Partial Recursive Fibonacci tree

```
S  VP
S  VP
S  NP
NP  VP, V
DET  N
DET  N
```

she programs the robot with a friend
If $k$ is the number of words in a sentence and the sentence can be produced using a grammar that is in Chomsky-Normal Form, the # of steps in the derivation is $2^k - 1$. 

\[ S \rightarrow \text{NP VP} \]
\[ \rightarrow \text{she VP} \]
\[ \rightarrow \text{she VP PP} \]
\[ \rightarrow \text{she V NP PP} \]
\[ \rightarrow \text{she programs NP PP} \]
\[ \rightarrow \text{DET N PP} \]
\[ \rightarrow \text{the N PP} \]
\[ \rightarrow \text{the robot PP} \]
\[ \rightarrow \text{A NP} \]
\[ \rightarrow \text{with NP} \]
\[ \rightarrow \text{with DET N} \]
\[ \rightarrow \text{with AT N} \]
\[ \rightarrow \text{with a friend} \]