announcements: monday

- change of venue
- project lab
- overall goal
- replication section(s)
reminder: reaction notes

• “3 things”
• something neat
• unclear/more info
today:
intro to game theory
but first:

rational choice theory
rational choice theory: game theory :: scoring rules: MSR
individual decision making

- actions/strategies
- preference order >
example: choosing classes

• actions/strategies
  CS46(Theory)
  CS63(AI)
  CS75(Compilers)

• preference order >
  CS46 > CS63 > CS75
utility/payoff function

- set of available strategies $S$
- preferences as utilities

$\forall a, b \in S \ u(a) > u(b) \text{ iff } a \succ b$
example: choosing classes

• actions/strategies
  CS46(Theory)
  CS63(AI)
  CS75(Compilers)

• preference order >
  CS46 > CS63 > CS75

• utility function
  \( u(\text{CS46}) > u(\text{CS63}) > u(\text{CS75}) \)
game theory
model of strategic interactions between multiple players
project dilemma

• 2 member project group
• options:
  • goof off
  • work hard
project dilemma preferences

• worst case being “taken advantage of”
• best case “taking advantage of”
• prefer both work hard to both goof off

clearly, not this class!
preferences as utilities

- prefer both work hard to both goof off
- worst case being “taken advantage of”
- best case “taking advantage of”

- $u_1(H, H) > u_1(G, G)$
- worst case: $u_1(H, G)$
- best case: $u_1(G, H)$

$G$: goof off  \hspace{1cm} H: work hard
defining the utility function

• worst case: \( u_1(H, G) \)
• best case: \( u_1(G, H) \)
• \( u_1(H, H) > u_1(G, G) \)

\[
\begin{align*}
\ u_1(G, H) & > u_1(H, H) > u_1(G, G) > u_1(H, G) \\
\ u_2(H, G) & > u_2(H, H) > u_2(G, G) > u_2(G, H)
\end{align*}
\]

\( G: \) goof off \hspace{1cm} \( H: \) work hard
defining the utility function

\[
\begin{align*}
  u_1(G, H) &> u_1(H, H) > u_1(G, G) > u_1(H, G) \\
  3 &> 2 > 1 > 0 \\
  u_2(H, G) &> u_2(H, H) > u_2(G, G) > u_2(G, H)
\end{align*}
\]

\textbf{G}: goof off  \hspace{1cm} \textbf{H}: work hard
the utility matrix (normal form)

<table>
<thead>
<tr>
<th></th>
<th>H</th>
<th>G</th>
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<tbody>
<tr>
<td>H</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>G</td>
<td>1</td>
<td>0</td>
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</tbody>
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Player 1

G: goof off  H: work hard
### the utility matrix (normal form)

\[
\begin{array}{c|cc|c}
 & \text{H} & \text{G} & \text{Player 2} \\
\hline
\text{H} & (2,2) & (0,3) \\
\text{G} & (3,0) & (1,1) \\
\end{array}
\]

\[
u_1(G, H) > u_1(H, H) > u_1(G, G) > u_1(H, G)
\]

**Player 1**

**G**: goof off

**H**: work hard
arms race

• 2 countries
• options:
  • build nuclear bomb
  • don’t build bomb
arms race preferences

• worst case
  being **disarmed** when other country is armed
• best case
  being **armed** when other country is disarmed
• prefer
  **both disarmed** to **both armed**
exercise:
define the utility function

\[ u_1(A, D) > u_1(D, D) > u_1(A, A) > u_1(D, A) \]

\textbf{D}: disarmed \quad \textbf{A}: armed
exercise: fill the utility matrix

<table>
<thead>
<tr>
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<th>country 2</th>
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<tbody>
<tr>
<td></td>
<td>D</td>
</tr>
<tr>
<td>country 1</td>
<td>(2,2)</td>
</tr>
<tr>
<td></td>
<td>(3,0)</td>
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D: disarmed  A: armed
compare the utility matrices

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**G**: goof off  
**H**: work hard  
**D**: disarmed  
**A**: armed