INFORMATICS INSTITUTE OF TECHNOLOGY
In collaboration with
UNIVERSITY OF WESTMINSTER
Algorithms
5SENG002C

Coursework

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Algorithmic Approach taken

Algorithmic Strategy

- Ford-Fulkerson algorithm was used to calculate the max flow of the flow network.
- Breadth First Search (BFS) was used to find whether a path exists from source to sink. The reason for choosing BFS was because BFS always picks up the path with the minimum number of edges. The worst-case time-complexity can be reduced as well. The **greedy** algorithmic approach was taken in this case. (Singh, n.d.)

Chosen Data Structure & its Traversal Towards Solution

- A LinkedList (queue) has been used for the queue that is created in the Breadth First Search (BFS) method. In BFS *poll* method of the LinkedList was used to return the first element of the queue and remove it from the queue. (Anon., n.d.)
- I have used a 2-dimensional array ([][] graph) to represent the flow network's graph as a matrix. The 1st index of the array gives the starting node, 2nd index gives the ending node of a link. The value at the 2nd index gives the capacity from the starting node to the ending node. If there is a capacity, a link exists between the two nodes.
- An array ([] parent) was used to store the residual path in BFS.
- When taking inputs from the user a HashMap was used instead of an ArrayList to get inputs because then, the order of entering inputs won't matter. This was implemented for the ease of coding.

Pseudocode in plain English

```
BEGIN
INPUT graph with capacities of links, source, sink of flow network
Initialize the Residual graph from the initial graph and the parent array
max_flow = 0, max_integer_value = 2147483647
WHILE there's a path from source to sink:
        path_flow = max_integer_value
        path_flow = MIN(path_flow, capacity_of_residual_link)
        max_flow =  max_flow + path_flow
END WHILE
DISPLAY max_flow
END
```

Methodology for empirically analysing the performance of the algorithm

Input data size		Time spent to produce the outcome (in nanoseconds)	Ratio changes in time	$\log_2$ ratio of times
Nodes	Links			
6	10	6248500		
12	20	10739800	1.71878	0.235
24	40	15172100	1.4	0.146
48	80	20936200	1.3799	0.1398

Conclusions algorithmic performance

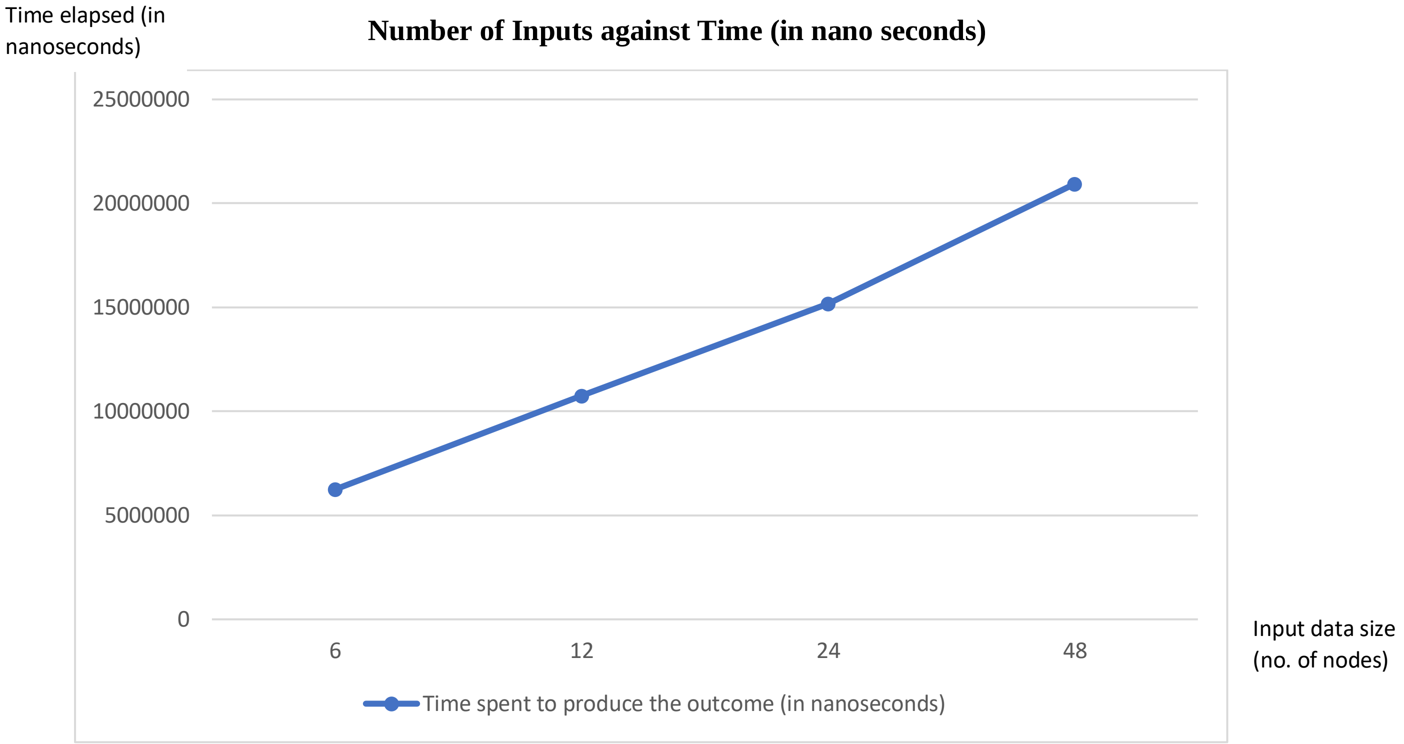
~~The $\log_2$ ratio of the time spent seems to converge to a constant 0.14~~

According to the code, the highest complexity given is a double loop. This gives n^2.

When the number of elements in both arrays in the 2D graph are equal, accessing the elements of the 2D array is n^2 as well. This is because the run time is directly proportional to the elements in the array. (Anon., n.d.)

Therefore, Big O = $O(n^2)$

Graph (Discrete Fourier Transformation)



References

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