**Unit 4 Algorithmics**

**SAC 3 – Outcome 3**

Answer all questions on lined paper.

1. “The barber in Seville shaves all men who do not shave themselves, and only those men. Does the barber shave himself?” Explain the problem behind this question, and how it was part of the crisis facing mathematics in the early 20th century. (2 marks)
2. Describe key features of a Turing machine. (3 marks)
3. State what the Halting Problem sought to find. (1 mark) (NOT CONCLUSION)
4. Explain Turing’s argument which shows that the Halting Problem is undecidable. (3 marks)
5. What is the significance of Turing’s conclusion for the entscheidungsproblem? (2 marks) SHOULD BE 1??
6. Rajesh argues that we could change the design of our hypothetical Halting machine so that the paradox does not arise. Explain why this does not affect the conclusion of the Halting Problem. (1 mark) ADDRESS HIM SPECIFICALLY
7. With reference to our knowledge of other minds, discuss whether or not it is reasonable to believe that a computer is sentient (conscious) in light of the Chinese Room Argument. Make sure that you present a balanced discussion. (3 marks)

Question 6 to 9 relate to the following case study.

The government has decided to use artificial intelligence in order to predict the probability of criminals reoffending, and hence whether or not to release them from prison early. They have gathered data on 50,000 offenders, including: age, sex, ethnicity, nature of offence committed, history of offending and religious belief.

The outcomes we aim to predict (and are known for our training data) are:

1. whether or not the person reoffended during the two years following their release
2. if so, what was the seriousness of that offence, on a binary scale – serious or minor.
3. Explain how a binary classification SVM could be best constructed to solve this problem. (2 marks)
4. We find that the margin generated is very small BUT THERE IS A HIGH DEGREE OF ACCURACY WITH TRG DATA. What problem does this indicate? Explain how this problem could cause our SVM to make an incorrect prediction. (2 marks)
5. How would a neural network allow us to generate a more nuanced model? Answer specifically to the scenario as stated. (1 mark)
6. Discuss the ethical issues that are raised by using artificial intelligence in this way when compared to using human judgement (i.e. a parole board, usually comprised of three people). Explain whether the issues you discuss are more likely to arise for a neural network or a SVM. You should consider transparency, bias, fairness and human dignity. (5 marks)