expectimax

CSCI 373

WOODLE

CEDAR
EBONY
MAPLE
BEECH
BIRCH

the target word is chosen uniformly at random but not revealed to us

WOODLE

	$P(t)$
CEDAR	$\frac{1}{5}$
EBONY	$\frac{1}{5}$
MAPLE	$\frac{1}{5}$
BEECH	$\frac{1}{5}$
BIRCH	$\frac{1}{5}$

the target word is chosen uniformly at random but not revealed to us

✓ CEDAR	CEDAR	CEDAR	CEDAR	CEDAR
EBONY	✓ EBONY	EBONY	EBONY	EBONY
MAPLE	MAPLE	✓ MAPLE	MAPLE	MAPLE
BEECH	BEECH	BEECH	✓ BEECH	BEECH
BIRCH	BIRCH	BIRCH	BIRCH	✓ BIRCH

is EBONY a good guess? ✓/×


✓ CEDAR
× EBONY
MAPLE
× BEECH
× BIRCH
2 remain
× CEDAR
✓ EBONY
× MAPLE
× BEECH
× BIRCH
1 remains
CEDAR
× EBONY
✓ MAPLE
× BEECH
× BIRCH
2 remain
× CEDAR
× EBONY
× MAPLE
✓ BEECH
× BIRCH
1 remains
× CEDAR
× EBONY
× MAPLE
× BEECH
✓ BIRCH
1 remains
is EBONY a good guess?

✓ CEDAR	× CEDAR	CEDAR	× CEDAR	× CEDAR
× EBONY	✓ EBONY	× EBONY	× EBONY	× EBONY
MAPLE	× MAPLE	✓ MAPLE	× MAPLE	× MAPLE
× BEECH	× BEECH	× BEECH	✓ BEECH	× BEECH
× BIRCH	× BIRCH	× BIRCH	× BIRCH	✓ BIRCH

expected # of remaining words after guessing EBONY = $\boxed{?}$

expected # of remaining words after guessing EBONY = $\boxed{?}$

$$2 \cdot P(\text{CEDAR}) + 1 \cdot P(\text{EBONY}) + 2 \cdot P(\text{MAPLE}) + 1 \cdot P(\text{BEECH}) + 1 \cdot P(\text{BIRCH})$$

✓ CEDAR	× CEDAR	CEDAR	× CEDAR	× CEDAR
× EBONY	✓ EBONY	× EBONY	× EBONY	× EBONY
MAPLE	× MAPLE	✓ MAPLE	× MAPLE	× MAPLE
× BEECH	× BEECH	× BEECH	✓ BEECH	× BEECH
× BIRCH	× BIRCH	× BIRCH	× BIRCH	✓ BIRCH

expected # of remaining words after guessing EBONY = $\boxed{1.4}$

$$2 \cdot \frac{1}{5} + 1 \cdot \frac{1}{5} + 2 \cdot \frac{1}{5} + 1 \cdot \frac{1}{5} + 1 \cdot \frac{1}{5}$$

✓ CEDAR	CEDAR	CEDAR	CEDAR	CEDAR
EBONY	✓ EBONY	EBONY	EBONY	EBONY
MAPLE	MAPLE	✓ MAPLE	MAPLE	MAPLE
BEECH	BEECH	BEECH	✓ BEECH	BEECH
BIRCH	BIRCH	BIRCH	BIRCH	✓ BIRCH

is BIRCH a good guess? ✓/×

✓ CEDAR	× CEDAR	× CEDAR	× CEDAR	CEDAR
× EBONY	✓ EBONY	× EBONY	× EBONY	EBONY
× MAPLE	× MAPLE	✓ MAPLE	× MAPLE	MAPLE
× BEECH	× BEECH	× BEECH	✓ BEECH	BEECH
× BIRCH	× BIRCH	× BIRCH	× BIRCH	✓ BIRCH
1 remains	1 remains	1 remains	1 remains	1 remains

is BIRCH a good guess? ✓/×

✓ CEDAR	× CEDAR	× CEDAR	× CEDAR	CEDAR
× EBONY	✓ EBONY	× EBONY	× EBONY	EBONY
× MAPLE	× MAPLE	✓ MAPLE	× MAPLE	MAPLE
× BEECH	× BEECH	× BEECH	✓ BEECH	BEECH
× BIRCH	× BIRCH	× BIRCH	× BIRCH	✓ BIRCH

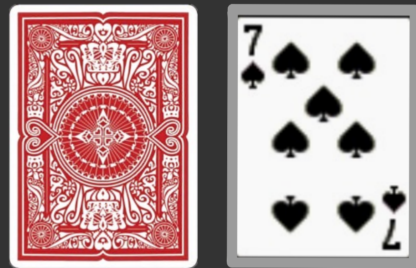
expected # of remaining words after guessing BIRCH = $\boxed{?}$

$$1 \cdot P(\text{CEDAR}) + 1 \cdot P(\text{EBONY}) + 1 \cdot P(\text{MAPLE}) + 1 \cdot P(\text{BEECH}) + 1 \cdot P(\text{BIRCH})$$

