Active Learning and Regularization

SRP Pitch by Ilia

Link to the slides

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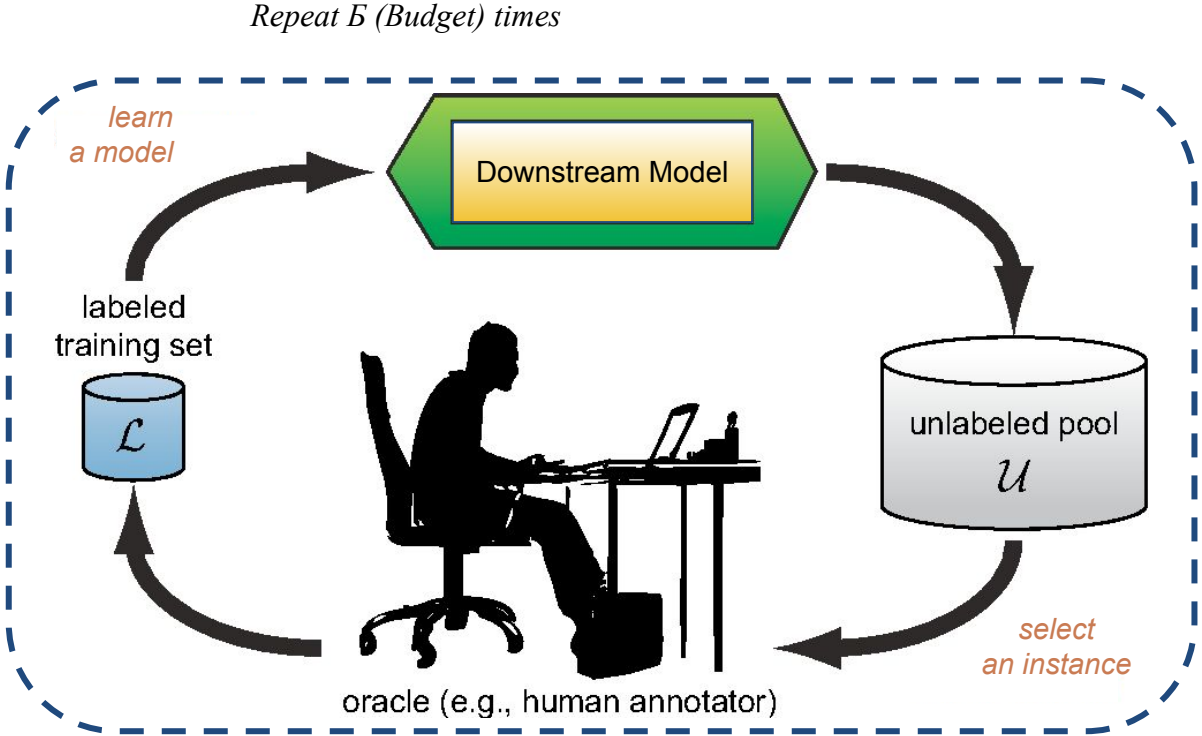
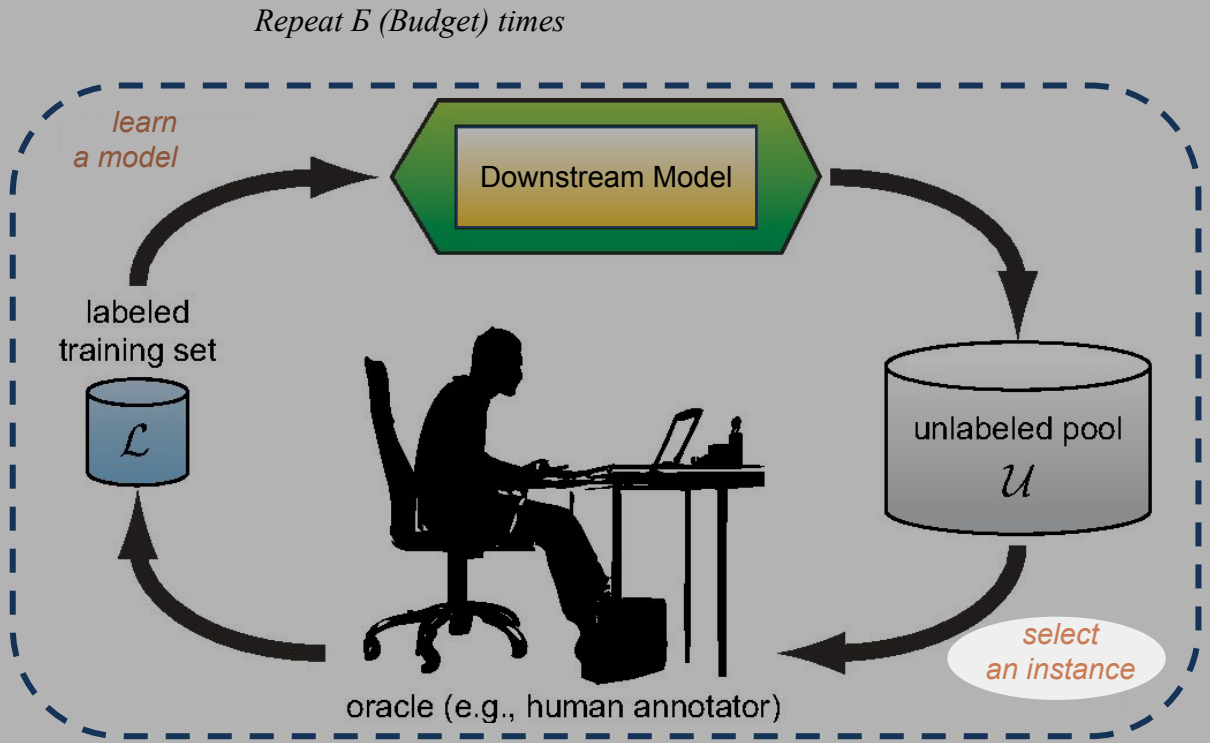
Active Learning



