Daily Log

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June-July 2022

1 Day 1 - 13/06/22

- Saw YouTube videos about convexity and duality, mathematical optimisation. Namely - Convex Optimisation 1 by Stephen Boyd, Convex Optimisation Basics, The Hessian Matrix - Definition and Worked Example, Convexity and the principle of duality, What is mathematical optimisation? ,KKT Conditions and the interior point method, the proximal operator
- Went through webpages regarding convex optimisation

2 Day 2 - 14/06/22

- Saw YouTube videos about general optimisation and quasiconvex functions solved a few basic optimisation problems. Made notes about a few important pointers. The videos watched were: Understanding quasiconcave and quasiconvex functions, Linear Algebra - Projection onto surfaces
- Went through the julia language syntax

3 Day 3 - 15/06/22

- Wrote the math to figure out the projection operators on 3 kinds of sets. N-dimensional balls, n-dimensional equations represented by A'X = b, n-dimensional half-planes represented by

$$A'X \leq b$$

- Wrote a running julia code for the above task

4 Day 4 - 16/06/22

- Wrote a running julia code that runs a constrained gradient descent program, when given a function f(x) = x' * A * x + b' * x, and a given domain set.

5 Day 5 - 17/06/22

- Finished the initial set of homework problems given in notes.pdf, wrote the solutions in my notebook. Researched about the interesting parts of the questions while going through them.
- Attended the seminar by Jonathan Eckstein

6 Day 6 - 20/06/22

- Tried to plot my gradient descent program using a projection operator in Julia.
- Had a progress check done with Zev at 2pm
- Started reading about asynchronous programming, and the abstract of the Comb18 research paper.

7 Day 7 - 21/06/22

- Read about the principle of duality. Watched this video to understand duality better : Bierlaire (2015) Optimization: principles and algorithms, EPFL Press. Section 4.1
- Researched more about asynchronous programming.
- Mathieu explained duality and block-iterativeness.

8 Day 8 - 22/06/22

- Had a 2 hour session with Zev at 2pm. Discussed the mathematical definition of gradient, learned about subgradients an subdifferentials. Started to understand Algorithm 4, to start solving our problem.

9 Day 9 - 23/06/22

- Learned how to use indicator functions and prox operators in Julia, and installed the required libraries.
- Spent time decoding the notation of the research paper, under algorithm 4.
- Tried to run a tried and tested code by Douglas and Rachford.

10 Day 10 - 24/06/22

- Made a note of how I am to proceed with the coding part of the algorithm, noted my approach and doubts.
- Had a meet with Zev and cleared the notation and algorithmic doubts. Here are the highlights of the session: 1) gamma and mu are random sequences of numbers, their values lie between epsilon and 1/epsilon. 2) K is the part with the linear operators, i.e. parts which are not in I. 3) Parts in I include the functions with ONLY 1 variable. 4)

11 Day 11 - 27/06/22

- Made the first draft of the running program in Julia
- Tried to tune the hyperparameters to give an optimal solution but ended up with a convergent solution, on the wrong side of the domain.

12 Day 12 - 28/06/22

- Exported the important variables from the julia file to a text file and then imported them into a python notebook
- Made a plot for the optimisation, tried a few heuristics with the hyperparameters I could tune.

13 Day 13 - 29/06/22

- Solved the problem of the final result staying out of the given bounds, but faced a new problem - what exactly are the dual solutions and what is their significance in this algorithm?
- Experimented with the parameters further.

14 Day 14 - 30/06/22

- Had a meeting with Zev to discuss further doubts. Made some corrections to the previous algorithm to have our first working draft ready. Discussed the next steps, and got a homework question - visualise the conjugate of a function.