Computational Social Processes

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Rensselaer

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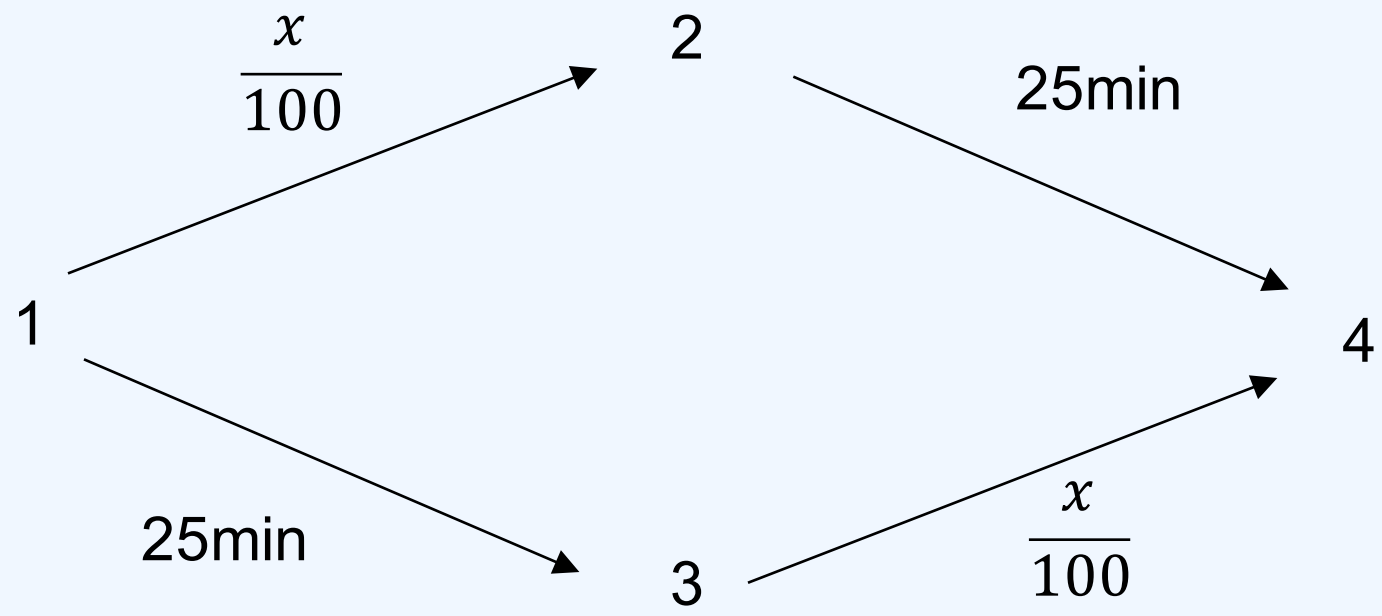
This class

- Economics: decision making by multiple actors, each with individual preferences, capabilities, and information, and motivated to act in regard to these preferences.
- Computer science: study of representation and processing of information for the purpose of specific calculation tasks.

Tragedy of the commons: Braess' Paradox

- 2000 travelers from 1 to 4



- Centralized goal: minimize max delay
  - 1000 1→ 2→4; 1000 1→ 3→4;
  - minimax delay: 35min
- No one wants to deviate

Tragedy of the commons: Braess' Paradox

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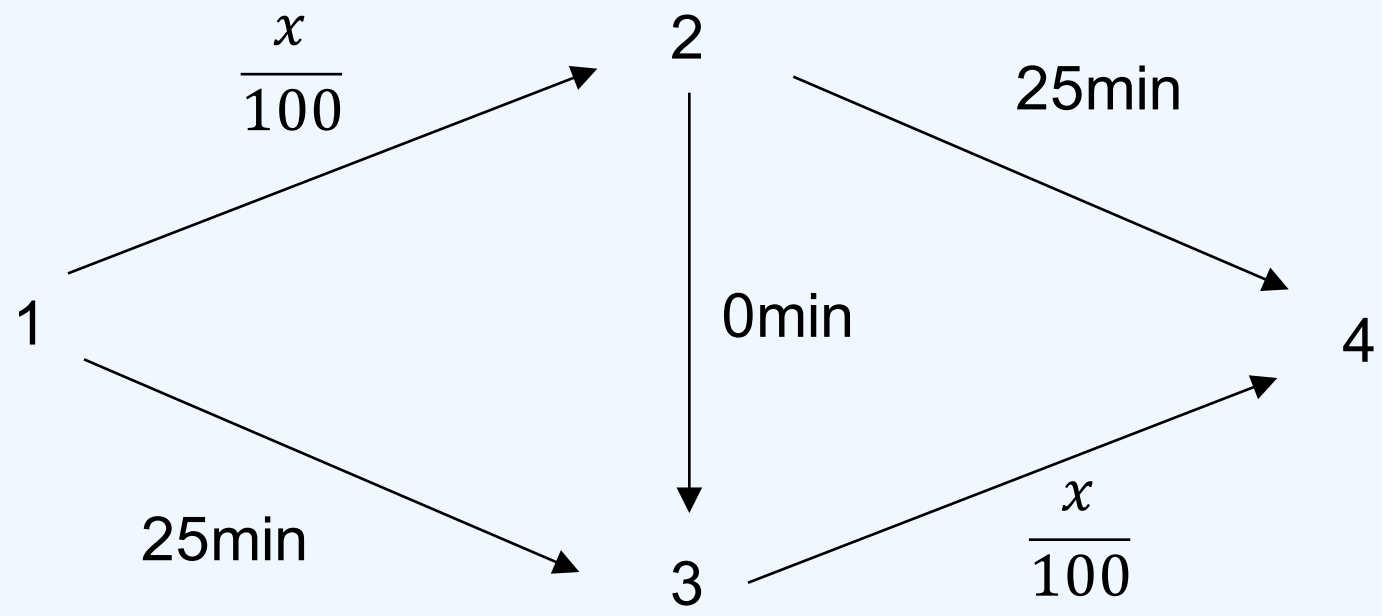