High Level Visualization of pool-based AL
[Settles, 2009]



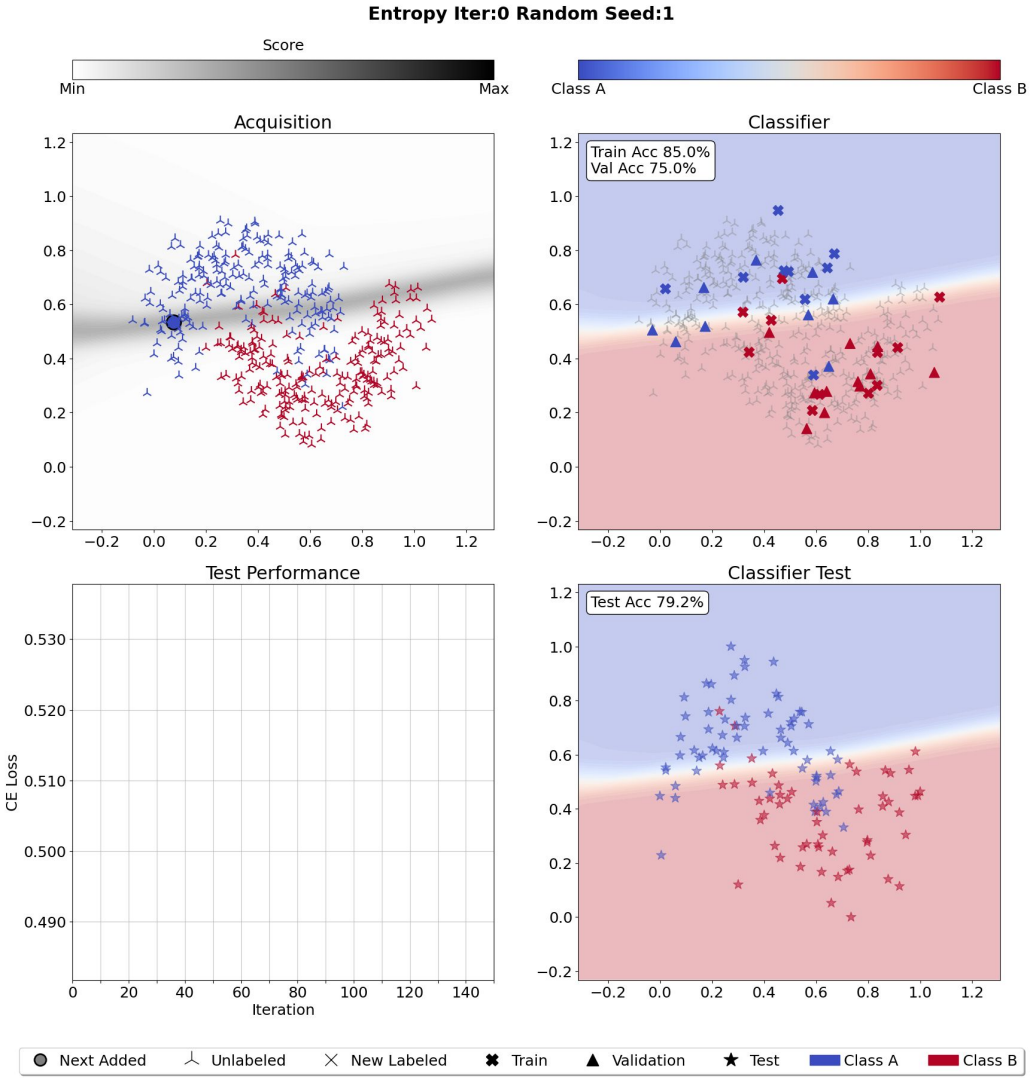
Active Learning

High Level Visualization of pool-based AL
[Settles, 2009]

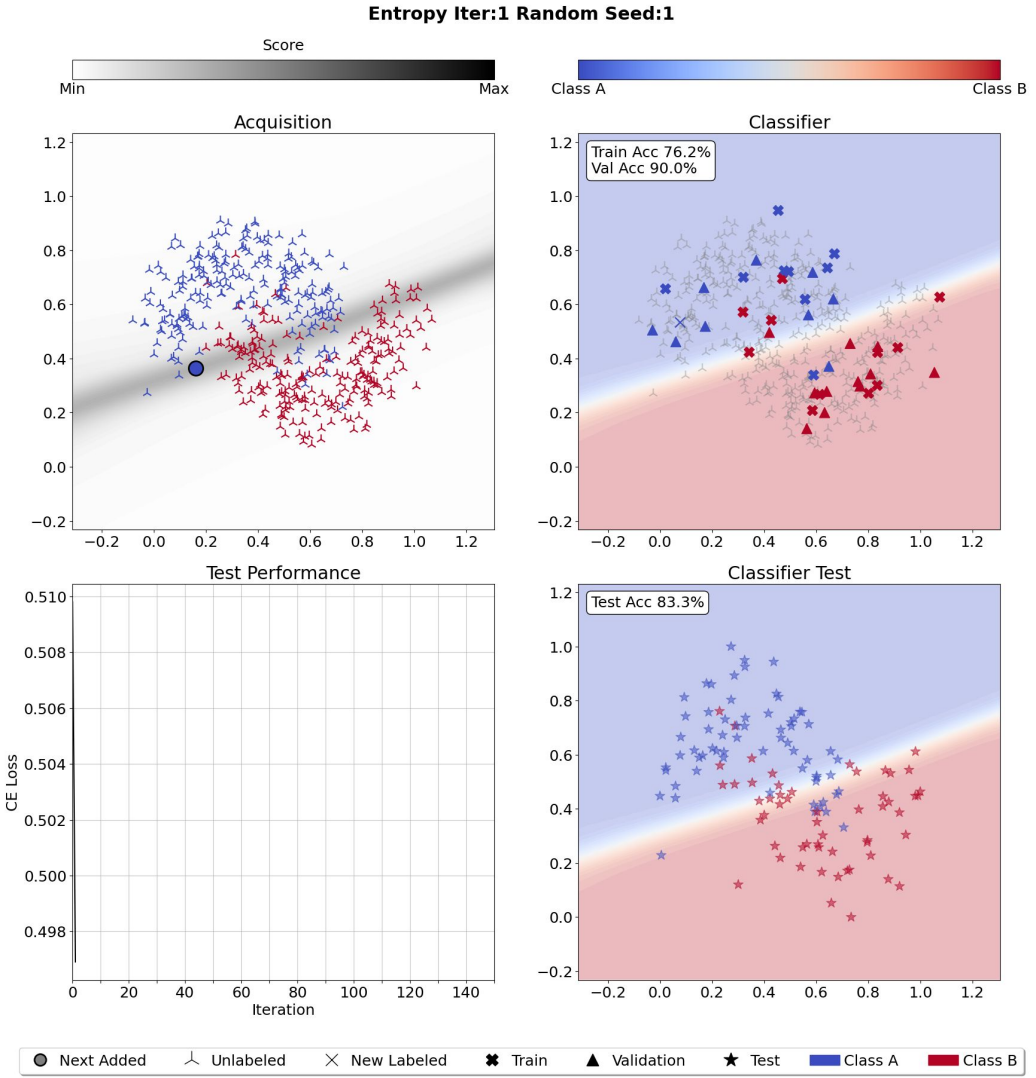
Acquisition Function — a scoring criterion Φ used to select the most informative instance x^* from an unlabeled pool $\mathcal{U}$ for labeling to improve a downstream model $\mathcal{M}$ the most. If there are multiple instances with equal scores, one of them is selected randomly using a uniform distribution.

