Lab 3
Constraint Satisfaction Problem

CSE 4712
ARTIFICIAL INTELLIGENCE LAB

MARCH 6, 2023

Contents

1 Introduction

In this lab, you will create simple CSPs and solve them using the amazing applet provided by AIspace. The code for this lab requires running a Java applet. So you need to have Java installed on your computer.

In Linux, check if Java is installed on your computer by running the following command in the terminal:

```
java -version
```

The output should display the version of the Java package installed on your system. If it does not, you need to install Java Runtime Environment (JRE).

In Windows, you can check if Java is installed by following the instructions below:

- Select Start →Control Panel →Add/Remove Programs

- Here you can see the list of installed software on your computer.

- Check if Java name is listed in the installed software list.

If not, you need to install Java Runtime Environment (JRE).

Files to Edit and Submit: You will create XML files corresponding to the solutions of the tasks provided. You will load them one by one to demonstrate whether they work or not.

Evaluation: Your implementations will be inspected manually.

Academic Dishonesty: We will be checking your implementation against other submissions in the class for logical redundancy. If you copy someone else's files and submit it with minor changes, we will know. We trust you all to show your own work only; please don't let us down. If you do, we will pursue the strongest consequences available to us.

Getting Help: You are not alone! If you find yourself stuck on something, contact us for help. Office hours, Google Classroom, and Emails are there for your support; please use them. We want these labs to be rewarding and instructional, not frustrating and demoralizing. But, we don't know when or how to help unless you ask.

Google Classroom: Please be careful not to post spoilers.

2 Welcome to Consistency Based CSP Solver

Download and open the `constraint.jar` file to start solving CSPs. After opening it, you will be able to load sample CSPs by going to `File -> Load Sample CSP` and choosing the one that you want to load. For example, we have already seen the `Five Queens Problem` in our classes.

There are two tabs in the applet, namely `Create` and `Solve`. In the `Create` tab, you can create new CSPs or edit an existing one. It allows you to create variables, create constraints, connect variables to constraints, select and move the placed objects, delete objects, and set properties. In the `Solve` tab, you can assign values for variables, apply arc consistency, apply backtracking to solve problems, etc.

Play around with the applet to get an idea about how it works. Then formulate and solve the following tasks using it.

3 Question 1 (5 points): Eating Out

Zara (Z), Ismael (I), Fahad (F), and Nancy (N) came to Kacchi-Bhai, a restaurant near their university. The restaurant serves Special Rice (S), Biriyani Rice (B), Kashmiri Naan (K), and Paratha (P). You overhear their conversations, and come up with the following preferences:
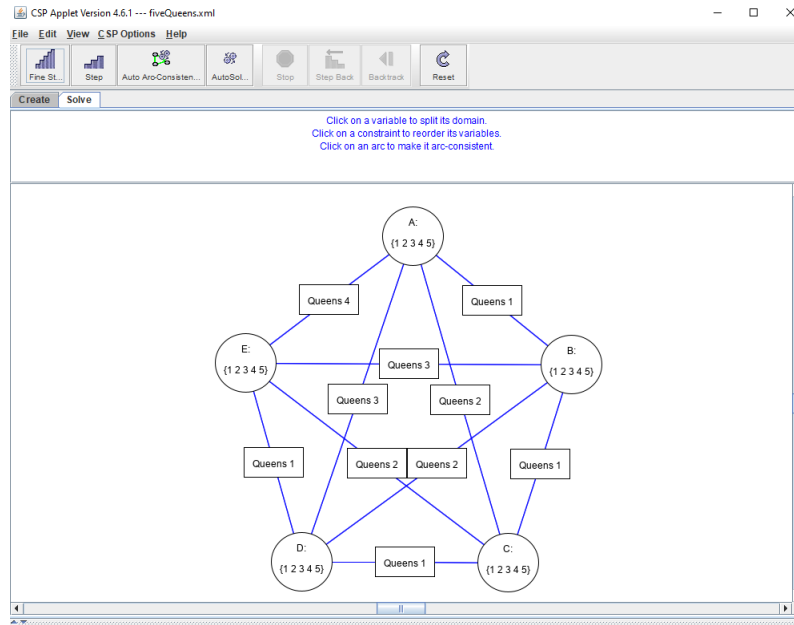
- Zara does not like Paratha.

