Spanning Trees of a Triangle Snake Graph by BFS and DFS Algorithms

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Abstract: Possible spanning trees of a triangular snake graph are outlined and extracted the spanning trees of a triangular snake graph by applying the method of breadth-first search and depth-first search algorithms; shows arrived spanning trees are not identical.

Index Terms: Graph; triangular snake graph; tree; spanning tree; complement; algorithm; breadth-first search; depth-first search Subject classification codes: 05C05; 05C85

I. INTRODUCTION

Here we introduce the spanning trees of a triangular snake graph by applying breadth-first search and depth-first search algorithms. The graph \( G = (V, E) \) is denoted by \( G = G(V, E) \) where \( V \) is called the vertex set contains \( n \) vertices and \( E \) is called the edge set contains \( m \) edges. A graph \( G \) is said to be a tree if it is connected and has no cycles. A subgraph \( T \) of \( G \) is called a spanning tree of \( G \) if \( T \) is a tree and \( T \) contains all vertices of \( G \) (Chandrasekharaiah 2012). A triangular snake graph is a triangular cactus graph whose block-cut point graph is a path. A triangular snake graph has \((2n + 1)\) vertices and \((3n)\) edges, where \( n \) is the number of blocks in the triangular snake graph and it is denoted by \((TS)_n\) (Selvi 2015).

Graph \( G = (TS)_2 \) is a closed walk has \( n = 5, m = 6, 2\)-Blocks, \( m - n + 1 = 2 \) chords with respect to spanning tree \( T \) and \( T \) has \((n - 1) = 5 \) edges. The complement of \( T \) in \( G \) is denoted by \( \overline{T} \) or \( T^c \). Spanning trees of triangular snake graph \( G = (TS)_2 \) are shown in Figures 2(a) to (i).

Figure 1. Triangular snake graph \( G = (TS)_2 \)

Figure 2 (a)

Figure 2 (b)

Figure 2 (c)

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II. RESULTS AND DISCUSSION

In this section, we are applying two methods to find a spanning tree of a connected graph called a triangular snake graph. The first of these is known as the breadth-first search (BFS) and the second is known as the backtracking or depth-first search (DFS) algorithms (Grimaldi and Ramana 2004).

A. Breadth-First Search (BFS) algorithmic method

Step 1. Start with vertex $v_1$. Insert $v_1$ in queue $Q$ and initialize tree $T$ as this vertex. (This vertex will turn out to be the root of the resulting tree $T$).

Step 2. We delete $v_1$ from $Q$ and visit the vertices adjacent to it, namely $v_1, v_2, v_3, v_4$ (These vertices have not been previously considered). This results in our attaching to $T$ the edges $\{v_1, v_2\}, \{v_1, v_3\}, \{v_1, v_4\}, \{v_1, v_5\}$.

Step 3. We insert $v_2, v_3, v_4, v_5$ in $Q$. Returning to Step 2, we delete each of these vertices from $Q$. At this stage, all the vertices of $G$ have been visited and we stop the process.

Thus, a spanning tree that consists of the edges $\{v_1, v_2\}$, $\{v_1, v_3\}, \{v_1, v_4\}, \{v_1, v_5\}$ has been determined.

$$G = (TS)_2$$
This breadth-first search spanning tree is shown in Figure 3.

![Figure 3. Breadth-First Search Spanning Tree](image)

**B. Depth-First Search (DFS) algorithmic method**

Step 1. Assign the first vertex $v_1$ to the variable $V$ and initialize tree $T$ as just the vertex $V_1$ (the root).

Step 2. We find that the vertex $v_2$ is the first vertex $w$ such that \(\{v_1, w\} \in E\) and $w$ has not been considered earlier. So, we attach the edge $\{v_1, v_2\}$ to $T$, assign $v_2$ to $V$ and return to Step 2. At $v_2$, we find that the first adjacent vertex (not considered earlier) that provides an edge for $T$ is $v_3$. Consequently, the edge $\{v_2, v_3\}$ is attached to $T$, $v_3$ is assigned to $V$ and we again return to Step 2 in such a way that no cycles formed in the graph. Now, we note that there is no new vertex which we can obtain from $v_3$, because the adjacent vertex $v_1$ has already been considered. Step 3. Continuing the process, we attach the edges $\{v_1, v_3\}$ and $\{v_4, v_5\}$ to $T$. Thus, a spanning tree that consists of the edges $\{v_1, v_3\}, \{v_2, v_3\}, \{v_1, v_5\}, \{v_3, v_4\}$ has been determined. Continue this process till all the vertices of the $G$ have been visited. This depth-first search spanning tree is shown in Figure 4.

![Figure 4. Depth-First Search Spanning Tree](image)

For a given triangular snake graph, the breadth-first search and the depth-first search spanning trees are not identical (even for a given order of the vertices of $G$).

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