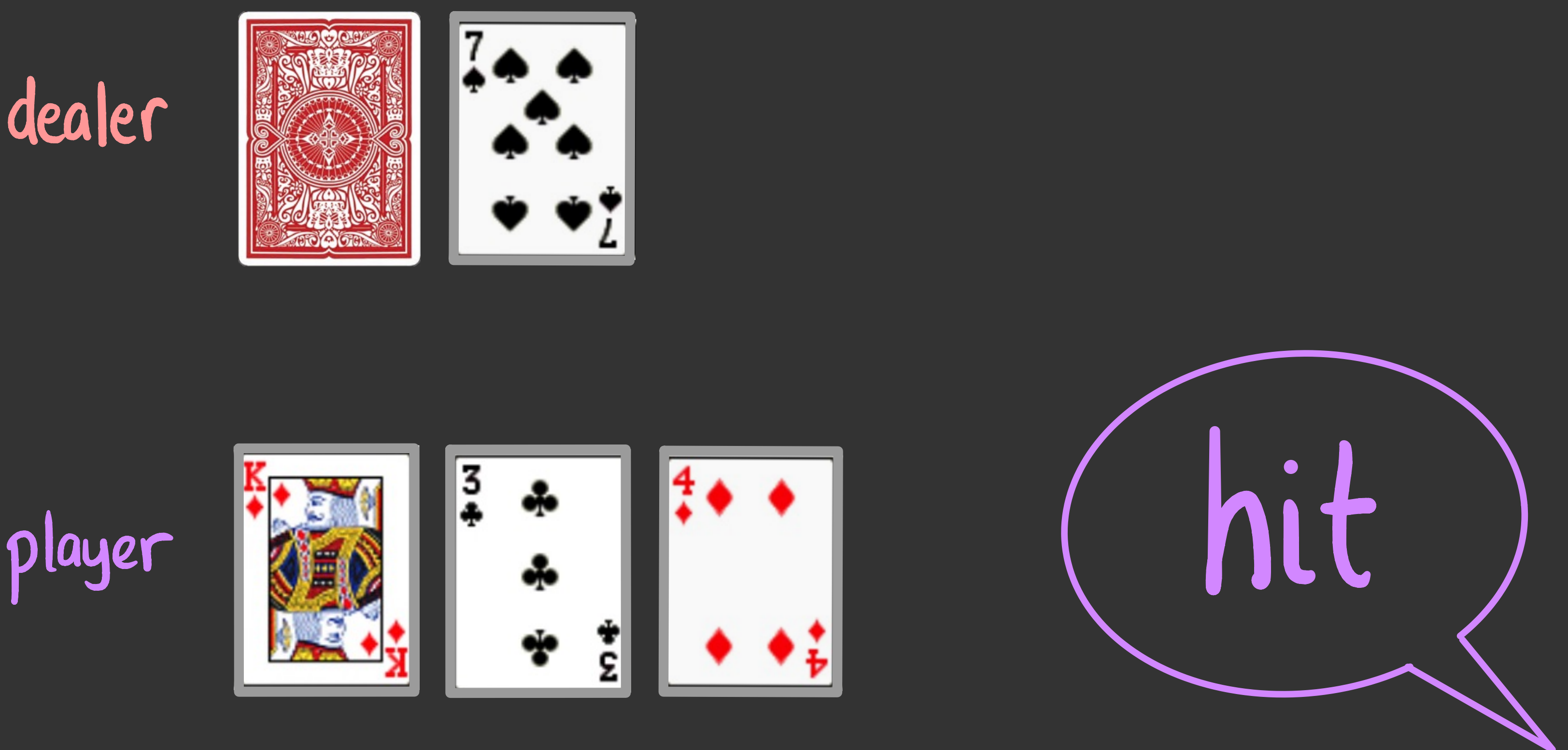
expected # of remaining words after guessing BIRCH = $\boxed{1.0}$

$$1 \cdot \frac{1}{5} + 1 \cdot \frac{1}{5} + 1 \cdot \frac{1}{5} + 1 \cdot \frac{1}{5} + 1 \cdot \frac{1}{5}$$

