

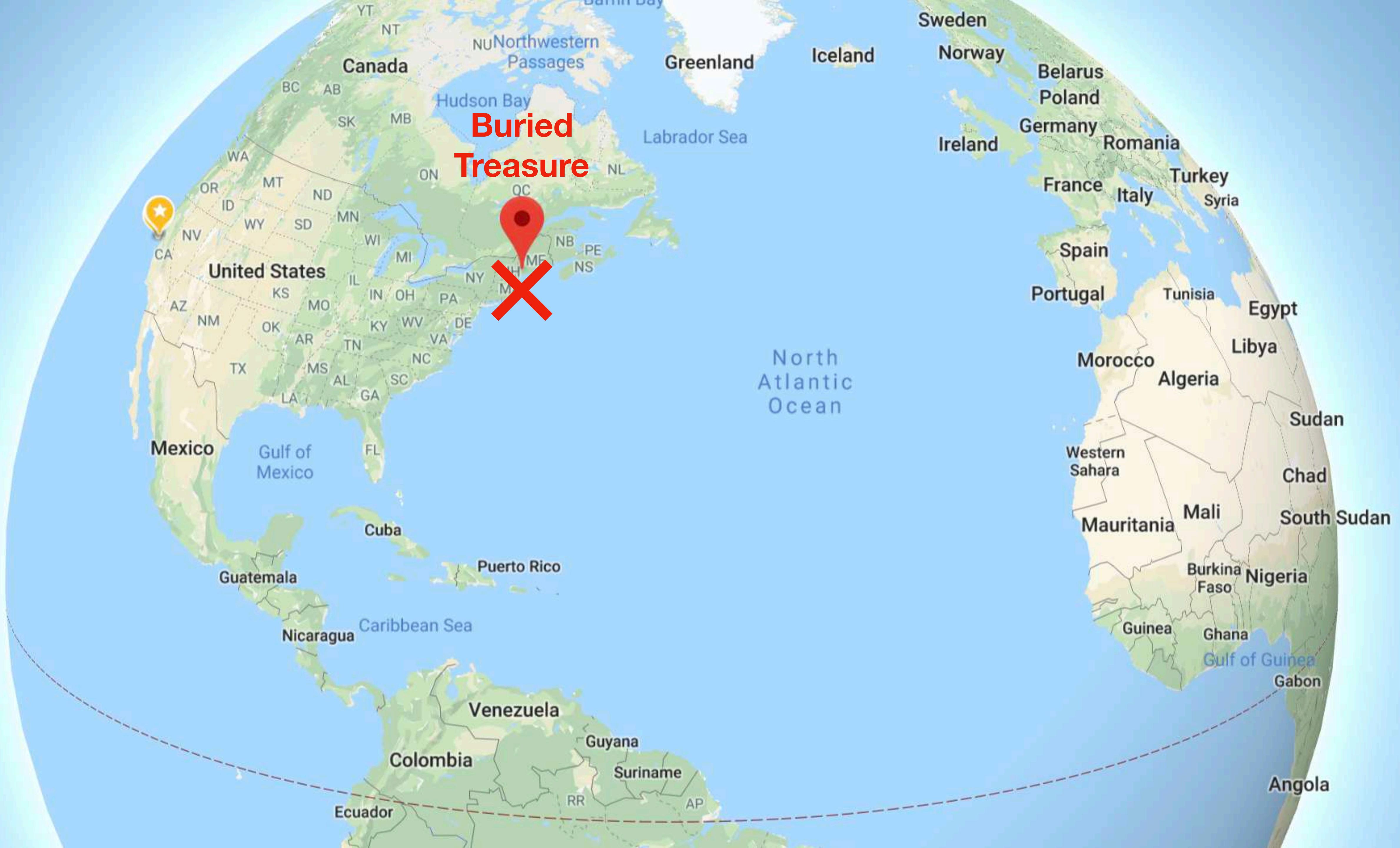
High-Impact AI Solutions Start With Mechanism Design

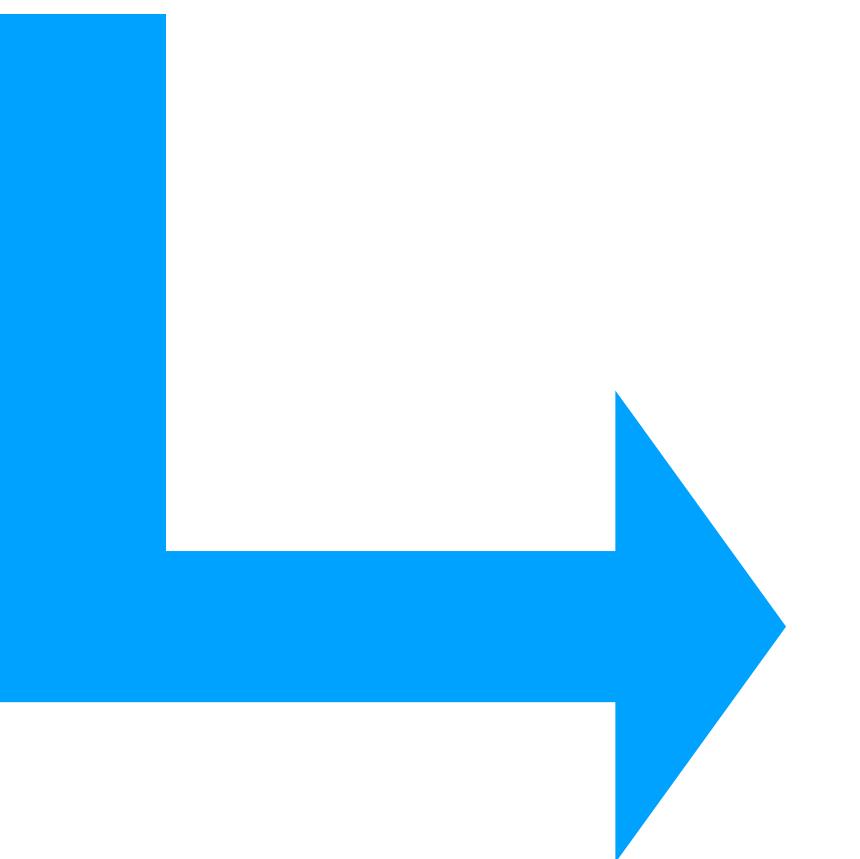
Eric Sodomka
Research Scientist, Facebook



DSN Artificial Intelligence Executive MasterClass - November 20, 2019

**Buried
Treasure**

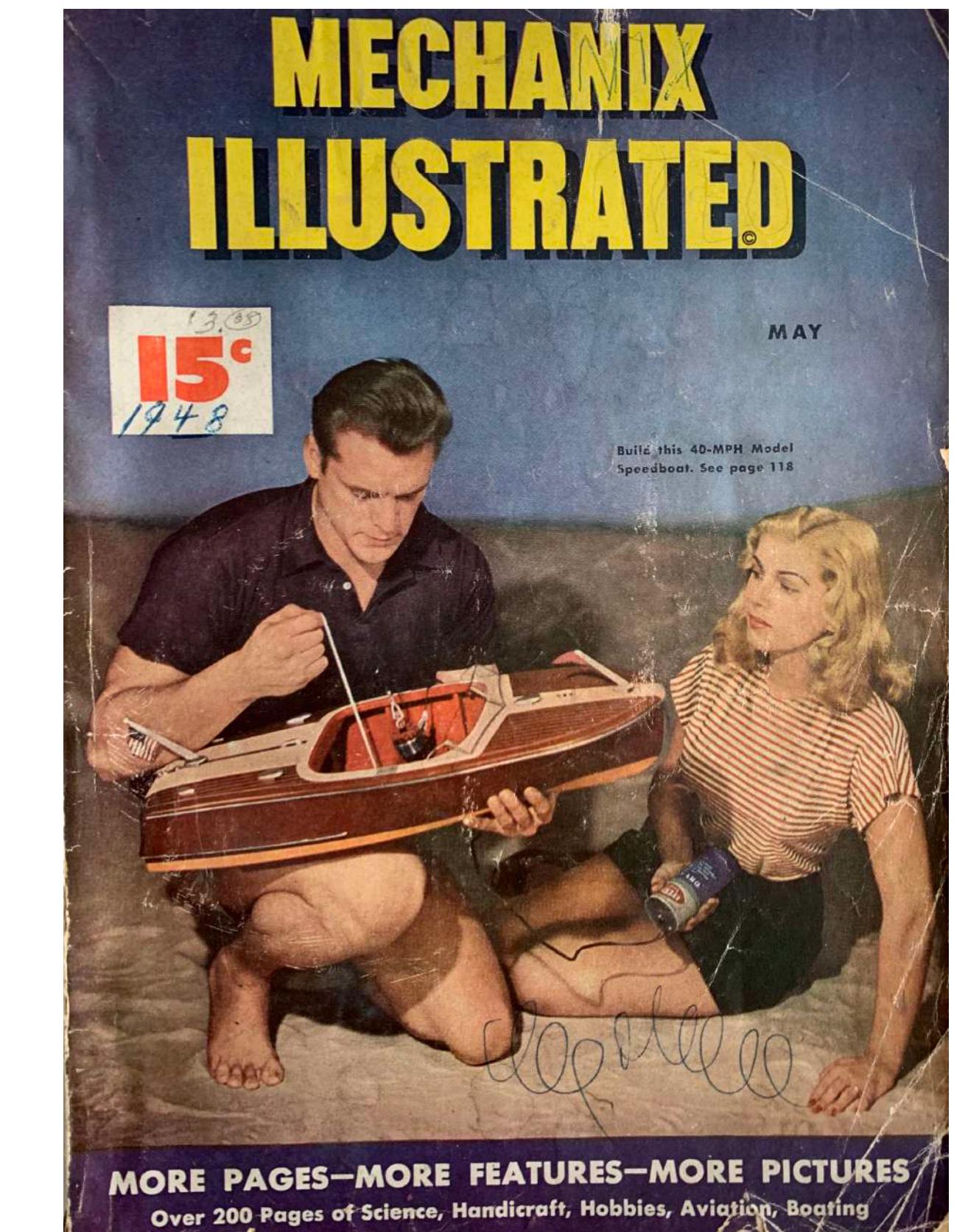
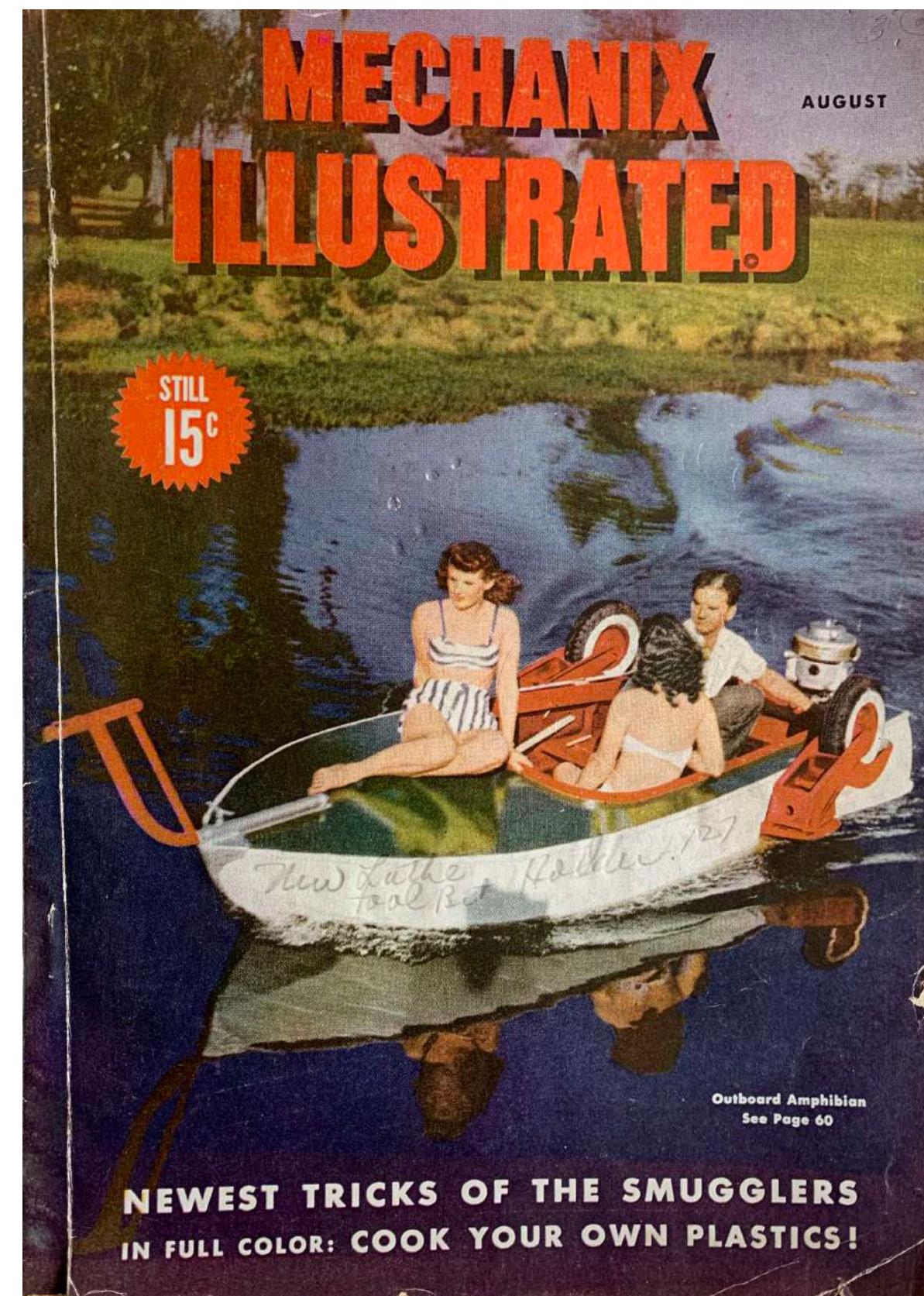






MECHANIX ILLUSTRATED®

THE HOW-TO-DO MAGAZINE



25¢

MARCH



**TV TELEPHONE—One Of The
AMAZING MARVELS OF TOMORROW**

See Page 68

Amazing Marvels of

TOMORROW

Here is an on-the-spot report
of what the future holds for you—by
MI's editor in the year 2055!

Recorded by O. O. Binder

GREETINGS, people of 1955, from the 21st
Century!

This is Jon Graw, editor of MECHANIX ILLUSTRATED in 2055 A.D., speaking to you over the new Future Phone recently invented. Merely by dialing MI-1955, my call hooked into a time trunk-line that connected with your phone circuits. Thus, we of a century ahead can speak directly to you and give you a peek into your future.

Perhaps many of the things of which I shall speak will seem amazing wonders to you, too fanciful to be true. But don't underestimate your scientists and technicians of 1955, for they will produce inventions and make discoveries of which you know nothing as yet, or hardly dream of. If not you, then your children or grandchildren will see them come to pass, one by one.

Suppose we take you on a tour of our world of 2055, as if you had been bodily transported here and saw it all with your own eyes. Suppose, too, that you are a typical citizen of our time, living in a suburban community.

A typical community of the future—covered with a giant Glasssteel shell and weather-controlled.

