AI intro Homework #2

NCTU Spring 2018

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1. Tick-tack-toe min-max

(a) Win (1): 17, 18, 20, 22, 26, 27, 29, 30, 31, 33

Lose (-1): 8, 11, 14, 37, 40, 41, 42

Draw (0): 35, 36, 38, 39

(b) Node 1

Node #	1	2	3	4	5	6	7	8	9	10	11
Minimax val	1	-1	-1	-1	1	1	1	-1	0	1	-1

Node #	12	13	14	15	16	17	18	19	20	21	22
Minimax val	1	1	-1	1	1	1	1	0	1	0	1

Node #	23	24	25	26	27	28	29	30	31	32	33
Minimax val	-1	0	0	1	1	-1	1	1	1	-1	1

Node #	34	35	36	37	38	39	40	41	42		
Minimax val	-1	0	0	-1	0	0	-1	-1	-1		

(c) α-β pruning

skipped: 9, 10, 12, 13, 15, 16, 23~34, 37~42

2. tic-tack-toe evaluate function

(a) Evaluation function F

if terminal, and x wins, F = MIN

, and o wins, F = MAX

If not terminal, X = # of line of x when fill all the blank with x

Y = # of line of o when fill all the blank with o

Evaluate function F = Y – X

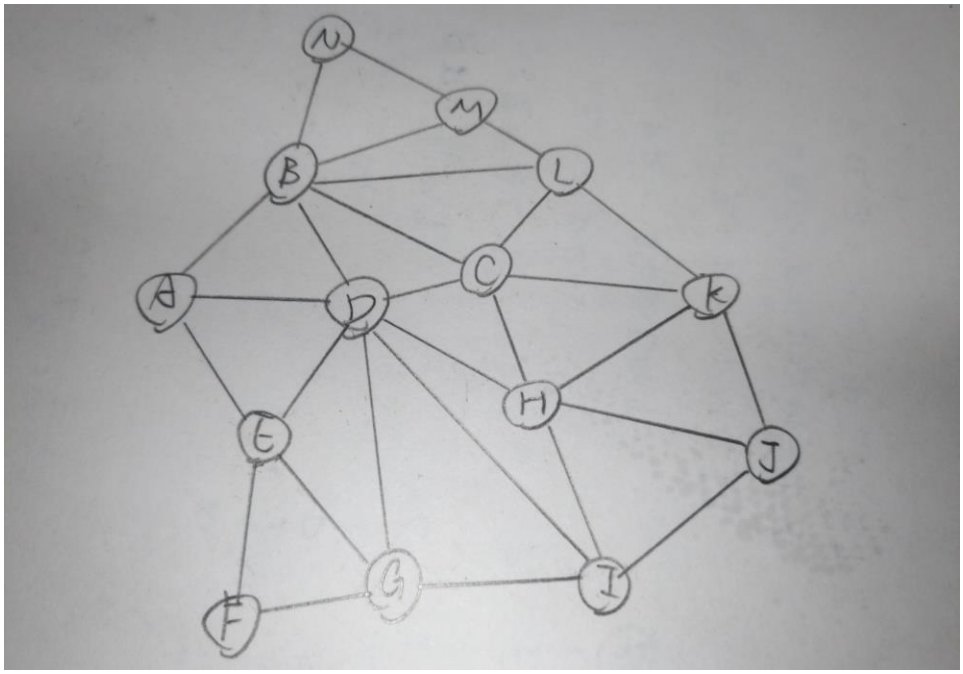
The function implies the chance of x and o to make a line(s). The more line it makes, the more chances it wins. And the same rule applies to the opponent.

