Artificial Intelligence

Fiona Yan Liu

Department of Computing

The Hong Kong Polytechnic University

Learning Outcomes of Lecture 02

- Understand the related concepts of rational agent
- Master how to use rational agent to solve the real-world problem
- Know the latest techniques of rational agent
- Understand the relation between informed search and uninformed search
- Master the typical search algorithms
- Understand the related concepts of heuristics

Agenda

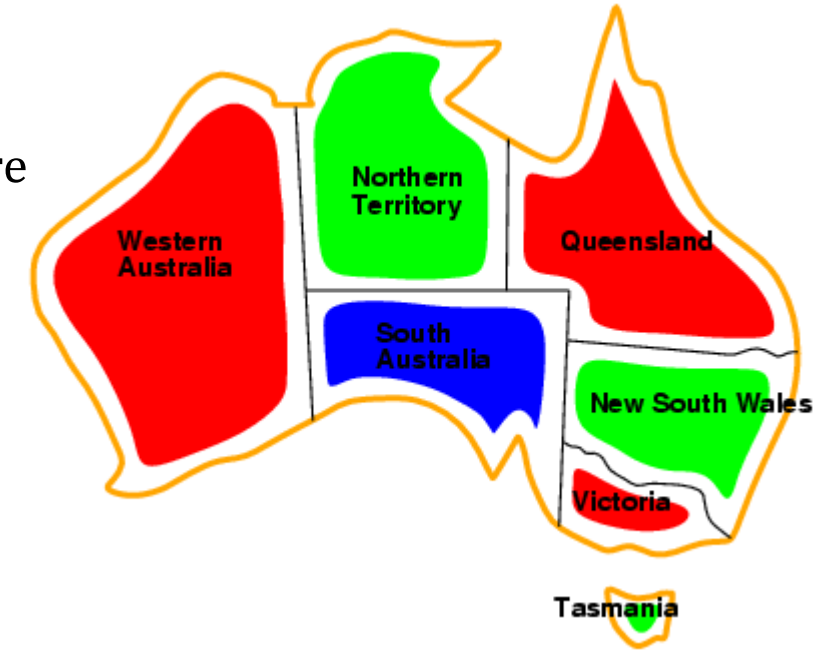
- Constraint
  - Something that controls what you do by keeping you within particular limits:
- Constraint satisfaction problem
- Games

Agenda

- Constraint
- Constraint satisfaction problem
- Games

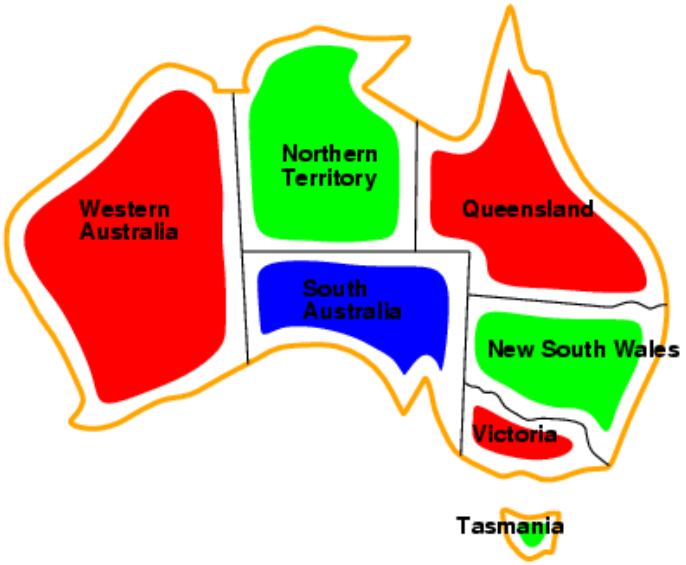
Constraint Satisfaction Problems

- Map-coloring
  - Adjacent regions must have different colors
  - WA = red, NT = green, Q = red, NSW = green, V = red, SA = blue, T = green
- Classical search problem
  - Each state is atomic with no internal structure
  - These states can be evaluated and test to see whether they are goal states
- Constraint satisfaction problem (CSP)
  - State is defined by variables X_i with values from domain D_i
  - Goal test is a set of constraints specifying allowable combinations of values for subsets of variables
- CSP consists of three components
  - A set of variables
  - A set of domains
  - A set of constrains

