Robust Neural Networks

Part 5: Conclusions and Future Directions

Key Takeaways

Role of Gradients

- **Robustness** under distributional shift in domains, environments, and adversaries are **challenges** for neural networks
  - **Gradients at Inference** provide a **holistic solution** to the above challenges
- **Gradients** can help **traverse** through a trained and unknown **manifold**
  - They approximate **Fisher Information** on the projection
  - They can be **manipulated** by providing **contrast** classes
  - They can be used to construct **localized contrastive** manifolds
  - They provide **implicit knowledge** about **all classes**, when only **one data** point is available at inference
- Gradients are useful in a number of **Image Understanding** applications
  - Highlighting features of the current prediction as well as **counterfactual** data and **contrastive** classes
  - Providing **directional information** in anomaly detection
  - **Quantifying uncertainty** for out-of-distribution, corruption, and adversarial detection
  - Providing **expectancy mismatch** for human vision related applications

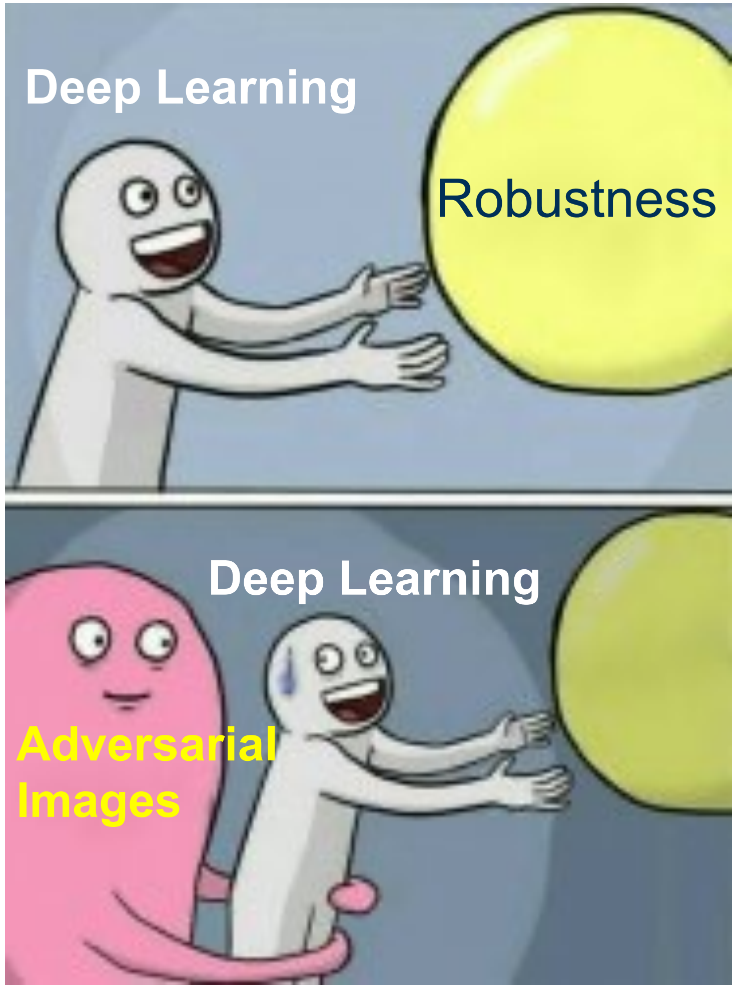
Future Directions

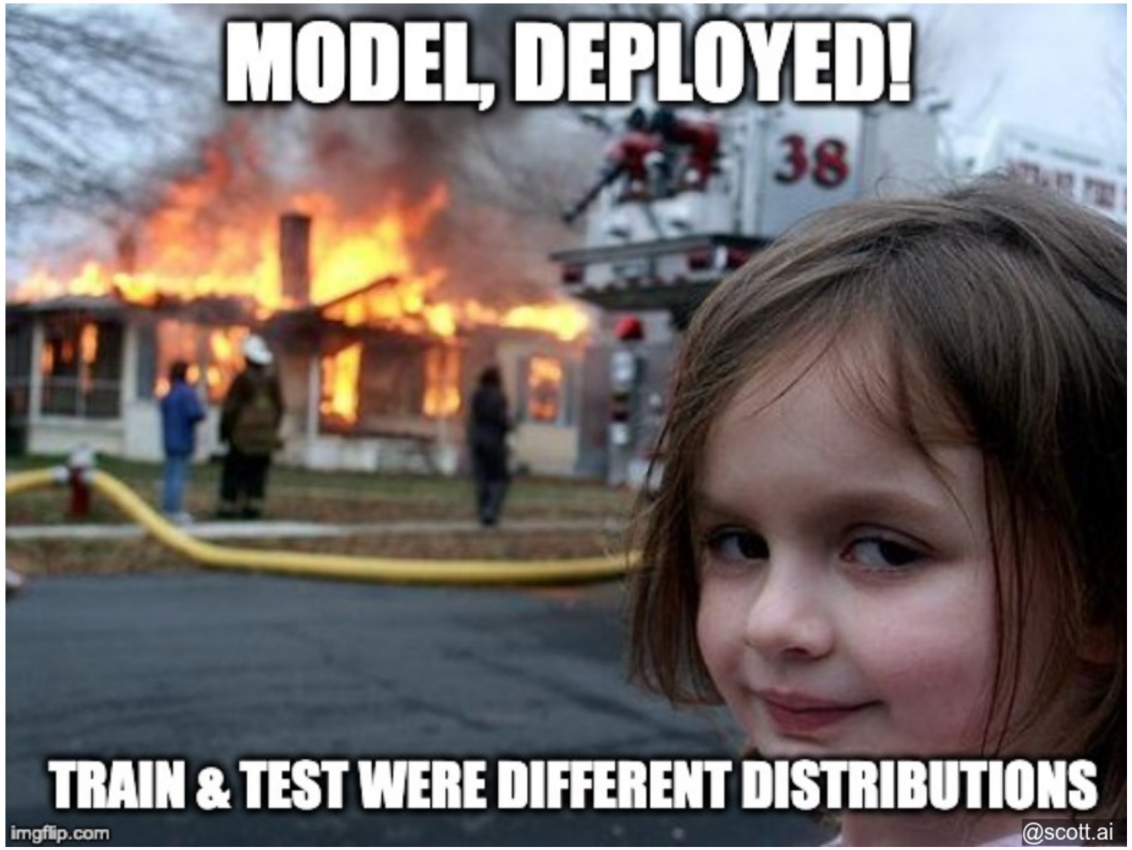
Research at Inference Stage

- **Test Time Augmentation (TTA) Research**
  - Multiple augmentations of data are passed through the network at inference
  - Research is in designing the best augmentations
- **Active Inference**
  - Utilize the knowledge in Neural Networks to ***ask it to ask us***
  - Neural networks ask for the best augmentation of the data point given that one data point at inference
- **Uncertainty in Explainability, Label Interpretation, and Trust quantification**
  - Uncertainty research has to expand beyond model and data uncertainty
  - In some applications within medical and seismic communities, there is no agreed upon label for data. Uncertainty in label interpretation is its own research
- **Test-time Interventions for AI alignment**
  - Human interventions at test time to alter the decision-making process is essential trustworthy AI
  - Further research in intelligently involving experts in a non end-to-end framework is required

Memes to Wrap it Up

Robustness at Inference





Cannot depend on training to construct robust models

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Tutorial Materials

Accessible Online

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https://alregib.ece.gatech.edu/wacv-2024-tutorial/

