Flows - secondary slides

Proseminar Algorithmen auf Graphen

Nils Wagner

RWTH Aachen University

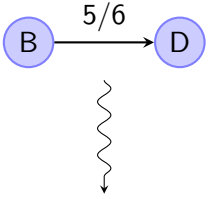
May 21, 2024

Ford-Fulkerson Method

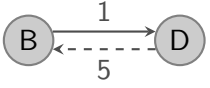
Ford-Fulkerson Method

1: initialize flow f with 0
2: **while** there exists an augmenting path p in the residual network G_f **do**
3: augment flow f along p
4: **end while**
5: **return** f

edge in flow network G



edge in residual network G_f



Ford-Fulkerson Method (with DFS)

```
1:  for each edge (u, v) ∈ E do
2:      f(u, v) ← 0
3:  end for
4:  while there exists an augmenting path p in the residual network G_f do
5:      c_f(p) ← min{c_f(u, v) | (u, v) ∈ p}
6:      for each edge (u, v) ∈ p do
7:          if (u, v) ∈ E then
8:              f(u, v) ← f(u, v) + c_f(p)
9:          else
10:             f(v, u) ← f(v, u) − c_f(p)
11:         end if
12:     end for
13: end while
14: return f
```

$O(E)$

DFS: $O(E)$

$O(|f|)$ times

$O(|f|E)$

$O(E)$

Ford-Fulkerson Method (with BFS) / Edmonds-Karp Algorithm

```
1:  for each edge (u, v) ∈ E do
2:      f(u, v) ← 0
3:  end for
4:  while there exists an augmenting path p in the residual network G_f do
5:      c_f(p) ← min{c_f(u, v) | (u, v) ∈ p}
6:      for each edge (u, v) ∈ p do
7:          if (u, v) ∈ E then
8:              f(u, v) ← f(u, v) + c_f(p)
9:          else
10:             f(v, u) ← f(v, u) − c_f(p)
11:         end if
12:     end for
13: end while
14: return f
```

$O(E)$

BFS: $O(E)$

$O(VE)$ times

$O(VE^2)$

$O(E)$