

GWV – Grundlagen der Wissensverarbeitung

Tutorial 7: Constraint Satisfaction

Exercise 7.1: (Constraints)

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| |
| of |
| 12 |

- Formalize this riddle in the form of a constraint network, with the constraints being reasonably small. (I.e. writing a single constraint is not a good solution!) In the following pattern each letter stands for a digit so that the resulting sum is correct. (4 Pt.)

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  S E N D
  M O R E
  =====
M O N E Y

```

- Manual constraint solving.

| | D1 | D2 | D3 |
|----|----|----|----|
| A1 | | | |
| A2 | | | |
| A3 | | | |

Crossword puzzles are often used in newspapers because they provide joy in solving semi-complex problems by combining logics and human experience. For the crossword above we want to find 6 words of length 3 that fit into the 3×3 table in a way that 3 words can be read horizontal from left to right and 3 words can be read vertically from top to bottom. Choose the words from the following list:

add, ado, age, ago, aid, ail, aim, air,
 and, any, ape, apt, arc, are, ark, arm,
 art, ash, ask, auk, awe, awl, aye, bad,
 bag, ban, bat, bee, boa, ear, eel, eft,
 far, fat, fit, lee, oaf, rat, tar, tie.

First, try to solve the problem without any formal methods or tools. How do you approach this problem as a human? (It is not necessary to give a full solution to the problem at this point, but you should report on the strategies you employ as a human and the problems you encounter.) (1 Pt.)

- Solve the problem by hand using *domain consistency* as a first step and as a second step the *arc consistency*. **Document this process thoroughly.** (3 Pt.)

*Hint: Executing the **arc consistency** algorithm by hand you will be faced with a lot of non-deterministic choices. Though the algorithm will terminate correctly regardless of these choices, the time it takes to do so may vary greatly. To keep you from executing a lot of processing steps by hand, you may choose whatever option you think will be most beneficial. (In a way you can act as an intelligent heuristic for the algorithm.)*

- Implement the **arc consistency** algorithm (found in sect. 4.5 of Poole and Mackworth (2010)) along with a suitable representation of the problem to solve this puzzle. (4 Pt.)

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Achievable score on this sheet: 12*