Cryptographic Techniques to Ensure Fair Randomness in Legal Processes

Henry Corrigan-Gibbs and Keith Winstein
Department of Computer Science

Coalition Challenges Selection of Judges in Same-Sex Marriage Case

Adam Liptak

SIDEBAR NOV. 10, 2014

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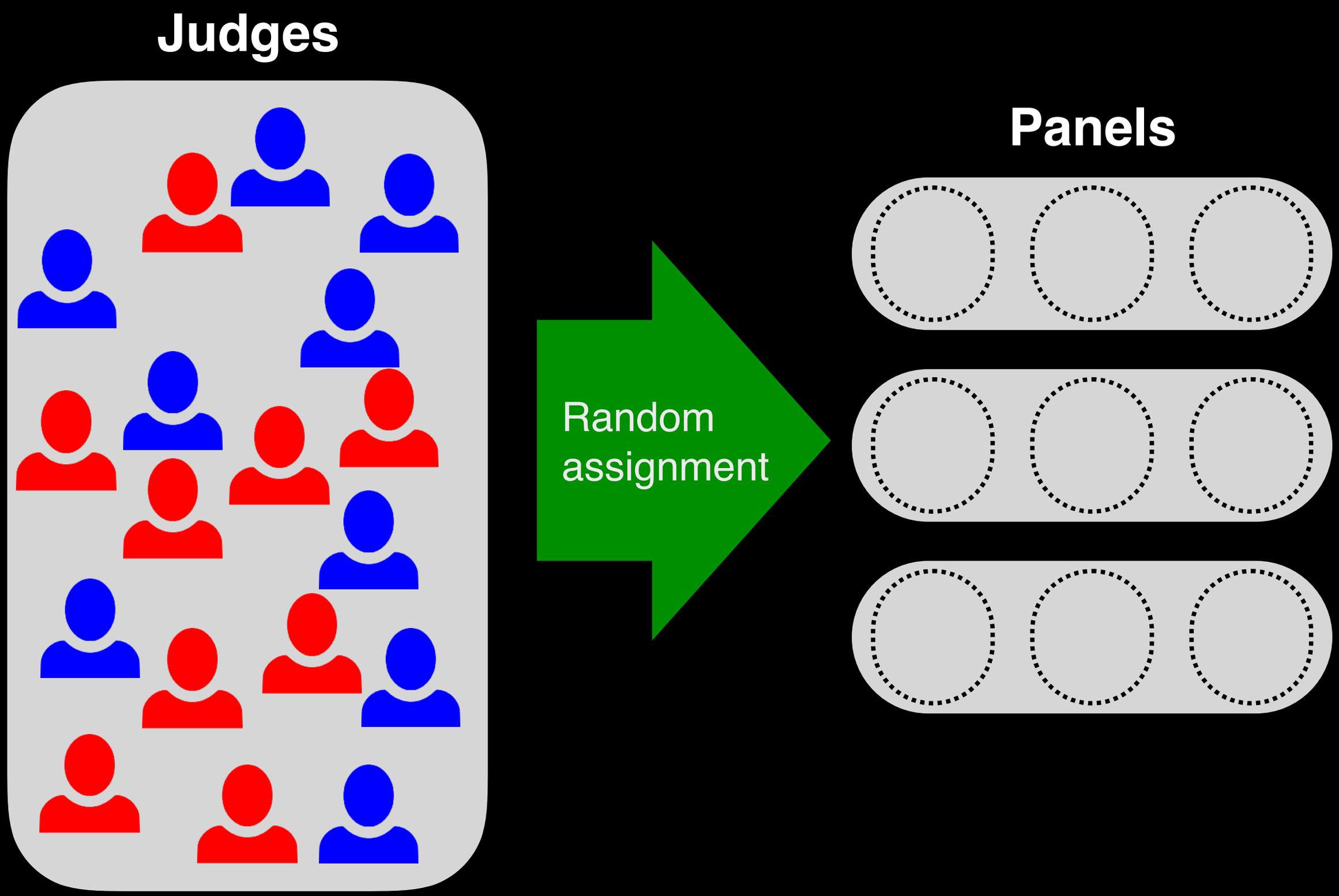
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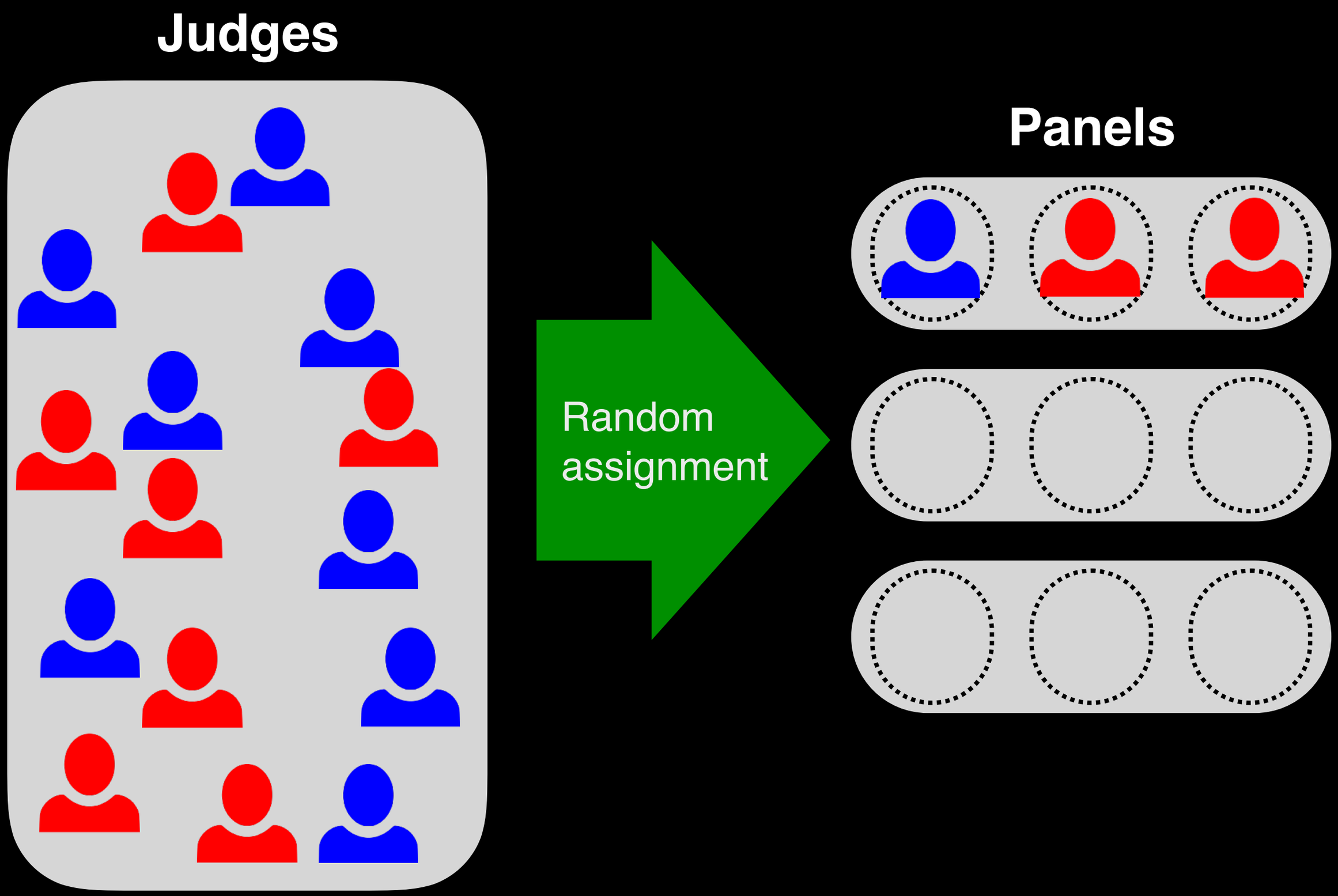
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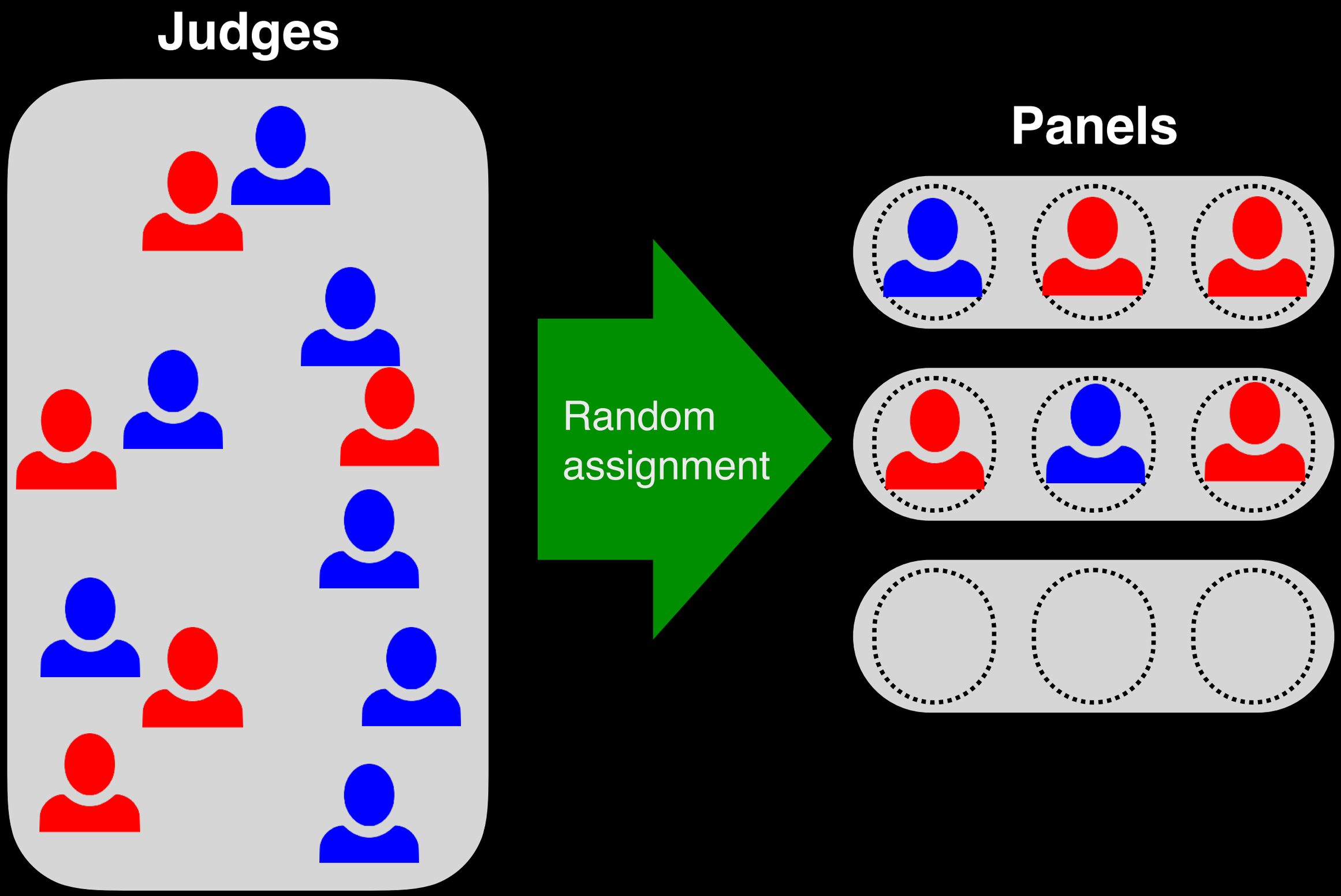
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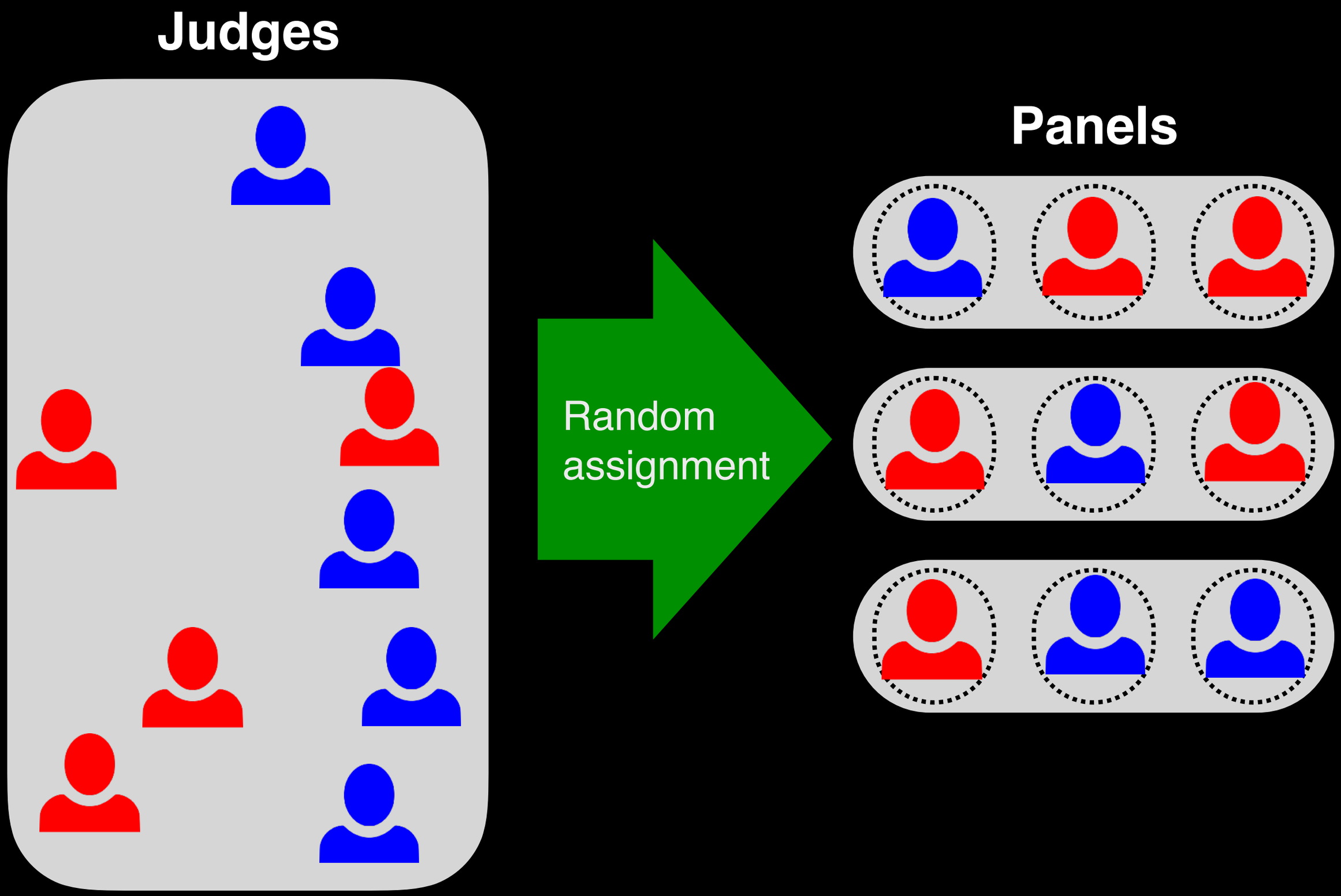
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At the same time, a new study by two law professors supports the idea that many federal appeals courts are not selecting their panels perfectly randomly.

"We found strong evidence in the majority of circuits that they're not using a random assignment process to form their panels," said Marin K. Levy, a law professor at Duke and one of the study's authors.

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"If any of the 12 circuits are using a nonrandom process," he said, "it's most likely to be the Ninth Circuit."

Draft Document

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Adam S. Chilton[*] *& Marin K. Levy*[**]

Abstract

A fundamental academic assumption about the federal courts of appeals is that the three-judge panels that hear cases have been randomly configured. Scores of scholarly articles have noted this "fact," and it has been relied on heavily by empirical researchers. Even though there are practical reasons to doubt that judges would always be randomly assigned to panels, this assumption has never been tested. This Article fill this void by doing so.

