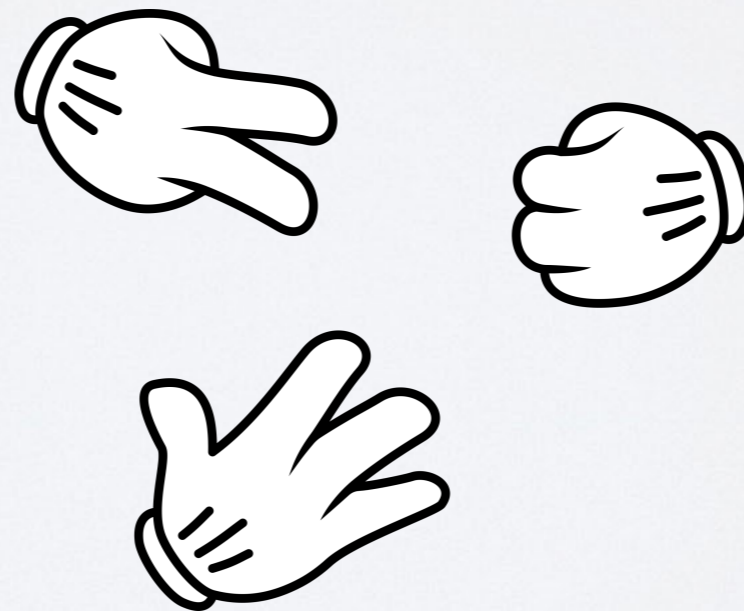


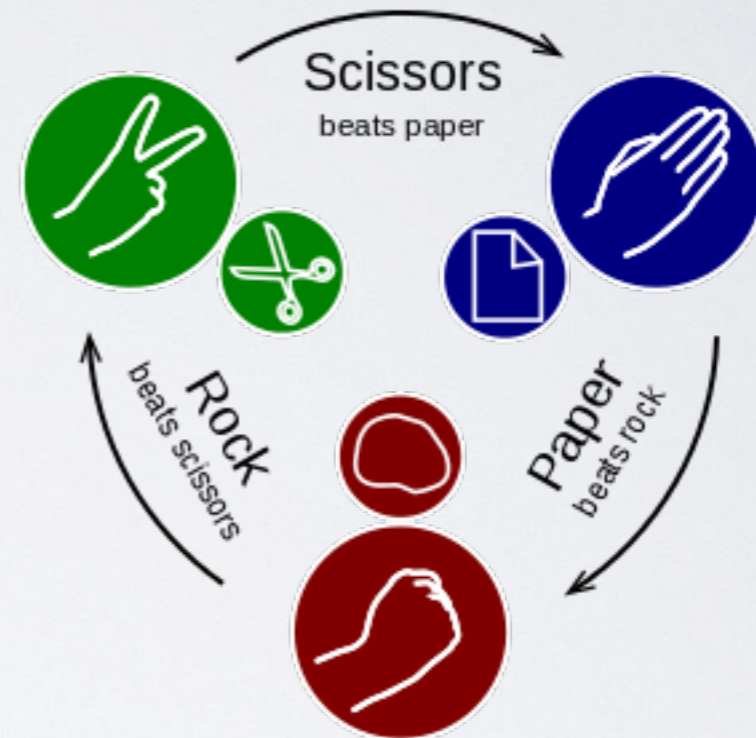
A ROCK-PAPER-SCISSOR COMPUTER PROGRAM

Yi Shu-Xu



THE RULE

- Two people show one of their hand simultaneously, with one of the three shapes:
- rock: a fist
- paper: a flat palm
- scissor: a V gesture
- each shape can win over other shape as illustrated on the right



THEORY

- Define the hand of me in round n : M_n which can take value of “rock, paper or scissor”
- the hand of my opposite in round n as: O_n
- you decide your hand in the next round based on your opposite in this round, so: $M_{n+1} = S * O_n$
- where “S” is the “strategy operator”.