Art by Gurney Miller

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COVER STORY

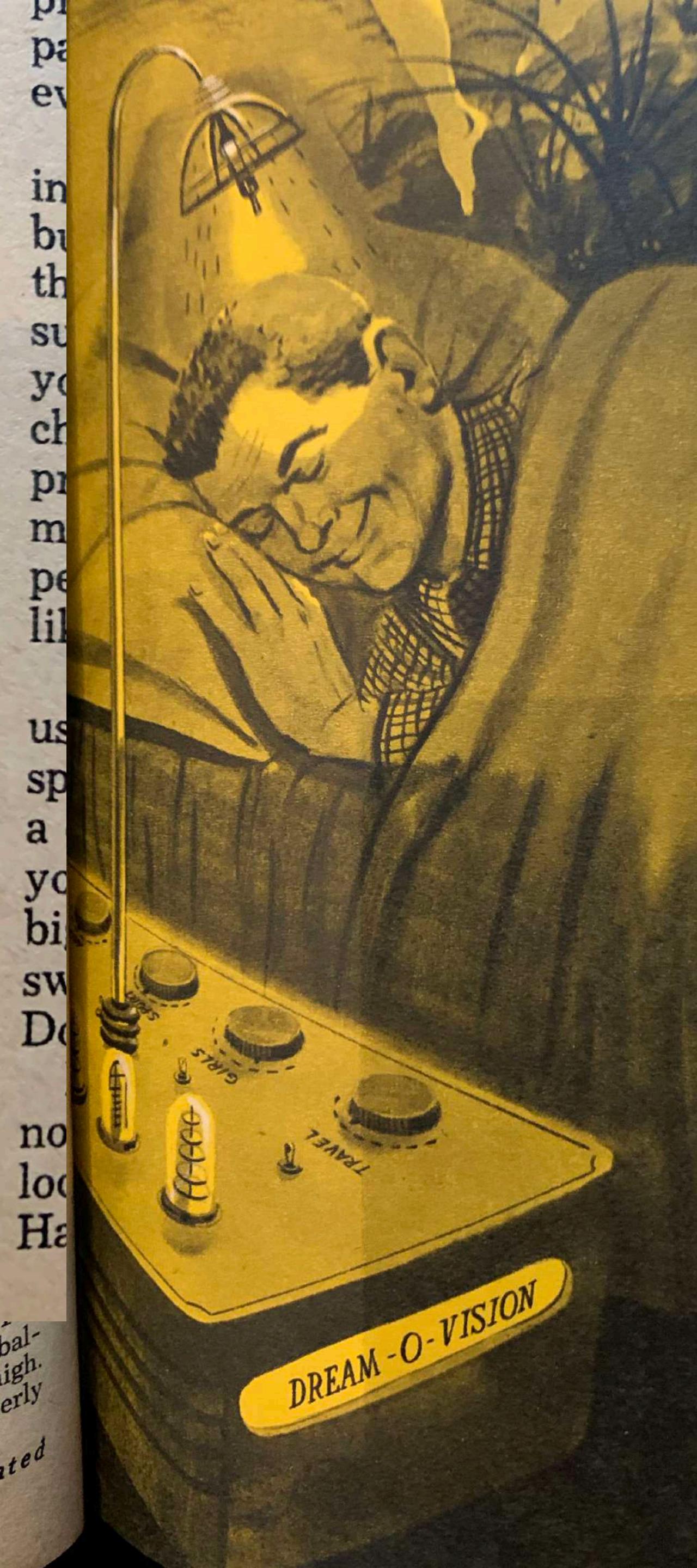




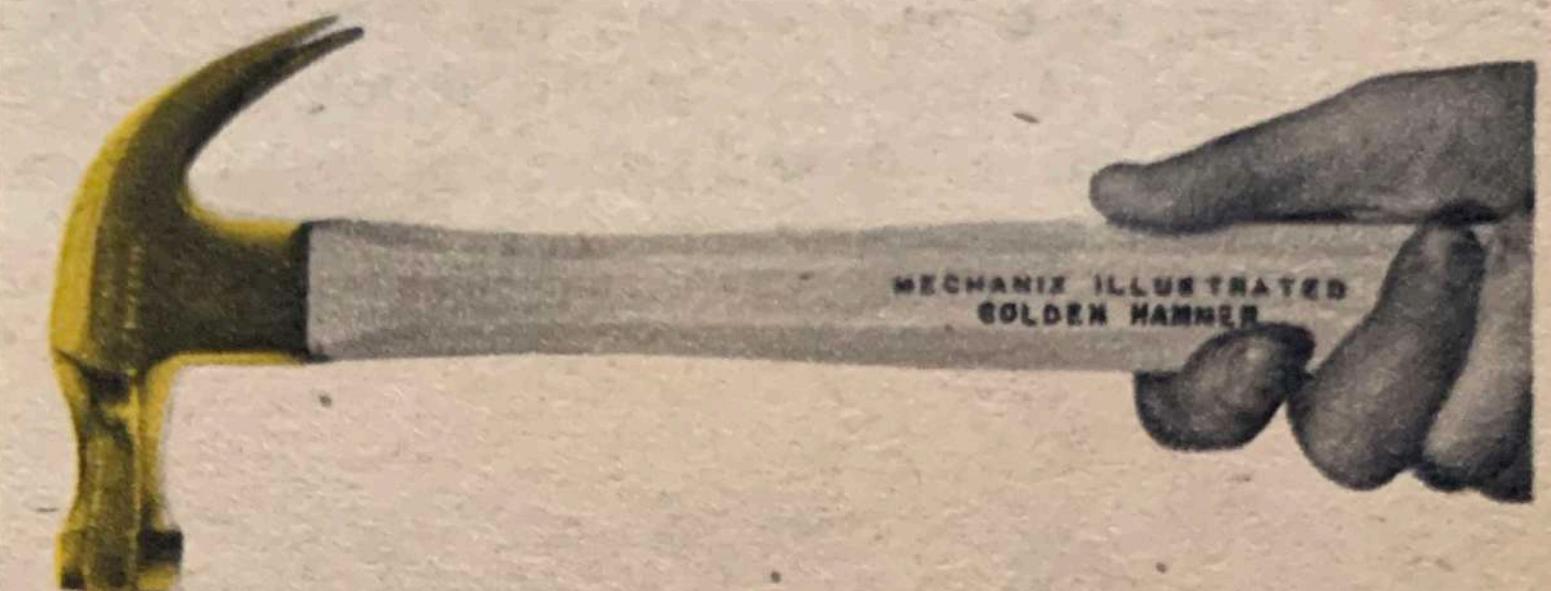
Commuting has become a pleasure with individual Shoulder Jets, powered by atomic fission. Airlanes are marked by balloons at various levels.



In 2055 your food will be prepared by the electronic Meal-o-Matic. Just turn the dials to the meal desired and out it pops, hot and savory.



FREE! 50 GOLDEN HAMMERS!



WHAT invention do you think will be in general use in 2055? If you can come up with a good one *not* described in this article and drawings, you can win a bright, new Golden Hammer—MI's famous special award. We're giving 50 Golden Hammers for the 50 best Amazing Marvels of Tomorrow suggested by 50 of our most imaginative readers.

The invention you suggest must be described in 50 words or less. It can be in the fields of communication, transportation, entertainment, or any other part of modern living. Submit only one invention and address it to Tomorrow, MECHANIX ILLUSTRATED, 67 West 44th St., New York 36, N. Y. All entries must be postmarked no later than March 31, 1955. No entries can be returned and we cannot enter into correspondence with entrants.

Winners' names and suggestions will be published in a forthcoming issue of MI. You might be one of those lucky 50—so get busy! Those Golden Hammers are really beautiful!

VISION

To build a world-class Artificial Intelligence knowledge, research and innovation ecosystem that delivers high impact & transformational research, business use applications, AI-first start-ups, employability and social good use cases; such that in 10 years, Nigeria will become one of the top 10 AI talent/knowledge destinations with 20% GDP multiplier impact.



#1million_AITalents_in_10_years

1st Artificial
Intelligence Book
for Primary and
Secondary Schools

Motivating Problem: Blind Spots

	country	authors	submitted	accepted	acceptance rate	PC members
1	Australia	1	0.2	0.2		
2	Austria	4	1.33	1	0.75	0
3	Canada	7	4.37	1.83	0.42	2
4	Chile	3	1.5	0.03		
5	China	5	1.92			1
6	Czechia	2	1			2
7	France	15	5.5			0
8	Germany	24	11.25			0
9	Greece	8	2.5			3
10	Hong Kong	0	0	0		4
11	Hungary	4	1.58	0.5	0.32	1
12	India	14	5.75	0.25	0.04	0
13	Israel	34	21.23	6.03	0.28	2
14	Italy	5	2.33	1.33	0.57	4
15	Japan	3	3.08	1.92	0.62	2
16						0

Where are the mechanism design
researchers from Nigeria?

Announcing the winners of the Facebook Mechanism Design for Social Good research awards

March 22, 2019

Announcing the winners of the Facebook Mechanism Design for Social Good research awards

By: Eric Sodomka



Last June, at the 19th ACM Conference on Economics and Computation (EC 2018), we introduced the Facebook research awards in mechanism design for social good.

We asked researchers to consider the following problem: Suppose there is an existing online platform that is actively used by the population, and an existing set of social ills (e.g., unemployment, disease, poverty, divisiveness, loneliness). How should one design mechanisms on top of such an online platform to build community in a way that alleviates those social ills?

We received 58 submissions for this award. Amongst those, we chose three winners to each receive an

Related Content

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[Announcing the winners of the 2019 Testing and Verification research awards](#) 

October 14, 2019

Blog
[Computer Vision for Global Challenges research award winners](#) 

October 11, 2019

Blog
[Announcing the winners of phase two content policy research awards](#) 

September 30, 2019

Blog
[Announcing the winners](#) 

Announcing the winners of the +

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facebook research

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Blog

The winners are as follows:

- **Mechanisms for Crowdsourcing with Small-Holder Farmers.** *PI: Mutembesa Daniel (Makerere University). Collaborators: Boi Faltings (EPFL); Christopher Omongo (National Crops Resources and Research Institute); Humphrey Mutaasa (Uganda National Farmers Federation).*
- **Modern Social Choice: Mechanisms and Platforms for Large Scale Deliberation.** *Co-PIs: Ashish Goel (Stanford University); James S. Fishkin (Stanford University); Kamesh Munagala (Duke University).*
- **Promoting Diversity in Peer Production through Mechanism Design.** *Co-PIs: Zhiwei Steven Wu (University of Minnesota); Haiyi Zhu (University of Minnesota).*

Mechanisms for crowdsourcing with small-holder farmers

The problem: Farmers in the developing world rely on a healthy crop to provide for their families, but that crop is continually at risk of being destroyed. Diseases and pests can ruin a farmer's entire harvest, and outbreaks can affect the broader farming community. Such dangers are hard to detect in their early stages, and farmers need to be warned before they become a threat to the community. Identifying damaged

Announcements



Eric Sodomka

Admin · November 7 at 2:14 PM

Call for collaborations between Harvard's EconCS course attendees and aspiring EconCS/mechanism design researchers from Data Science Africa

This is a call for students from David Parkes's course ([CS136: Economics and Computation](#)) to collaborate on final course projects with past attendees from Data Science Africa (or anyone else in this group with a real-world problem in mechanism design).

At past Data Science Africa events, we have run contests to identify real-world problem...

[See More](#)



27

20 Comments 1 Share

Like

Comment

Share

COMING SOON: Global Challenges in Economics and Computation

Objective: Identify a real-world, socially impactful problem in your region that could benefit from the tools of mechanism design.

Don't know much about mechanism design? No problem! See the brainstorming form.

Contest Details (TENTATIVE)

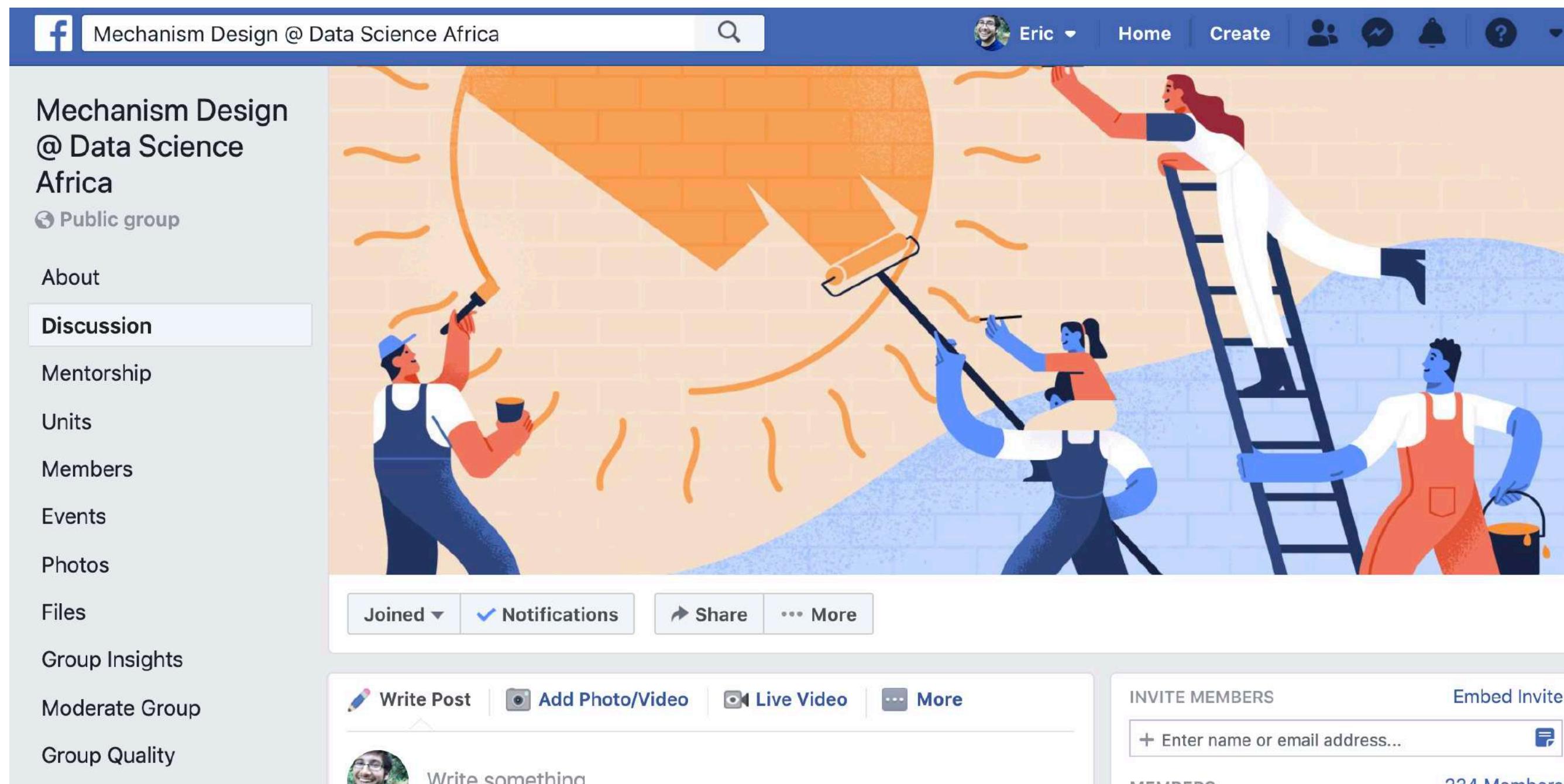
- **Deadline:** Early next year
- Proposals must apply research in EconCS to help achieve a **U.N. sustainable development goal**
- Eligible PI: **Resident of a low- or middle-income country, interested in joining the EconCS community**
- Must partner with someone who can deploy solution. May partner with someone currently in EconCS community.
- Award: \$150K total (~15 prizes of ~\$10K each)

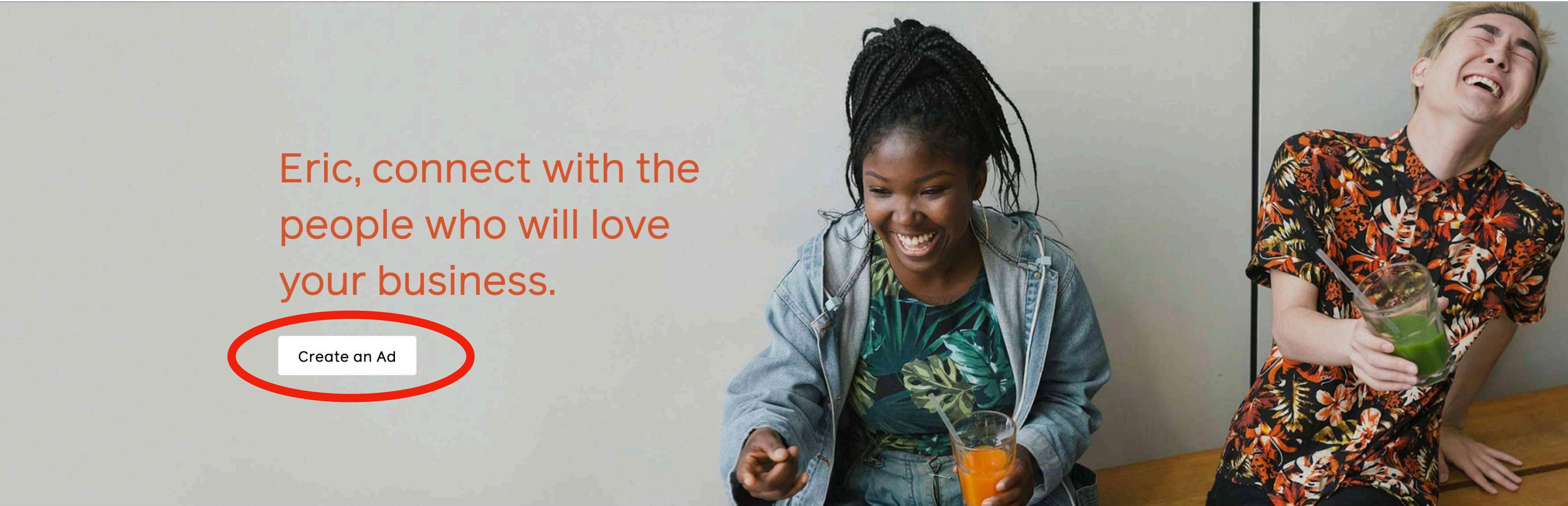
Relevant Links

- Brainstorming form (for ideas):
bit.ly/ai-exec-brainstorm
- Problem submission form (for feedback):
bit.ly/ai-exec-problem
- Facebook group (for announcement):
bit.ly/ai-exec-group

Join the group to be eligible for a book at end of this tutorial:

[bit.ly/ai-exec-group](https://www.facebook.com/groups/ai-exec-group/)

