# Mathematics in Computing: 4COSC007C

## Tutorial 4

1. Let $A = \{a, b, c\}$ and $B = \{1, 0\}$. Which of the following relations is a function with the domain $A$ and the co-domain $B$

   i. $\{(x, y)|x \in B, y \in A\}$

   ii. $\{(a, a), (b, b), (c, c), (1, 1), (0, 0)\}$

   iii. $\{(a, 1), (b, 1), (c, 1)\}$

   iv. $A \times B$

   v $\{(x, y)|x \in A, y \in B\}$

2. Let $A = \{Mary, John, Peter, Chris\}$ and $B = \{Accountant, Lawyer, Programmer, Lecturer\}$. Which of the following relations is a function with domain A and co-domain B:

   i. $\{(Mary, Accountant), (John, Lawyer), (Peter, Programmer), (Chris, Lecturer)\}$.

   ii. $\{(Mary, Accountant), (John, Lawyer), (Peter, Programmer), (Chris, Programmer)\}$.

   iii. $\{(Mary, Accountant), (John, Lawyer), (Peter, Programmer)\}$.

   iv. $\{(Mary, Programmer), (John, Programmer), (Peter, Programmer), (Chris, Programmer)\}$.

   v. $\{(Mary, Accountant), (John, Lawyer), (Peter, Lecturer), (Peter, Programmer)$ $, (Chris, Programmer)\}$.

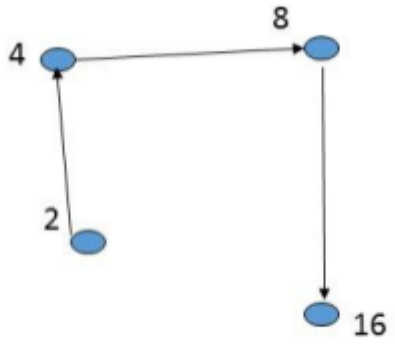
3. For each of the following graphs represented in the diagrams below do the following:

   i. form set V of all its nodes and set E of all its edges

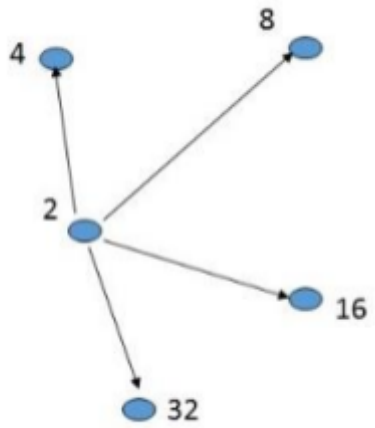
   ii. determine if it is a directed or undirected graph

   iii. determine if it is a cyclic or acyclic graph, for a cyclic graph give an example of a cyclic path in it

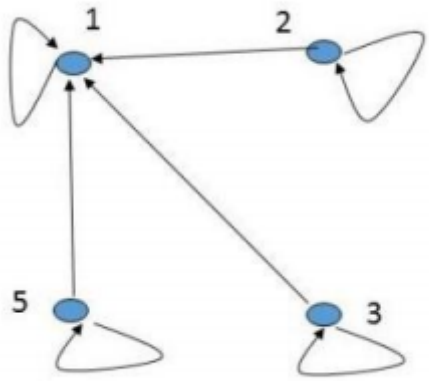
   iv. determine a pattern a graph can represent




(a)




(b)




(c)

4. For each of the following graphs defined by the given set of nodes, V, and set of edges, E, do the following:

   i. draw its representation corresponding to the definition of V and E

   ii. determine if it is a directed or undirected graph

   iii. determine if it is a cyclic or acyclic graph, for a cyclic graph give an example of a

   iv. cyclic path in it.

