Functional Programming Assignment 1
Theoretical Questions

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Question 2.2

The Rubik's cube can be twisted in six directions. For each state six new (non-distinct) states can be generated. n moves can be represented by the following mathematical function:

$$f(n) = 6^n \text{ for all } n \in \mathbb{N} \tag{1}$$

Question 3.2

Figure 1 indicates that there is a correlation between the running time and the memory usage. As n increases, so does the size of the search space grow exponentially. However, in terms of actually memory usage on the operating system we do not see this exponential growth, we instead see a logarithmic increase in memory usage of the process over the run duration.

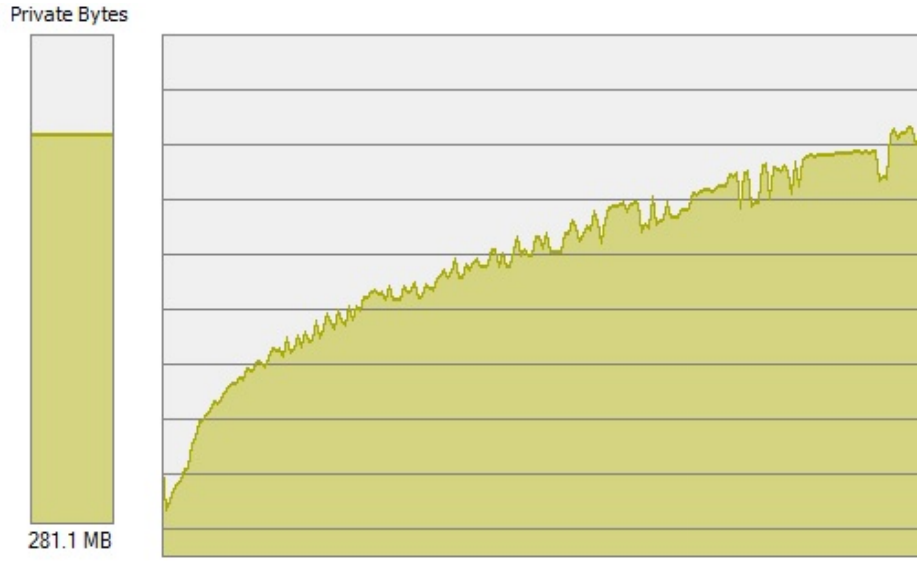

Figure 1: Memory Usage Over Time

Size of n	Peak Memory Usage (MB)	Running Time (Seconds)
1	n/a	0.047
2	n/a	0.049
3	n/a	0.055
4	n/a	0.098
5	n/a	0.355
6	53.9	7.034
7	273.2	213.197
8	null	null

Table 1: Memory usage and running time for different size of n

Tests were conducted for n up to size 8. The results would indicate ...

Question 4

Using function 1, the number of states that can be generated from 10 moves where 6 possible rotations can be made for each state is

$$\begin{aligned} f(10) &= 6^{10} \\ &= 60466176 \text{ states} \end{aligned}$$

Function 1 can be optimised such that from a given non-initial state, the new states generated are only those that will not undo the last move.

$$f(n) = \begin{cases} 6^n & \text{if } n \in T = \{0, 1\} \\ 5^n & \text{if } n \in \mathbb{N} \setminus T \\ 0 & \text{otherwise} \end{cases} \tag{2}$$