Voting system

NETWORKS INFO 2040 / CS 2850 / ECON 2040 / SOC 2090

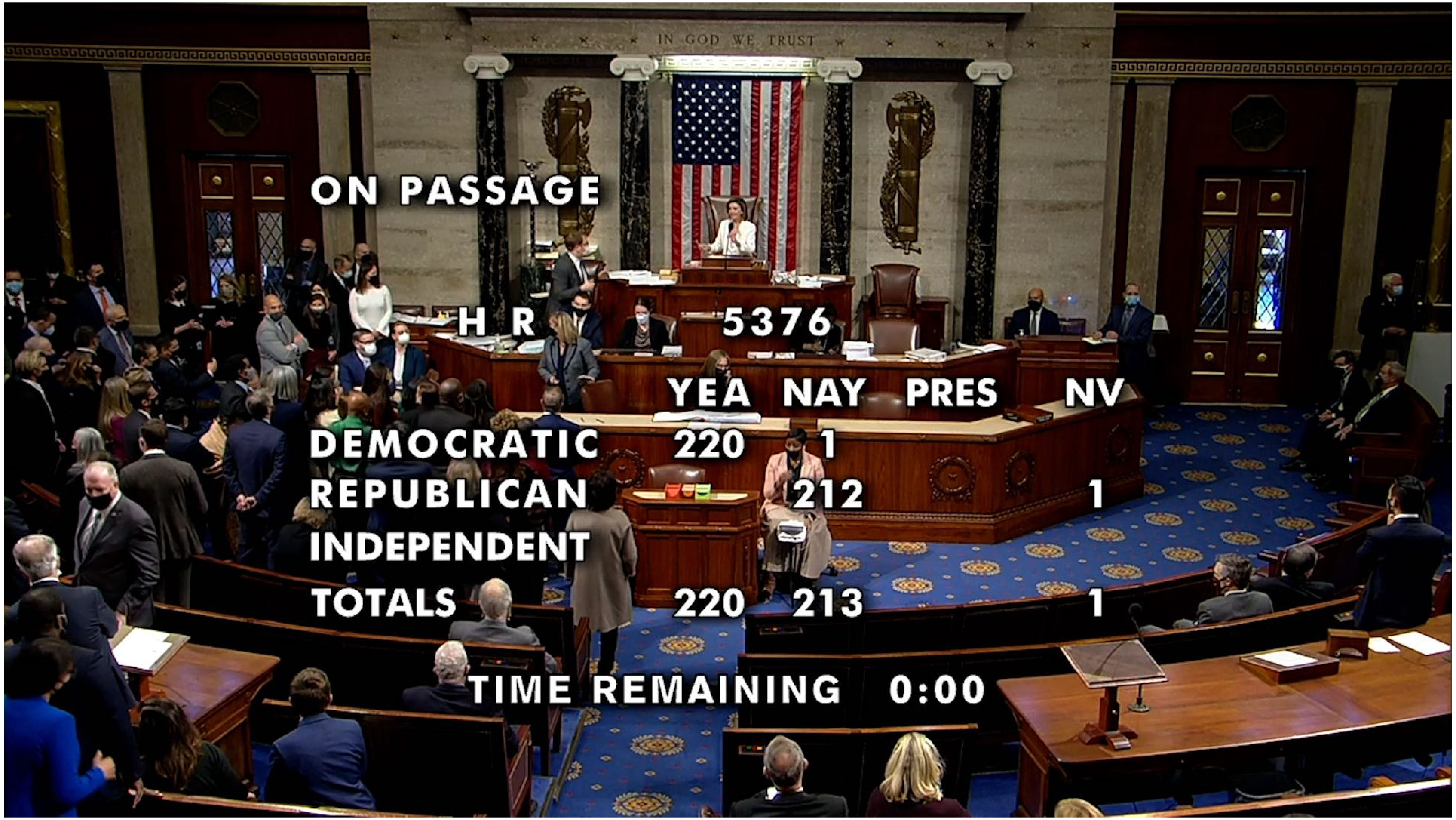
Cornell Bowers C·IS
College of Computing and Information Science

- Reading Chapter 23 / Written handout (Canvas)
- PS 9 out (due on Thur): answers typed, assign numbers
- Final Exam: Dec 12th afternoon
- Review session (Dec 6th / 8th)

