Active Information Acquisition

He He
Paul Mineiro & Nikos Karampatziakis
University of Maryland, College Park
Microsoft Cloud and Information Services Lab

Overview
Dynamically seek information needed most

- Adaptive: selection of next information depends on past information and intermediate predictions
- Cost-efficient: stop and output results as soon as enough information has been acquired

Problem formulation
- State: information acquired so far and intermediate predictions
- Action: get a new piece of information or stop (and output current prediction)
- Loss: task loss + λ · information cost

Method
Our goal is to learn
- Task predictor: takes in partial input, outputs (intermediate) prediction
- Information selector: takes in a state representation, outputs the next action

Learning to Search (Daumé III et al, 2014)
- An imitation learning framework via online cost-sensitive classification
- Explore by rolling in with learned policy; assign credit by rolling out with the reference policy
- Reference policy: greedily choose the next action that yields the minimum immediate loss
- Jointly learn the task predictor and the information selector

TL;DR
- When to stop: sentiment classification on Amazon book reviews
  - Read a review from the beginning; 2 actions (stop and continue)
  - Task predictor: bag-of-words; one-against-all (5 classes)
- Where to focus: image recognition on PASCAL VOC 2011
  - Divide an image into 5x5 patches; reveal one patch at a time; 26 actions (patch ID and stop)
  - Patch aggregation: linear logistic regression using patch features from last layer of CNN
  - Baseline: heuristically selected patches (going from middle to outer part)

TB;DL
- Spend more on hard problems!
- Low budget: focus on the middle part; less dynamic
- High budget: explore outer part; more dynamic