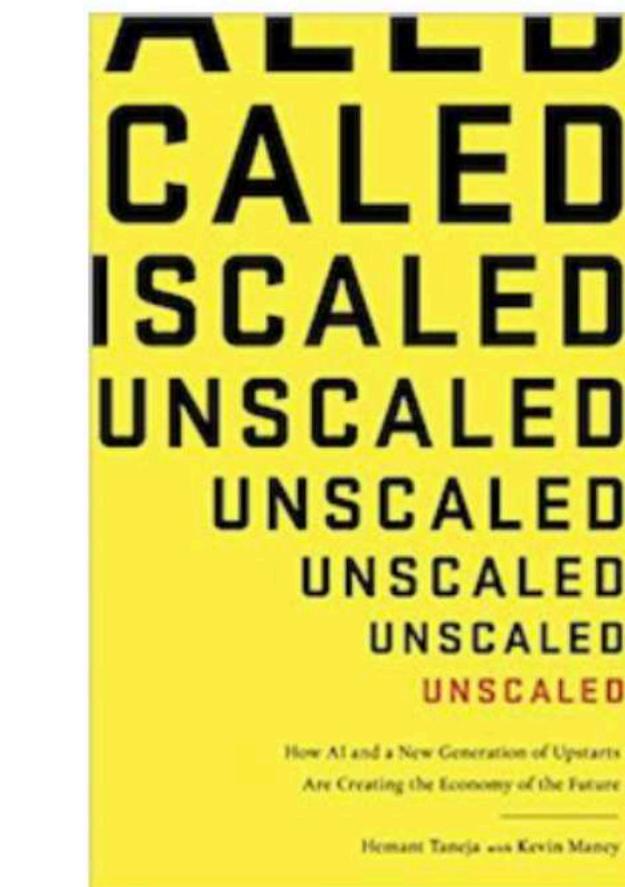
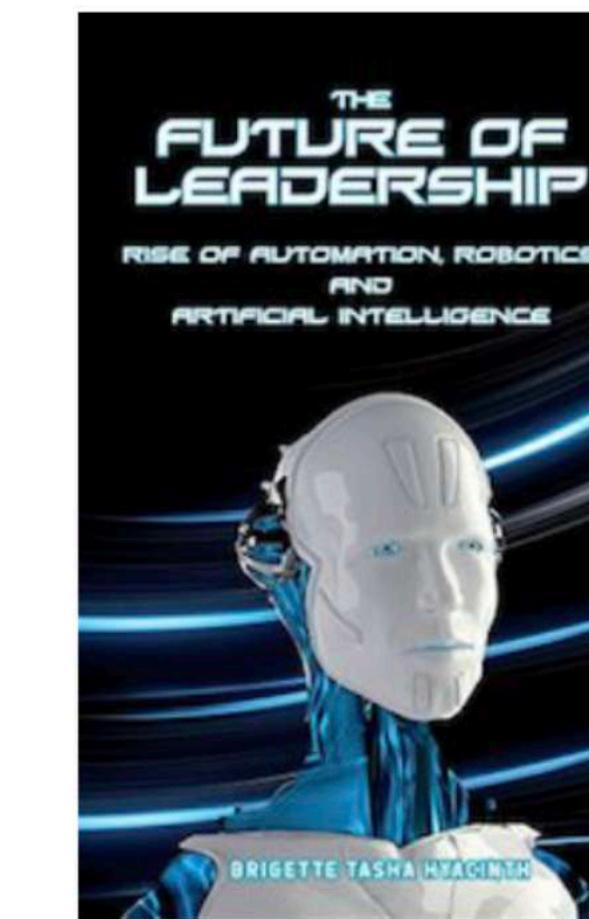
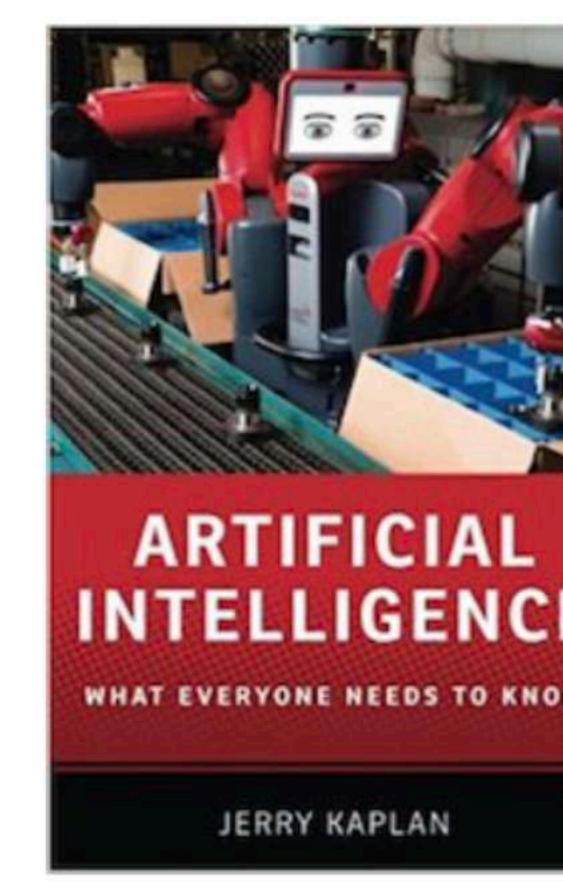
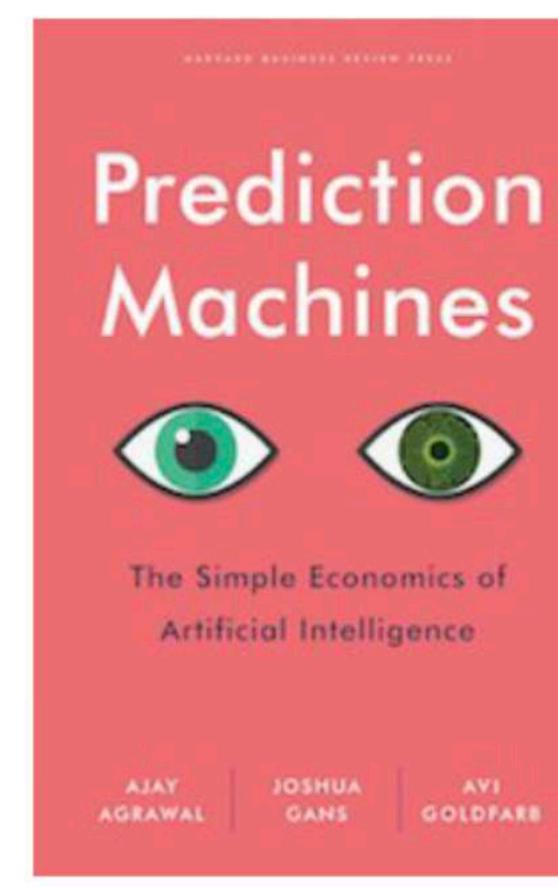
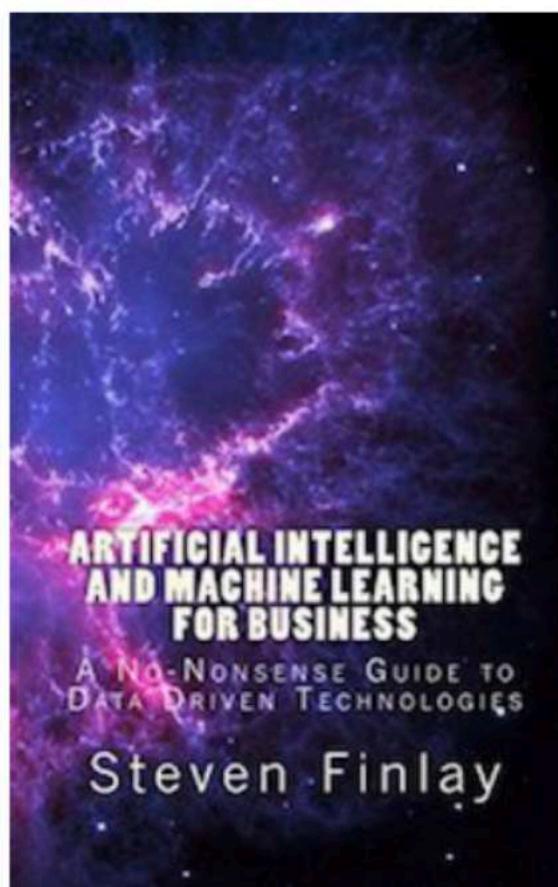
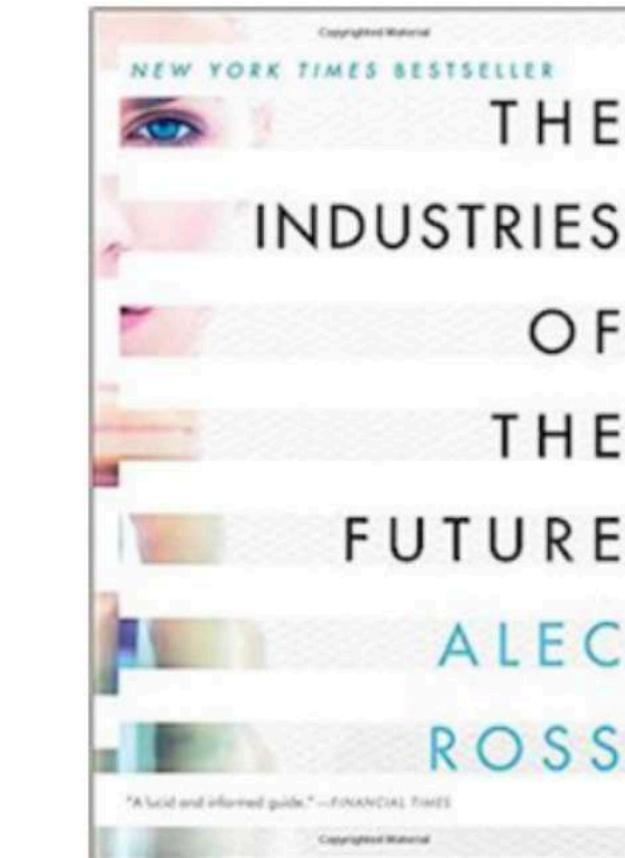
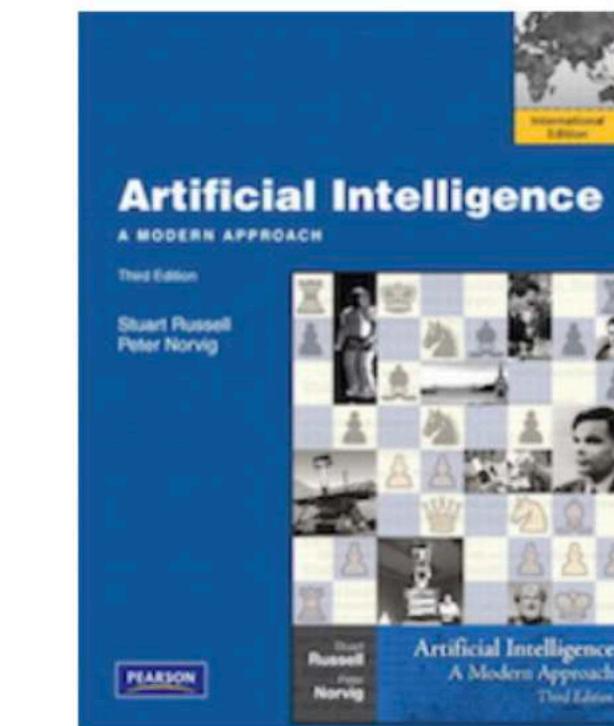
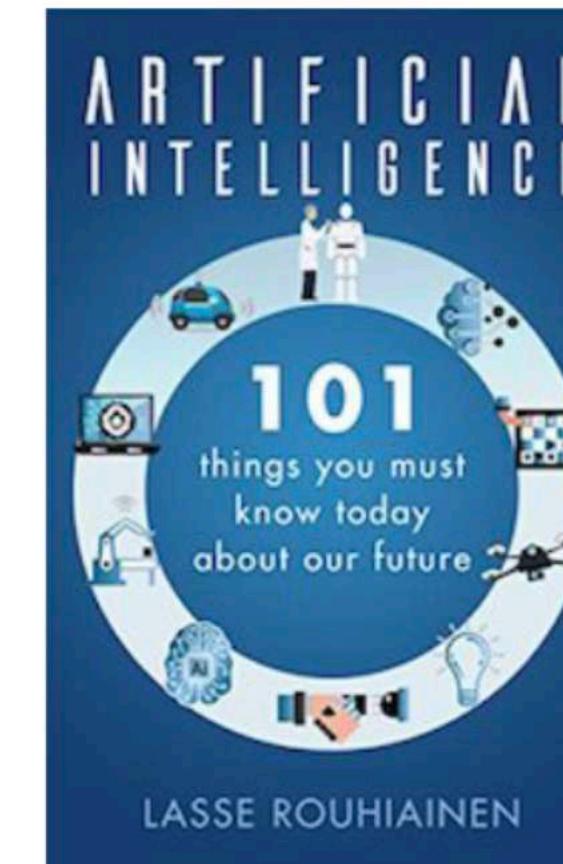
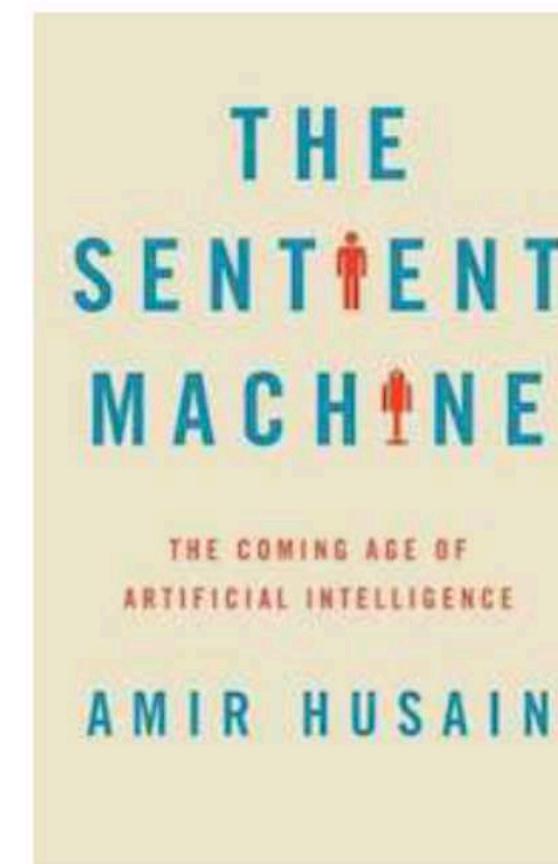
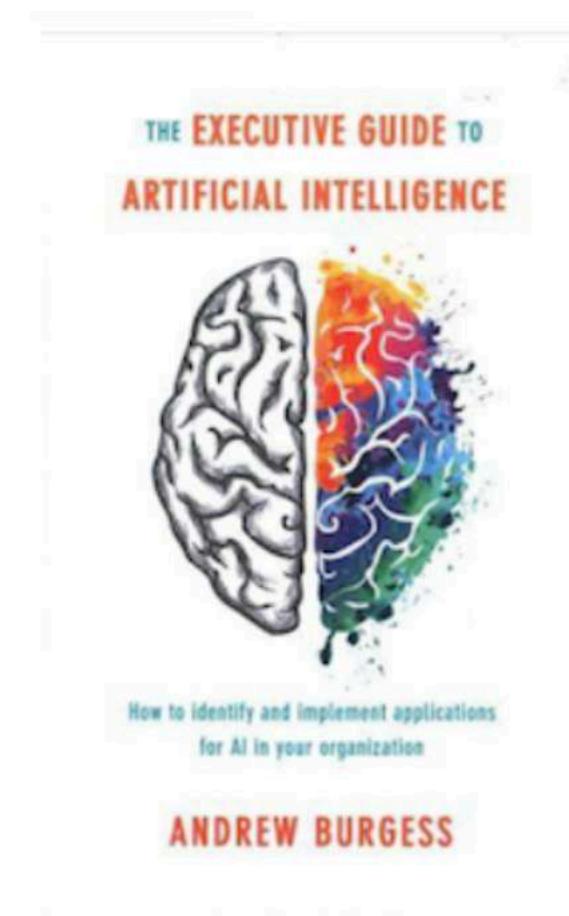




Eric, connect with the
people who will love
your business.

Create an Ad

The Problem: Giving out Books



An Initial Proposal

Random Assignment

1. **Randomly order attendees:** assign each a unique number 1 through 100.
2. In that attendee order, give each attendee a **randomly chosen book** amongst those remaining.

Discuss with your Neighbor

- Do you have any complaints about Random Assignment?
- Can you come up with anything better?

Random Assignment

1. **Randomly order attendees:** assign each a unique number 1 through 100.
2. In that attendee order, give each attendee a **randomly chosen book** amongst those remaining.

Done? Join Facebook Group **Mechanism Design @ Data Science Africa** bit.ly/ai-exec-group.
We'll draw winners from that group at the end of the talk to play the "book giveaway" game.

Complaints about Random Assignment?

Random Assignment

1. **Randomly order attendees:** assign each a unique number 1 through 100.
2. In that attendee order, give each attendee a **randomly chosen book** amongst those remaining.

Complaints about Random Assignment?

- “It doesn’t consider what I want.”
- “I have to trade with people afterwards to get something better.”
- Benefit: “It’s quick and easy.”

Random Assignment

1. **Randomly order attendees:** assign each a unique number 1 through 100.
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Did you come up with anything better?

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2. In that attendee order, give each attendee a **randomly chosen book** amongst those remaining.

Did you come up with anything better?

Choose Your Favorite

1. **Randomly order attendees:** assign each a unique number 1 through 100.
2. In that attendee order, give each attendee **the choice of their favourite book** amongst those remaining.

Random Assignment

1. **Randomly order attendees:** assign each a unique number 1 through 100.
2. In that attendee order, give each attendee a **randomly chosen book** amongst those remaining.

Can Eric allocate books on his own time?

Can Eric allocate books on his own time?

Choose Your Favorite (by proxy)

1. Have each participant submit their **preferences over books**.
2. **Randomly order attendees:** assign each a unique number 1 through 100.
3. In that attendee order, give each attendee **their favorite book amongst those remaining, according to their reported preferences**.

Can Eric allocate books on his own time?

Serial Dictatorship

1. Have each participant submit their **preferences over books**.
2. **Randomly order attendees:** assign each a unique number 1 through 100.
3. In that attendee order, give each attendee **their favorite book amongst those remaining, according to their reported preferences**.

Evaluating Mechanisms

- How is **Serial Dictatorship** better than **Random Assignment**?
- What does it mean for a mechanism to be “good”?

