Learning from the Best: Active Learning for Wireless Communications

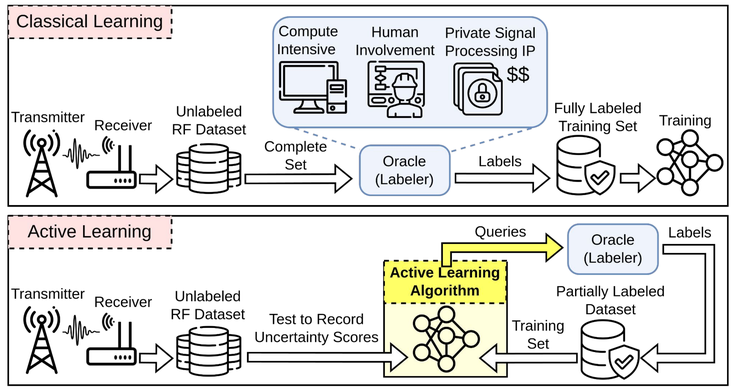
Nasim Soltani*, Jifan Zhang*, Batool Salehi, Debashri Roy, Robert Nowak, and Kaushik Chowdhury

Northeastern University

THE UNIVERSITY of WISCONSIN MADISON

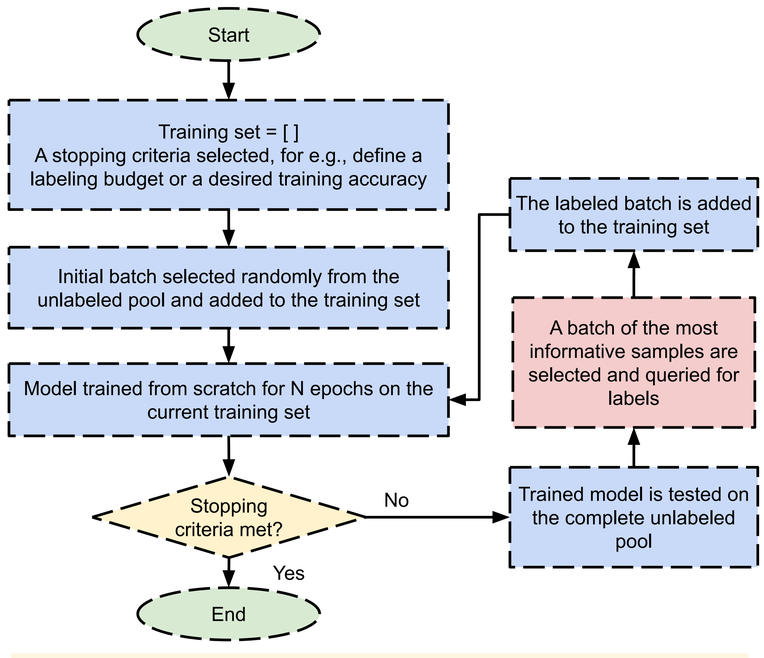
EDGE Institute

Active Learning



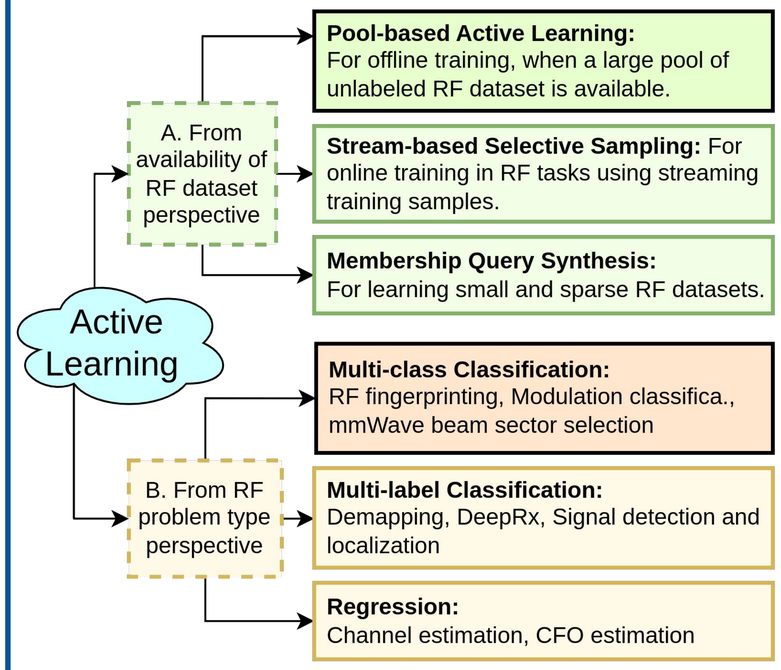
- We have unlimited labeling budget → Classical Learning
- We have a limited labeling budget → Active Learning