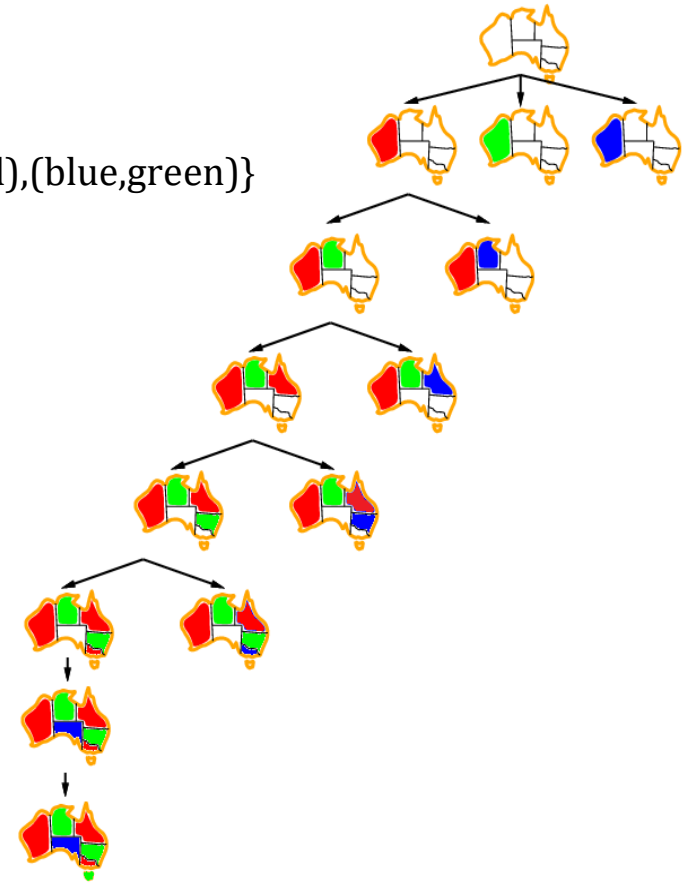


Solve Map-Coloring Problem using Search Tree

- Variables {WA, NT, Q, NSW, V, SA, T}
- Domains Di = {red,green,blue}
- Constraints: adjacent regions must have different colors
  e.g.WA ≠ NT, or (WA,NT) in {(red,green),(red,blue),(green,red), (green,blue),(blue,red),(blue,green)}

