

1 Artificial Intelligence (SBH)

EvilRobot has two dogs called Fido and Fifi. All three of them enjoy pie and sausages so much that they like to steal them. At the beginning of the day the butcher has some sausages and the pieShop has some pie. Also, EvilRobot and his pets are at home, but they aim to end the day having relieved the local businesses of their products.

- (a) Give a detailed definition of a *Constraint Satisfaction Problem (CSP)*. Include in your answer a definition of what it means for an assignment to be *consistent* and to be *complete*, and for an assignment to be a *solution*. [4 marks]
- (b) Consider the constraint C on four variables $\{V_1, V_2, V_3, V_4\}$ each of which has the domain $\{\text{true}, \text{false}\}$, with

$$C = \{(\text{true}, \text{true}, \text{true}, \text{true}) \\ (\text{true}, \text{false}, \text{true}, \text{false}) \\ (\text{false}, \text{true}, \text{false}, \text{false}) \\ (\text{false}, \text{false}, \text{false}, \text{true}) \\ (\text{false}, \text{false}, \text{true}, \text{true})\}.$$

Explain how this constraint can be replaced by a collection of binary constraints having an identical effect. [3 marks]

- (c) Describe the *state-variable representation* for planning problems. Illustrate your answer by showing how the action of EvilRobot (or one of his pets) stealing something could be represented in the scenario set out at the beginning of this question. [5 marks]
- (d) Explain how the *state* of a planning problem can be represented in the state-variable representation. [2 marks]
- (e) Using your example of the stealing action provided in part (c), explain how this planning problem might be translated into a CSP. You should include in your explanation examples of the translation for actions, state variables, and action preconditions and action effects, but you need not describe the translation for frame axioms. [6 marks]