   a. $V = \{d, e, f, g\}$; $E = \{(d, e), (e, f), (f, g), (g, d)\}$

   b. $V = \{a, b, c, d, e\}$; $E = \{(a, b), (a, c), (a, d), (a, e), (b, c), (c, d), (d, e)\}$

   c. $V = \{a, b, c\}$; $E = \{(a, a), (a, b), (b, b), (b, a), (b, c), (c, c), (c, b), (a, c), (c, a)\}$

5. We analyze the database for the National Express for the journeys from London betweenbv8 am and 9 am on Friday 28th October 2016 to the following destinations: Manchester, Birmingham. Bristol, Southampton, Glasgow, Edinburgh. Consider a graph, G, with the following definition of sets of nodes, V, and edges, E:
   $V$ = {Manchester, Birmingham. Bristol, Southampton, Glasgow, Edinburgh}; E is a set of all pairs $(x, y)$ , such that $x \in V$, $y \in V$and the price for journey from London to $x$ is less than the price for a journey from London to $y$

| | | | |
|---|---|---|---|
| **Manchester, at 9 am** | **£15.00** | **Southampton at 8 am** | **£7.20** |
| **Birmingham, at 8 am** | **£15.70** | **Glasgow at 8 am** | **£23.00** |
| **Bristol, at 8.30 am** | **£15.70** | **Edinburgh at 9 am** | **£30.00** |

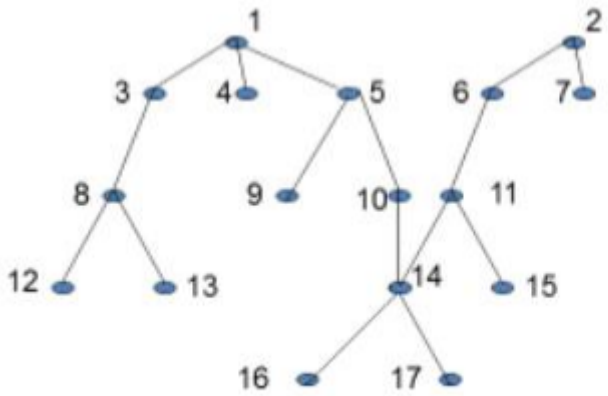
   Your task is

   a. To list all pairs $(x, y) \in E$
   b. To draw the representation of this graph showing its nodes and edges

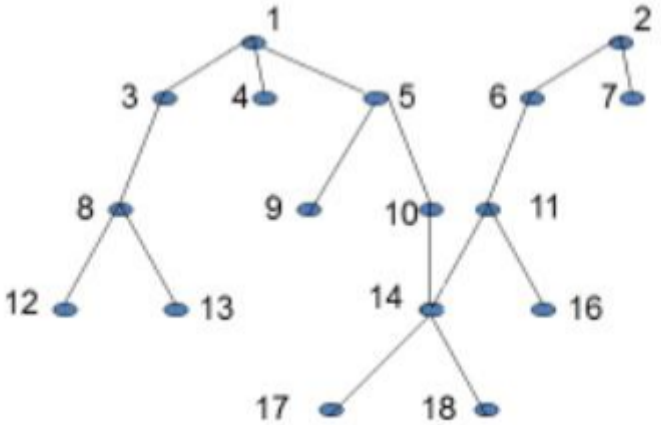
6. In the figures below you will see attempts to draw rooted trees. Justify if graphs drawn are trees. For those cases where you established trees identify

   i. All leaves of a tree
   ii. Depth of a tree
   iii. If a tree is a binary tree

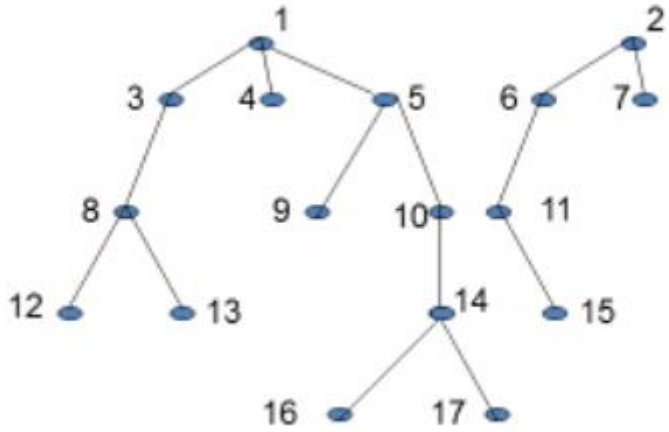
   (a.) In a graph below we attempt to have a tree with root nodes 1 and 2



