CS5201: Advanced Artificial Intelligence

Automated Problem Solving

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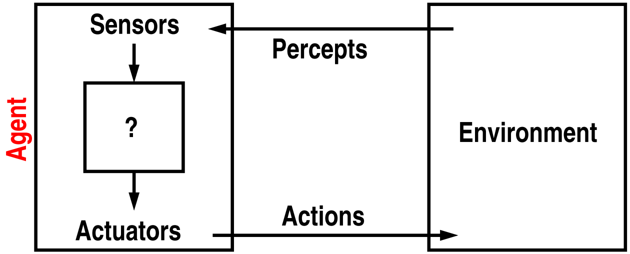
Agent and Environment

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators
- Environment — Fully / partial observable, deterministic / stochastic, episodic / sequential, static / dynamic, discrete / continuous, known / unknown



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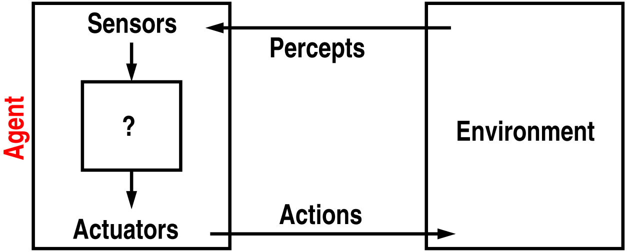
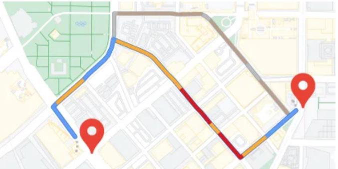
  - Known & partially observable - card games
  - Unknown & fully observable - video games



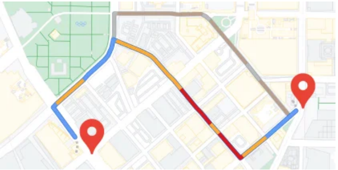
Complex problems & solutions-1



Route finding

image source: internet

Complex problems & solutions-1



Route finding

Playing chess

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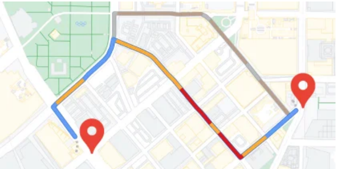
Complex problems & solutions-1



Route finding

Playing chess

Assembly line

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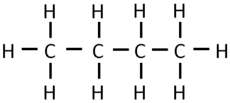
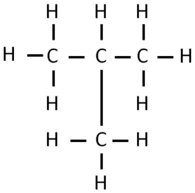
Complex problems & solutions-2



Butane C_4H_{10}

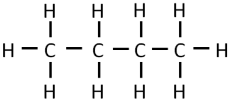


Iso-Butane C_4H_{10}

Chemical synthesis

image source: internet

Complex problems & solutions-2



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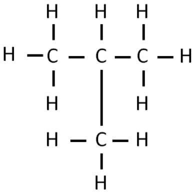

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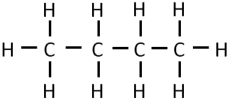
Chemical synthesis

$$\int \frac{x^4}{(1-x^2)^{\frac{5}{2}}}dx$$

Symbolic integration

image source: internet

Complex problems & solutions-2



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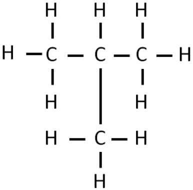

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Symbolic integration

Timetable generation

image source: internet

Automated problem solving by search

- **Generalized techniques for solving large class of complex problems**
- **Problem statement is the input and solution is the output (sometime problem specific algorithm / method could be the output)**

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- Challenges: Size of implicit state space, Capturing domain knowledge, Intelligent algorithms that work in reasonable time and memory, Handling incompleteness and uncertainty

Tower of Hanoi

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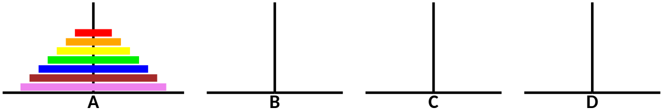

