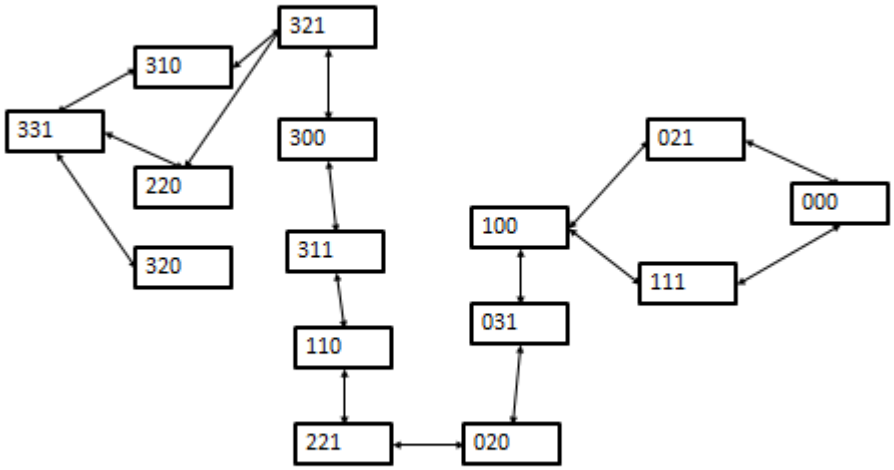
Homework 1 solutions

Problem 1a and 1c:

We can use a state description of the following form: *(M,C,B)* where *M* is the number of missionaries on the start side, *C* is the number of cannibals on the start side and *B* is 1 if boat is on the start side and 0 otherwise. The start state is (3,3,1) and the goal state is (0,0,0). The state-space graph is shown below.



Missionaries and Cannibals: State-space graph

Problem 1b. The operators can be defined using if-then rules as follows:

If State is (331) then successors are (310), (220) and (320)

If State is (021) then successors are (100) and (000)

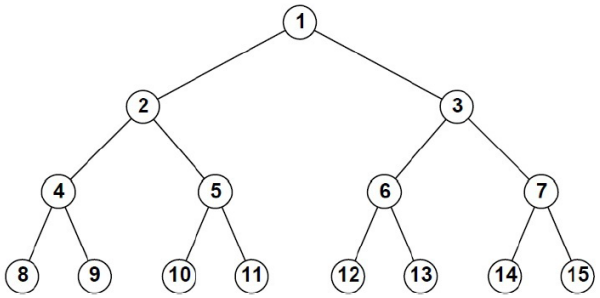
And so on. (Many other solutions are acceptable here. A more generic solution is more desirable but this would do).

Problem 1d. Many DFS search traces are possible. The luckiest one is:

(331)->(310)->(321)->(300)->(311)->(110)->(221)->(020)->(031)->(100)->(111)->(000)

Problem 2:

Consider the search tree given below. The start state is number 1 and each state k has two successors: numbers $2k$ and $2k+1$. Suppose that the goal state is 12.



1. (5 points) Assuming that you always expand left child first, list the nodes that will be visited by Iterative Deepening search (IDS).

Solution: The IDS trace is given below.
IDS:

- Depth-bound =1: 1
- Depth-Bound =2: 1,2,3
- Depth-Bound =3: 1,2,4,5,3,6,7;
- Depth-Bound =4: 1,2,4,8,9,5,10,11,3,6,12

Problem 3:

Let d be the maximum-depth of the search tree, b be its branching factor and $m \leq d$ be the depth of the **unique path** to the (unique) goal state.

1. (5 points) What is the minimum and maximum number of nodes that might be generated by depth-first search?

Solution: Minimum: O(bm) and Maximum: $O(b^d)$

2. (5 points) What is the minimum and maximum number of nodes that might be generated by breadth-first search?

Solution: Minimum: $O(b^{m-1})$ and Maximum: $O(b^m)$