Node #	5	6	7	8	9	10	11	12	13	14	15	16
F	1	0	1	MIN	0	1	MIN	0	0	MIN	1	0

(b) 1

3. CSP

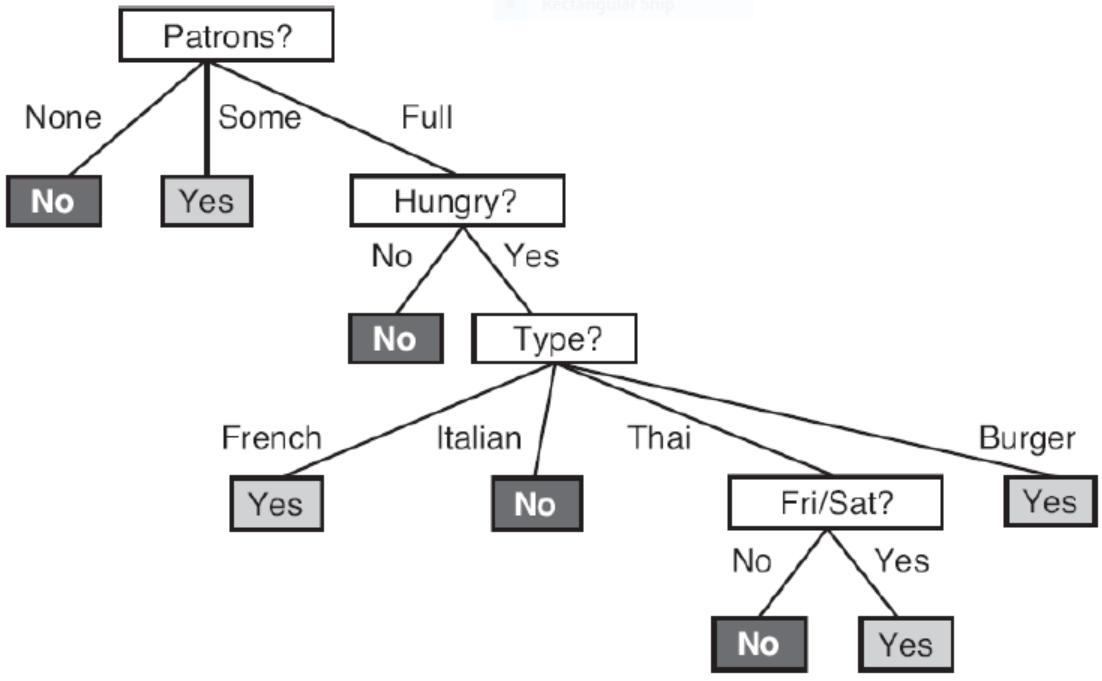
(a)



(b) Backtrack + forward checking + (MRV, degree heuristic, LCV)

Reg	Val	A	B	C	D	E	F	G	H	I	J	K	L	M	N
x	x	1234	1234	1234	1234	1234	1234	1234	1234	1234	1234	1234	1234	1234	1234
D	1	234	234	234	1	234	1234	234	234	234	1234	1234	1234	1234	1234
B	2	34	2	34	1	234	1234	234	234	234	1234	1234	134	134	134
C	3	34	2	3	1	234	1234	234	24	234	1234	124	14	134	134
H	2	34	2	3	1	234	1234	234	2	34	134	14	14	134	134
I	3	34	2	3	1	234	1234	24	2	3	14	14	14	134	134
G	2	34	2	3	1	34	134	2	2	3	14	14	14	134	134
E	3	4	2	3	1	3	14	2	2	3	14	14	14	134	134
A	4	4	2	3	1	3	14	2	2	3	14	14	14	134	134
K	1	4	2	3	1	3	14	2	2	3	4	1	4	134	134
L	4	4	2	3	1	3	14	2	2	3	4	1	4	13	134
J	4	4	2	3	1	3	14	2	2	3	4	1	4	13	134
M	1	4	2	3	1	3	14	2	2	3	4	1	4	1	34
F	1	4	2	3	1	3	1	2	2	3	4	1	4	1	34
N	3	4	2	3	1	3	1	2	2	3	4	1	4	1	3

4. Decision tree



Step 0 : $G = 1 - (\frac{1}{2})^2 - (\frac{1}{2})^2 = \frac{1}{2}$

Step 1 ($G(A) = \frac{1}{2}$) :

Alt. Y: $\frac{1}{2}$ N: $\frac{1}{2}$ $\Delta G = \frac{1}{2} - (\frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{2}) = 0$

Bar Y: $\frac{1}{2}$ N: $\frac{1}{2}$ $\Delta G = \frac{1}{2}$

Fri/Sat Y: $1 - (\frac{2}{5})^2 - (\frac{3}{5})^2 = \frac{12}{25}$ N: $1 - (\frac{3}{7})^2 - (\frac{4}{7})^2 = \frac{24}{49}$ $\Delta G = \frac{1}{2} - (\frac{5}{12} \times \frac{12}{25} + \frac{7}{12} \times \frac{24}{49}) = \frac{1}{10}$

Hun Y: $1 - (\frac{5}{7})^2 - (\frac{2}{7})^2 = \frac{20}{49}$ N: $1 - (\frac{1}{5})^2 - (\frac{4}{5})^2 = \frac{8}{25}$ $\Delta G = \frac{1}{2} - (\frac{7}{12} \times \frac{20}{49} + \frac{5}{12} \times \frac{8}{25}) = \frac{9}{10}$

Pat. Some: $1 - (\frac{4}{4})^2 = 0$ Full: $1 - (\frac{2}{6})^2 - (\frac{4}{6})^2 = \frac{8}{9}$ None: $1 - (\frac{2}{3})^2 = 0$ $\Delta G = \frac{1}{2} - (\frac{1}{2} \times \frac{8}{9}) = \frac{5}{18}$ ⇒ Max ΔG