Figure 1: Five Queens in `constriant.jar` Applet

- Ismael and Fahad want to grab a bite of each other's food. So they want to order different dishes.

- Fahad likes Rice items. So he'll either take Special Rice or Biriyani Rice.

- Zara wants to take a unique dish. However, she loves to copy Ismael and will order the same dish as Ismael.

- Nancy will not order Kashmiri Naan as she had them earlier.

Formulate the problem as CSP and explore the possible solution(s).

4   Question 2 (6 points): Finding Houses

Four people, Ali (A), Shohoz (S), Moinul (M), and Rafi (R) are looking to rent space in an apartment building. There are three floors in the building: 1, 2, and 3 (where 1 is the lowest and 3 is the highest). More than one person can live on a single floor, but each person must be assigned to some floor. The following constraints must be satisfied on the assignment:

- Ali and Shohoz must not live on the same floor.

- If Ali and Moinul live on the same floor, they must both be living on floor 2.

- If Ali and Moinul live on different floors, one of them must be living on floor 3.

- Rafi must not live on the same floor as anyone else.

- Rafi must live on a higher floor than Moinul.

Formulate the problem as CSP and explore the possible solution(s).

5   Question 3 (7 points): Playing Chess

The four-queens puzzle is the problem of placing four chess queens on a 4×4 chessboard so that no two queens threaten each other; thus, a solution requires that no two queens share the same row, column, or diagonal.

Formulate the problem as CSP and explore the possible solution(s).

Hint: The problem looks daunting at first considering the large number of constraints that you have to go through. However, the CSP applet has a trick up its sleeve to specify the constraints. Have a look at how `5 queens problem` is formulated.

6 Question 4 (10 points): Scheduling Tasks

You need to prepare a schedule for two faculty members, X and Y. They need to carry out the following tasks:

(G) Gather contents for Technical Report Writing (TRW) Lab, which takes 1 hour.

(Q) Check quiz scripts, which takes 2 consecutive hours.

(C) Take Artificial Intelligence (AI) class, which takes 1 hour.

(T) Conduct TRW Lab, which takes 1 hour.

(L) Take AI lab, which takes 2 consecutive hours.

The schedule consists of one-hour slots: 8am-9am, 9am-10am, 10am-11am, 11am-12pm. The requirements are as follows:

- At any given time, each faculty member can do at most one task (G, Q, A, T, L).

- The AI class (C) must happen before AI lab (L).

- The contents (G) should be gathered before taking the TRW Lab (T).

- The TRW Lab (T) should be finished by 10 am.

- X is going to gather contents for TRW (G) since s/he's good at browsing contents.

- The other faculty member not conducting TRW lab (T) should attend the lab, and hence cannot do anything else at that time.

- The person taking TRW Lab (T) does not take AI Lab (L)

- The person taking AI Lab (L) must also take the AI class (C)

- Checking quiz scripts (Q) takes 2 consecutive hours and hence should start at or before 10 am.

- Taking AI Lab (L) takes 2 consecutive hours and hence should start at or before 10 am.

Formulate the problem as CSP and explore the possible solution(s).

7 Evaluation

Once you are done with the tasks, call your course teacher and show them your implementations.

8 Submission

Submit one file: `StudentID_L3.pdf` (StudentID will be replaced by your student ID) under **Assignment 3** on **Google Classroom**. The file can contain (but not limited to) screenshots, analysis of the problem, your formulation, explanation of the solutions, any interesting findings, any problems that you faced and how you solved it, behavior of the code for different hyperparameters, etc. All in all, the file is treated as lab report containing your **implementation** and **findings**.

You will have 2 weeks to submit the file.