GOALS:

1) the simplest SAT-UNSAT transition (→ Chris Moore)
2) the simplest replica calculation (→ Giulio Biroli, Florent Krzakala)
3) illustrate RSB in fully connected models (→ Federico Ricci)
4) connection of SAT-UNSAT and jamming (→ Sid Nagel, Karen Daniels)
5) connection between spin glasses and glasses (→ Giulio Biroli, Gilles Tarjus, Ludovic Berthier)
6) connection with packing problems in large dimensions (→ Henry Cohn)

OUTLINE

A. Perceptron
   1. Definitions
      a. Perceptron
      b. Constraint satisfaction
      c. Stat mech formulation
   2. Replica method
      a. General calculation
      b. Replica symmetric solution
   3. The SAT-UNSAT transition
      a. SAT phase
      b. UNSAT phase
      c. Landscape
      d. Isostaticity
   4. Non-convex perceptron
      a. Full phase diagram and RSB
      b. Geometric interpretation

B. Spheres
   1. Spheres as constraint satisfaction problem
      a. General formulation
      b. Differences: quenched disorder, crystal
      c. The Franz-Parisi potential
   2. Spheres in infinite dimensions
      a. Liquid phase: virial expansion
      b. Results for the transition densities
      c. Out-of-equilibrium: phase diagram and J-line
   3. Criticality of jamming

REFERENCES:

– Part A and part B1 are based on SciPost Phys. 2, 019 (2017), also on arXiv:1702.06919
– For Replica Symmetry Breaking, see Castellani-Cavagna arXiv:cond-mat/0505032 or FZ, arXiv:1008.4844
– Part B2 is based on the draft of the book available in this Dropbox folder
– For part B3 see Annual Review of Condensed Matter Physics, Vol. 8, 265-288 (2017), also on arXiv:1605.03008