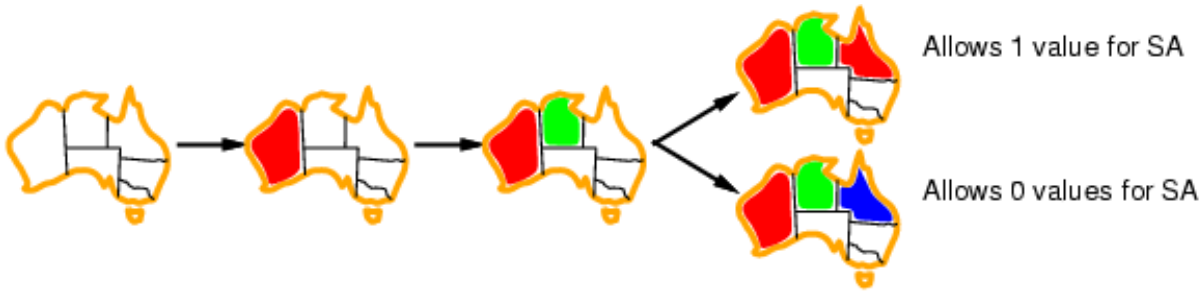


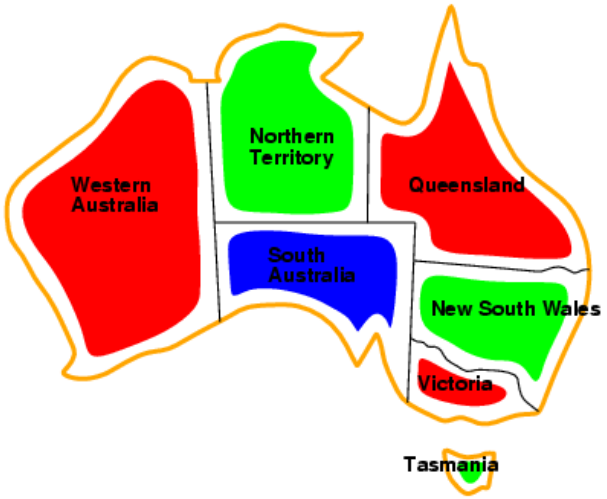


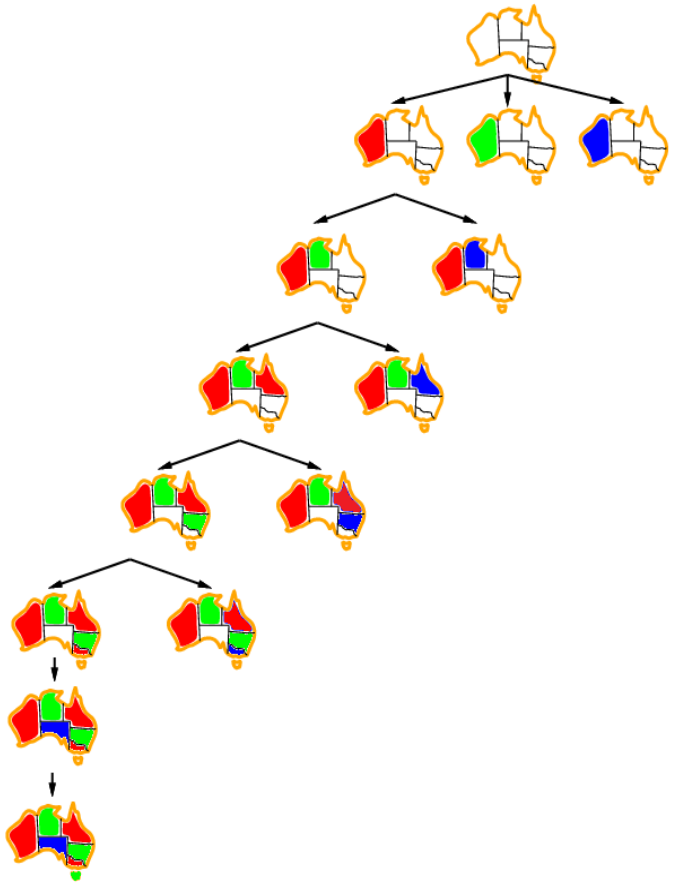


Least Constraining Value

- Strategies to speedup the search
  - Given a variable, choose the least constraining value



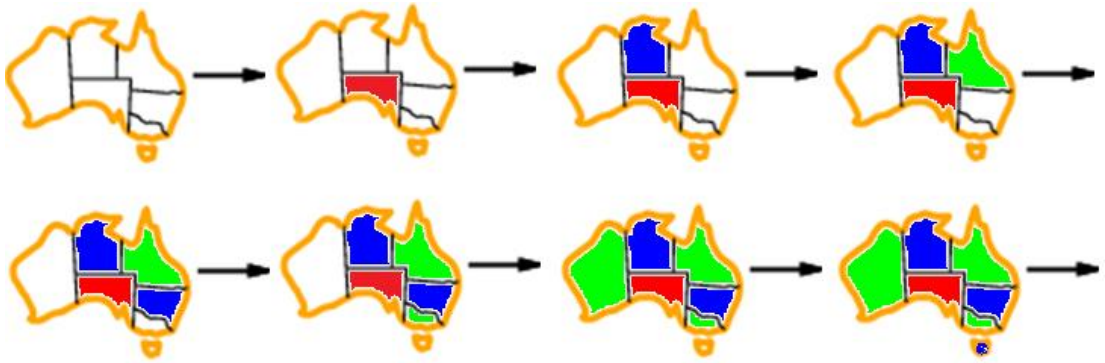




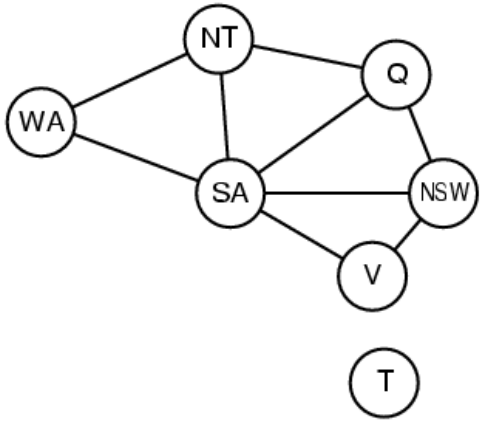
Most Constrained Variable

- Constraint graph
  - nodes are variables, arcs are constraints
- Most constrained variable
  - Choose the variable with the fewest legal values

