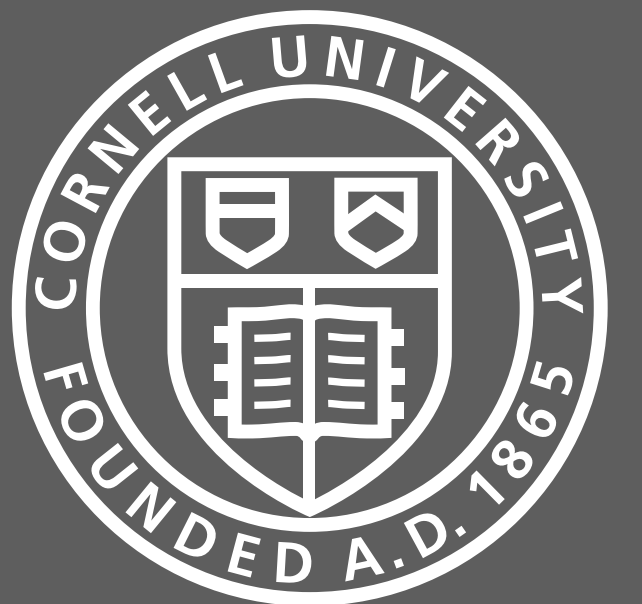


Approval Voting

Paul Gözl

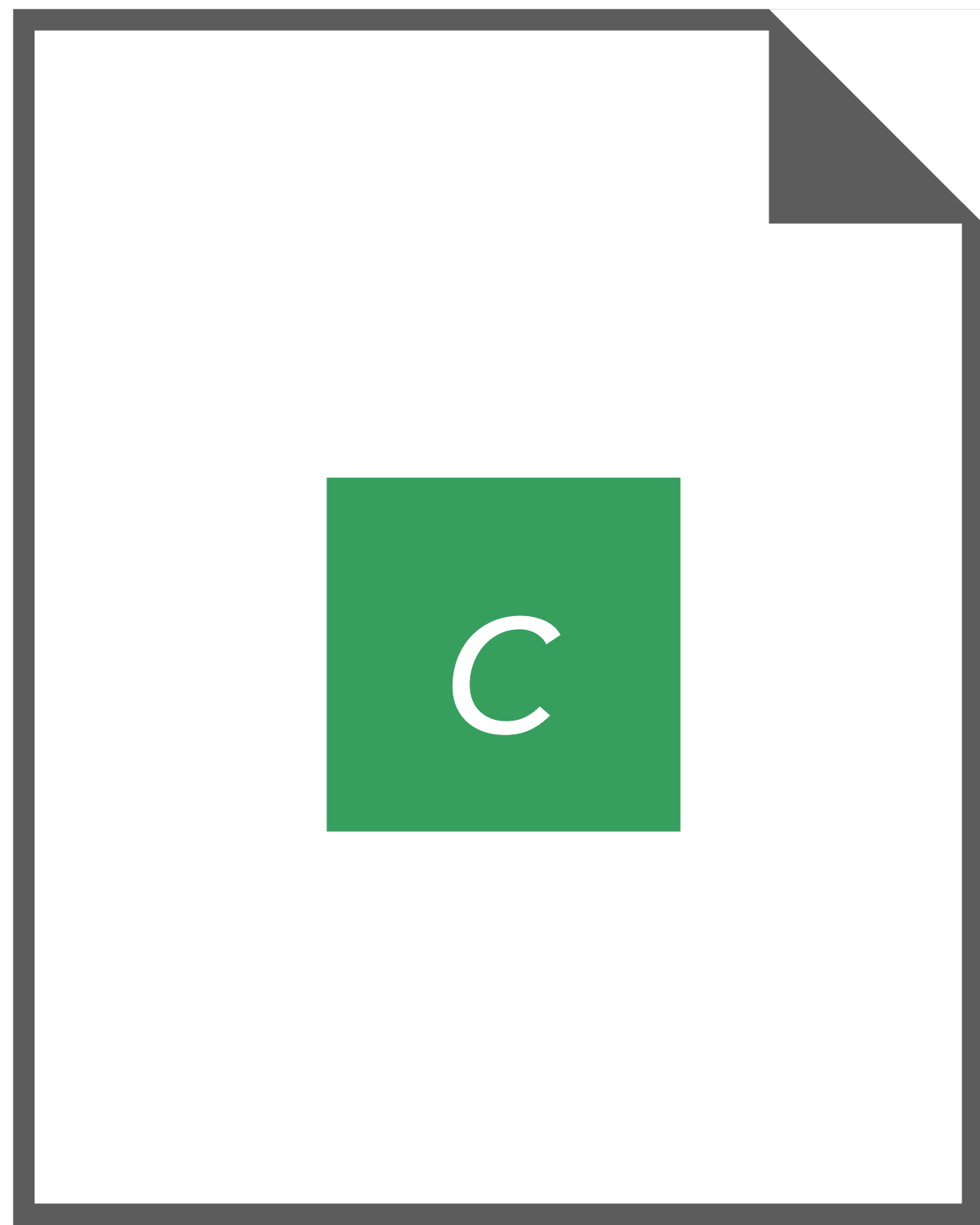
Lecture 10, ORIE 4360/5360, Fall '26



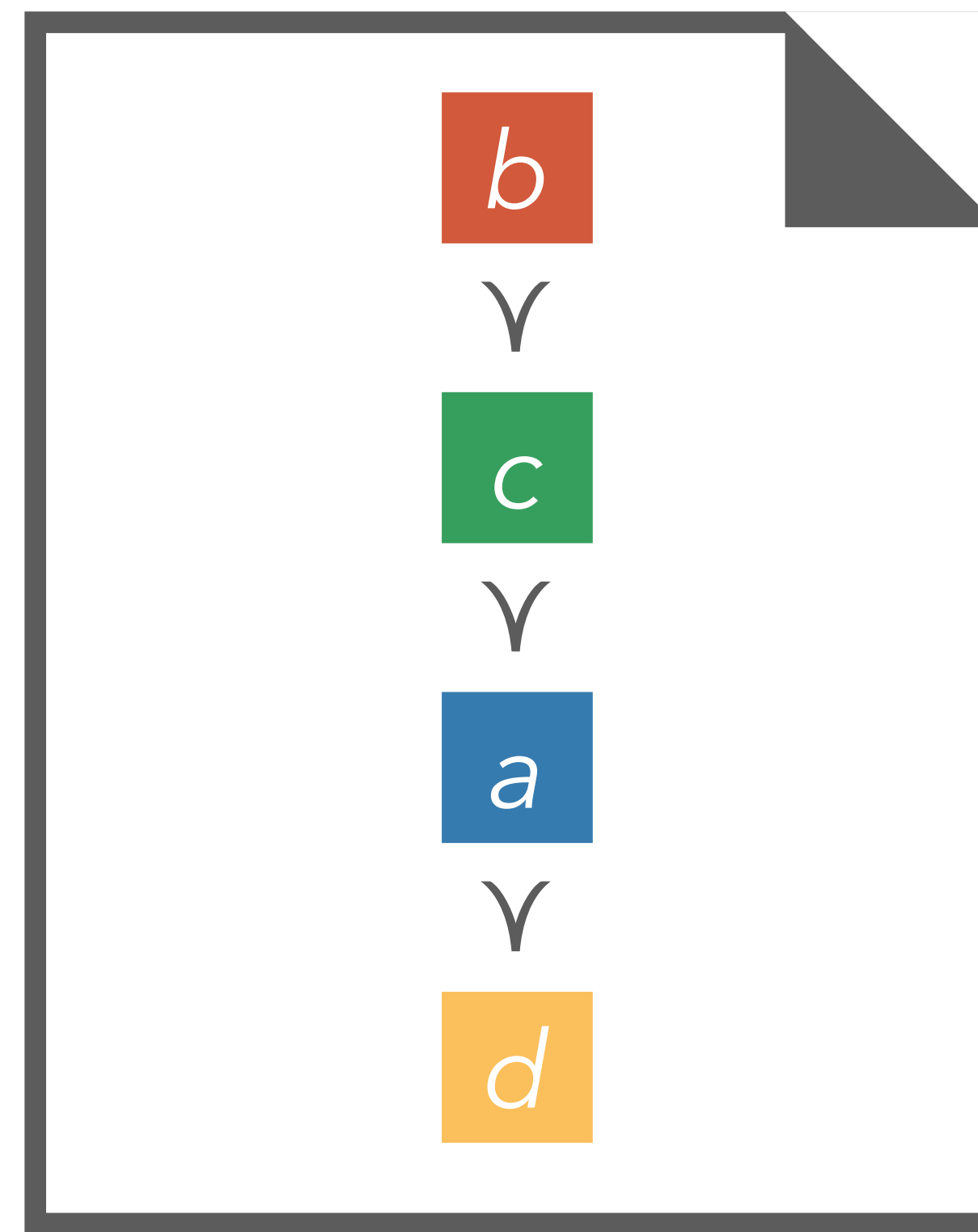
Ballot Formats

2

Plurality Ballot



Ranking Ballot



Founded 1880
Incorporated 1905
Member of The
Associated Press

The Cornell Daily Sun

WEATHER
Sunny
Gusty
Hi: 65

"Ithaca's Only Morning Newspaper"

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16 PAGES—TEN CENTS

Cornell Gridders Edge Columbia As Marinaro Sets Rushing Mark

By JON SHURE

Thrilled by the electrifying running of Ed Marinaro, and kept in their seats by a dramatic battle that wasn't decided until the closing minutes, 23,000 spectators watched Saturday as Cornell rallied for a 24-21 victory over Columbia. John Killian's 37-yard field goal with five minutes left made the difference.

Marinaro, the All-America tailback, eclipsed Steve Owens' NCAA rushing record with yards to spare, amassing 272 yards and scoring two touchdowns. Marinaro's 47 carries tied his



ROBERTSON '48

U.S. Pulls Division From Viet

Saigon (AP) — The U.S. Command announced yesterday the deactivation of one of its two remaining combat divisions in Vietnam and the cutback of nearly 3,000 more troops.

The announcement underscored what President Nguyen Van Thieu said earlier in his inaugural address: "Today, you have seen that the contribution in

Conley and McNeill Seen As Mayoral Frontrunners

By JOEL RUDIN

If tomorrow's mayoral election were a "normal" two-candidate affair, there is little doubt that Republican nominee Keith McNeill would be elected over Democrat-Liberal nominee Ed Conley.

But with three well-known independent candidates also on the ballot, all of them considered conservative, liberal Ed Conley has an unusual opportunity to defeat the moderate-conservative McNeill in this politically conservative community.

Conley has stated that he needs the support of the "academic community" as well as the city's liberal electorate in order to win.

He supports the right of 18-year-old college students living in Ithaca in off-campus apartments to register and vote in local elections. While obviously helping to gain him student support, this stand might damage him considerably among Ithaca voters, liberal and conservative alike.

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Cornell Gridders Edge Columbia As Marinaro Sets Rushing Mark



A NEW NUMBER TWO: Oklahoma's Steve Owens became college football's second-leading rusher on this play as tailback Ed Marinaro eludes Paul Kaliades (61) and Mike Evans (88) for three yards.

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Conley, Seventh Ward Alderman, for only two years and perhaps the least well-known of the candidates, has been campaigning door-to-door, and said that by election day he would have visited every household with a voter.

