Course Scheduling as a Constraint Satisfaction Problem

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Abstract

The current system for selecting courses at Davidson College is known as "Webtree". Webtree selects courses for students, in order of class seniority, in a random order within their class. This outdated system has been in place for decades, and is very static. We attempt to redesign Webtree such that it selects courses for students in a more efficient way. By framing the problem as a constraint satisfaction problem, we have created a more optimal solution to assigning courses than the current system.

1 Introduction

With over 400 courses offered every semester at Davidson College, assigning students courses based on their preferences is not a trivial task. For years, the Office of the Registrar has used "Webtree", a system designed to be fair yet give students preferential treatment according to seniority. Webtree, untouched in the past several decades, remains a constant source of confusion, and later in the course selection process, frustration. At first, students are overwhelmed by the non-intuitive user interface. Once Webtree has run, students are then disappointed by the courses they receive. Due to the static nature of Webtree, it is not uncommon for students to receive only one or two courses after an entire run of Webtree (with four courses being a full course-load).

Course scheduling is a common problem for artificial intelligence researchers and much work has gone into efficient ways to assign courses. However, Davidson College's Webtree is a unique problem that has not been studied yet, to our knowledge. Much of the prior research into course scheduling involves placing courses in appropriate classrooms and at appropriate times. Davidson College's course selection is unique because course ceilings are strictly enforced, to ensure that class enrollment sizes are kept small to give students the necessary attention to foster a positive learning environment. Additionally, room selection is rarely an issue at Davidson College because very few classes exceed an enrollment of 30 students, and so most classes can fit into most rooms.

Recently, researchers have been framing the university course selection problem as a constraint satisfaction problem (Sampson, Freeland, and Weiss 1995). Constraint satisfaction problems maximize or minimize an objective function over a set of constraints.

In this section, you should introduce the reader to the problem you are attempting to solve. For example, for the first project: describe the 15-puzzle, and why it's interesting as an A.I. problem. You should also cite and briefly describe other related papers that have tackled this problem in the past — things that came up during the course of your research. In the AAAI style, citations look like (Russell and Norvig 2003) (see the comments in the source file `intro.tex` to see how this citation was produced). Conclude by summarizing how the remainder of the paper is organized.

2 Background

The current system of course selection, Webtree, was designed to allow students to customize their course selections to deal with various contingencies. For example, a student might want a different second course option depending on whether or not he or she successfulling recieved his or her first option. Webtree consists of three binary trees (depth of 3), which are traversed according to an elaborate algorithm. Students' fourth class is ranked in order 1 – 4, and is selected according to availability in that order. For a visual representation of Webtree, as well a chance to imagine the confusion that many students feel when filling it out, see Figure 1)

Describe any background information that the reader would need to know to understand your work. You do not have to explain algorithms or ideas that we have seen in class. Rather, use this section to describe techniques that you found elsewhere in the course of your research, that you have decided to bring to bear on the problem at hand. Don't go overboard here — if what you're doing is quite detailed, it's often more helpful to give a sketch of the big ideas of the approaches that you will be using. You can then say something like "the reader is referred to X for a more in-depth description of...", and include a citation.

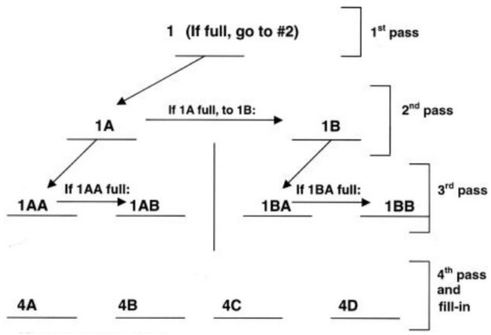

Figure 1: The complicated nature of Davidson College's Webtree. Image courtesy of Davidson College Registrar.

Alternately, you may have designed a novel approach for the problem — your own algorithm or heuristic, say. A description of these would also be placed in this section (use subsections to better organize the content in this case).

3 Experiments

In this section, you should describe your experimental setup. What were the questions you were trying to answer? What was the experimental setup (number of trials, parameter settings, etc.)? What were you measuring? You should justify these choices when necessary. The accepted wisdom is that there should be enough detail in this section that I could reproduce your work *exactly* if I were so motivated.

4 Results

Present the results of your experiments. Simply presenting the data is insufficient! You need to analyze your results. What did you discover? What is interesting about your results? Were the results what you expected? Use appropriate visualizations. Prefer graphs and charts to tables as they are easier to read (though tables are often more compact, and can be a better choice if you're squeezed for space). **Always** include information that conveys the uncertainty in your measurements: mean statistics should be plotted with error bars, or reported in tables with a ± range. The 95%-confidence interval is a commonly reported statistic.

5 Conclusions

In this section, briefly summarize your paper — what problem did you start out to study, and what did you find? What is the key result / take-away message? It's also traditional to suggest one or two avenues for further work, but this is optional.

6 Acknowledgements

Thanks to Jackson Spell for his tip on using pseudo-booleans.

References

Russell, S. J., and Norvig, P. 2003. *Artificial Intelligence: A Modern Approach*. Pearson Education.

Sampson, S. E.; Freeland, J. R.; and Weiss, E. N. 1995. Class scheduling to maximize participant satisfaction. *Interfaces* 25(3):pp. 30–41.