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Research Paper Review

The paper I chose was the program to solve sudoku by Richard Bird. The reason I chose it was that I have some experience with solving sudoku (albeit not using code) so it was interesting to think of a solution before reading the paper and then reading about the way the author solved it. This paper is about using a functional language to approach solving sudokus. The author presents his method for creating a solution.

His assumption is that the initially given board is valid and does not contain duplicates. This is a reasonable assumption although it would not be difficult to implement a check to ensure this validity. He presents a wholemeal type programming style by attempting to solve this by solving every single sudoku solution for the given board first and working backwards to more efficient programming and valid solutions for given boards. This seems an easy way to work through the program but I would be concerned about efficiency as it would be almost impossible to use the first solution he proposes in the paper. He says himself that it would have 9^40 boards to test for validity in the end and no programmer would be willing to wait that long nor store that kind of data. I did think this was an interesting way to approach a problem however as most times people would have a focus on efficiency from the beginning which may not enable them to come up with the best solution.

After having found all these solutions the author then attempts to “prune” the solutions. In this section, he gives a matrix of “choices” for each cell that is not already fixed i.e. one choice for that cell. He gives a series of calculations needed using some laws he came up with for filtering these boards. I think that these proofs were a very interesting part of this paper as it shows his thought process and made it easier to follow along with how the solution was progressing and more specifically why the solution worked. After explaining this prune function he also has an inexecutable piece of code with around 3^40 boards to check and this is if half of the entries are fixed. It seems reasonable that a reader at this point would think that the obvious solution is to use the prune function more than once. So the question is: why add another section when the solution seems so obvious?

The final section of this solution is to use this pruning function in a more useful way. Instead of using the matrix cartesian product when there are no more choices available. Instead, use cells that have at least two choices and generate an expanded matrix of its fixed choices. Then apply prune to these matrices and discard any blocked ones until all we have are fixed choices. Blocked matrices were a key idea in this paper and I felt as though the author disregarded this until the end of the paper. It seems an easy idea that could have been introduced at the start. It is any matrix that contains a cell with zero choices or the same fixed choice appears in more than one position - a duplicate. The second idea of this section is to do expanding on the cell with the smallest number of choices. This makes sense in terms of optimising the program. The author claims that this final solution is quite fast - taking a second or two to solve a sudoku.

In general, I think this is quite an elegant solution to the sudoku problem.

- Main points of the paper - example assumptions made, arguments presented, data analyzed, and conclusions drawn.
- My opinion - quality + impact

This project is about engaging with some ideas from the research literature on Functional Programming, as we have done in the discussion sessions all semester. There is a list of papers on Blackboard. You are to select one paper to review and comment on; you may suggest another paper instead if you like, but I have to approve it in advance to ensure it's relevant to the module.

The review should take the form of a short written piece (around two to three pages will usually be enough, but you can write more if you find yourself needing to), and should consist of more than just a summary of the paper's contents.

The article by Mitzenmacher linked at the top of the Papers folder on Blackboard contains a good description of the approach you should take; it talks about a "one page review", but I want you to try to expand on your analysis and give your opinion in a little more detail). In particular, at the end of that article this structure is suggested:

- A one or two sentence summary of the paper.
- A deeper, more extensive outline of the main points of the paper, including for example assumptions made, arguments presented, data analyzed, and conclusions drawn.
- Any limitations or extensions you see for the ideas in the paper?
- Your opinion of the paper; primarily, the quality of the ideas and its potential impact

Grading

Your report will be assessed on how well you engage with the critical analysis. Merely summarizing the ideas in the paper without giving any of your own thoughts will be enough to pass, but it will not be sufficient for a high mark. Some measure of critical engagement is needed for that.

The deadline for this assignment has been set as late as it possibly can be, and *no extensions are possible. If your assignment is not in by the end of the day on the 13th then I will not have it marked in time for the exam board.*