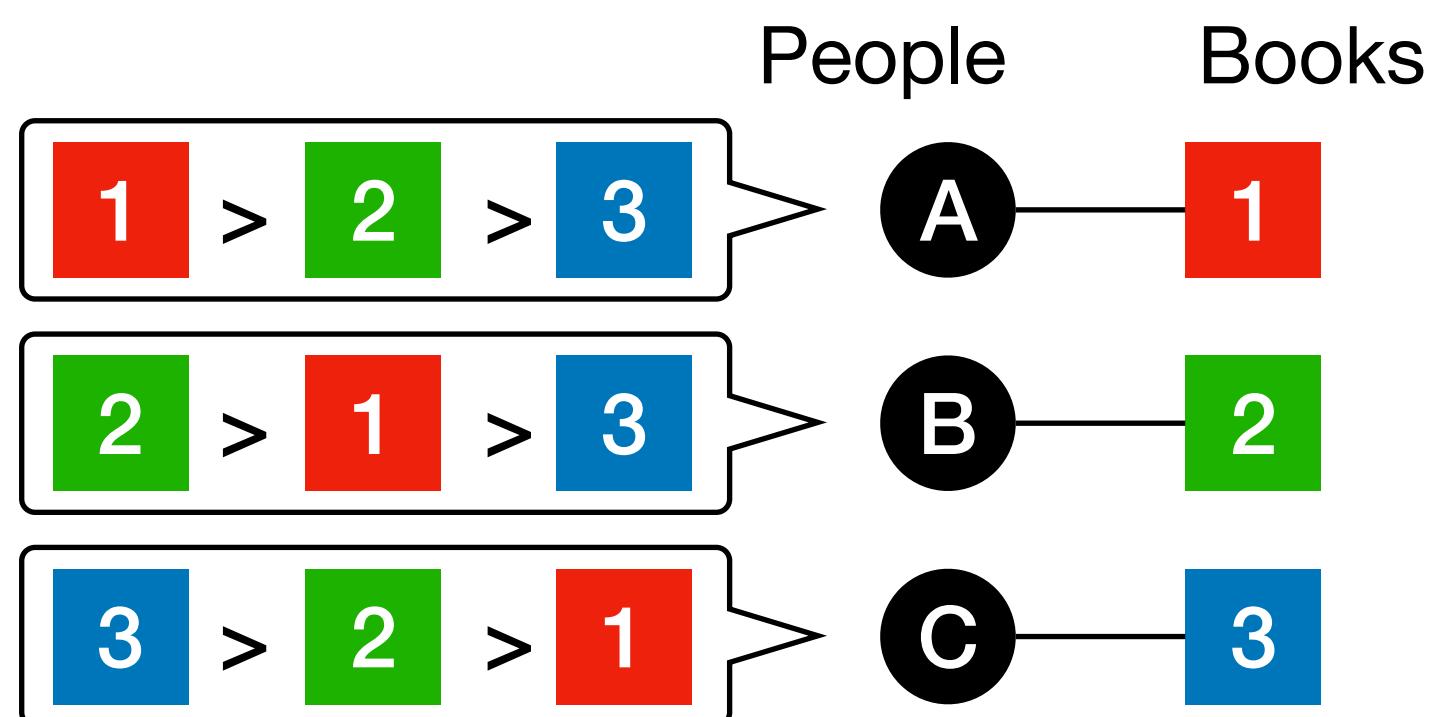
One Notion of Goodness

- An outcome is **pareto optimal** if you can't make someone better off without making someone else worse off.
- An outcome is pareto optimal if there is no alternative outcome for which (1) everyone is at least as happy, and (2) someone is happier.

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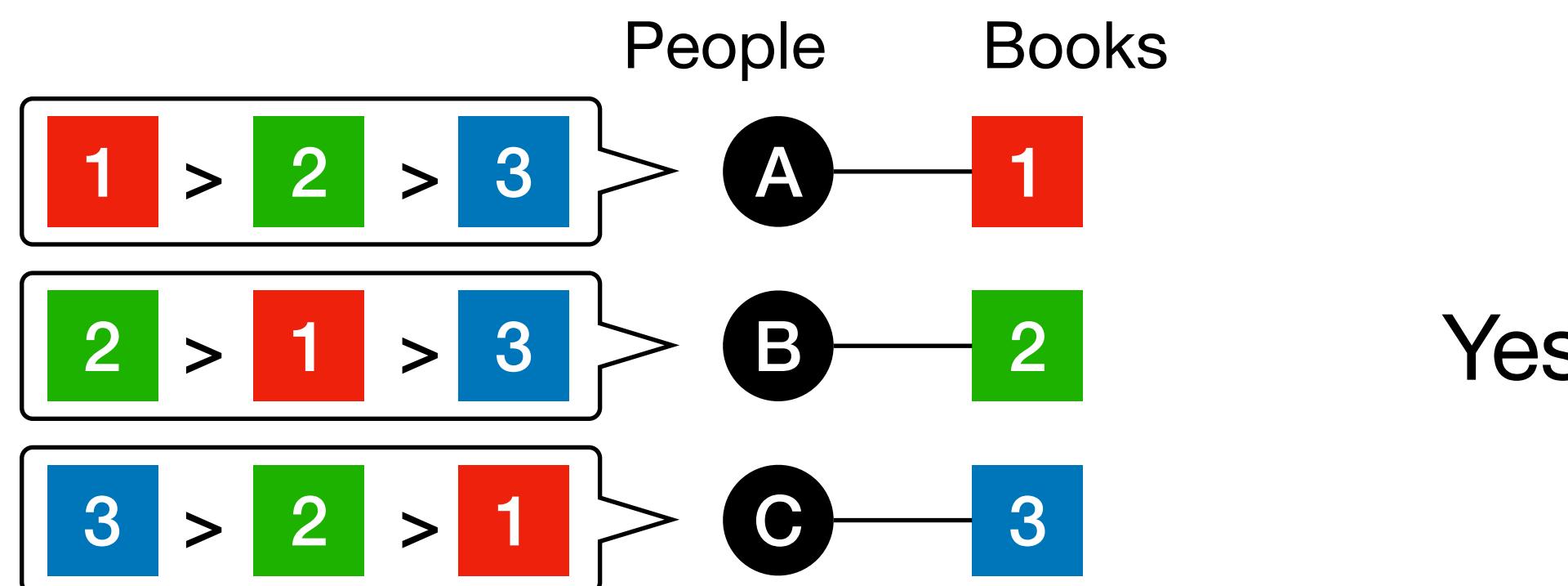
Is this outcome pareto optimal?



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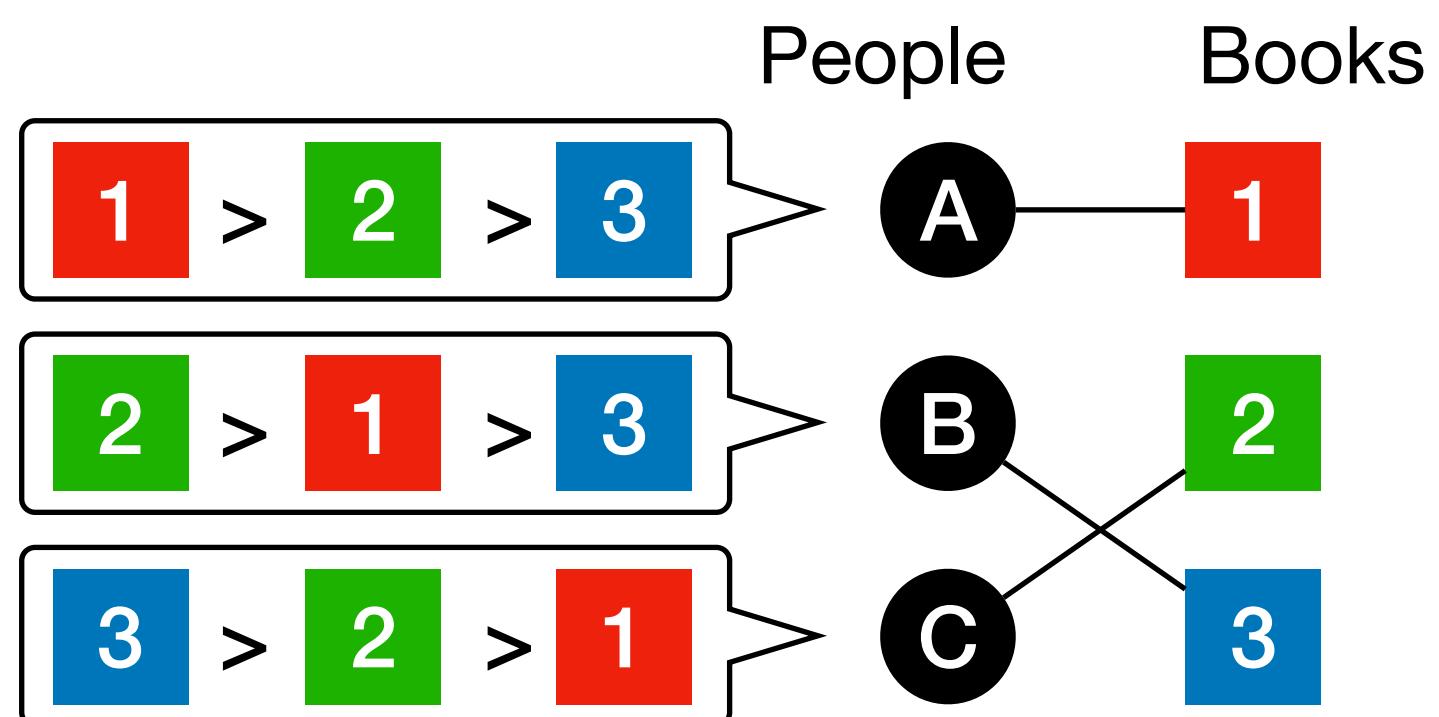
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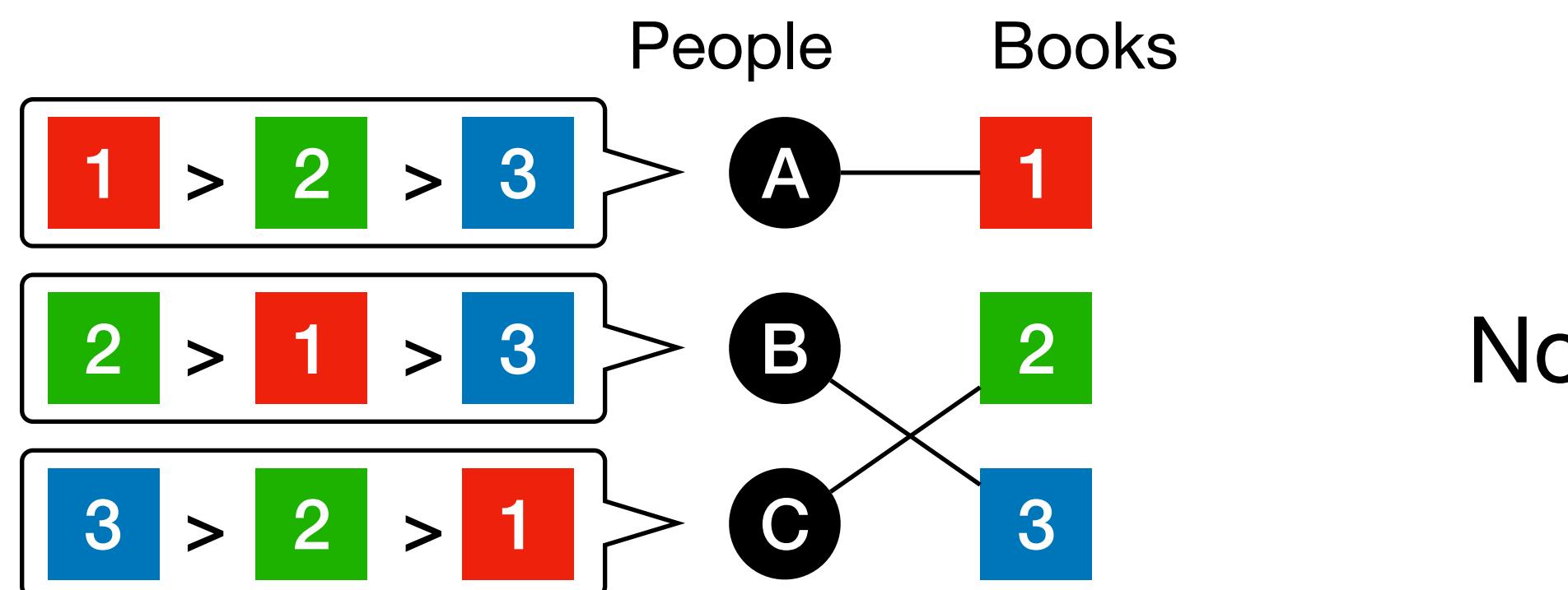
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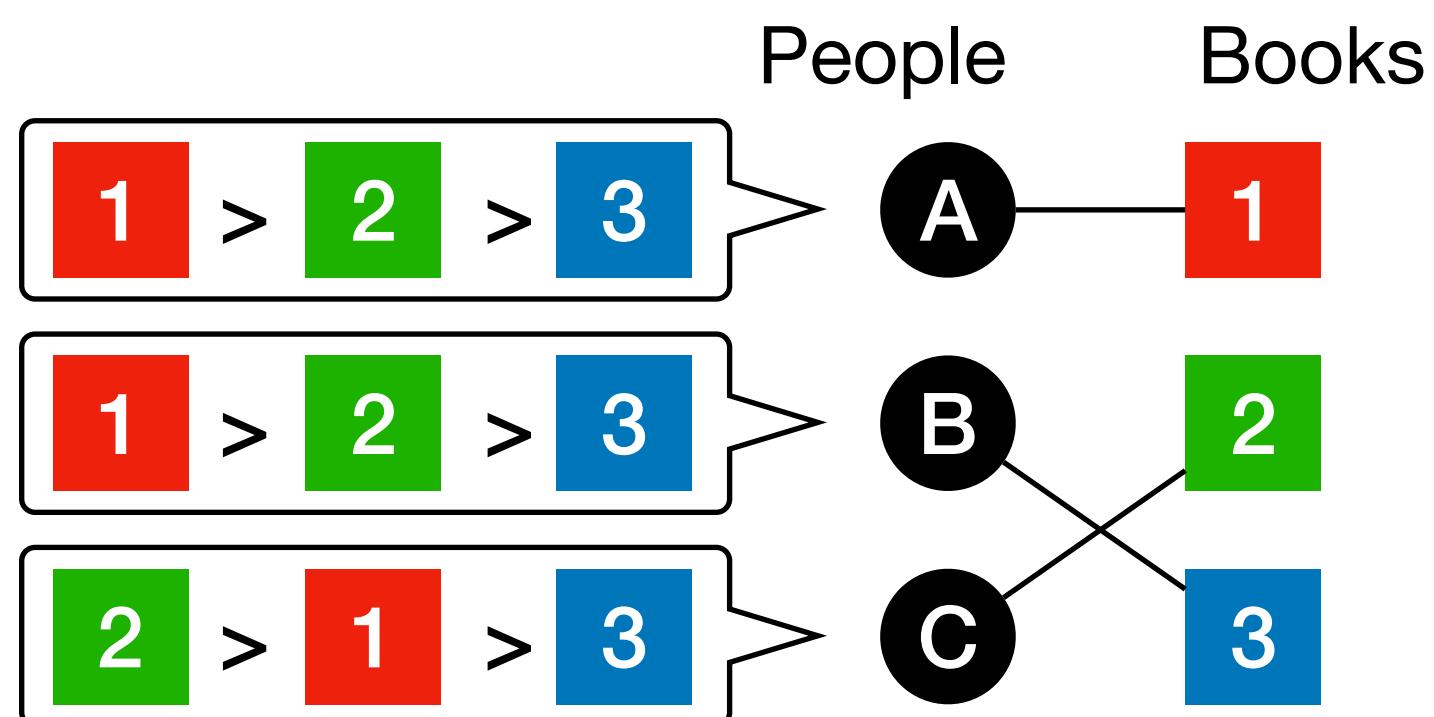
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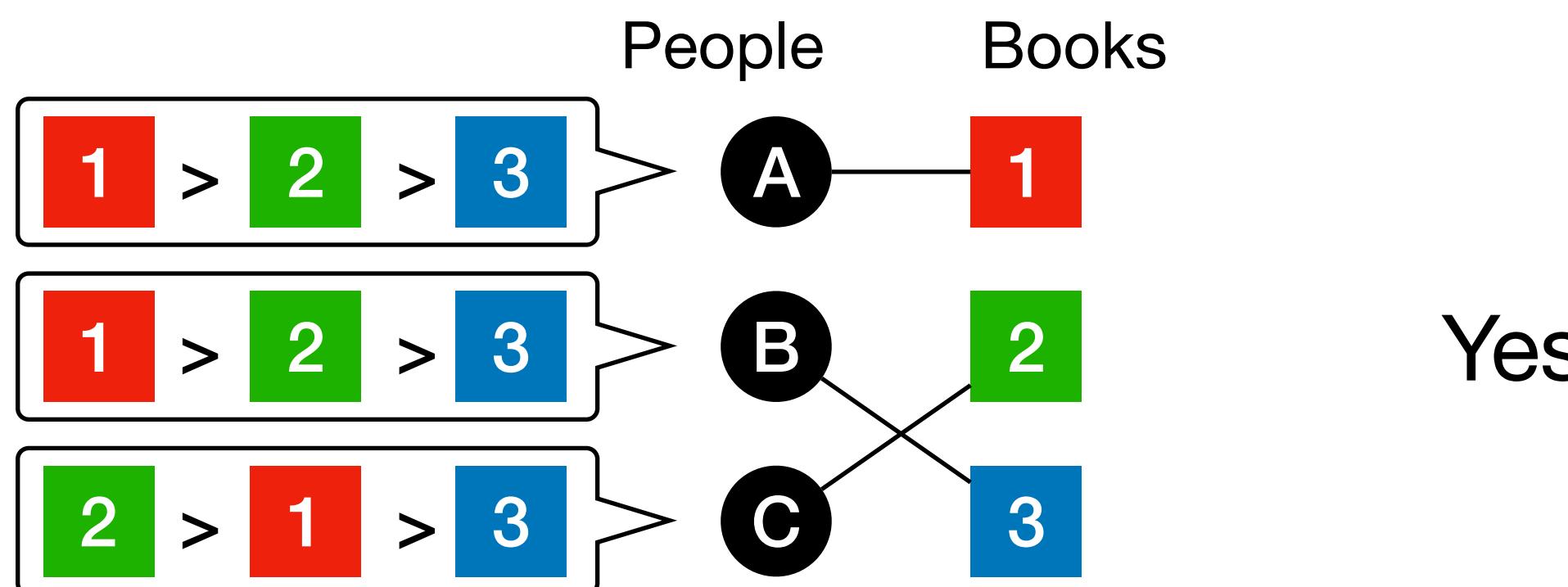
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Is this outcome pareto optimal?



Is the Serial Dictatorship outcome always Pareto Optimal?

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Recall

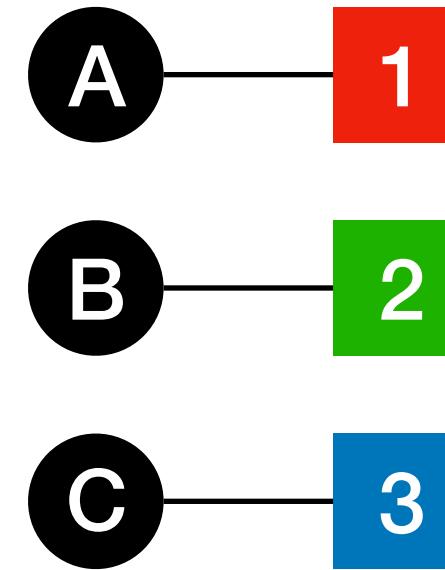
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Is the Serial Dictatorship outcome always Pareto Optimal?

