Mastermind

September 4, 2023

Instructions

In this exercise, we'll be exploring the foundational principles of *propositional logic* and *knowledge engineering*. Propositional logic is a branch of logic that studies ways of joining and/or modifying entire propositions to form more complicated propositions. In knowledge engineering, we use this logical foundation to construct knowledge bases that can be used to make deductions and reason about the world.

The classic game of Mastermind provides a perfect playground for this. Your task is to utilize propositional logic to deduce the correct sequence of colors in the game, given a set of clues. This involves setting up a knowledge base, adding constraints based on the rules of the game, and then using model checking to deduce the correct color sequence.

Let's begin!

1. **Complete the `logic_template.py` file**:
    - Start with the `logic_template.py` file. In this file, you'll encounter placeholders marked 'YOUR CODE HERE'.
    - Your task is to replace these placeholders with the appropriate code. The comments above each placeholder provide hints about what needs to be implemented.
    - Once you've filled in the necessary code, save the file as `logic.py`.
2. **Google Colab Setup**:
    - Go to https://colab.research.google.com/Google Colab.
    - Upload the `mastermind_exercise.ipynb` notebook.
    - Once the notebook is open in Colab, you'll also need to upload the completed `logic.py` file. Use the file upload feature in Colab to do this.
3. **Working with the Jupyter Notebook in Colab**:
    - In the Colab notebook, follow the instructions in each section.

- To utilize the functions and classes from your `logic.py` file, execute the following import statement:

```
from logic import *
```

- Work through the notebook sections as outlined:
  - **Setting Up Symbols**: Define symbols for each color-position combination.
  - **Constraint 1**: Ensure each color occupies one of the four positions.
  - **Constraint 2**: Ensure a color doesn't occupy multiple positions.
  - **Constraint 3**: Ensure a position isn't occupied by multiple colors.
  - **Adding Clues**: Based on provided clues, add logical sentences to the knowledge base.
  - **Model Checking**: Implement the model checking process to deduce the correct sequence of colors.

4. **Finalizing Your Work**:
   - After completing all sections, run all cells in the notebook to ensure there are no errors.
   - You should see the correct deduction of the color sequence.
   - Try modifying the knowledge base (provide different clues) to see how the results of the game change!

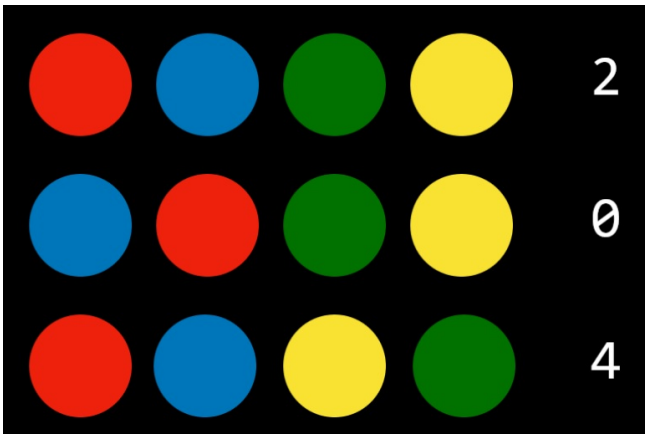

Figure 1: Game of Mastermind: the 4 colors need to be put in the right order