

SelectiveNet: A Deep Neural Network with an Integrated Reject Option



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Abstract

- We discuss the problem of selective prediction in DNN (also known as reject option).
- The proposed architecture jointly learns the classifier and the rejection function.
- SOTA results for classification and regression compared to MC-dropout and Softmax Response

Selective Prediction

Selective classifier is a pair (f, g):

$$(f,g)(x) = \begin{cases} f(x), & \text{if } g(x) = 1; \\ \text{don't know}, & \text{if } g(x) = 0. \end{cases}$$

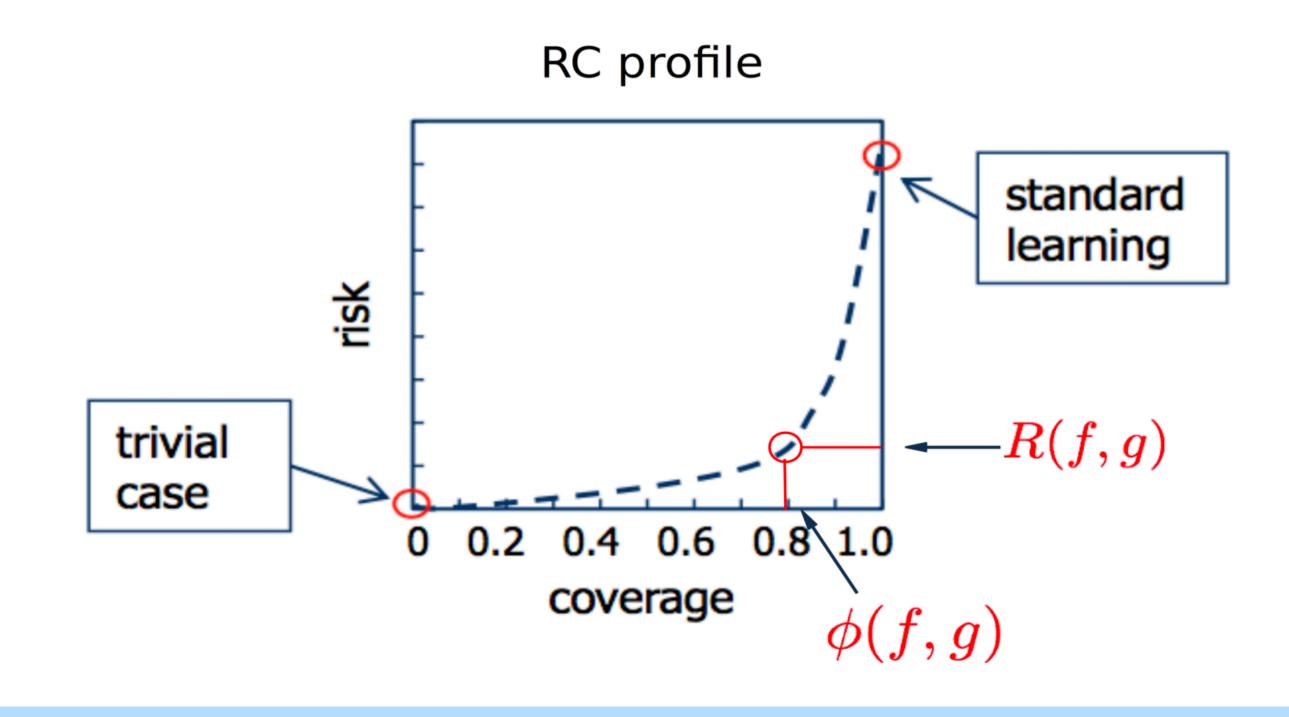
Coverage:

