

SDSC6015 (Semester A, 2025)
Stochastic Optimization for Machine Learning
Group Project (4-5 persons per group)

1 Components of the Project

You will work on a specific topic, which you need to do

- Live Presentation (20 mins) + Q&A (5 mins) on **weeks 12-13**
 - Please prepare slides for the presentation.
 - **Submit your slides on/before Nov 26, 6 pm.**
 - Voting for the winners. There will be reward :)
- Code
 - Code that can reproduce your results.
- Demos (Optional)
- Feedback
 - Ask questions to other presentations.
 - Provide anonymous feedback to other groups.
- What you should cover
 - Background, motivation, and the main idea
 - Algorithm
 - Theory & Convergence results (no long proof) and comparison
 - Numerical experiments
 - Conclusion + limitation & strength of the methods + possible extensions (theory & algorithm & application)
 - Reference material
- This project is worth 30% of your grade (so total 30 points), in which

- Presentation: 12 points
- Content: 12 points
- Participation: 6 points (*i.e.* attendance, feedback, questions, and paying attention during other presentation)

2 Submission and Timeline

Each group will be named “Group x ”, where $x \in \{A, B, \dots, Z\}$. Please submit the files using the file names that are provided below.

- **ON/BEFORE Oct 14**

- Form your own group and post your group on Canvas.
- Anyone who does not have a group by that time will be assigned to a group.

- **ON Oct 17**

- Confirm topic on Canvas in class together.

- **ON/BEFORE Nov 26, 6 pm**

- Pdf file: slides,
File name: Group-[group name]_slides.pdf (*e.g.* Group_A_slides.pdf)
- MP4 files: any video/animation/demonstration that is used in the presentation
File name: Group-[group name]_demo-[i]-[before/during/after].mp4
(*e.g.* Group_A_demo.1_before.mp4, Group_A_demo.1_during.mp4, Group_A_demo.2_before.mp4, . . .)
- Txt/py files (let me know if you need cpp, hpp, or others): code
File name: Group-[group name]_c-[filename].txt (*e.g.* Group_A_c_main.txt, Group_A_c_solver.txt, . . .)
- *** Zip file: Group-[group name].zip (*e.g.* Group_A.zip), but name your files as advised above.

3 Topics

You do NOT need to follow the reference material. They are just for your reference, in case you do not know these algorithms before. Therefore, you should **GO BEYOND** the material we provided below.

- **WEEK 12**

- 2:00pm Stochastic Gradient Descent

Reference: https://www.mit.edu/~gfarina/2024/67220s24_L10_sgd/L10.pdf

- 2:30pm Momentum Methods

Reference: <https://www.sciencedirect.com/science/article/pii/S08933608098001166>

- 3:00pm Adaptive Gradient

Reference: <https://conferences.mpi-inf.mpg.de/adfocs-22/material/alina/adaptive-gd-notes.pdf>

- 3:30pm Adaptive Moment Estimation

Reference: https://www.mit.edu/~gfarina/2024/67220s24_L13_adagrad/L13.pdf

- 4:00pm Primal-Dual Algorithm

Reference: <https://link.springer.com/article/10.1007/s10851-010-0251-1>

- **WEEK 13**

- 2:00pm Coordinate Descent

Reference: <https://arxiv.org/abs/1502.04759>

- 2:30pm Incremental Algorithm

Reference: <https://dspace.mit.edu/bitstream/handle/1721.1/73452/bertsekas-incrementalproximal.pdf?sequence=1>

- 3:00pm Frank-Wolfe Algorithm

Reference: <https://arxiv.org/pdf/2311.05313>

- 3:30pm Zero-Order Optimization

Reference: https://tyj518.github.io/files/lecture_notes_zo.pdf

- 4:00pm Cubic Regularization

Reference: <https://link.springer.com/article/10.1007/s10107-006-0706-8>

4 Tips for Effective Oral Presentations

Please follow the below advice for your presentation.

- **Do not use any script.** You should NOT read from your phone or a piece of paper. Only use your slides as reference.
- **Avoid placing long paragraphs of text on your slides.** The audience will find it difficult to follow.
- **Make eye contact** with the audience from time to time.
- **Keep track of the time** and stay within the allotted limit.
- Speak with confidence. Project your voice so that everyone in the room can hear you clearly.
- Control your pace and use pauses effectively. Speak slowly when needed, vary your tone, and pause to highlight key points.
- Use natural and purposeful hand gestures that support your message.
- Minimize filler words such as “um” or “uh.” Replace them with a brief pause. Consider recording yourself to identify and improve speech patterns.
- **Prepare for technical issues.** Save a copy of your slides on your laptop, bring necessary adapters, and have a plan in case equipment fails.