

SGN-13000/SGN-13006 Introduction to Pattern Recognition and Machine Learning  
Department of Signal Processing, Tampere University of Technology  
Exercise 1

Be prepared for the exercise sessions. You may ask TA questions regarding your solutions, but don't expect them to show you how to start from the scratch. Before the end of the session, demonstrate your solution to TA to receive exercise points.

**1. Machine learning applications and formal description (30 points)**

- (a) Define two applications which should be solvable by machine learning (but not traditional computing) and two which are probably not or which are extremely hard to solve.  
Don't use the applications mentioned during the lectures and justify your answers.
- (b) For the two applications for which solutions are supposed to exist, define the task (T), performance measure (P) and learning experience (E).
- (c) In context of machine learning, define/describe the following terms (check Ref.[1]):
  - (a) Prior information / prior knowledge
  - (b) Training data/set
  - (c) Evaluation data/set (Ref[1], page 17)
  - (d) Test data/set
  - (e) Overfitting
  - (f) Supervised Learning
  - (g) Unsupervised learning
- Ref. [1] <http://people.cs.pitt.edu/~milos/courses/cs2750-Spring03/lectures/class2.pdf>
- (d) Why mathematical models - for example probability distribution functions - are used in machine learning? I.e. what does the model stand for? Why it is very difficult if not impossible to implement a machine learning application without any mathematical model?

**2. 2D linear model with more than two training points (30 points)**

- (a) During the lectures, we derived a solution of a linear model for two points. We also started to sketch a solution for  $N$  points - continue that.
- (b) Implement your solution in Matlab and test it with several points (Hint: *figure; axis([0 5 0 5]); ginput(5);* can be used to open a figure, define axes between 0,5 and to give five (or any number) 2D points).