

(2012)

Tree Graph Analysis*

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Abstract: We continue the analysis of deadlock problem by studying the features of tree type graph.

Keywords and phrases: Runtime deadlock, Tree, Graph.

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1. Introduction

We continue the analysis of deadlock problem by studying the features of tree type graph.

2. Tree and its number of edges

We can consider a *tree* is a graph that is only one root node. From this root node, we can reach any other node and the path is unique (the vertex/node edge sequence is unique). Normally we consider tree is un-directed graph. However, if we consider every edge is bi-directional will give us great advantage. In the practice of this article, we use the parent node to sub-node direction to construct the graph, the sub-node to parent node edge to uniquely identify a node.

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Corollary 2.1. *A tree with n nodes has $n - 1$ edges, $n \in \mathbb{N}$.*

Proof. We use mathematical induction.

Step 1, a tree with 1 node has zero nodes.

Step 2, let a tree T with m nodes and $m - 1$ edges, $m \in \mathbb{N}$.

Step 3, we try to add one more node to T . Case I. If the node will take the place of the root or be a leaf node, then we can add only one edge. Case II If we want to put the node between two existing node, we will have to remove the old edge and put two new edges. Case II we gain net one more edge. There are no other cases.

So the new tree with $m + 1$ has m nodes. \square

3. Tree and connected cyclic graph

Corollary 3.1. *A connected graph with n nodes is a-cyclic \iff it is a tree, namely it has $n - 1$ edges, $n \in \mathbb{N}$.*

Proof. Again, we use mathematical induction.

Let a connected graph with m node be a tree, thus a-cyclic.

We put number $m + 1$ node to it. If we put the node only, then the graph is not connected. If we put only one edge, it follows the discussion of the last section.

If we put two or more edges, then there must be one or more cycles. \square

4. Conclusion from above sections

From the discussion in the above sections, we can draw some very important conclusions. Here, we leave them to the readers.

We show these conclusions in our coding projects.

5. A tree utility program, BFS and DFS traversal

We attach Java program that can be use to construct a tree. After the tree is constructed, we can use BFS or DFS to print the tree. The readers will also see the program will assist the proper construction of a tree.

6. Treeter a snapshot tool

Treeter is a visualization tool of a tree. We use it to render a tree to jpeg file. Unfortunately, it can not create a file has more than 65500 pixels. In the next phase, we will move to OpenGL, theoretically, we will not have a soft limit as javax.imageio.

7. Discussion

This article is not peer reviewed. The attached coding projects are not either. If you find some errors or you want to give some comments, please contact the author. Corollary [2.1](#) and Corollary [3.1](#) are not new inventions, you can refer to general computer science or mathematics texts.

References