Variable	WA	NT	SA	Q	NSW	V	T	Weight
WA	0	1	1	0	0	0	0	2
NT	1	0	1	1	0	0	0	3
SA	1	1	0	1	1	1	0	5
Q	0	1	1	0	1	0	0	3
NSW	0	0	1	1	0	1	0	3
V	0	0	1	0	1	0	0	2
T	0	0	0	0	0	0	0	0

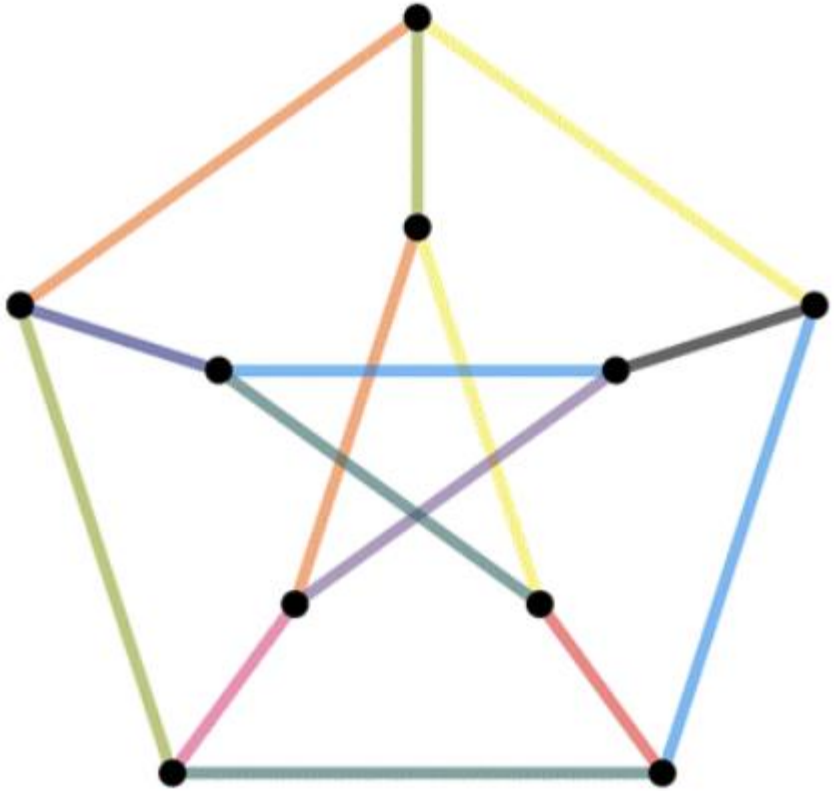






Applications

- CSP enable solutions of complex problems
  - Exam and class scheduling
  - Job scheduling
  - Air traffic flow management
  - Bandwidth allocation in wireless communication
  - Register allocation in computer compiler