Voting

Cindy Burkett
State Representative
CindyBurkett.org
REPUBLICAN
Kenneth SHEETS
RON NATINSKY
FOR DALLAS COUNTY JUDGE
RonNatinsky.com
Carol DONOVAN
CAROLFORTEXAS.COM
Jeb Hensarling
LISA GREEN
For County Criminal Court
LET'S GET REAL
TEXAS VALUES
Vote Democratic
IT RED
.KEEPITRED.COM

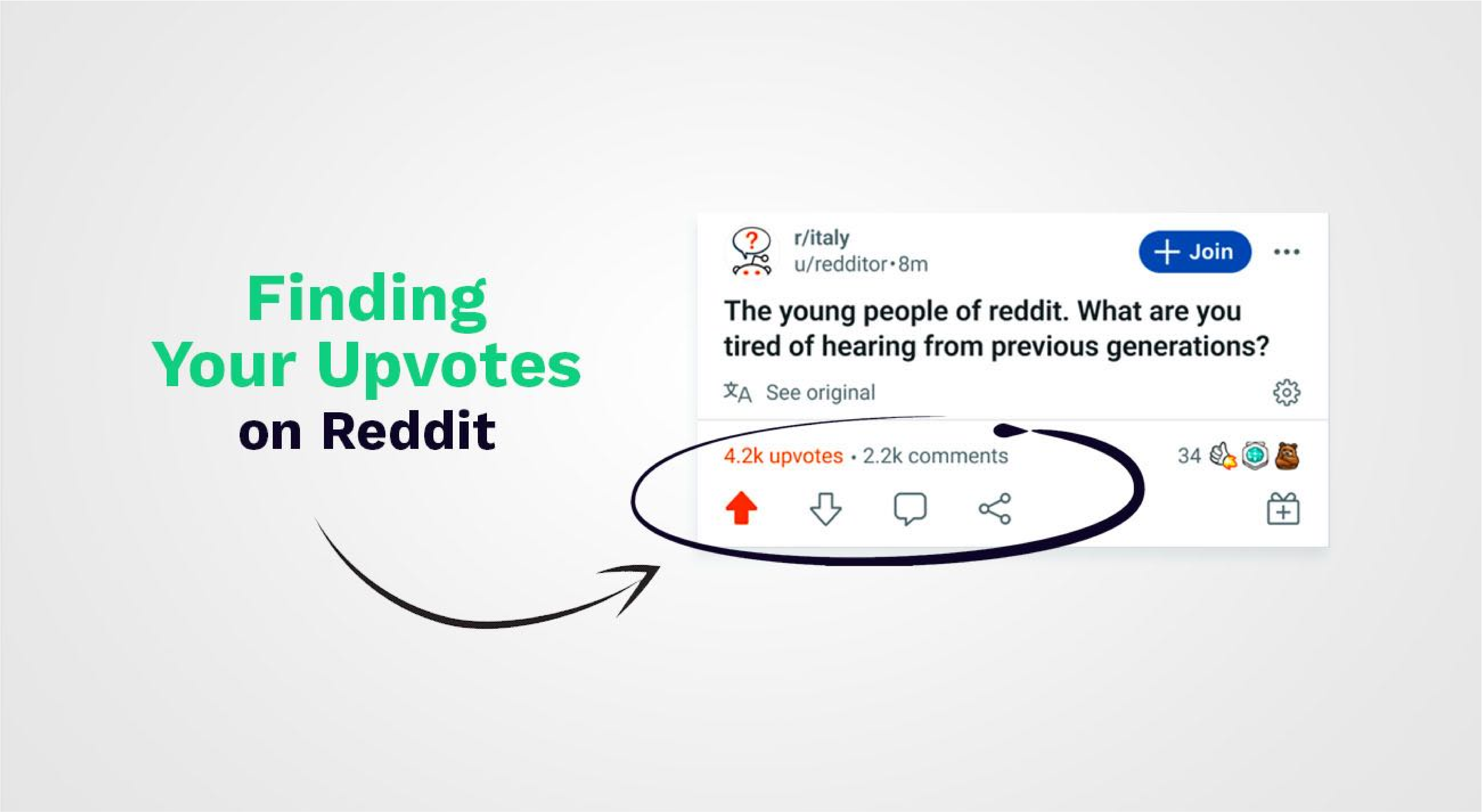
Voting


IN GOD WE TRUST
ON PASSAGE
H R 5376
YEA NAY PRES NV
DEMOCRATIC 220 1
REPUBLICAN 212 1
INDEPENDENT
TOTALS 220 213 1
TIME REMAINING 0:00