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Tragedy of the commons: Braess' Paradox

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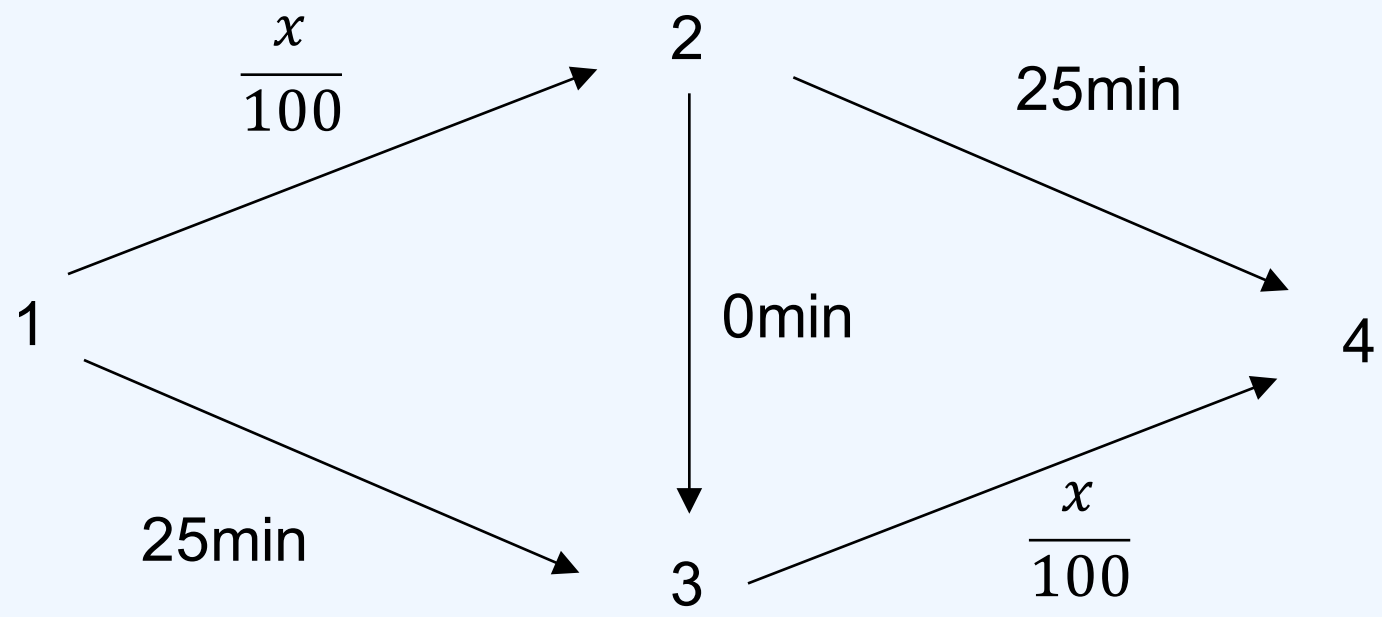
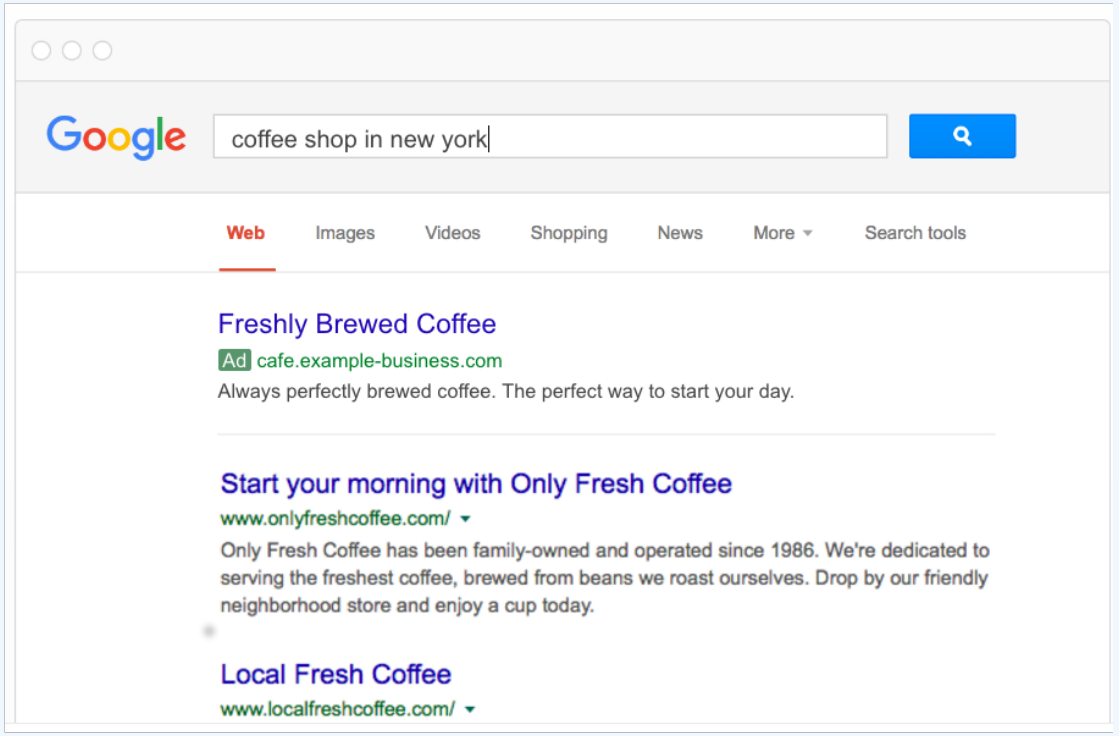