McNeill has tried to reach voters at public gatherings, some individual contact, and through the media. However, having issued all his major position papers with the exception of his proposal for a "Smaller City Mayor's Conference," before the Sept. 14 Republican primary, McNeill

President Seeks New Legislation For Foreign Aid

Washington (AP) — The Nixon administration hopes to bounce back from a Senate vote to kill the foreign-aid program by winning congressional passage of stop-gap legislation and enactment of a brand new aid bill.

White House officials said yesterday President Nixon wants aid continued in a coordinated way and has no intention of seeking piecemeal supplemental appropriations to continue one or another section

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Marinaro, the All-America tailback, eclipsed Steve Owens' NCAA rushing record with yards to spare, amassing 272 yards and scoring two touchdowns. Marinaro's 47 carries tied his own Ivy League record set at Princeton last season.

The crowd was anxiously awaiting the historic eight yards that Marinaro had to travel, but had to wait until the third time Cornell had possession. On first and 10, big Ed swept around right end for six yards, bringing the crowd to its feet. He got the call again on the next play, and red balloons and champagne corks were launched skyward as number 44 lurched through the center of the line for three yards.

The game was marked by turnovers, as the momentum shifted back and forth all afternoon. The Red defense thwarted the Lions with four interceptions and two fumble recoveries, while the dogged visitors capitalized on a pair of Cornell fumbles.

Quarterback Don Jackson managed to keep the Lions in the ball game, combining his passing efforts with an underrated running attack. The junior signal caller completed 14 of 28 attempts for 235 yards.

Columbia grabbed the early lead, using speedy little John Sefcik's 20-yard punt return to set up the first score.

The first of two interceptions by Cornell's sophomore sensation linebacker Bob Lally

Continued on Page 16



BOB PERSONS '48
Regards to Davy

Alumni Return For Sun, Fun And Football

Hundreds of alumni in red jackets with a big white "C" on the pocket invaded the University this weekend, as part of Homecoming 1971.

Some of them hadn't been back since their graduation 20 years ago, and others, such as Dorothy K. Kesten '44, "come back at least six times a year."

The general consensus was that "Cornell has changed." More students, more buildings, more relaxed atmosphere.

"They were more jeans," said one alumnus to another.

"But we still love it," remarked Henrietta B. Gehshaw '45. "Kids are still kids."

Many of the alumni thought the appearance of the student body had improved in the last five years.

"We only saw two bare-footed youths today," Marion M. Smith '29 said at the Alumni Banquet held in the Alice Statler Ballroom Friday night.

Vice president for campus

Continued on Page 11

U.S. Pulls Division From Viet

Saigon (AP) — The U.S. Command announced yesterday the deactivation of one of its two remaining combat divisions in Vietnam and the cullback of nearly 3,000 more troops.

The announcement underscored what President Nguyen Van Thieu said earlier in his inaugural address: "Today, you have seen that the contribution in human lives of allies has been gradually diminished and will end soon."

A communique from the headquarters of Gen. Creighton W. Abrams said that eight more Army units with 2,890 men had been phased out of the war zone, dropping U.S. strength to slightly below 200,000. All the units are either part of the Americal Division or support it.

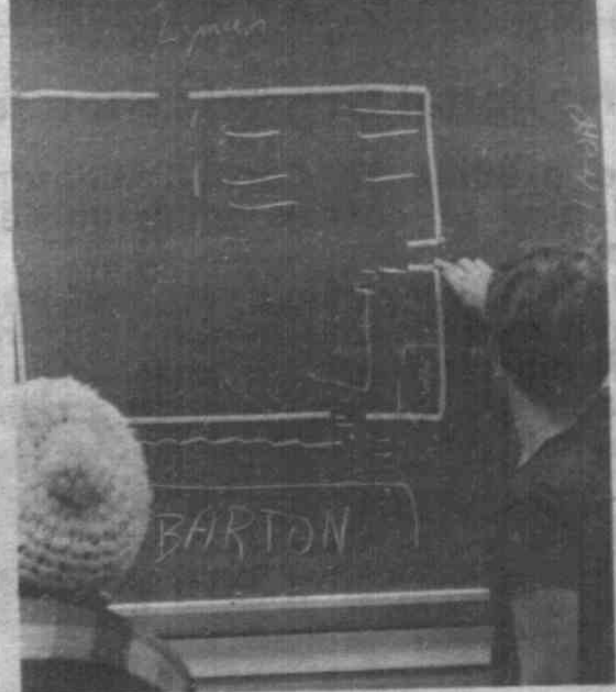
While the Americal figured in some of the toughest fighting of the war, it also was involved in several controversial incidents. The most notable of these were the My Lai massacre and the refusal of one of the division's companies to go into combat.

It is estimated that about 50 per cent of the division's troops will return to the United States, since these men have completed most of their 12-month combat tour. The remaining men, who have 10 or more months to serve, will be transferred to other units still active in Vietnam.

Its inactivation will leave only the U.S. 101st Airborne Division in Vietnam.

U.S. troop strength in Vietnam reached 543,000 men in April 1969, two months before President Nixon began disengaging American forces as part of his Vietnamization Program.

Women Invade Teagle Steamroom



—Photo by Elizabeth Ottenset

HOT STUFF: An unidentified male goes over plans for the Saturday invasion of the Teagle Hall steamroom at an advance Friday night meeting.

By PAULA GANTZ

Much more than excitement was in the air Saturday morning, as nine Cornell women staged a heated form of civil disobedience — occupation of the Teagle Hall steamroom.

The "steam-in" at the normally all-male facility was held to protest what participants believe are insufficient athletic facilities for University women.

According to a statement presented to Jon T. Anderson, director of physical education and athletics, when the women left Teagle, they demanded "that hours be established during which the facilities listed above (steamroom, exercise rooms and squash courts) can be opened to women. If the women's athletic budget can be juggled to enable men to use Helen Newman facilities, then it can be juggled to allow women to use Teagle facilities."