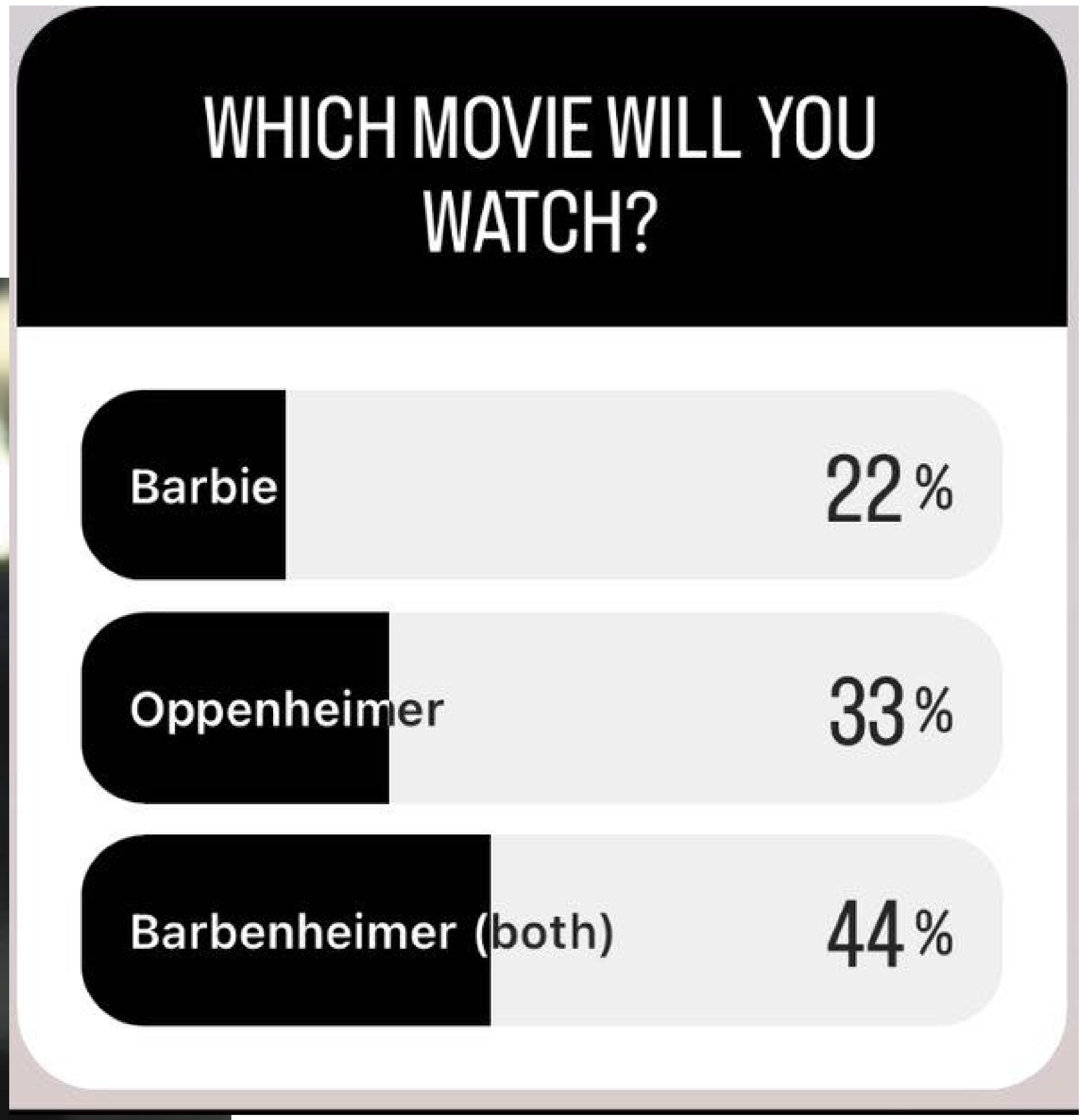
Voting

Voting

Voting


Finding
Your Upvotes
on Reddit
r/italy
u/redditor•8m
Join
The young people of reddit. What are you tired of hearing from previous generations?
See original
4.2k upvotes • 2.2k comments
34