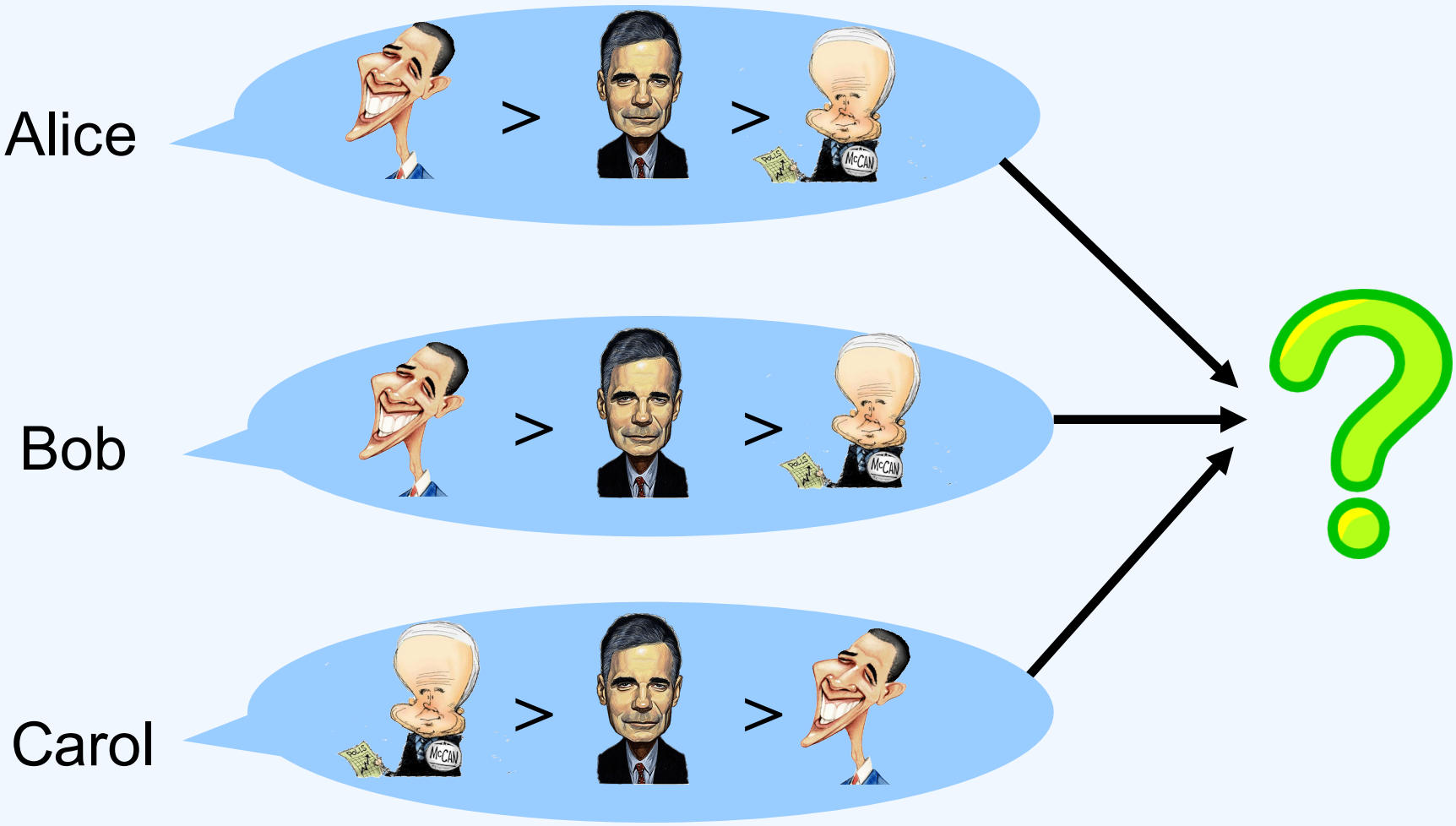
- No one wants 1→ 3→4
  - 1→ 2→3→4 is always better
- No one wants 1→ 2→4
  - 1→ 2→3→4 is always better
- Everyone goes 1→ 2→3→4, delay is 40min each
- Paradox: worse than the system without 2→3

Example 2: Auctions



- 2nd price auction
  - highest bid wins
  - charged the 2nd highest price

Example 3: Political elections



Goal of the course

- How to analyze the outcome?
  - Social choice, game theory
- How to incentivize people?
  - Mechanism design
- Economics + Computation
  - Incentives + computational thinking

Brief schedule

- Social choice
- Game theory
- Auctions
- Mechanism design
- Other topics
  - recommender systems
  - peer prediction

