COMP90046 Constraint Programming

Peter Stuckey

Critical Information #1

- Lecture times:
  - Mondays 12:00 - 13:00
  - Alan Gilbert 109 (Theatre 2)

- Workshop times:
  - Tuesdays 11:00 - 12:00 Alice Hoy 101
  - Fridays 11:00 - 12:00 Alice Hoy 3.33
  - workshops commence in week 2

Critical Information #2

- Flipped classroom Coursera Course
  - Enrol in Coursera using unimelb account
  - We will enrol you in
    - Basic Modeling Discrete Optimization
    - Advanced Modeling Discrete Optimization
- Each week
  - watch the lecture videos before Monday
  - attempt the workshop questions
- Mondays lecture will involve
  - questions to determine your understanding
  - fill in / revisions / your questions answered
  - group activities to support the material

Week 2 Survey 2A

- Coursera enrolment
  - A: not enrolled
  - B: enrolled
  - C: invited but not enrolled
  - D: enrolled in other cohort: not july 25
  - E:

Week 2 Survey 2B

- How many lectures in Week 1 have you watched
  - A: none
  - B: 1-2
  - C: 3-4
  - D: almost all
  - E: all

Week 2 Survey 2C

- How much of the workshop 0 have you attempted
  - A: none
  - B: 1 question
  - C: 2 questions
  - D: 3 questions
  - E: all

Week 2 Survey 2D

- How much of the workshop 0 have you successfully completed
  - A: none
  - B: 1 question
  - C: 2 questions
  - D: 3 questions
  - E: all

Week 2 Survey 2E

- How much of the MiniZinc tutorial have you read
  - A: none
  - B: some
  - C: chapter 2 in full
  - D: most of it
  - E: all of it

Week 2 Survey 2F

- What does the following MiniZinc model print

```
var 0..3: x;
var 1..4: y;
constraint x = y;
solve satisfy;
```

  - A: x = 0; y = 0;
  - B: x = 1; y = 1;
  - C: x = 2; y = 2;
  - D: x = 3; y = 3;
  - E: =====UNSATISFIABLE=====

Week 2 Survey 2G

- What does the following MiniZinc model print

```
var 0..3: x;
constraint x = x + 1;
solve satisfy;
```

  - A: x = 0;
  - B: x = 1;
  - C: x = 2;
  - D: x = 3;
  - E: =====UNSATISFIABLE=====

Week 2 Survey 2H

- What does the following MiniZinc model print

```
var 0..3: x;
constraint 2*x = x + 1;
solve satisfy;
```

  - A: x = 0;
  - B: x = 1;
  - C: x = 2;
  - D: x = 3;
  - E: =====UNSATISFIABLE=====

Week 2 Survey 2I

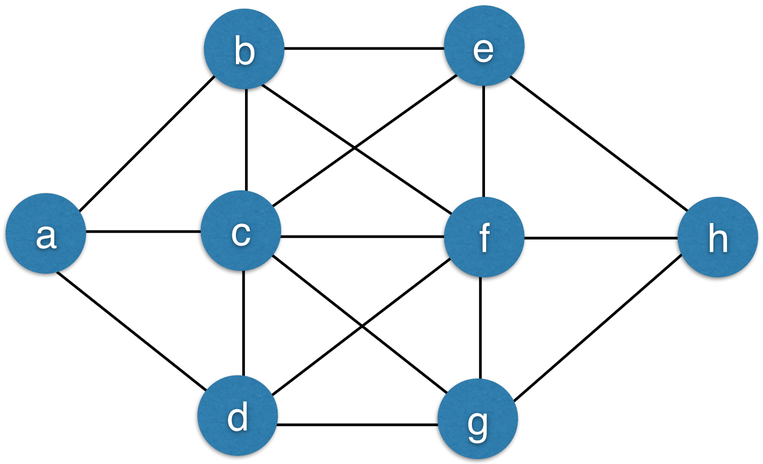
- What does the following MiniZinc model print

```
var 0..3: x;
var 1..4: y;
constraint y = x + 1;
constraint 2*y + 3*x = 12;
solve satisfy;
```

  - A: x = 0; y = 0;
  - B: x = 1; y = 2;
  - C: x = 2; y = 3;
  - D: x = 3; y = 4;
  - E: =====UNSATISFIABLE=====