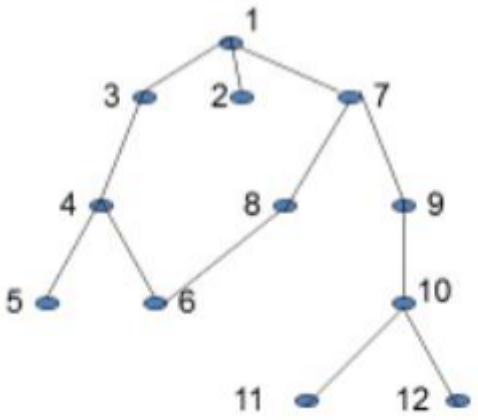
(b.) In a graph below we attempt to have a tree with root node 1 and a sub-tree with a root 2



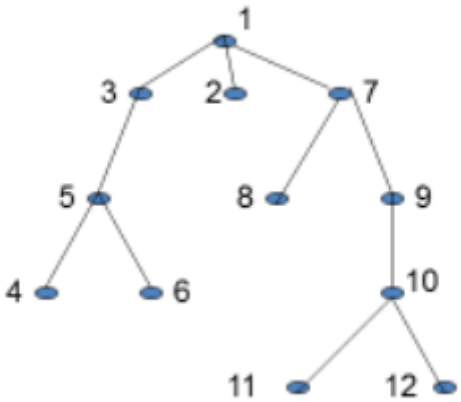

(c.) In a graph below we attempt to have a tree with root nodes 1 and a sub-tree with a root node 2



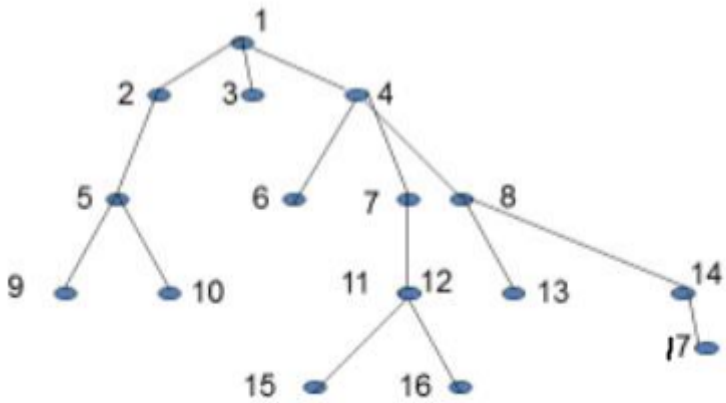
(d.) In a graph below we attempt to have a tree with root nodes 1 and a sub-tree with a root node 7



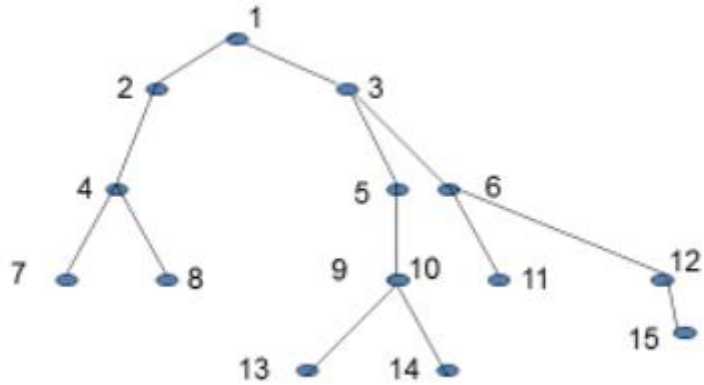

(e.) In a graph below we attempt to have a tree with root nodes 1 and a sub-tree with a root node 7



