Game theory (Ch. 17.5)
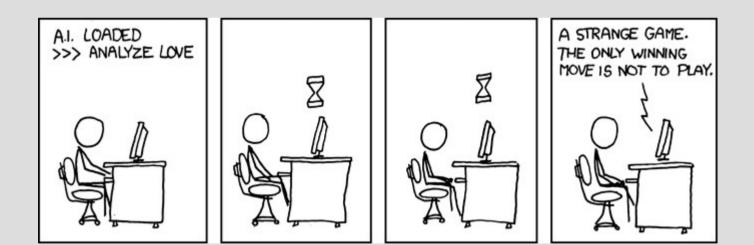
Announcements

Midterm Tuesday!

Find best strategy

How does this compare on PD?

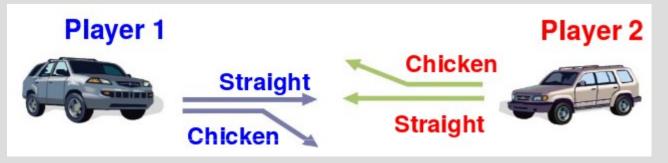|	Confess	Lie
Confess	-8 , -8	0 , -10
Lie	-10 , 0	-1 , -1

Player 1: p = prob confess...
P2 Confesses: -8*p + 0*(1-p)
P2 Lies: -10*p + (-1)*(1-p)

Cross at negative p, but red
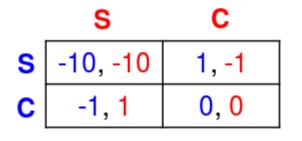line is better (confess)

Chicken

What is Nash for this game?
What is Pareto optimum?

	S	C
S	-10, -10	1, -1
C	-1, 1	0, 0

Game of Chicken

Player 1 — Straight / Chicken

Player 2 — Chicken / Straight

Chicken

To find Nash, assume we (blue) play S probability p, C prob 1-p

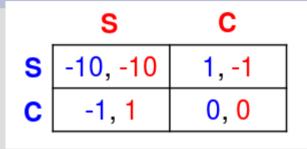|	S	C
S	-10, -10	1, -1
C	-1, 1	0, 0

Column 1 (red=S): p*(-10) + (1-p)*(1)
Column 2 (red=C): p*(-1) + (1-p)*(0)

Intersection: -11*p + 1 = -p, p = 1/10

Conclusion: should always go straight 1/10 and chicken 9/10 the time

Chicken

We can see that 10% straight makes the opponent not care what strategy they use:

	S	C
S	-10, -10	1, -1
C	-1, 1	0, 0

(Red numbers)

100% straight: $(1/10)*(-10) + (9/10)*(1) = -0.1$

100% chicken: $(1/10)*(-1) + (9/10)*(0) = -0.1$

50% straight: $(0.5)*[(1/10)*(-10) + (9/10)*(1)]$
$+ (0.5)*[(1/10)*(-1) + (9/10)*(0)]$
$=(0.5)*[-0.1] + (0.5)*[-0.1] = -0.1$

Chicken

The opponent does
not care about action,
but you still do (never considered our values)

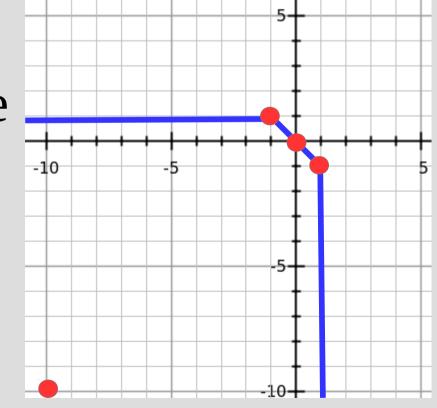|	S	C
S	-10, -10	1, -1
C	-1, 1	0, 0

Your rewards, opponent 100% straight:
$$(0.1)*(-10) + (0.9)*(-1) = -1.9$$
Your rewards, opponent 100% curve:
$$(0.1)*(1) + (0.9)*(0) = 0.1$$
The opponent also needs to play at your
value intersection to achieve Nash

Chicken

Pareto optimum?
All points except (-10,10)

Can think about this
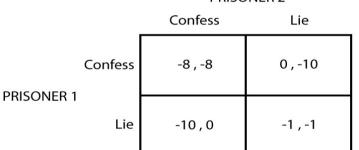as taking a string from the
top right and bringing the
it down & left

Stop when string going
straight left and down

	S	C
S	-10, -10	1, -1
C	-1, 1	0, 0

Repeated games

In repeated games, things are complicated

For example, in the basic PD, there is no benefit to "lying"

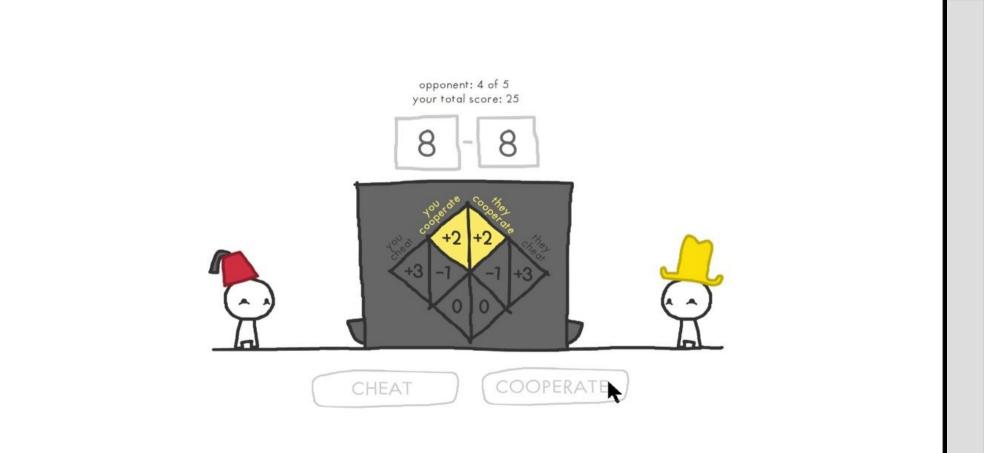|	PRISONER 2	
	Confess	Lie
PRISONER 1 Confess	-8 , -8	0 , -10
Lie	-10 , 0	-1 , -1

However, if you play this game multiple times, it would be beneficial to try and cooperate and stay in the [lie, lie] strategy

Repeated games

One way to do this is the <u>tit-for-tat</u> strategy:
1. Play a cooperative move first turn
2. Play the type of move the opponent last played every turn after (i.e. answer competitive moves with a competitive one)

This ensure that no strategy can "take advantage" of this and it is able to reach cooperative outcomes

Repeated games

Two "hard" topics (if you are interested) are:

1. We have been talking about how to find best responses, but it is very hard to take advantage if an opponent is playing a sub-optimal strategy

2. How to "learn" or "convince" the opponent to play cooperatively if there is an option that benefits both (yet dominated)

Repeated games

http://ncase.me/trust/