To determine whether the circuit courts utilize random assignment, we have created what we believe to be the largest dataset of panel assignments of those courts constructed to date. Using this dataset, we tested whether panel assignments are, in fact, random by comparing the actual assignments to truly random panels generated by code that we have created to simulate the panel generation process. Our results show evidence of non-randomness in the majority of the federal courts of appeals. Moreover, our findings specifically show a lack of randomness along several key dimensions: the distribution of conservative judges, female judges, and minority judges.

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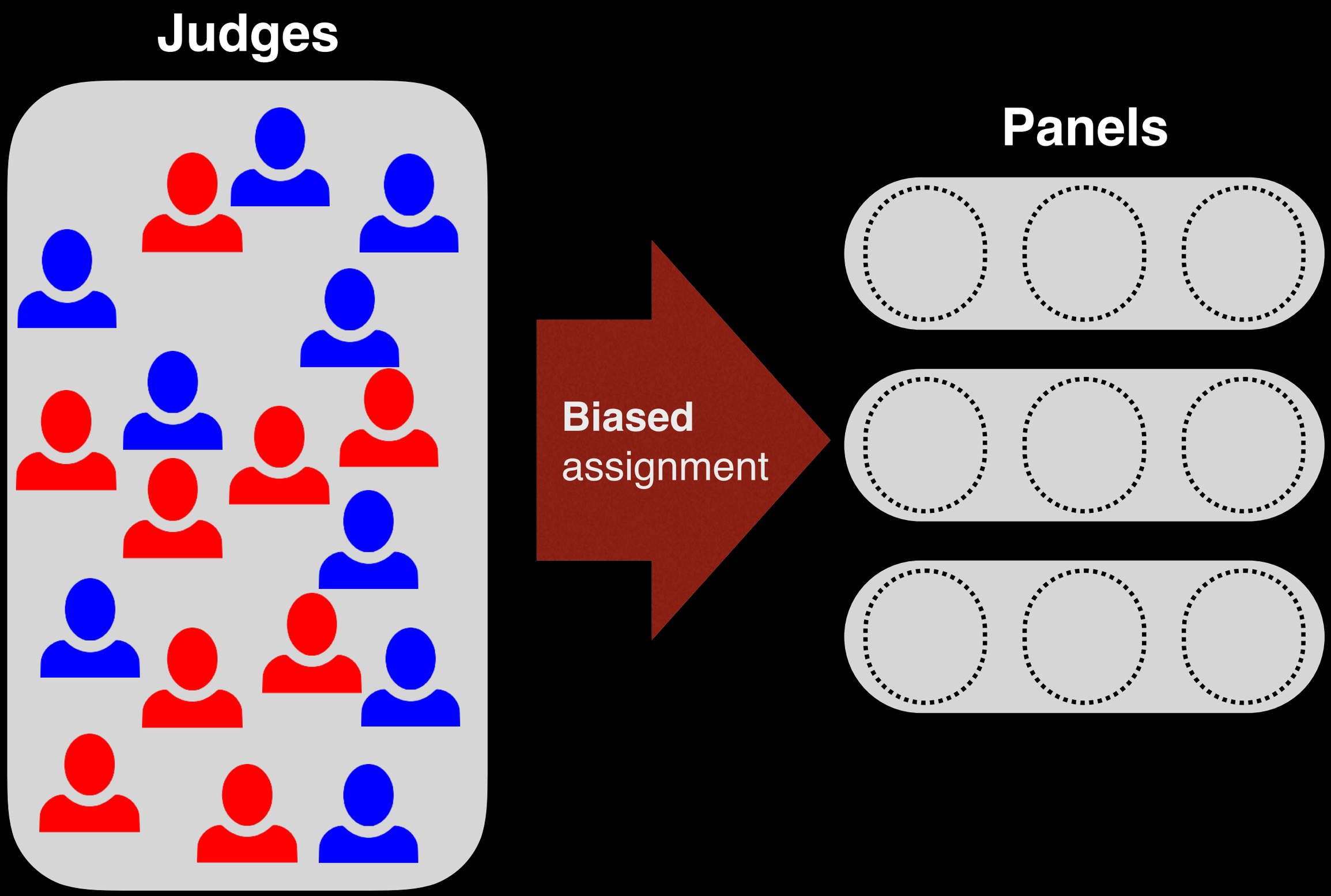
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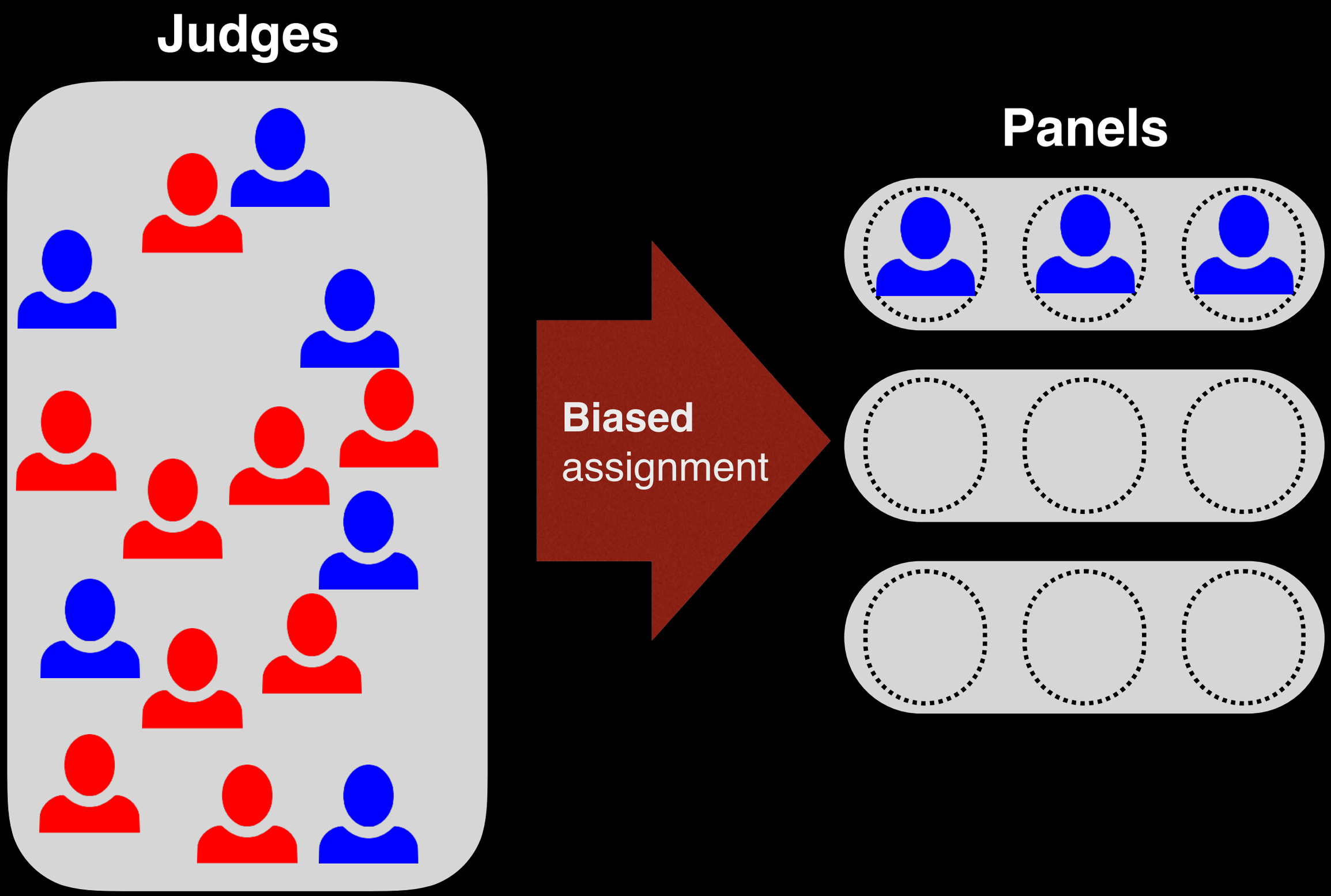
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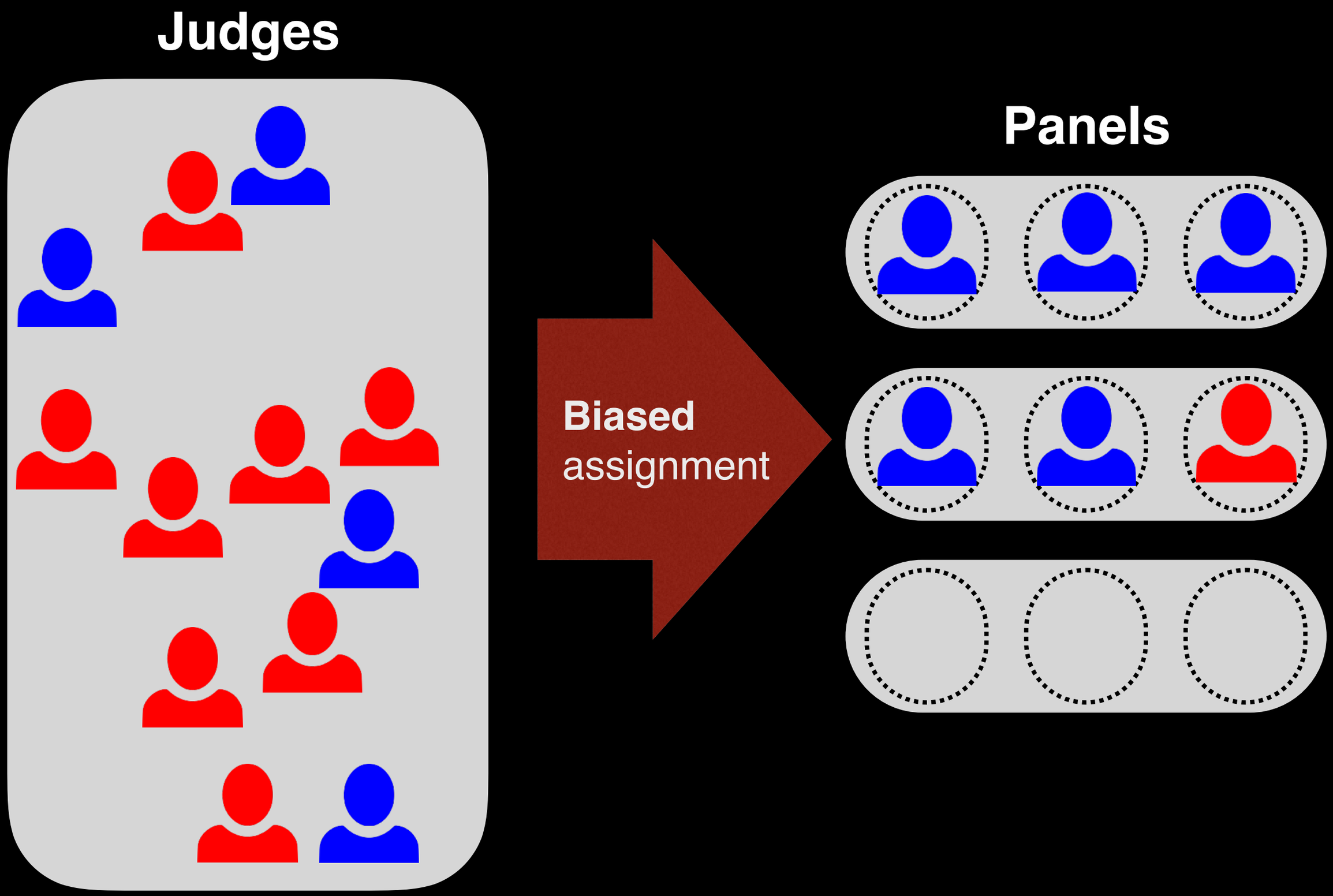
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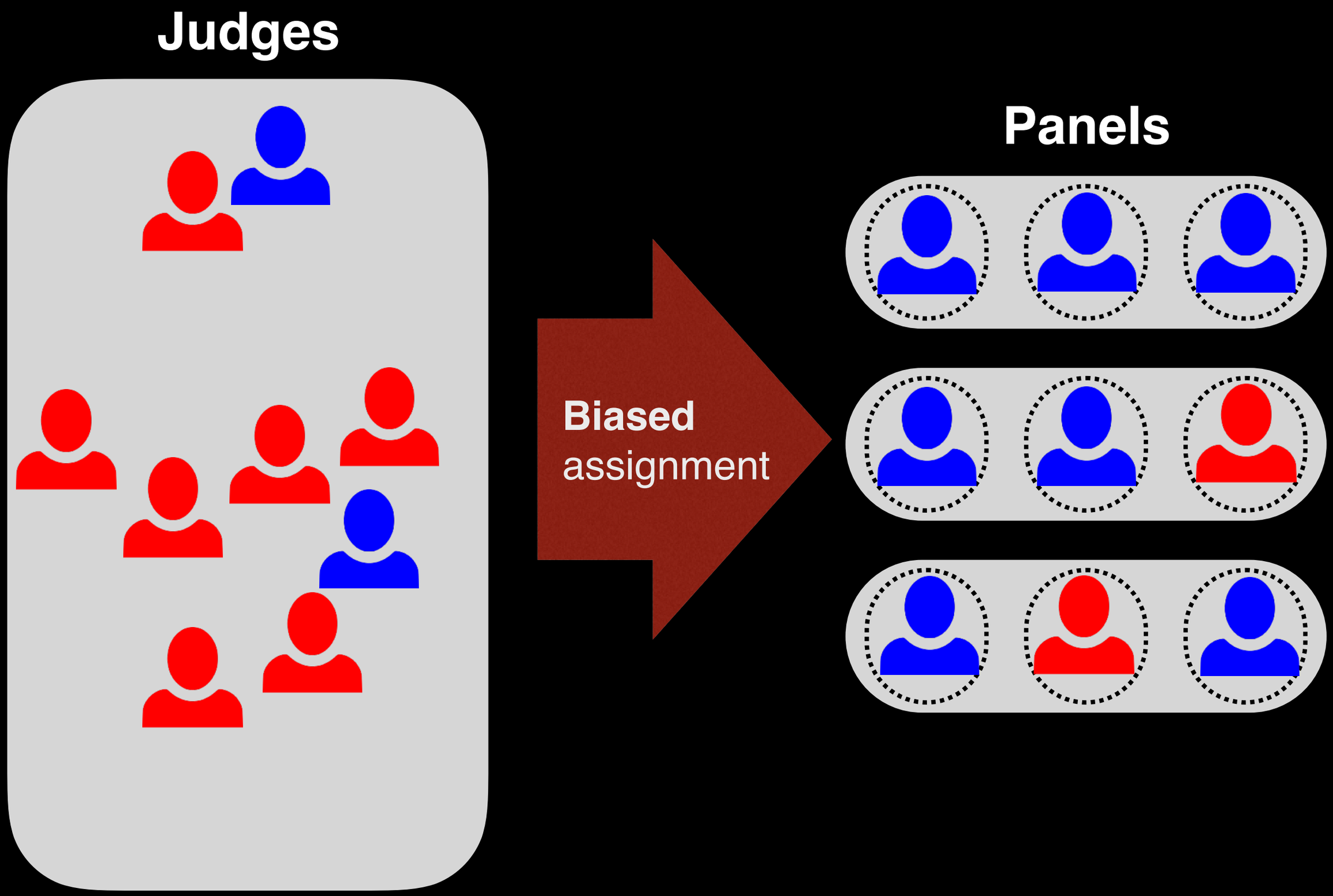
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Hope: Cryptographic tools can make almost any algorithm open and accountable.

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These cryptographic techniques also apply to:
visa lotteries, tax audits, airport screening, school lotteries, etc.

PART I

The Perils of Retrospective Analysis

PART II

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3. **Test** how likely the actual panel assignments would be under a truly random (ideal) assignment.

