CS149 Introduction to Combinatorial Optimization

Problem 1

There are 5 girls in a long row in math class.¹ Each girl has a favourite chocolate bar, colour, pet, hobby, and would like to go on a certain holiday. All the girls like different things. Your task is to use the following clues to determine who owns the crocodile.

- Hannah likes the wispa bite
- The person with the hamster likes swimming
- Jo eats dairy milk
- Jessica is on the left of Georgina
- Lucy is the first on the left
- The first person on the right likes swimming
- The person who eats Milky Bars owns a horse
- The person in the middle eats Dairy Milk
- Jessica likes green
- The person on the left of the middle wants to go to Tobago
- The person who wants to go to the Maldives likes lilac
- The person who likes Wispa Bites sits next to the person who wants to go to Florida
- The person who likes pink wants to go to Florida
- the person who sits first on the left likes lilac
- The girl that likes blue owns a puppy
- The person who likes skiing sits next to the person who has a hamster
- The girl on the right of the girl who likes tennis likes horse riding
- The girl next to the girl who likes Milky bar likes Boost
- The girl who likes purple wants to got to Canada
- The girl who likes Crunchies owns a rabbit
- The girl who likes skiing sits next to the girl who plays ten-pin bowling
- Jessica wants to go to Australia

Assume All Diff constraint is present.

¹This puzzle was created by pupils from Wadebridge School in Cornwall.

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Problem 2

Consider the set of variables x_1, x_2, \ldots, x_n . Some variables have already taken a value. That is, there is a set $I \subseteq \{1, 2, \ldots, n\}$ such that $x_i = c_i$ for all $i \in I$ (the c_i s are known). Show that we can decide in polynomial time where there exists an assignment of the values in $\{0, 1, \ldots, n^5\}$ to the rest of the x_i s such that for all $i = 1, 2, \ldots, n-1$ we have $x_{i+1} \ge x_i^2 - 2x_i + 3i^2 - 5i$. For extra credit, solve the same problem, but with a slightly different constraint replacing the

For extra credit, solve the same problem, but with a slightly different constraint replacing the old ones: $x_{i+1} \ge x_i^2 - 2x_{i-1} + 3i^2 - 5i$ for $2 \le i \le n-1$. The sole difference is replacing $-2x_i$ with $-2x_{i-1}$ and updating the range of i to avoid referencing the non-existant x_0 .

Problem 3

Find an assignment of digits to letters (each letter gets a different number) to make the equation work. Is your solution unique?