List of topics:

Week 1: Problem solving – definition of the main concepts.
1.1 Gestalt influence.
1.2 Insight problems: the status of the "aha!" criterion.
1.3 Search problems.
1.4 The scientific status of a goal-directed behavior.
1.5 Forming mental representations.

Week 2: Animal problem solving: innovative use of tools.
2.1 Early research with chimpanzees.
2.2 The role of brain size – how carnivores solve the puzzle box problem.
2.3 Self recognition in a mirror.
    2.3.1 A new test for the presence of consciousness.
    2.3.2 Why does the mirror reflect left and right but not top and bottom?
2.4 Chimpanzee's visuomotor coordination using camera mages.
2.5 Innovative problem solving in crows, parrots and hyenas.
    2.5.1 Innovative tool use in crows.
    2.5.2 Tool use by Kea and New Caledonian Crows.
    2.5.3 Wild and captive spotted hyenas.
2.6 Visual navigation – chimps and monkeys solve the traveling salesman problem (TSP).

Week 3: Modern research on the human's ability to solve problems that have large spaces.
3.1 Permutations and combinations. Polynomial and exponential number of computations.
3.2 Nearest Neighbor algorithm for the TSP.
3.3 Something was in the air – how the Cognitive Science community actually discovered the TSP.
    3.3.1 The role of global perceptual factors, namely, the convex hull and clustering.
    3.3.2 Cognitive challenge to AI.
    3.3.3 Perceptual vs. analytical processing.

Week 4: The exponential pyramid representation that compensates for the exponentially-large problem spaces.
4.1 Complexity classes: P, NP, NP hard, NP complete problems.
4.2 The exponential pyramid as a model of the human visual system.
    4.2.1 Speed-accuracy tradeoff.
    4.2.2 Mental size transformation.
4.3 Pyramid model for the TSP.
    4.3.1 Hierarchical clustering – self-similar operations.
    4.3.2 Coarse-to-fine solution process using a pyramid algorithm for the TSP.
4.4 Solving the 2D and 3D TSP in real and virtual environments: perception meets problem solving.

Week 5: Heuristic function, distance and direction in solving problems.
5.1 Heuristic function and an A* algorithm.
5.2 Human performance – the concept of direction.
5.3 Continuous and discrete geometry of direction and distance.
5.4 Pyramid model for solving the 15-puzzle.

Week 6: Insight and creative thinking.
6.1 Scientific discovery.
    6.1.1 Galileo's law of free fall.

6.1.2 Archimedes's law of the lever.
6.1.3 Symmetry of the natural laws.
6.1.4 Einstein's theories of relativity.
6.2 A few more brain teasers called insight problems.
6.3 Broader context for insight.

Week 7: Inference in perception. Perceptual representation: a rejoinder to insight.
7.1 Gestalt tradition – solving ill-posed problems and their relationship to insight.
7.2 Figure-Ground organization and curve integration as examples of visual inference.
7.3 Formalism of Forward and Inverse Problems.
7.4 More on implicit and explicit constraints in 3D shape recovery.
7.5 Physics connection via the least-action principle.
7.6 Data mining and knowledge discovery.

Week 8: Cognitive inference. Mental representations.
8.1 Multidimensional Scaling (MDS) as a tool for data visualization.
8.2 Clustering methods.
8.3 Using clusters to explain memory organization.
8.4 TSP with obstacles.

Week 9: Theory of Mind (ToM).
9.1 Visual perspective taking.
9.2 Strategic reasoning in matrix games.

Week 10: Solving problems in Physics and Mathematics.
10.1 Physics education.
10.2 Intuitive physics and causal reasoning.
10.3 Solving problems in Mathematics. Polya's contributions.

Textbook: Pizlo, Z. (2022) Problem Solving: Cognitive Mechanisms and Formal Models. To be published.