Appendix B:
Simulated Distribution of Female Judges

	Actual Panels	Simulated Mean	90% Confidence Interval		Significance
D.C. Circuit					
0 Women	158	166	149	184	
1 Women	272	261	242	279	
2 Women	77	79	66	93	
3 Women	3	4	1	7	
1st Circuit					
0 Women	131	137	123	150	
1 Women	148	140	126	154	
2 Women	18	21	14	29	
3 Women	1	0	0	1	
2nd Circuit					
0 Women	558	570	540	600	
1 Women	608	594	564	624	
2 Women	155	160	141	180	
3 Women	11	11	6	16	
3rd Circuit					
0 Women	311	296	275	317	
1 Women	263	297	275	318	***
2 Women	93	72	59	86	**
3 Women	2	4	1	8	
4th Circuit					
0 Women	263	263	243	283	
1 Women	266	268	248	288	
2 Women	67	62	50	75	
3 Women	1	3	1	6	*
5th Circuit					
0 Women	271	278	256	301	
1 Women	422	419	394	443	
2 Women	176	164	145	183	
3 Women	8	16	10	23	**
6th Circuit					
0 Women	391	392	366	419	
1 Women	566	563	534	591	
2 Women	219	226	204	248	
3 Women	30	25	17	33	

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- Even if <u>all courts</u> are using good randomness, C-L will falsely accuse eight circuits of bad behavior on average.

Why can multiple hypothesis testing be problematic?

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Alaska	32	Idaho	13	Michigan	12	New York	27	Tenn.	6
Arizona	17	Illinois	13	Minn.	9	N.C.	42	Texas	32
Arkansas	43	Indiana	46	Miss.	15	N.D.	12	Utah	29
California	6	Iowa	18	Missouri	50	Ohio	17	Vermont	2
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Even if the lottery *weren't rigged*, we would expect to see a few **18**s just by random chance.

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Problem: Editing the hypotheses after running the statistical tests can lead to spurious findings (“*p*-hacking”).

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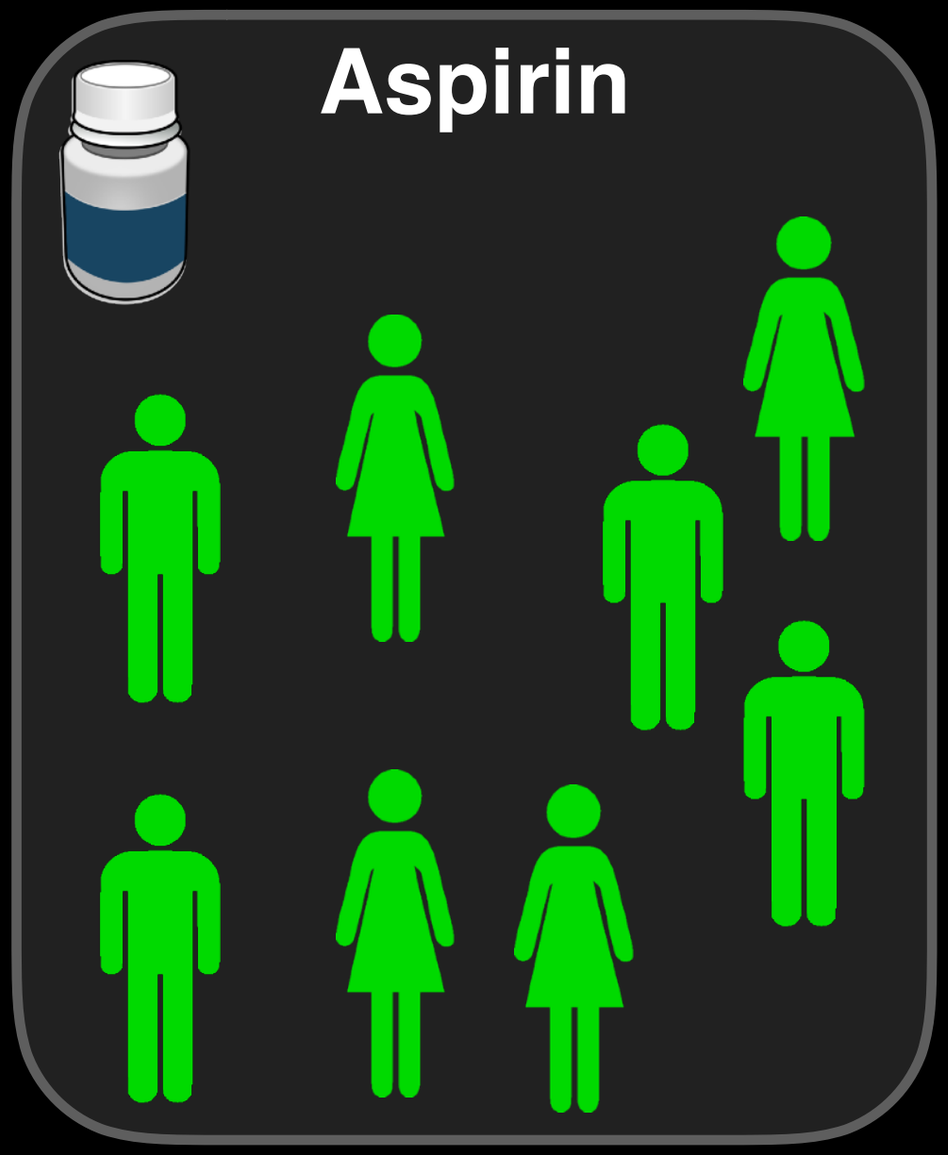

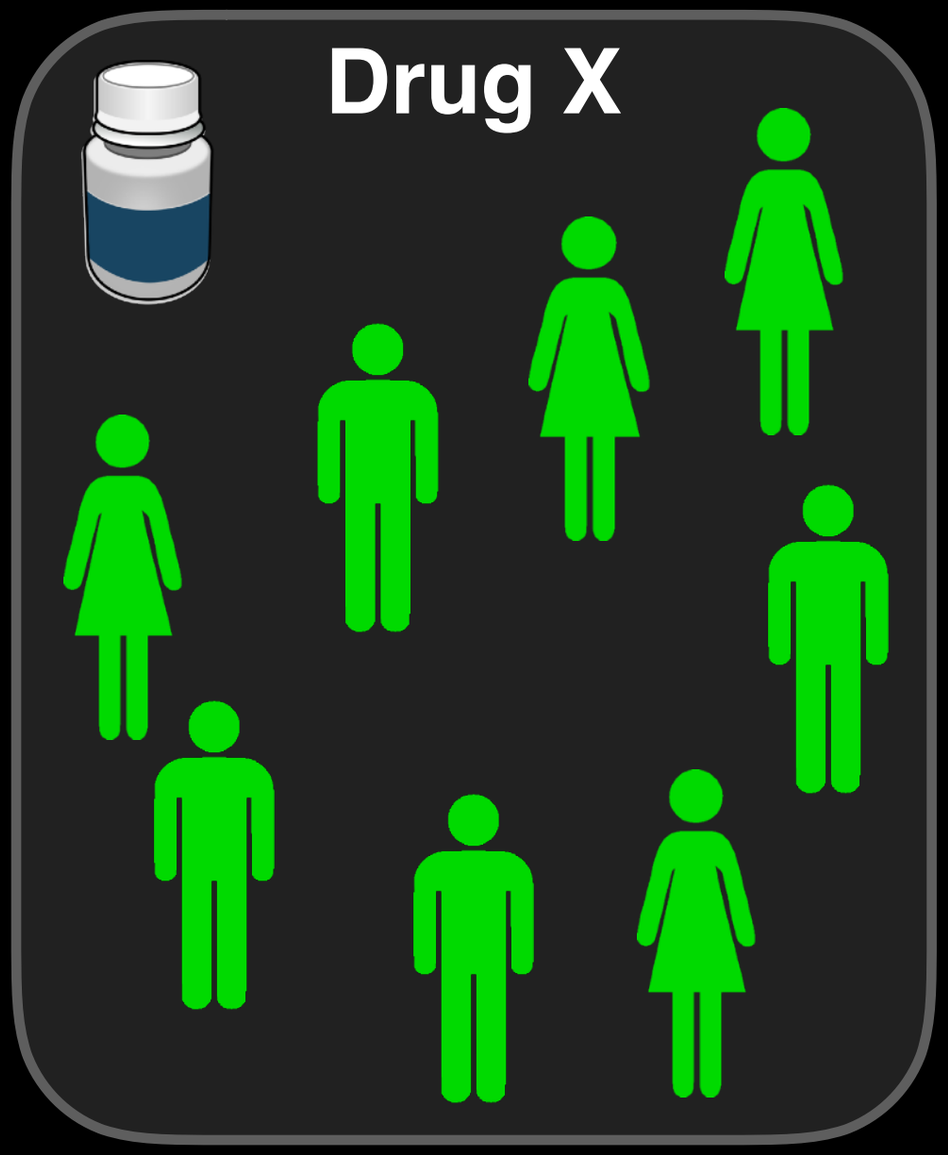

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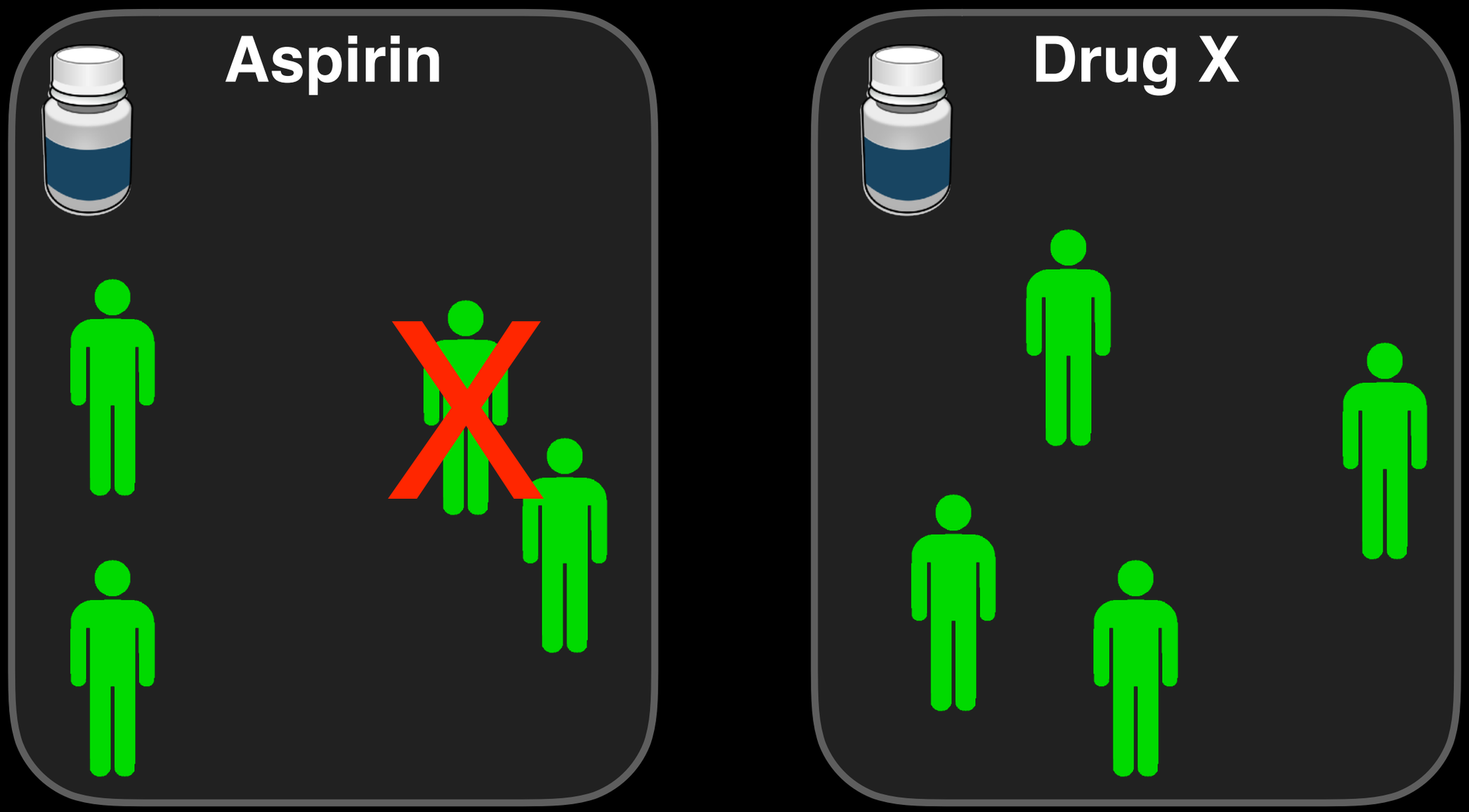

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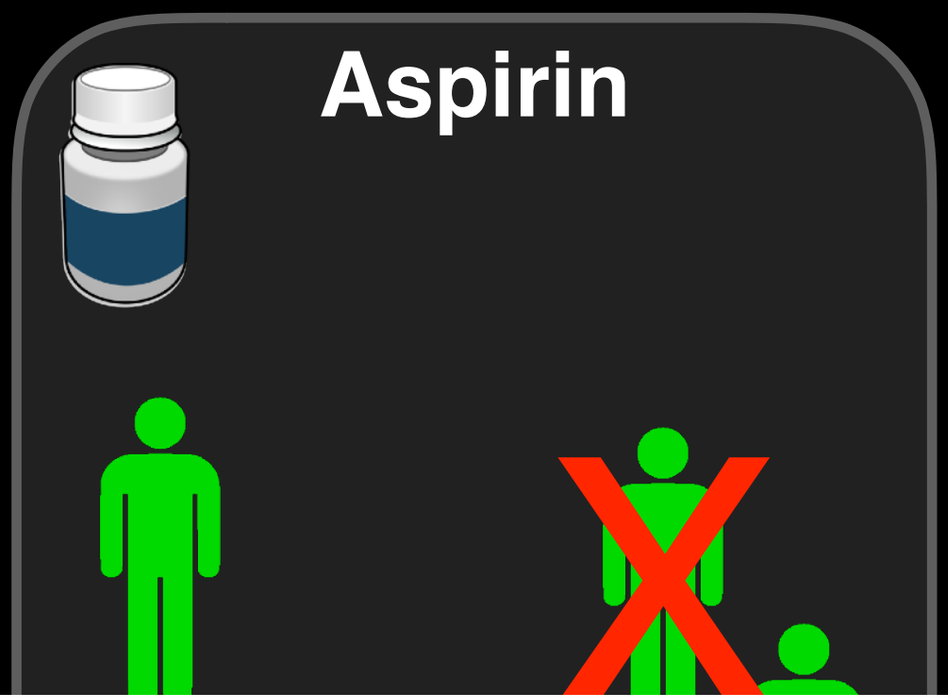