Two jug problem

- There is a large bucket B full of water and Two (02) jugs, J1 of volume 3 liter and J2 of volume 5 liter. You are allowed to fill up any empty jug from the bucket, pour all water back to the bucket from a jug or pour from one jug to another. The goal is to have jug J1 with exactly one (01) liter of water
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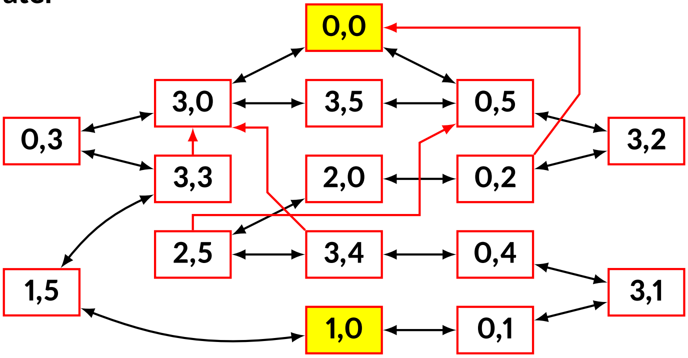
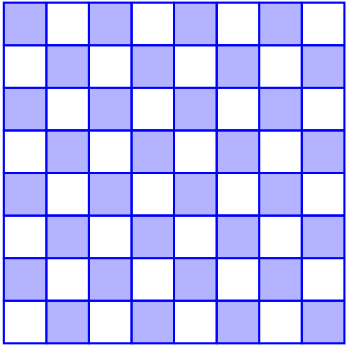


Partial state-space

N-Queens



Need to place N-queens on this board
Rules: No queens are attacking each other

Number conversion

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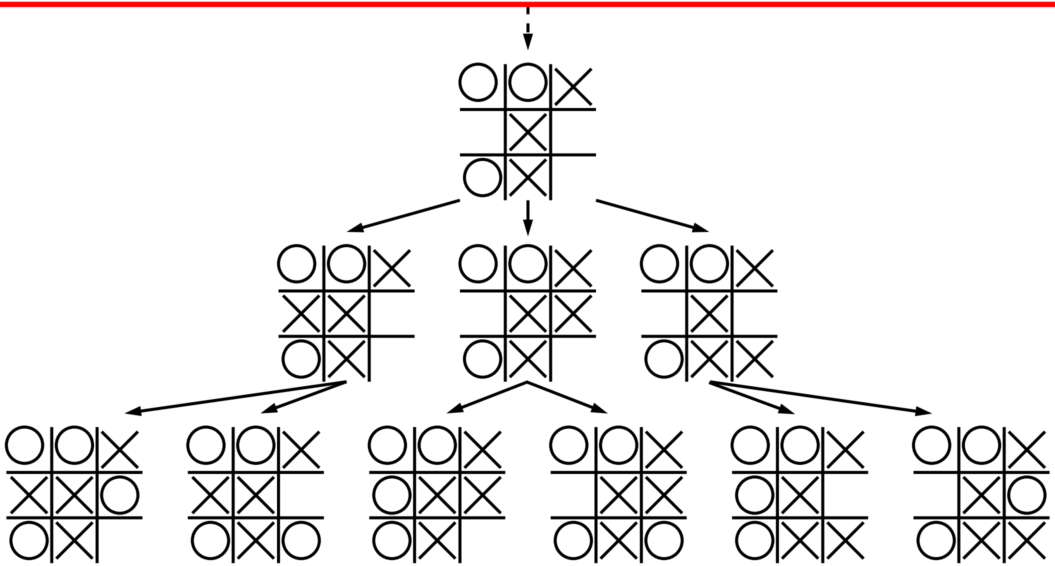
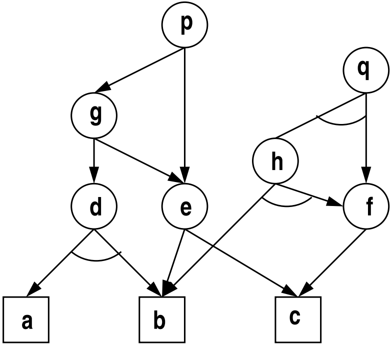
  - $\sqrt{30.69333} = 5.54015$
  - $\lfloor 5.54015 \rfloor = 5$

