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Weeks 1 and 2

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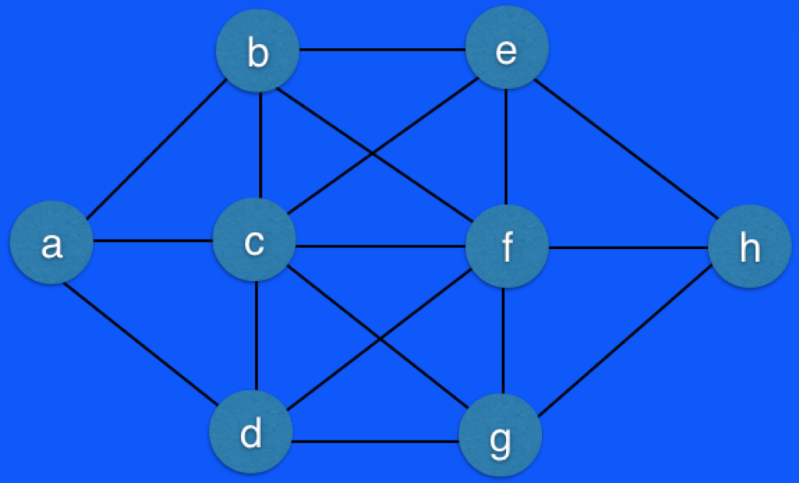
Let's look at Survey 1

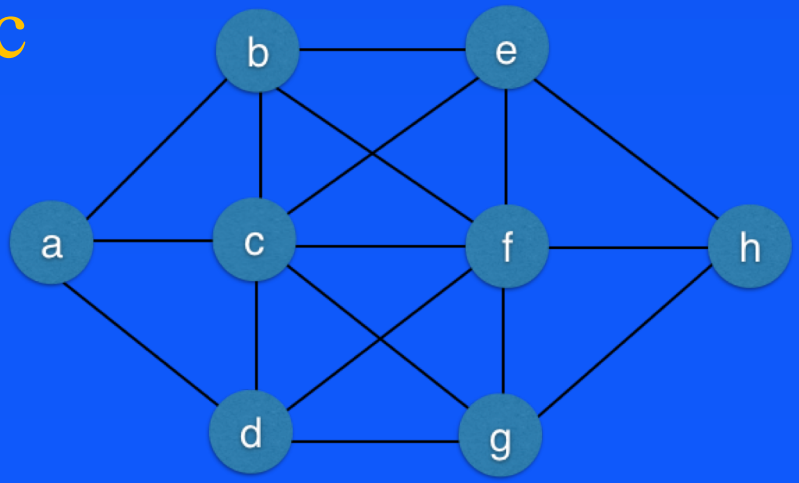
Graph Labeling

- 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
- Solve it by hand first!



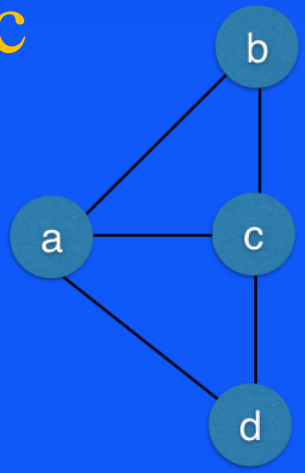
Graph Labeling

- 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
- Find all solutions



A Smaller Graph

- 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
- Find all solutions



In-class Survey

- What would the following 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=====

In-class Survey

- What would the following 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

- Given estimates of future power needs (demands and planned) for the next T * 10 years
- Given the capacity per year of current plants
- Decide to build coal, nuclear, or solar power plants to meet the needs
  - A nuclear plant costs 10B, last 60 yrs and generates 4GW
  - A coal plant costs 1B, lasts 20 yrs and generates 1GW
  - A solar plant costs 2B, lasts 30 yrs 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];
```

- Minimize cost

Manual (Hand) Solution?

MiniZinc Solution

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Let's look at Survey 2

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Teammate Selection

- Xavier, Yuri, and Zena each have to pick indoor soccer teams from the players:
  - Goalies: Ant, Bee
  - Defence: Chu, Deb, Eve, Fin
  - Offence: Ged, Hel, Ila, Jan, Kim
- Each team has to have one goalie, two defences, and two offences and one reserve (of any type)

Teammate Selection (cont'd)

- The teams of Xavier and Yuri can only have two common members, similarly for Xavier and Zena
- Each captain has a perceived value of each player. Choose the teams which maximise the total perceived value of all capatains

```
value = [| 2, 5, 6, 8, 9, 5, 8, 7, 7, 4, 6
         | 9, 8, 4, 7, 6, 4, 5, 3, 5, 5, 7
         | 8, 4, 3, 3, 6, 2, 5, 5, 3, 2, 5 |];
```

Manual (Hand) Solution?

MiniZinc Solutions

- Using set variables
- Using arrays

Who is a Knight?

- On the island of knights and knaves you meet three brother natives who say
  - Larry: I am a knight like my brother Liam
  - Liam: At least one of us is a knave
  - Tim: All my brothers whose name starts with T are knights

A: [no, no, yes] B: [yes, yes, no]

C: [no, no, no] D: [yes, yes, yes]

E: [yes, no, yes]

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Build a MiniZinc model to answer!

More Knights and Knaves

- Island of tall and short knights and knaves
  - tall knights and short knaves always speak truth
  - short knights and tall knaves always lie
- You meet a short and tall native, they say
  - X: my partner is a knight
  - Y: we are both knights
- Who is which???

More Knights and Knaves

- A: X is a tall knight, Y is a short knight
- B: X is a tall knave, Y is a short knight
- C: X is a short knight, Y is a tall knave
- D: X is a short knave, Y is a tall knight
- E: X is a short knight, Y is a short knight

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Build a MiniZinc model to answer!