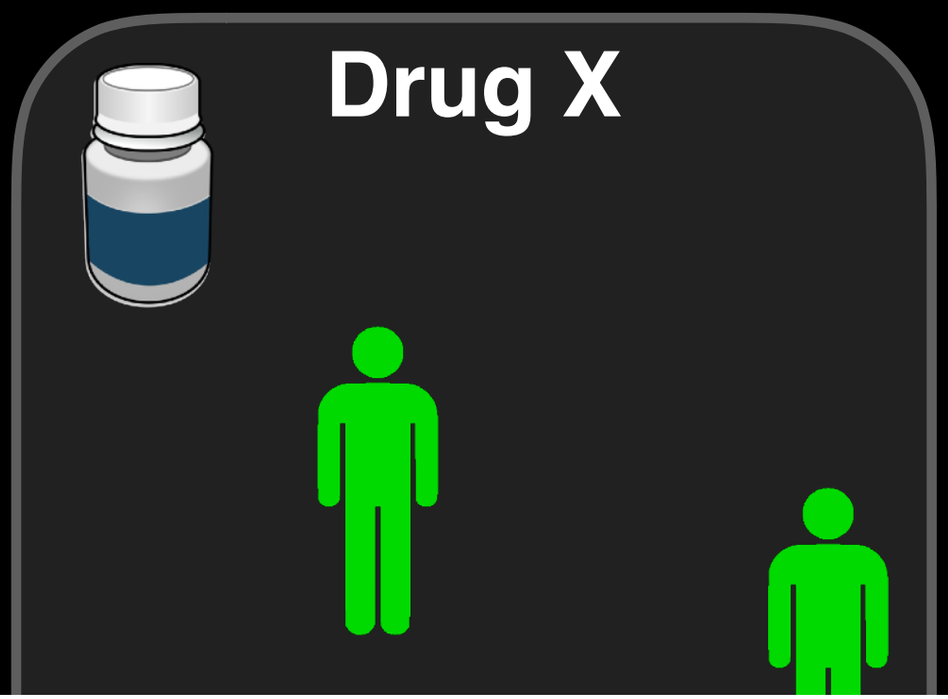

Clinical Trial Finds New Drug X Safer Than Aspirin Among Men

Outcome

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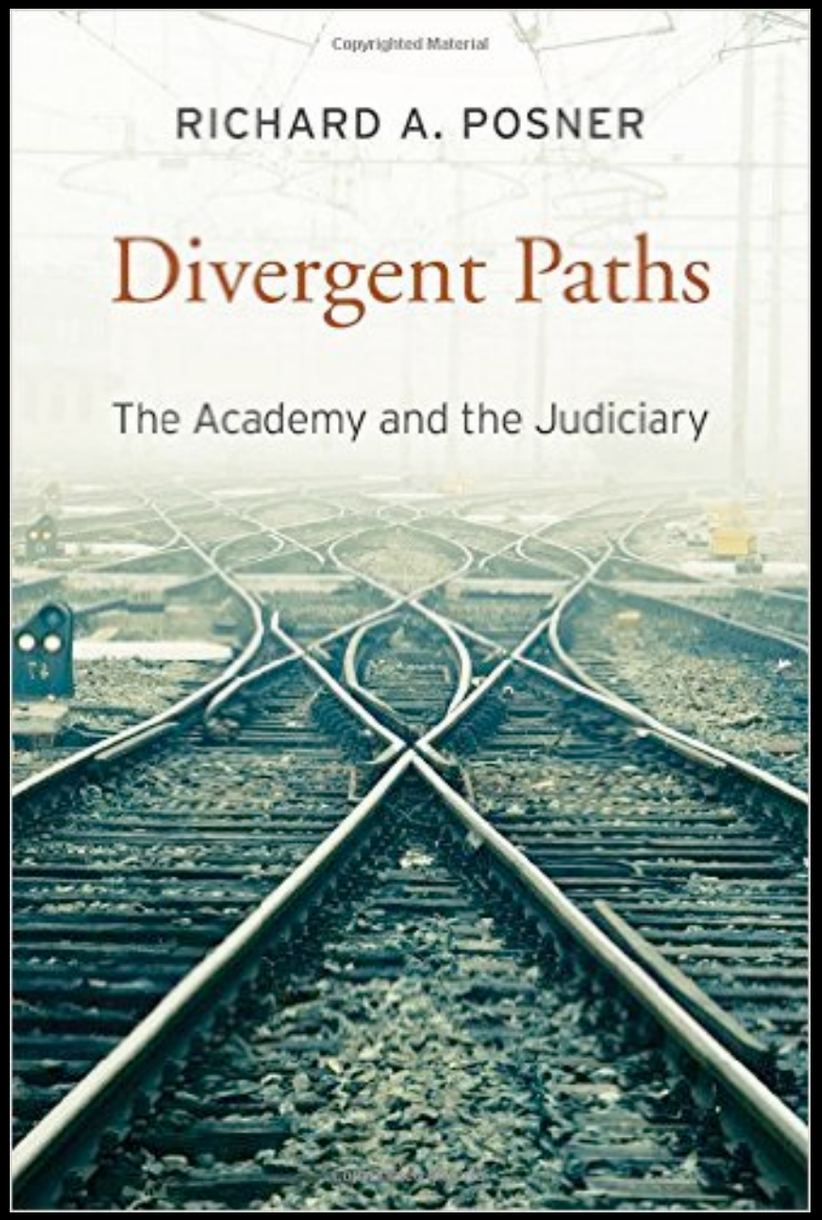

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"A recent article, however, employing **sophisticated statistical methods**, identifies four circuits—D.C., Second, Eighth, and Ninth—in which assignments are not random, but indeed appear to produce an ideological slant."

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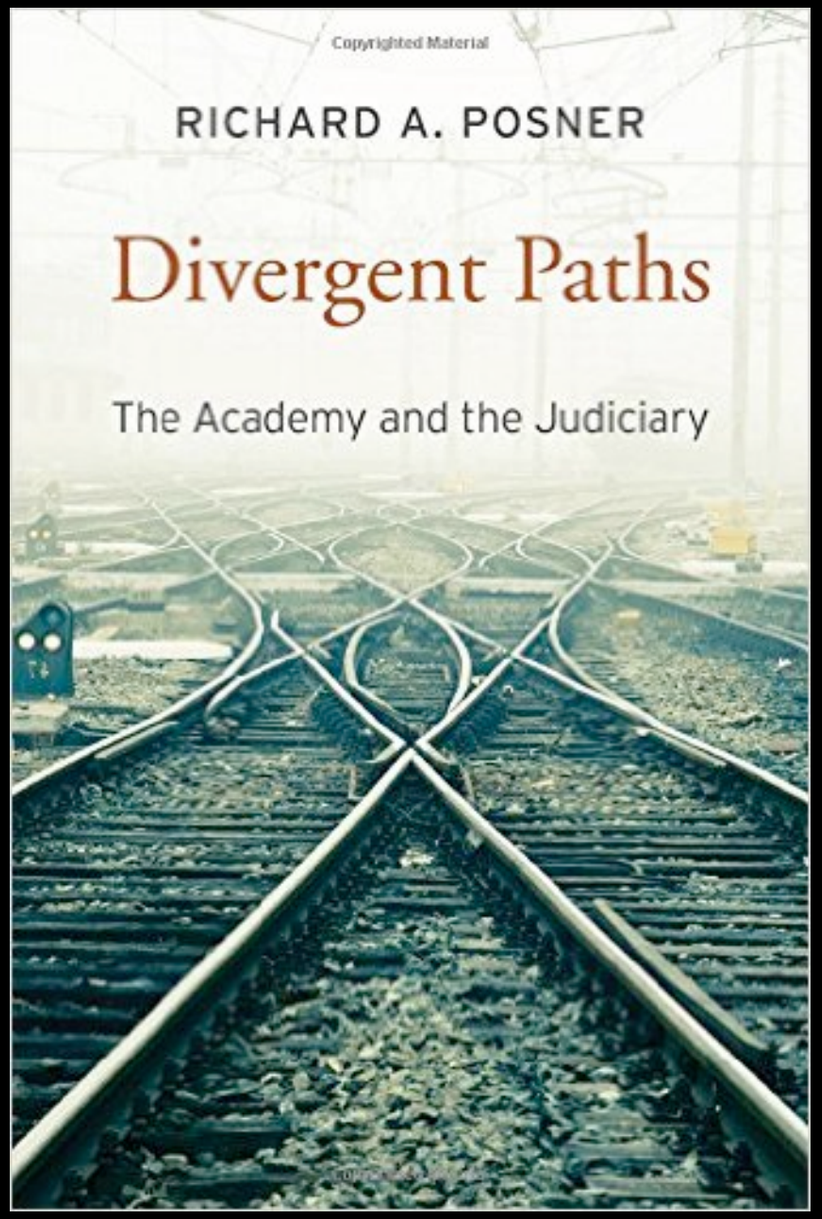

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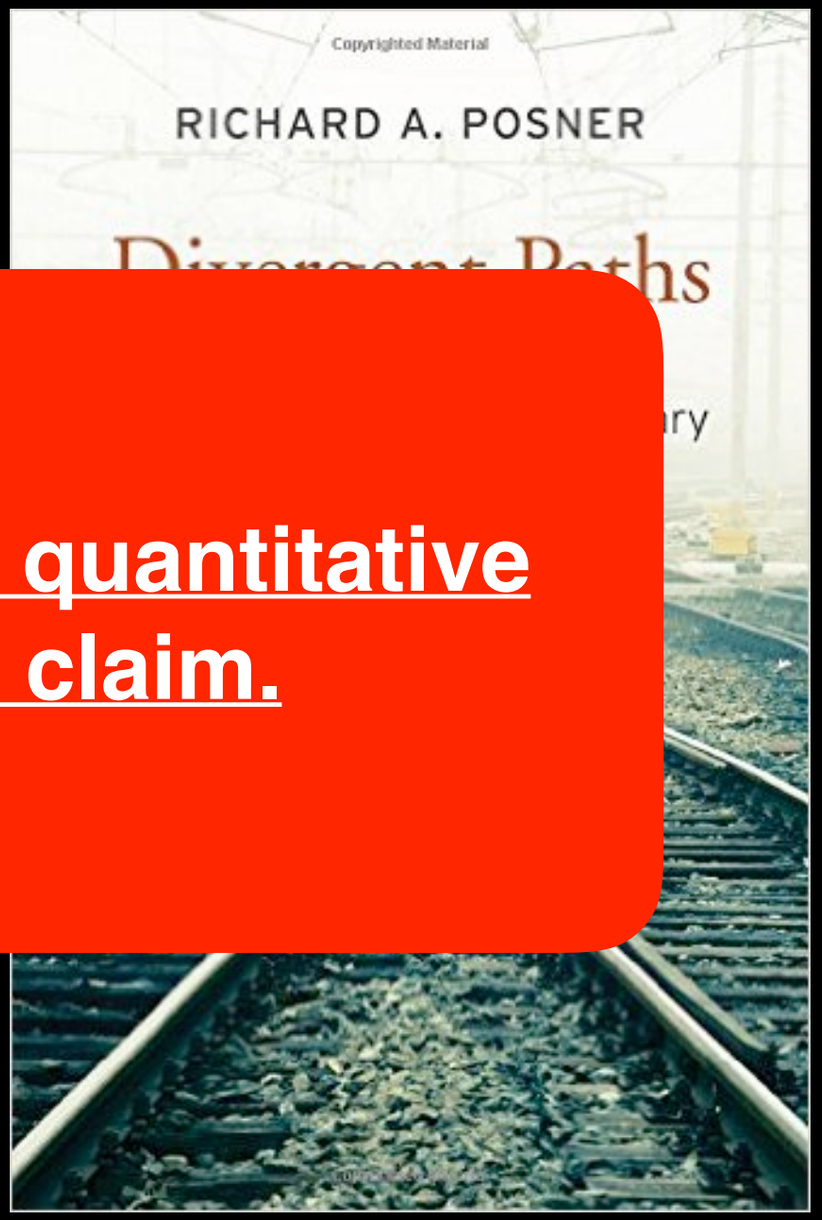

<u>The study provides no quantitative evidence for this claim.</u>

Recommendations

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For law review editors: Consider consulting external reviewers about papers with a heavy computational or statistical angle.

PART I

The Perils of Retrospective Analysis

PART II

Cryptographic Techniques to Ensure Fair Randomness

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Cryptographic Techniques to Ensure Fair Randomness

Randomness

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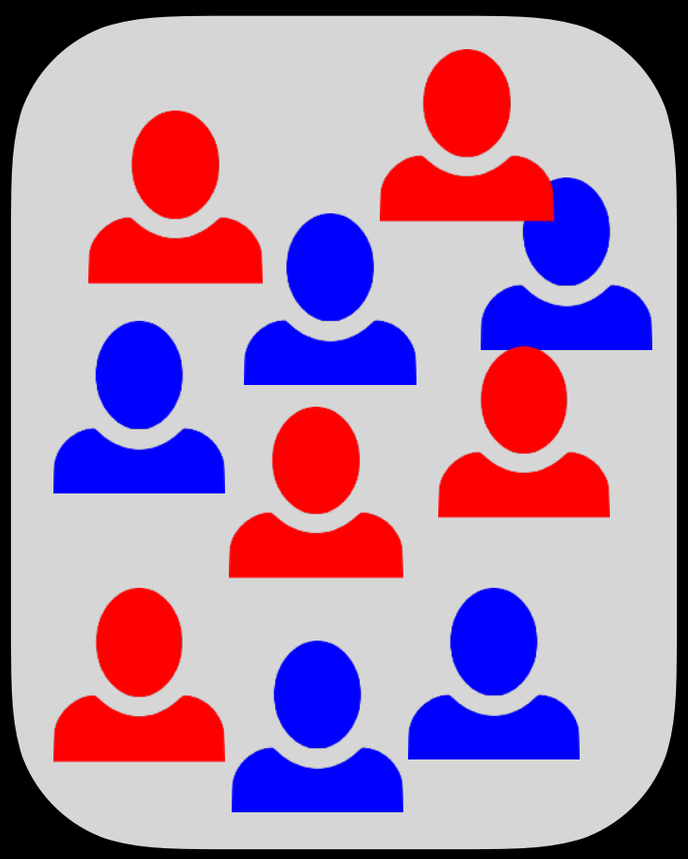

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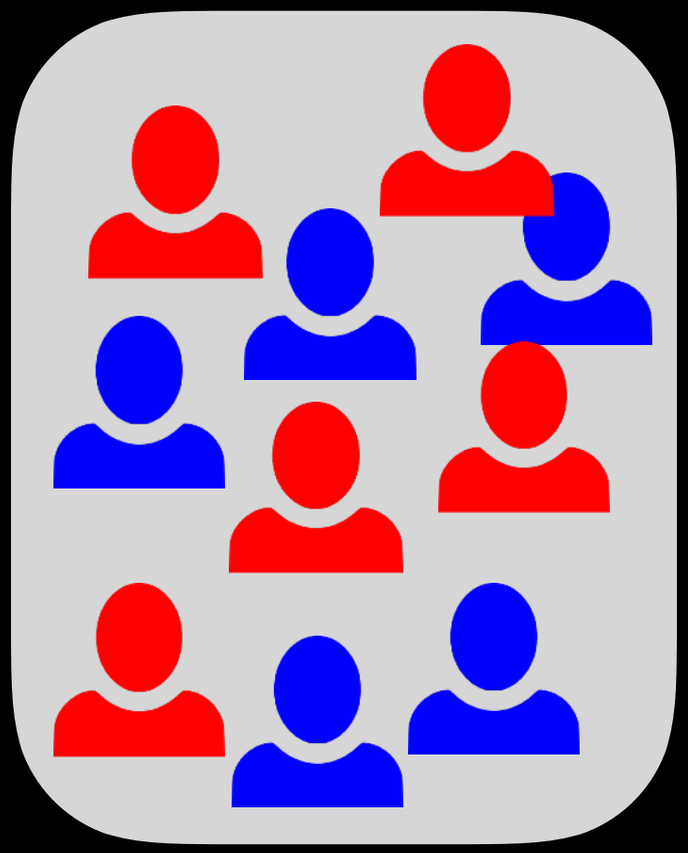
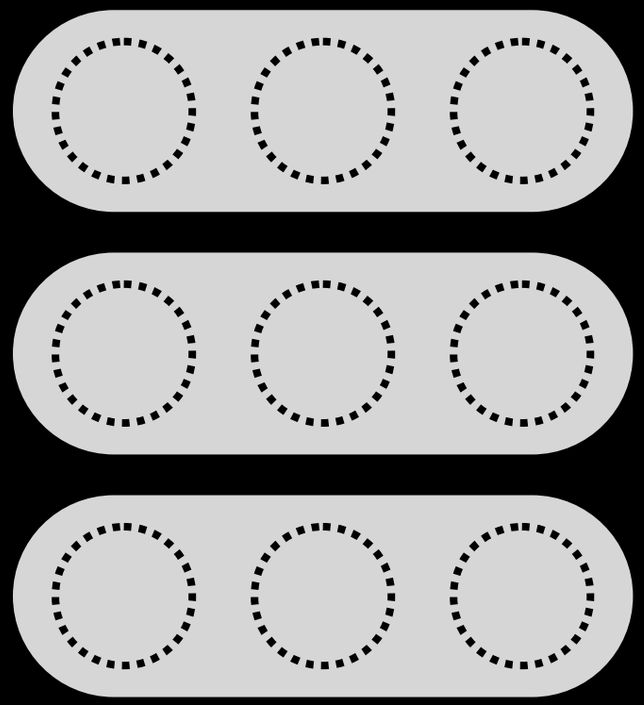