$$\phi(g) = E_P[g(x)]$$

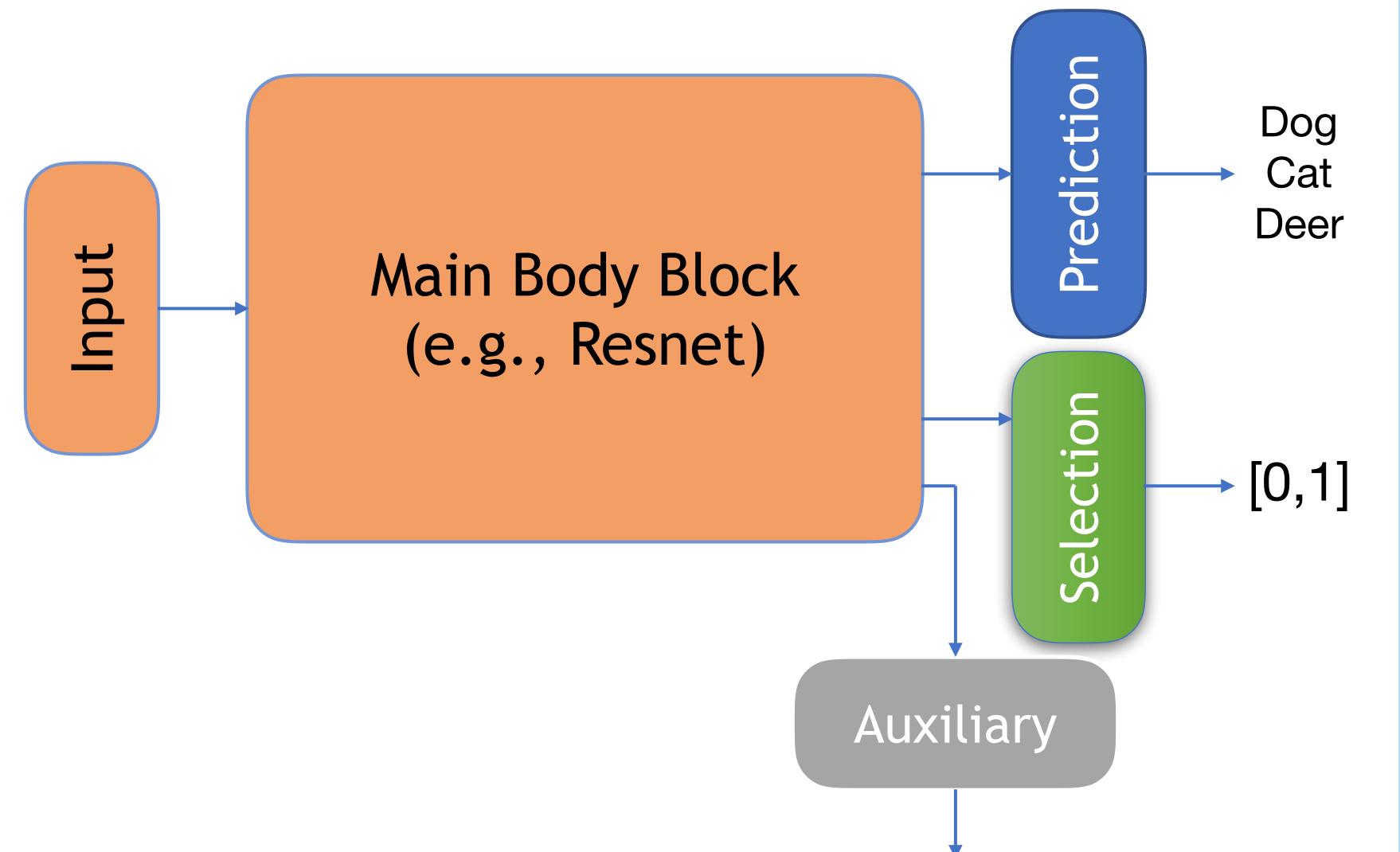
Selective Risk:

$$R(f,g) = \frac{E_P[\ell(f(x),y)g(x)]}{\phi(g)}$$

Risk coverage (RC) profile:



Architecture and Optimization



Optimization inspired by interior point methods

Constrained optimization problem:

$$\theta^* = \arg\min_{\theta \in \Theta} (R(f_{\theta}, g_{\theta}))$$

$$s.t. \ \phi(g_{\theta}) \ge c.$$

Unconstrained empirical objective:

$$\mathcal{L}_{(f,g)} = \hat{r}_{\ell}(f,g|S_m) + \lambda \Psi(c - \hat{\phi}(g|S_m))$$

$$\Psi(a) = \max(0,a)^2$$

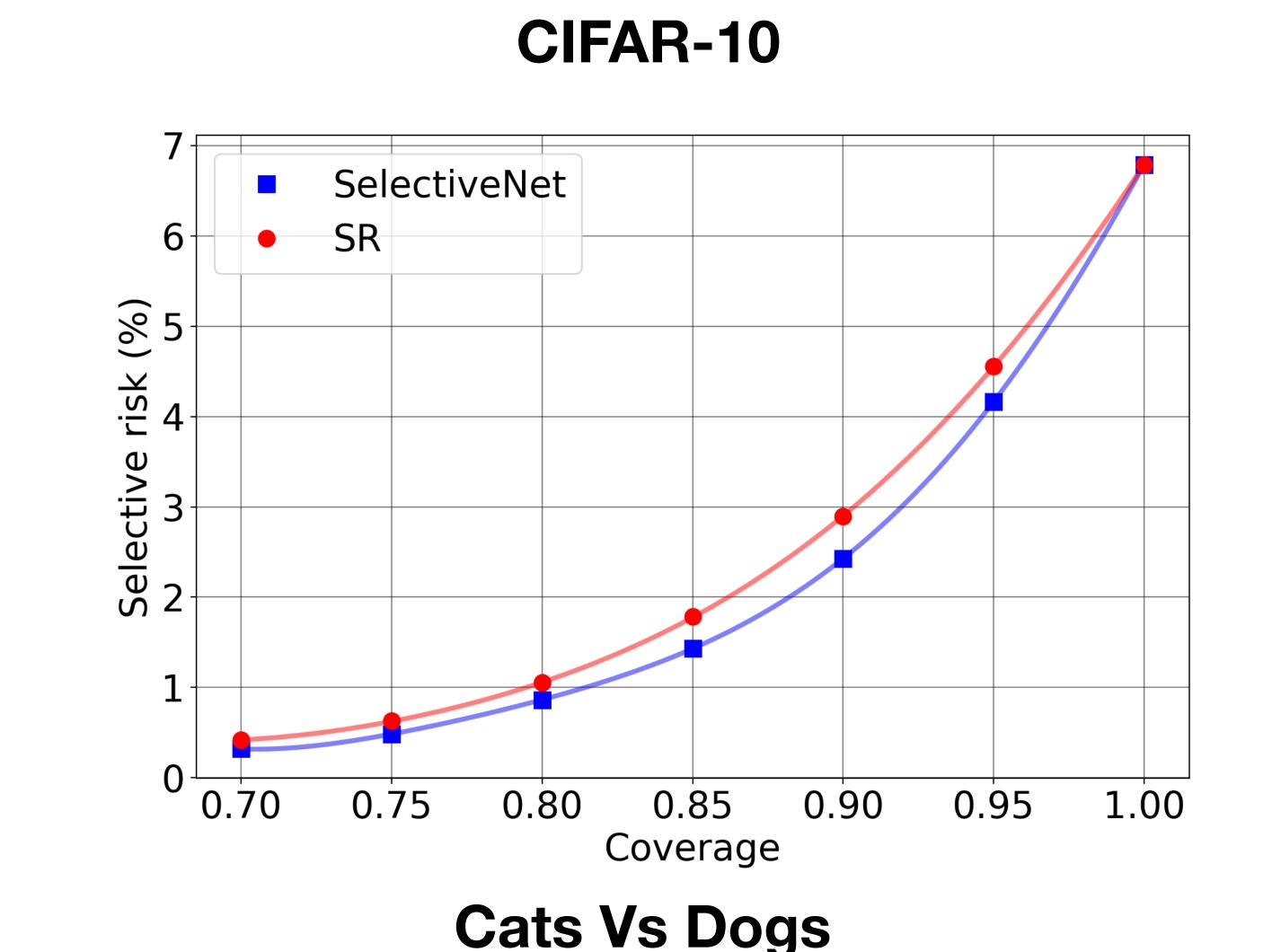
$$\hat{r}(f, g|S_m) = \frac{\frac{1}{m} \sum_{i=1}^{m} \ell(f(x_i), y_i) g(x_i)}{\hat{\phi}(g|S_m)}$$