$$x^* \sim \text{Uniform}(\{x \in \mathcal{U} \mid \Phi(x, \mathcal{M}) = \max_{x \in \mathcal{U}} \Phi(x, \mathcal{M})\})$$

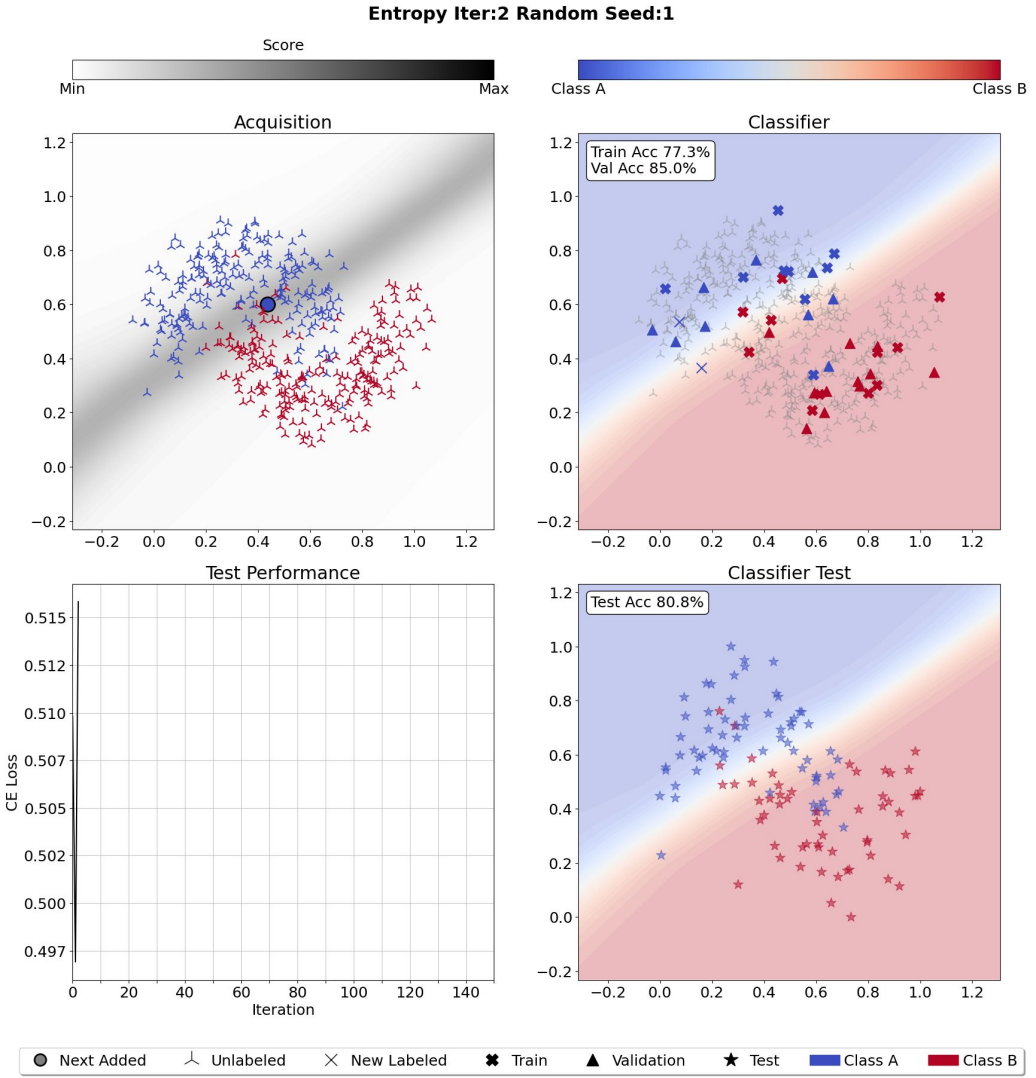
Active Learning



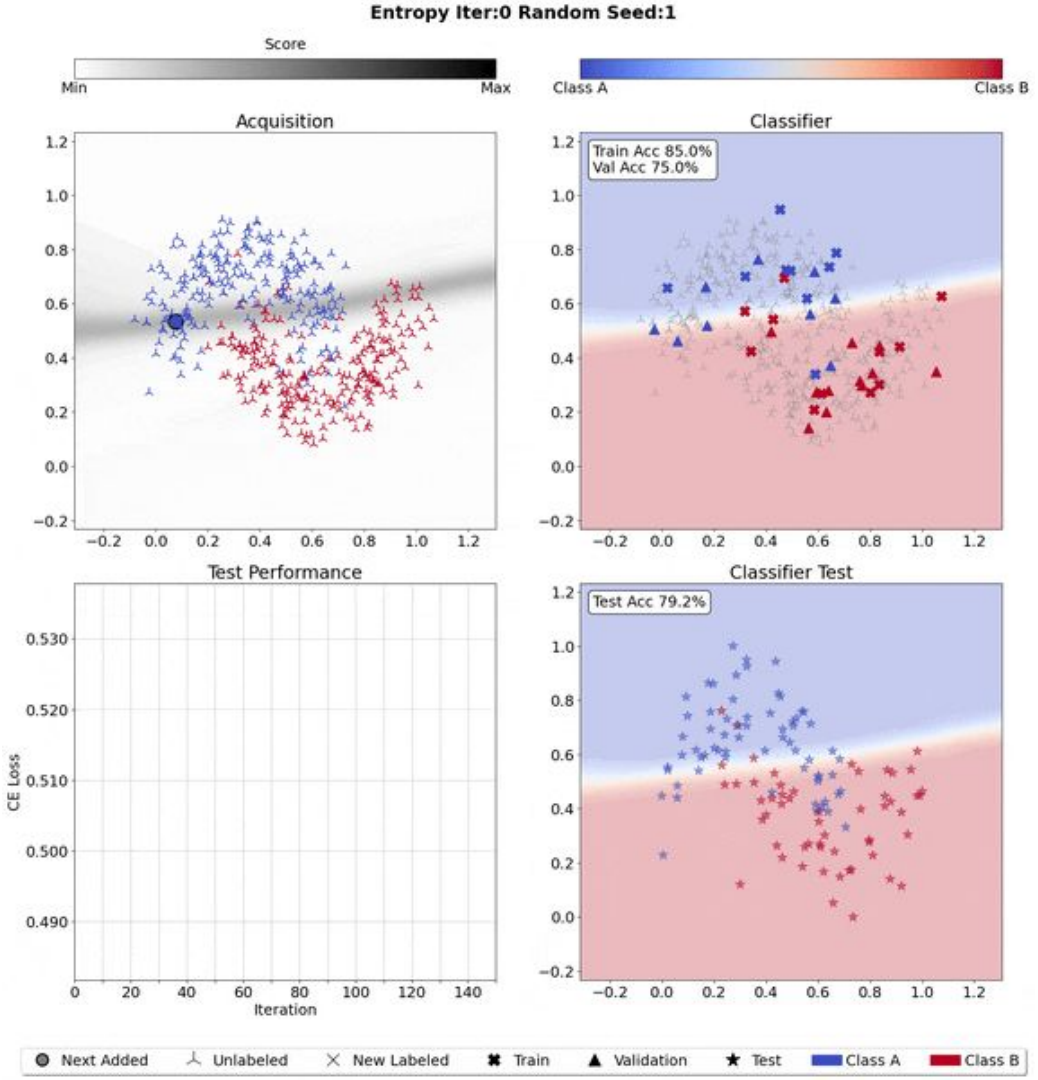
Active Learning



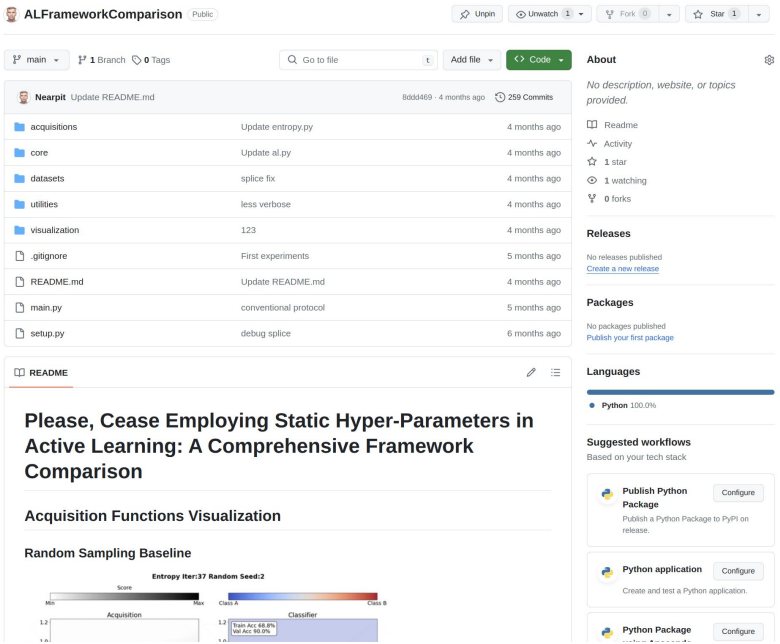
Active Learning



