

Simulated Annealing

$x \leftarrow$ initial state

time $\leftarrow 1$

Until termination

$x' \leftarrow$ neighbor of x .

$T \leftarrow 1/time$.
temperature.

if $F(x') > F(x)$

$x \leftarrow x'$

else.

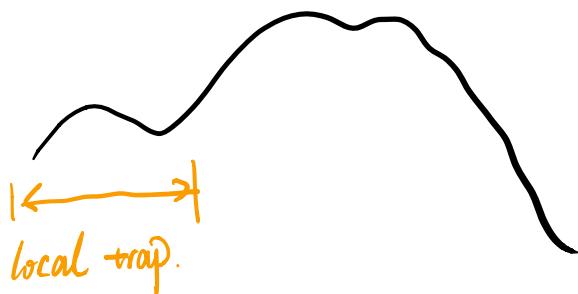
hypo parameter.

$$\text{if } \text{rand}() \leq P^{\frac{1}{k}} [e^{-\frac{F(x) - F(x')}{T}}]$$

$x \leftarrow x'$

final \leftarrow time + 1

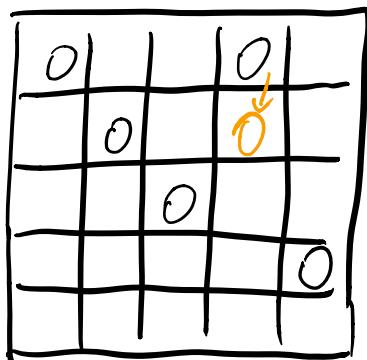
$F(x) - F(x')$
Here is how possible
we accept the change.



"KNOT THEORY"

choose neighbor random.

Eight queen problem.



Find neighbor.
move one random.

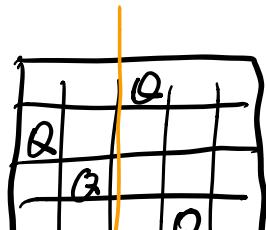
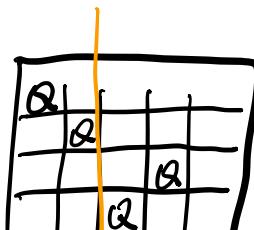
nature evolution. Genetic Alg.

Population of proposed solutions

mimic Select for Fitness.

bio-evolution Reproduction / Crossover

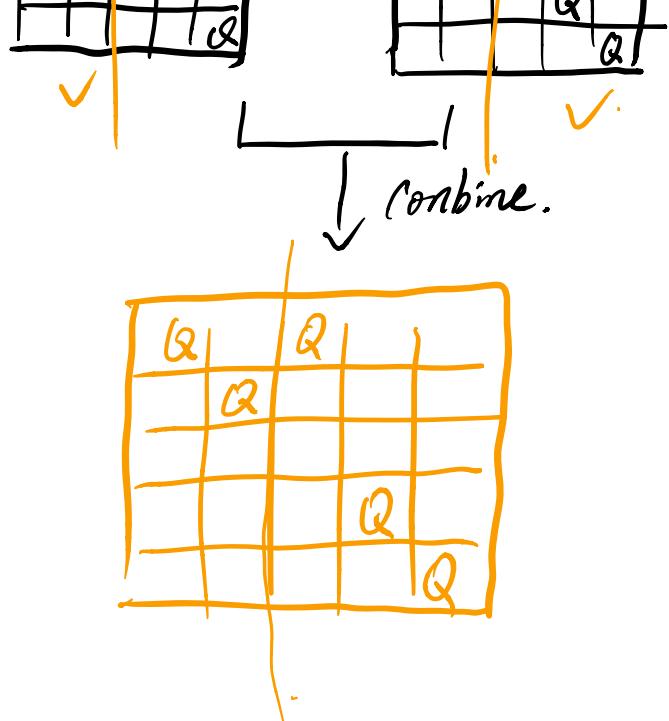
Mutation maintain variation.



pick random.

0	1	0	0	0	1	0	1
0	1	1	1	0	0	1	1
<hr/>							
0	1	0	1	0	1	1	1

mutation.



generate new & novel solution.

