

Artificial Intelligence – Exercise 3

Task 1: Constraint-Programming

Describe briefly how the following solving heuristics for CSPs work. Distinguish them from each other. In which problems (in which solving phase) does the heuristic work best? Estimate the run time of the heuristics and explain your results.

1. Minimum Remaining Value
2. Degree Heuristic
3. Least Constraining Value

Task 2: Cryptoarithmic Puzzle

The following cryptoarithmic problem is given. Each number from 0 - 9 can only be assigned to at most one letter. As per usual with cryptoarithmic puzzles, leading zeros are prohibited.

1. State a representation of the puzzle as a constraint problem with all constraints and value ranges for the variables.
2. Solve the problem and describe the path to solution. State the individual steps according to the presented techniques for constraint problem solving (MRV-Heuristic, Degree-Heuristic, Edge-consistency, Global Constraints, Forward Checking, Guessing by Depth-First-Search). Use the table below to record your solution steps.

$$\begin{array}{rcccccc} & & & S & E & N & D \\ + & & & M & O & R & E \\ \hline = & M & O & N & E & Y \end{array}$$

Technik	S	E	N	D	M	O	R	Y	X_1	X_2	X_3	X_4

Task 3: Propositional Logic

Decide if the following sentences are valid, unsatisfiable or neither of them. Check your answers using a truth table.

1. $Smoke \vee Fire \vee \neg Fire$
2. $(Smoke \Rightarrow Fire) \wedge \neg Fire \wedge Smoke$
3. $(Smoke \Rightarrow Fire) \Rightarrow (\neg Smoke \Rightarrow \neg Fire)$
4. $((Smoke \wedge Heat) \Rightarrow Fire) \Leftrightarrow ((Smoke \Rightarrow Fire) \vee (Heat \Rightarrow Fire))$

Task 4: CNF

Rewrite the following formula in the conjunctive normal form (CNF):

$$A \Leftrightarrow (B \vee \overline{C})$$

Task 5: Resolution

Check using the target literal **Fun** the following sentences. First convert them to the CNF, then use resolution on the facts.

1. $Wind \Rightarrow FlyKite$
2. $Child \wedge FlyKite \Rightarrow Fun$
3. $Wind \wedge Child$