People Books



**Outcome from
Serial Dictatorship**

Recall

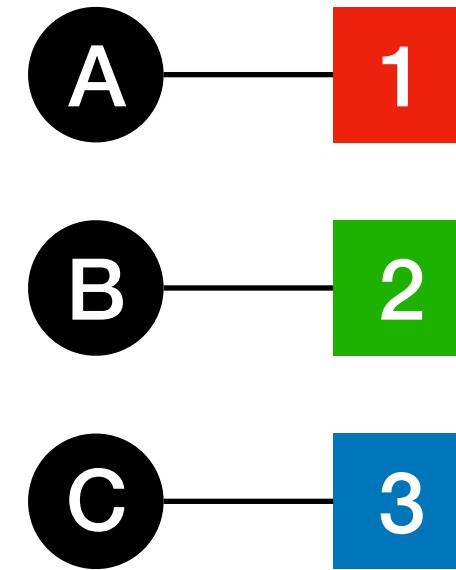
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People Books



Can we find a “better”
outcome where everyone is
just as happy, and some are
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Outcome from
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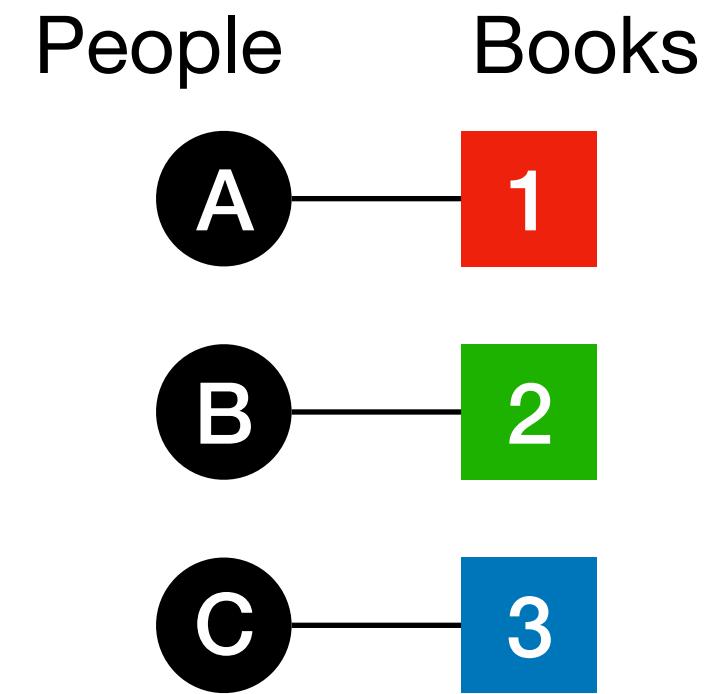
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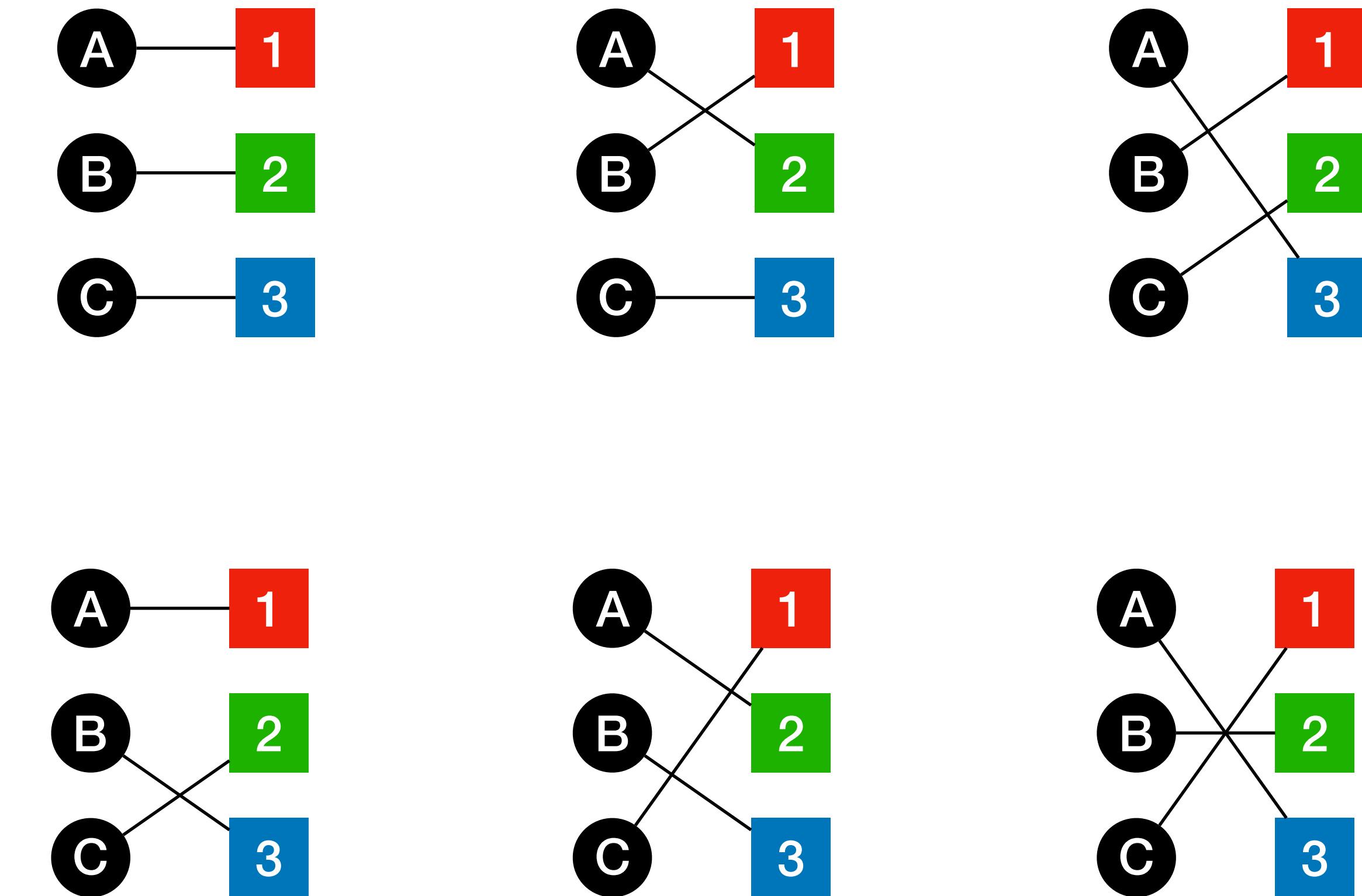
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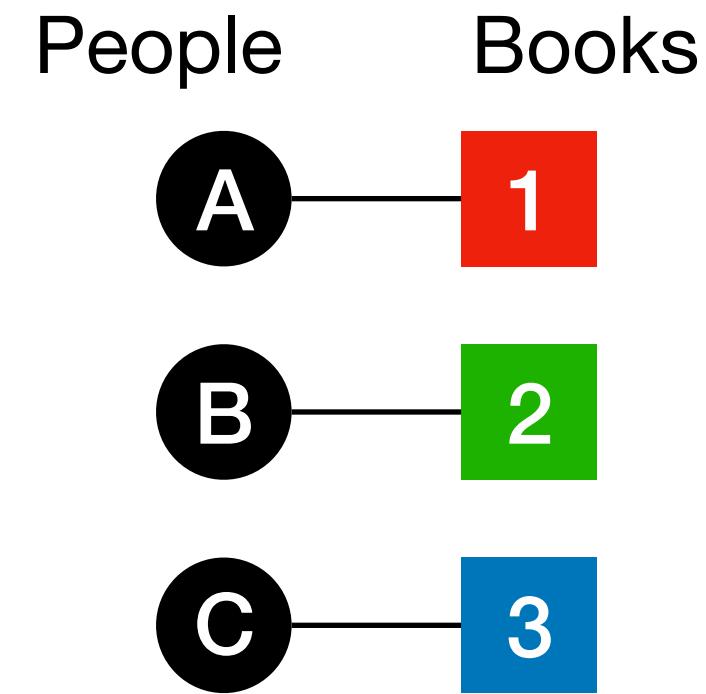
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All possible outcomes
(where everyone is matched)

Is the Serial Dictatorship outcome always Pareto Optimal?

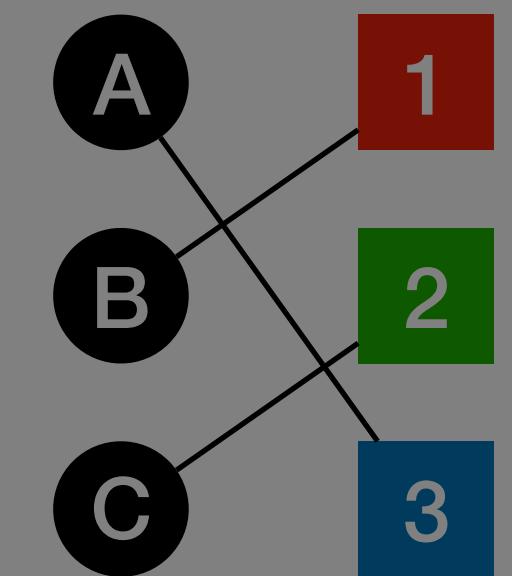
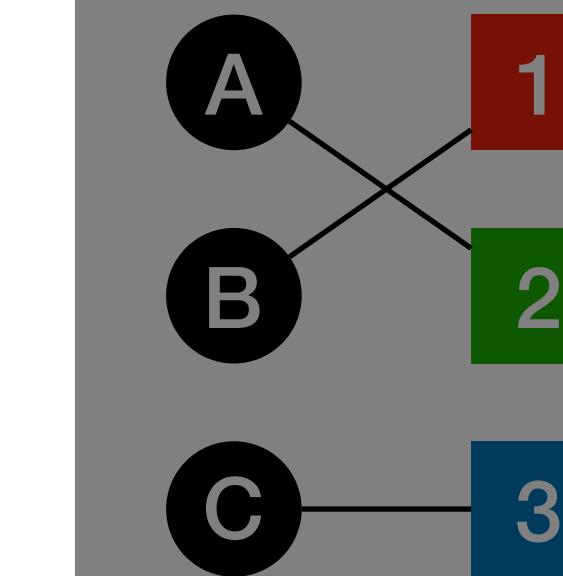
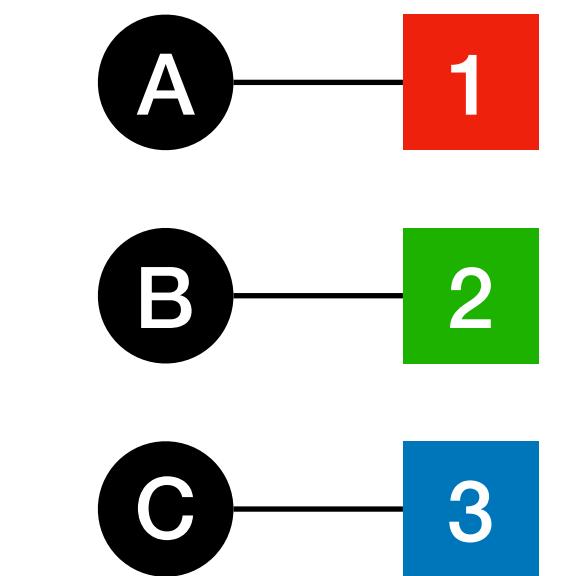


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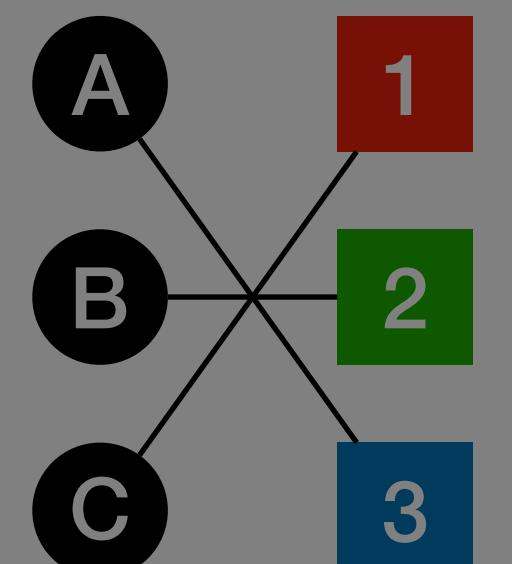
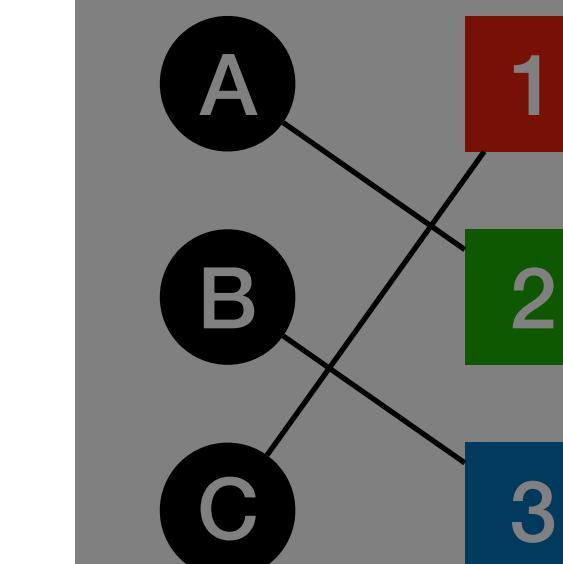
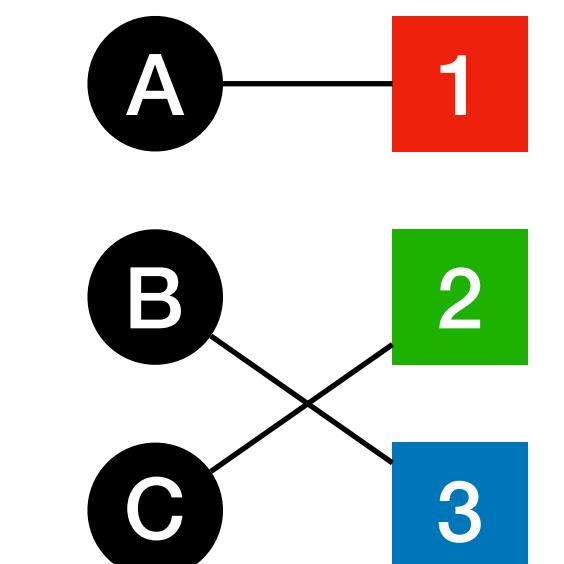
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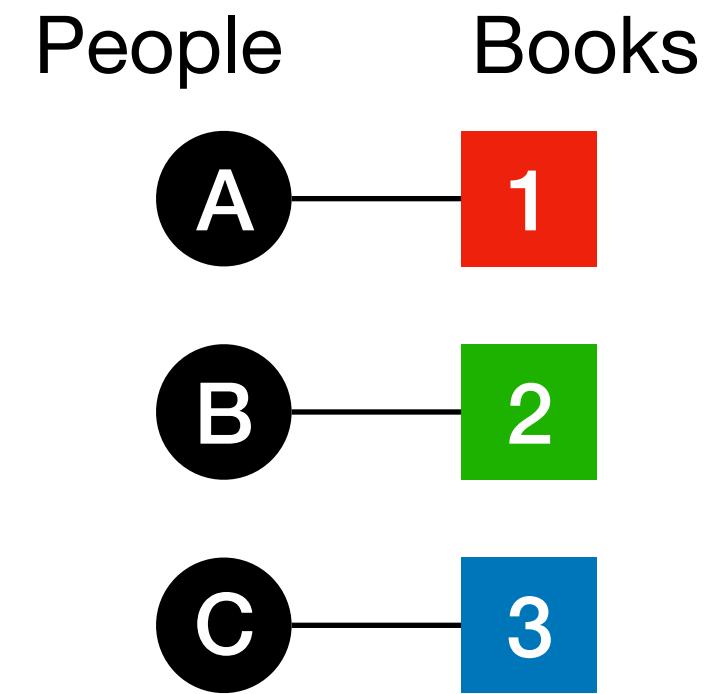