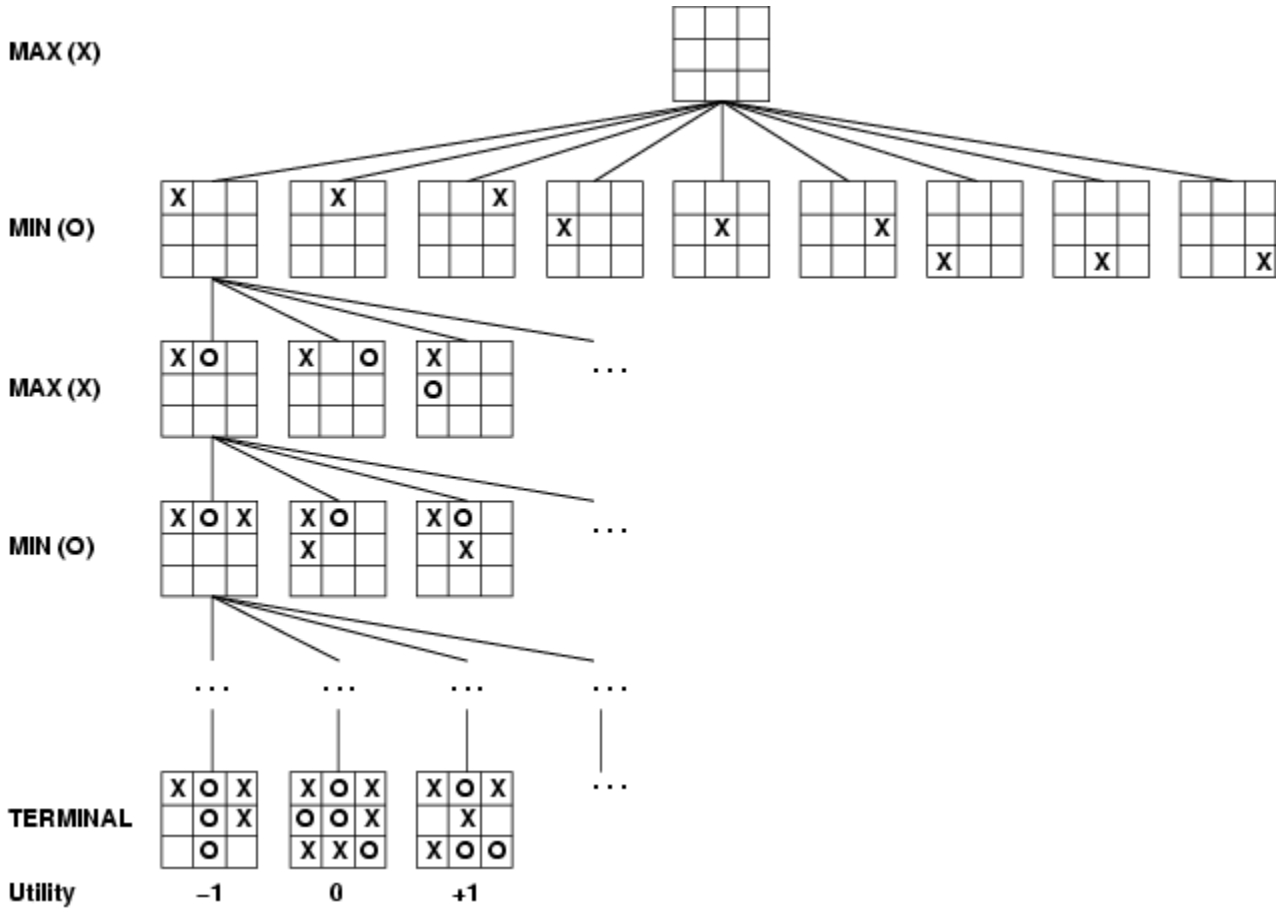
Agenda

- Constraint
- Constraint satisfaction problem
- Games

Games

- Multiagent environment
  - In which each agent needs to consider the actions of other agents
  - And how they affect its own welfare
- Games
  - Views any multiagent environment as a game, provided that the impact of each agent on the other is significant
- Games in AI
  - The state of a game is easy to represent
  - Agents are usually restricted to a small number of actions
  - Outcomes are defined by precise rules