Panels



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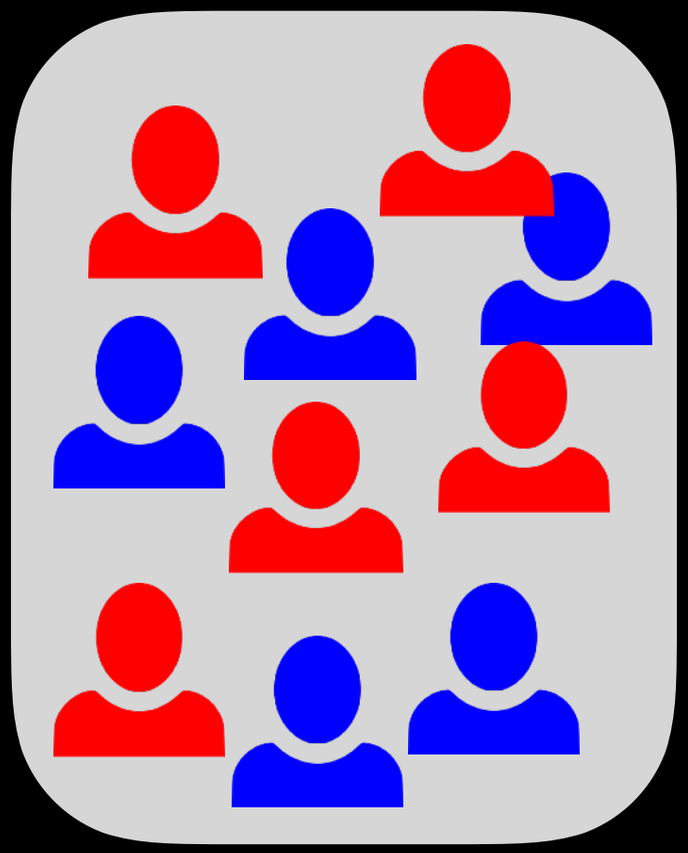

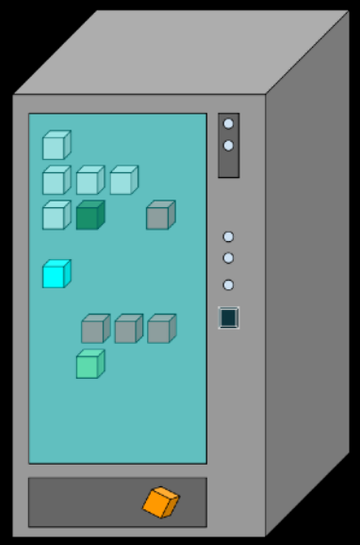

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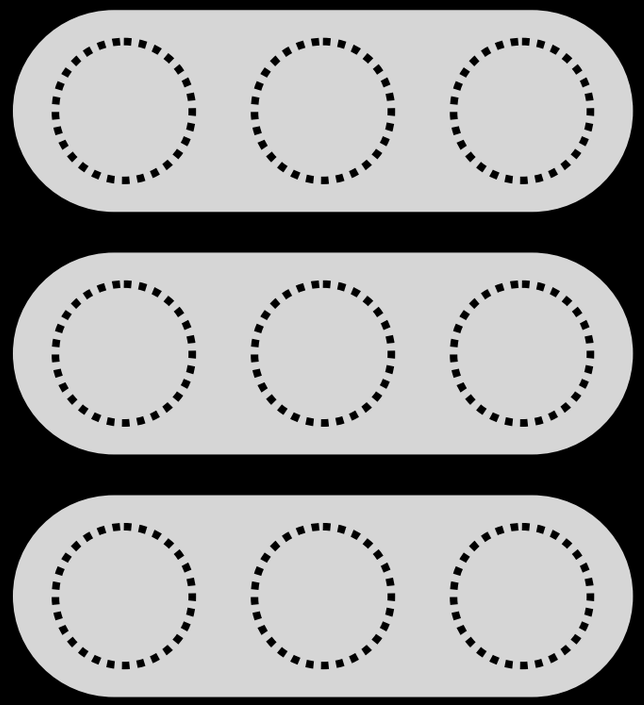

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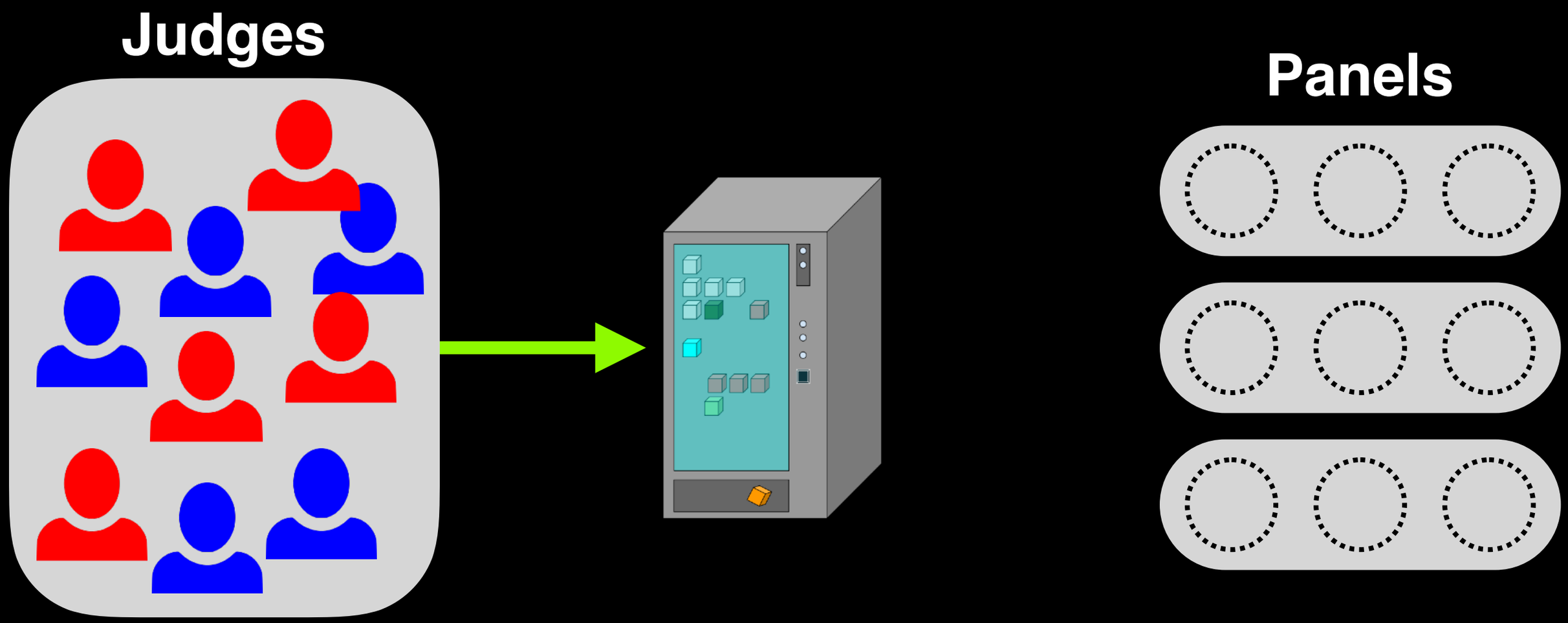

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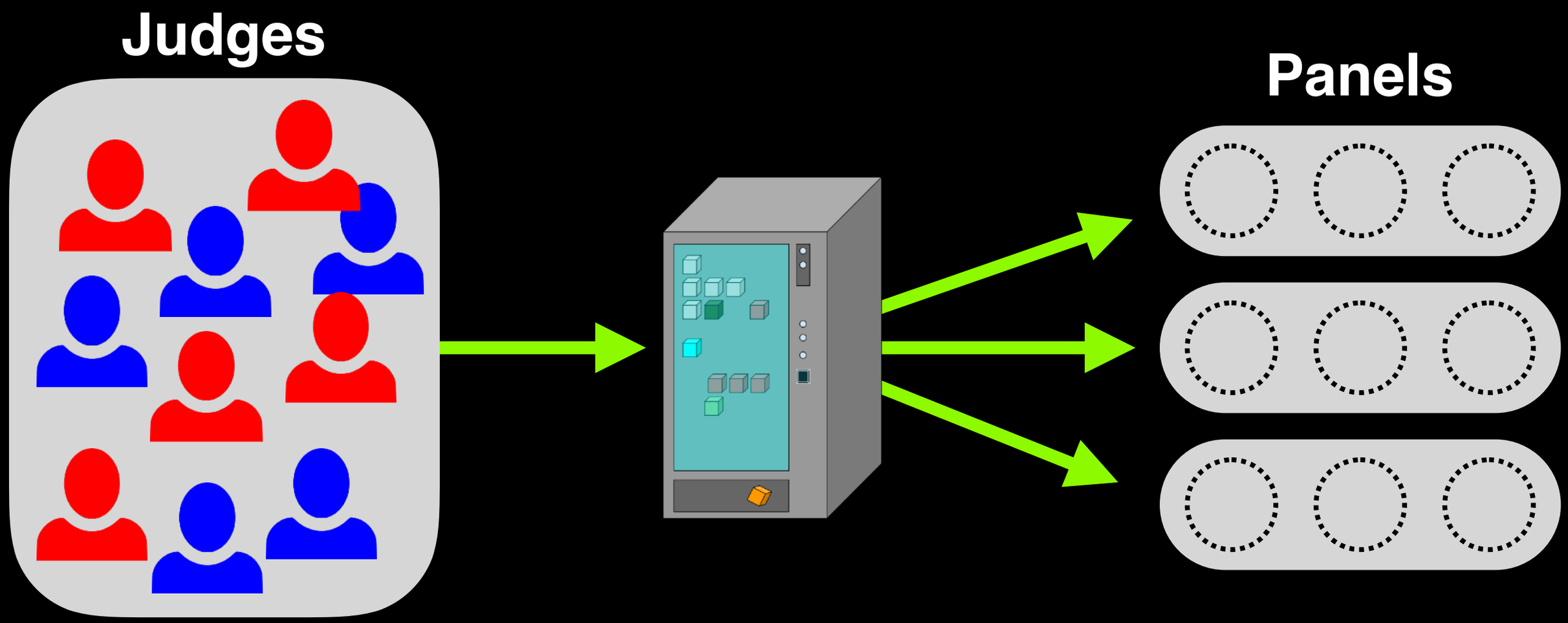

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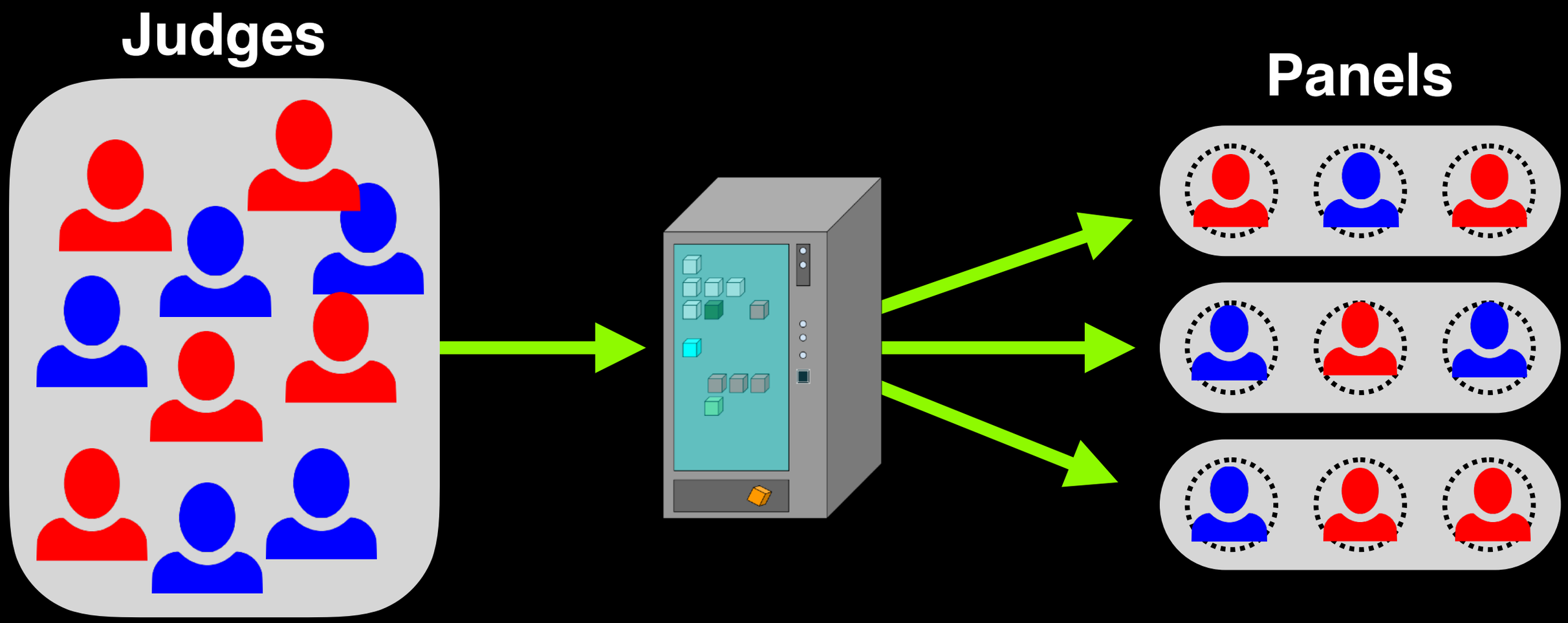

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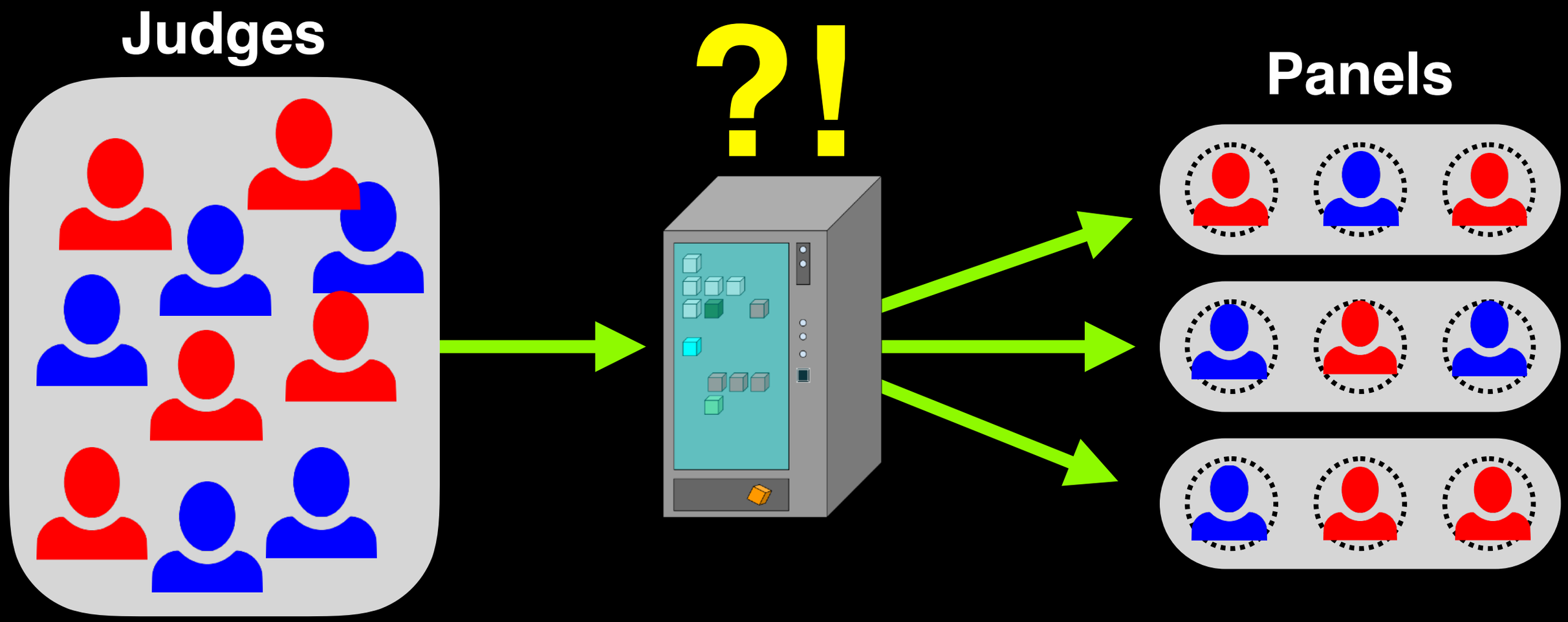

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Three Cryptographic Ideas

1. Coin-Flipping Protocols
2. Fair Exchange
3. Randomness Beacons

Three Cryptographic Ideas

1. **Coin-Flipping Protocols**
2. Fair Exchange
3. Randomness Beacons

Tool 1: Coin-Flipping Protocol

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(We can think of *N* as between 1 and 100.)