THEORY

- There is only three independent operations from one hand to another:
- 1. Identical: e.g., from rock to rock: we denote: $S=I$
- 2. Roll upward: e.g., from rock to paper. we denote: $S=U$
- 3. Roll downward: e.g., from rock to scissor: We denote: $S=D$
- There are relations: $D=U^2$, $I=U^3$ the index 2 or 3 means “roll upward twice or three times”

more relations:

$$I*U=U, I*D=D, I=D^3=D*U=U*D, D^2=U, U^{i+3}=U^i \dots\dots\dots$$

THEORY

- Let's see how many different strategies one can have based on the combination of the tree basics:

Strategy level	Me	Opposite
S_0	$M_{n+1} = I * M_n$	$O_{n+1} = I * O_n$
S_1	$M_{n+1} = U * O_n$	$O_{n+1} = U * M_n$
S_2	$M_{n+1} = U^2 * M_n$	$O_{n+1} = U^2 * O_n$
S_3	$M_{n+1} = I * O_n$	$O_{n+1} = I * M_n$
S_4	$M_{n+1} = U * M_n$	$O_{n+1} = U * O_n$
S_5	$M_{n+1} = U^2 * O_n$	$O_{n+1} = U^2 * M_n$

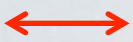
THEORY

- If your opposite using S_i and you use S_{i+1} , you win in the next round! And we see than $S_{i+6}=S_i$
Therefore there is only six strategies in all!
- You only need to know what strategy your opposite is using in this round. *People usually insist on the same strategy for many round. (that's our important assumption!)*

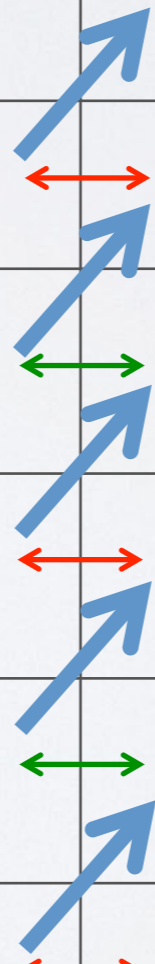
THEORY

- Say, in the first round, your hand is rock, and the opposite is scissor. And in the next round the opposite changed to paper. His strategy can be:
- $U * M_n$ or $D * O_n = U^2 * O_n$, in other words: S_1 or S_2
- So you decide to use S_2 or S_3