1/80

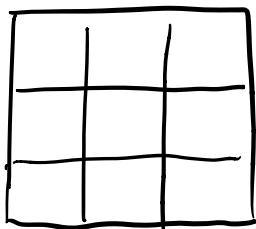
Best 50

Best 50 + bad 10

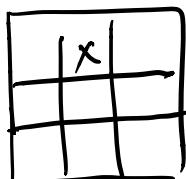
AI can be bias because of datasets.

keep variation. maintain a small population of bad

Games.

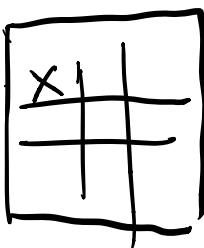


Two players.

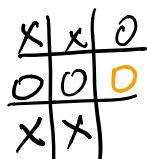
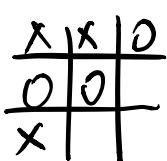


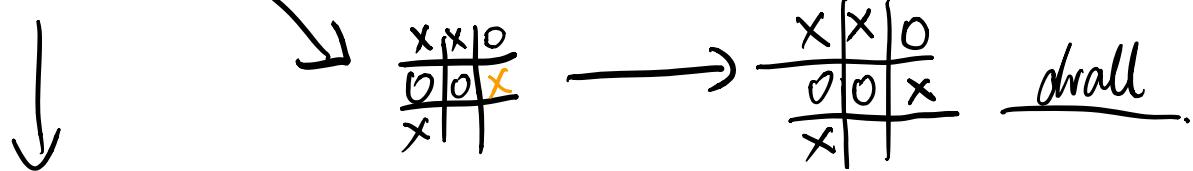
How to choose?

9 possibility



what possible later moves.



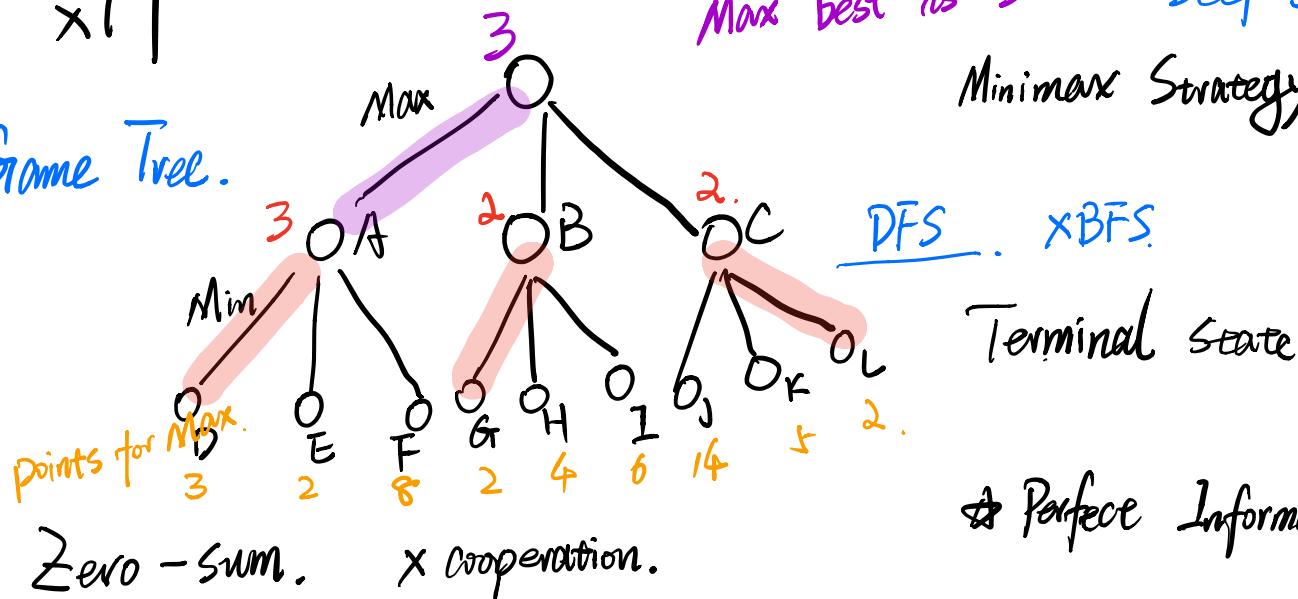


E.g. Alpha GO

Max best is 3 Deep Blue.

