OR Mini-projects
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**Goal:** Investigate a small subject by groups of 1, 2, or 3. Write a short summary of your findings (2 pages max. by group). Prepare a presentation for the last course (10 minutes by group, slides or blackboard).

**Projects list:**

i – **Expander graphs** graph theory ★★
   Give a definition, remarkable properties, and their practical interest.

ii – **Random Geometric graphs** graph theory ★★
   Give a definition, investigate connectivity, and their practical interest.

iii – **Proof of Nash’s Theorem** game theory ★★
   Prove the result from best responses and Kakutani’s fixed point theorem.

iv – **Game of Duel** game theory ★★★
   Two duelists can shoot at each other anytime between time 0 and 1 but the probability of hitting the rival grows linearly with time \( p(t) = t \). If a duelist hits the opponent before, it gets +1 and the other one gets −1; for any other situation, they both get 0. Study the game.

v – **Voting systems** game theory ★★★ / ★★★ / ★★★
   Lay down the usual theory of voting, introduce the Condorcet winner and how Majority Judgement can be a better electoral system than simple majority.

vi – **Entropy** geometry-adapted optimization ★
   Give an information theoretic view on entropy. Explain entropic coding such as Huffman.

vii – **Riemannian optimization** geometry-adapted optimization ★★
   Give the definitions of a Riemannian manifold, tangent space, retraction. Explain how proximal gradient directly translates on a manifold such as the sphere.

viii – **Wasserstein barycenters** optimal transport ★
   Give the definition and investigate the simple cases of diracs and Gaussian distributions.

ix – **Wasserstein gradient flows** optimal transport ★★
   Give the definition, intuitive interpretation, and computational methods.