

T-61.3050 PROBLEMS 10/2007

In T1 on 23 November 2007 at 10 o'clock.

You should solve the problems before the problem session and give the solved problems to the assistant. Please write clearly and leave a wide (left or right) margin. The solutions should be stapled together **with a cover sheet** containing your name, student number and the numbers of problems you have solved.

For the problems where a “correct” solution exists (math and algorithm questions) the assistant will present one possible solution during the session. In some cases the questions do not have a single correct answer, but the idea is that you think about the problem and are prepared to discuss it with the assistant and other students during the session.

See <http://www.cis.hut.fi/Opinnot/T-61.3050/2007/problems> for up-to-date information of the problem sessions.

1. (a) Show that the derivative of the sigmoid function is $\text{sigmoid}'(t) = \text{sigmoid}(t)(1 - \text{sigmoid}(t))$.
 - (b) Show that the derivative of the cost function (negative log-likelihood) is $\partial\mathcal{L}(W)/\partial w = \sum_{t=1}^N (y^t - r^t)x^t$ and $\partial\mathcal{L}(W)/\partial w_0 = \sum_{t=1}^N (y^t - r^t)$, where $y^t = P(r^t = 1 \mid x) = \text{sigmoid}(wx + w_0)$ and $w, w_0, x^t \in \mathbb{R}$.
 - (c) Sketch a binary classification data of the form $\mathcal{X} = \{(r^t, x^t)\}_{t=1}^N$, with a sigmoid function that would best fit the data. How could you interpret the fitted sigmoid function?
2. Consider the lectures given so far and come up with *three* suitable examination questions related to their contents. The first question should be of the form: “Explain in about two or three sentences the following concepts: a) X, b) Y, c) Z”. The second one should deal with a single topic but in more detail. It may have multiple parts, but could also be one smallish essay, for example. The final question should be similar to the ones discussed in the weekly problem sessions. Answering it should probably involve some mathematics. Some of your questions might appear in the examination!

BONUS! This is not a problem, but just a reminder to think about topics for the recap lecture on December 11. Send us topics that we should emphasize on the recap lecture (or on earlier lectures or problem sessions), as well as any calculations etc. that you would like that we would go through in more detail.