



# Tecnológico de Monterrey

Tecnológico de Monterrey - Campus Monterrey  
School of Engineering and Sciences  
Engineering in Computational Technologies  
Analysis and Design of Advanced Algorithms

## Class Activity 6: Paths with Breadth First Search

Group: 607  
Team #3

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Miguel Ángel Álvarez Hermida a01722925

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ClassAct6\_PathWBreathFirstSearch.py x

```
ClassAct6_PathWBreathFirstSearch > ClassAct6_PathWBreathFirstSearch.py > read_graph_from_txt
1 # Analysis and Design of Advanced Algorithms
2 # Group #607
3 # Team 3
4 # Luis Salomón Flores Ugalde
5
6 # Santiago Quintana Moreno A01571222
7 # Miguel Ángel Álvarez Hermida A01722925
8
9 # ----- PATHS WITH BFS -----
10
11 from collections import defaultdict, deque
12 from pathlib import Path
13
14 def read_graph_from_txt(rel_path, source=None, sink=None):
15     base_dir = Path(__file__).parent if "__file__" in globals() else Path.cwd()
16     file_path = (base_dir / rel_path).resolve()
17
18     capacity = defaultdict(lambda: defaultdict(int))
19     with file_path.open("r", encoding="utf-8") as f:
20         lines = [ln.strip() for ln in f if ln.strip()]
21
22     n = int(lines[0].split()[0])
23     for ln in lines[1:]:
24         u, v, c = map(int, ln.split())
25         capacity[u][v] += c
26         _ = capacity[v]
27
28     if source is None:
29         source = 0
30     if sink is None:
31         sink = n - 1
32
33     for u in range(n):
34         _ = capacity[u]
35
36     return capacity, source, sink
37
38
39
40 def _reconstruct_path(parent, s, t):
41     if t not in parent:
42         return None
43     path = []
44     cur = t
45     while cur != -1:
46         path.append(cur)
47         cur = parent[cur]
48     return list(reversed(path))
```

...

powershell x

```
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python3
.13.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/ClassAct6_PathWBreathFirstSearch/ClassAct6_PathWBreathF
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python3
.13.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/ClassAct6_PathWBreathFirstSearch/ClassAct6_PathWBreathF
irstSearch.py"
Max-Flow by Ford-Fulkerson (DFS) and Edmonds-Karp (BFS)

Graph: flow-grafo-2.txt
Ford-Fulkerson (DFS) max flow: 23 | augmentations: 4
Edmonds-Karp (BFS) max flow: 23 | augmentations: 4

Graph: flow-grafo-4.txt
Ford-Fulkerson (DFS) max flow: 10 | augmentations: 4
Edmonds-Karp (BFS) max flow: 10 | augmentations: 4

Graph: flow-grafo-5.txt
o Ford-Fulkerson (DFS) max flow: 19 | augmentations: 4
Edmonds-Karp (BFS) max flow: 19 | augmentations: 4
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms>
```

main

0 0 0

Go Live

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ClassAct6\_PathWBreathFirstSearch.py U x

40 def \_reconstruct\_path(parent, s, t):  
47 cur = parent[cur]  
48 return list(reversed(path))  
49  
50 def \_find\_path\_dfs(residual, s, t):  
51 parent = {s: -1}  
52 stack = [s]  
53 while stack:  
54 u = stack.pop()  
55 for v, cap in residual[u].items():  
56 if cap > 0 and v not in parent:  
57 parent[v] = u  
58 if v == t:  
59 return \_reconstruct\_path(parent, s, t)  
60 stack.append(v)  
61 return None  
62  
63 def \_find\_path\_bfs(residual, s, t):  
64 parent = {s: -1}  
65 q = deque([s])  
66 while q:  
67 u = q.popleft()  
68 for v, cap in residual[u].items():  
69 if cap > 0 and v not in parent:  
70 parent[v] = u  
71 if v == t:  
72 return \_reconstruct\_path(parent, s, t)  
73 q.append(v)  
74 return None  
75  
76  
77 def max\_flow(capacity, s, t, method="dfs"):  
78 residual = defaultdict(lambda: defaultdict(int))  
79 flows = defaultdict(lambda: defaultdict(int))  
80  
81 nodes = set(capacity.keys())  
82 for u in capacity:  
83 for v in capacity[u]:  
84 residual[u][v] += capacity[u][v]  
85 \_ = residual[v]  
86 nodes.add(v)  
87 for u in nodes:  
88 \_ = residual[u]  
89 \_ = flows[u]  
90  
91 path\_finder = \_find\_path\_bfs if method == "bfs" else \_find\_path\_dfs  
92  
93 flow\_value = 0