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(We can think of *N* as between 1 and 100.)

Principle: The best (only?) way to be sure that a “random” number is really random is to pick it yourself. [Blum 1983]

Tool 1: Coin-Flipping Protocol

Petitioner 

Respondent 

Tool 1: Coin-Flipping Protocol

“Cryptographic commitment”

Petitioner 

Respondent 

Tool 1: Coin-Flipping Protocol

"Cryptographic commitment"

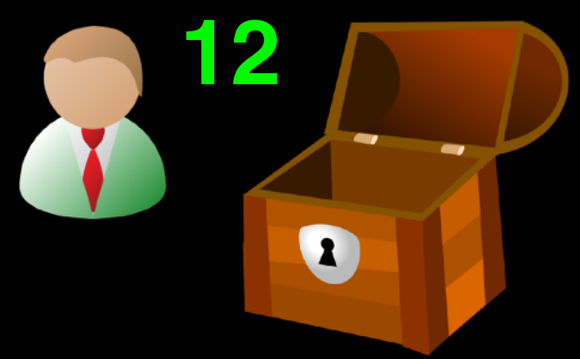
Petitioner

Respondent

Tool 1: Coin-Flipping Protocol

"Cryptographic commitment"

Petitioner



Respondent

Tool 1: Coin-Flipping Protocol

"Cryptographic commitment"

Petitioner  

Respondent 

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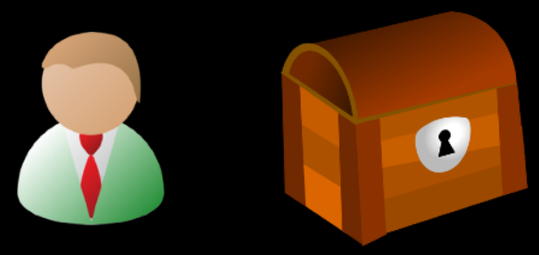

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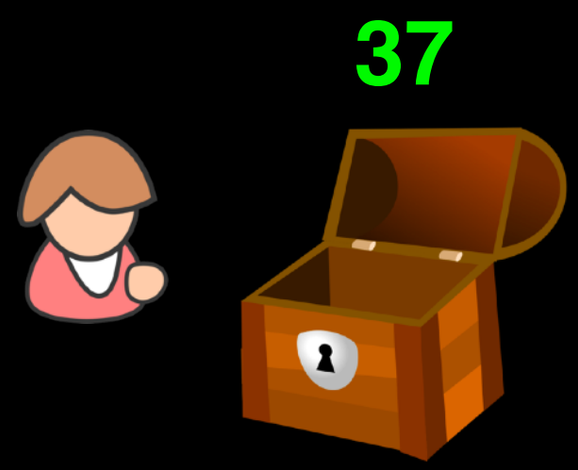

Tool 1: Coin-Flipping Protocol

Clerk's Office

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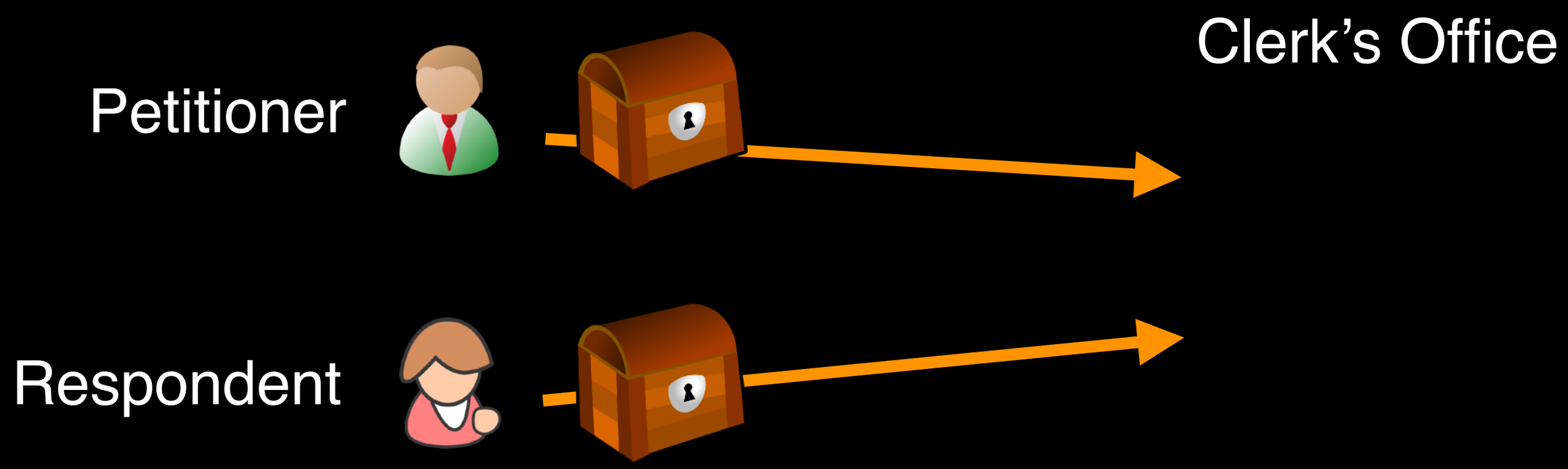

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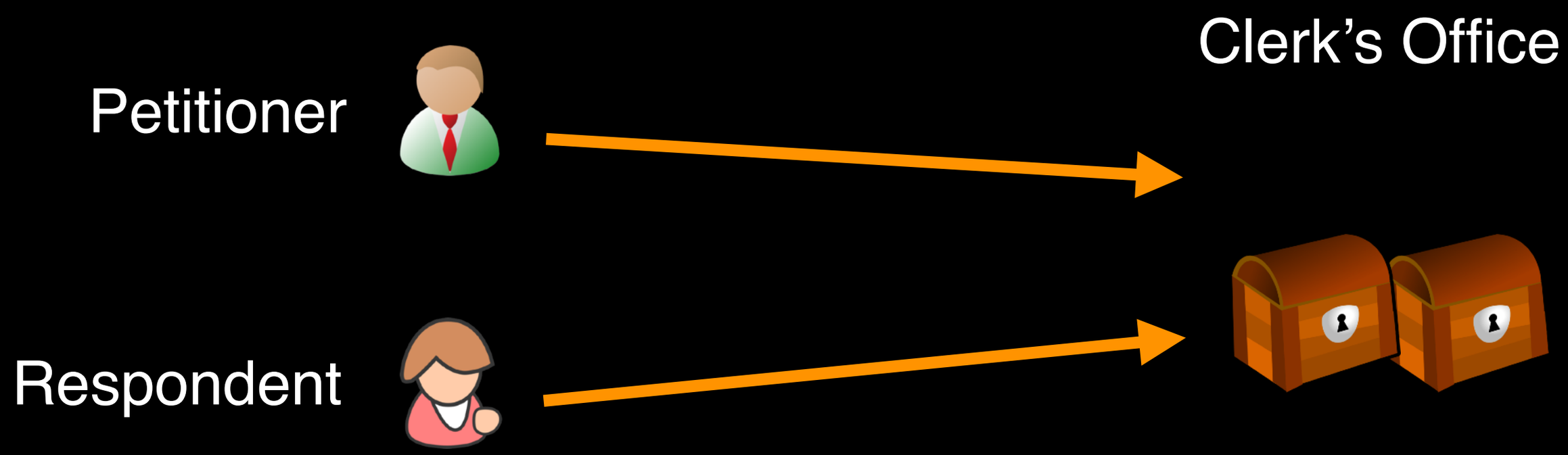

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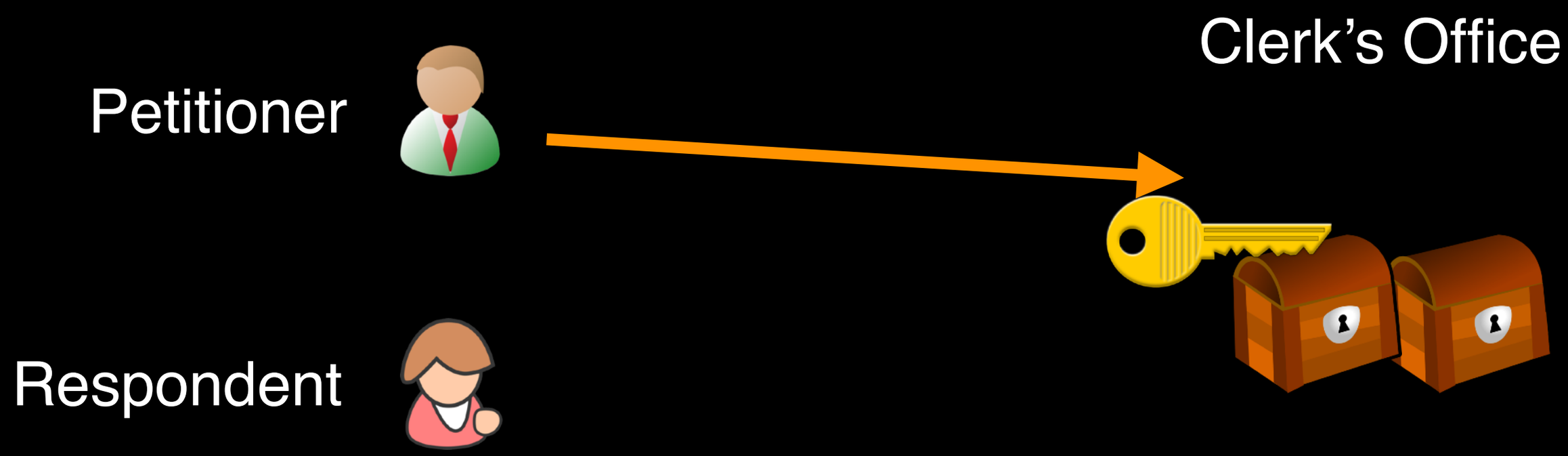

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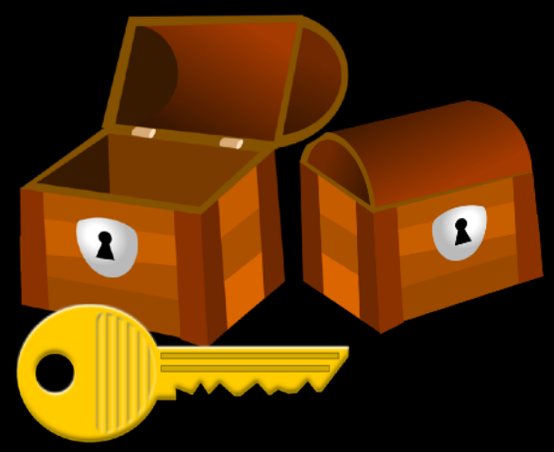

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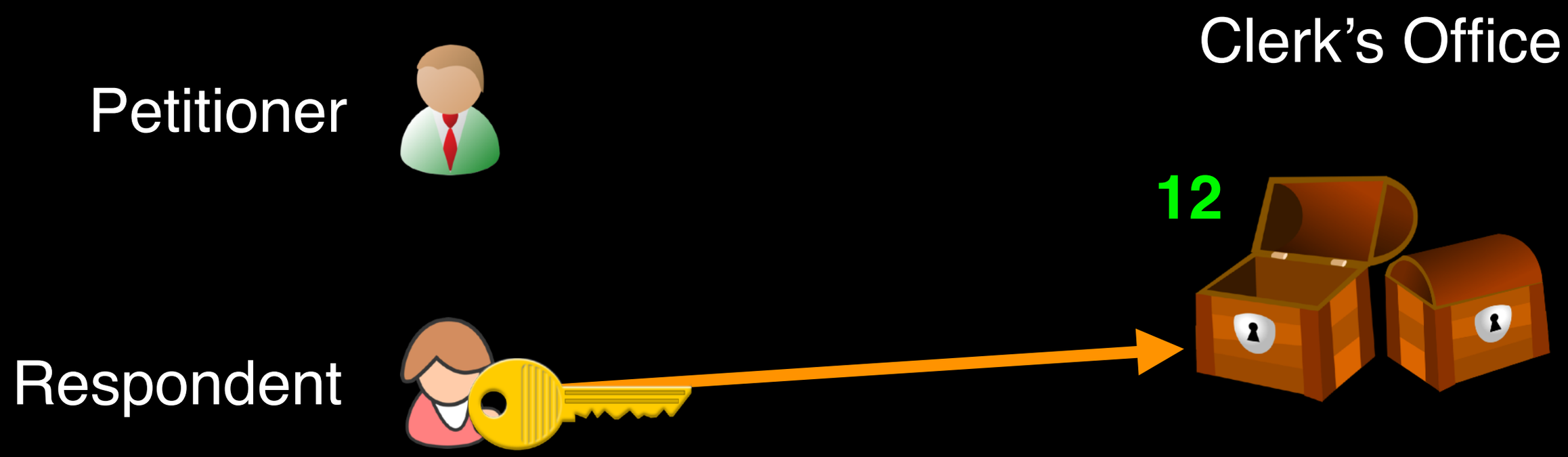

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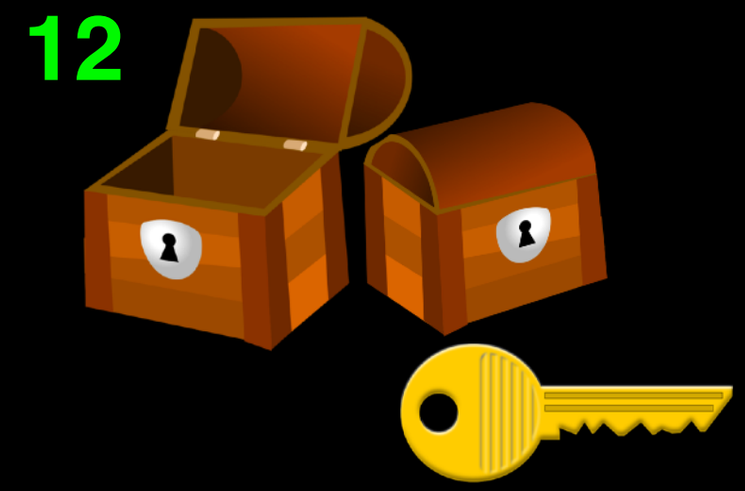

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Clerk's Office

Use **12** + **37** = **49** as the random number.

Tool 1: Coin-Flipping Protocol

Clerk's Office

Petitioner

Respondent

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If the sum is over 100, use only the last two digits

Are we done?

