**18.03.2003**

# Evolutionary Computation BLG602E

## Midterm Exam

In the Boolean satisfiability problem (SAT), the task is to make a compound statement of Boolean variables evaluate to TRUE.

For example consider the following problem of 16 variables given in conjunctive normal form:

$$F = (x_5 \vee \overline{x}_{12} \vee x_{16}) \wedge (\overline{x}_4 \vee \overline{x}_6) \wedge (x_2 \vee x_{13} \vee \overline{x}_7 \vee \overline{x}_9 \vee \overline{x}_{14}) \wedge (x_1 \vee \overline{x}_8 \vee x_{11} \vee x_{15}) \wedge (x_3 \vee \overline{x}_{10})$$

Here the task is to find the truth assignment for each variable $x_i$ for all $i = 1, 2, ....., 16$ such that $F = TRUE$.

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**1.** *(15 points)* What is the size of the search space? If the number of variables in the SAT problem increases, why would it be a good idea to use a heuristic search technique to solve it?

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**We want to use a genetic algorithm to solve the above given 16 variable SAT problem example.**

**2.** *(15 points)* Choose an encoding and representation for individuals. Explain the reason of your choice and show an example individual.

**3.** *(25 points)* Design an evaluation function to determine how good each solution candidate is. Explain why you chose this evaluation method and calculate the fitness of an example individual using the evaluation function you designed.

**4.** *(25 points)* Choose the necessary parameters and operators and give the pseudocode of the genetic algorithm you designed for the solution of the above given 16 variable SAT problem. (**Note:** Use a proportional selection method.)

**5.** *(20 points)* In later generations of the genetic algorithm you designed in the previous questions, what problems can you encounter due to all individuals in the population becoming similar? What can you do to remedy these problems? Explain.

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