Lecture Graphical Models
`https://ml01.zrz.tu-berlin.de/wiki/Main/SS09_GraphicalModels`
Machine Learning Group, TU Berlin

Instructors: Dr. Ulf Brefeld, Dr. Marc Toussaint
Tutor: Tobias Lang, `lang@cs.tu-berlin.de`

Sheet 9

Due: 30 June 2009

1. Predicting with a structured SVM

In sheet 7, you had to learn and apply a HMM to predict the labels of the sentences in the "Spanish News Wire" data-set. This time please use a structured SVM for this task. Note that in this case you have to make use of the features. Compare your SSVM results to your HMM results.

You may use the implementation of a structured SVM called SVM^{hmm} which you find at `http://svmlight.joachims.org/svm_struct.html`.

2. Relation to logistic regression

Please show that conditional random fields generalize logistic regression. In particular, take a look at the CRF given in slide 22 of lecture 9. We are interested in the special case of binary classifiction, i.e. $Y \in \{+1, -1\}$. Then, the joint feature map is given by

$$\Phi(\mathbf{x}, y) = (\, [[y = +1]]\psi(\mathbf{x})^T,\ [[y = -1]]\psi(\mathbf{x})^T \,)^T \,.$$

In your proof, from the CRF formulation you have to derive the logistic regression function

$$P(Y = +1|\mathbf{x}, \hat{\mathbf{w}}) \,.$$

3. Dual formulation of SSVM optimization

In slide 7 of lecture 9, you are given the primal formulation of the optimization problem for a structural soft-margin SVM. Please derive the dual formulation as given in slide 19 of lecture 9. To do so, you may want to use the Lagrangian given in slide 16 and the partial derivatives provided in slides 17 and 18.