1. Light Up:

   Description: m × n grid of black and white squares. An action (clicking on a cell) places a light bulb on a white square. Some of the black squares have a number between 0 and 4 that represents the number of light bulbs that should be placed directly next to that square, horizontally or vertically. A light bulb illuminates the row and column of white squares in each of the four directions, until the beam reaches a black square or the edge of the grid. The goal is to illuminate every single white square, without any light bulb illuminating another light bulb.

   Question: Given a Light Up puzzle, does a solution exist?

   Reference: McPhail, B. (2005). Light Up is NP-Complete.

2. FreeCell:

   Description: It is played with a standard deck of 52 cards. These are initially arranged into eight stacks of six or seven cards each, with every card being visible. Cards can be moved between the stacks, the four free cells and the four foundation cells. The cards are subject to the following rules.

   1. Only cards in a free cell or on the top of a stack may be picked up.
   2. Only one card can be picked up at any time.
   3. A card may be added to a non-empty stack if the card being deposited is one less than the current value and has a different colour. For example, placing 3♠ on 4♦.
   4. Cards may be stored in a free cell, but only one card can occupy any free cell.
   5. If a stack is empty, a card may be added to it (making it a stack with one card).
   6. Aces may be placed on the empty foundation stacks. Following this, cards may be added to the foundation stacks as long as they are one value higher and of the same suit. For example, placing 2♣ on A♣

   Question: Given a FreeCell puzzle, does a solution exist?

   Reference: Helmert, M. (2003). Complexity results for standard benchmark domains in planning. Artificial Intelligence, Vol. 143, No. 2, pp. 219–262.

3. Sudoku:

   Description: It is played on an $n^2 \times n^2$ grid that is divided into $n \times n$ equal segments. Initially some cells in the grid contain a number between 1 … n^2. An action inserts a number between 1 … n^2 into an empty cell. The goal is to fill the grid with numbers such that every row, column, and segment contains the numbers 1 … n^2 without any repetitions.

   Question: Given a Sudoku instance, does it have any solutions?

   Reference: Yato, T. and Seta, T. (2003). Complexity and Completeness of Finding Another Solution and Its Application to Puzzles. IEICE TRANSACTIONS on Fundamentals of Electronics, Communications and Computer Sciences, Vol. 86, No. 5, pp. 1052–1060

4. Spiral Galaxies (or Tentai Show):

   Description: It is played on an m × n grid. k markers are within the grid, located in the center of cells, on the partitions between cells or at the intersection of four cells. The goal is to separate the grid into k segments so that each segment contains a marker at its center, and each segment is symmetrical under 180° rotations.

   Question: Given an instance of Spiral Galaxies, is there a solution?

Reference: Friedman, E. (2002). Spiral Galaxies Puzzles are NP-complete

5. Pearl Puzzle:

Description: It is played on an m × n grid of squares. Each square can contain a white pearl, a black pearl, or be empty. The goal is to construct a closed path that does not cross itself, and that passes through every pearl such that the path turns 90° through each black pearl and is straight immediately before and afterwards, and such that the path is straight through every white pearl and turns 90° immediately before or afterwards.

Question:

1. the path turns at every black pearl, but does not turn immediately before or after, and
2. the path does not turn at any white pearl, but does turn immediately before or after.

Reference: Friedman, E. (2002). Pearl Puzzles are NP-complete.