Course info

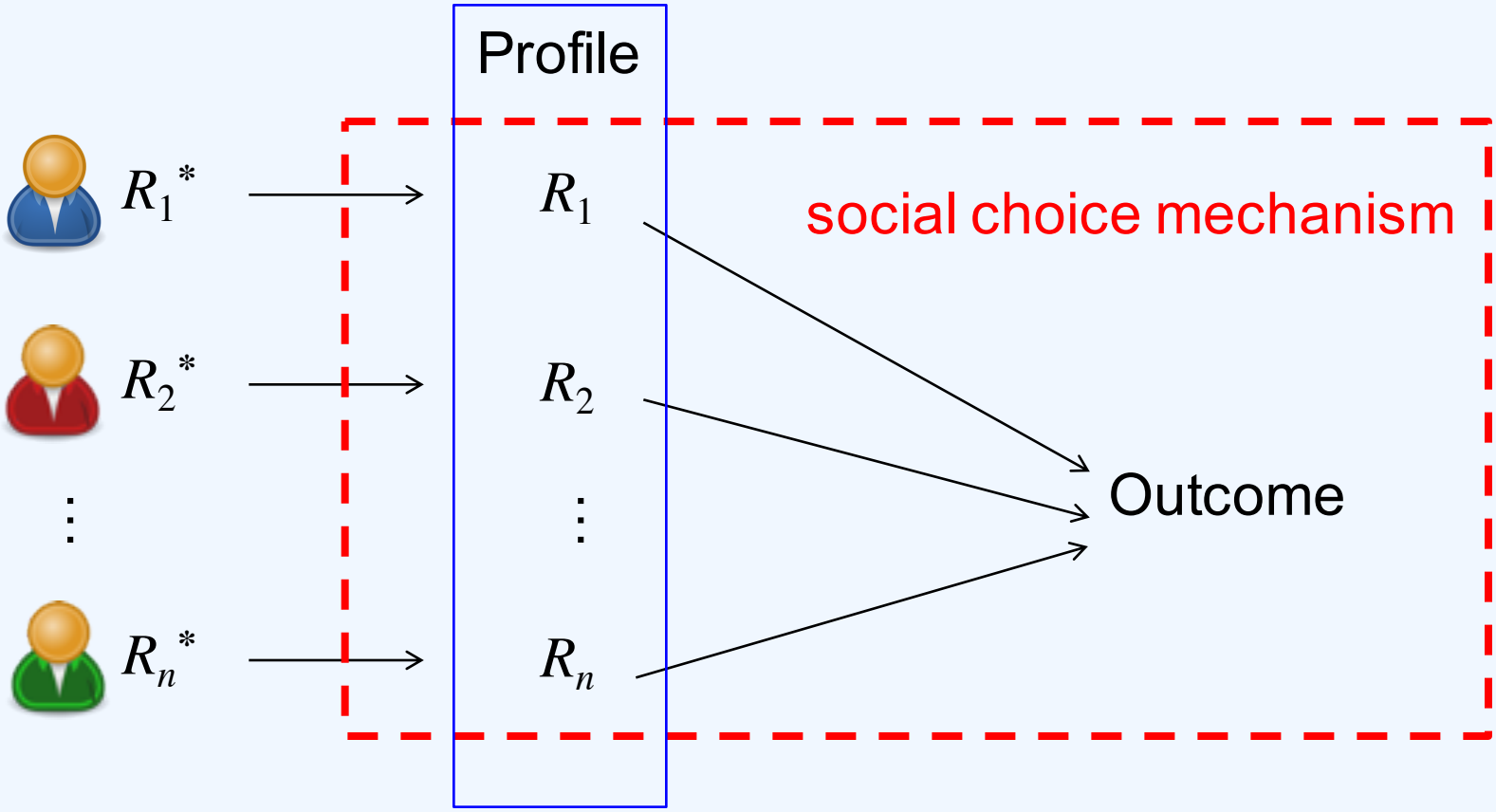
- Textbook: none
- TA: none
- Office hours: TBD
- Final grades: participation 10%, Homeworks 20%, others TBD
  - Option1: Mid 35%; Final 35%
  - Option2: Mid 20%; Final 20%; Project 30%
  - Option3: Mid 20%; No final; Project 50%
  - Project: research projects, max 3 members per team
  - http://opra.cs.rpi.edu:8000/polls/98/

Social choice

"*social choice is a theoretical framework for analysis of combining individual preferences, interests, or welfares to reach a collective decision or social welfare in some sense.*"