The invasion had been in the planning stages for over a week, but had been delayed several

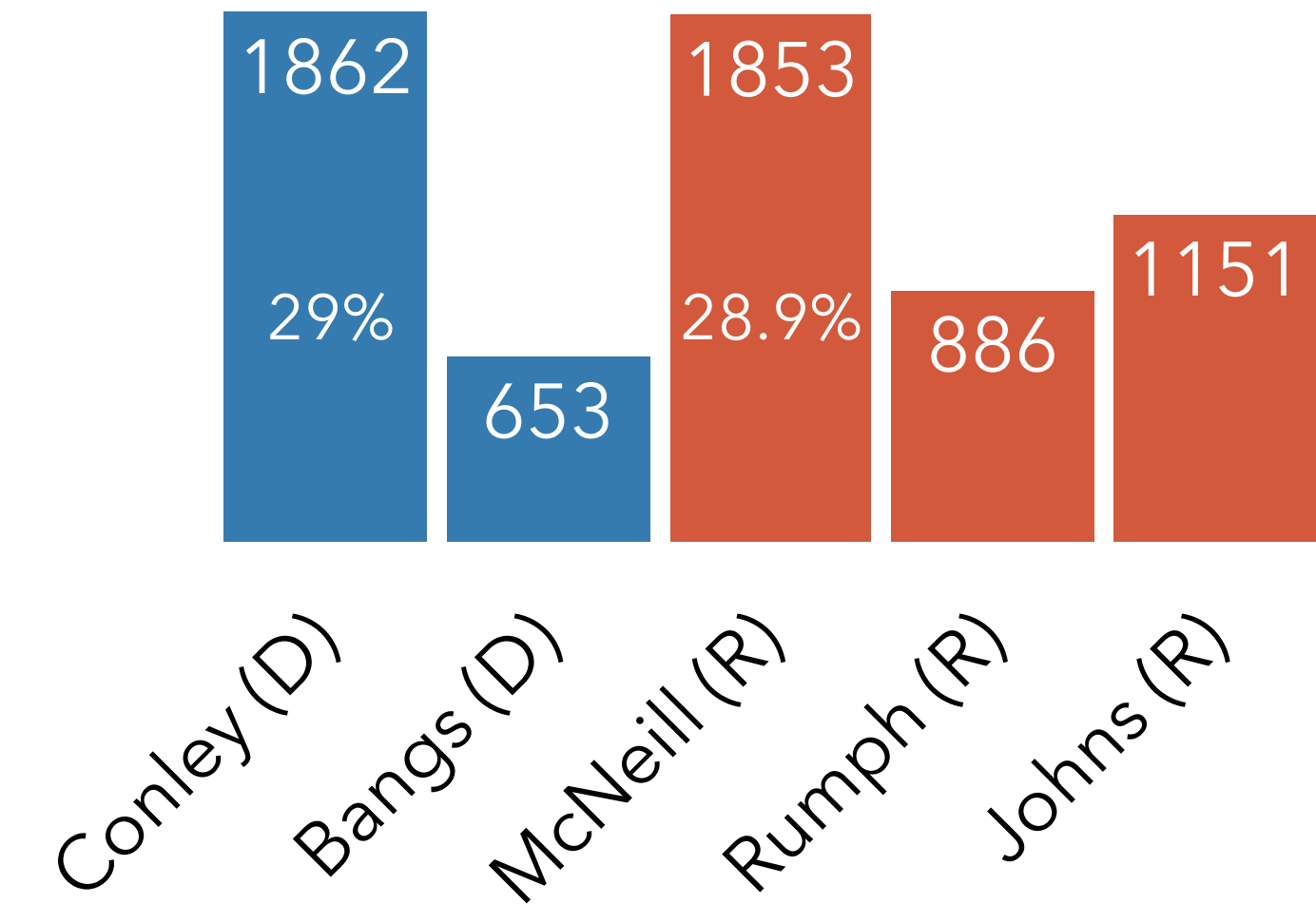
Continued on Page 6



—Photo by Elizabeth Ottenset

ALL STEAMED UP: Cornell women, hot under the collar that C.U. has but one steam room which is in Teagle Hall, occupying the aforementioned steamroom on Saturday.

Nov 2, 1971 election:



McNeill Concedes Defeat To Democratic Candidate

Republican candidate Keith McNeill formally conceded the mayoral election to Democrat Edward Conley, who won the election by nine votes.

McNeill's "one initial word of advice" to Conley according to a statement issued Friday "was concerned with the fact that the primary expression of the majority of the voters involved the breakdown of that which was considered the "Moderate-to-Conservative" portion of the electorate.

If, as the news media has done, my vote total is to be bracketed with the Johns and Rumph portion, and possibly with those who voted for Mr. Bangs also, then the overwhelming majority of the voters have expressed a desire for economies in government and all possible relief in the tax situation."

