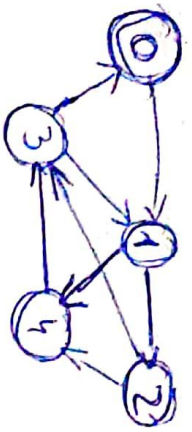


Lab 2 - Lowest length path between s and t by using backward breadth - first search from t.



Min- dictionary

| | | |
|---|---|-----------|
| 0 | - | [3] |
| 1 | - | [0, 3] |
| 2 | - | [1] |
| 3 | - | [2, 1, 4] |
| 4 | - | [1, 2] |

| $\Delta = 3, t = 4$ | x | y | queue: queue | visited | dist - dictionary | dict - next (successor) | | | | | | | | | | | | | | | | | | | | |
|---------------------|---|---|---|--------------------|---|-------------------------|---|---|---|---|--|---|---|---|---|---|---|---|---|---|---|--|---|---|---|--|
| initialization | | | $\leftarrow [4] \leftarrow$ | {4} | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td></td><td></td><td></td><td>0</td></tr></table> <small>beg</small> | 0 | 1 | 2 | 3 | 4 | | | | | 0 | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr></table> | 0 | 1 | 2 | 3 | 4 | | | | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| iteration 1 | 4 | | $\leftarrow [1, 4] \leftarrow$ | {4, 1} | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>1</td><td></td><td></td><td>0</td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 1 | | | 0 | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>4</td><td></td><td></td><td></td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 4 | | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | | | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| iteration 1.1 | | 1 | $\leftarrow [1, 1, 4] \leftarrow$ | {4, 1, 1} | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>1</td><td>1</td><td></td><td>0</td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 1 | 1 | | 0 | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>4</td><td>1</td><td></td><td></td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 4 | 1 | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | 1 | | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| iteration 1.2 | | 2 | $\leftarrow [1, 1, 2, 4] \leftarrow$ | {4, 1, 2, 1} | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>1</td><td>1</td><td>2</td><td>0</td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 1 | 1 | 2 | 0 | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>4</td><td>1</td><td>2</td><td></td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 4 | 1 | 2 | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | 1 | 2 | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | |
| iteration 2 | 1 | | $\leftarrow [1, 2, 1] \leftarrow$ | {4, 1, 2, 1, 1} | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>2</td><td>1</td><td>1</td><td>0</td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 2 | 1 | 1 | 0 | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>4</td><td>1</td><td>2</td><td></td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 4 | 1 | 2 | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | 1 | 1 | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | |
| iteration 2.1 | | 0 | $\leftarrow [1, 2, 0, 1] \leftarrow$ | {4, 1, 2, 1, 0} | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>2</td><td>1</td><td>1</td><td>0</td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 2 | 1 | 1 | 0 | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>4</td><td>1</td><td>2</td><td></td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 4 | 1 | 2 | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | 1 | 1 | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | |
| iteration 2.1 | | 3 | $\leftarrow [1, 2, 0, 3, 1] \leftarrow$ | {4, 1, 2, 1, 0, 3} | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>2</td><td>1</td><td>1</td><td>0</td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 2 | 1 | 1 | 0 | <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td></td><td>4</td><td>1</td><td>2</td><td></td></tr></table> | 0 | 1 | 2 | 3 | 4 | | 4 | 1 | 2 | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | 1 | 1 | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | |

$\Delta = 3 \Rightarrow$ stop.

beginning with $\Delta = 3$.

The path is built from dict - next [1] = 4 = t

$\Delta = 3$, dict - next [3] = 1, dict - next [1] = 4 = t

path = [3, 1, 4], length = dist[Δ] = dist[3] = 2

graph100k.txt - 1 - 0 100

length = 8.

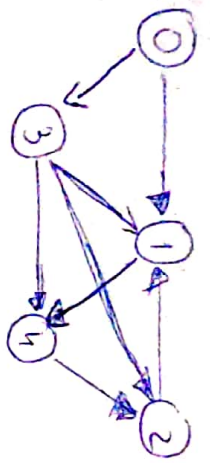
100 \rightarrow 1

length = 8.

[1, 17024, 27474, 14969, 3079, 4156, 32753, 14973, 100]

54527, 6606, 53263, 95330, 93655

59288, 1]



Min-dictionary

| | | |
|---|---|-----------|
| 0 | - | [] |
| 1 | - | [0, 2, 3] |
| 2 | - | [3, 4] |
| 3 | - | [0] |
| 4 | - | [1, 3] |

| $s=0, t=4$ | X | Y | queue | visited | dist-dictionary | next-dictionary |
|---------------------------|---|---|---|-----------------------------|---|---|
| initialization | | | $\leftarrow [4] \leftarrow$ | $\{4\}$ | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ |
| iteration 1 | 4 | | $\leftarrow [4] \leftarrow$ $\leftarrow [1, 3] \leftarrow$ | $\{1, 4\}$ $\{1, 3, 4\}$ | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 1 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 4 & 1 & 1 & 4 & 1 \\ \hline \end{array}$ |
| iteration 1.1 | | 1 | $\leftarrow [1, 3] \leftarrow$ | | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 1 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 4 & 1 & 1 & 4 & 1 \\ \hline \end{array}$ |
| iteration 1.2 | | 3 | $\leftarrow [1, 3] \leftarrow$ | | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 1 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 4 & 1 & 1 & 4 & 1 \\ \hline \end{array}$ |
| iteration 2 | 1 | | $\leftarrow [3] \leftarrow$ $\leftarrow [1, 3] \leftarrow$ | | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 1 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 4 & 1 & 1 & 4 & 1 \\ \hline \end{array}$ |
| iteration 2.1 | | 0 | $\leftarrow [1, 3] \leftarrow$ | | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 1 & 1 & 2 & 3 & 4 \\ \hline \end{array}$ | $\begin{array}{ c c c c c } \hline 0 & 1 & 2 & 3 & 4 \\ \hline 4 & 1 & 1 & 4 & 1 \\ \hline \end{array}$ |
| $s=4=0 \Rightarrow$ stop. | | | | | | |

The path is built from next beginning with $s=0$.

$s=0$, next $[0]=1$, next $[1]=4=t$
 path = $[0, 1, 4]$, length = dist $[0] = 2$.

graph1k.txt \rightarrow 1 \rightarrow 100 [1, 5, 487, 1175, 699, 624, 100] length = 6
 100 \rightarrow 1 [100, 416, 354, 865, 103, 1] length = 5

graph1k.txt \rightarrow 1 \rightarrow 100 [1, 7317, 4418, 2404, 630, 1494, 739, 4722, 100] length = 8
 100 \rightarrow 1 [100, 5568, 2781, 1451, 4997, 528, 4260, 1] length = 7