Regularization - Auxiliary output:

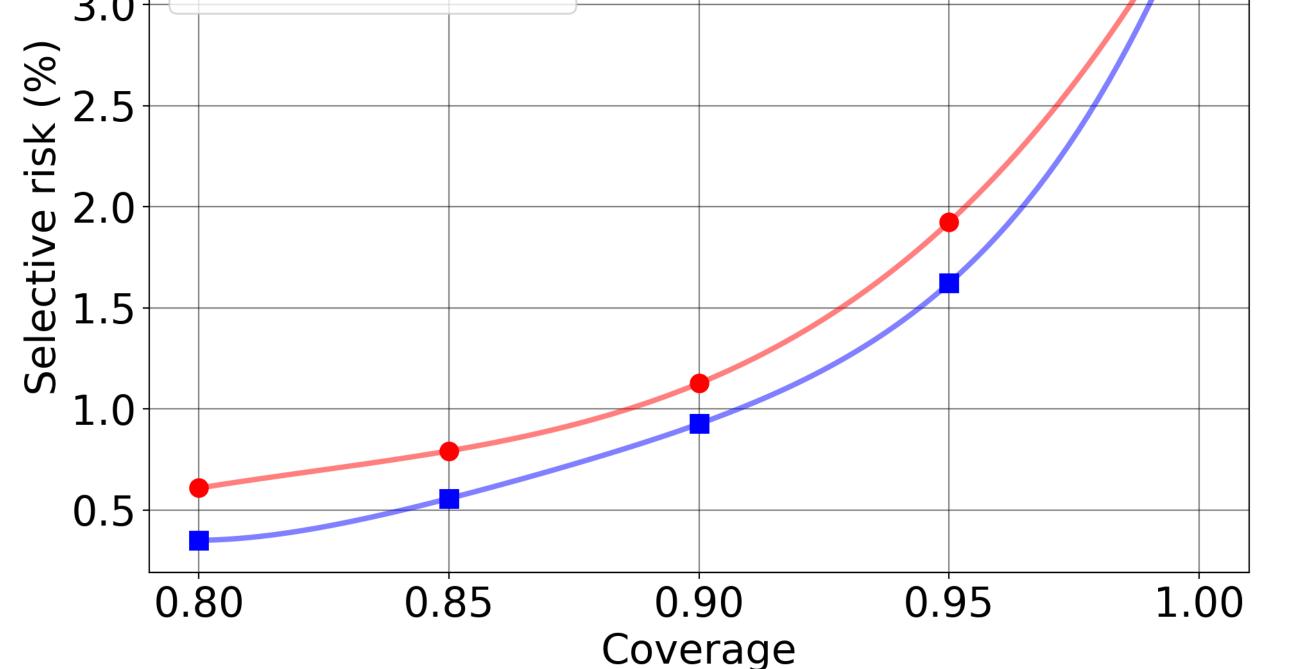
$$\mathcal{L}_h = \hat{r}(h|S_m) = \frac{1}{m} \sum_{i=1}^m \ell(h(x_i), y_i)$$

