Course Overview
CS 598: Deep Generative and Dynamical Models

Instructor: Arindam Banerjee

August 23, 2021
General Information

- Course Number: CSci 598
- Class: Tue Thu 02:00-03:15 pm
- Location: Siebel 0216
- Instructor: Arindam Banerjee
  - Office Hours: Tue Thu 05:00 - 06:00 pm (zoom)
- TA: Anant Dadu
  - Office Hours: ...
- Web page (public): arindam.cs.illinois.edu/courses/f21cs598
- Canvas page (internal): canvas.illinois.edu/courses/13791
- Slack, for discussions
- Emails, cc both, start subject with “[598] ...”
Course Activities

- **Please** read the syllabus carefully

- **Presentations**: 30% of total grade
  - Group activity, groups of 2 (or 3)
  - 20%: Presentation for 2 (of 23) classes
  - 10%: Blog post for 2 classes, corresponding to presentations

- **Reviews**: 30% of total grade
  - Individual activity
  - 30%: Review 10 (of 23) classes
  - Each review is 3% of total grade

- **Project**: 40% of total grade
  - Group activity, groups of 2 (or 3)
  - Proposal, progress report, final report, presentation
Course Activity: Presentations

- Group activity, groups of 2 or 3
  - Groups will be class specific
  - Presentation for 2 (of 23) classes: $20\% = 2 \times 10\%$
  - Slides due by 12 noon before in-class presentation
  - Plan for a 60 min presentation
  - Work together on the presentation

- Blog post for those 2 classes: $10\% = 2 \times 5\%$
  - Draft due 7 days (end-of-day) after presentation
  - Plan for a $\sim10$ min read
  - Work together on the post

- Submit ranked preferences over all 23 classes
  - Due: **Mon, Aug 30, 12 noon**
  - Assignments finalized by Tue, Aug 31
  - Each class will be assigned to 2 or 3 students
Course Activity: Reviews

- Individual activity
- Review material for 10 (of 23) classes: $30\% = 10 \times 3\%$
  - Exclude the 2 classes where you are one of the presenters
  - Each class has 2-3 papers, the review should cover all the papers
  - Review is 4 pages + additional pages for references and appendices
  - The 4 pages can include figures/results
- Submit list of 10 (of 23) classes
  - Due: **Mon, Sept 13, 12 noon**
  - You can start doing reviews (for the week of Sept 6)
  - Exclude the 2 classes where you will be a presenter
- Guidelines: Use proper section breaks, flow of ideas
  - Problem(s) considered, related work
  - Main result, associated results, what was new
  - Key insights, ideas used/introduced
  - Potential limitations, if any, and future directions
- Due end-of-day, the day before in-class presentation
Course Activity: Projects (To Do)

- Groups of 2 or 3 students
- Project
  - Team: 2-3 members, due Fri, Sept 17
  - Proposal: 2-pages + refs, due Fri, Oct 1
  - Progress Report: 4-pages + refs + appendices, due Fri, Nov 5
  - Final Report: 8-pages + refs + appendices, due Wed, Dec 08
  - Presentation: Thu, Dec 02 or Tue, Dec 07
- Scope of project: deep generative or dynamical models
  - AR, VAE, NF, GAN
  - NODE, NSDE, SBM, DS
  - ...
- Discuss with project partners before proposal
- Can re-scope project during progress report, with justification
- Cannot simply apply existing methods to existing datasets
- Honest effort counts: “I cannot believe it’s not better”
Schedule: Autoregressive Models

AR 1  (Tue, Sept 07) Neural Autoregressive Models
  - Larochelle et al., AISTATS, 2011.
  - Germain et al., ICML, 2015.

AR 2  (Thu, Sept 09) PixelCNN+variants, Quantiles
  - Oord et al., ICML, 2016.
  - Ostrovsky et al., ICML, 2018.