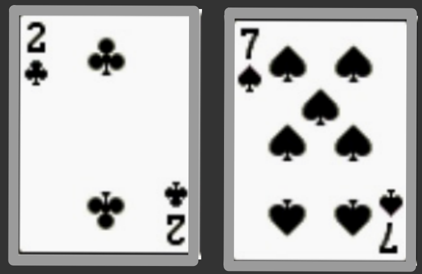
dealer



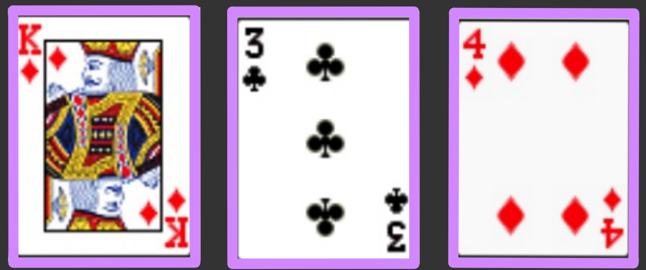
player


dealer
player
hit

dealer



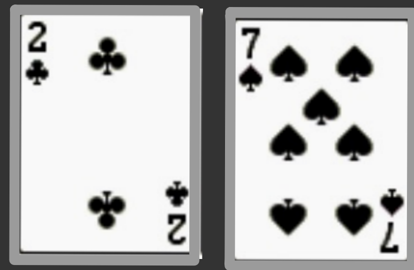
17
player



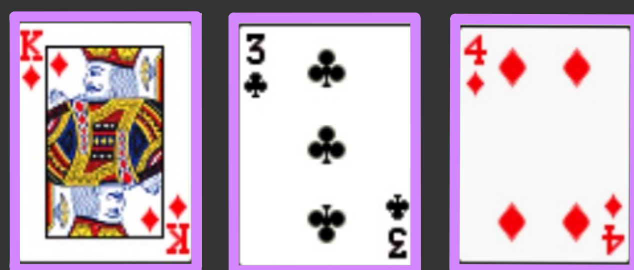
stand

dealer must hit on 16 or less
dealer must stand on 17 or more

dealer



17
player



dealer must hit on 16 or less
dealer must stand on 17 or more

dealer

hit

17
player

dealer must hit on 16 or less
dealer must stand on 17 or more

dealer
19

stand

17
player

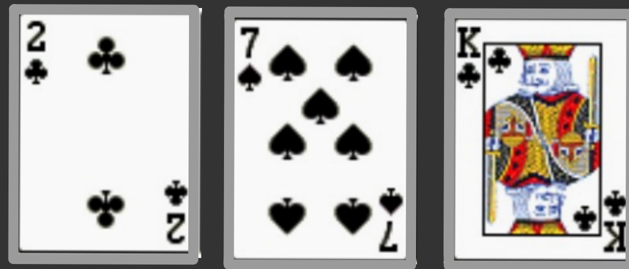
dealer must hit on 16 or less
dealer must stand on 17 or more

but this is not really a two player game, as the dealer has no agency

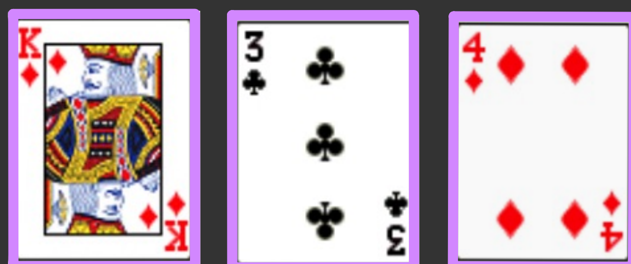
dealer must hit on 16 or less
dealer must stand on 17 or more

winner

dealer
19



17
player

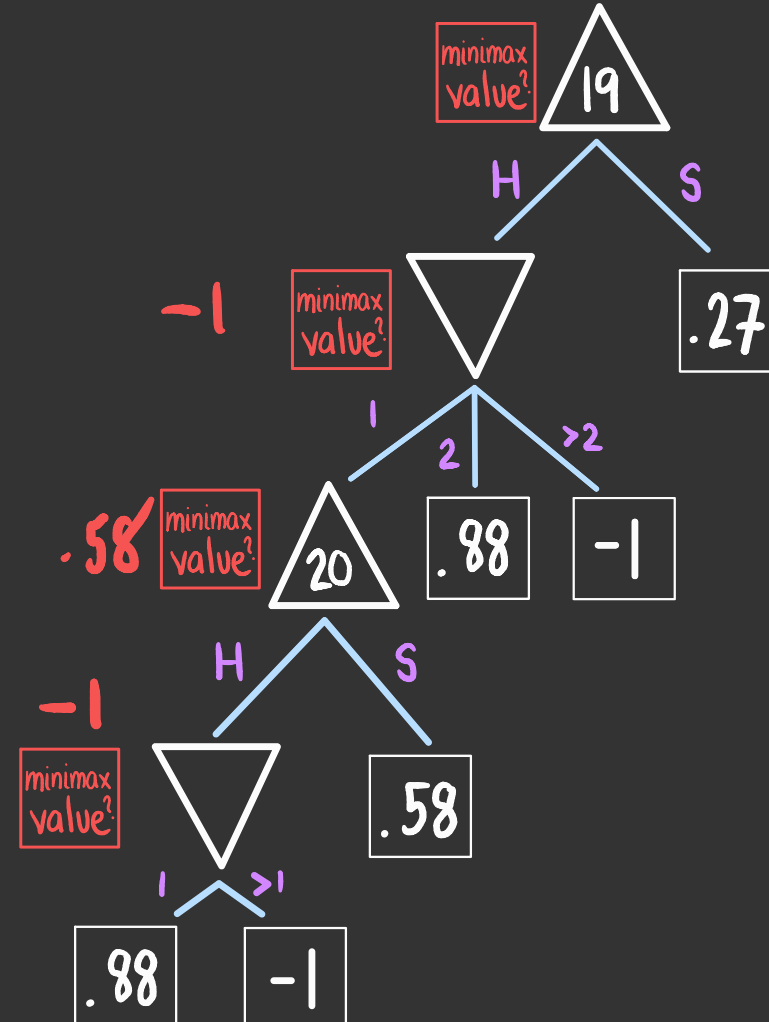


who are we playing against, really?

fate

player's final total	probability of win	draw	loss	expected utility $1 \cdot P(\text{win}) + 0 \cdot P(\text{draw}) - 1 \cdot P(\text{loss})$
21	.88	.12	0	.88
20	.70	.18	.12	.58
19	.57	.13	.30	.27
18	.43	.14	.43	0
17	.28	.15	.57	−.29
16	.28	0	.72	−.44
bust	0	0	1	−1

