Machine Intelligence 1 **Exercise Sheet 11**
WS 2016/17, Obermayer/Böhmer due: 26.01.2017

Message Passing

Exercise T11.1: Message passing (tutorial)

(a) What is a tree and what is a bipartite graph?

(b) How can a conditional marginal be expressed by a bipartite tree?

(c) Explain at an example (Lecture 3.2, p. 18) how marginalization can be performed.

(d) How can all marginals be computed simultaneously by three message passes?

(e) Formulate the *sum-product algorithm* for message passing.

Exercise H11.1: The grand classification challenge (homework, 10 points)

Note: this exercise can be handed it in groups of up to 3 students (see instructions below).

The file `digits.zip` provided on ISIS contains training and test images of handwritten digits.

- Each row describes one of the 28x28 pixel sample-images (see a few examples below).
- For the training set, the first number represents the target class (i.e. 0-9).
  For the testset, these assignments are random and can be ignored.
- The remaining numbers define the image in a sparse representation, i.e., by giving pairs of `PixelID:GrayValue` where black pixels (`GrayValue`=0) are not explicitly listed. To import the data in python, you can use e.g. `svm_read_problem` from `svmutil` (see the website of `libsvm` listed in H8.2 of Ex. 8), in R: `read.matrix.csr` from the package `e1071` reads data in sparse matrix format. The function `loaddigit` for Matlab can be found on ISIS.

(a) (2 points) Download the datasets and visually inspect a few of the images. Plot the first 12 training images with their labels.

(b) (3 points) Take a classification algorithm of your choice (e.g. MLPs, C-SVMs, KNN) and use the training data to find the (hyper) parameters that will allow you to optimally predict new example digits. Prepare a short presentation (as PDF file) of your algorithm / training strategy and how well it performed on the training data.

(c) (2-15 points) Predict the class labels for the images from the test dataset and submit them by email until the 26th of January, 10 am (see note below). The achieved points will depend on the test-accuracy:

- Anybody who achieved accuracy above 75% earns 2 points.
- Anybody who achieved accuracy above 85% earns 5 points.
- Anybody who achieved accuracy above 90% earns 10 points.
- All winners of the challenge (rounded down to 2 digits) receive additional 5 points!

Submission of test-results by email:
Results can be submitted in groups up to 3 students. Each group must have a unique name (e.g. `YourGroupName42`). This name may only contain Latin characters and numbers. Blank spaces, underscores, slashes and arithmetic signs are explicitly forbidden. All group members must be able to present their results at the tutorial. The email to `mailto:wendelin@ni.tu-berlin.de` must have a subject containing `MI1_challenge` and your group's name. The email itself must contain all group members' names and a short one-sentence description of the employed method. The predicted labels of the test set must be attached as a text-file, named after your group with the ending `.txt`, e.g. `YourGroupName42.txt`. The text-file must have 500 rows and contain only the class labels in the sequence matching the images in the test-set.

Total 10 points.

Note: This exercise sheet counts as 10 points, but allows you to earn up to 20 points.