2.Advanced Algorithms

powershell x

```
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python3  
.13.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/ClassAct6_PathWBreathFirstSearch/ClassAct6_PathWBreathF  
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python3  
.13.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/ClassAct6_PathWBreathFirstSearch/ClassAct6_PathWBreathF  
firstSearch.py"  
Max-Flow by Ford-Fulkerson (DFS) and Edmonds-Karp (BFS)  
  
Graph: flow-grafo-2.txt  
Ford-Fulkerson (DFS) max flow: 23 | augmentations: 4  
Edmonds-Karp (BFS) max flow: 23 | augmentations: 4  
  
Graph: flow-grafo-4.txt  
Ford-Fulkerson (DFS) max flow: 10 | augmentations: 4  
Edmonds-Karp (BFS) max flow: 10 | augmentations: 4  
  
Graph: flow-grafo-5.txt  
Ford-Fulkerson (DFS) max flow: 19 | augmentations: 4  
Edmonds-Karp (BFS) max flow: 19 | augmentations: 4  
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms>
```

main\* 0 0 0

File Edit Selection View Go Run Terminal Help

ClassAct6\_PathWBreathFirstSearch.py U X

77 def max\_flow(capacity, s, t, method="dfs"):

78 path = path\_finder(residual, s, t)

79 while path:

80 flow\_value += bottleneck

81 augmentations.append((path, bottleneck))

82 return flow\_value, flows, residual, augmentations

83

84 def run\_on\_file(rel\_path):

85 cap, s, t = read\_graph\_from\_txt(rel\_path)

86

87 ff\_val, \_, \_, ff\_steps = max\_flow(cap, s, t, method="dfs")

88 ek\_val, \_, \_, ek\_steps = max\_flow(cap, s, t, method="bfs")

89

90 print(f"\nGraph: {rel\_path}")

91 print(f" Ford-Fulkerson (DFS) max flow: {ff\_val} | augmentations: {len(ff\_steps)}")

92 print(f" Edmonds-Karp (BFS) max flow: {ek\_val} | augmentations: {len(ek\_steps)}")

93

94 def main():

95 files = [

96 "flow-grafo-2.txt",

97 "flow-grafo-4.txt",

98 "flow-grafo-5.txt",

99 ]

100 print("Max-Flow by Ford-Fulkerson (DFS) and Edmonds-Karp (BFS)")

101 for rel in files:

102 run\_on\_file(rel)

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ClassAct6\_PathWBreathFirstSearch.py U x

121 def run\_on\_file(rel\_path):

122

123

124 ff\_val, \_, ff\_steps = max\_flow(cap, s, t, method="dfs")

125 ek\_val, \_, ek\_steps = max\_flow(cap, s, t, method="bfs")

126

127 print(f"\nGraph: {rel\_path}")

128 print(f" Ford-Fulkerson (DFS) max flow: {ff\_val} | augmentations: {len(ff\_steps)}")

129 print(f" Edmonds-Karp (BFS) max flow: {ek\_val} | augmentations: {len(ek\_steps)}")

130

131 def main():

132 files = [

133 r"flow-grafo-2.txt",

134 r"flow-grafo-4.txt",

135 r"flow-grafo-5.txt",

136 ]

137 print("Max-Flow by Ford-Fulkerson (DFS) and Edmonds-Karp (BFS)")

138 for rel in files:

139 run\_on\_file(rel)

140

141 if \_\_name\_\_ == "\_\_main\_\_":

142 main()

143

...

powershell x

PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python3.13.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/ClassAct6\_PathWBreathFirstSearch/ClassAct6\_PathWBreathFirstSearch.py"

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Ford-Fulkerson (DFS) max flow: 19 | augmentations: 4

Edmonds-Karp (BFS) max flow: 19 | augmentations: 4

PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms>

main\*

0 0 0



```
● PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python
.13.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/ClassAct6_PathwBreathFirstSearch/ClassAct6_PathwBreath
PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> & C:\Users\santy\AppData\Local\Microsoft\WindowsApps\python
.13.exe "d:/1.SQM/1.UNIVERSIDAD/5. QUINTO SEMESTRE/2.Advanced Algorithms/ClassAct6_PathwBreathFirstSearch/ClassAct6_PathwBreath
irstSearch.py"
```

Max-Flow by Ford-Fulkerson (DFS) and Edmonds-Karp (BFS)

Graph: flow-grafo-2.txt

Ford-Fulkerson (DFS) max flow:	23		augmentations: 4
Edmonds-Karp (BFS) max flow:	23		augmentations: 4

Graph: flow-grafo-4.txt

Ford-Fulkerson (DFS) max flow:	10		augmentations: 4
Edmonds-Karp (BFS) max flow:	10		augmentations: 4

Graph: flow-grafo-5.txt

- Ford-Fulkerson (DFS) max flow: 19 | augmentations: 4
- Edmonds-Karp (BFS) max flow: 19 | augmentations: 4

PS D:\1.SQM\1.UNIVERSIDAD\5. QUINTO SEMESTRE\2.Advanced Algorithms> □

[https://colab.research.google.com/drive/1\\_Ha60Mu4n2Rv73LMrAdA1LFSTfroMsuI?usp=sharing](https://colab.research.google.com/drive/1_Ha60Mu4n2Rv73LMrAdA1LFSTfroMsuI?usp=sharing)