A is worse off



All possible outcomes
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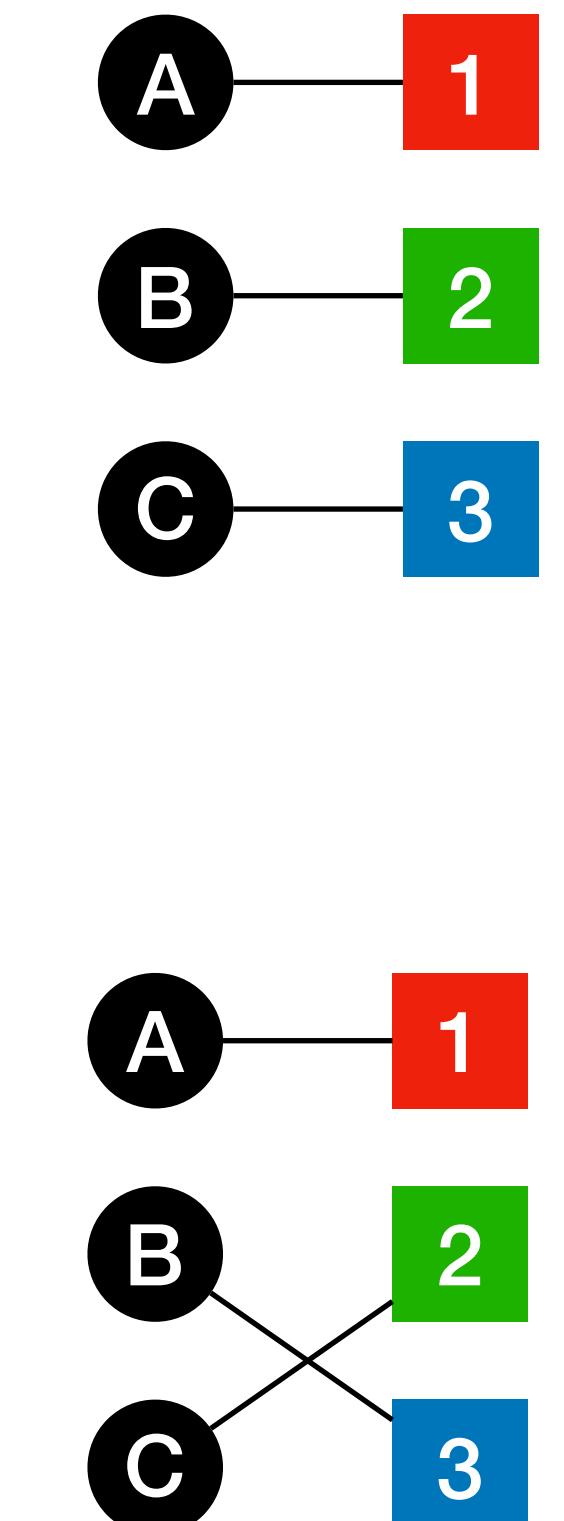
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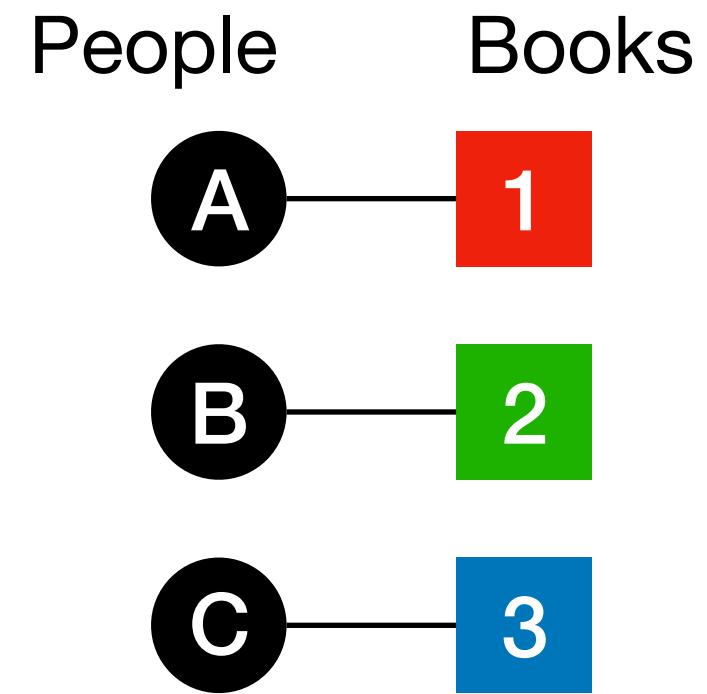
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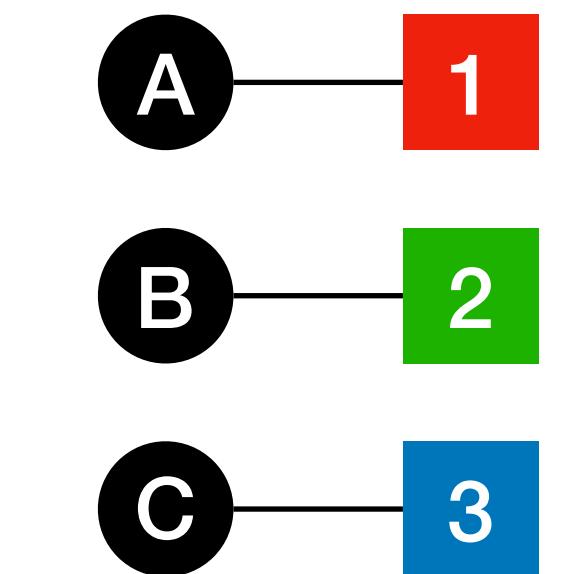
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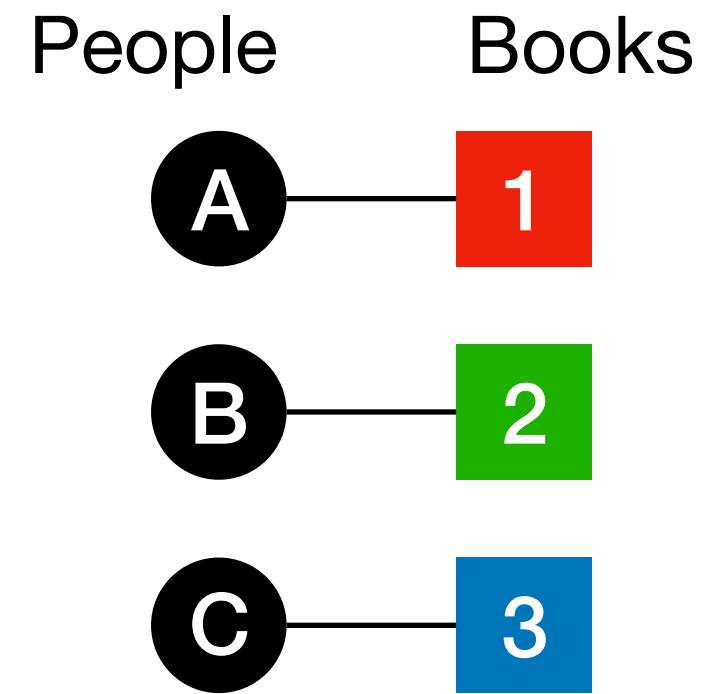
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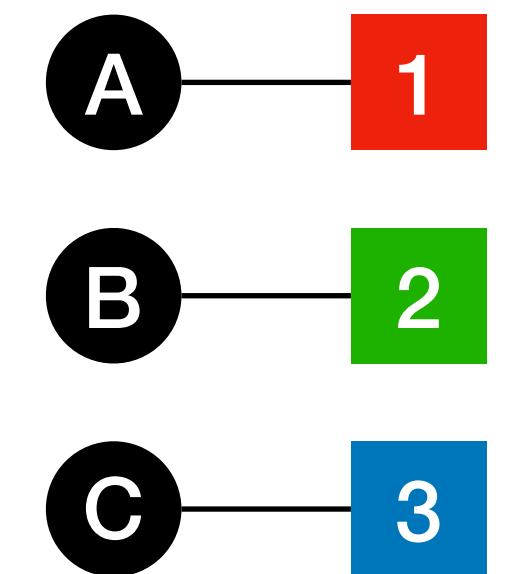
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Serial Dictatorship mechanism:

(1) Randomly order people. (2) Match each person with their most-preferred available book.

An outcome is **pareto optimal** if there is no alternative outcome for which (1) everyone is at least as happy, and (2) someone is happier.

Can we find a “better”
outcome where everyone is
just as happy, and some are
happier?

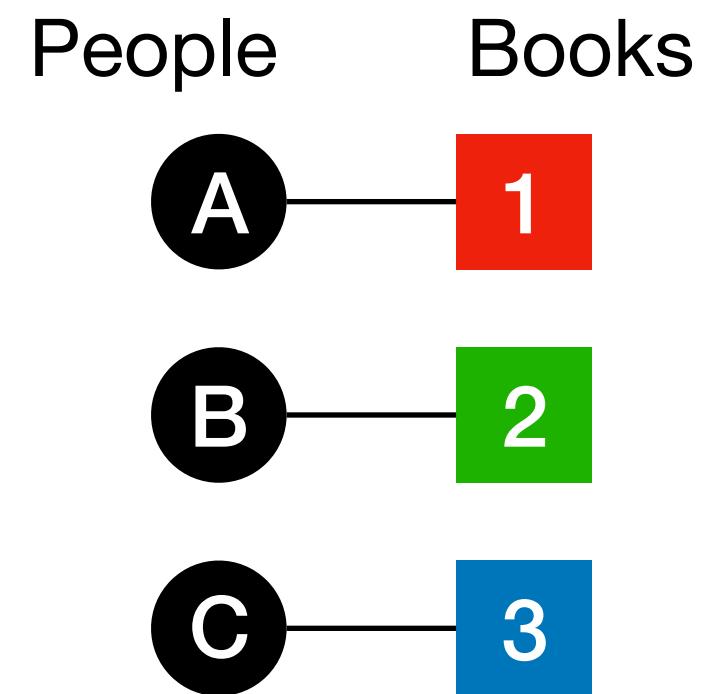


A is worse off

B is worse off

All possible outcomes
(where everyone is matched)

Is the Serial Dictatorship outcome always Pareto Optimal?



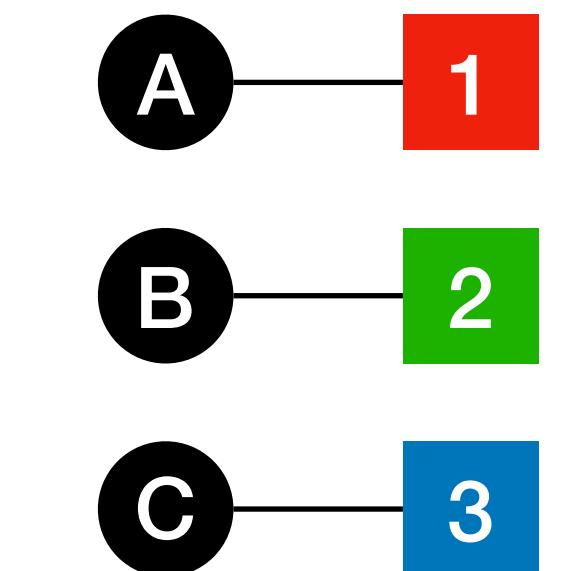
Outcome from
Serial Dictatorship

Recall

Serial Dictatorship mechanism:
(1) Randomly order people. (2) Match each person with their most-preferred available book.

An outcome is **pareto optimal** if there is no alternative outcome for which (1) everyone is at least as happy, and (2) someone is happier.

Can we find a “better”
outcome where everyone is
just as happy, and some are
happier?



Only one outcome where
nobody is worse off than
Serial Dictatorship outcome

A is worse off

B is worse off

All possible outcomes
(where everyone is matched)

Another Notion of Goodness

- A mechanism is **strategyproof** if honesty is the best policy.
- A mechanism is strategyproof if lying about your preferences can't make you better off.

Is the Serial Dictatorship strategyproof?

Is the Serial Dictatorship strategyproof?

- Your reported book preferences don't affect your turn order.

Is the Serial Dictatorship strategyproof?

- Your reported book preferences don't affect your turn order.
- Your reported book preferences don't affect what anyone before you gets.

Is the Serial Dictatorship strategyproof?

- Your reported book preferences don't affect your turn order.
- Your reported book preferences don't affect what anyone before you gets.
- Thus, your reported book preferences don't affect what books are available on your turn.

Is the Serial Dictatorship strategyproof?

- Your reported book preferences don't affect your turn order.
- Your reported book preferences don't affect what anyone before you gets.
- Thus, your reported book preferences don't affect what books are available on your turn.
- Serial Dictatorship gives you the best available book on your turn (according to reported preferences).

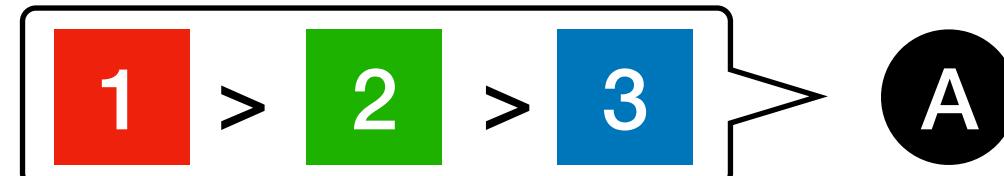
Is the Serial Dictatorship strategyproof?

- Your reported book preferences don't affect your turn order.
- Your reported book preferences don't affect what anyone before you gets.
- Thus, your reported book preferences don't affect what books are available on your turn.
- Serial Dictatorship gives you the best available book on your turn (according to reported preferences).
- Thus, any misreport of preferences could only result in you getting a book you like less.

The Abridged Serial Dictatorship

Abridged Serial Dictatorship

1. Have each participant submit their preferences over their **top K** books.
2. Randomly order attendees.
3. In that order, give each attendee their favorite book amongst those remaining, according to their reported preferences. **If all their favorite books are gone, give them nothing.**