Minimax Strategy

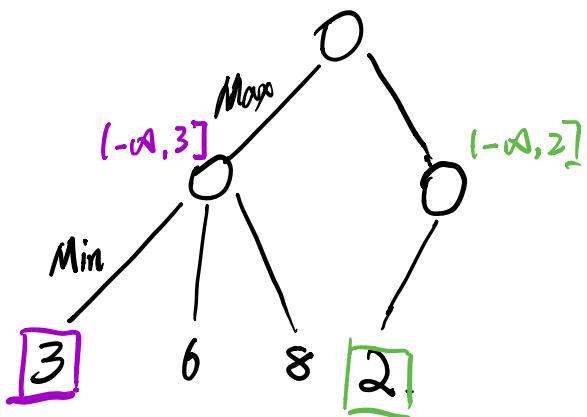
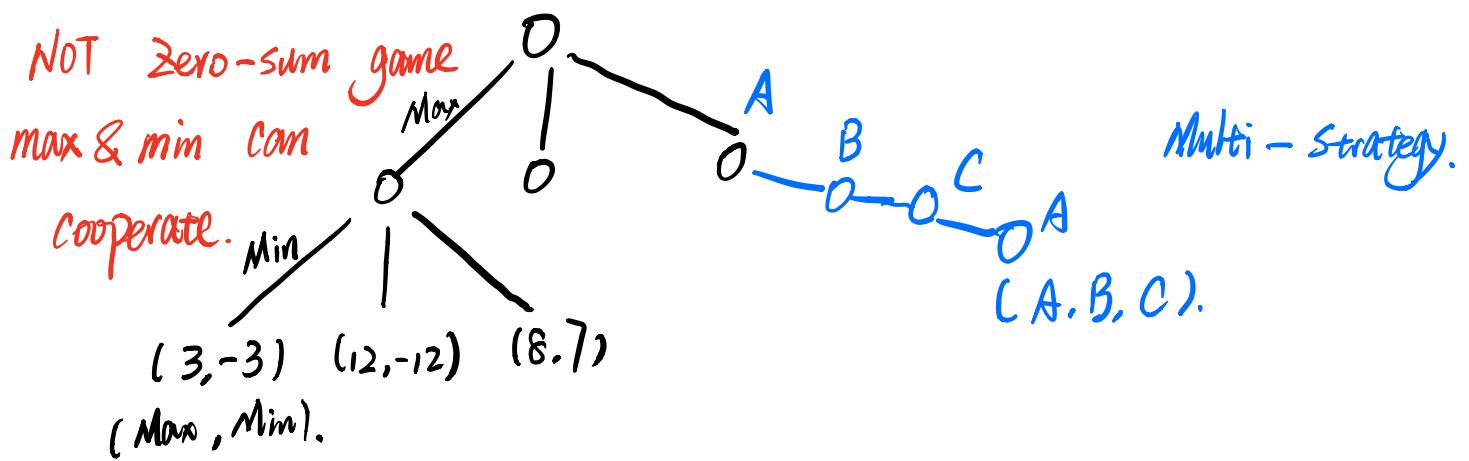
Game Tree.



Terminal State

* Perfect Information.

fixed before start. no freewill.