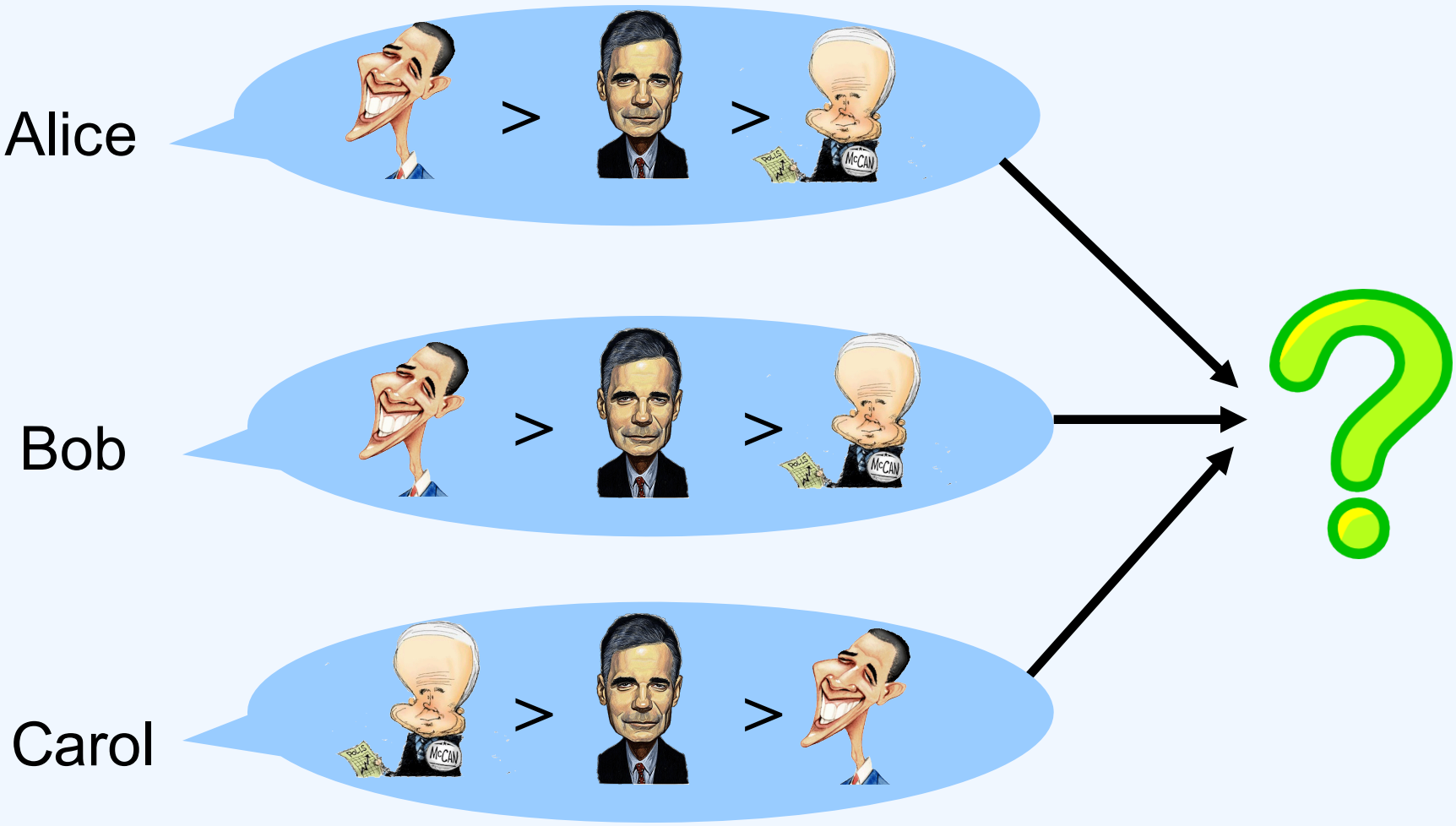
---Wikipedia Aug 26, 2013

Social choice problems



- Agents
- Alternatives
- Outcomes
- Preferences (true and reported)
- Social choice mechanism

Example 3: Political elections

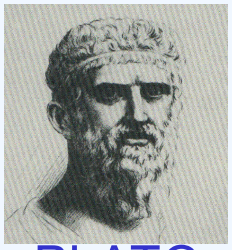


Why this is social choice?

- Agents: {Alice, Bob, Carol}
- Alternatives: {  ,  ,  }
- Outcomes: winners (alternatives)
- Preferences (vote): rankings over alternatives
- Mechanisms: voting rules

A very brief history of social choice

Ancient Greece: 4th C. B.C.

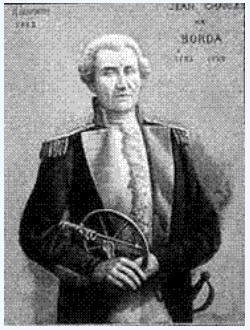


PLATO

13thC.:

LULL

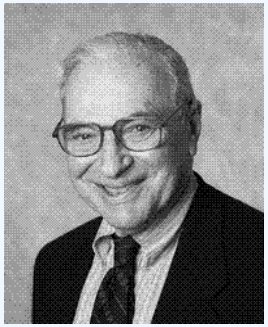
French revolution: 18th C.



BORDA

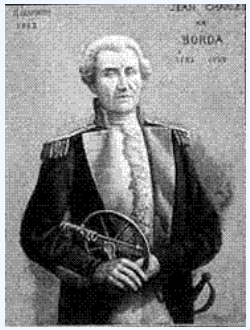
CONDORCET

Modern: 20th C.