Voting


WHICH MOVIE WILL YOU WATCH?
Barbie 22 %
Oppenheimer 33 %
Barbenheimer (both) 44 %

Individual preferences

A finite set of alternatives A, B, C, …

Individual preferences

A finite set of alternatives X, Y, Z, …

Preference: X $>_i$ Y or Y $>_i$ X **between any pair of alternatives** X and Y

Prefer X: $X >_i Y$

$\boxed{\text{individual}}$

Prefer Y: $Y >_i X$

Individual preferences

A finite set of alternatives X, Y, Z, …

Preference: $X >_i Y$ or $Y >_i X$ **between any pair of alternatives** X and Y

Completeness Either $X >_i Y$ or $Y >_i X$, but not both

Transitivity If $X >_i Y$ and $Y >_i Z$, then $X >_i Z$

Does the following relationship satisfy completeness and transitivity?

X X

FIFA World Cup (round-robin tournament)

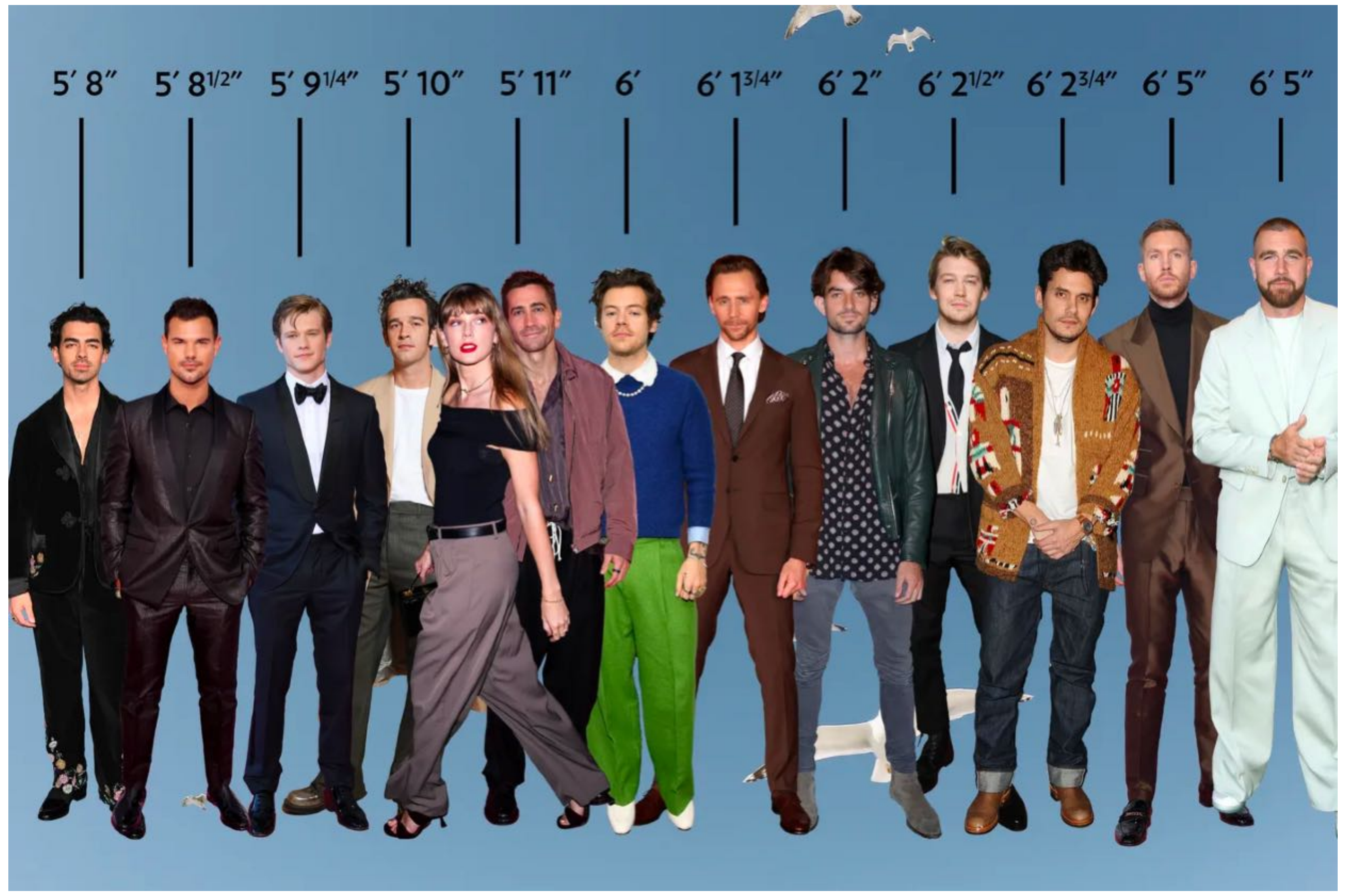
4 teams, each scheduled for 3 matches against others

