Minibatch and Momentum Model-based Methods for Stochastic Non-smooth Non-convex Optimization

This document serves as `README` file of the supplementals material contains

1. Integrity Check for Supplementary Materials
2. Instructions on Code
3. Reproduction of Experiments

1 Integrity Check

All the materials are packed in a `.zip` file `SupplementartMaterials.zip` and after unpacking, the directory `.\SupplementartMaterials\` contains

- `README.pdf`
- `submission_7321_supplementary.pdf`: contains all the proof for the theoretical results of the paper and additional experiment results that are absent in the paper due to space limit.
- `\code`: contains all the codes to reproduce the results in this paper.

2 Code Instructions

The code is implemented in `MATLAB R2019b` environment and requires external library Gurobi 9.1.0 for solving quadratic programs. Although Gurobi is a commercial solver, free academic license is available upon requests. See

- https://www.gurobi.com

for more information.
The directory `.\code\` contains

- `\opt`: Source code that implements three model-based methods `SGD`, `SPL`, `SPP` as well as their extrapolation extensions `SEGD`, `SEPL`, `SEPP`; with(out) minibatch.
- `\data`: Scripts to generate synthetic data.
- `\test`: Scripts to reproduce results of experiments in the paper.

3 Reproduce the Experiments

This section contains instructions for reproducing experiment results in this paper. There are in all 10 kinds of experiments that correspond to different datasets and extensions. We introduce them one-by-one.
To reproduce the results, one can use the following procedure.

1. Setup and configure the `Gurobi` optimization solver
2. Add path `supp\opt`, `supp\data`, `supp\test` in `MATLAB 2019b` (or higher version)

Dataset/Exp	Momentum	Minibatch	Momentum & Minibatch	Image Recovery
Synthetic Phase Retrieval	1	1	1	0
`Zipcode` Phase Retrieval	1	1	1	1
Synthetic Blind Deconvolution	1	1	1	0

Table 1: Experiment setups

3. Generate test data in `supp\data` directory (or directly use our provided copy)

   This can be done by running `supp\data\DataGenerator.m` for the synthetic data and for the `Zipcode` dataset one may ensure that `supp\data\loadzip.m` and `supp\data\zipcode.mat` are added to environment path of `MATLAB`

4. Run corresponding test scripts (introduced below) to obtain results

We note that the plotted figures may be different from the ones paper in MarkerSize and styles. In addition, in tests involving only momentum, parameter `gamma` will represent $1/\gamma$ in theoretical analysis.

3.1 Synthetic Phase Retrieval

- Minibatch (`test_312.m`, `test_312_inner.m`) evaluates:
  1. Speedup and batchsize m
  2. Speedup and initial stepsize α_0
  3. The number of iterations on reaching certain accuracy and α_0
- Momentum & Minibatch (`test_313.m`, `test_313_inner.m`) evaluates the number of epochs on reaching certain accuracy with momentum and with(out) minibatch.

3.2 Zipcode Phase Retrieval

- Minibatch (`test_322.m`, `test_322_inner.m`)

  that evaluates
  1. Speedup and batchsize m
  2. Speedup and initial stepsize α_0
  3. The number of iterations on reaching certain accuracy and α_0
- Momentum & Minibatch (`test_323.m`, `test_323_inner.m`)

  that evaluates the number of epochs on reaching certain accuracy with momentum and with(out) minibatch.
- Image Recovery (`test_324.m`)

  that plots progress of image recovery based on some `Zipcode` digit.

The first three tests replicate the setup of `Synthetic Phase Retrieval`.
Image Recovery
To reproduce image recovery, one can adjust value of parameter `idx` in the script as well as that of p_{fail} (assign `pfail =` $10p_{\text{fail}}$).

3.3 Synthetic Blind Deconvolution

- Minibatch (`test_332.m`, `test_332_inner.m`)

  that evaluates
  1. Speedup and batchsize m
  2. Speedup and initial stepsize α_0

3. The number of iterations on reaching certain accuracy and α_0

- Momentum & Minibatch (`test_333.m`, `test_333_inner.m`)

  that evaluates the number of epochs on reaching certain accuracy with momentum and with(out) minibatch.

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