Approval Ballots

	☒
	☐
	☒
	☐

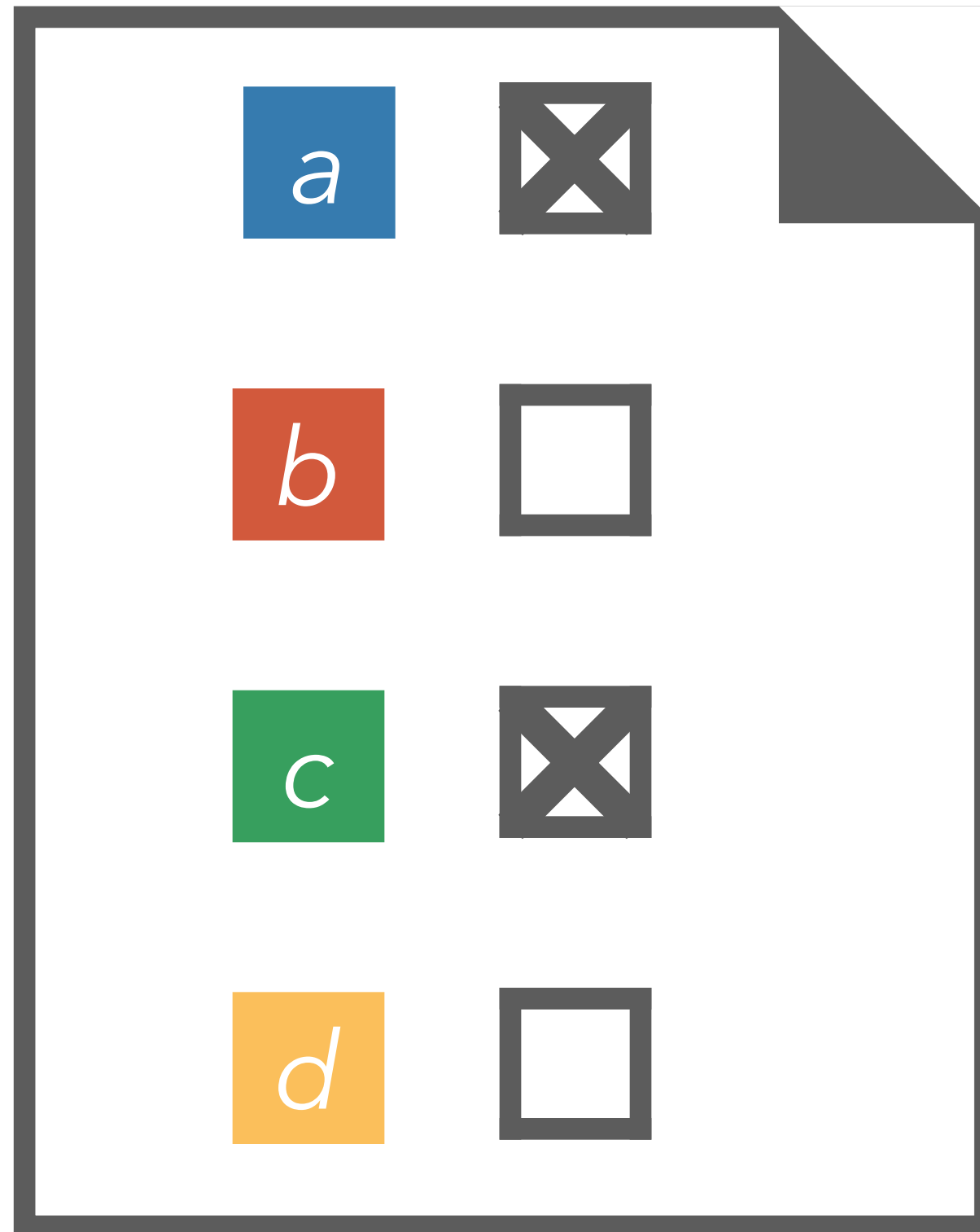
Voters can *approve*
any number of
candidates.



Robert Weber
(ORIE PhD'74)

Voting Rules for Approval Ballots

7



Voters can *approve* any number of candidates.

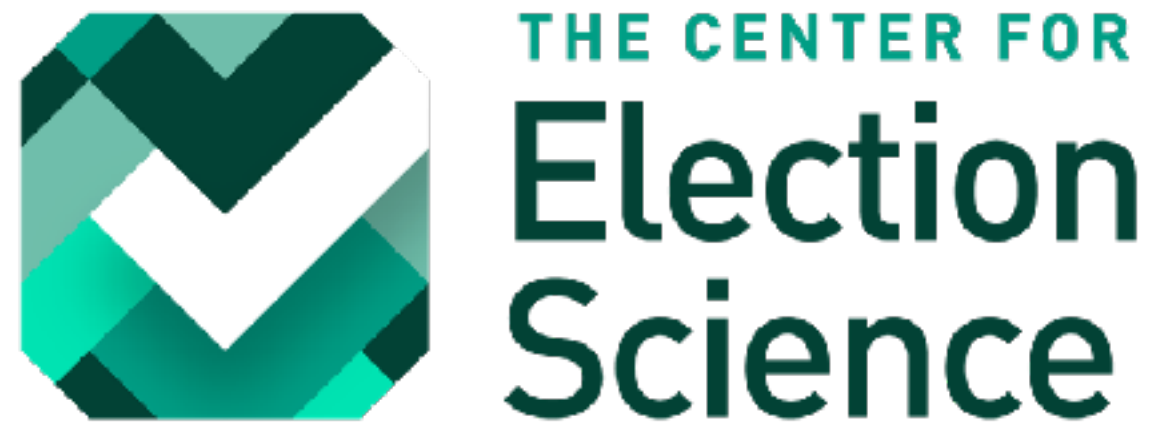
Q: Define a voting rule for choosing the winning alternative for a profile of approval ballots!

Approval Voting (AV)

Compute each alternative's **approval score** by counting how many voters approve it. Alternative with highest approval score wins under AV.

(Confusingly, the ballot format is often also referred to as "approval voting".)

Advocates' Arguments



- More expressive than plurality, simpler than rankings
- Reduces spoiler effect
- AV results are easy to understand
- Non-frontrunners get better measure of support.

Real-World Usage

10

Fargo, ND elected major with approval voting until 2025 state ban.



St. Louis, MO has an approval-based based primary for major: two candidates with highest approval score advance to run-off.

Old Voting Model

11

Voters $N = \{1, 2, \dots, n\}$, alternatives $M = \{a, b, \dots\}$, $|M| = m$.

Each voter i has a **ranking** $\sigma_i \in \mathcal{L}$ over the alternatives; $a \succ_{\sigma_i} b$ means that i prefers a to b .

A preference profile $\sigma \in \mathcal{L}^n$ is a collection of all voters' rankings.

A social choice function is a function $f: \mathcal{L}^n \rightarrow M$; a social welfare function is $f: \mathcal{L}^n \rightarrow \mathcal{L}$.