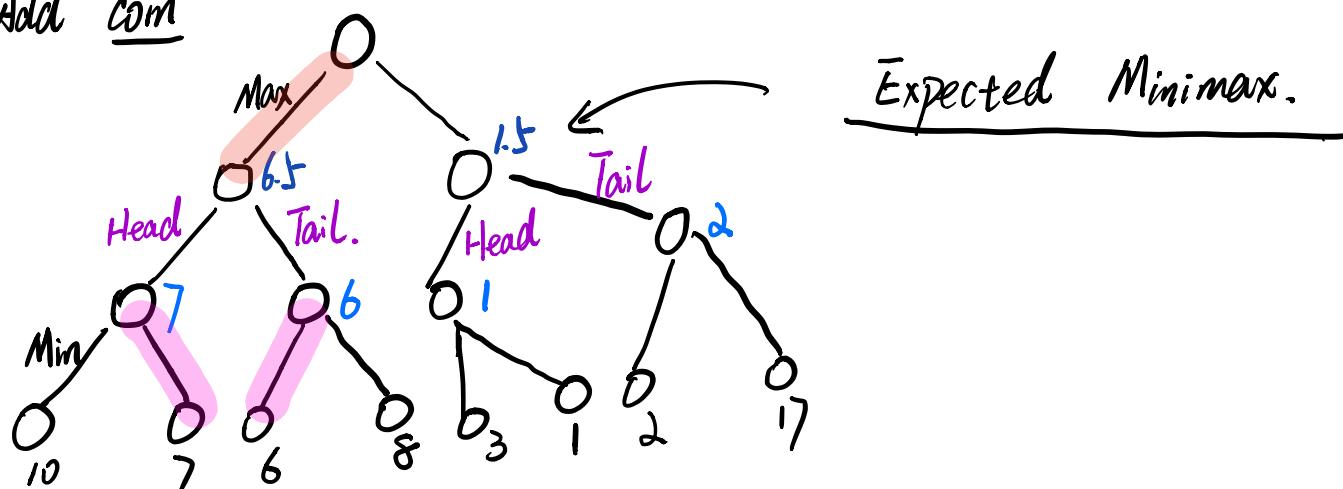
Always choose 3 over 2.
So there's no need to go down.

track upper & lower boundary.

? heuristic.
estimate for node efficiency.

difficulty control. — depth of search.

Add coin



Constraint Satisfaction Problems. (How to play)

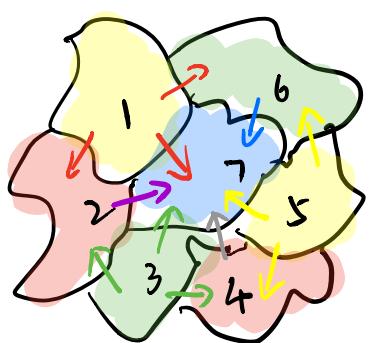
Variables

values $A + B + C = 1$

constraints. $A + B$ C must be Zero.

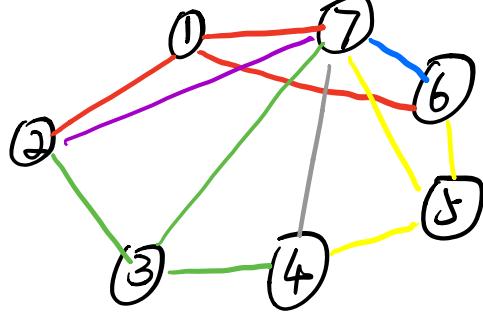
$A, B, C \in \{0, 1\}$.

E.g. Map Color Problem.



Four Color Theory.

4-color to color a map
and no neighbors are the same.

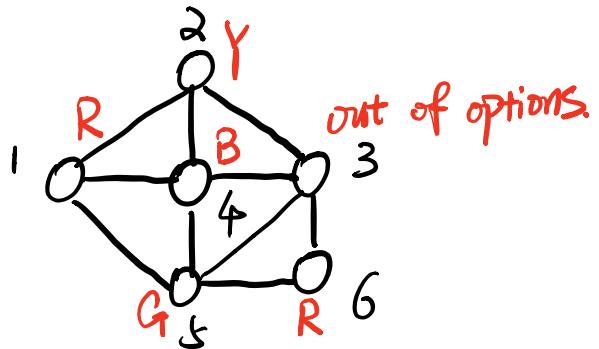


Start with 7
4 level DFS. X
Back-track. ✓.
How to simplify?

possible choice.

