Adaptive vs Non-Adaptive
- In adaptive model we observe the feedback after each test.
- In non-adaptive model:
  - No observed feedback
  - The same sequence for every chosen hypothesis
  - Can be used for batch-mode testing
  - No real-time processing time

Bayesian Active Learning
- A set of data points, each has an unknown label
- A set of linear classifiers, under each the data points have specific labels
- One classifier has happened based on a distribution
- We want to query labels of data points one by one until we identify the classifiers
- Noisy labels when data is within a threshold of classifiers boundaries
- Minimizing the number of queries

Medical Diagnosis
- Diseases: with probability of happening.
- Tests: with costs.
  - Each test has +/- outcome for each disease.
  - We want to identify the disease of the patient by taking tests one by one, and observing each test outcome before choosing the next one.
Goal: minimizing expected cost of diagnosis.

Adaptive Algorithms
- Simple greedy style algorithms
- Repeatedly selecting a test that maximizes a combination of:
  - The expected number of eliminated hypotheses
  - The minimum probability of eliminated hypotheses
- Updating the set of compatible hypotheses based on observed feedback

Non-Adaptive Algorithms
The non-adaptive algorithm comes in two phases:
- In phase 1, using sampling we run an algorithm by [Azar, Gamzu’11] for Submodular Function Ranking problem on our instance, to estimate a score for each element.
- In phase 2, we choose the test with maximum score. If it is smaller than a threshold, the approximation fails and we need to run all tests.

Experiments
- Information Theoretic Lower Bound (Entropy)
- Low Adaptive
- Our Algorithms: Non-Adaptive, ODTN-r and ODTN-h

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WISER:
- 415 chemicals
- 78 tests/symptoms
- 243 classifiers
- 100 points

Number of Tests
7.994 9.707 11.568
8.777 10.452 12.211

Number of Queries
9.941 9.152 9.777

Optimal Decision Tree with Noisy Outcomes
Su Jia, Fatemeh Navidi, Viswanath Nagarajan, R. Ravi

Optimal Decision Tree
- Hypotheses: with a distribution, based on which one of them (i*) has happened.
- Decisions: with costs and +/- outcomes on hypotheses.
- We make decisions one by one, and observe the feedback, before the next one.
Goal: minimizing expected cost of identifying the hypothesis that has happened.

Toxic Chemicals Identification
- Missing Data
- Device Errors
- Inconsistent behaviors

Noise Model
- We can model unknown outcomes to be + or - with probability ½ each.
- Extension to other probabilities
- Persistent Noise
Example: In table above if i* = 2 and we run test 3, then we observe + w.p. ½ or - w.p. ½. While we always observe - if we run test 2.