Course Project

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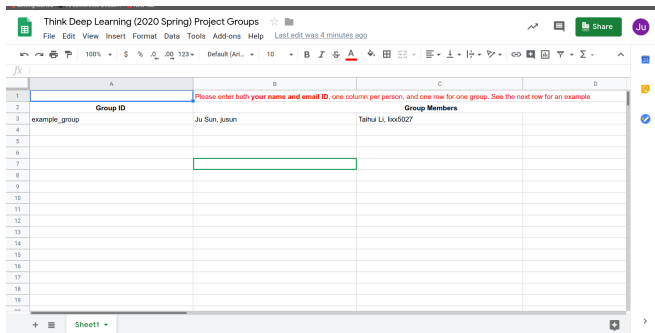## Outline

Logistics

Project ideas

Timeline & LaTeX template

- – Proposal (5%, 1 page): Feb 16th
- – Progress presentation (5%, 2-3 mins): Mar 26th
- – Progress report (5%, 2 pages): Mar 28th
- – Final report (25%, $6 - 8$ pages): May 12th
- – Poster presentation?
- – Publisable results $\implies$ A!

Template for all writeups: NeurIPS 2019 style

```
https://neurips.cc/Conferences/2019/PaperInformation/
StyleFiles
```

– Each group: 2 or 3 students; 1 permitted but discouraged

– All submissions as a group (in Canvas as group assignment);
   the group gets the same score

Proposal

- What problem?

- Why interesting?

- Previous work

- Your goal

- Plan and milestones

Overview

Roughly by ascending level of difficulty

– Literature survey/review

– Novel applications

– Novel methods

– Novel theories

Excerpt from a research project is fine, but you should describe your own contributions

A coherent account of recent papers in a focused topic

– Description and comparison of main ideas, or

– Implementation and comparison of performance, or

– Both of the above

should complement the topics we cover in the course

Random topics

- DL for noneuclidean data (e.g., graph NN, manifold NN)

- transformer models for sequential data

- generative models (e.g., GAN, VAE)

- 2nd order methods for deep learning

- differential programming

- universal approximation theorems

- DL for 3D reconstruction

- DL for video understanding and analysis

- DL for solving PDEs

- DL for games

- RL for robotics

- adversarial attacks; robustness of DL

- privacy, fairness in DL

- visualization for DNN

- network quantization and compression

- hardware/software platforms for DL

- automated ML; architecture search

- optimization/generalization theory of DL

Novel applications

Apply DL to **new** application problems

    – A good place to start: Kaggle `https://www.kaggle.com/`
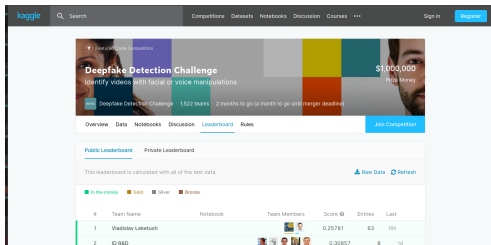
    – Think about data availability

        Google dataset search
        `https://datasetsearch.research.google.com/`

    – Think about GPUs

Where to find inspirations

- arXiv machine learning
  https://arxiv.org/list/cs.LG/recent
- Recent conference papers
    - ML: NeurIPS, ICML, ICLR, etc
    - CV: ICCV, ECCV, CVPR, etc
    - NLP: ACL, EMNLP, etc
    - Robotics: ICRA, etc
    - Graphics: SIGGRAPH, etc
- Talk to researchers!

Create new **NN models or training algorithms** to improve the state-of-the-art
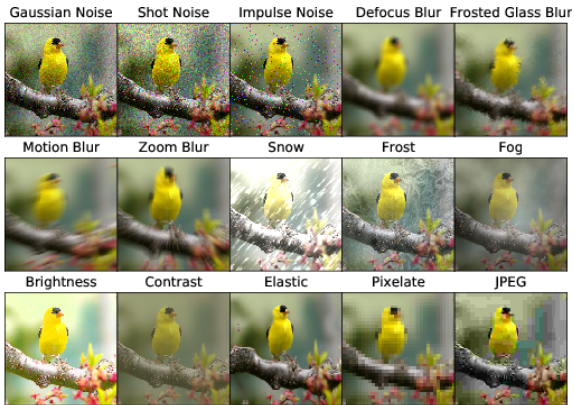
Where to start:

– Kaggle (again)!
– arXiv machine learning and recent conference papers
– ICLR reproducibility challenge: `https://reproducibility-challenge.github.io/iclr_2019/`
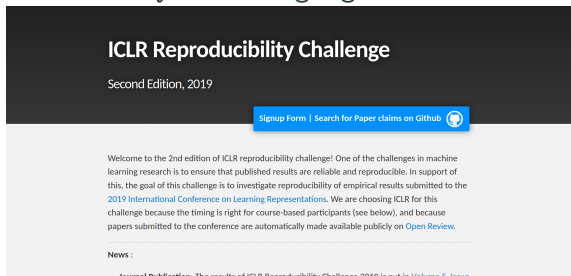
Equally interesting to fool/fail the state-of-the-art, i.e., exploring robustness of DL

Credit: ImageNet-C

Novel theories

Nothing is more practical than a good theory. – V. Vapnik

- universal approximation theorems
- nonconvex optimization
- generalization

Where to start:

- Analyses of Deep Learning (Stanford, fall 2019)
  https://stats385.github.io/

- Theories of Deep Learning (Stanford, fall 2017)
  https://stats385.github.io/stats385_2017.github.io/

- Toward theoretical understanding of deep learning (ICML 2018 Tutorial)
  https:
  //unsupervised.cs.princeton.edu/deeplearningtutorial.html

Questions?