IIT Madras

ONLINE DEGREE

Mathematics for Data Sciences 1
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Week 10 - Tutorial 02

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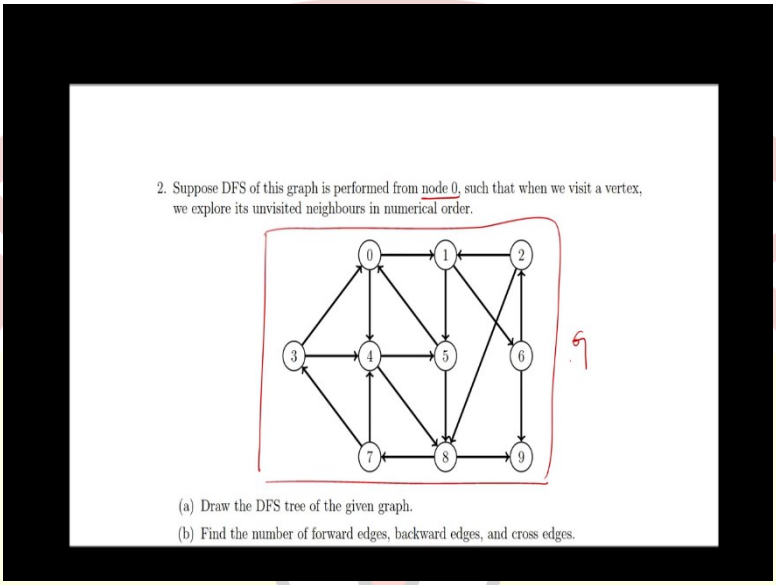

Hello everyone. Let us try to solve the second tutorial question related to graph theory. Suppose, DFS on this graph is performed from node 0, such that when we visit a vertex, we explore its unvisited neighbours in numerical order. So, this is a graph given to us. If you see this is a directed graph G, so we are asked to draw the DFS tree of the given graph and to find the number of forward edges, backward edges, and cross edges.

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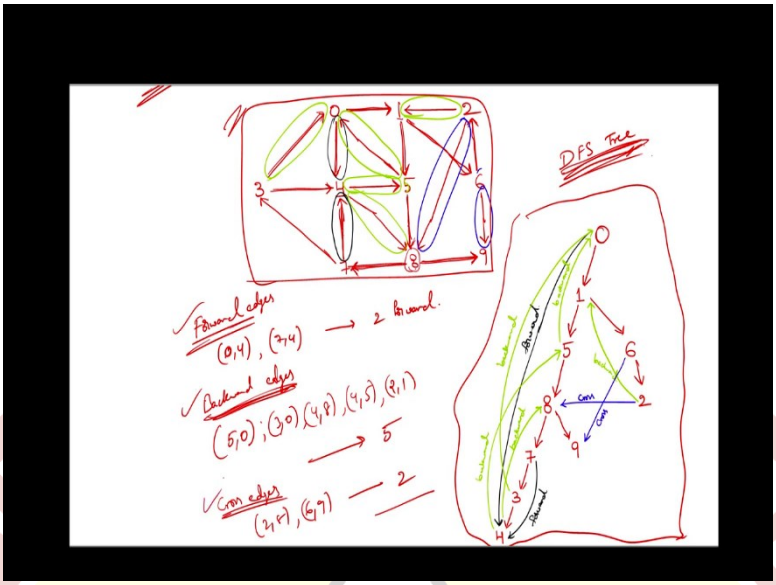

So, this is the graph given to us, we have to draw the DFS tree starting from node 0. From node 0, we have two outgoing edges, which goes to vertex 1 and vertex 4. So, we are supposed to take the numerical order into consideration. So, we will be taking this outward edge to 1. And from 1 there are two outgoing edges, 1 is to, 1 goes to 5, and other goes to 6. So, we will be exploring 5, considering numerical order. And from 5, there are two outgoing edges to 0 and to 8. As 0 is an explored vertex, we will be taking this outgoing edge to 8 and from 8 there are again two outgoing edges, which goes to 9 and which goes to 7.

So, we will be taking this outgoing edge, which goes to 7, and from 7 again there are two outgoing edges, which goes to vertex 3 and vertex 4. We will be taking vertex 3 and from 3 again two outgoing edges to 0 and to 4. And 0 is unexplored vertex, so we will be going to 4, and from 4 there are two outgoing edges with goes to vertex 5 and vertex 8 but vertex 5 and 8 are already visited. So, we will come back from 4 to 3, and from 3 to 7, and from 7 to 8, from 8 if you see, we explored 7.

Now, the unexplored vertex will be 9. So, from 8 there will be an outgoing edge to 9 but from 9 there are no outgoing edges, we will come back to 8, and back to 5, and back to 1. Now from 1, there is an outgoing edge that goes to 6, which is still an unexplored vertex. So, from 1, there will be 6 outgoing vertexes, outgoing edge from 1 to 6 and from 6 there is an outgoing edge to 2. So, from 2, there is an outgoing edge to 1 but 1 is already been explored.

So, if you see, this will be the DFS tree, when we start with node 0. So, we got the DFS tree. Now, we have to find the number of forward edges, number of backward edges, and number of cross edges. So, we will try to find all the edges which are forward, backward, and cross

edge. If you see here, there is an edge from 0 to 4, which is an outgoing edge from 0, and to the vertex 4. So, as it is an outgoing edge from 0 to 4, this will be a forward edge. So, this will be a forward edge.

And in the same way, if you see this 7 to 4, there is an outgoing edge from 7 and an incoming edge to 4. So, 7 to 4 this will also be forward edge. And now, if we see this edge that goes from vertex 5 to vertex 0. So, from vertex 5 to vertex 0. So, this will be a backward edge, and if you see this edge which goes from 4 to vertex 8, this will also be a backward edge, and if you see this edge, it goes from 3 to 0, this is also a backward edge.

And if you see this edge, it goes from 4 to 5, this will also be a backward edge. If you see this edge from 2 to 1, this will also be a backward edge. If you see 6 to 9, this is an edge from 6 to 9, as 6 and 9 are in two branches this will be a cross edge. And if is you see 2 to 8, this will also be a cross edge. So, the number of forward edges are, so the forward edge are 0,4, 7,4, two forward edges. The number of backward edges are, 5,0, 3,0, 4,8, 4,5, 2,1. So, there are total 5 backward edges. And cross edges are 2,8, 6,9, 2.

Therefore, in this given graph, after finding this DFS tree, there are two forward edges, 5 backward edges, and 2 cross edges. When a directed graph is given, we can draw a DFS tree. And from DFS tree, we can find the number of forward, backward, and cross edges. Thank you.