ARROW

The Borda voting rule

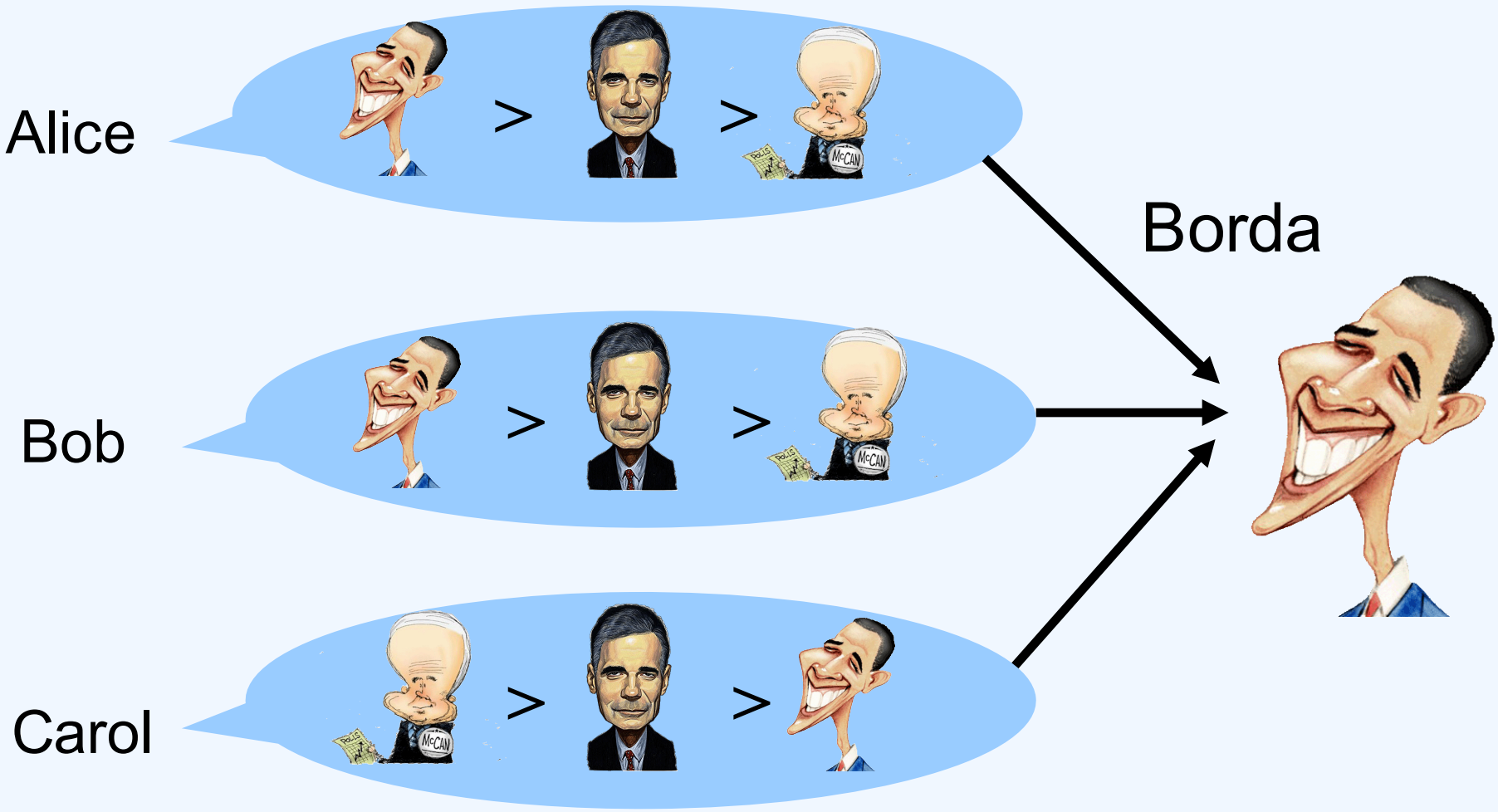


BORDA


LULL

- Input: profile of rankings over alternatives
- Output: a single winner
  - For each vote R, the alternative ranked in the i-th position gets m-i points
  - The alternative with most total points is the winner
    - Use some tie-breaking mechanism whenever there is a tie