Approval Voting Model

12

Voters $N = \{1, 2, \dots, n\}$, alternatives $M = \{a, b, \dots\}$, $|M| = m$. Set $\mathcal{P}^*(M) := \mathcal{P}(M) \setminus \{\emptyset\}$.

Each voter i has an **approval set** $A_i \in \mathcal{P}^*(M)$ of alternatives; $x \in A_i$ means that i approves x .

A preference profile $A \in \mathcal{P}^*(M)^n$ is a collection of all voters' approval sets.

An (irresolute) social choice function is a function $f: \mathcal{P}^*(M)^n \rightarrow \mathcal{P}^*(M)$.

Resoluteness

Following previous definition, would define a social choice function as ~~$\mathcal{P}^*(M)^n \rightarrow M$~~ . Output is a single winner, must already resolve ties (=resoluteness).

Instead, we define an (irresolute) social choice function is a function $f: \mathcal{P}^*(M)^n \rightarrow \mathcal{P}^*(M)$.

That f maps to sets of alternatives (not just one winning alternative) means that the rule gives all alternatives tied for winning, must break ties later.

Approval Voting (AV), Formally

14

$$f_{AV}(A_1, \dots, A_n) = \operatorname{argmax}_{x \in M} \left| \{i \in N \mid x \in A_i\} \right|.$$

Here, we're using the argmax in the sense that it gives us the set of all alternatives with maximum approval score.

Characterization of AV

Theorem [Fishburn 1978, Brandl & Peters 2022].

In approval voting, f_{AV} is only f to satisfy:

- **Reinforcement**: If A_1, A_2 are profiles for disjoint sets of voters N_1, N_2 and $f(A_1) \cap f(A_2) \neq \emptyset$, then $f(A_1, A_2) = f(A_1) \cap f(A_2)$.
- **Faithfulness**: For $n = 1$, $f(A_1) = A_1$.
- **Disjoint equality**: For $n = 2$, if $A_1 \cap A_2 = \emptyset$, then $f(A_1, A_2) = A_1 \cup A_2$.

Question

16

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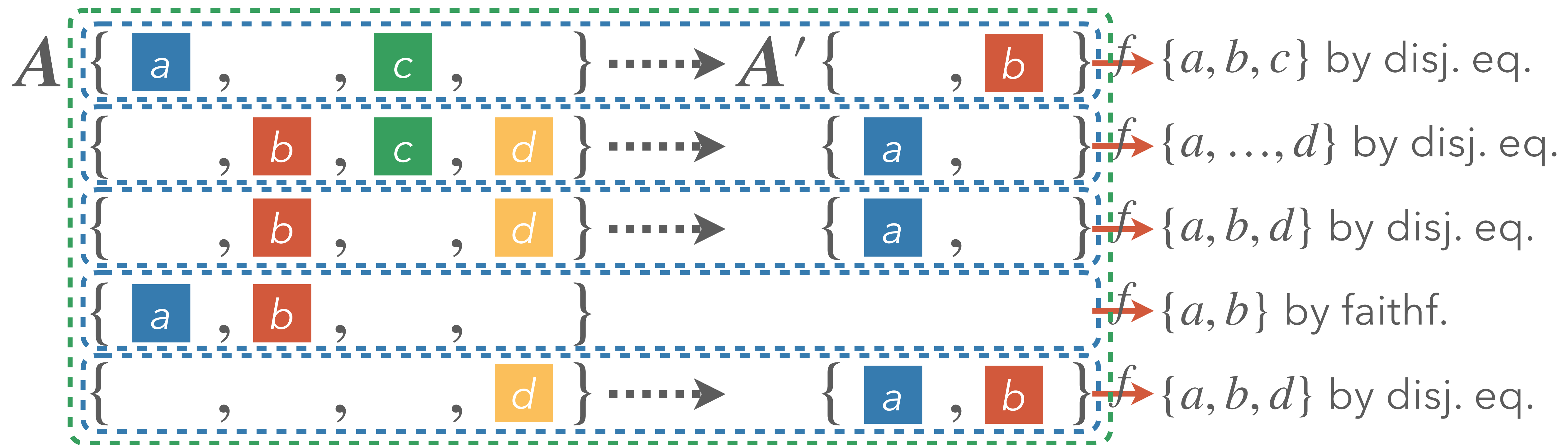
Q: Can you find another SCF satisfying
faithfulness and disjoint equality?
...reinforcement & faithfulness?
...reinforcement and disjoint equality?

Proof

17

Fix f satisfying the three properties and some A . First, show $f_{AV}(A) \subseteq f(A)$.

Let $a \in f(A)$ and assume for contradiction that $b \in f_{AV}(A) \setminus f(A)$.