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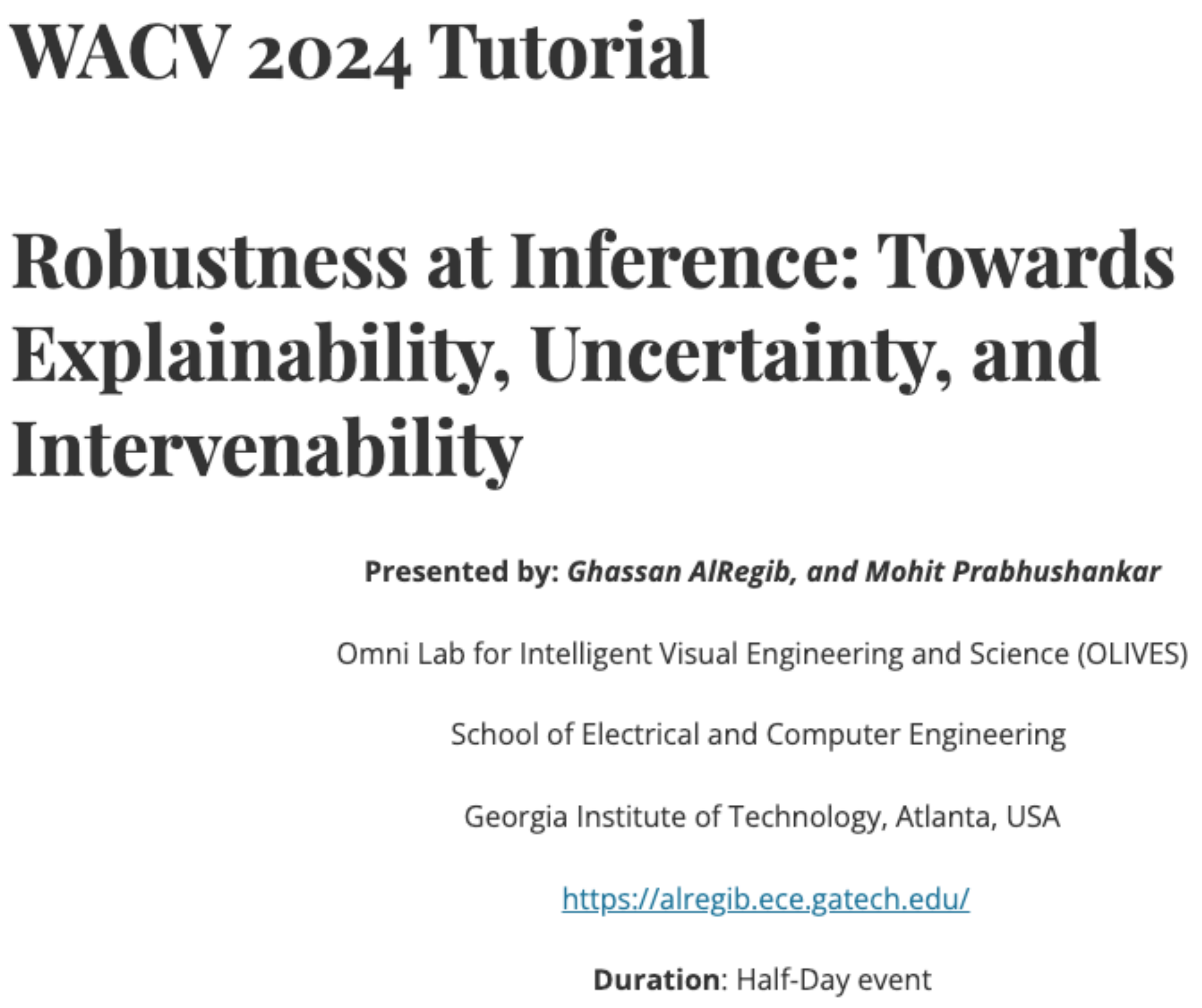

WACV 2024 Tutorial

Robustness at Inference: Towards Explainability, Uncertainty, and Intervenability

Presented by: ***Ghassan AlRegib, and Mohit Prabhushankar***

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Duration: Half-Day event