Example of Borda

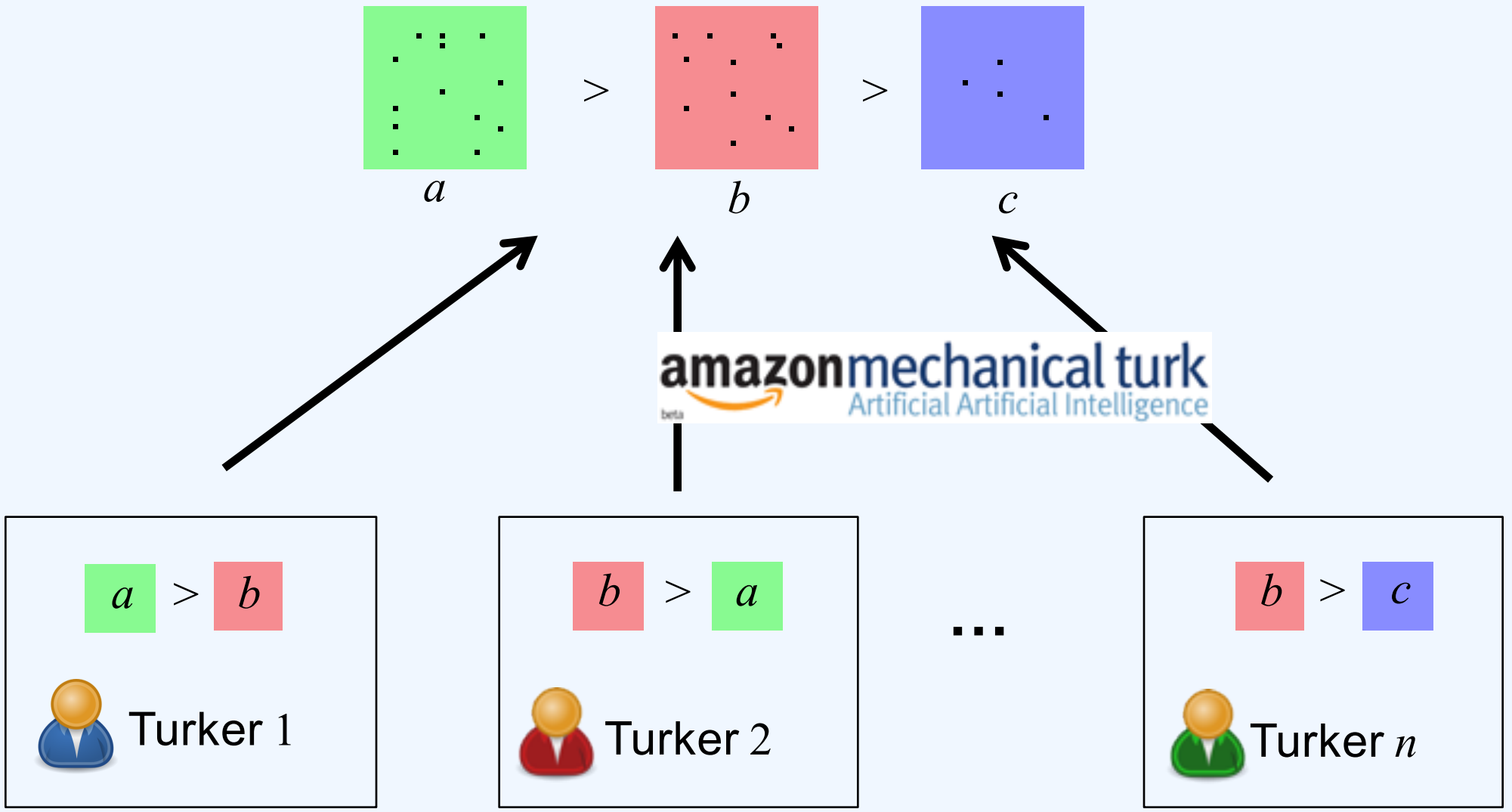


Total scores : 2+2+0=4 : 1+1+1=3 : 0+0+2=2

Other voting rules?

- Many other voting rules beyond Borda will be discussed in the next class
- Which one is the best?
  - Hard to compare. Criteria will be discussed in the next class

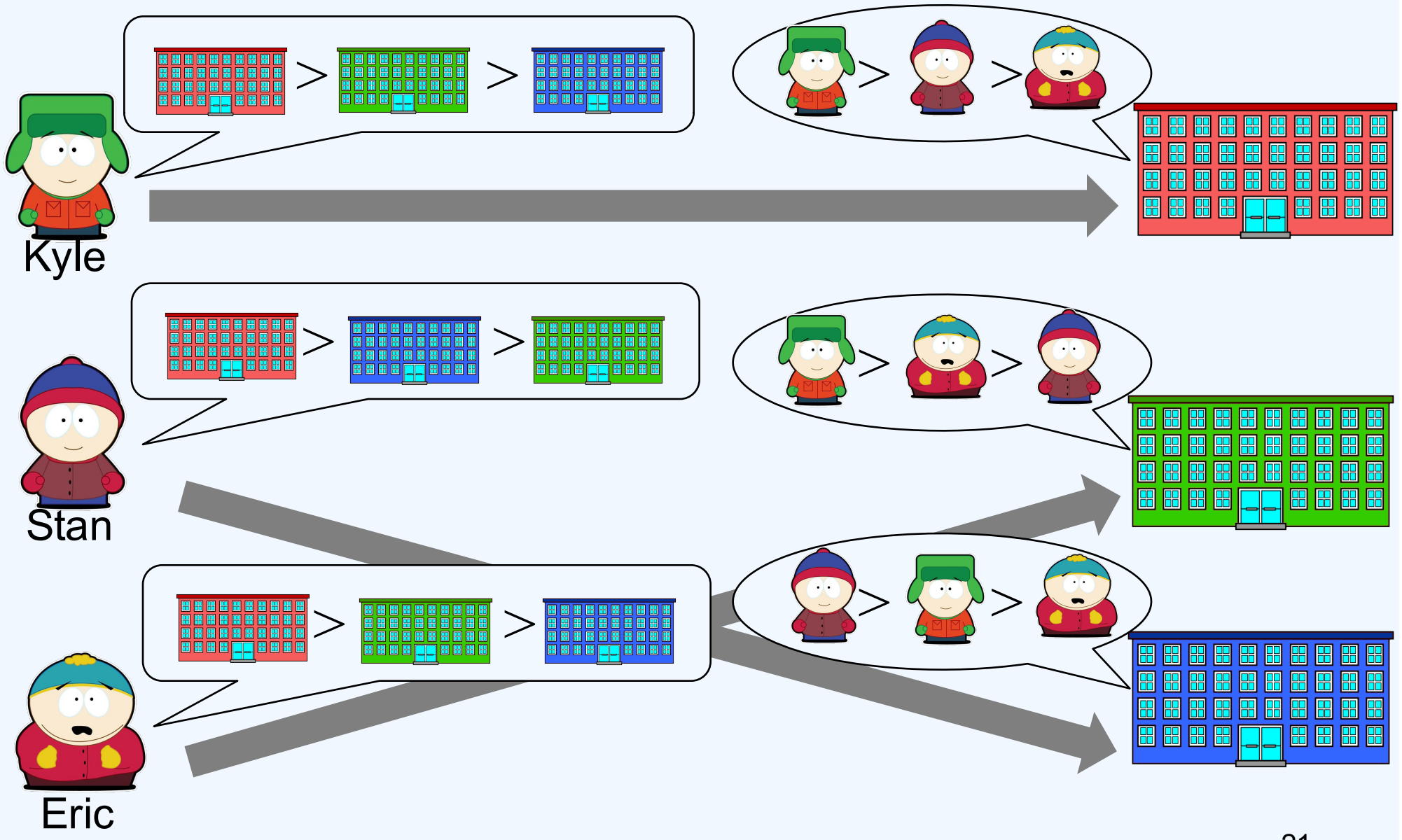
Example2: Crowdsourcing



Why this is social choice?

- Agents: Turkers
- Alternatives: { a , b , c }
- Outcomes: rankings over the pictures
- Preferences: pairwise comparisons
- Mechanisms: Maximum likelihood estimator
- More in the “statistical approaches” class
- Goal: truth

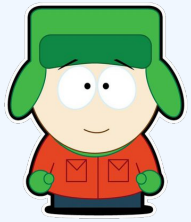
Example3: School choice



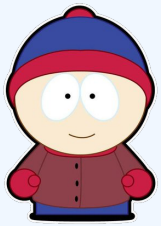
Why this is social choice?

