
 5  color[s] ← GRAY
 6  d[s] ← 0
 7  π[s] ← NIL
 8  Q ← ∅
 9  ENQUEUE(Q, s)
10  while Q ≠ ∅
11       do u ← DEQUEUE(Q)
12          for each v ∈ Adj[u]
13               do if color[v] = WHITE
14                     then color[v] ← GRAY
15                          d[v] ← d[u] + 1
16                          π[v] ← u
17                          ENQUEUE(Q, v)
18          color[u] ← BLACK
```

$O(V)$

$O(E)$

$O(V + E)$

Breadth-first search

- https://github.com/aruntakhur/SitareUniversity/blob/main/BFS_AI_2025.ipynb

Questions?

References

- Introduction to Algorithms, Chapter 22.2 Breadth First Search, Authors: Cormen, Leiserson, Rivest, and Stein.