Graph-based Active Learning for Semi-supervised Classification of SAR Data

Kevin Miller

University of California, Los Angeles

Team: Dr. Andrea L. Bertozzi (UCLA), Dr. Jeffrey Calder (UMN), Jack Mauro (LMU), Jason Setiadi (UMN), Xoaquin Baca (HMC), and Zhan Shi (UCLA)

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A Case for Semi-Supervised Learning

Our technology-rich and connected world produces lots of **Data**...

- Unlabeled Data : Inputs
  - **Easy to Collect/Generate**
- Labeled Data : Inputs + Outputs ("Labels")
  - **Difficult to Collect/Generate**

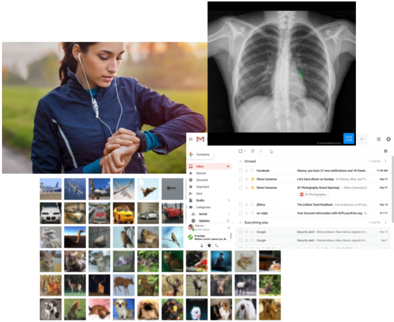
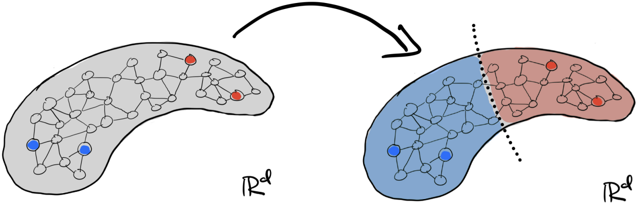


image credits: see references

Idea: *Given a small amount of labeled data* **and a similarity graph created from all inputs**, *can I infer "accurate" labelings for the unlabeled data?*



Great, you've leveraged using both labeled and unlabeled data!...

Why not try to improve?

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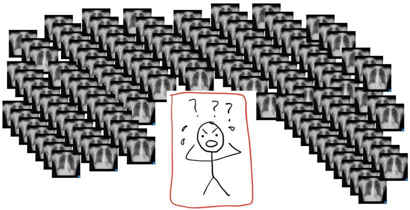
Why not try to improve?

- Hand-label **the entire** dataset...

  COSTLY



A Case for Active Learning

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Why not try to improve?

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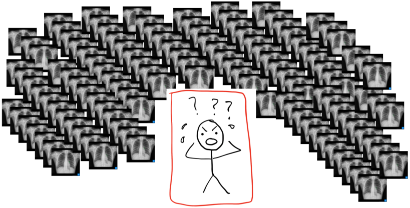
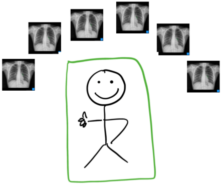


- Hand-label **only a few more**?

  DOABLE



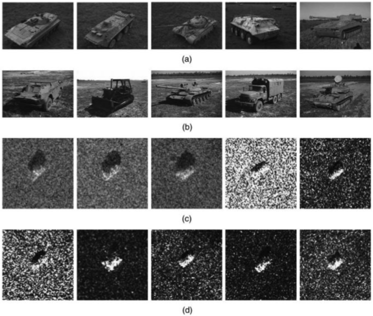


Fig. 2 MSTAR database. (a) and (b) Visible light images for BMP2, BTR70, T72, BTR60, 2S1, BRDM2, D7, T62, ZIL131, and ZSU23/4. (c) and (d) Corresponding SAR images for 10 targets measured at azimuth angle of 45 deg.

Figure 1: image credit: Perumal, Vasuki (2013)

MSTAR Dataset

- Synthetic Aperture Radar (SAR)
- Automatic Target Recognition (ATR)
- 6,784 images of size 88×88

Predefined train vs test split based on azimuth angle ($15°$ vs $17°$)

SAR Data Pipeline

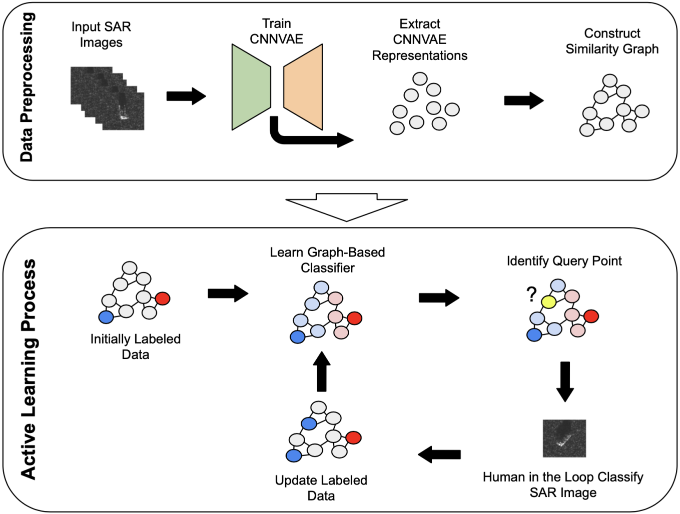


Figure 2: SAR Data Graph-Based Active Learning Pipeline

MSTAR Results

With graph built from CNNVAE representations and *1 initially labeled point per class*, select 500 active learning query points sequentially.

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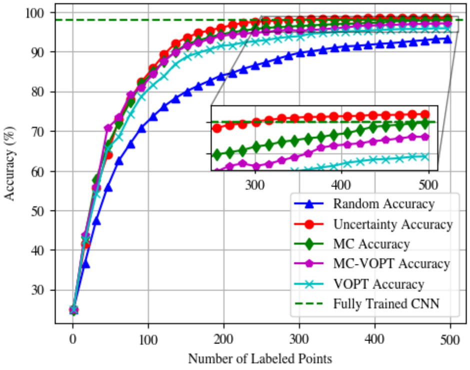

Figure 3: MSTAR Active Learning Results

Results:

Achieve within 400 queries!

- 99% accuracy with $< 10\%$ training data
- *SOTA CNN*: 98% Accuracy, but uses **all** training data

Acknowledgements

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