CMPUT 366 Assignment 2, Nicholas Serrano, 1508361

Analyzing plots

In this assignment, we are to create a class that can perform back tracking search to solve sudoku puzzles for a given heuristic. In this assignment we used the MRV heuristic which will tell the back tracking algorithm to pick a variable with the smallest domain, and a First Available heuristic which will simply pick whatever variable is first variable. Let us compare the runtimes between using these two heuristics.

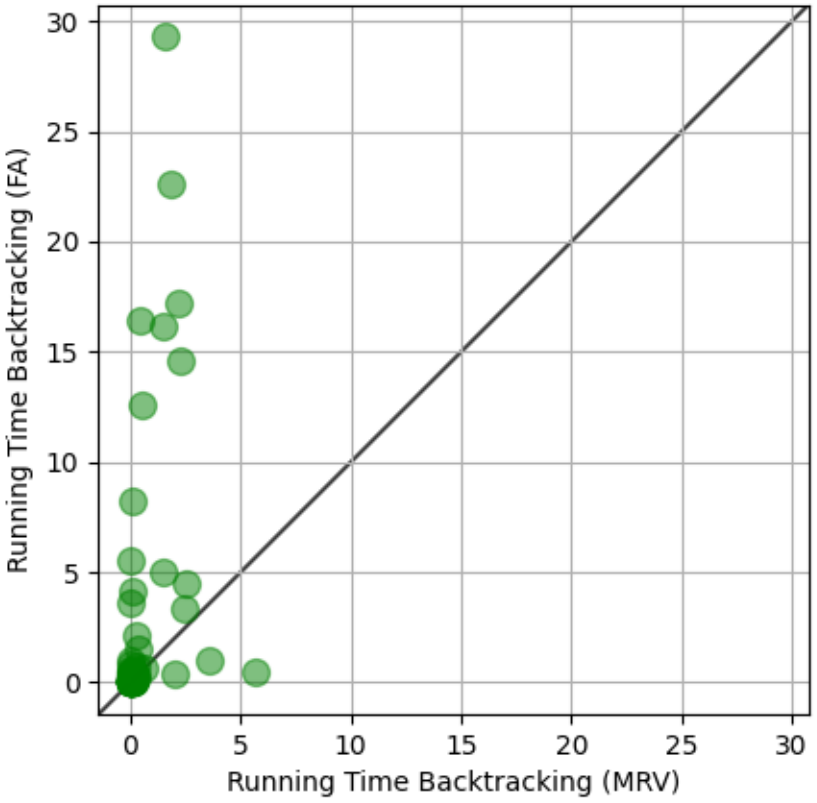

Figure 1: Runtime Comparison

Figure 1 shows the runtime comparison when running the algorithm with the 2 different heuristics. Many of the points in this plot are highly concentrated towards the left side of the plot, and many of the points are located vertically higher. What this is telling us is that the runtime for backtracking using the MRV heuristic, is vastly shorter for the average case. Why is this the case? For MRV, we are picking the variable with the smallest domains. What this means is that if we pick a variable that takes us down a patch that leads to an invalid solution, the algorithm can realize this faster. That is, we can fail quicker, so we can backtrack much earlier

and look for a better solution to the problem. The smaller domain set means less options to assign the variable, and thus can assign values quicker and detect failure quicker. With the first available heuristic, we are not performing any logic whatsoever to decide the next variable. So, if we pick a bad variable, the algorithm will waste a lot of time, that is it takes much longer to realize that the variable picked will lead to failure. This extra time wasted time is greatly reflected in figure 1. Plot points located at the very top, took an extremely long time for the First Available algorithm to solve, while the MRV algorithm was able to solve very quickly. So why are there a few points to the right side of line where First Available is faster? This is because the top 95 problem set has a few problems that are simple enough to the point where reasoning isn't as required. Unlike the First Available heuristic, the MRV heuristic pays a slight cost every time it computes the next MRV variable. For simpler problems, this total extra time might cause more time then to solve the problem with no reasoning at all, as it was in the case for the few points on the right side of the line. But for the average case, using a MRV heuristic will yield better results then the naïve First Available heuristic.