THEORY

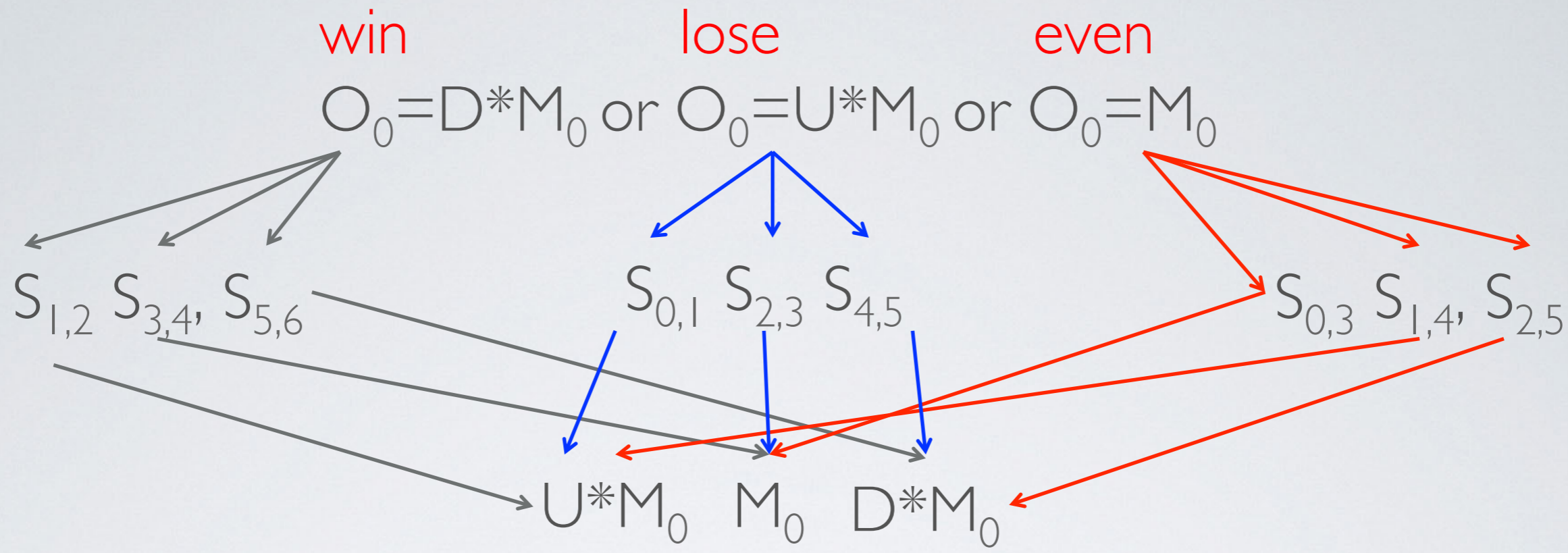
 outcome flips
  outcome remains

Strategy level	Me	Opposite
S_0	$M_{n+1} = I * M_n$	$O_{n+1} = I * O_n$
S_1	$M_{n+1} = U * O_n$	$O_{n+1} = U * M_n$
S_2	$M_{n+1} = U^2 * M_n$	$O_{n+1} = U^2 * O_n$
S_3	$M_{n+1} = I * O_n$	$O_{n+1} = I * M_n$
S_4	$M_{n+1} = U * M_n$	$O_{n+1} = U * O_n$
S_5	$M_{n+1} = U^2 * O_n$	$O_{n+1} = U^2 * M_n$