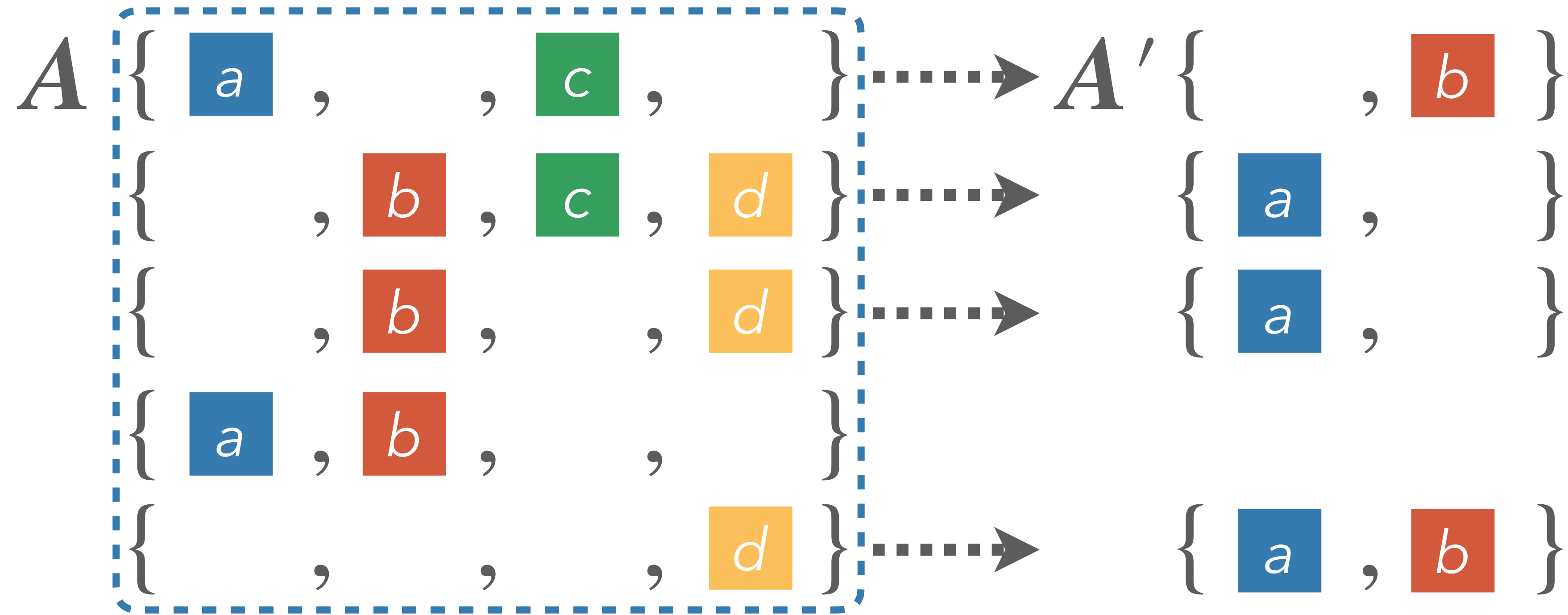


Add voters A' with opposite a, b approvals. $\{a, b\} \in f(A, A')$ by reinforcement

Proof

Fix f satisfying the three properties and some A . First, show $f_{AV}(A) \subseteq f(A)$.

Let $a \in f(A)$ and assume for contradiction that $b \in f_{AV}(A) \setminus f(A)$.



Since $b \in f_{AV}(A)$, A' has no more people approving b but not a than people approving a but not b .

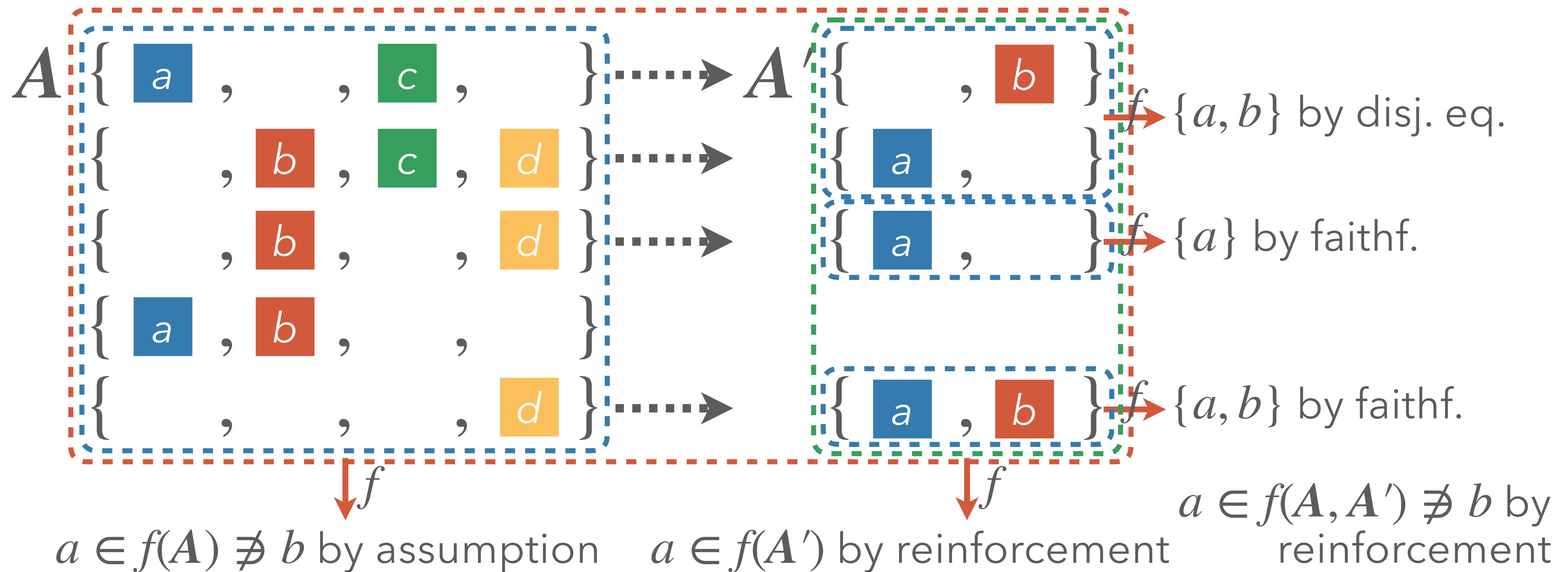
Can match them into pairs $\{a\}, \{b\}$, leaving only $\{a\}$ and $\{a, b\}$.