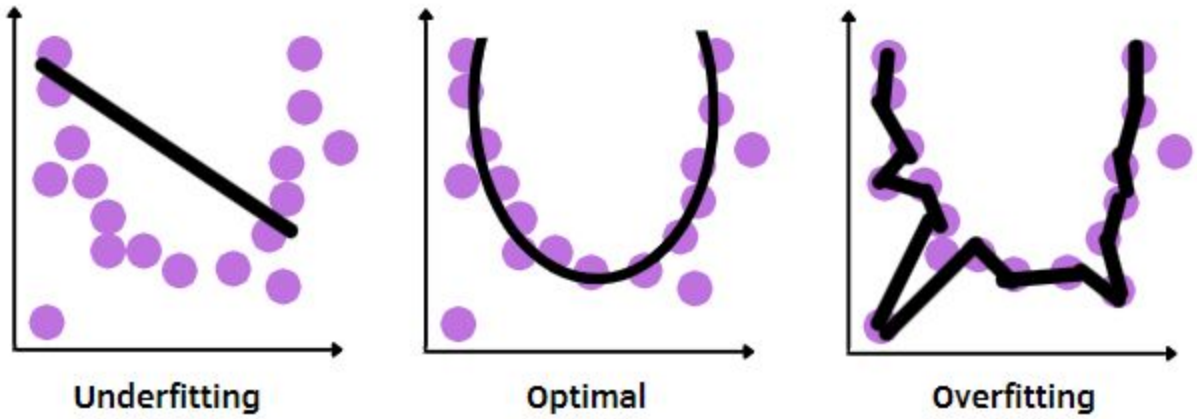
Active Learning



GitHub Repository with more examples



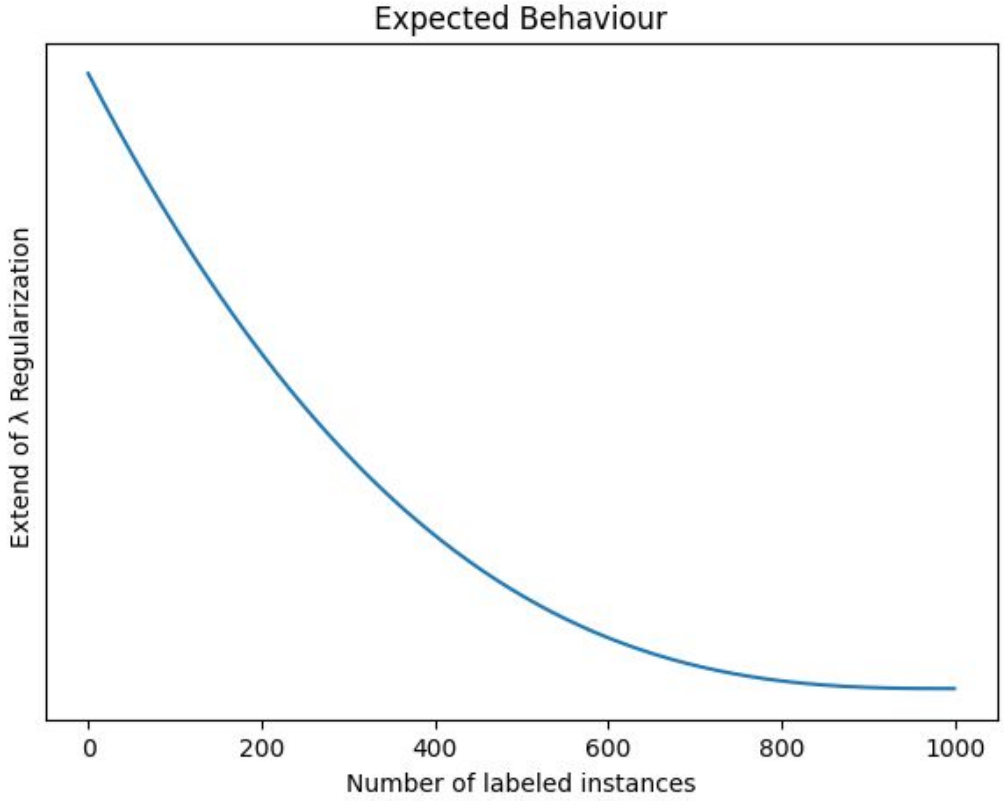
https://github.com/Nearpit/ALFrameworkComparison



(model is too simple)

(model is too complex and captures even noise in the data)

Regularization



Current Hypothesis

Desirable Result/Goal

Build a new acquisition function that relies on regularization

Preliminary work – Get aware of the problem's domain

1. **ANY PAPER YOU find suitable** – keep in mind, it's your research experience
2. Overall AL – [Settles, 2009]
3. AL Training protocol – [Munjal et al., 2022]
4. Acquisition families:
    a. Ensembles – [Beluch et al., 2018]
    b. Uncertainty-based:
        i. Entropy/Margin/etc… – [Settles 2009]
        ii. BALD&DBAL – [Gal et al., 2017]
    c. Geometrical-based:
        i. Core-set – [Sener and Savarese, 2018]
        ii. TypiClust – [Hacohen et al., 2022]