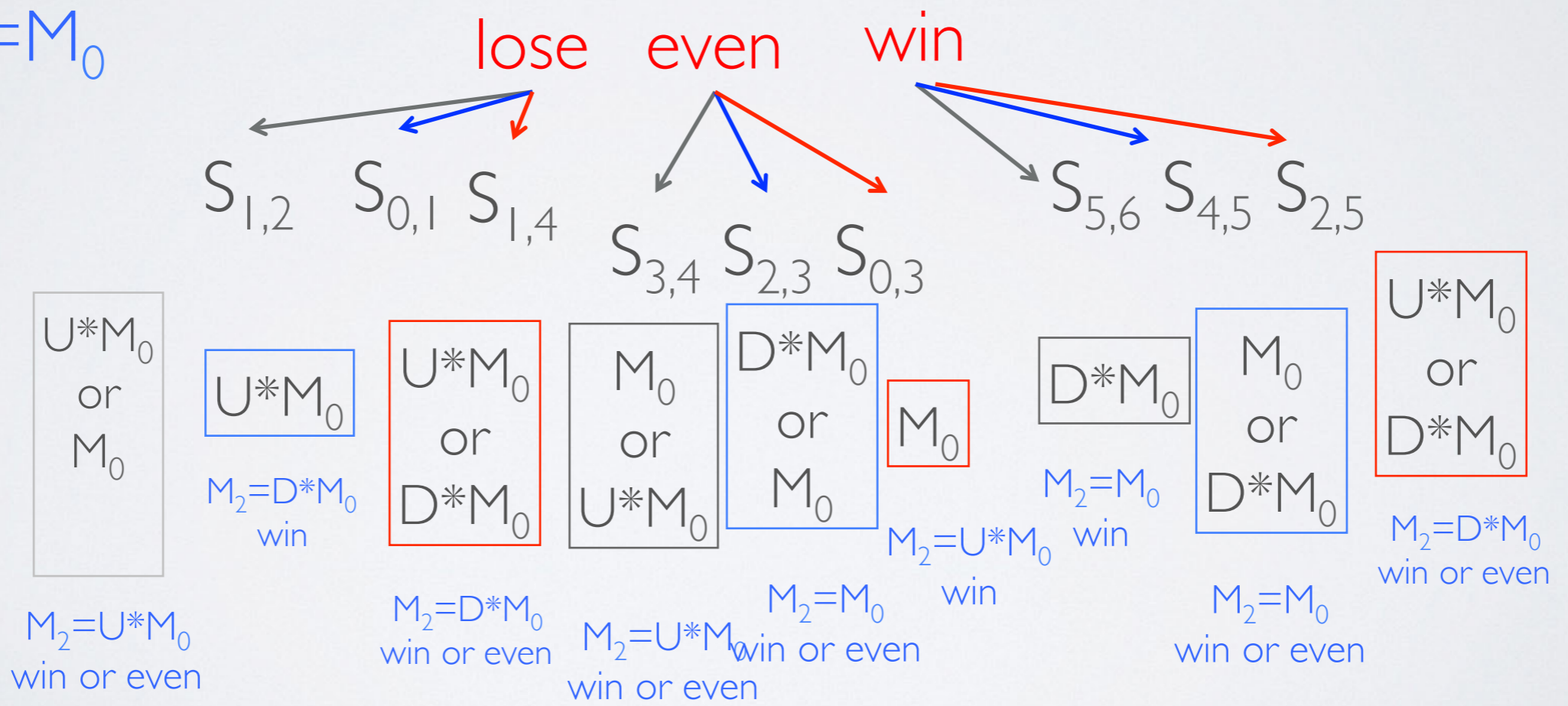


THEORY

- if you win the second round (Scissor), you want the outcome to remain. Then S_2 is the better choice (paper): Either the opposite is S_1 ($U^*Scissor=rock$) or S_2 ($D^*paper=rock$) you will win.
- if you lose the second round (rock), still S_3 is better: Either the opposite is S_1 ($U^*rock=paper$) or S_2 ($D^*paper=rock$), you won't lose



if $M_1 = M_0$



You'll never lose the third round!

- In the first and second round, you show the same hand. If the result is:
- win-even: then you show U^*M_0 , the outcome will be even or win. “Even” means your opposite’s strategy is S_4 , then you go to S_5 in the follow. “win” means your opposite is S_3 , then you go to S_4 . You will be winning from then.
- win-lose: you show U^*M_0 , the outcome will be even or win. “Even” means your opposite’s strategy is S_1 , then you go to S_2 in the follow. Otherwise go to S_3 . You will be winning from then.

- win-win: keep M_0 , you will win again.
- lose-win: keep M_0 , even (go to S_5) or win (to S_0).
- lose-even: keep M_0 , even (to S_4) or win (to S_3)
- lose-lose: D^*M_0 , will win
- even-win: D^*M_0 , even (to S_0) or win (to S_3)
- even-even: U^*M_0 , will win
- even-lose: D^*M_0 , even (S_5) or win (S_2)

- you insist on your strategy, until you lose. That means you opposite finally change his/her strategy. Then from this round, you repeat the analysis above, and find your new corresponding strategy again.
- The above-mentioned procedure is too complicated to do by human. Therefore I wrote an app to do it.

THE APP

It's an android based game called: Rock-paper-scissor master, *with astronomy features.* there's only a Chinese interface version

Choose an astronomer to challenge

guide

advisor mode



THE APP

I will leave the introduction of the astronomy feature later.

As a competition between human and a computer, you'd better let the player be sure that the computer is not cheating. Because, in principle, you will not notice that the computer shows its hand 0.1 s after you show yours, and thus win every round.



THE APP

Anti-cheating mechanism:

So I let the computer show its hand before the player in every round.

But then how to prevent the player from cheating?

In every round, the player is asked to press and hold this yellow button



THE APP

Anti-cheating mechanism:

In every round, the player is asked to press and hold this yellow button

Once this button is released, the computer will show its hand, and the player should make the choice of the hand very quick (within 0.4 second) the time is not sufficient for the player to respond to the computer's hand



THE APP

For each round, your health bar reduces if you lose. And your opposite's health bar reduces if you win.

This game is generally following the algorithm described above.

I always add some more functions, such that if you have a certain pattern like rock-rock-scissor-paper-rock-rock-scissor-paper-rock-rock-scissor-paper- It'll know.



THE APP

- Different astronomers share the same algorithms. However they have different rules of the health reduce, thus the difficulty against each other is not the same.

THE APP

- 苏亚邪夫(Sunyaev): the famous Soviet and Russian astronomer. He invented the *Standard accretion disk*. So he is a *standard opposite*.
- 霍金 (Hawking): Playing with him, your health bar is gradually evaporating during the competition, following a rule of *Hawking evaporation*.
- 古斯(Guth): If you're hit successively, your blood will go nonlinearly. Like a *cosmic inflation*.
- 钱德拉 (Chandrasekhar) : When you're blood is 1.4 times more than Chandra's (*the Chandrasekhar limit*), his blood will burst to the same as yours. Like the supernova explosion, this only happen once.
- 爱丁顿 (Eddington) : His blood can not be less than half of yours. (*Eddington limit*) When reach this limit, your blood will reduce accordingly.