Tic-Tac-Toe



AND/OR States-space

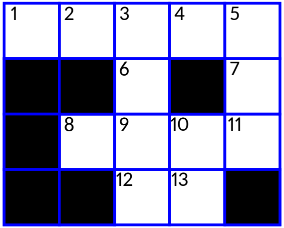


a
b
c
a AND b –> d
c OR b –> e
c –> f
d OR e –> g
b AND f –> h
g OR e –> p
h AND f –> q

State-spaces

$$\begin{array}{ccccc} & S & E & N & D \\ + & M & O & R & E \\ \hline M & O & N & E & Y \end{array}$$

Cryptarithmetic



Fill in words from the list in the given 4×4 board:
HOSES, LASER, SHEET, SNAIL, STEER, ALSO, EARN, HIKE, IRON, SAME, EAT, LET, RUN, SUN, TEN, YES, BE, IT, NO, US

Crossword

States, Spaces, Solutions, Search

- States
  - Full / perfect, partial information states
- State transformation rules
  - Deterministic, non-deterministic outcomes
- State space as generalized games
  - Single player (OR) vs multi-player (AND-OR)
  - Adversarial, probabilistic graphs
- Solutions
  - Paths, sub-graphs, expected outcomes
- Costs
- Size
- Domain knowledge
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Chess

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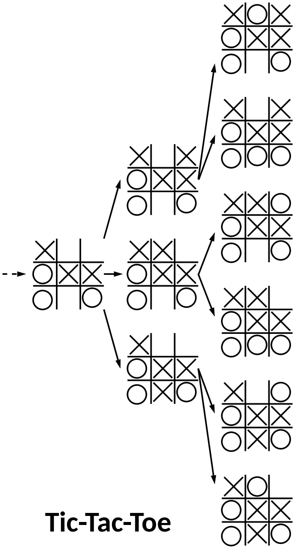

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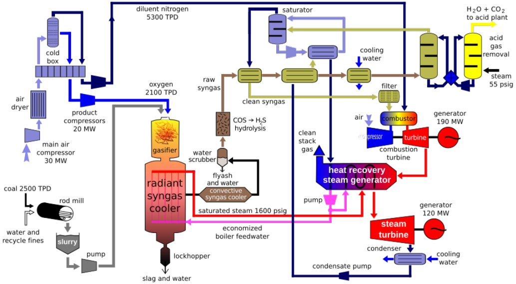

Chemical plant

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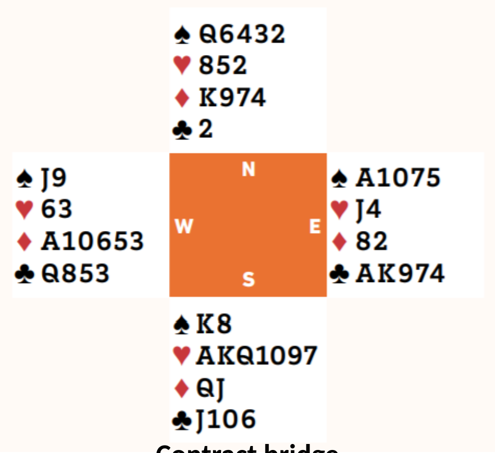

Contract bridge

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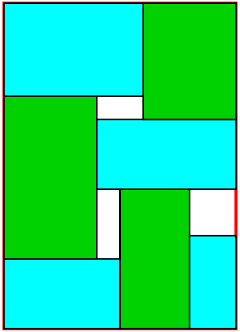

Placement

Thank you!