CORK INSTITUTE OF TECHNOLOGY
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Computing@CIT

DECISION ANALYTICS.

Lab04: Boolean Satisfiability and Planning

BACKGROUND.

In Lecture 8 we looked at the following problem:

You find yourself on the shore of a river with a wolf, a sheep, and a cabbage. You can only take a maximum of one of these with you on the boat. Obviously you want to ferry all across, so you need to make multiple journeys back and forth. The problem is, if you leave the wolf and the sheep unattended, the wolf will eat the sheep. Also, if you leave the sheep and the cabbage alone on one shore, the sheep will have eaten the cabbage when you return.

Your task:

Come up with a plan how to ferry all three over the river, never leaving wolf and sheep or sheep and cabbage unattended.

(Hint: it will take 8 crossings to reach the other side of the river with the sheep and the cabbage unharmed)

Task 1.

Write a Python program that creates a CP-SAT model and adds all Boolean variables necessary for representing the predicates required for this problem to this model.

Task 2.

Formulate the initial and goal state in terms of the variables created in task 1 and add them to the CP-SAT model as constraints.

Task 3.

Create the additional Boolean variables required to model the operators of this problem and add them to the CP-SAT model.

Task 4.

Formulate the pre- and post-conditions for all operators defined in task 3 and add the resulting operator encodings to the CP-SAT model.

Task 5.

Formulate the frame axioms for the predicates defined in task 1 and add them as constraints to the CP-SAT model.

Task 6.

Formulate the complete exclusion axioms for the operators defined in task 3 and add them as constraints to the CP-SAT model.

Task 7.

Formulate the additional constraints that neither the wolf and the sheep nor the sheep and the cabbage can ever be left alone and add them as constraints to the CP-SAT model.

Task 8.

Implement a CpSolverSolutionCallback that prints out the sequence of operations indicated by the variables identified in task 3. Run the solver for the model and print out the results.

How many different solutions do you get?