Hw #1 ENEE610 Sanaz Adl

10/18/05

1) a

$$\text{cutset matrix} = C = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & -1 & -1 & -1 \end{bmatrix}$$

$$\text{Tieset Matrix} = T = \begin{bmatrix} -1 & -1 & -1 & 0 & 1 & 0 & 0 & 0 \\ -1 & -1 & 0 & 1 & 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 \\ -1 & -1 & -1 & 1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

b

$$C^T = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & -1 \\ 1 & 0 & 0 & -1 \\ 1 & 1 & 1 & -1 \end{bmatrix}$$

$$CC^T = \begin{bmatrix} 5 & 3 & 2 & -3 \\ 3 & 4 & 2 & -2 \\ 2 & 2 & 3 & -1 \\ -3 & -2 & -1 & 4 \end{bmatrix} \Rightarrow \det(CC^T) = 45$$

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c

$$A_a = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & -1 & 1 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 1 & 1 & 1 \\ 0 & 0 & -1 & 0 & -1 & 0 & 0 & -1 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & -1 & 1 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 1 & 1 & 1 \end{bmatrix}$$

d

$$A_a A_a^T = \begin{bmatrix} 3 & 1 & 0 & -1 & -1 \\ -1 & 3 & -1 & -1 & 0 \\ 0 & -1 & 3 & -1 & -1 \\ -1 & -1 & -1 & 4 & -1 \\ -1 & 0 & -1 & -1 & 3 \end{bmatrix} \Rightarrow \det(A_a A_a^T) = 0$$

Since $\det(A_a A_a^T) = \det(A_a)\det(A_a^T)$ and $\det(A_a) = \det(A_a^T) =$

So $\det(A_a A_a^T) = 0$ Also $A_a A_a^T$ is symmetric

The result of problem 3.12 is incorrect since it says that the number of trees in a graph is equal to $\det(A_a A_a^T)$

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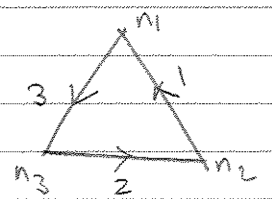
e) $\det(AA^T) = \det\begin{bmatrix} 3 & -1 & 0 & -1 \\ -1 & 3 & -1 & -1 \\ 0 & -1 & 3 & -1 \\ -1 & -1 & -1 & 4 \end{bmatrix} = 45$

So we conclude that $\det(AA^T) = 45 = \det(CC^T)$

So the correction to problem 3.12 would be this: The number of trees n_t is given by: $n_t = \det(AA^T)$ in which A is the incident matrix of the graph which does not include the ground node in the graph.

Example:



Choose n_3 as ground

number of trees $= 3$

$$A = \begin{bmatrix} -1 & 0 & 1 \\ 1 & -1 & 0 \end{bmatrix} \Rightarrow A^T = \begin{bmatrix} -1 & 1 \\ 0 & -1 \\ 1 & 0 \end{bmatrix}$$

$\det(AA^T) = 3$ = number of trees