$a \in f(A) \not\subseteq b$ by assumption

Proof

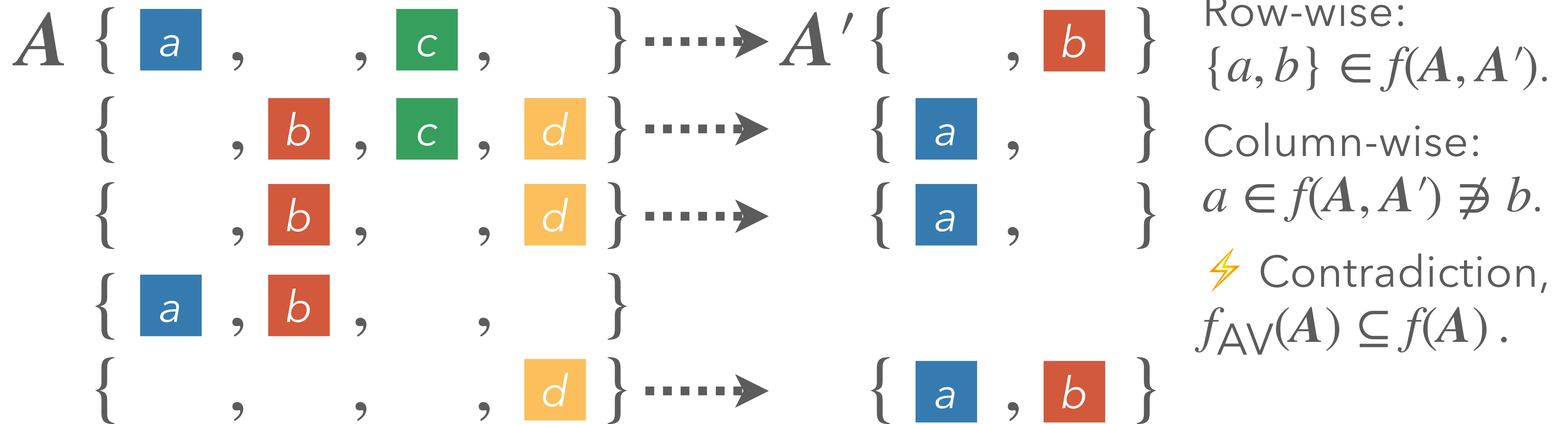
Fix f satisfying the three properties and some $\mathbf{A}$. First, show $f_{\Delta V}(\mathbf{A}) \subseteq f(\mathbf{A})$.

Let $a \in f(\mathbf{A})$ and assume for contradiction that $b \in f_{\Delta V}(\mathbf{A}) \setminus f(\mathbf{A})$.



Fix f satisfying the three properties and some A . First, show $f_{AV}(A) \subseteq f(A)$.

Let $a \in f(A)$ and assume for contradiction that $b \in f_{AV}(A) \setminus f(A)$.



Proof

21

Fix f satisfying the three properties and some A .

Proof that $f(A) \subseteq f_{AV}(A)$ essentially the same.



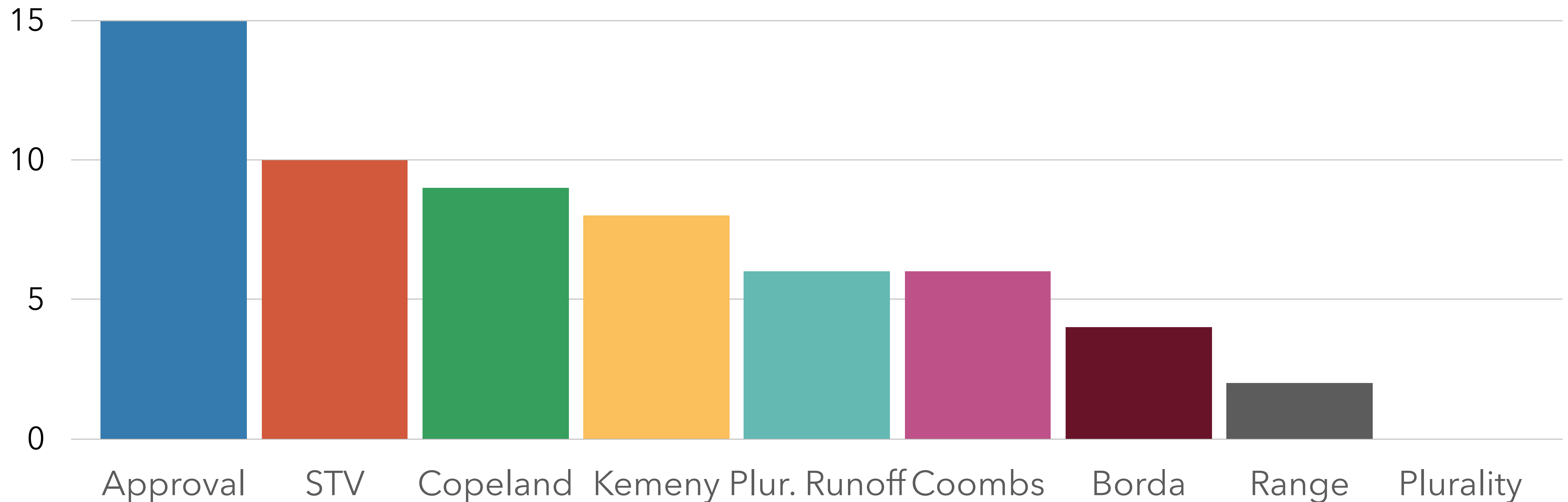
Characterization of AV

Theorem [Fishburn 1978/Brandl & Peters 2022].
In approval voting model, f_{AV} is only f to satisfy reinforcement, faithfulness, and disjoint equality.
If one adds anonymity and neutrality, can replace disjoint equality by a form of strategyproofness, cloneproofness, or others...

Liked by Voting Theorists

23

Approval scores for different voting rules by 22 voting theorists: "What is the best voting rule for your town to use to elect the mayor?"



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Poundstone (2008): *Gaming the Vote*.

Brandl & Peters: *Approval Voting under Dichotomous Preferences*. Journal of Economic Theory (2022).

Fishburn: *Axioms for Approval Voting*. Journal of Economic Theory (1978).