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CS 4300 - Artificial Intelligence

A3 - Report

1. Introduction

For this assignment, we were asked to study constraints and arc reduction algorithms AC-1 and AC-3. In this homework, we will identify what is different between the two. We were also asked to study the conditional expected reduction in ones for a given starting number of ones, find the best regression fit and report the constants in the complexity functions of the two algorithms, and find the relative execution time ratio of the two algorithms (as a function of p and N).

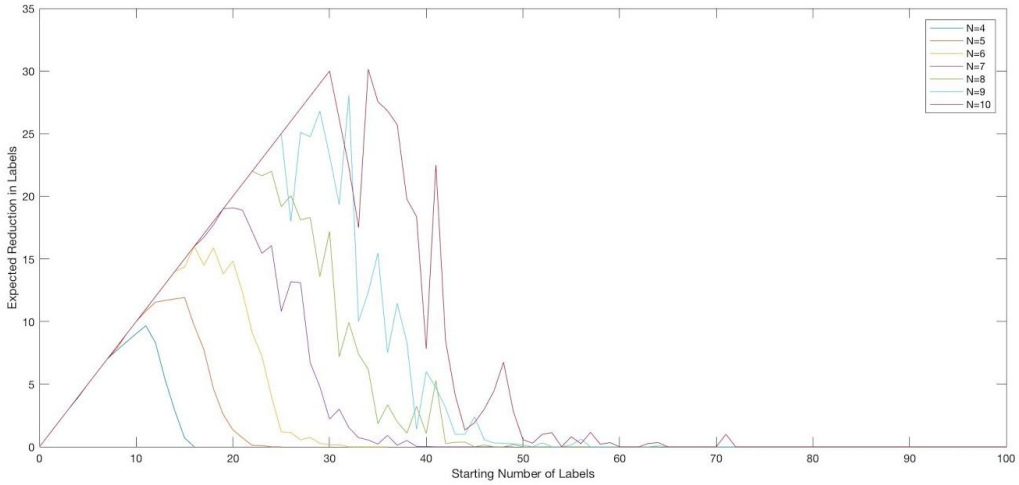
2. Method

In order to examine the AC-3 and AC-1 algorithms we first coded them up in Matlab. We then ran the algorithms against random boards of size N in order to determine the expected number of reductions on average. Ultimately for each N we average the expected number of reductions for each corresponding number of nodes. To test the time it takes for the two methods to complete the work we started a clock with “Tic” and stopped it with “Toc” directly before and after for both AC-1 and AC-3 on the same boards. The difference between AC-1 and AC-3 is where they revise each of their data sets. AC-3 is more clever in the way that it does its revising and as a result skips many comparisons that AC-1 would have to do.

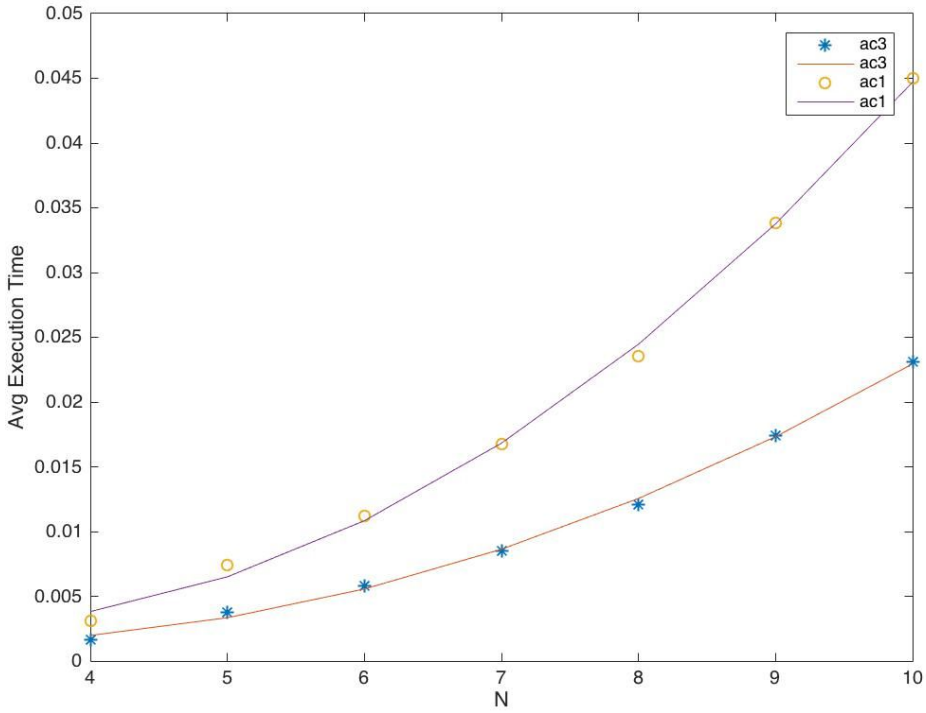
3. Verification of Program

For our verification, we used some of the class quiz solutions as hard coded input and tested output to decide if it was what we wanted it to be. We also designed a few other test cases that we went through by hand. A solid and easy way to double check out work was to check the results from AC3 vs AC1. If they were the same and equaled the solution, we were achieving the correct solution.

4. Data and Analysis



Both AC-1 and AC-3 give the same number of reductions, as expected. If you examine the graph as the N rises the total number of expected reductions goes up for each number of starting ones.



As is evident from the above graph AC-3 is faster than AC-1. AC-3 appears to take a third as much time as AC-1.

5. Interpretation

AC3 is only better than AC1 due to performance. Both algorithms accomplish the same reduction in nodes foreach number of labels. AC3 has significantly better timing statistics. As N goes to infinite values, the difference in time between AC1 and AC3 can be determined by a constant factor. Since both timing graphs resemble quadratic plots, we can see that the factor influencing AC3 is at least p3 = ⅓ of AC1's p1. This performance boost is due to the outside queue structure that minimizes the number of unnecessary constraint tests.

6. Critique

This assignment was very reasonable, the most difficult thing was just understanding where to start. I didn't fully realize that the Revise function is the same for both AC-1 and AC-3. Once I understood that they both revise the same way the next step was translating the pseudo code in the Mackworth paper which presented its own challenges. The pseudo code gives a high level understanding of how the algorithms work but are missing a lot of implementation details. After translating the algorithms we tested them against random N queens boards and compared the run times and results. One of my only criticisms of the assignment is that the timing could be inaccurate. The amount of overhead to set up each of the algorithms is different but the setup for each method isn't being timed around.

7. Log

Problem	Dusty (hours)	Scott (hours)
Report	5	5
A3	2	6
A1	8	8
Revised	12	8
Plots	2	2
Predicate	.5	.5