Price 3: $1 - (\frac{1}{3})^2 - (\frac{2}{3})^2 = \frac{4}{9}$ 2: $1 - (\frac{2}{2})^2 = 0$ 1: $1 - (\frac{1}{7})^2 - (\frac{6}{7})^2 = \frac{24}{49}$ $\Delta G = \frac{1}{2} - (\frac{3}{12} \times \frac{4}{9} + \frac{7}{12} \times \frac{24}{49}) = \frac{13}{126}$

Rain Y: $1 - (\frac{1}{5})^2 - (\frac{2}{5})^2 = \frac{12}{25}$ N: $1 - (\frac{2}{7})^2 - (\frac{5}{7})^2 = \frac{24}{49}$ $\Delta G = \frac{1}{10}$

Res. Y: $1 - (\frac{3}{5})^2 - (\frac{2}{5})^2 = \frac{12}{25}$ N: $1 - (\frac{3}{7})^2 - (\frac{4}{7})^2 = \frac{24}{49}$ $\Delta G = \frac{1}{10}$

Type F: $\frac{1}{2}$ B: $\frac{1}{2}$ T: $\frac{1}{2}$ I: $\frac{1}{2}$ $\Delta G = 0$

Time 10: $1 - (\frac{4}{6})^2 - (\frac{2}{6})^2 = \frac{4}{9}$ 30: $\frac{1}{2}$ 60: 0 (✓) $\Delta G = \frac{1}{2} - (\frac{6}{12} \times \frac{4}{9} + \frac{4}{12} \times \frac{1}{2}) = \frac{1}{9}$

Step 2 ($G(A) = \frac{4}{9}$)

Alt. Y: $1 - (\frac{3}{5})^2 - (\frac{2}{5})^2 = \frac{12}{25}$ N: 0 $\Delta G = \frac{4}{9} - \frac{5}{6} \times \frac{12}{25} = \frac{2}{45}$

Bar Y: $1 - (\frac{2}{3})^2 - (\frac{1}{3})^2 = \frac{4}{9}$ N: $\frac{4}{9}$ $\Delta = \frac{4}{9} - (\frac{1}{2} \times \frac{4}{9} - \frac{1}{2} \times \frac{4}{9}) = 0$

Fri/Sat
Y: $\frac{12}{25}$
N: 0
$\Delta G = \frac{2}{45}$

Hun
Y: $1-(\frac{2}{4})^2-(\frac{2}{4})^2=\frac{1}{2}$
N: 0
$\Delta G = \frac{4}{9}-(\frac{4}{6}\times\frac{1}{2}) = \frac{1}{3}$ ⇒ Max ΔG

Price
3: 0
1: $\frac{1}{2}$
$\Delta G = \frac{1}{9}$

Rain
Y: $\frac{1}{2}$
N: $1-(\frac{1}{4})^2-(\frac{3}{4})^2=\frac{3}{8}$
$\Delta G = \frac{4}{9}-(\frac{1}{3}\times\frac{1}{2}+\frac{2}{3}\times\frac{3}{8}) = \frac{1}{36}$

Res
Y: 0
N: $\frac{1}{2}$
$\Delta G = \frac{1}{9}$

Type
F: 0
B: $\frac{1}{2}$
T: $\frac{1}{2}$
I: 0
$\Delta G = \frac{4}{9}-(\frac{1}{3}\times\frac{1}{2}+\frac{1}{3}\times\frac{1}{2}) = \frac{1}{9}$

Time
10: $\frac{1}{2}$
30: $\frac{1}{2}$
60: 0
$\Delta G = \frac{1}{9}$

step 3 $(G(A) = \frac{1}{2})$

Alt ⇒ Y

Bar
Y: $\frac{1}{2}$
N: $\frac{1}{2}$
$\Delta G = 0$

Fri/Sat
Y: $\frac{4}{9}$
N: 0
$\Delta G = \frac{1}{2}-(\frac{1}{3}\times\frac{4}{9}) = \frac{1}{8}$

Price
3: 0
1: $\frac{4}{9}$
$\Delta G = \frac{1}{4}$

Rain
Y: 0
N: $\frac{4}{9}$
$\Delta G = \frac{1}{6}$

Type
B: 0
T: $\frac{1}{2}$
I: 0
$\Delta G = \frac{1}{2}-(\frac{1}{2}\times\frac{1}{2}) = \frac{1}{4}$ ⇒ Max ΔG

Time
30: $\frac{1}{2}$
10: $\frac{1}{2}$
$\Delta G = 0$