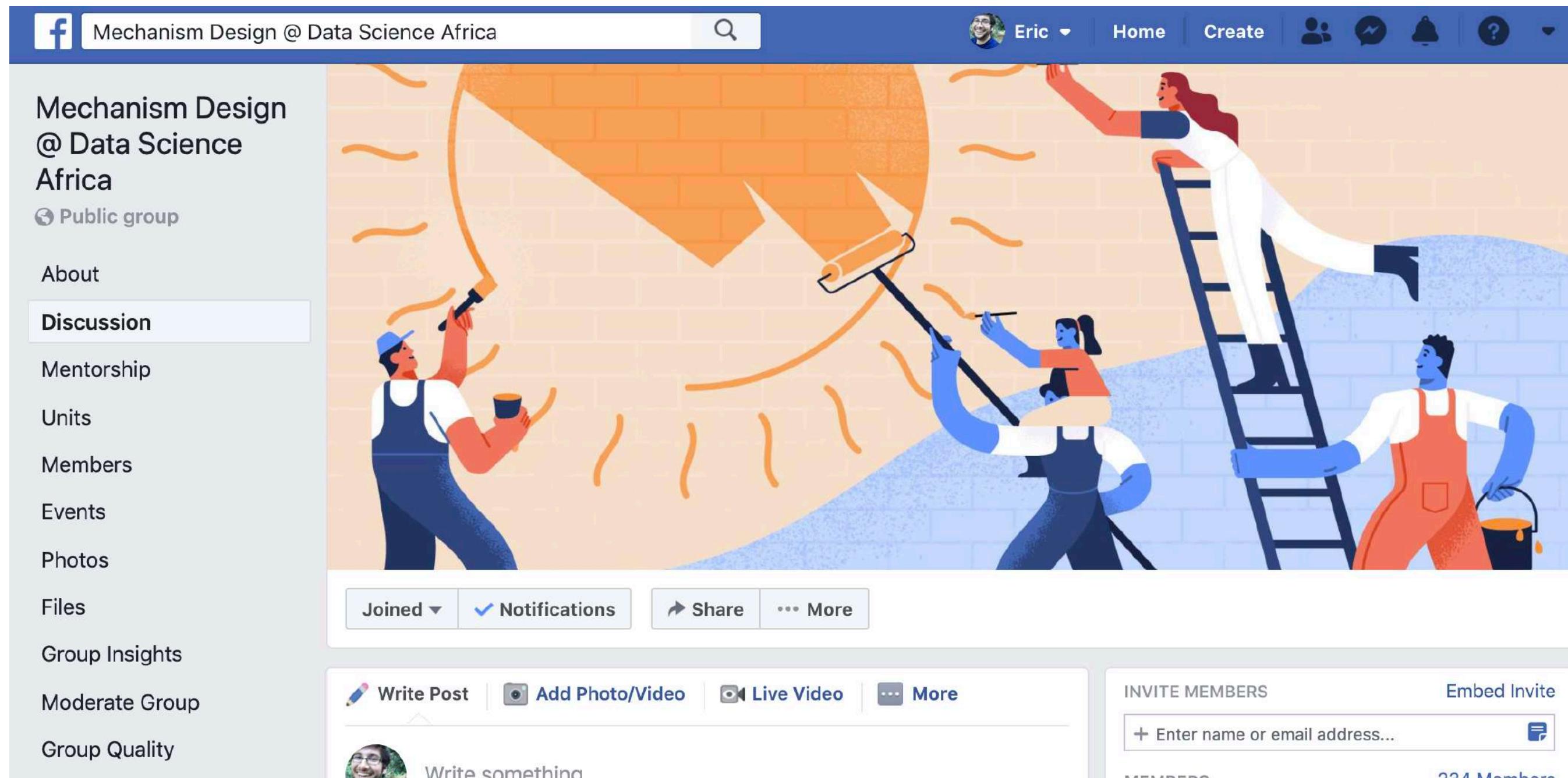
Serial dictatorship: full list



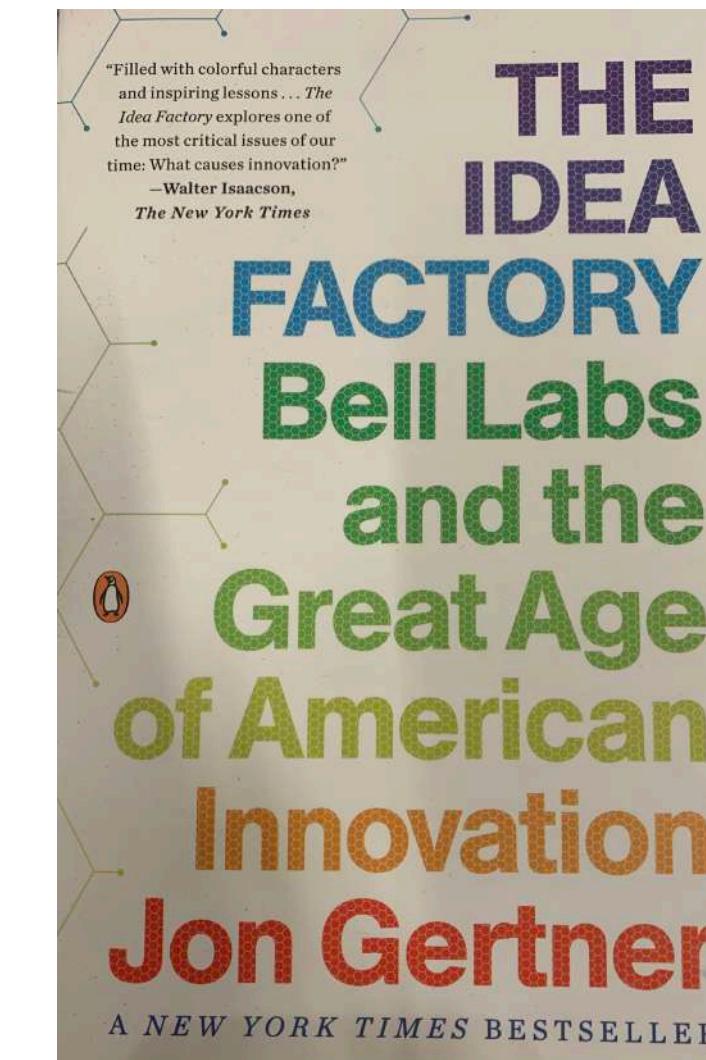
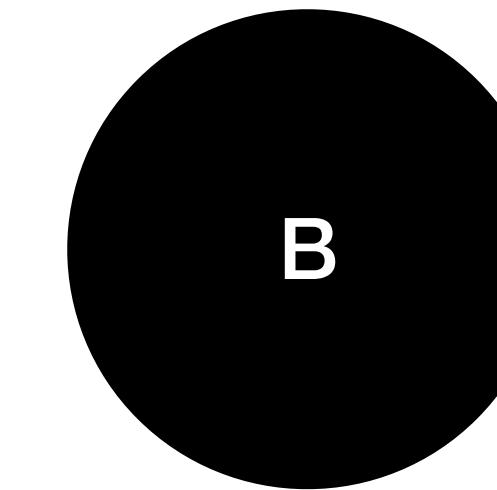
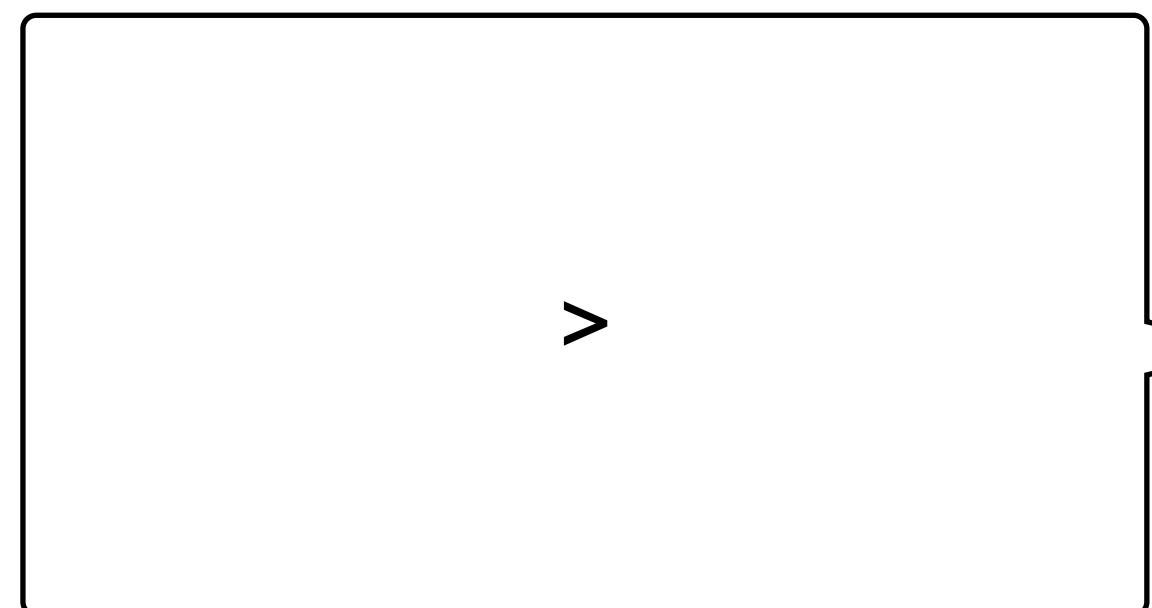
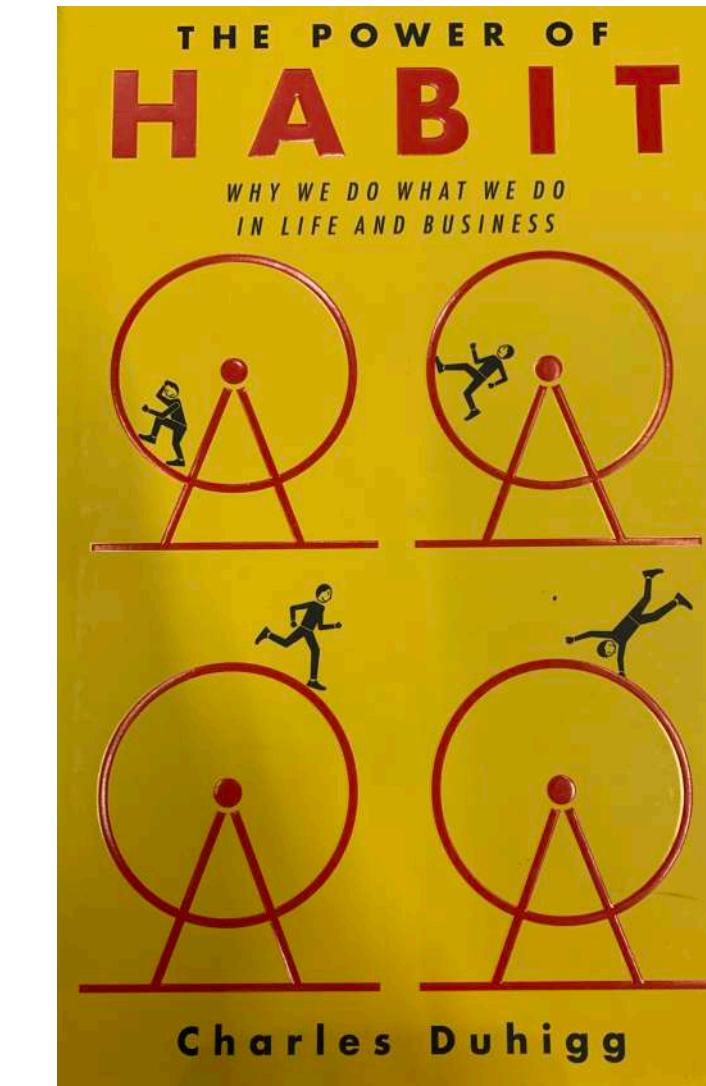
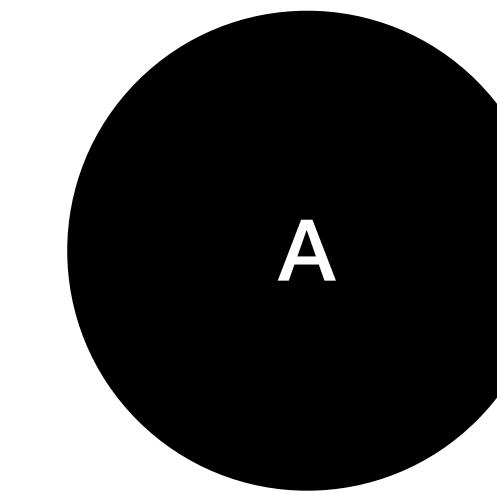
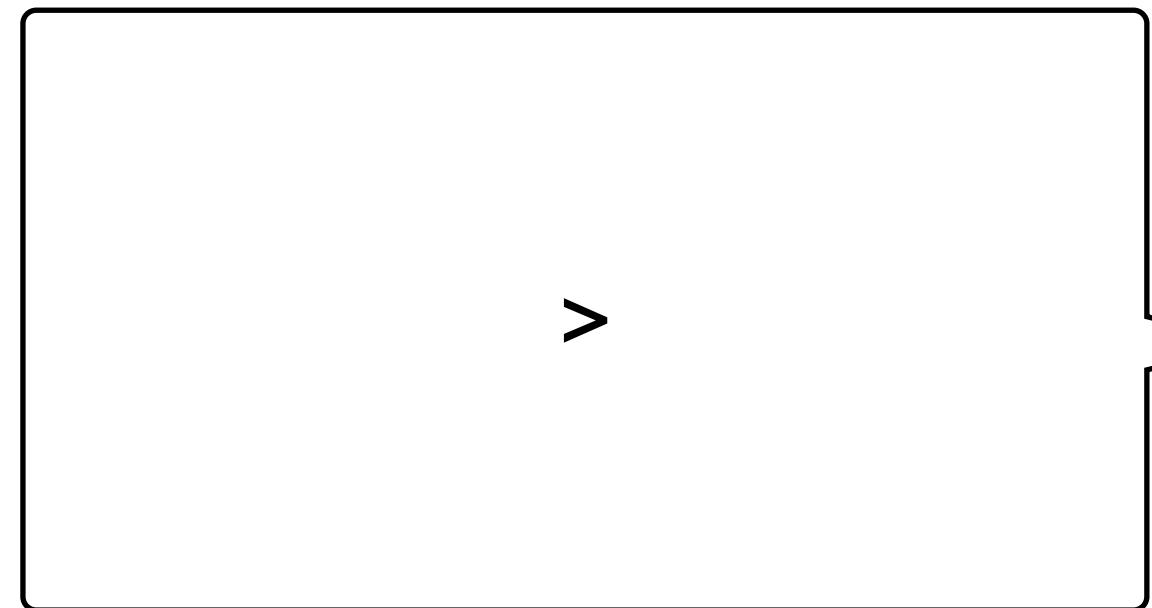
Abridged Serial dictatorship: truncated list

**Is the Abridged Serial Dictatorship strategyproof?
(examples)**

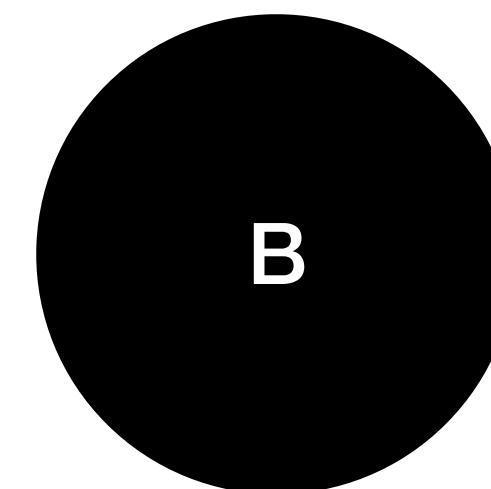
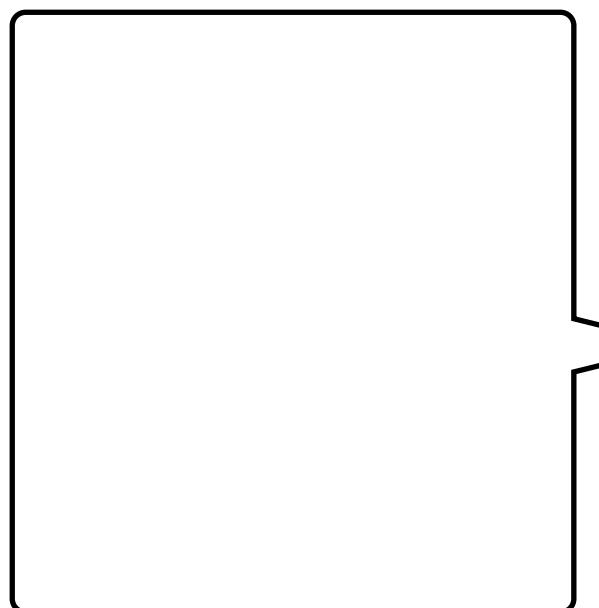
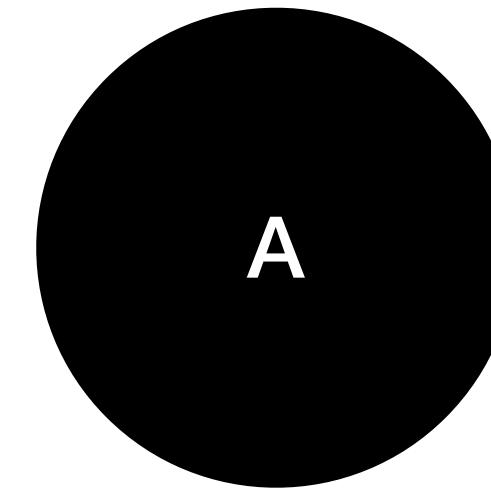
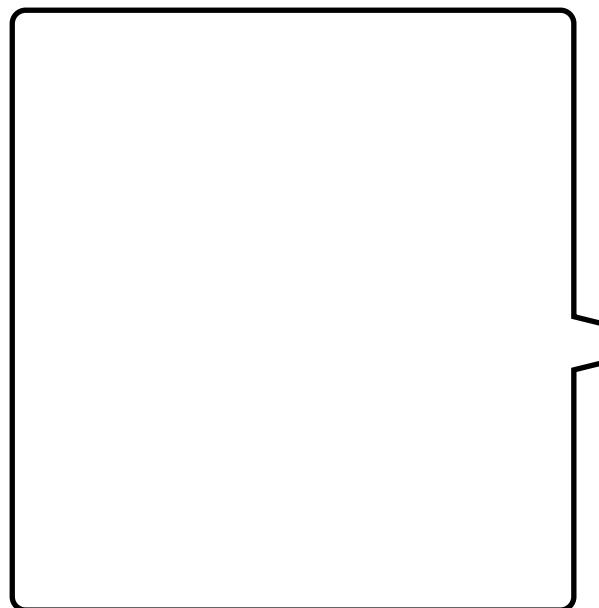
Last chance to join the group to be eligible for contest: bit.ly/ai-exec-group



Example 1: Serial Dictatorship



Example 2: Abridged Serial Dictatorship



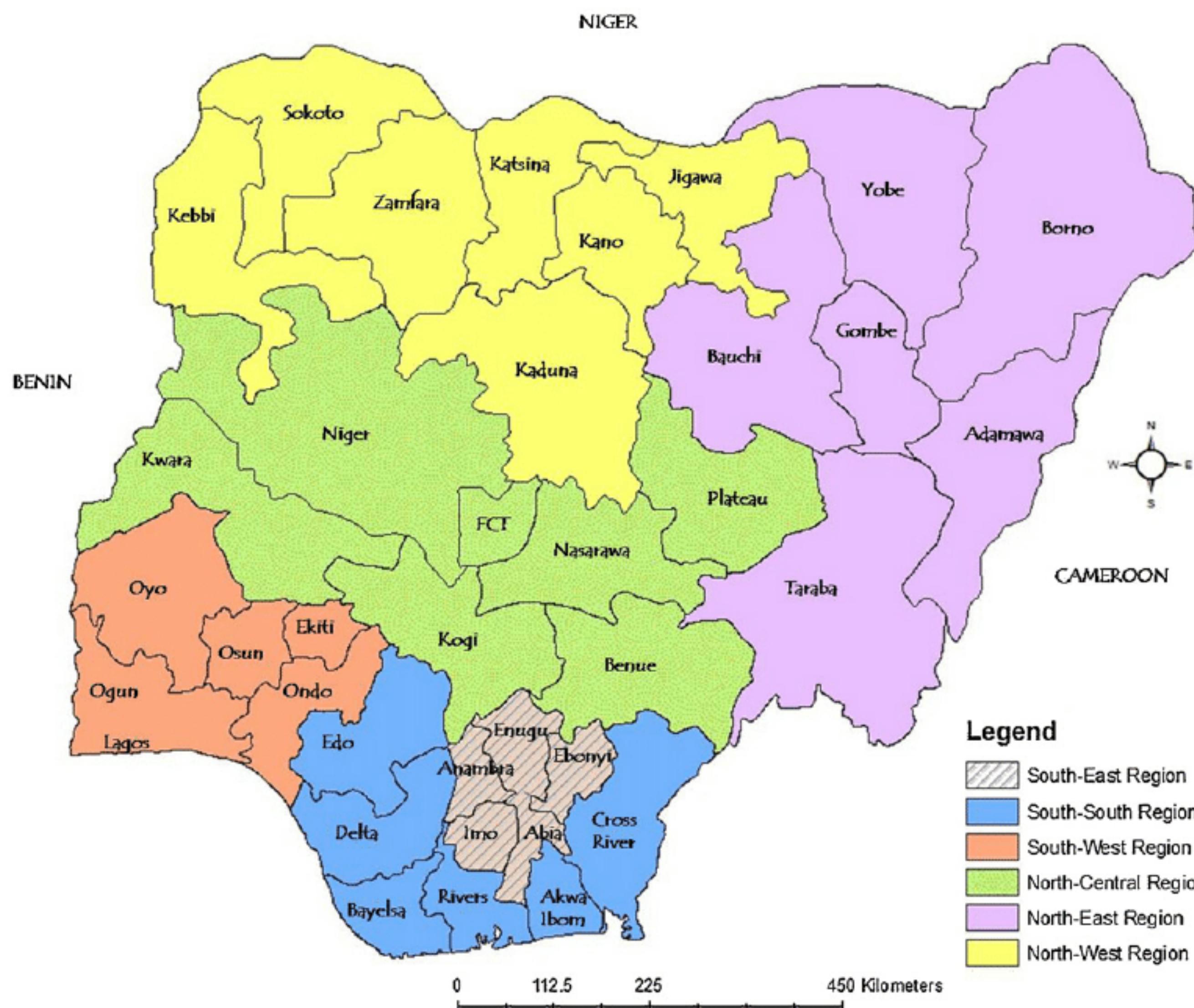
Things to remember

- The rules of the game matter
- Small changes to the rules can make a big difference

Discussion

- Can you think of other systems that you regularly participate in that are clearly not strategyproof, or that do not produce Pareto optimal outcomes?
- What are some real-world problems that feel similar to “book giving” problems?
- (Discuss for 2-5 minutes)





State	Zone	Region	Country
Sokoto	North West		
Zamfara			
Katsina			
Kebbi			
Jigawa			
Kaduna			
Kano	North Central		
Benue			
FCT			
Kogi			
Kwara			
Nasarawa			
Plateau	North East		
Niger			
Adamawa			
Bauchi			
Borno			
Gombe			
Taraba	South West		
Yobe			
Ekiti			
Lagos			
Ondo			
Ogun			
Osun	South South		
Oyo			
Akwa Ibom			
Bayelsa			
Cross River			
Edo			
Delta	South East		
Rivers			
Abia			
Imo			
Anambra			
Enugu			
Ebonyi			
Akwa Ibom			

Choosing state of preference

State of Deployment

Note: If you choose any of the following states: BORNO, YOBE, AND ADAMAWA, you will be allowed to relocate to any other state apart from your State of origin during the orientation course. Please note that the orientation will take place in the states mentioned above here.

