NUMERICAL OPTIMISATION
ASSIGNMENT 3

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EXERCISE 1

Derive the 2D subspace trust region method for convex functions (with s.p.d. Hessian). Note that

(i) when p is constraint to a subspace $V = \text{span}(g, B^{-1}g)$, it can be expressed as a linear combination of basis vectors $p = Va$. You can use any basis, here orthonormal basis is useful;

(ii) use the result in Theorem 4.1 to obtain optimal p. Observe that complementarity condition (Theorem 4.1 equation (4.8a)) results in two cases;

(iii) use Theorem 4.1 equation (4.8a) to obtain an explicit expression for each coefficient a_i and plug them into the remaining condition; *Hint: After using the eigenvalue decomposition of $B_V = V^T BV$, this can be reduced to finding the roots of a 4th order polynomial.*

Submit solution via `TurnitIn`. **[40pt]**

EXERCISE 2

Implement the 2D subspace trust region method for convex functions (with s.p.d. Hessian). This implementation should return the *Cauchy point* whenever the gradient and Newton steps are collinear.
Submit your implementation via `Cody Coursework`. **[20pt]**

EXERCISE 3

Implement a trust region function based on Algorithm 4.1 in Nocedal Wright. Let this function take a handle to a solver for the constraint quadratic model problem as an argument. This will allow us to plug in different solvers to obtain different trust region methods.
Submit your implementation via `Cody Coursework`. **[20pt]**

EXERCISE 4

Apply the trust region method to Rosenbrock function with a nearby starting point $(1.2, 1.2)$ and a farther away point $(-1.2, 1)$. Pay attention to the choice of trust region radius in each case. *Hint: In case you are not confident with your implementation of the 2D subspace method, you can implement the dogleg method, which is provided in Nocedal Wright.*
Submit solution via `TurnitIn`. **[20pt]**

Remark. The submission to `TurnitIn` should not be longer than 4 pages. Avoid submitting more code than needed (if any) and focus on explaining your results.