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1. Pseudocode:
//input: n, a positive integer, and a two-dimensional matrix W of integer values
//output: a message stating either “ring” for ring topology, “star” for star topology, “complete” for fully connected mesh, or “neither” if the weight matrix does not represent either of these three topologies.

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//n is the number of node; count is the tracking number of edges
of individual node

int n, count, center
bool cond


//Reading the input is NOT part of the algorithm so the timer starts
after reading the input. Depending on platform so the implementation of
this section varies.
star the timer now.


cond←true                       //assuming the graph is a ring


//In ring graph, each node only has exact 2 edges
for i←0 to i<n do               //starting exhaustive search
     count←0                    //initializing count to before
                                //checking nodes
     for j←0 to j<n do          //checking value in each node
          if W[i][j] > 0 and W[i][j] < 100
               count++
     //if any node has more or less than 2 edges, then the graph
     is not a ring
     if count != 2
          cond←false            //graph is not ring
          i←n                   //exiting the outer loop
if cond = true do
     Print “The graph is ring”
     stop the timer now.
     print the elapse time
     terminate the program


cond←true                       //assuming the graph is a star
center←0                        //center = 0 meaning that there is no
                                //center node yet
```

```
//In star graph, the center node has (n-1) edges while others have
only 1 edge
for i←0 to i<n do
     count←0
     for j←0 to j<n do
          if W[i][j] > 0 and W[i][j] < 100
               count++
     if count != 1 and center = 1
          cond←false
          i←n
//if a node has n-1 edges and there is no center node yet,
if count = n-1 and center = 0 //the center node is found
     center←1
//if the is one center node and the condition of star is met
if cond = true and center = 1
     Print “The graph is star”
     stop the timer
     print the elapse time
     terminate the program


cond = true;                    //assuming the graph is a connected
                                //MESH
//In a fully connected MESH, all nodes have (n-1) edges
for i←0 to i<n do
     count = 0
     for j←0 to j<n do
          if W[i][j] > 0 and W[i][j] < 100
               count++
     if count != (n-1)
          cond←false
if cond = true do
     Print “The graph is fully connected MESH”
else do
     // because we check all the condition to this point, the
     // graph is neither one type.
     Print “The graph is neither type”
stop the timer now
print the elapse time
terminate the program
```

2. Analysis of the pseudocode:

$$\sum_{i=0}^{n}\sum_{j=0}^{n}1+\sum_{i=0}^{n}\sum_{j=0}^{n}1+\sum_{i=0}^{n}\sum_{j=0}^{n}1=3\sum_{i=0}^{n}\sum_{j=0}^{n}1=3\sum_{i=0}^{n}(n-0+1)=3\sum_{i=0}^{n}(n+1)=3\sum_{i=0}^{n}n+3\sum_{i=0}^{n}1$$

$$= \quad 3n\sum_{i=0}^{n}1+3\sum_{i=0}^{n}1=3n(n-0+1)+3(n-0+1)=3n(n+1)+3(n+1)=3n^2+3n+3n+3$$

$$= \quad 3n^2+6n+3\in O(n^2)$$

3. Prove the efficiency:

$$3n^2+6n+3\le 3n^2+6n^2+3\le 3n^2+6n^2+3n^2\le 12n^2\ \forall\, n\ge 1$$

Therefore, c = 12 and $n_0 = 1$ => $O(n^2)$