On-the-Job Learning with Bayesian Decision Theory
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Big picture
How do you deploy a high accuracy classifier starting with zero training examples?

What is on-the-job learning?
- On-the-job learning allows a system to query the crowd for labels on the uncertain parts of an input as it arrives before making a prediction.
- Can maintain accuracy on difficult examples by asking the crowd for assistance.
- Reduces costs on simpler examples by learning a better prediction model online (on-the-job).
- User specifies a base prediction model and how to trade off accuracy, cost and latency.
- System optimizes for utility using ideas from game playing and Bayesian decision theory.

Related work
Online active learning chooses the most informative examples to label after classification. Impossible to maintain high accuracy initially.
Active classification learns a static policy from a labelled dataset to choose features to query at test time.
On-the-job learning combines advantages of both the above methods. Note, Legion:AR (?) studied the user interface aspects of on-the-job learning, while we study the machine learning aspects of it.

Example: named entity recognition on tweets

How marginals evolve after incorporating responses

Approximating utility with MCTS
- Stochastic game between system and crowd.
- States capture time, queries in flight and received responses.
- Actions are querying for a label, waiting or returning current best guess.
- The system chooses actions that maximize utility.
- Approximated by Markov Chain Tree Search (MCTS) with progressive widening, using an environment model.

Takeaway
On-the-job learning is capable of making consistently accurate predictions while reducing annotation costs.

Conclusions and Future Work
- Consider on-the-job learning to get accurate labels on your next project for cheap.
- Easy to use open-source implementation, LENSE, available!
- Future directions include improving confidence estimation, learning from measurements and more applications.