CS412/CSC2506 Project Proposal

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I. Introduction

For the course project, we propose to compare different Probabilistic Graphical Model *learning algorithms* in terms of their speed, performance and memory. Specifically, we plan to follow the approach described in [1].

We plan to implement and compare the following learning algorithms on the same graphical model using the same dataset:

- Iterated Conditional Modes (ICM)
- Exact EM
- Gibbs Sampling EM
- Variational EM
- Structured Variational EM
- Sum Product EM

The target application for this project is foreground/background segmentation, where the foreground and background images come from a pre-defined library. In this case, the graphical model is built around four sets of variables:

- f: class index for the foreground
- m: a binary mask ($m_i = 1$ indicates that pixel z_i is a foreground pixel)
- b: class index for the background
- z: the observed pixel intensities

II. Dataset

Parallel to the problem described in [1], we have generated a similar dataset where each image consists of randomly picking a background image and a foreground image and paste them together.

Fig. 1. Background images

Fig. 2. Foreground images

Fig 1 shows the background images used, fig 2 shows the foreground images used, and fig 3 shows some of the generated images. Only the generated combined images are presented to our model and are used for model learning.

Fig. 3. Samples of combined images

III. Additional Resources

In addition to [1], the following papers also provide some details on the different learning algorithms:

- Dempster, A.P.; Laird, N.M.; and Rubin D.B., Maximum Likelihood from Incomplete Data via the EM Algorithm, Proc. Royal Statistical Soc., vol. 39, pp. 1-38, 1977.
- Kschischang, F.R.; Frey B.J.; and Loeliger H.-A., Factor Graphs and the Sum-Product Algorithm, IEEE Trans. Information Theory, special issue on codes on graphs and iterative algorithms, vol. 47, no. 2, pp. 498-519, Feb. 2001.

References

[1] Frey, B.J.; Jojic, Nebojsa, "A comparison of algorithms for inference and learning in probabilistic graphical models," Pattern Analysis and Machine Intelligence, IEEE Transactions on , vol.27, no.9, pp.1392,1416, Sept. 2005.