1. The algorithm we saw for finding the maximum agreement homeomorphic subtree of two evolutionary trees, the dynamic programming considered subtrees. We saw that there are $O(n)$ subtrees for an $n$-leaf tree. Write the exact number of subtrees for a binary evolutionary tree with $n$ leaves. Prove your claim.

**Answer:**

The number is $4n - 6$. Since every edge in the tree has precisely two subtrees (one on each side) and the number of edges is $2n - 3$, because this is an unrooted full binary tree. See the proof for that in *mod alef*.

**Errors:**

2. Consider the following integer program:

**Objective function:** $\max 4x_1 - 5x_2$.

**Constraints:**

$\begin{align*}
\text{quad } x_1 - x_2 &\geq 0 \\
\text{quad } x_1 &< 3 \\
\text{quad } x_1 &\geq 0 \\
\text{quad } x_2 &\geq 0
\end{align*}$

Does the above IP have a solution? What is it?

**Answer:**

For illustration purposes, take $x_1 = x$ and $x_2 = y$. The constraints give us the domain:
The function $4x - 5y$ in this domain gets the maximum value when $x$ is largest and $y$ is smallest. We are looking at integers which means $x = 2$ and $y = 0$.

**Errors:**

3. Let $P$ be a pattern of length $m$. If you are given the KMP automaton, can you deduce from it the locations in the witness table that have a "*"? How?

**Answer:**

The fail link from the accepting state of the KMP automaton points to the first location where there is a "*" (assume it points to state $k$, then there is a "*" in location $m - k + 1$ of the witness table). Following the failure link from state $k$, say to state $\ell$, means putting a "*" in location $m - \ell + 1$ of the witness table. We continue in this fashion until the failure link points to state 0.

**Errors:**

GOOD LUCK