Problem: The respondent sees the output *N* before the petitioner does. This creates a loophole…

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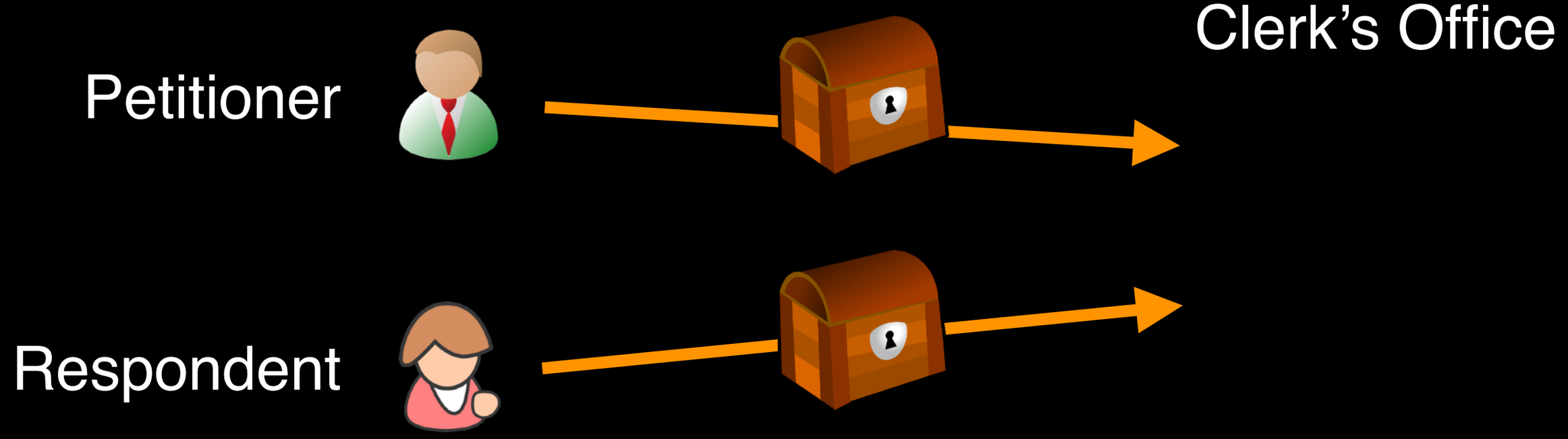

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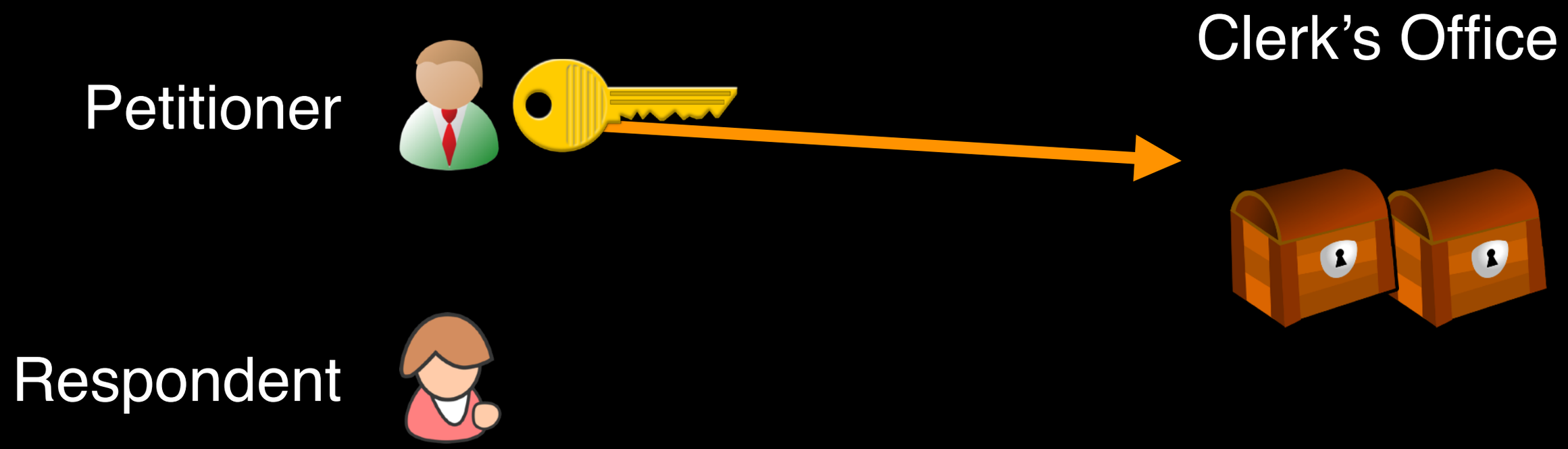

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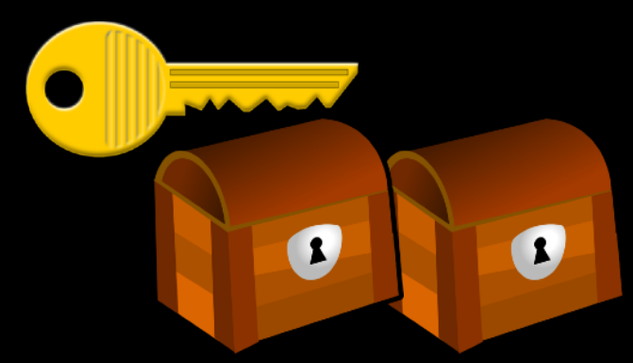

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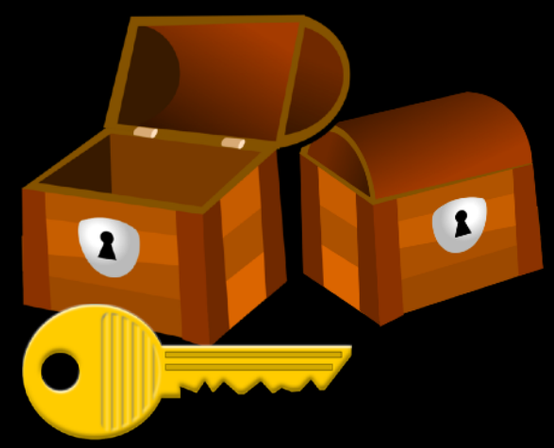

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Petitioner

Respondent

Clerk's Office

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Petitioner

Respondent

My number is 37, so we will get panel 49.

Clerk's Office

Are we done?

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Petitioner

Respondent

I don’t like panel 49.

Clerk’s Office

Are we done?

Problem: The respondent sees the output N before the petitioner does. This creates a loophole…

Petitioner

Respondent

I lost my key!

Let's start over.

Clerk's Office

Are we done?

Problem: The respondent sees the output *N* before the petitioner does. This creates a loophole…

Petitioner

Respondent

The Russians hacked my laptop!

Let's start over.

Clerk's Office

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Petitioner

Respondent

Clerk's Office

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Petitioner

Petitioner may choose the panel.

Clerk's Office

Respondent

Three Cryptographic Ideas

1. **Coin-Flipping Protocols**
2. Fair Exchange
3. Randomness Beacons

Three Cryptographic Ideas

1. Coin-Flipping Protocols
2. **Fair Exchange**
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Tool 2: Fair Exchange

[Blum 1981], [Damgård 1993]

Clerk's Office

Petitioner 

Respondent 

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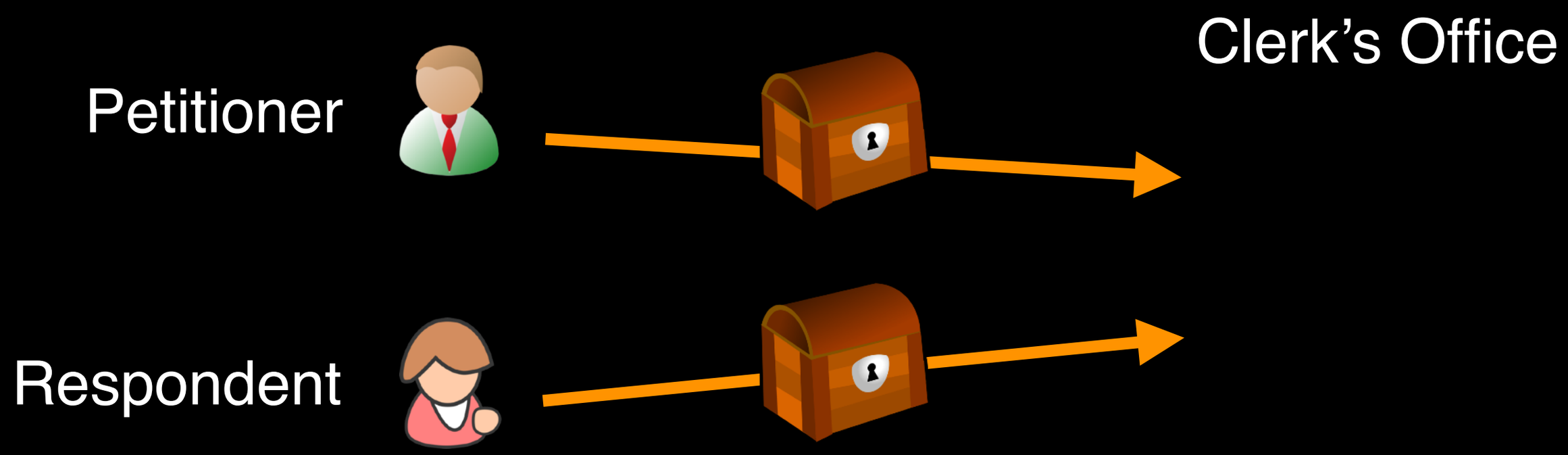

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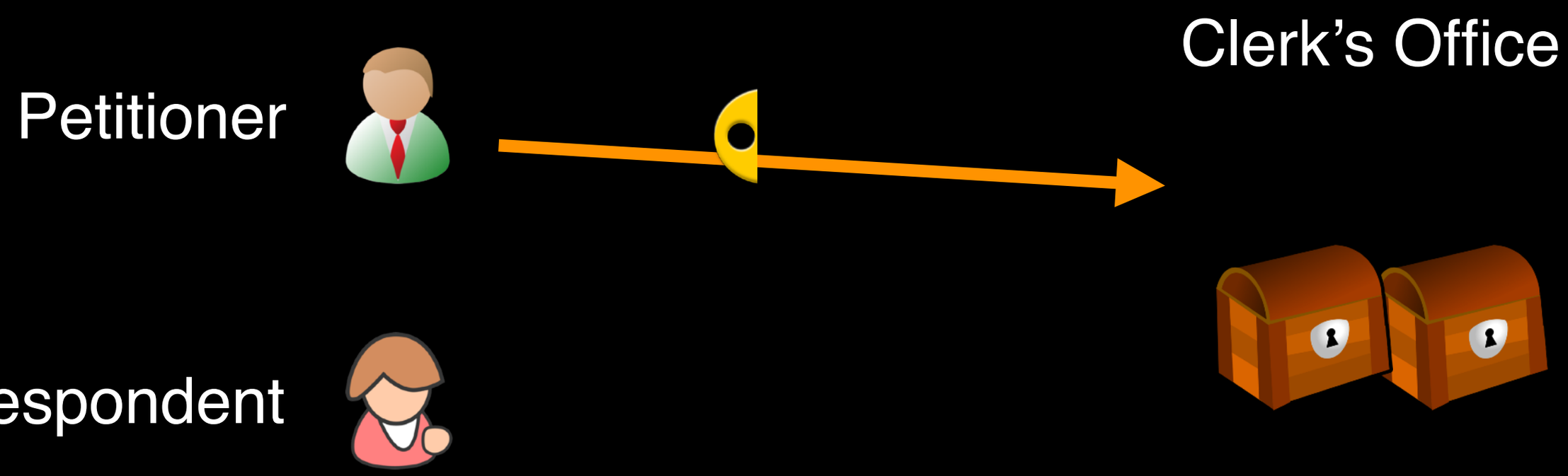

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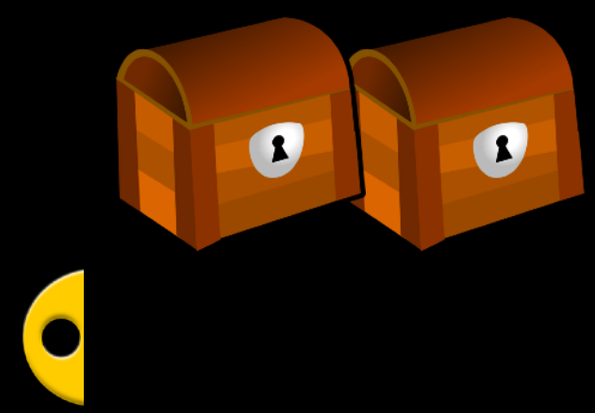

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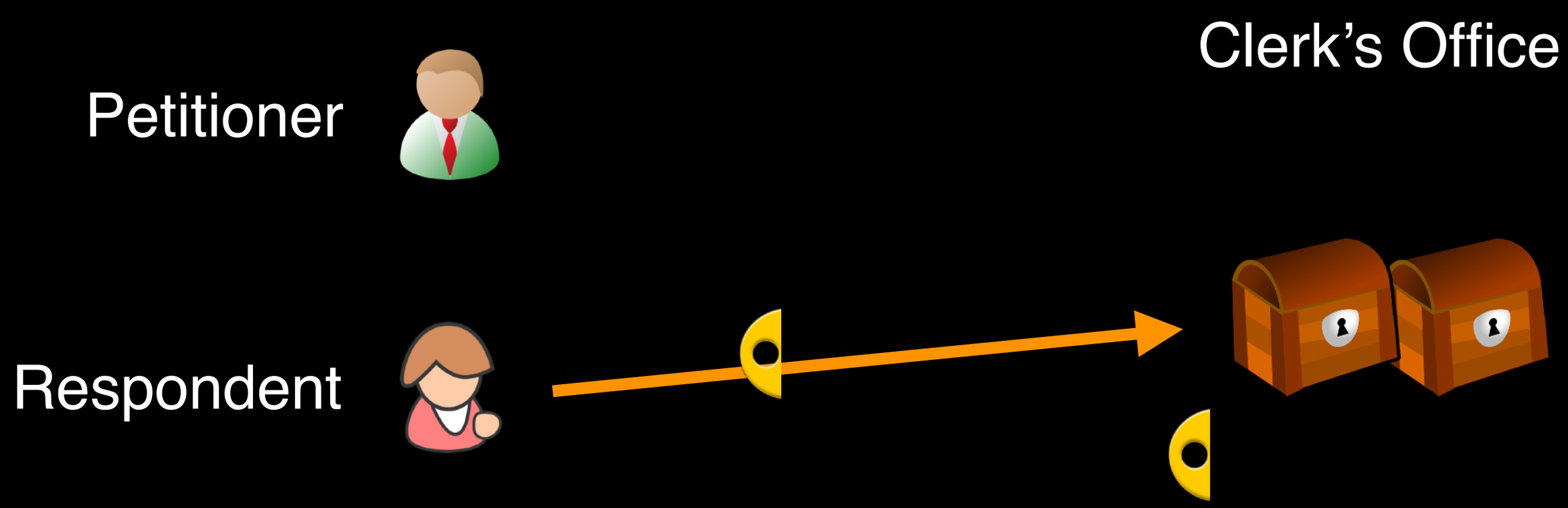

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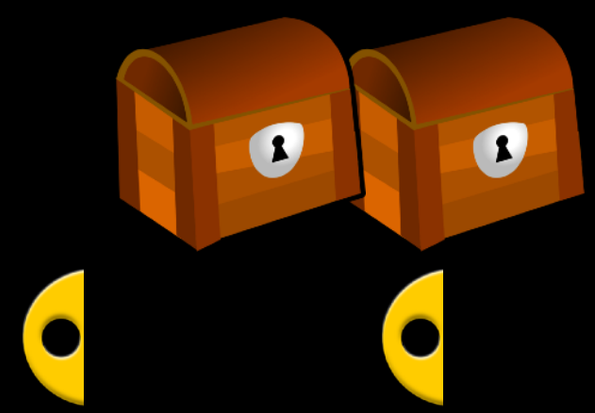

