Computer Systems Lab Research Proposal Exploring the Use of Fuzzy Constraint Satisfaction Problems to Evaluate the Happiness of Society.

Peter Ballen

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Abstract

The goal of this project is to explore the use of and solving of fuzzy constraint satisfaction. In this project, I will apply the prinicpals of fuzzy constraint satisfaction to a randomly generated society with the goal of making the digital populace as happy as possible.

Keywords: fuzzy constraint satisfaction, soft constraint satisfaction.

1 Introduction - Elaboration on the problem statement, purpose, and project scope

1.1 Scope of Study

Fuzzy constraint satisfaction problems are similar to regular constraint satisfaction problems, but are far more useful in the real world. Regular constraint satisfaction problems are useful when all constraints are hard and cannot be violated, however they are only capable of finding a perfect solution. If no solution exists, the algorithm will fail. Fuzzy constraint satisfaction problesn are used instead when the constraints are soft. Instead of demanding a perfect solution, it instead searches for an optimal solution that best satisfies the given constraints.

This is incredibly important in the real world because many real problems do not have simple "perfect" solutions. Instead, it becomes necessary to compromise and come up with the best answer. The work done in this project is a simple demonstration of applying this idea to a easily modeled society.

1.2 Type of research

The ultimate goal of this project is not to make a group of imaginary citizens "happy", but to explore the applications and extensions of fuzzy constraint satisfaction problems. The simulated society is useful in this regards as it posesses sufficient complexity to be nontrivial while being simple enough to easily model.

2 Background and review of current literature and research

Lots of work has been invested in regular constraint satisfaction problems. The basis of any constraint satisfaction problem is that there are a number of constraints, formally called tuples, that can be either satisfied or violated. A solution to the problem is one that satisfies every tuple.

The N-Queens problem was first proposed by Max Bezzel. First, imagine an 8x8 chess board (in reality, N can equal any number, but it is easier to imagine a standard-size board for this problem). Next, place eight queens on the board such that no queen is threatening another; that is to say that no two queens are on the same row, column, or diagonal. This forms the basis of a constraint satisfaction problem. There are a large number of tuples (no queen can threaten another) and a solution (the board with eight queens placed on it).

Now imagine the same chess board, but try to place nine queens on it such that no queen threatens another. There is no perfect solution - it is simply impossible. A regular constraint satisfaction problem would be fail miserably. However, a fuzzy constraint satisfaction problem could find an optimal solution so that the lowest number of queens threaten one another. This simple example shows the superiority of fuzzy constraint satisfaction.

3 Procedures and Methodology

We now move onto a more complicated example. Pretend for a moment that every voter could be placed on a two-dimensional axis: Socially conservative/liberal and economically conservative/liberal. Also assume that each point on the graph was identical to every other point at that location. For example, if Alice and Aerith are both at .4 socially and .6 economically, then they have completly identical values. While this is obviously not true in real life, it is a necessary assumption for the purposes of this simluaion. Note that in this example, the two categories are completely independent: where a voter stands on social issues has no baring on where he/she stands on economic issues.

Now, imagine a proposed governmental plan that can be rated on these two axis. A voter is happier with a given proposal when that proposal is "closer" to his position on the political axis. For example, both Alice and Aerith mentioned above would be happy with a proposal that ranks .43 socially and .59 economically. In contrast, they would not favor a proposal that ranks .23 socially and .89 economically.

Now imagine three voters, Alice. Bob, and Carlos. Each voter is located at a different location on the political axis. Using Python, I will create a program that will find a proposal that will satisfy all three voters the most. It is impossible to find a pefect solution, making regular constraint satisfaction techniques. Instead, by making use of fuzzy constraint satisfaction, it will be possible to find the optimal solution that best satisfies all given turples.

4 Expected Results

Given a group of randomly created voters, the code should be able to create a proposal that best satisfies all of the voters.

Although I intend to keep the model relatively simple, the problem could easily be expanded to deal with problems of vastly greater complexity.