we could model **blackjack** as minimax against fate

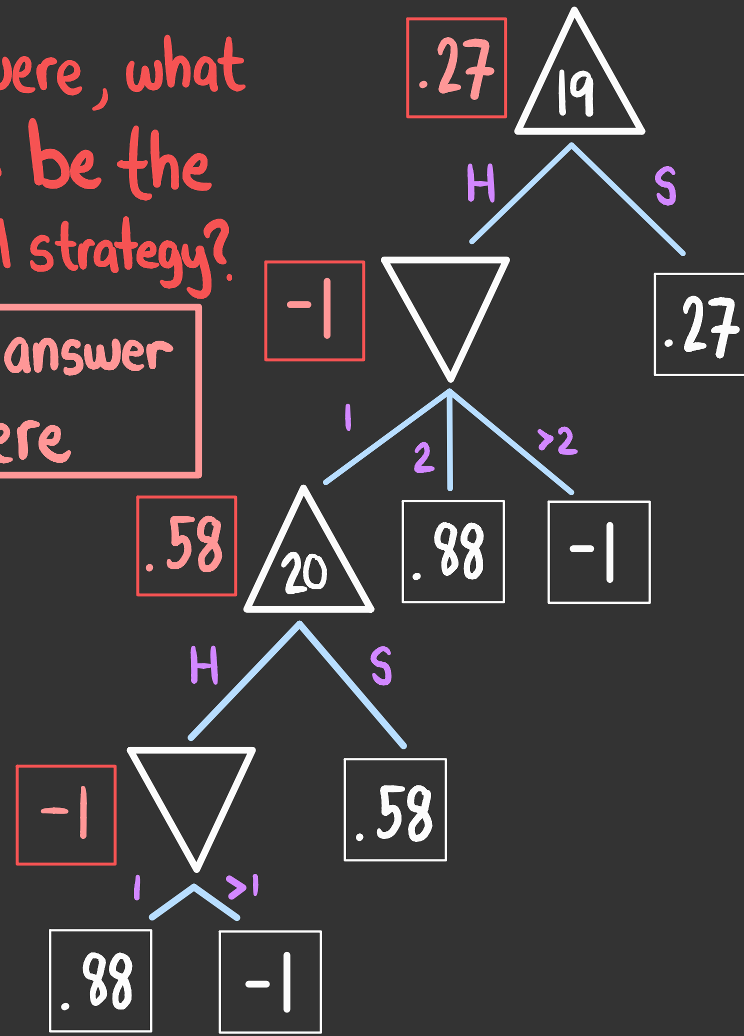


we could model blackjack as minimax against fate

but fate isn't out to get us

if it were, what would be the optimal strategy?

your answer here



we could model

blackjack

as minimax

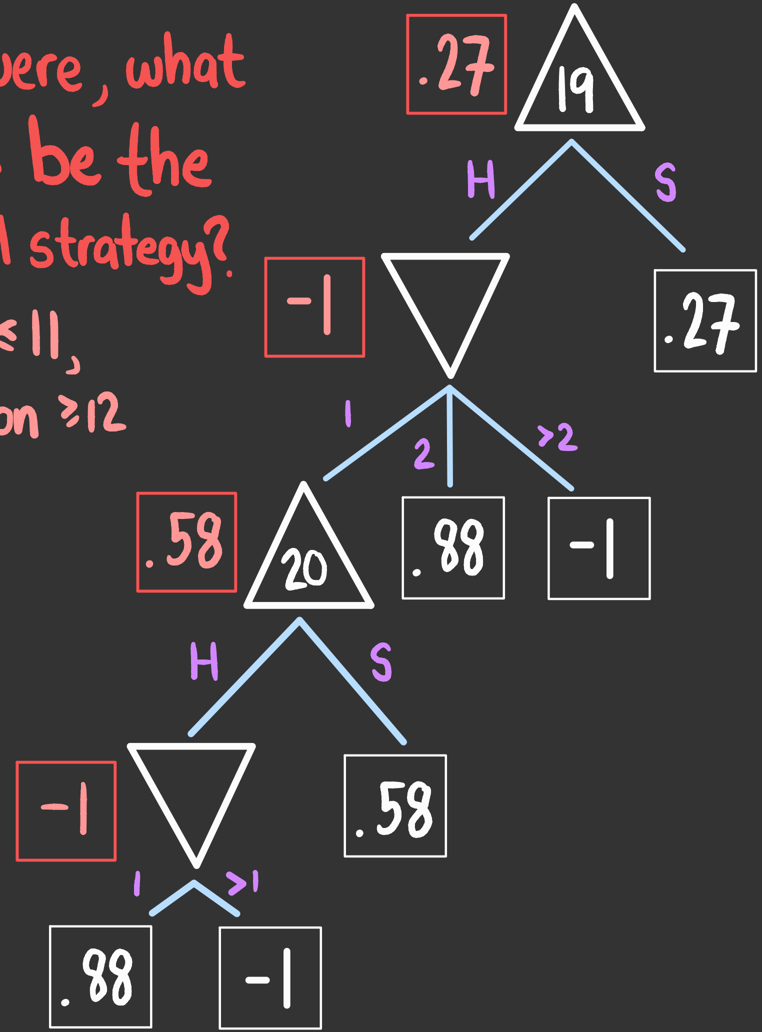
against fate

but fate isn't

out to get us

if it were, what would be the optimal strategy?

