Test 6

Dr G. Scarciotti

February 13, 2025

- **Please submit a pdf with your answers on blackboard by Thursday 23rd of February at 13:00.**

  Use the handouts to reply to these questions. Do not use generative AI tools. Note that each answer is in the handouts.

  You cannot answer using screenshots. You need to reply by typing or in your own writing. This promotes subconscious retention.

  This is an individual test. You cannot collaborate with other students or any other individual. This must be your work.

  You should be able to complete this in 1 page. Do not write, nor spend too much time on this.

Please state name, surname and CID.

1. (2 marks) Let $p^*(u, v)$ the optimal value of a perturbed problem. Assume $p^*(u, v)$ is differentiable at $u = 0$, $v = 0$ and that strong duality holds.
   - Provide the relation between the optimal dual variables and the optimal value of the perturbed problem.
   - Using these relations explain what happens when tightening or loosening the i-th inequality constraint by a small amount.
2. (2 marks) Explain the factor-solve method.
3. (2 marks) Explain why sparsity is important when solving linear equations.
4. (2 marks) Provide a bound on $f(x) - p^*$ using strong convexity.
5. (2 marks) Using classical convergence analysis provide an upper bound on the number of iterations until $f(x^{(k)}) - p^* \leq \varepsilon$.

Non-assessed questions, for self-study - Do not submit

- Write the Karush-Kuhn-Tucker (KKT) conditions.
- Explain why it may be useful to introduce new variables in a problem in the context of duality.
- Define strong convexity.
- Write the Netwon step and the Newton decrement.