If I: prefer $X >_i Y$ if X "defeats" Y in their match

Individual preferences

Does the following relationship satisfy completeness and transitivity?

? ✓



Comparing the "heights"

If I: prefer X $>_i$ Y if X is higher than Y

Group preferences

Preference: X $>_i$ Y or Y $>_i$ X **between any pair of alternatives** X and Y

Completeness Either X $>_i$ Y or Y $>_i$ X, but not both

Transitivity If X $>_i$ Y and Y $>_i$ Z, then X $>_i$ Z

A complete and transitive relation arises from some ranked list of the alternatives.

$X >_i Y \qquad Y >_i Z \qquad X >_i Z$

X	Y	Z
No. 1	No. 2	No. 3

Group preferences

① Set x^* as No. 1

② Repeat this for all options except x^*

$\Rightarrow$ New "x^{**}" as No. 2

Preference: X $>_i$ Y or Y $>_i$ X **between any pair of alternatives** X and Y

Completeness Either X $>_i$ Y or Y $>_i$ X, but not both

Transitivity If X $>_i$ Y and Y $>_i$ Z, then X $>_i$ Z

A complete and transitive relation arises from some ranked list of the alternatives.

Alternatives $x_1, x_2, \ldots, x_n$

Select x^* which "beats" the most number of others

We can show x^* beats everyone

$x^* <_i y$

Contradiction:

$\boxed{A\text{: options beaten by } x^*}$

$\Rightarrow$ y beats x^*, y also beats everyone in A $\Rightarrow$ y beats more options than x^*

Individual preferences

How do we aggregate individual preferences?

If there are only 2 alternatives: Majority rule

Group preferences

How do we aggregate individual preferences?

If there are > 2 alternatives: *Very hard*

Group preferences

How do we aggregate individual preferences?

Person 1: $X >_1 Y >_1 Z$

Person 2: $Y >_2 Z >_2 X$

Person 3: $Z >_3 X >_3 Y$

Compare X vs Y (X > Y)

Y vs Z (Y > Z)

X vs Z (Z > X)

Group preferences

How do we aggregate individual preferences?

Person 1: $X >_1 Y >_1 Z$

Person 2: $Y >_2 Z >_2 X$

Person 3: $Z >_3 X >_3 Y$

Condorcet Paradox:
Nontransitive group preferences arising from transitive individual preferences

How do we aggregate individual preferences?

Group i (40%) : $X >_i Y >_i Z$

Group j (30%): $Y >_j Z >_j X$

Group k (30%): $Z >_k X >_k Y$

Compare X vs Y $\qquad X > Y$

Compare $\underbrace{\text{(Winner between X and Y)}}_{X < Z}$ vs Z $\Rightarrow$ Winner : Z

Group preferences

How do we aggregate individual preferences?

Group i (40%) : $X >_i Y >_i Z$

Group j (30%): $Y >_j Z >_j X$

Group k (30%): $Z >_k X >_k Y$

Group preferences

100 people in total

How do we aggregate individual preferences?

2 1 0

Group i (40%) : $X >_i Y >_i Z$

Group j (30%): $Y >_j Z >_j X$

Group k (30%): $Z >_k X >_k Y$

$X: 40 \times 2 + 30 \times 1 = 110$

$Y: 30 \times 2 + 40 \times 1 = 100$

$Z: 30 \times 2 + 30 \times 1 = 90$

In each person's choice No. 1 gets 2 points

No. 2 1

No. 3 0

Count total # points for each option. $\Rightarrow$ Group-level ranking.