hit on ≤11, stand on ≥12

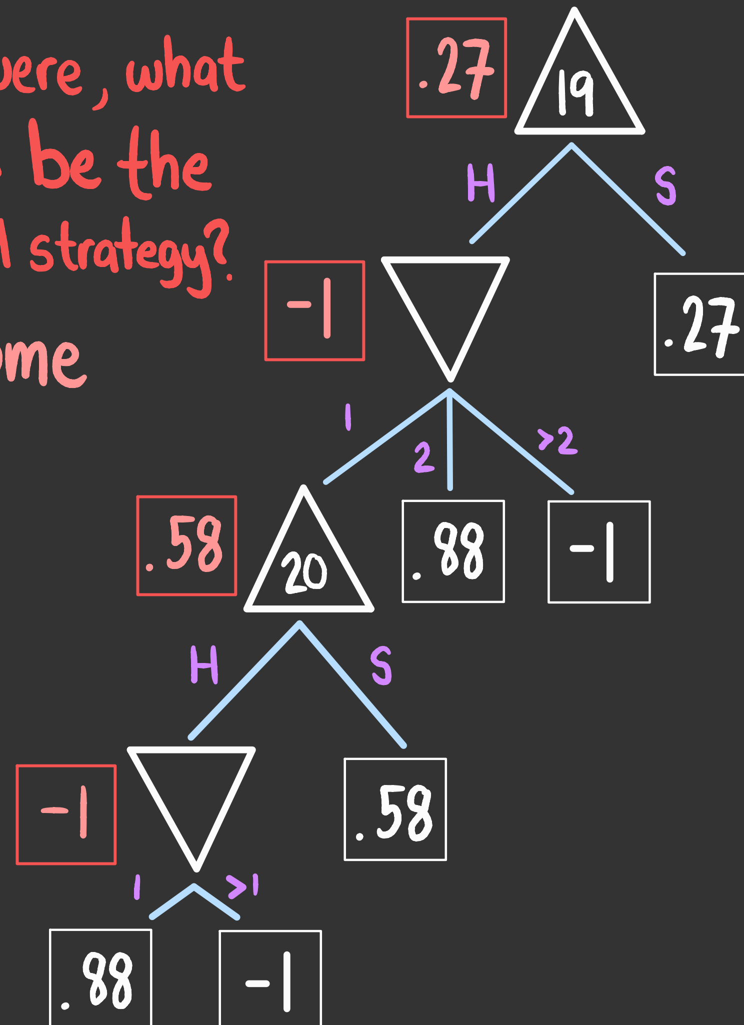


we could model **blackjack** as minimax against fate

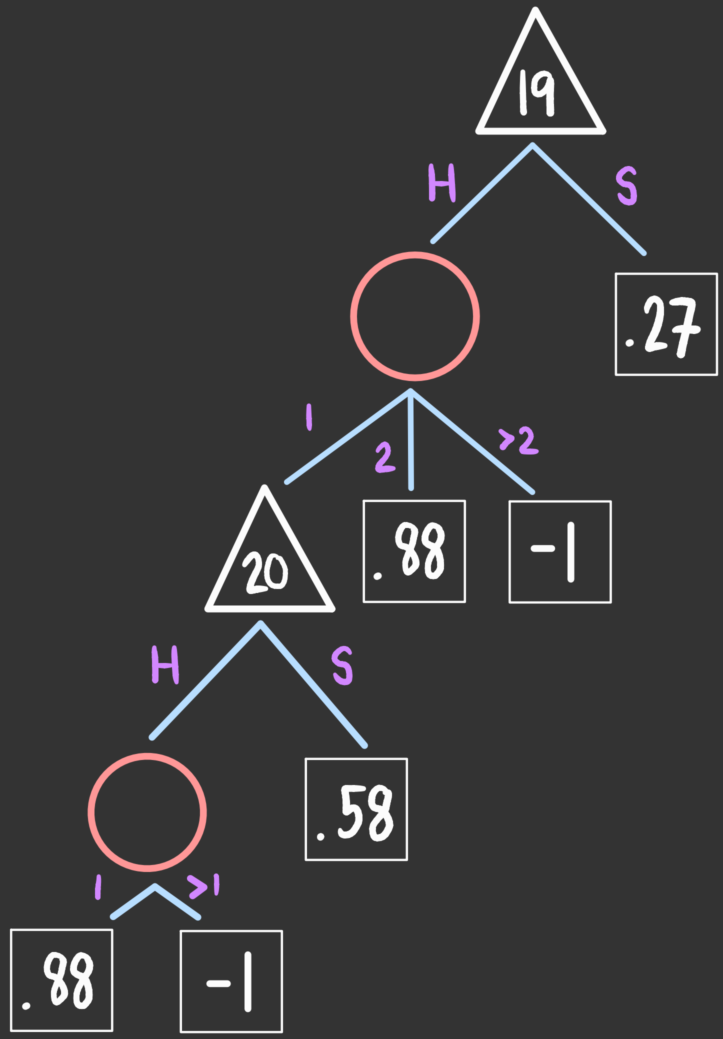
but fate isn't out to get us

if it were, what would be the optimal strategy?