Pool-based Active Learning

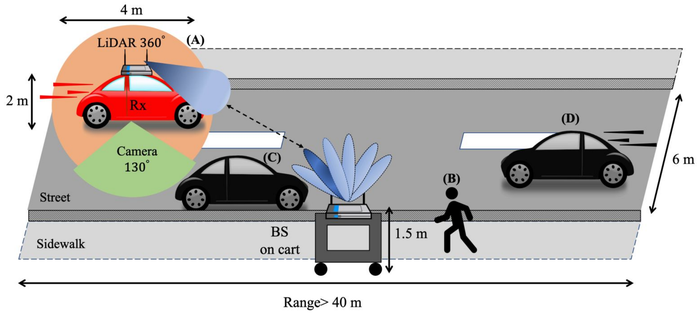


- Stopping Criteria: Iterative training stops when the training budget or desired accuracy is achieved.
- Informativeness Measure: Depends on the active learning algorithm.

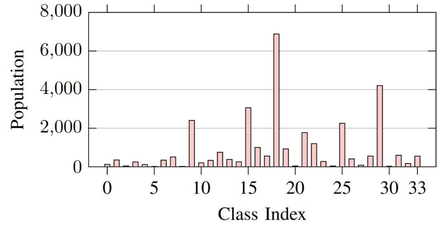
Active Learning for Wireless Comms.



mmWave Beam Sector Selection



- FLASH Dataset: Multi-modal (image, LiDAR, GPS) dataset collected from an autonomous car, while driving.
- The dataset has 34 classes (distinct beam indexes) and is extremely class imbalanced.

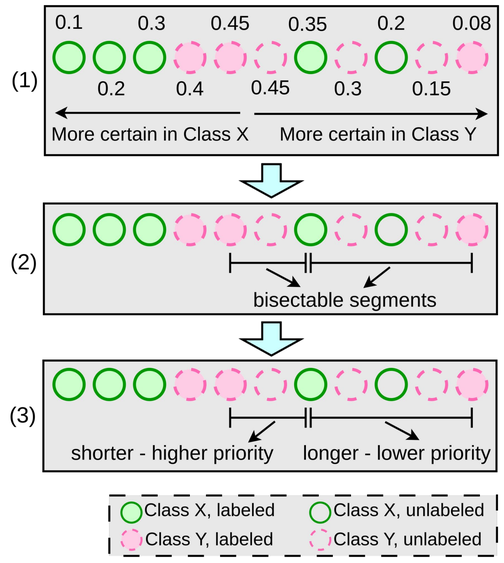


GALAXY for Imbalanced Datasets

(1) Uncertainty scores are calculated and the graphs are composed with sorted uncertainty scores for each class X versus all other classes as class Y.

(2) Bisectable segments are identified.

(3) Bisectable segments are prioritized and the samples around all identified cuts in the bisectable segments are queried based on the priority.



- Cuts: edges that have nodes classified as different classes of X and Y.
- Bisectable segment: segment of consecutive nodes if its two ends are labeled as X and Y, and it contains no labeled cuts.

Evaluation

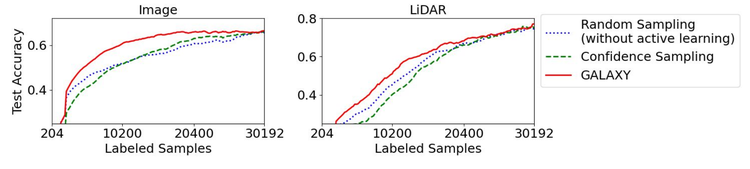
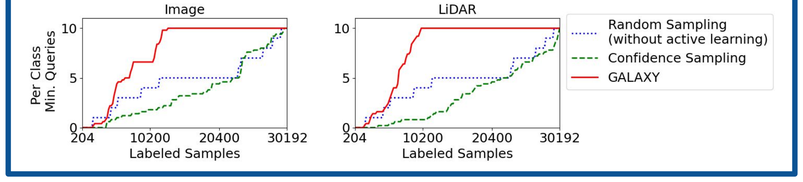


Image: GALAXY reaches acc. 60% with 50% and 40% fewer labels compared to random and confidence sampling.

LiDAR: GALAXY reaches acc. 71% with 11% and 10% fewer labels compared to random and confidence sampling.



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