1	2	3	4	5	6
R	R	R	R	R	R
G	G	G	G	G	G
B	B	B	B	B	B
Y	Y	Y	Y	Y	Y

← out of options. → Backtrack.



Search Alg (DFS, BFS)

Informed (A*)

Local Search (Hill, S.A.)

Adversarial Search

Const. Sat. Prob. Backtracking DFS

Flow chart

Initial knowledge.
↓

→ Explore & collect Data
↓

update knowledge base. → Some solutions.

Logic.

Initial : $A \rightarrow B$

Collect Data : A KB: $A \rightarrow B, A \cdot B$

Update KB = B

$$\begin{array}{ccc} A & B & A \Rightarrow B \\ T & T & T \end{array}$$

$$\begin{array}{ccc} T & F & F \end{array}$$

$$\begin{array}{ccc} F & T & T \end{array}$$

$$\begin{array}{ccc} F & F & T \end{array}$$

> No counter evidence.

hence, TRUE.

A: "my prints are on the gun"

B: "I am the murderer"

$A \Rightarrow B$: "If prints, then murderer"

Modus Ponens.

$$A \Rightarrow B, A \models B$$

F entell (force B to be True).

Modus Tollens

$$A \Rightarrow B, \neg B \models \neg A$$

Logical Agents.

Truth Table (Top Section):

A	B	$\neg A$	$\neg B$	$A \Rightarrow B$	$\neg A \wedge B$	$\neg A \vee B$	$A \wedge \neg B$	$A \vee B$
T	T	F	F	T	F	T	F	T
T	F	F	T	F	F	T	F	T
F	T	T	F	T	T	T	T	T
F	F	T	T	F	T	T	F	T

Hypothesis KB (Bottom Section):

$$A \Rightarrow B, B, A \wedge C$$

Query:

$$A \wedge \neg B$$

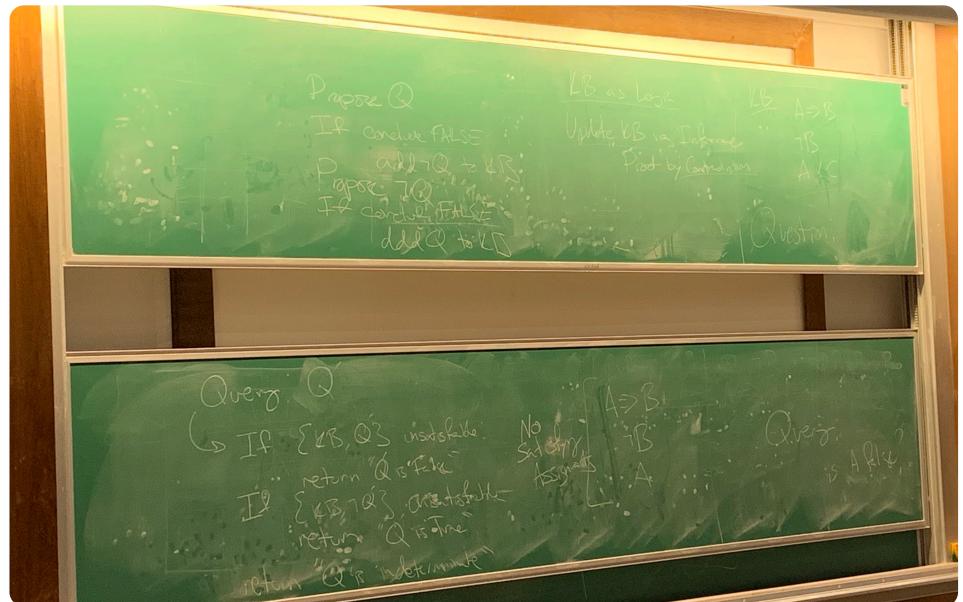
KB:

$$A \Rightarrow B$$
$$B$$
$$A \wedge C$$

Resolution Inference Rules.

$$(A \vee B), (\neg B \vee C) \models (A \vee C)$$

"complete"



Logic \rightarrow Logic Inference.

Logic as search.

\hookrightarrow proof by contradiction.

(queries).

Logic as satisfiability.