go home



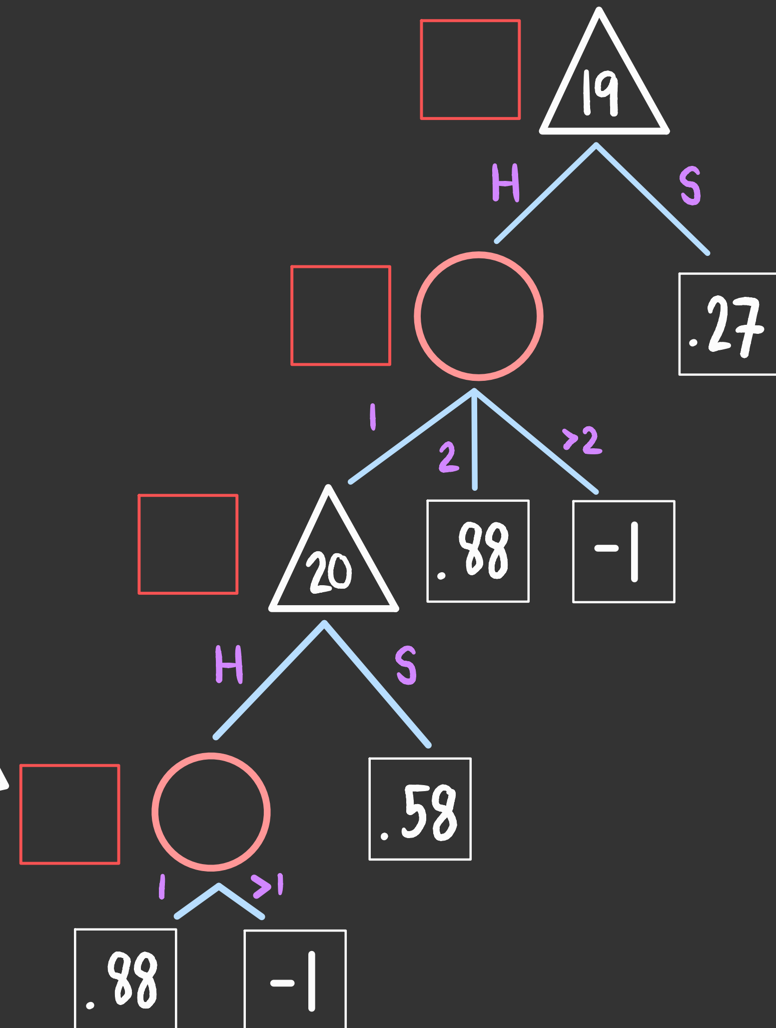
rather than having fate **oppose** us, let's have fate play **randomly**



