



# Midterm Exam Outline

Math 132B: Optimization  
Professor: Paul J. Atzberger

- Constrained Optimization
  - canonical formulations for optimization problems
    - set constrained
    - equality constraints
    - inequality constraints
    - both equality & inequality
  - geometric interpretation of equality constraints
    - level sets of constraints
    - curves within constraint space
    - definition of regular points
    - definition of tangent plane, normal plane
    - definition of tangent space, normal space
    - orthogonality of tangent & normal space
    - local decomposition theorem for  $\mathbb{R}^n$  at regular points
- Lagrangians for constraints
  - equality case
  - inequality case
  - mixed equality & inequality
  - Necessary conditions for minimizers
    - first-order conditions for Lagrangians
    - second-order conditions for Lagrangians
  - Sufficient conditions for minimizers
    - second-order conditions for Lagrangians

- Karuch-Kuhn-Tucker (KKT) conditions
  - Results for
    - equality case (method of lagrange multipliers)
    - inequality case (KKT equations)
    - mixed equality & inequality (KKT equations)
  - Example cases (KKT conditions)
    - linear objective with linear constraints
    - quadratic objective with quadratic constraints
    - general smooth non-linear objectives and constraints
- Linear Programming
  - canonical formulation of the primal problem
  - slack variables
  - definition of a basic feasible point  $x$
  - definition of basis set  $\mathcal{B}$  and basis matrix  $B$
  - KKT conditions for linear programming
  - dual formulation