Example of a Partial Game Tree

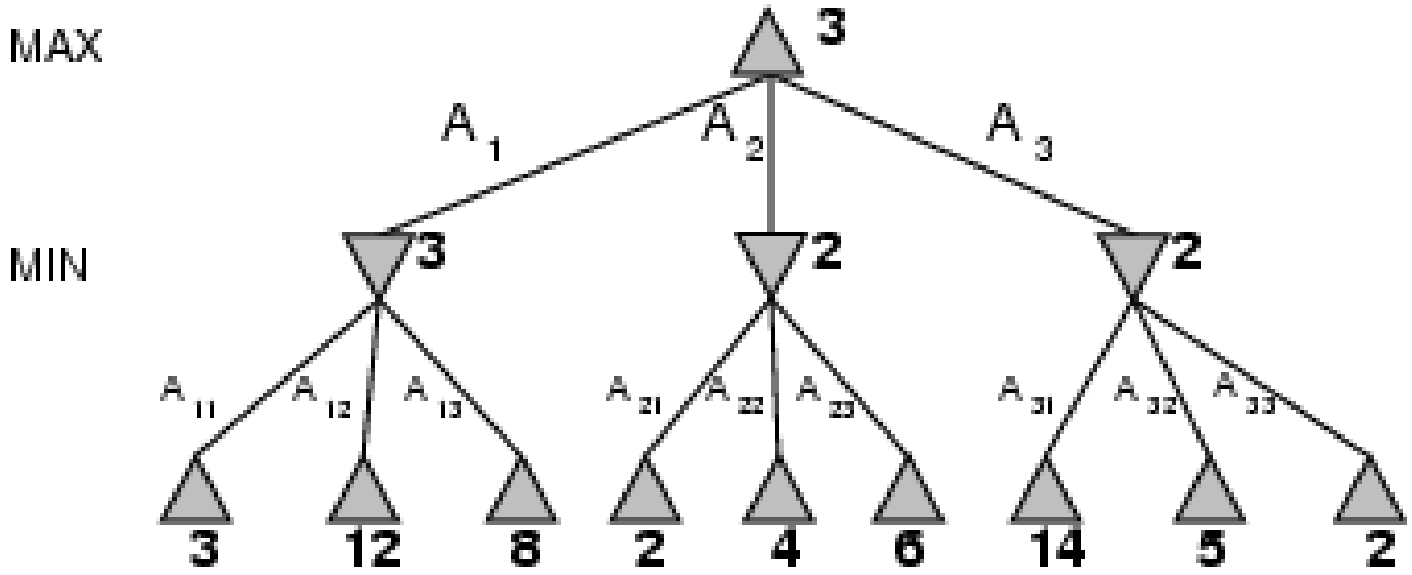


Formulate Game to Search Problem

- S_0
  - The initial state, which specifies how the game is set up at the start
- Player(s)
  - Defines which players has the move in a state
- Actions(s)
  - Defines a set of legal move in a state
- Result(s, a)
  - The transition model, which defines the result of a move
- Terminal-Test(s)
  - A terminal test, which is true when the game is over
- Utility(s, p)
  - A utility function, also called an objective function or payoff function
  - Defines the final numeric value for a game that ends in terminal state s for a player p

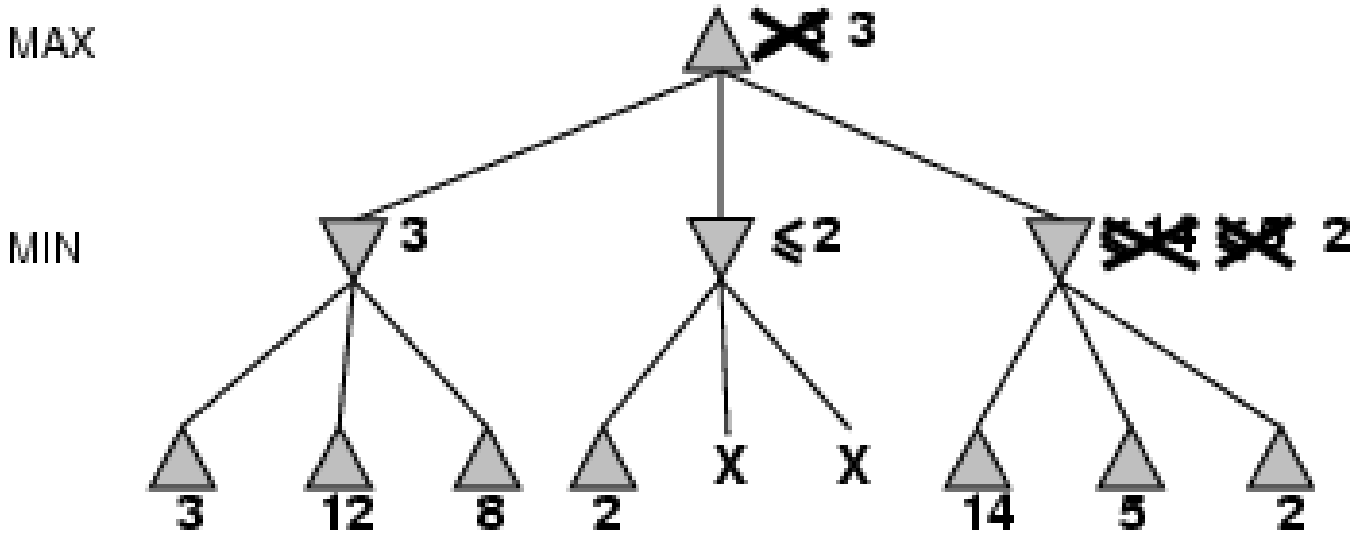
Optimal Decision in Games

- Perfect play for deterministic games
  - Idea: choose move to position with highest minimax value
  - best achievable payoff against best player



α-β Pruning

- α
  - Best already explored option along path to the root for maximizer
- β
  - Best already explored option along path to the root for minimizer



Arrangement of Following Classes

- Classes and labs on Oct. 1
  - Be cancelled due to the public holiday
- Class on Oct. 8
  - Quiz 3 covers lecture 3
  - Decision tree
- Lab on Oct. 8
  - AI-powered Audio generation
- Happy National Day !