$$P(1)\cdot .88 + P(>1)\cdot -1$$

$$= \boxed{?}\cdot .88 + \boxed{?}\cdot -1$$

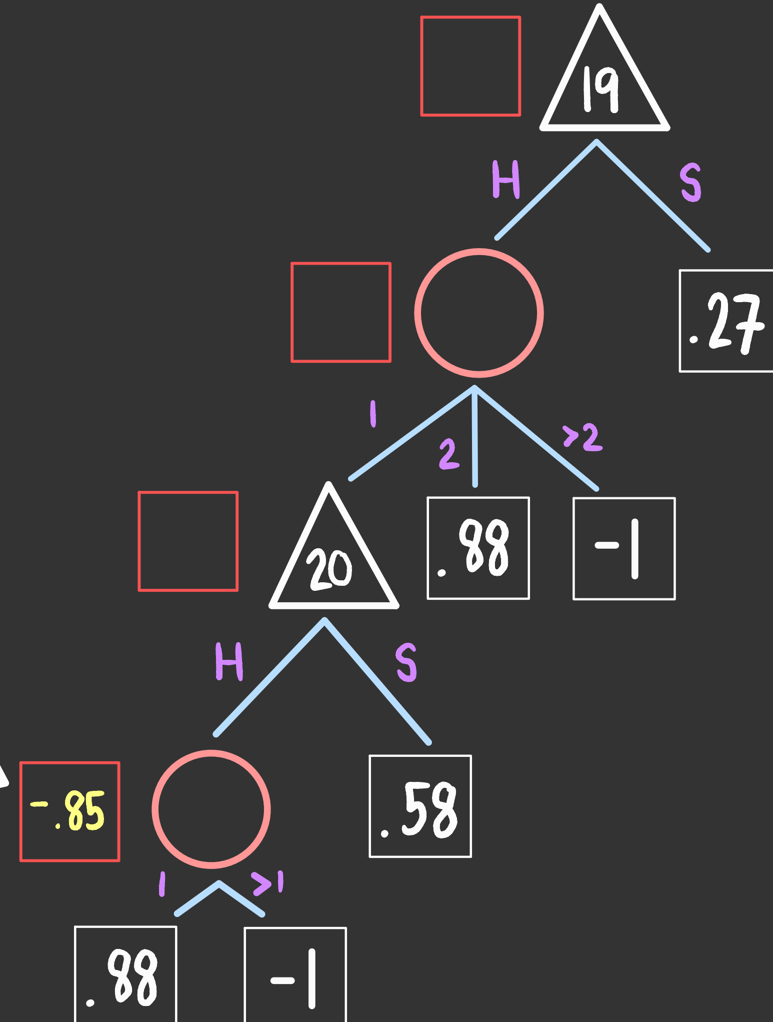
$$= \boxed{?}$$



$$P(1) \cdot .88 + P(>1) \cdot -1$$

$$= \frac{1}{13} \cdot .88 + \frac{12}{13} \cdot -1$$

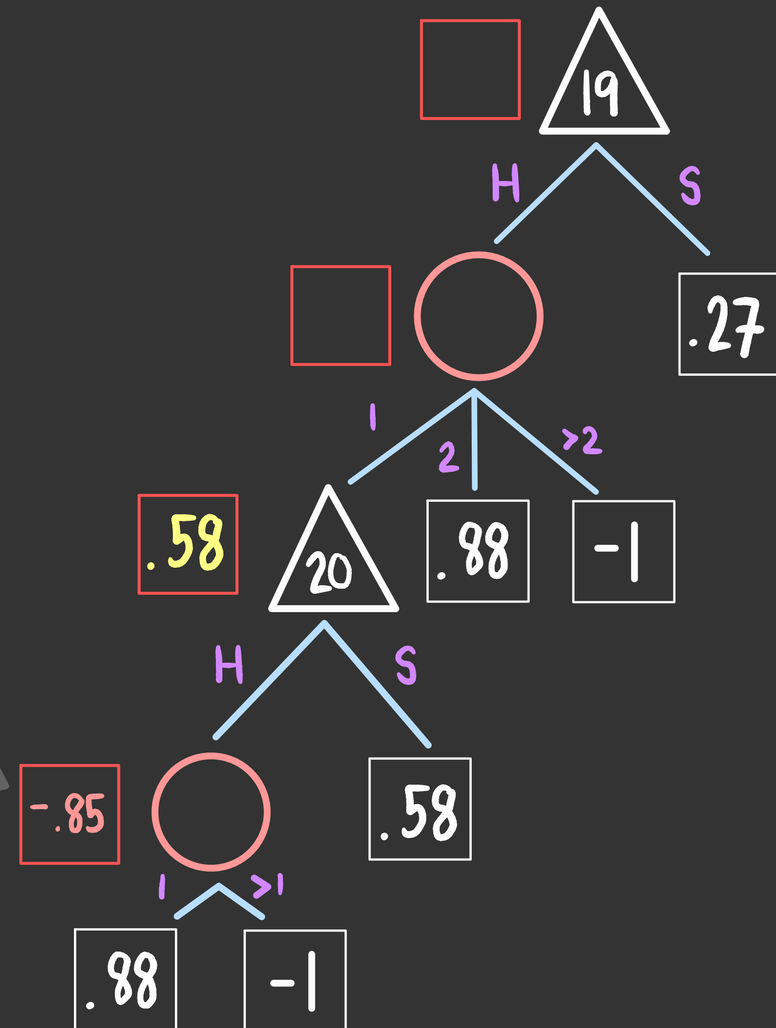
$$= -.85$$



$$P(1)\cdot .88 + P(>1)\cdot -1$$

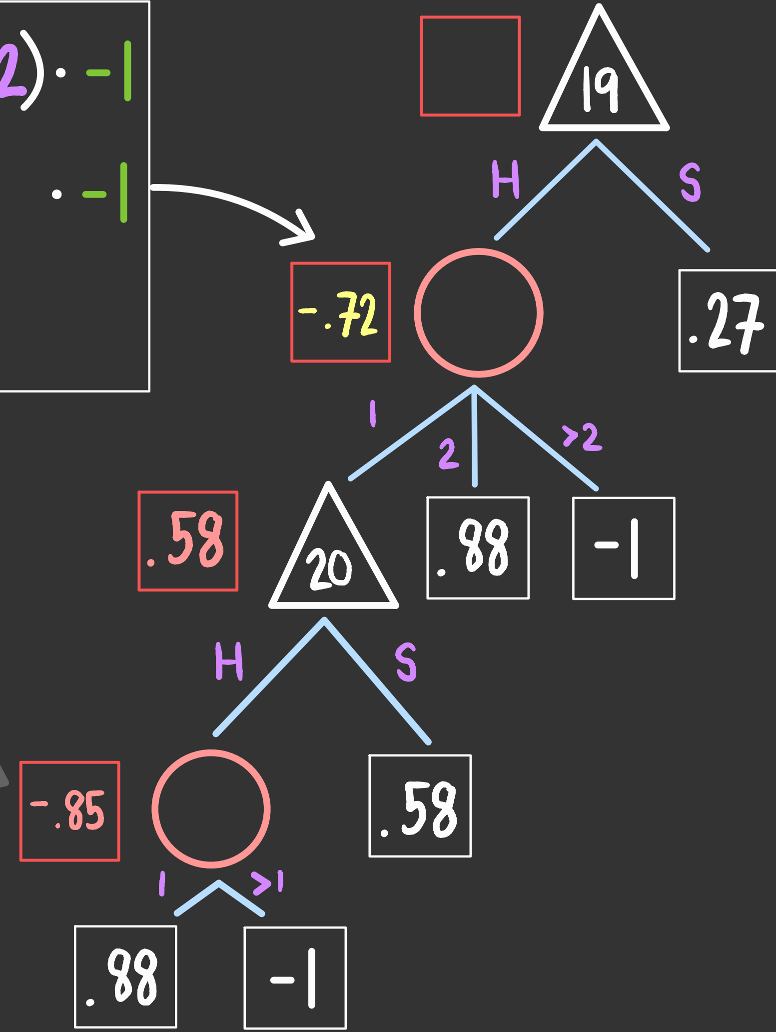
$$= \frac{1}{13}\cdot .88 + \frac{12}{13}\cdot -1$$

