**3.4 Homework Task Submission**

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| **Answer all parts of this Homework task and submit your work into VSV Online as PDF and SnapApps/Edgy .xml or Python3/Trinket code files. This homework is required to demonstrate learning outcomes to a satisfactory standard.**  **For this Homework Submission 2 Files are expected:**  **• 1 PDF file with text responses for the Problem parts 1a) to 1e) inclusive**  **• 1 .xml SnapApps/Edgy export file or Python3/Trinket file addressing Problem part f)** |
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| **A PLANNING PROBLEM**  **Problem:**  Three teachers must cross a river. Two students have a small sail boat and are willing to help. Their small boat can hold either the two students or one teacher, all the people present know how to sail the boat. |  |

**Complete the following parts a) to f) inclusive for this SAT Folio task, scan and submit your work as a PDF file.**

1. Give a written description of how these people can safely cross the river.

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| If both the kids cross the river, one of them can come back with the boat. This allows the one kid on the other side to come back with the boat. Now they would have successfully transported one teacher to the other side and they can repeat this until everybody is on the other side. |

1. Use a pictorial representation to show all the possible ways of getting from the “initial state” where all are on the one side of the river to the “final state” where all are on the other side of the river.

Let 3, 2 b | 0, 0 represent 3 teachers and 2 students on the left, and 0 of both on the right, with the boat on the left.

2, 2 | 1, 0 b

2, 2 b | 1, 0

2, 1 | 1, 1 b

3, 1 b | 0, 1

3, 0 | 0, 2 b

3, 2 b | 0, 0

3, 1 | 0, 1 b

This is the only way to exit the loop and has effectively moved one adult to the other side and returned to the initial state. All other ways go back to the initial state, so the only way to move forward is repeating this loop 3 times.

1. List the minimum number of possible boat trips that can be done safely

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| The minimum number of possible boat trips is 13. This is evident by the list below where A = adult and K = kid:  AAAKK  AAA -> KK 1  AAAK <- K 2  AAK -> AK 3 AAKK <- A 4  AA -> AKK 5  AAK <- AK 6  AK -> AAK 7  AKK <- AA 8  A -> AAKK 9  AK <- AAK 10  K -> AAAK 11  KK <- AAA 12  AAAKK. 13 |

1. What is the minimum number of possible states that can exist for this problem? Justify your response.

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| Since there are 3 adults and 2 kids, there can either be 0, 1, 2, or 3 adults and 0, 1 or 2 kids on either side. The boat can also be on either side, meaning there are 4 \* 3 \* 2 = 24 variations of this setup. Along with this, the boat also can’t be on a side by itself (not possible within the problem), so 24 – 2 = 22 states for the problem. |

1. What Abstract data types can be used to represent this model? Justify your selection(s).

Two lists can be used to model the situation, one for either side. This is because the order of the adults and the kids does not matter, but they do have to be stored on a particular side, but we do not only want be able to access the first or last element, we want anyone to be able to board the boat.

1. Create your model in a coding language in either **SnapApps/Edgy** or **Python3/Trinket** using the Abstract data types you’ve selected from **part e),** export your code and include it with this homework submission.

For my code submission, I ended up landing on the dictionary ADT instead, as the code was cleaner. This is because removing objects from lists cannot be done in O(1) time, and we only really care about how many teachers or students are on either side. As such, the dictionary is implemented similar to a hash table, but instead of <key, bucket> pairs, they are <key, integer> pairs where the integer represents the number of each person type on that side.