AR 3  (Tue, Sept 14) Transformers
  - Child et al., arXiv, 2019.
Schedule: Variational Autoencoders (1 of 2)

VAE 1 (Thu, Sept 16) Evidence Lower Bound
- Burda et al., ICLR, 2016.
- Rainforth et al., ICML, 2018.
- Alemi et al., ICML, 2018.

VAE 2 (Tue, Sept 21) Improved Inference, Representation
- Sonderby et al., NeurIPS, 2016.
Schedule: Variational Autoencoders (2 of 2)

VAE 3  (Thu, Sept 23) Deep Hierarchical

VAE 4  (Tue, Sept 28) Disentanglement
- Chen et al., NeurIPS, 2018.
- Locatello et al., ICML, 2019.
Schedule: Normalizing Flows (1 of 2)

NF 1 (Thu, Sept 30) Improved Flows
- Dinh et al., ICLR, 2016
- Dinh et al., ICLR, 2017
- Kingma et al., NeurIPS, 2018

NF 2 (Tue, Oct 05) Autoregressive Flows
- Kingma et al., NeurIPS 2016
- Papamakarios et al., NeurIPS 2017
NF 3  (Thu, Oct 07) Neural, Residual Flows
   • Ho et al., ICML, 2019
   • Huang et al., ICML 2018
   • Chen et al., NeurIPS 2019

NF 4  (Tue, Oct 12) Discrete, Mixed Models
   • Tran et al., NeurIPS, 2019
   • Hoogeboom et al., NeurIPS 2019
   • Neilsen et al., NeurIPS 2020
Schedule: Generative Adversarial Networks (1 of 2)

GAN 1  (Thu, Oct 14) Info-GAN, f-GAN
- Chen et al., NeurIPS, 2016
- Nowozin et al., NeurIPS, 2016

GAN 2  (Tue, Oct 19) Cycle-GAN, DC-GAN
- Radford et al., arXiv 2015
- Zhu et al., ICCV 2017

GAN 3  (Thu, Oct 21) Wasserstein GANs
- Arjovsky et al., ICLR 2017
- Arjovsky et al., ICML, 2017
- Gulrajani et al., NeurIPS 2017
GAN 4 (Tue, Oct 26) Optimization
- Mescheder et al., ICML, 2018
- Jolicoeur-Martineasu, ICLR, 2018
- Sun, et al., NeurIPS, 2020

GAN 5 (Thu, Oct 28) Generalization
- Arora et al., ICML, 2017
- NeurIPS, Wu et al., 2019
Schedule: Neural Differential Equations

**NODE 1** (Tue, Nov 02) Neural ODEs 1
- Chen et al., NeurIPS 2018
- Finlay et al., ICML 2020

**NODE 2** (The, Nov 04) Neural ODEs 2
- Dupont et al., NeurIPS 2019
- Zhang et al., ICML 2020

**NSDE 1** (Tue, Nov 09) Stochastic Dynamics
- Salimans et al., ICML 2015
- Sohl-Dickstein et al., ICML 2015
Schedule: Score-based Models

**SBM 1** (Thu, Nov 11)
- Hyvarinen, JMLR 2005
- Song et al., NeurIPS 2019

**SBM 2** (Tue, Nov 16)
- Ho et al., NeurIPS 2020
- Song et al., ICLR 2021
DS 1  (Thu, Nov 18) Physics + ML
- Raissi et al., JCP 2019
- Brunton et al., PNAS 2016

DS 2  (Tue, Nov 30) Learning Operators
- Li et al., ICLR 2021
- Lu et al., NMI 2021
Grading

- Presentations: 30%
- Paper Reviews: 30%
- Project: 40%

Grading:

- A+: [95,100]
- A: [90,95)
- A-: [85,90)
- B+: [80,85)
- B: [75,80)
- B-: [70,75)
- C+: [65,70)
- C: [60,65)
- C-: [55,60)
- D: [50,55)
- F: [0,50)

Cut-offs may be adjusted slightly, your grade will not go down