$$\mathcal{L} = \alpha \mathcal{L}_{(f,g)} + (1 - \alpha) \mathcal{L}_h$$

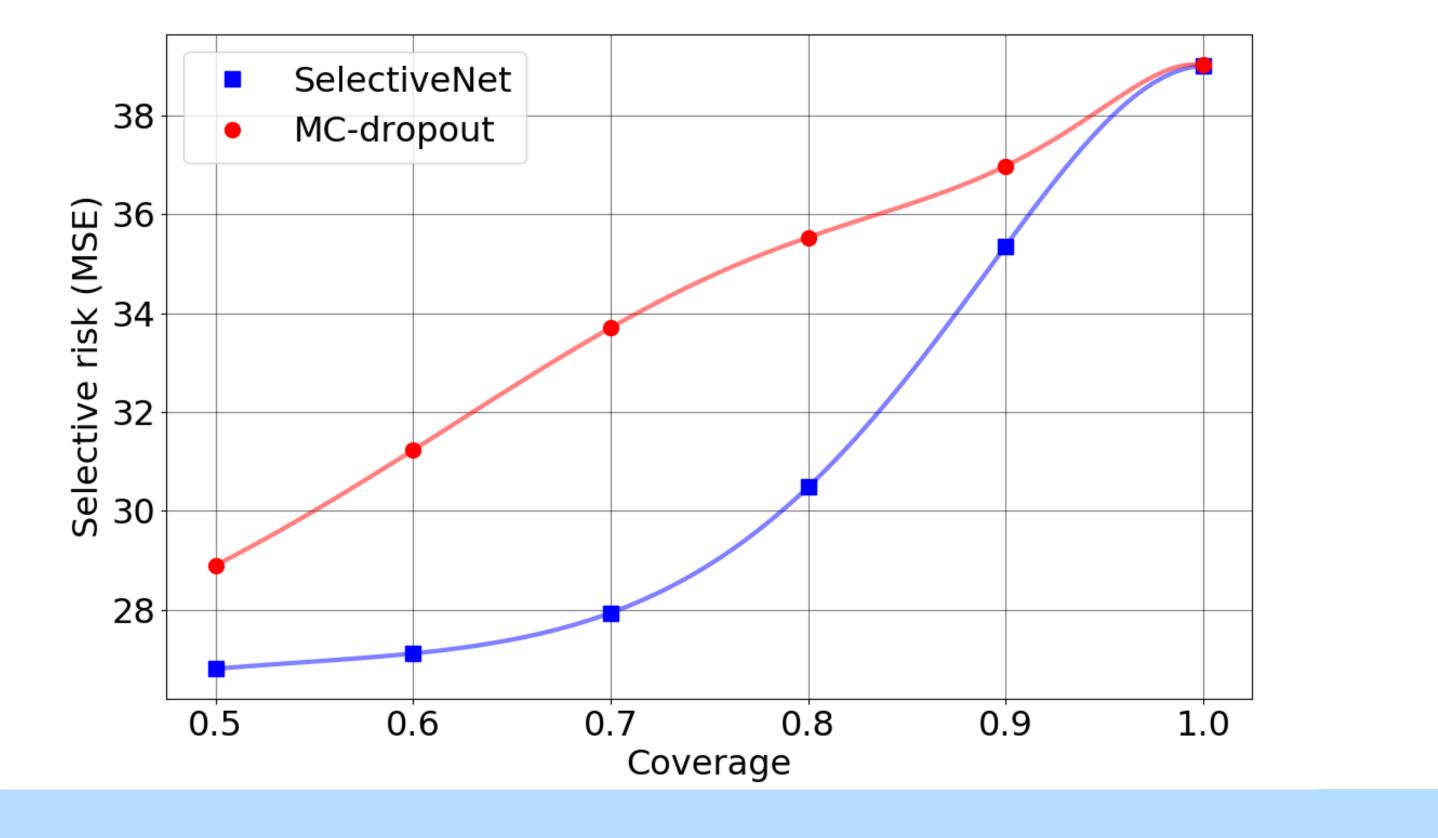
Empirical Results



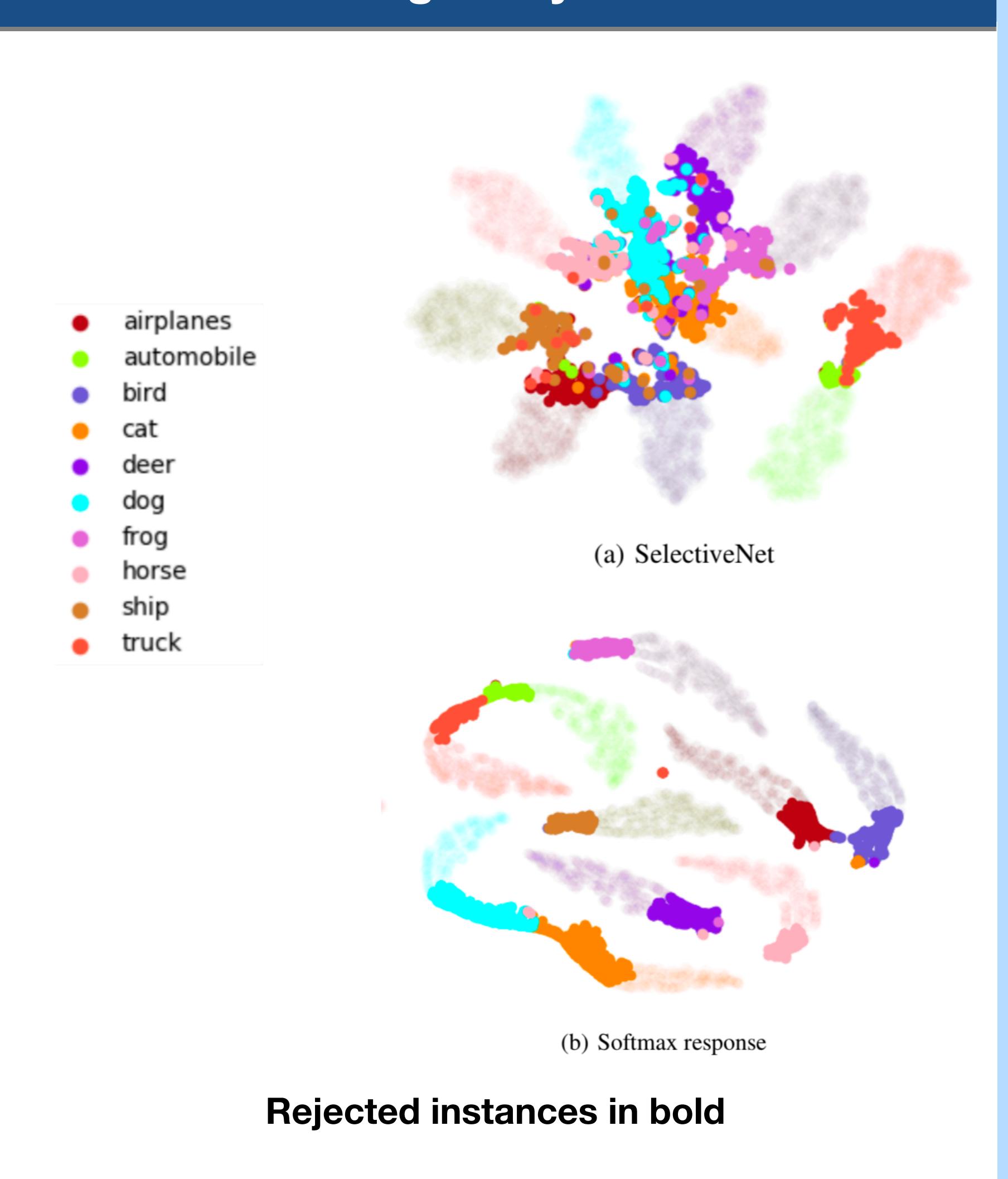




Concrete Compressive Strength - Regression



Embedding Analysis - t-SNE



Future Work

- Extend SelectiveNet to other learning tasks such as object detection
- Train SelectiveNet for multi-label classification
- Use SelectiveNet for Active Learning