A graph labelling problem

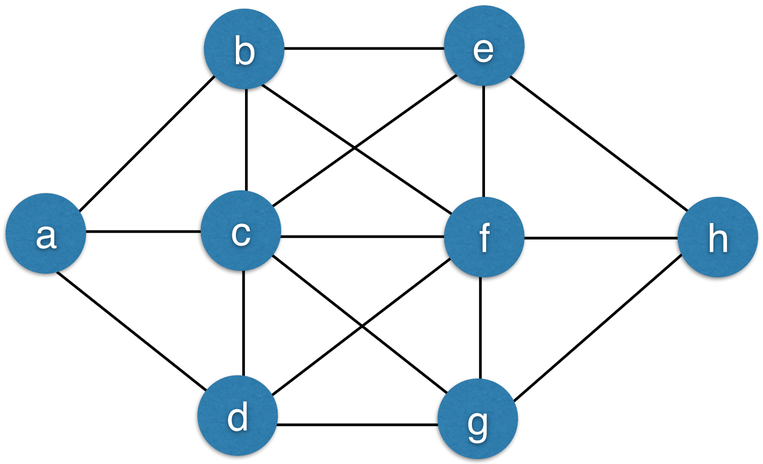
- Label each node in the graph with a different integer from 1 to 8 so that the label of the two endpoints of each edge differ by at least 2



- First solve it by hand

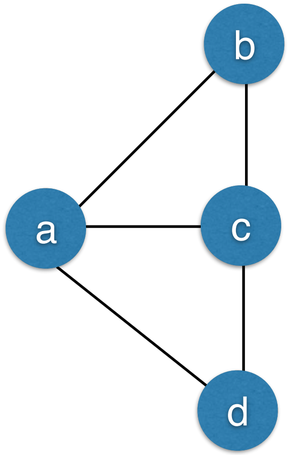
A graph labelling problem in MiniZinc

- Label each node in the graph with a different integer from 1 to 8 so that the label of the two endpoints of each edge differ by at least 2
- Now write a MiniZinc model for it
- Find all solutions



A smaller graph labelling problem in MiniZinc

- Label each node in the graph with a different integer from 1 to 6 so that the label of the two endpoints of each edge differ by at least 2
- Now write a MiniZinc model for it
- Find all solutions



Week 2 Survey 2J

- What does the following MiniZinc model print

```
array[1..10] of var 0..10: x;
constraint forall(i in 1..9)(x[i] < x[i+1]);
constraint x[5] != 5;
solve satisfy;
```

  - A: x = [0,1,2,3,4,5,6,7,8,9];
  - B: x = [1,2,3,4,5,6,7,8,9,10];
  - C: x = array1d(1..10,[0,1,2,3,4,5,6,7,8,9]);
  - D: x = array1d(1..10,[1,2,3,4,5,6,7,8,9,10]);
  - E: =====UNSATISFIABLE=====

Week 2 Survey 2K

- What does the following MiniZinc model print

```
array[1..10] of var 0..10: x;
constraint forall(i in 1..10)(x[i] > x[i+1]);
constraint x[5] != 5;
solve satisfy;
```

  - A: x = [9,8,7,6,5,4,3,2,1,0];
  - B: x = [10,9,8,7,6,5,4,3,2,1];
  - C: x = array1d(1..10,[9,8,7,6,5,4,3,2,1,0]);
  - D: x = array1d(1..10,[10,9,8,7,6,5,4,3,2,1]);
  - E: =====UNSATISFIABLE=====

Planning future power needs

- We are given estimates of future power needs for the next T * 10 years
- We are given the capacity per year of current plants
- We need to decide to build coal, nuclear, or solar power plants to meet the need.
  - Each nuclear plant costs 10B last 60 years and generates 4GW
  - Each coal plant costs 1B lasts 20 years generates 1GW
  - Each solar plant costs 2B lasts 30 years and generates 1GW

Planning future power needs

- We need to ensure that we have enough generation to meet needs
- No more than 40% of electricity can be generated by nuclear
- At least 20% of electricity is generated by solar.

- Sample problem data

```
T = 10;
e = [25, 25, 30, 25, 20, 20, 15, 15, 15, 12];
a = [18, 15, 12, 8, 4, 3, 2, 0, 0, 0];
```

Hand solution?

MiniZinc solution

Week 2 Survey 2L

- How much of Cryptarithm assignment one have you completed.
  - A: WHAT there is an ASSIGNMENT!
  - B: seen it
  - C: thought about it
  - D: tried it
  - E: finished it.

Checklist

- Things to be done
  - Check you can access the LMS page
  - Read the course handout
  - Download and MiniZinc and the MiniZincIDE
    - www.minizinc.org
  - Enrol in Coursera (www.coursera.org) using your unimelb account
  - Use the invitation to enrol in the private cohort: July 25 —