"AI Planning" – What It Is and What You Can Do for It

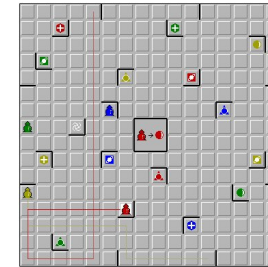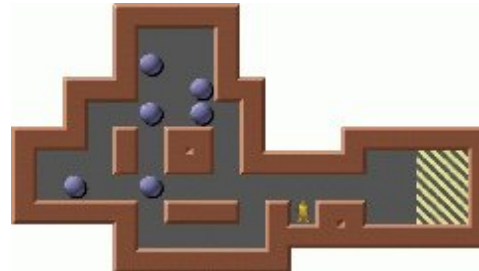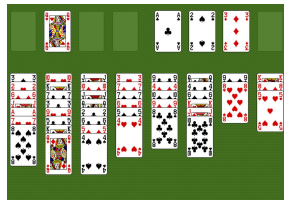P@trik Haslum

∼ RSISE/NICTA ∼

Think of Puzzles...

◇ 15-Puzzle

◇ Rubik's Cube

◇ Sokoban

◇ FreeCell

Real-Life Puzzles: Airport Ground Traffic Control

Photos copyright BAA plc.
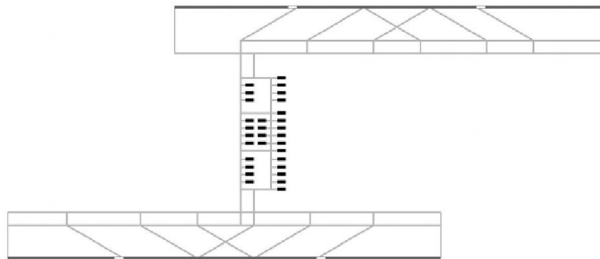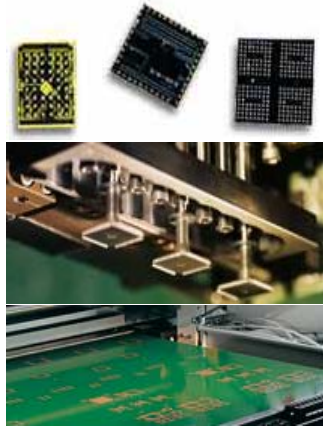

Figure from Trüg, Hoffmann & Nebel.

◊ Route aircraft between run-ways and terminals.

◊ Aircraft must be kept safely separated!
Safe distance depends on aircraft size and mode of travel (pushing or under own power).

◊ Minimize taxi and wait times.

Real-Life Puzzles: Manufacturing Automation
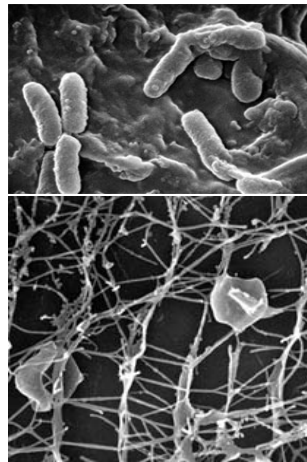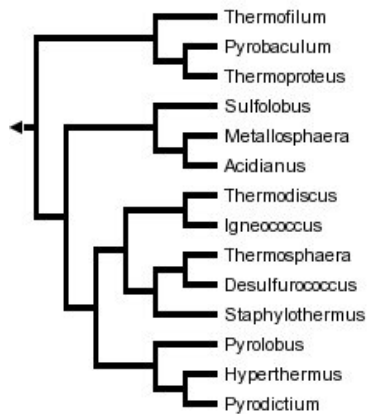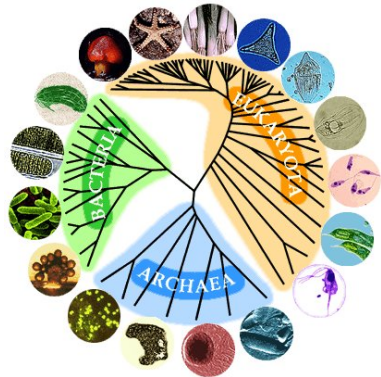

Photos copyright MYDATA automation AB.

◇ "Pick & Place" in circuit-board manufacturing.

◇ Plan component placement order & grouping, tray allocation, and movement path.

◇ Minimize (average) completion and reconfiguration time, subject to complex constraints (*e.g.* vibrations, acceleration, heat).

Real-Life Puzzles: Genome Rearrangement

◇ The relationship between different organisms can be measured by the number of "evolution events" (re-arrangements) that separate their genomes.

◇ Find shortest (or most likely) sequence of re-arrangements between pairs of genomes.

The AI Planner: A Universal Puzzle Solver

◇ What do all puzzles have in common?

  ○ There are **rules** which define the legal "moves" of the game.

  ○ There is an **objective**: A goal state to reach, and a measure of solution cost.

◇ To a **domain-independent** AI planner, formal **descriptions** of the rules and objective are given as **input** along with an instance of the problem to solve.

◇ The hardness of the domain-independent planning problem depends on the **expressivity** of the input **language**.

Some Suggested Projects/Topics

◇ Detection and use of symmetries in planning problems.

◇ Methods for splitting planning problems into parts that can be solved (semi-) independently and joining the solutions.

◇ Comparing approaches to managing uncertainty in planning.

◇ Bounded lookahead algorithms for planning problems with time and resource constraints.

◇ Designing a more usable problem specification language, with compilation to basic PDDL.

```
users.rsise.anu.edu.au/~thiebaux/student_projects.html
```