UNIVERSITETET I OSLO

Faculty of Mathematics and Natural Sciences

Exam in:	**INF3490/4490 — Biologically Inspired Computing**
Day of exam:	**December 1st, 2011**
Exam hours:	**14:30 – 18:30**
This examination paper consists of 3 pages.	
Appendices:	**None**
Permitted materials:	**None**

Make sure that your copy of this examination paper is complete before answering.

Problem 1

1a (weight 4%)

Mark each of the following statements as true or false. (+1% for each correct answer, –1% for each incorrect answer)

(i) Genetic Algorithm (GA) is a randomized parallel search algorithm, based on the principles of natural selection, the process of evolution.

(ii) GAs are exhaustive, giving out all the optimal solutions to a given problem.

(iii) GAs are used for solving optimization problems and modeling evolutionary phenomena in the natural world.

(iv) Under any circumstances, GAs always outperform other algorithms.

1b (weight 4%)

If all of the crossover operations between chromosomes in a generation do not produce significantly different offspring (given that each offspring consist of one half of each parent), what does it imply?

Mark each of the following statements as true or false. (+1% for each correct answer, –1% for each incorrect answer)

(i) The crossover operation is not successful.

(ii) The population is converging to a solution.

(iii) Diversity is so poor that the parents involved in the crossover operation are similar.

(iv) The search space of the problem is not ideal for GAs to operate.

1c (weight 4%)
State the importance of No Free Lunch Theorem.

1d (weight 7%)
Five strings have the following fitness values: 3, 6, 9, 12, 15. Under Roulette wheel selection, compute the expected number of copies of each string in the mating pool if a constant population size, n = 5, is maintained.

1e (weight (6% + 4%))
State the similarities and differences between genetic algorithm (GA) and evolutionary strategies (ES).

What are the meanings of $(\mu + \lambda)$-ES, and (μ, λ)-ES?

1f (weight 5%)
Explain the concept of domination for two solutions (x and y) of a multi-objective optimization problem (MOOP).

1g (weight 4%)
Why is parent selection not an issue in evolutionary programming (EP)?

1h (weight (4% + 4%))
Describe the general scheme of an interactive evolutionary computation (IEC) algorithm. In which situations would IEC be appropriate, and why?

Problem 2

2a (weight 6%)
Mark each of the following statements regarding artificial neural network as true or false. (+1% for each correct answer, –1% for each incorrect answer)

(i) The training time depends on the size of the network.
(ii) They only use forward connections.
(iii) Neural networks are inspired by the way the human brain works.
(iv) They are suited for real time operation due to their high computational rates.
(v) They are not fault tolerant.
(vi) They have the ability to learn by examples.

2b (weight 8%)
Explain how a gradient descent algorithm can be used to train Multi-Layer Perceptrons (MLPs).

2c (weight 7%)
Why do we use early stopping in back-propagation training? How do you know when to stop?

2d (weight 6%)
Explain k-fold cross validation.

2e (weight 7%)
An economics consulting firm has created a model to predict recessions. The model predicts a recession with probability 80% when a recession is indeed coming and with probability 10% when no recession is coming. The unconditional probability of falling into a recession is 20%. If the model predicts a recession, what is the probability that a recession will indeed come?

(Hint: You can check whether Bayes' rule is applicable to predict the situation)

2f (weight 7%)
What are the support vectors? Why they are important?

2g (weight (6% + 3%))
Describe Bayes' optimal classification and maximum a posteriori (MAP) in classification.

Why is Bayes' optimal classification better than maximizing the posterior probability in the case of classification?

2h (weight 4%)
Discuss the three essential learning processes for self organizing map (SOM).

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