Deep Gamblers: Learning to Abstain with Portfolio Theory
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Classification and the Inadequacy of nll loss
Want to find: \( \theta = \text{arg} \max \Pr(Y|\theta) \)
In practice, minimize negative log loss (nll loss):
\[
\min_{\theta} -\log p(Y|\theta)
\]

Toy Example: Image Rotation

Proposed Method: The Gambler’s Loss
\[
\max E \log(S) = \max \sum_{i=1}^{m} p_i \log(a_i b_i + b_0)
\]

Intuition: Prediction as Horse Race
Horse Race with Reservation
- \( m \) horses
- Betting strategy: \( \sum_{i=1}^{m} b_i \rightarrow \sum_{i=0}^{m} b_i \)
- Chance of winning: \( p_i \)
- Payoff if we bet on the winning horse: \( a_i \)
- Return after winning: \( S = a_i b_i \rightarrow a_i b_i + b_0 \)
Objective: maximize doubling rate:
\[
\max W = \max E \log(S) = \max \sum_{i=1}^{m} p_i \log(a_i b_i + b_0)
\]
- Classification Problem = Betting problem with Reservation with \( a = 1, b_9 = 0 \)
- Classification Problem \( \leq \) Betting problem with Reservation

Toy Example: Identifying Disconfident Images

SOTA Performance on Selective Classification

The Learned Representation is Better Separable

Surprising Benefit
- Training with gambler’s loss reduces overfitting
- Improved performance when noisy labels are present

Paper:
Code: