**COMP20003 – Algorithms and Data Structures**

**Assignment 3 Experimentation**

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**Introduction**

In this report, we aim to study the behavior of NP-Complete problems by running experiments on an algorithm to find the best solution to win the Peg Solitaire game.

**Discussion**

Table 1 summarizes the results obtained from the experimentation. As we can see from Figure 1 to Figure 4, the algorithm is able to find the solution to win the game for easier levels (layouts 0 to layout 4) for all budget values. However, this is not the case with harder levels as seen in Table 2, where we are only able to find the solution to win the game in layout 5 after increasing the budget to 1.5M. We are still not able to find a path to win the game for layouts 6 to 8 at the budget value of 1.5M.

Table 1

Summary of the results obtained from the experimentation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Max budget | Layout | Expanded Nodes | Generated Nodes | Number of pegs left | Expanded / Second | Total execution time (seconds) |
| 10k | 0 | 2 | 2 | 1 | 24 | 0.080689 |
| 1 | 3 | 3 | 1 | 36 | 0.081570 |
| 2 | 7 | 8 | 1 | 90 | 0.077425 |
| 3 | 3,541 | 10,282 | 1 | 38,528 | 0.091905 |
| 4 | 1,065 | 2,418 | 1 | 14,036 | 0.075876 |
| 5 | 10,000 | 26,495 | 4 | 78,000 | 0.128205 |
| 6 | 10,000 | 29,368 | 5 | 75,311 | 0.132782 |
| 7 | 10,000 | 32469 | 4 | 77,227 | 0.129487 |
| 8 | 10,000 | 27,562 | 6 | 77,477 | 0.129069 |
| 100k | 0 | 2 | 2 | 1 | 24 | 0.080014 |
| 1 | 3 | 3 | 1 | 40 | 0.074146 |
| 2 | 7 | 8 | 1 | 92 | 0.075958 |
| 3 | 3,541 | 10,282 | 1 | 38,317 | 0.092412 |
| 4 | 1,065 | 2,418 | 1 | 13,741 | 0.077502 |
| 5 | 100,000 | 359,818 | 3 | 223,357 | 0.447712 |
| 6 | 100,000 | 374,378 | 4 | 232,444 | 0.430211 |
| 7 | 100,000 | 386,440 | 2 | 216,258 | 0.462409 |
| 8 | 100,000 | 349,921 | 4 | 226,406 | 0.441684 |
| 1M | 0 | 2 | 2 | 1 | 25 | 0.078727 |
| 1 | 3 | 3 | 1 | 37 | 0.079223 |
| 2 | 7 | 8 | 1 | 89 | 0.078548 |
| 3 | 3,541 | 10,282 | 1 | 42,214 | 0.083882 |
| 4 | 1,065 | 2,418 | 1 | 11,979 | 0.088903 |
| 5 | 1,000,000 | 4,488,464 | 2 | 213,336 | 4.687426 |
| 6 | 1,000,000 | 4,481,233 | 3 | 225,972 | 4.425318 |
| 7 | 1,000,000 | 4,790,308 | 2 | 222,696 | 4.490425 |
| 8 | 1,000,000 | 4,073,028 | 4 | 226,535 | 4.414319 |
| 1.5M | 0 | 2 | 2 | 1 | 25 | 0.078362 |
| 1 | 3 | 3 | 1 | 36 | 0.083236 |
| 2 | 7 | 8 | 1 | 91 | 0.076654 |
| 3 | 3,541 | 10,282 | 1 | 42,113 | 0.084083 |
| 4 | 1,065 | 2,418 | 1 | 12,944 | 0.082275 |
| 5 | 1,500,000 | 4,898,609 | 1 | 276,055 | 3.949479 |
| 6 | 1,500,000 | 7,020,668 | 3 | 230,889 | 6.496614 |
| 7 | 1,500,000 | 7,173,504 | 2 | 219,128 | 6.845283 |
| 8 | 1,500,000 | 6,361,454 | 4 | 229,383 | 6.539281 |

Figure 1

A function of the number of pegs left on the board against the number of pegs present initially for a budget of 10k

Figure 2

A function of the number of pegs left on the board against the number of pegs present initially for a budget of 100k

Figure 3

A function of the number of pegs left on the board against the number of pegs present initially for a budget of 1M

Figure 4

A function of the number of pegs left on the board against the number of pegs present initially for a budget of 1.5M

Table 2

Table showing how the budget affects the solution quality for layout 5 to layout 8

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Layout Number | Number of pegs remaining on the board | | | |
| Budget of 10k | Budget of 100k | Budget of 1M | Budget of 1.5M |
| 5 | 4 | 3 | 2 | 1 |
| 6 | 5 | 4 | 3 | 3 |
| 7 | 4 | 2 | 2 | 2 |
| 8 | 6 | 4 | 4 | 4 |