Logistics: Project

- Project presentation
  - Dec 6/8 during lectures
  - Everyone is expected to attend both lectures
  - 10 minutes for presentation + 1~2 minutes for QA and transition

- Project reports
  - Due: Dec 9 (no late submissions)
  - Up to 6 pages (plus additional pages for only references/citations)
  - No strict format requirements
    - You are encouraged to use standard templates

- Check Piazza posts for details/updates

Assignment 4

- No class on Nov 22, Tuesday (thanksgiving week)

- Instead, I'll give a list of talks/tutorials relevant to this course.
  - Choose one of them, watch the content, and write a report
  - The report needs to be no less than 2 pages, with any reasonable format
  - The report will serve as your assignment 4

- More details will be announced next week

Peer Review

- Please submit the peer review by 6pm

Lecture 20

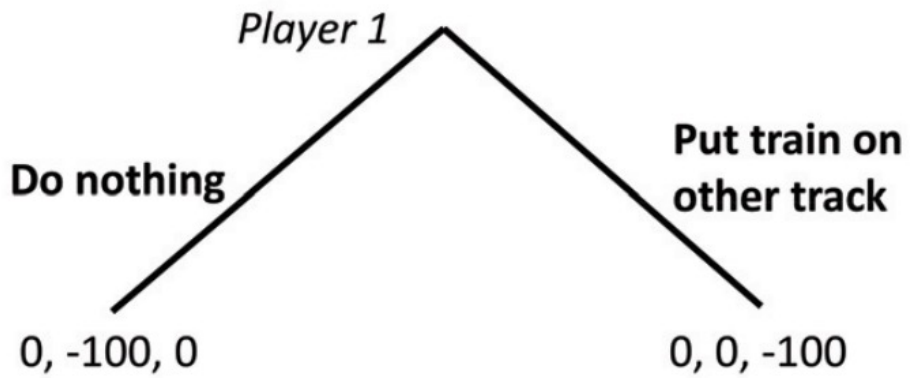
Continue on Ethical Decision Making
Computational Social Choice

Instructor: Chien-Ju (CJ) Ho

Algorithmic Ethical Decision Making

- A Top-Down Approach
  - Extending game theory / decision theory to incorporate ethics
    - Define what you mean by being ethical
    - Wire that in into the algorithm design

- If you can write down the “moral” utility…



Asimov's Three Laws of Robotics

- First Law: A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- Second Law: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- Third Law: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Algorithmic Ethical Decision Making

- Trust Game
  - Two players: Alice and Bob
  - Game flow
    - Alice receives 100 dollars and can decide to give back X dollars
    - Bob will then receive 3 * X dollars and can decide to give Alice Y dollars
- What's the equilibrium?
  - X = Y = 0
- In practice, people do give back money [Berg, Dickhaut, and McCabe 1995]
  - It feels morally *wrong* to not give some money back
  - If we can quantify this sense of moral, we can incorporate that in the utility
  - It's usually really hard to do so and everyone is different

A Related Concept

- A utilizing maximizing algorithm that respect given moral principles

  maximizing $utility(action)$

  subject to *moral principles*

- It can often be equivalently represented as follows
  [Using Lagrangian idea in convex optimization]

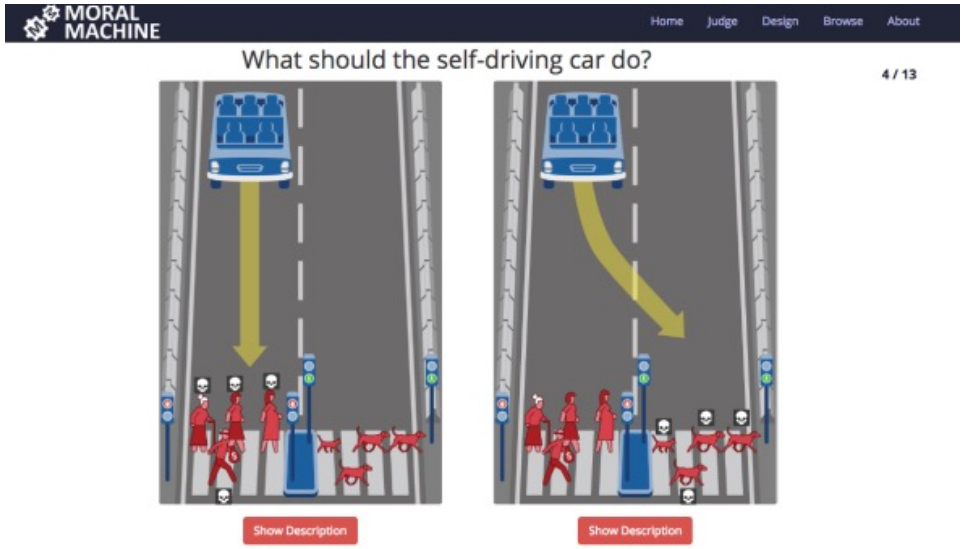
  maximize $utility(action) - \lambda * [moral\ principles]$

