AI4EO

Special Topics in Applications (AIL861)
Artificial Intelligence for Earth Observation
Lecture 19

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Learning with Noisy Labels

- ✔ Depends on how noisy are the labels (recall our discussion in the context of semantic segmentation change detection)

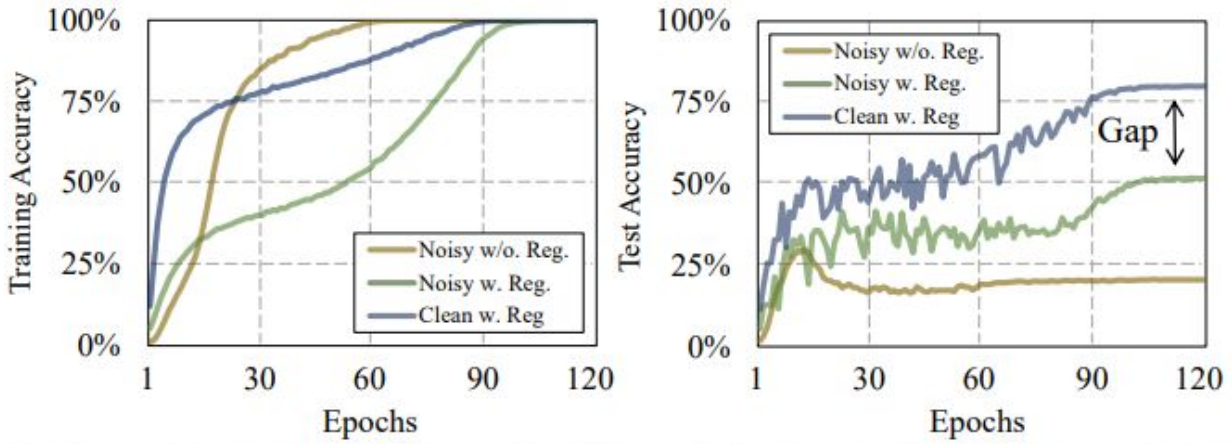

Fig. 1. Convergence curves of training and test accuracy when training WideResNet-16-8 using a standard training method on the CIFAR-100 dataset with the symmetric noise of 40%: "Noisy w/o. Reg." and "Noisy w. Reg." are the models trained on noisy data without and with regularization, respectively, and "Clean w. Reg." is the model trained on clean data with regularization.

Learning from Noisy Labels with Deep Neural Networks: A Survey, 2022

Temperature Forecasting by Deep Learning Methods

- ✔ From paper by same title as above
- ✔ They make use of 13 years of data from the ERA5 reanalysis, of which 11 years are utilized for training and 1 year each is used for validating and testing.
- ✔ Among other models, ConvLSTM is used.

Glaciers

- ✔ A slowly moving mass or river of ice formed by the accumulation and compaction of snow (generally on mountains or near the poles).
- ✔ Distinct from thin sea ice or lake ice that form on the surface of the bodies of water.
- ✔ Covers approximately 10% of world's land.

Glaciers : relatively good news

- ✔ Largest reservoir of fresh water on Earth.
- ✔ Store water as ice during cold season.
- ✔ Most glacial ice are in polar regions.

Glaciers : relatively bad news

- ✔ Change landscapes due to their weight (when they flow through some landscape).
- ✔ Warmer summer temperatures cause them to melt.
- ✔ If melted: may cause sea level rise, global flooding.

Glaciers and climate change

- ✔ Global climate change and other phenomena are strongly impacting glaciers.
- ✔ Strong repercussions on the availability of natural water resources for agricultural, civil and industrial purposes.
- ✔ A global crisis.
- ✔ “Even if we significantly curb emissions in the coming decades, more than a third of the world’s remaining glaciers will melt before the year 2100. “ (source: https://www.worldwildlife.org/)

How can AI/ML help?

- ✔ Glaciers are driven by very complex phenomena that are often complicated to model.
- ✔ A data-driven approach can help in predicting such phenomena without designing explicit physical models.
- ✔ Varied number of data sources can help, e.g., different types of Earth observation images, reanalysis data. Machine learning models have the capability to ingest and perform well with different types of data (if carefully designed).
- ✔ Many glacier-related problems are indeed similar to the other ML problems that we have already discussed (will be evident in the next slides).

Supraglacial Debris-Cover Extents

- ✔ Rocky debris on glacier surfaces influences ice melt rates.
- ✔ Thus, it is important to understand the extant of supraglacial debris.
- ✔ About 4.4% of all glacier areas are covered with debris. (source: Global Assessment of Supraglacial Debris-Cover Extents, 2018)
- ✔ ML can formulate this as a segmentation problem.

Research Questions?

- ✔ Most existing approaches are not ML-based. They use simple indices like a red to short-wavelength infrared (SWIR) band ratio or the normalized difference snow index. Can we use the result from such simple indices as a weak label and use those weak labels to train a superior model?
  (Recall our discussion wrt weak labels).

- ✔ Can we merely reapply a supervised semantic segmentation method trained on debris images from Europe to the glaciers in Himalayas?
  (Can be formulated as a domain adaptation or generalization problem)