$$= -.85$$



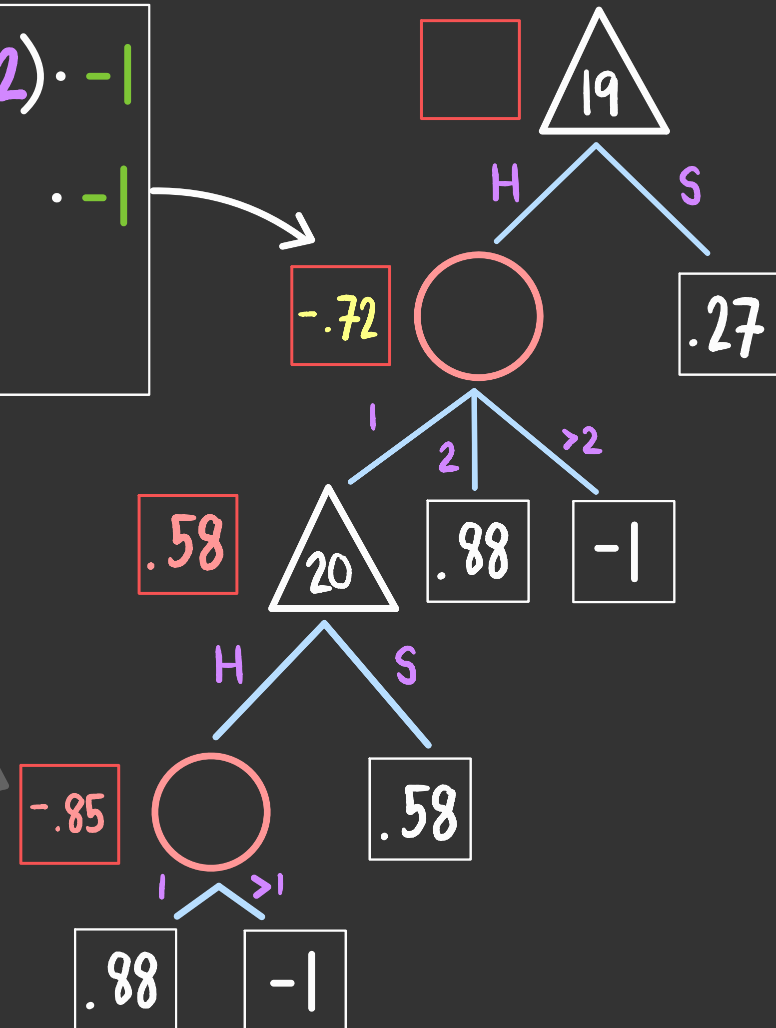
$$P(1) \cdot .58 + P(2) \cdot .88 + P(>2) \cdot -1$$
$$= \boxed{?} \cdot .58 + \boxed{?} \cdot .88 + \boxed{?} \cdot -1$$
$$= \boxed{?}$$

$$P(1) \cdot .88 + P(>1) \cdot -1$$
$$= \frac{1}{13} \cdot .88 + \frac{12}{13} \cdot -1$$
$$= -.85$$



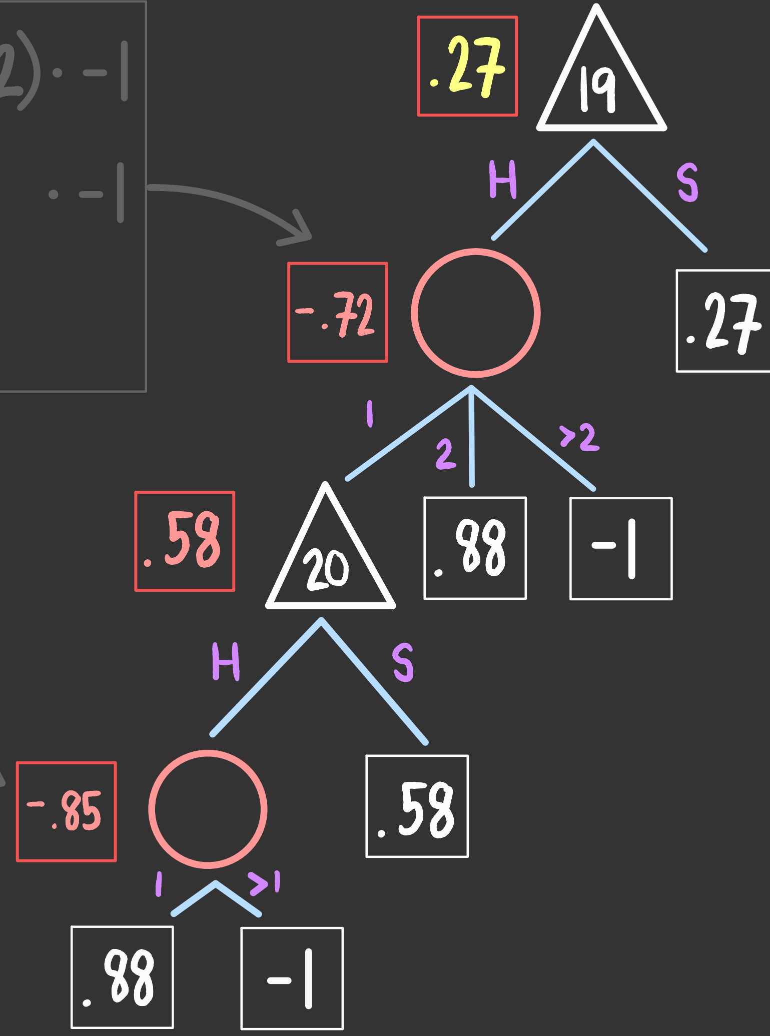
$$P(1)\cdot .58 + P(2)\cdot .88 + P(>2)\cdot -1$$
$$= \frac{1}{13}\cdot .58 + \frac{1}{13}\cdot .88 + \frac{11}{13}\cdot -1$$
$$= -.72$$

$$P(1)\cdot .88 + P(>1)\cdot -1$$
$$= \frac{1}{13}\cdot .88 + \frac{12}{13}\cdot -1$$
$$= -.85$$



$$P(1)\cdot .58 + P(2)\cdot .88 + P(>2)\cdot -1$$
$$= \frac{1}{13}\cdot .58 + \frac{1}{13}\cdot .88 + \frac{11}{13}\cdot -1$$
$$= -.72$$

$$P(1)\cdot .88 + P(>1)\cdot -1$$
$$= \frac{1}{13}\cdot .88 + \frac{12}{13}\cdot -1$$
$$= -.85$$



this variation of minimax is called

expectimax