- Agents: students and schools
- Alternatives: students and schools
- Outcomes: matchings between students and schools
- Preferences:
  - Students: rankings over schools
  - Schools: rankings over students
- Mechanisms: Stable matching (Nobel Prize 2012)
- More in the “matching” class

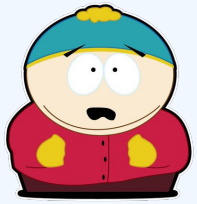
Example4: Resource allocation



1 > 2 > 3 > 4 > 5 > 6



1 > 6 > 2 > 3 > 5 > 4



6 > 5 > 4 > 3 > 2 > 1

Why this is social choice?

- Agents: {    }
- Alternatives: {  }
- Outcomes: allocations of papers to students
- Preferences: rankings over papers
- Mechanisms: sequential allocation
- More in the “fair division” class

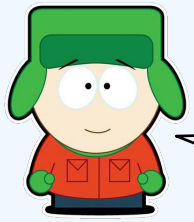
Sequential allocation

- Given
  - n students' preferences over $2n$ papers, and
  - an order O over the students
- SA_O has $2n$ rounds
  - In the first n rounds,
    - for each t =1 to n, the t-th student in O selects her most preferred paper that is available
  - In the next n rounds,
    - for each t =n to 1, the t-th student in O selects her most preferred paper that is available

Example

o

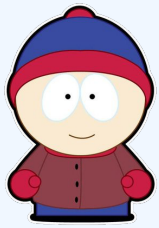
||



Kyle

1 > 2 > 3 > 4 > 5 > 6

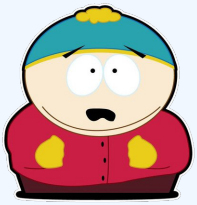
V



Stan

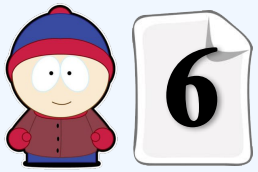
1 > 6 > 2 > 3 > 5 > 4

V



Eric

6 > 5 > 4 > 3 > 2 > 1

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
					

Is it a good mechanism?

- Sounds good
  - Efficient: if we have different preferences, then we will all (almost) get what we want
  - Fair: (1^{st} pick, last pick), (2^{nd} pick, 2^{nd} to last pick)…
- How can we formalize these arguments?

Next class

- Social choice
- Before next class
  - Sign up on piazza
  - Sign up on OPRA

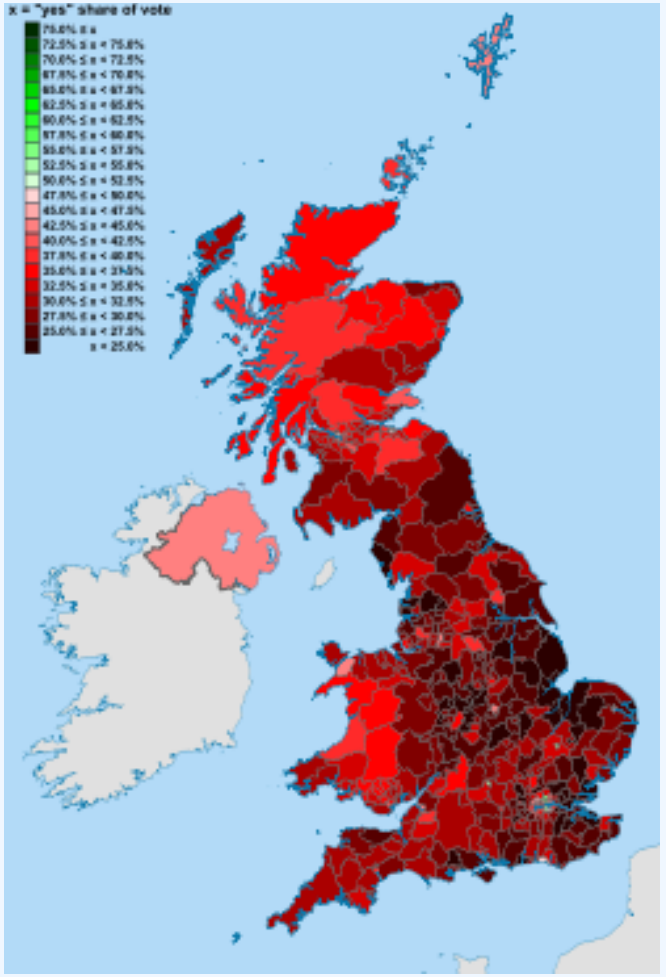
Why different from MOOC (e.g. coursera)

- Credits
- More interaction
  - Do feel free to interrupt with questions
- Hands-on research experience
- No similar course online
- I will be back to school eventually…

Change the world: 2011 UK Referendum

- The second nationwide referendum in UK history
  - The first was in 1975
- Member of Parliament election:

  Plurality rule ➔ Alternative vote rule
- 68% No vs. 32% Yes
- Why people want to change?
- Why it was not successful?
- Can we do better?

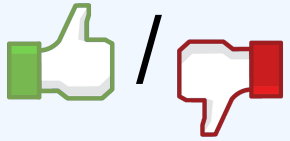


Example2: Multiple referenda

- In California, voters voted on 11 binary issues (/)
  - $2^{11}=2048$ combinations in total
  - 5/11 are about budget and taxes

- Prop.30 Increase sales and some income tax for education
- Prop.38 Increase income tax on almost everyone for education

Why this is social choice?

- Agents: voters
- Alternatives: $2^{11}=2048$ combinations of  /
- Outcomes: combinations
- Preferences (vote): Top-ranked combination
- Mechanisms: issue-by-issue voting
- More in the “combinatorial voting” class
- Goal: democracy