Data&Model Domain:

Path A:

1. Computer Vision **Embeddings** (raw data is computationally intractable on our cluster)
   a. CIFAR10/CIFAR100
2. Models
   a. Embedding retrieval
      i. ResNet/DinoV2
   b. Predictions
      i. Simple Linear Layer
3. Pros
   a. Much simpler to implement
   b. More generic approach
4. Cons
   a. Many pitfalls since I have never implemented it myself
   b. Less applicative in the real-world scenario

Path B:

1. Raw Tabular Data
   a. Spline, DNA, Synthetic Datasets, etc…
2. Models
   a. MLP
   b. ResNet [He et al., 2015]
   c. FT-Transformer [Gorishny et al,. 2023]
      SAINT [Somepalli et al., 2021]
   d. [Optional] XGBoost [Chen and Guastrin 2016]
3. Pros
   a. You'll get aware more about the State of the Art in the Tabular domain
   b. I will help you with it (my research domain)
4. Cons
   a. More challenging topic
   b. Much more coding

Data&Model Domain:

Path C:

1. Any domain **YOU** are intrinsically connected to
    a. Up to you
2. Any model **YOU** find fascinating and great performing
    a. Up to you
3. Pros
    a. Huge amount of experience(i.e. you will learn a lot)
    b. You'll be ready for any Industrial/PhD task
4. Cons
    a. HUMONGOUS amount of pitfalls
    b. It requires a lot of time investment

Desirable Result/Goal

Build a new acquisition function that relies on regularization

*and have some fun

Reminder:

Don’t forget to choose you topic preferences on Monday–Tuesday

Literature

- Beluch, William H., Tim Genewein, Andreas Nurnberger, and Jan M. Kohler. “The Power of Ensembles for Active Learning in Image Classification.” In 2018 IEEE/CVF Conference on Computer Vision and Pattern Recognition, 9368–77, 2018. https://doi.org/10.1109/CVPR.2018.00976.
- Gal, Yarin, Riashat Islam, and Zoubin Ghahramani. “Deep Bayesian Active Learning with Image Data.” arXiv, March 8, 2017. https://doi.org/10.48550/arXiv.1703.02910.
- Gorishniy, Yury, Ivan Rubachev, Valentin Khrulkov, and Artem Babenko. “Revisiting Deep Learning Models for Tabular Data.” arXiv, November 10, 2021. https://doi.org/10.48550/arXiv.2106.11959.
- Hacohen, Guy, Avihu Dekel, and Daphna Weinshall. “Active Learning on a Budget: Opposite Strategies Suit High and Low Budgets.” arXiv, June 16, 2022. https://doi.org/10.48550/arXiv.2202.02794.
- Munjal, Prateek, Nasir Hayat, Munawar Hayat, Jamshid Sourati, and Shadab Khan. “Towards Robust and Reproducible Active Learning Using Neural Networks.” arXiv, June 15, 2022. https://doi.org/10.48550/arXiv.2002.09564.
- Sener, Ozan, and Silvio Savarese. “Active Learning for Convolutional Neural Networks: A Core-Set Approach.” arXiv, June 1, 2018. https://doi.org/10.48550/arXiv.1708.00489.
- Settles, Burr. “Active Learning Literature Survey.” Technical Report. University of Wisconsin-Madison Department of Computer Sciences, 2009. https://minds.wisconsin.edu/handle/1793/60660.
- Somepalli, Gowthami, Micah Goldblum, Avi Schwarzschild, C. Bayan Bruss, and Tom Goldstein. “SAINT: Improved Neural Networks for Tabular Data via Row Attention and Contrastive Pre-Training.” arXiv, June 2, 2021. https://doi.org/10.48550/arXiv.2106.01342.