Differentiable Feature Selection with Concrete Autoencoders

Abubakar Abid
Muhammed Fatih Balin
James Zou

Poster: Thu Jun 13th 06:30 - 09:00 PM @ Pacific Ballroom #188
Unsupervised Feature Selection (UFS) is Widely Used in Machine Learning

- Identify the **subset** of most informative features in dataset
- **Simplifies** the process of training models
- Especially useful if the data is **difficult** or **expensive** to collect
Unsupervised Feature Selection (UFS) is Used Widely in Applied ML

- Example: the **L1000 Landmark Genes** [Lamb et al., 2006]
UFS Methods Typically Rely on Regularization

Unsupervised Discriminative Feature Selection (UDFS)  
[Yang et al., 2011]

Multi-Cluster Feature Selection (MCFS)  
[Cai et al., 2010]

Autoencoder Feature Selection (AEFS)  
[Han et al., 2017]

All based on $L_1$ or $L_{21}$ regularization
What about **directly backpropagating** through discrete “feature selection” nodes?
What about **directly backpropagating** through discrete “feature selection” nodes?

Replace the weights of the encoder with parameters of a **Concrete Random Variable** (Maddison, 2016)

---

*Differentiable Feature Selection and Reconstruction with Concrete Autoencoders*
Results on the ISOLET dataset (reconstruction error)
Results on the ISOLET dataset (classification accuracy)

![Graph showing reconstruction error and classification accuracy for different numbers of features selected on the ISOLET dataset](image-url)
Concrete Autoencoder (CAE) Genes Outperform the L1000 Landmark Genes!

![Graph showing Reconstruction error (lower is better) over Number of genes selected by CAE. The CAE-Selected Genes line shows a lower error than the 943 Landmark Genes line.](image)
Concrete Autoencoder Takeaways

- More effective than other feature selection methods based on regularization
- Implementation is just a few lines of code from a standard autoencoder
- Training time is similar to standard autoencoder per epoch
- Can be extended to supervised/semi-supervised settings
Start using concrete autoencoders today!

*Installation:* `pip install concrete-autoencoder`

*Code:* [https://github.com/mfbalin/Concrete-Autoencoders](https://github.com/mfbalin/Concrete-Autoencoders)

*For more details and results:*

Poster: Thu Jun 13th 06:30 - 09:00 PM @ Pacific Ballroom #188

Contact: a12d@stanford.edu, fatih.balin@boun.edu.tr