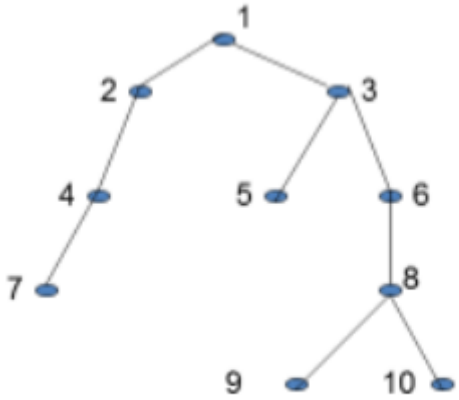

(f.) In a graph below we attempt to have a tree with root node 1



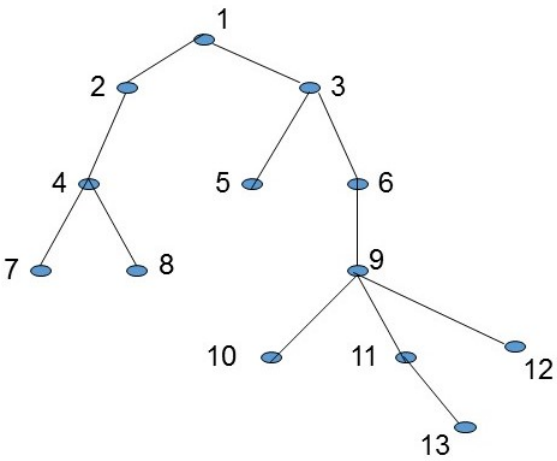
(g.) In a graph below we attempt to have a tree with root node 1




(h.) In a graph below we attempt to have a tree with root node 1




7. Which statement below is TRUE in relation to this graph



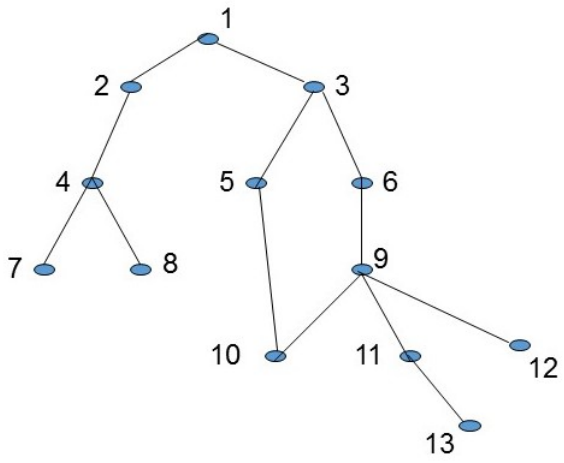
i. This is not a binary tree because node 9 has three children

ii. This is not a binary tree because node 11 has only one child

iii. This graph does not represent a tree at all.

iv. This is not a binary tree because nodes 2, 6 and 11 each has only one child.

8. Which statement below is true in relation to this graph




i. Disconnected and Cyclic

ii. Connected and Cyclic

iii. Disconnected and Acyclic

iv. Connected and Acyclic

9. A graph G is defined as follows: $V = \{a, b, c, d\}$ and $E = \{(a, b), (b, c), (c, d), (d, b)\}$. Which statement below IS NOT true in relation to this graph

i. G has four nodes

ii. G is Cyclic

iii. G has four edges

iv. G has only one cycle

10. A graph G is defined as follows: $V = \{a, b, c, d, e\}$ and $E = \{\{a, b\}, \{b, c\}, \{c, d\}, \{e, e\}\}$. Which statement below is true in relation to this graph

i. G has four nodes

ii. G is disconnected

iii. G has five edges

iv. G is acyclic