CS4530: Modelling and Problem Solving
Homework 1

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This homework is encouraged but optional. It is designed to be completed individually. A solution sketch is provided. The questions refer to MiniZinc and the solutions are provided in MiniZinc; you can use CPMpy if you prefer. ©2024 TU Delft

Exercise 1

Consider the famous arithmetic puzzle: `SEND + MORE = MONEY`.

Your task is to find distinct digits for the letters such that the equation holds. (Neither `S` nor `M` may be zero.) Write a constraint model in MiniZinc to solve the puzzle. Find the solution.

Now consider the puzzle: `SEND + MOST = MONEY`.

Again write a constraint model in MiniZinc to solve the puzzle. Find a solution (there are more than one).

Now introduce a new problem variable `money`. Constrain `money` to be the sum of the letters `MONEY`. How big can `money` be at most, i.e., which initial domain can you give for the variable `money`?

Find the solution to the puzzle that has the largest value for `money`.

Models can be found at: `https://tinyurl.com/ipa19cp`

Exercise 2

Try the sudoku model found at `https://tinyurl.com/ipa19cp` with some of the different `sudoku_*` data files. Which solver works best?

Try replacing the `alldifferent` global constraint with a set of pairwise inequality constraints. How does it affect performance?

Exercise 3

Consider the following investment problem:

Project name	Value	Budget (k)	Personnel
Ischia	6000	35	5
Speltra	4000	34	3
Hotel	1000	26	4
Restaurant	1500	12	2
ContoA	800	10	2
ContoB	1200	18	2
Scuola	2000	32	4
Dago	2200	11	1
Lago	900	10	1
small	3800	22	5
Iper	2900	27	3
Bivio	1300	28	2
Tela	800	16	2
Idro	2700	29	4
Batment	2800	22	3

Available is a 225K budget, 28 persons, and at most 9 projects can be chosen. Which is the best combination of projects?

Consider the additional constraints about prohibited or required project combinations:

Project name	Value	Budget	Personnel	Not With	Require
Ischia	6000	35	5	10	-
Speltra	4000	34	3	-	-
Hotel	1000	26	4	-	15
Restaurant	1500	12	2	-	15
ContoA	800	10	2	6	-
ContoB	1200	18	2	5	-
Scuola	2000	32	4	-	-
Dago	2200	11	1	-	7
Lago	900	10	1	-	-
small	3800	22	5	1	-
Iper	2900	27	3	15	-
Bivio	1300	28	2	-	-
Tela	800	16	2	-	2
Idro	2700	29	4	-	2
Batment	2800	22	3	11	-

Which is the best combination of projects now?

Solution to similar problem available at `https://tinyurl.com/ipa19cp`