Assignment Two

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Question One

Derivation

You will find the derivation tree below for the modified Missionaries and Cannibals problem, with four membors of each party. A small problem arises since the boat's capacity is *n - 1*, where n is the members of one party, and both partys have n members.

Assume the same starting conditions, where c is the number of cannibals and m is the number of missionaries on the target side of the river. All cannibals and missionaries are on the starting side of the river, thus $c = 0$ and $m = 0$.

$$
\begin{aligned}
S(c,m) &\rightarrow^1 A(1,1) \\
&\rightarrow^2 p(1,1)A(3,0) \\
&\rightarrow^2 p(1,1)p(3,0)A(2,2) \\
&\rightarrow^2 p(1,1)p(3,0)p(2,2)A(1,3) \\
&\rightarrow^2 p(1,1)p(3,0)p(2,2)p(1,3)A(2,3) \\
&\rightarrow^2 p(1,1)p(3,0)p(2,2)p(1,3)p(2,3)A(3,3) \\
&\rightarrow^2 p(1,1)p(3,0)p(2,2)p(1,3)p(2,3)p(3,3)A(3,4) \\
&\rightarrow^2 p(1,1)p(3,0)p(2,2)p(1,3)p(2,3)p(3,3)p(3,4)A(4,4) \\
&\rightarrow^3 p(1,1)p(3,0)p(2,2)p(1,3)p(2,3)p(3,3)p(3,4)p(4,4)
\end{aligned} \tag{1}
$$

Grammar

Below is the general controlled grammar for the Missionaries and Cannibals problem. Most of the changes occur in the functions and predicates.
Let c be the number of cannibals and m be the number of missionaries on the target side of the river, and n be the number of members in each party. If we assume the capacity of the boat is also n, then much of the problem stays the same.

L	Q	Kernel	F_T	F_F
1	Q_1	S(c,m) $\rightarrow$ A(c + 1, m + 1)	{2}	$\varnothing$
2	Q_2	A(c,m) $\rightarrow$ p(c, m)A(f_1(c,m), f_2(m))	{2}	{3}
3	Q_3	A(c,m) $\rightarrow$ p(c, m)	$\varnothing$	$\varnothing$

- Predicates
  - Q_1 = true
  - $Q_2(c, m)$ = true if $(c > 0 \wedge c < n) \vee (m > 0 \wedge m < n)$
  - $Q_3(c, m)$ = false if $(c = n \wedge m = n) \vee ((c > m) \vee (3 - c) > (3 - m))$
- Functions
  - The functions stay the same as well, only replacing n where there are /3/s.

Question Two

Grammar

Below is a derivation for the Tower of Hanoi with four pivots and n disks.

L	Q	Kernel	F_T	F_F
1	Q_1	S(n,x,y,z) $\rightarrow$ A(n,x,y,z)	{2}	$\varnothing$
2	Q_2	A(n,x,y,z) $\rightarrow$ A(f_1(n),x,f_2(x,y,z),z),\(n,x,y,z)A(f_1(n),f_2(x,y,z),y,z)	{2}	{3}
3	Q_3	A(n,x,y,z) $\rightarrow$ p(n,x,y,z)		

Derivation