- Informally, these ethical/fairness discussions often lead to defining utility

Algorithmic Ethical Decision Making

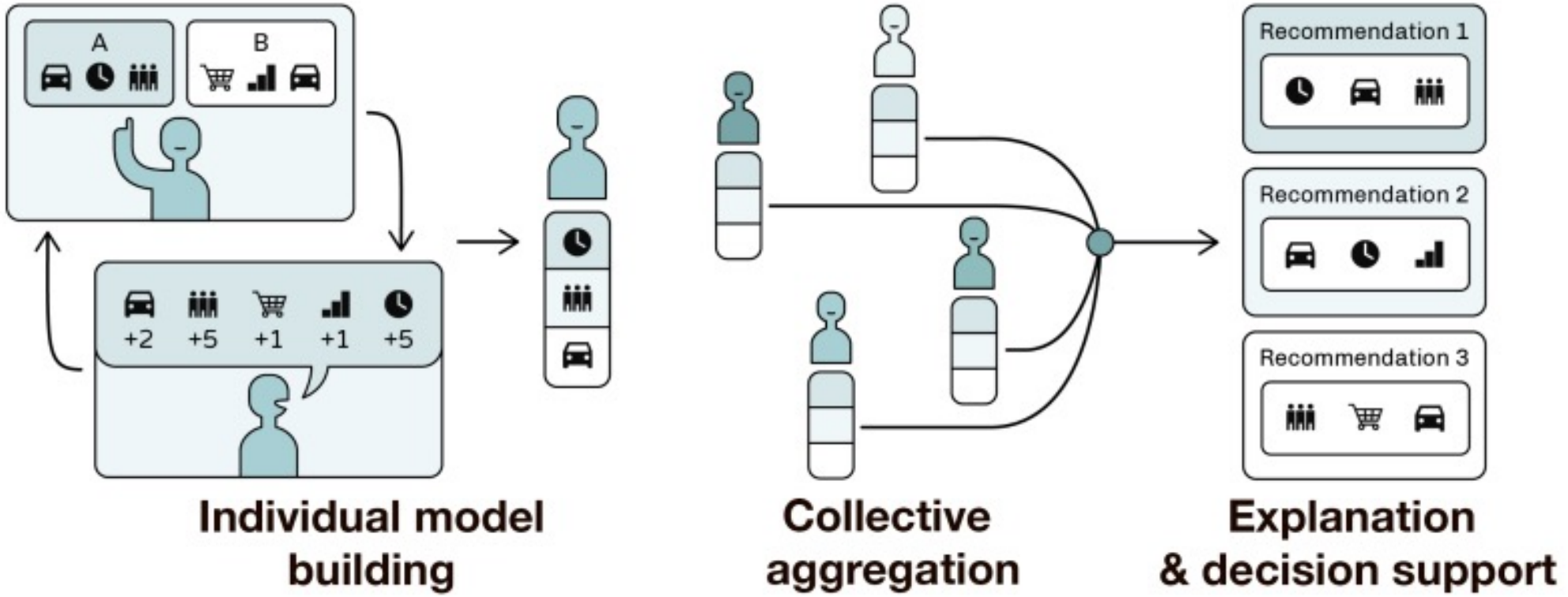
- A Bottom-Up Approach

- Learning/summarizing from human judgements
  - Collect data sets of human judgments
  - Apply machine learning
  - Make decision based on predictions



