15 Puzzle

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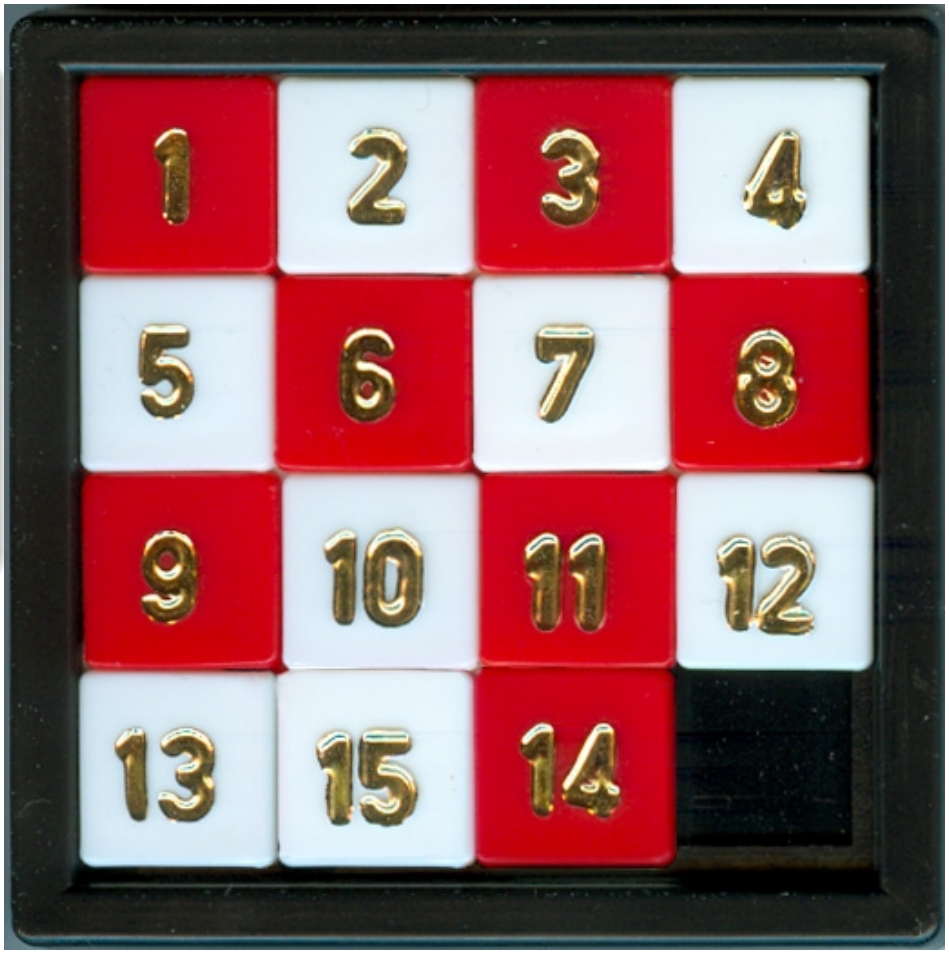
Overview

The 15 Puzzle

Rules

- 4x4 grid of tiles
- 1 empty tile
- tiles adjacent to the empty tile can be moved
- goal is to bring the tiles in order



Goals

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- implement validator to ensure solvable initial state
- implement puzzle solver
- create a web interface

Challenges

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- generating puzzles of different difficulty

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- scalability of encoding
- generating puzzles of different difficulty
- can unique solutions be guaranteed?

Technology Stack

Z3

Encoding Idea

State S for 3x3 puzzle

$S := \{A, B, ..., I\}$ a set of integer variables.
$\forall x \in S$ have $x \in \{0 - 8\}$

A	**B**	**C**
D	**E**	**F**
G	**H**	**I**

Table: State S

Encoding Idea

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Table: State S

Final State S

$S = \{A = 0; B = 1; ...; I = 8\}$ where I is the empty tile.

Encoding Idea

A	B	C
D	E	F
G	**H**	**I**

Table: S

A	B	C
D	E	F
G	**I**	**H**

Table: S'

Exapmple of valid Transition $\{S, S'\}$

$$S_A = S'_A \wedge S_B = S'_B \wedge \ldots \wedge S_G = S'_G \wedge S_H = S'_I \wedge S_I = S'_H \quad (1)$$

Encoding Idea

A	**B**	**C**
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Table: S

A	**B**	**C**
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Encoding Idea

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Table: S

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Exapmple of valid Transition $\{S, S'\}$

$$\wedge S_H = S'_I \wedge S_I = S'_H \qquad (1)$$

Encoding Idea

A	B	C
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Table: S

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Exapmple of valid Transition $\{S, S'\}$

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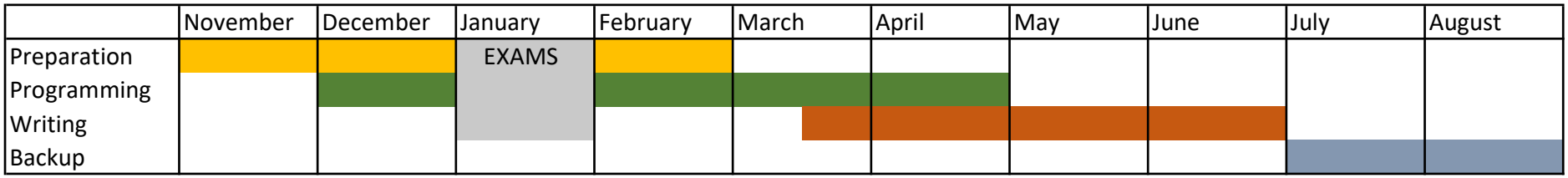
Timetable


November
December
January
February
March
April
May
June
July
August
Preparation
Programming
Writing
Backup
EXAMS

Questions?