Please carefully select your desired state of deployment from the available options. This is a Pilot/Survey/Trial; you may NOT be deployed to any of the selected states. NYSC reserves the authority to deploy you to any state, geographical region apart from states you selected.

First state of deployment:

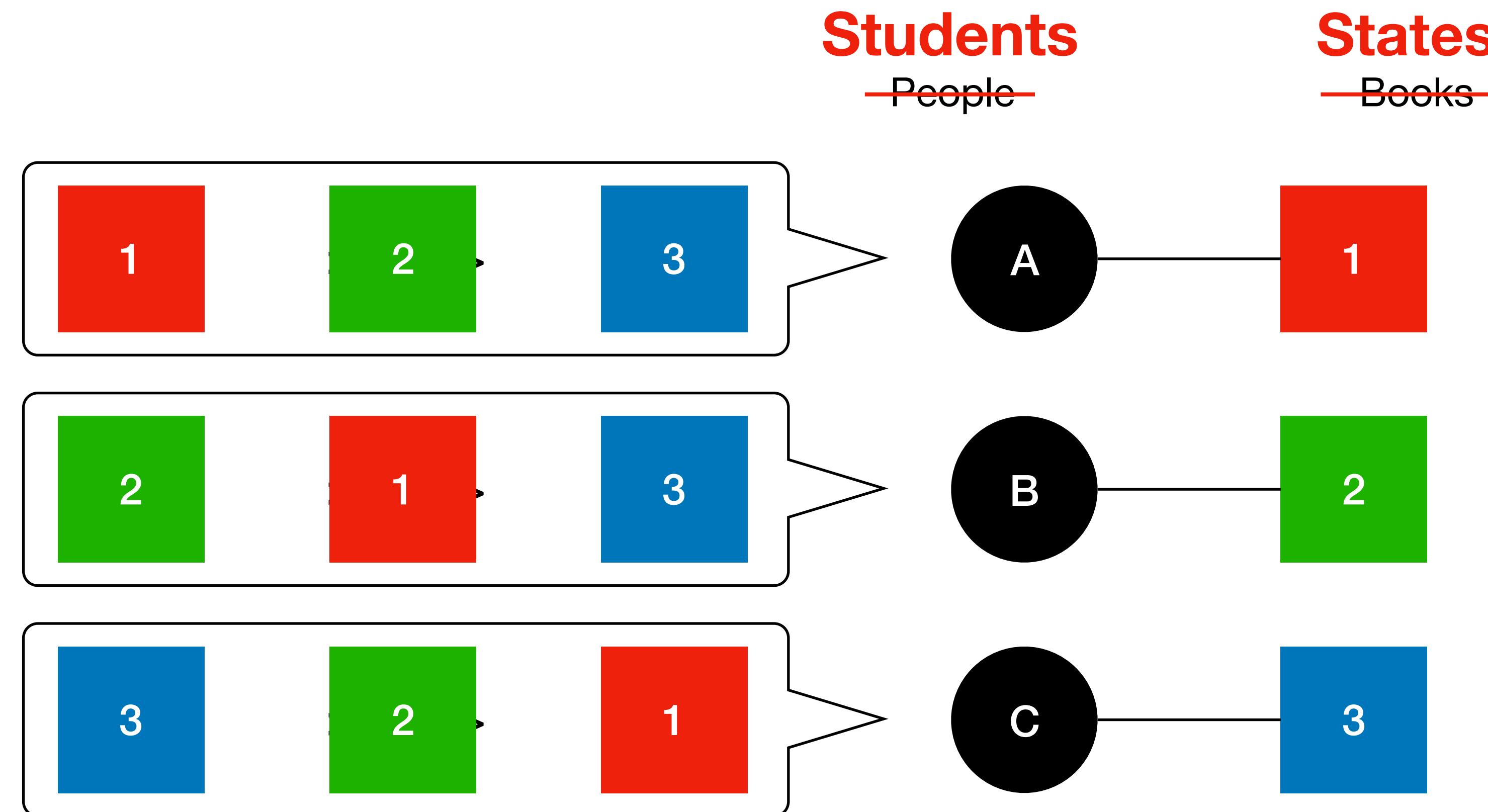
Second state of deployment:

Third state of deployment:

Fourth state of deployment:

I, Ohimai Micheal Okhamuafen confirm that all the information supplied herewith are valid. I agree that the Scheme should

NYSC Matching



MD4SG '19

3rd Workshop on Mechanism Design for Social Good

June 28, 2019 at Phoenix, AZ, USA

[Home](#)[Program](#)[Call For Participation](#)[Invited Speakers](#)[Travel Support](#)[Conference Registration](#)[About](#)

Program

The full program of the workshop will take place on June 28 in **Room 232A** at the Phoenix Convention Center in Phoenix, Arizona. A [PDF](#) of the program is available for download. We welcome all participants to attend the lunchtime poster session and [vote for your favorite poster!](#)

Time	Event	Authors
7:30-8:30	Networking Breakfast (<i>West building, Room 101A</i>)	Sara Kingsley and Eric Sodomka
8:30-8:35	Opening Remarks	Rediet Abebe and Irene Lo

8:35-09:45

Session 1: Developing World

8:35-9:20	Keynote: Research Experiences Developing Technology in/for/from Africa	Sekou Remy
9:20-9:35	Design of Incentive Programs for Optimal Medication Adherence	Sze-Chuan Suen, Diana Negoeescu and Joel Goh
9:35-9:40	Bridging Markets for Small Scale Farmers with Mechanism Design	Mwiza Simbeye , Mwila Kangwa and Patrick Sikalinda
9:40-9:45	Mechanism Design for Matching in Nigeria's National Youth Service Corps: A Case Study	Ifeoma Okoh , Oluwakemi Akinwehinmi, Israel Akowe, Oluwakemi Fasae, Memunat Ibrahim , John Ojetunde, Peter Ogunremi, Rachel Ojo, Ifeoluwa Oladeji, Olajide Oladejo, Oluwafemi Olaoye, Tosin Oyetayo, Emmanuel Ozi-Yusuf and Eric Sodomka

What did you learn?

What did you learn?

- Mechanism design
- Serial dictatorship
- Pareto optimal
- Strategy proof
- “Abridged serial dictatorship”

prediction markets

voting

online labor markets

two-sided matching

cryptocurrency

security games

online learning

crowdsourcing

auctions

reputation systems

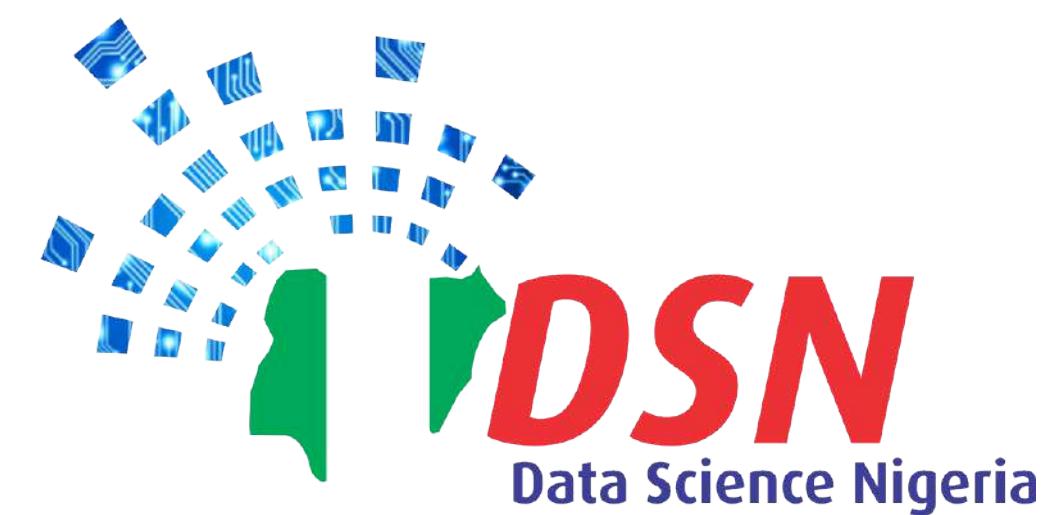
team formation

money-burning mechanisms

Local Challenges in Mechanism Design

- **Exercise: Identify a real-world problem in your business (or elsewhere) that could benefit from the tools of mechanism design.**
- **<http://bit.ly/ai-exec-brainstorm>**
- **<http://bit.ly/ai-exec-problem>**
- **<http://bit.ly/ai-exec-group>**
- I guarantee feedback for anyone here who submits by this Friday at 11:59PM.

“The wearer of the shoe knows where it pinches.”



Baseline algorithm

- Student is allocated a state on first-come, first-serve basis
- Student specifies a set (unordered) of four preferred states amongst those states with remaining capacity: two from North, two from South, all from different zones.
- Randomly choose a state amongst preferred states that are still available.
- If none available, ask to resubmit.

Objectives

- Diversity: Want students allocated to a given state to have home states that are representative of broader Nigeria.
- Efficiency and individual rationality: Want students to be satisfied with allocation (avoid redeployments).
- Fairness: Ensure no group is systematically getting worse matchings.
[don't have issue where 1 state is worse off]

Opportunities to improve baseline

- Students care about more than state (e.g., job type, rural versus urban).
- Two-stage decomposition (students to states, then students to jobs) can lead to inefficiencies.
- Diversity: While baseline ensures student is equally likely sent to North versus South, stronger guarantees on diversity are possible (e.g., by state).
- Efficiency: Baseline may result in students preferring to swap their states, at no cost to diversity.
- Fairness: Since first-come, first-serve, those with poorer internet accessibility have fewer options available.

Alternative algorithm

- Fix a maximum quota for each type. (Student's type is the state from which they are originally from.)
- Have students submit preferences over states. (Full preference list. Rank all states.)
- Randomly order students from 1 to N.
- For a given student, allocate them to their favorite state for which there is still capacity for their type.

Toy example

- 2 states (R, B) – each zone has a single state, and each region has a single zone

State	Zone	Region	Country
R	R	R	N
B	B	B	

Toy example

- 2 states (R, B) – each zone has a single state, and each region has a single zone
- Each state has capacity 2

Capacity Per State			
State	Zone	Region	Country
R	R	R	N
B	B	B	

Toy example

- 2 states (R, B) – each zone has a single state, and each region has a single zone
- Each state has capacity 2
- 4 students (R1, R2, B1, B2) from states (R, R, B, B). Arrive in order (R1, R2, B1, B2).

Students from Each State		Capacity Per State		State	Zone	Region	Country
R1	R2			R	R	R	N
B1	B2			B	B	B	

Toy example

- 2 states (R, B) – each zone has a single state, and each region has a single zone
- Each state has capacity 2
- 4 students (R1, R2, B1, B2) from states (R, R, B, B). Arrive in order (R1, R2, B1, B2).
- Each student (R1, R2, B1, B2) prefers state (R, B, R, B), respectively.

Students from Each State		Capacity Per State		State	Zone	Region	Country
R1	R2			R	R	R	N
B1	B2			B	B	B	

preferences of each student

State	R1	R2	B1	B2
R	1	2	1	2
B	2	1	2	1

Toy example

- 2 states (R, B) – each zone has a single state, and each region has a single zone
- Each state has capacity 2
- 4 students (R1, R2, B1, B2) from states (R, R, B, B). Arrive in order (R1, R2, B1, B2).
- Each student (R1, R2, B1, B2) prefers state (R, B, R, B), respectively.
- Baseline Algorithm: Student specifies most preferred state in each zone; randomly allocate to a preferred state.

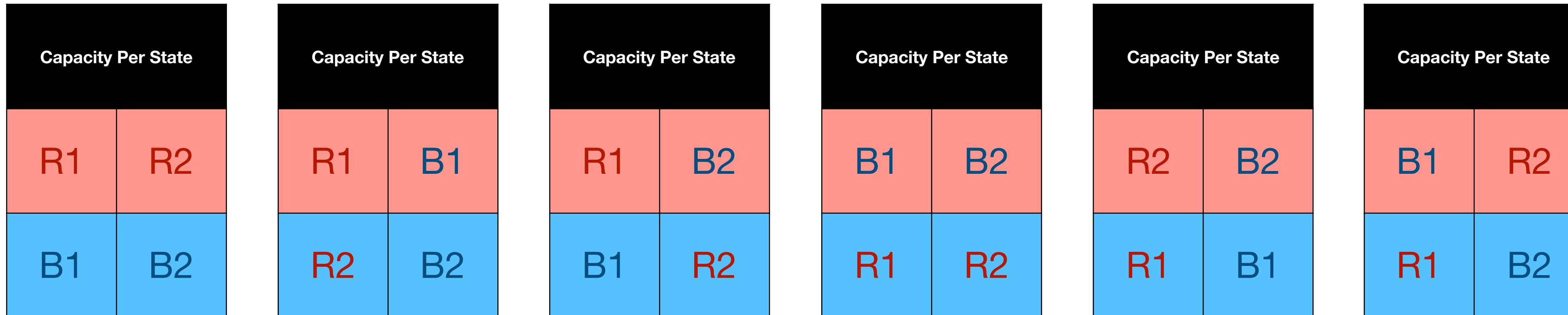
Students from Each State		Capacity Per State		State	Zone	Region	Country
R1	R2			R	R	R	N
B1	B2			B	B	B	

preferences of each student

State	R1	R2	B1	B2
R	1	2	1	2
B	2	1	2	1

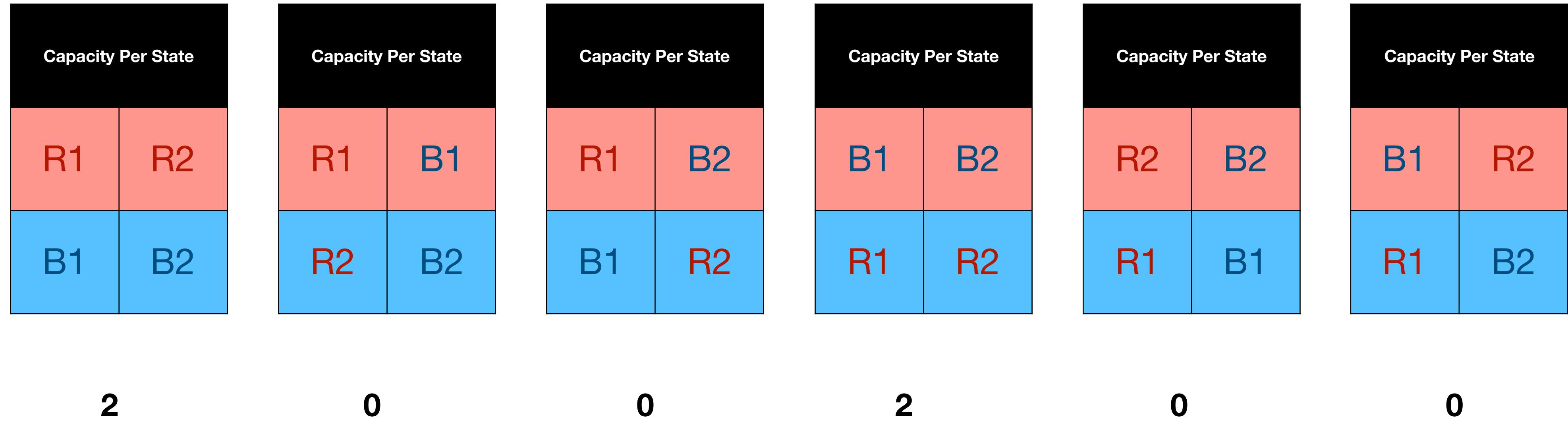
Toy example (continued)

- Baseline algorithm: In this toy example, there is only a single state per zone, and only two zones, so the student effectively has no choice but to state preference as {R, B}.
- The student is then randomly allocated to one of the two preferred states. After all students are allocated through the baseline, there are six equally likely outcomes:



- Alternative algorithm: Maximum quota of each type is 1. Always outputs the second outcome from those above.

**Distance from
perfectly diverse**



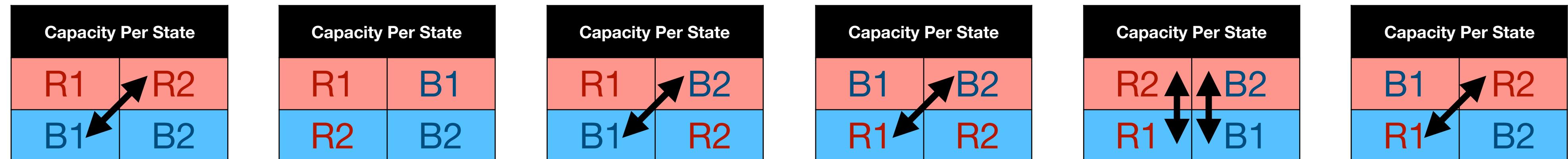
**Preference
allocated for
(R1, R2, B1, B2)**

(1, 2, 2, 1) (1, 1, 1, 1) (1, 2, 1, 2) (1, 2, 2, 1) (2, 2, 2, 2) (2, 1, 2, 1)

State	R1	R2	B1	B2
R	1	2	1	2
B	2	1	2	1

preferences of each student

**Desired swap
that maintains or
improves diversity**



Proposed evaluation

- Randomly split students from each state into test and control group
- Split available slots in each state into test/control (half test, half control)
- Control group: Baseline Algorithm (first-come, first-serve; choose top 4, randomly assign)
- Test group: Alternative Algorithm (matching with quotas)
- Observe: (1) Diversity of allocation; (2) Number of students that redeploy

Next steps

- Understand errors in assumptions about baseline/objectives
- Run simulations to quantify potential gains (data required to run realistic instances)
- Can provide additional examples if the above example was useful.
- We're interested in a unified collaboration with Sidmach and NYSC. What would that take? We can bring other mechanism design experts on board to help, if desired.