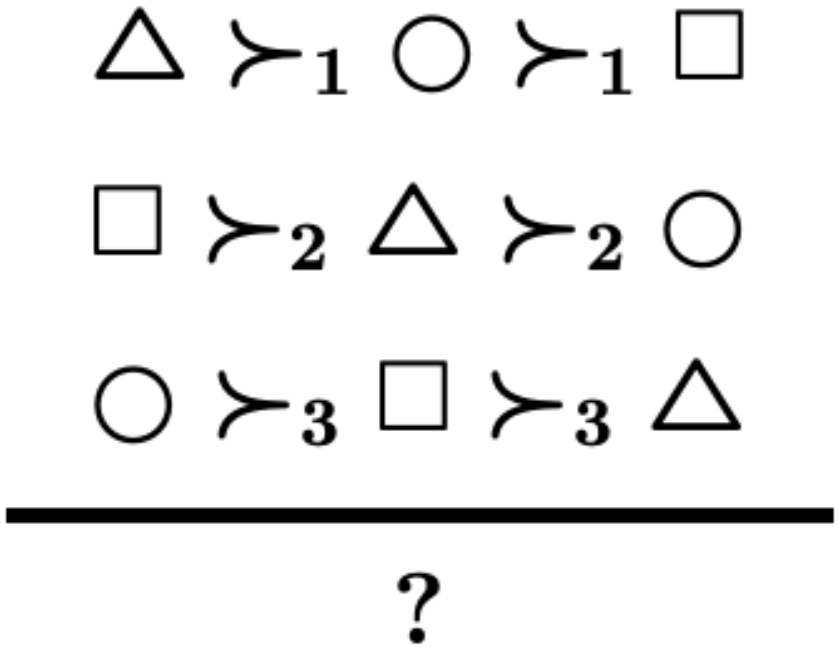
Incorporating Preferences from Stakeholders

- WeBuildAI: A Participatory Approach [Lee et al. 2019]



What if People Disagree?

- Social choice theory
  - Given a set of preferences on actions, what is the action we should take?



Voting – One Common Form of Social Choice

- Consider the following voting rules (there are a lot more…)
  - Plurality: elect the candidate ranked first most often
  - Borda: assume m candidates, each voter gives $m-1$ points to the candidate she ranks first, $m-2$ to the candidate she ranks second, etc., and the candidate with the most points wins
  - Approval: voters can approve of as many candidates as they wish, and the candidate with the most approvals wins

- Consider this example (bold blue indicates "approval")

5 voters think: **A** $\succ$ B $\succ$ C
4 voters think: **C** $\succ$ B $\succ$ A
2 voters think: **B** $\succ$ **C** $\succ$ A

Who wins the election for each of the voting rule?

We need to be very clear about what properties we are looking for

Arrow's Impossibility Theorem

- Some nice criteria we might want to have:
  - **Unanimity**: If every prefers A over B, then the group prefers A over B
  - **Non-dictatorship**: no person's preference is always strictly preferred than others
  - **Independence**: If for two sets of preferences, A and B have the same order between sets, A and B should have the same order in the group decision

- Arrow's Impossibility Theorem
  - No mechanism satisfies the three criteria when the number of candidates ≥ 3

Things could be even more complex

- Consider the artificial scenario, assume we use plurality voting

  40% voters think: Trump $\succ$ Biden $\succ$ **Sanders**
  35% voters think: Biden $\succ$ **Sanders** $\succ$ Trump
  25% voters think: **Sanders** $\succ$ Biden $\succ$ Trump

- If everyone vote according to their preferences, Trump wins.
- Supporters of **Sanders** might strategically change their votes to Biden to prevent Trump from winning

Axiom Based Approach

- Define a set of axioms that we like
  - **Unanimity, Non-dictatorship, Independence, Strategy-proof,…**
- They can’t be satisfied simultaneously
  - Trade-off is required (sounds familiar….)
- Common approaches
  - Pick a subset to satisfy => leading to different mechanisms (voting rules)
  - More CS-style approach: allow some properties to be “approximately” satisfied
  - Crowdsourcing the trade-offs
    - (then often again leading to new trade-offs….)