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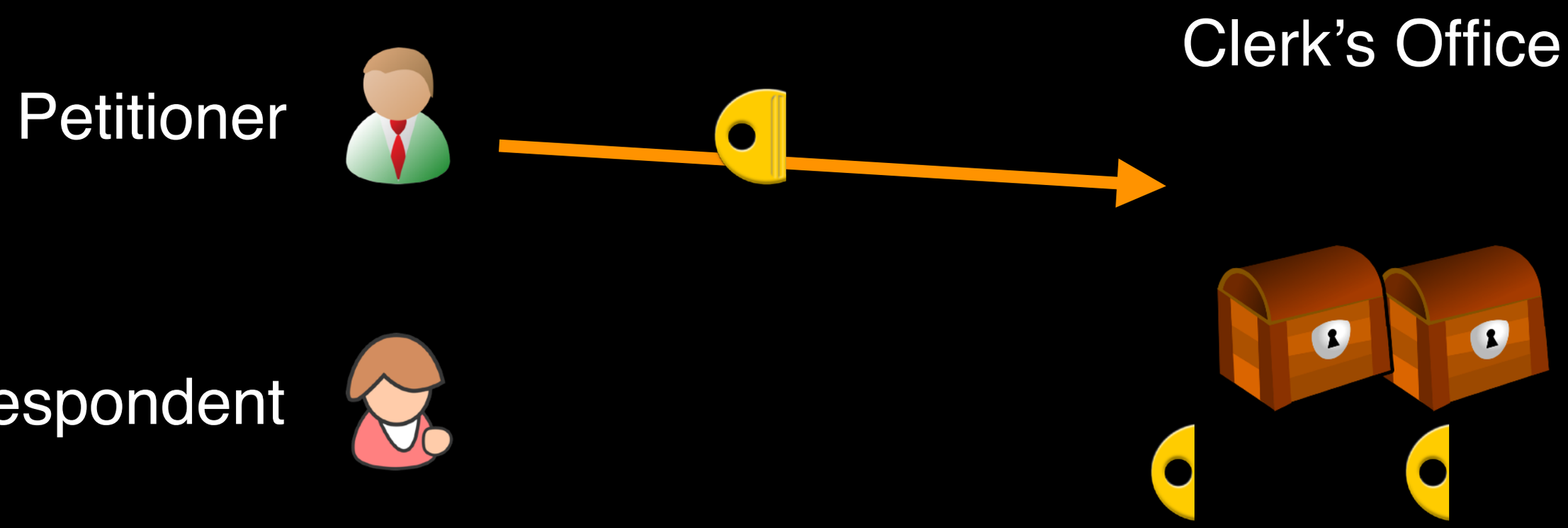

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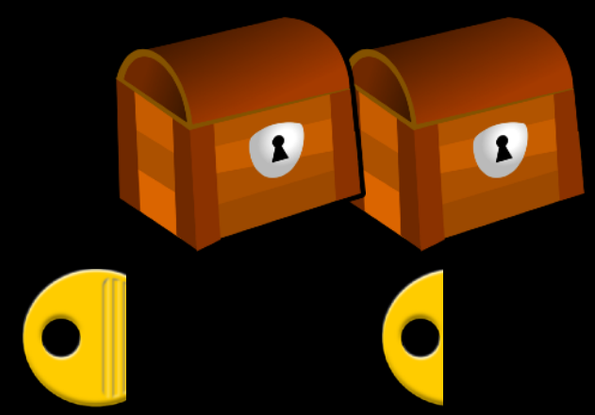

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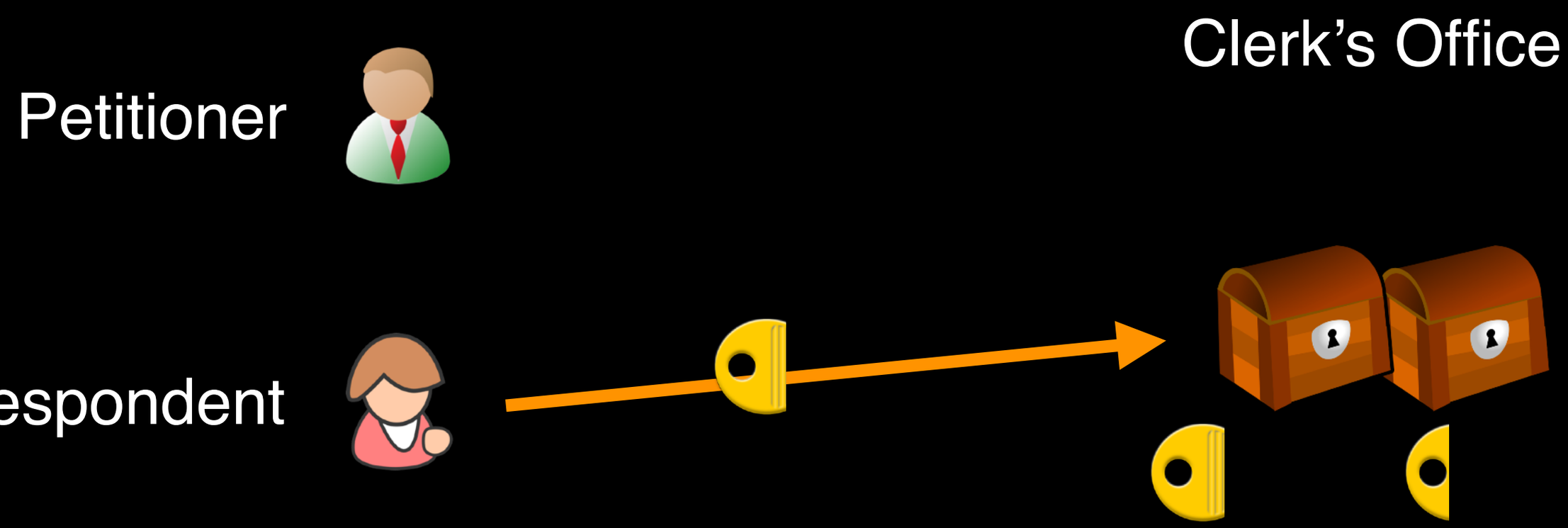

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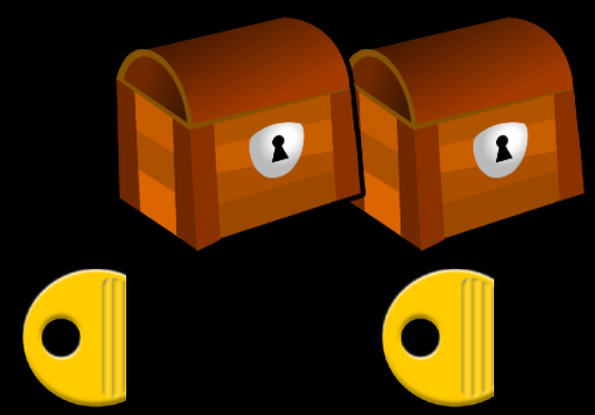
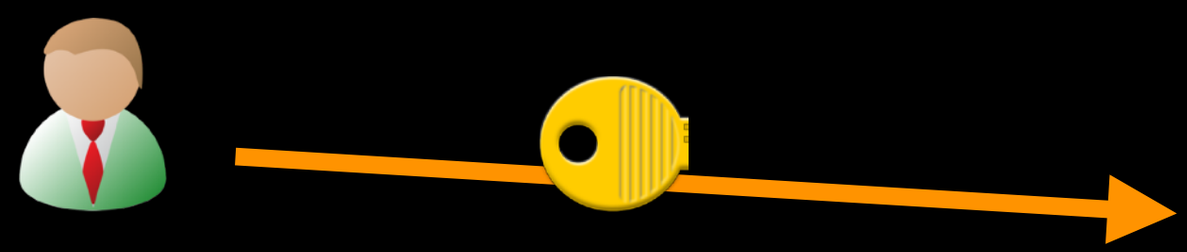


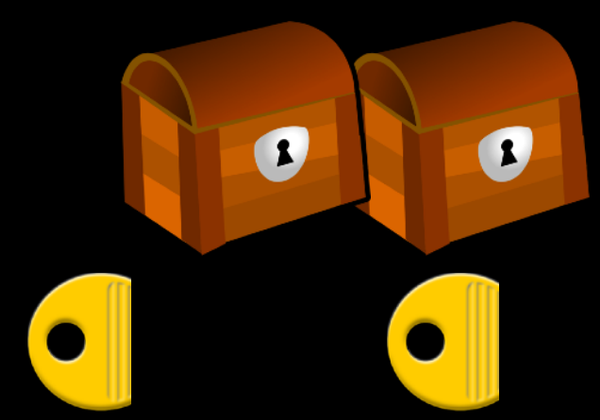
Tool 2: Fair Exchange

Clerk's Office

Petitioner



Respondent



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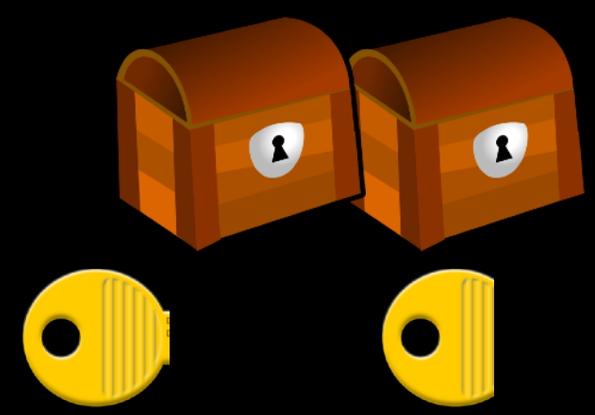

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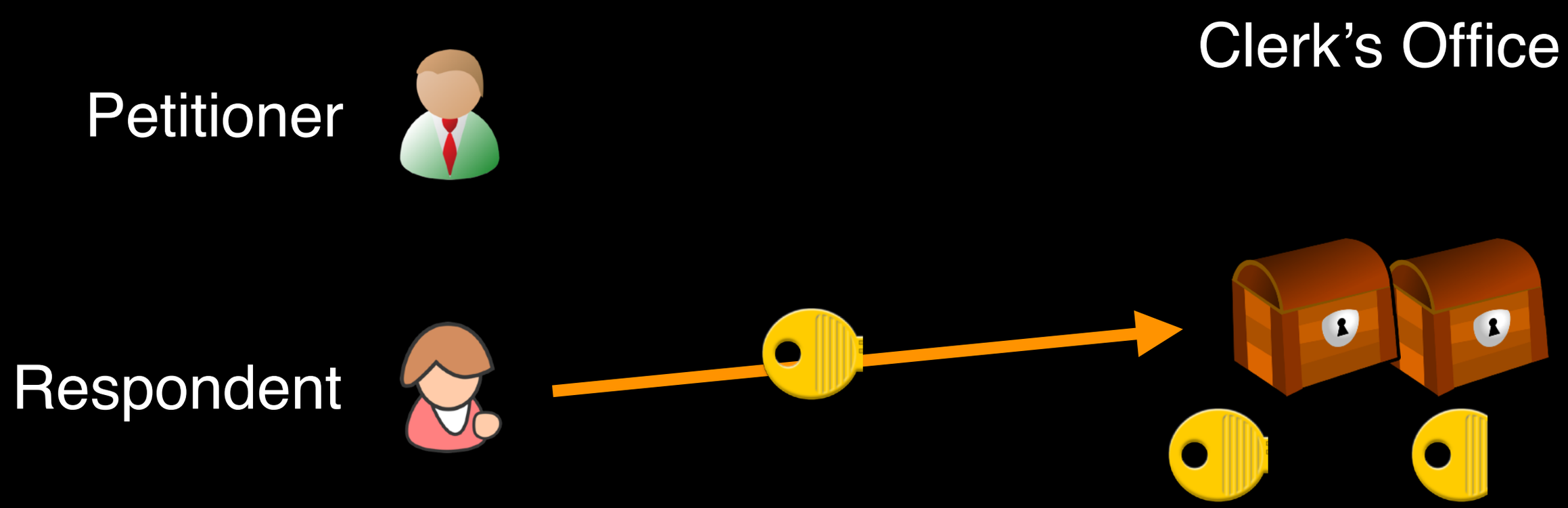

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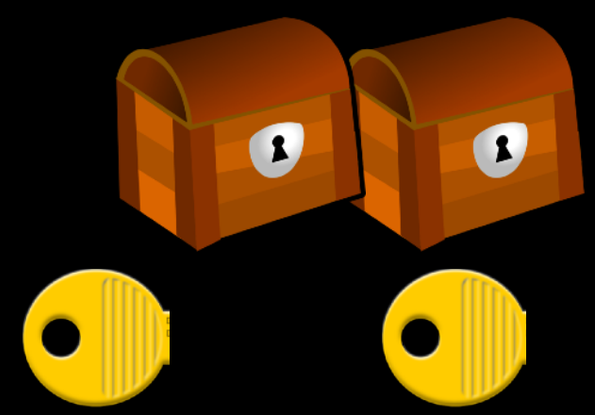

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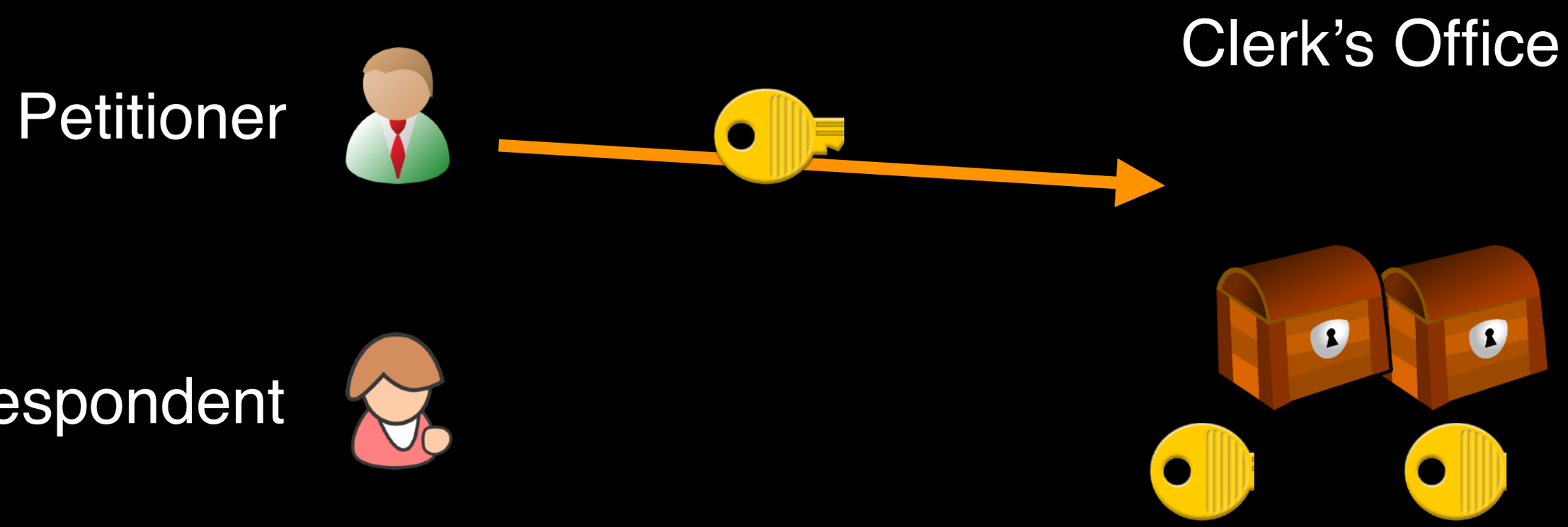

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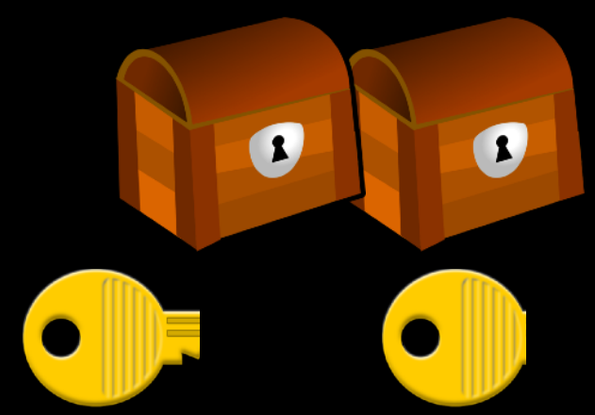

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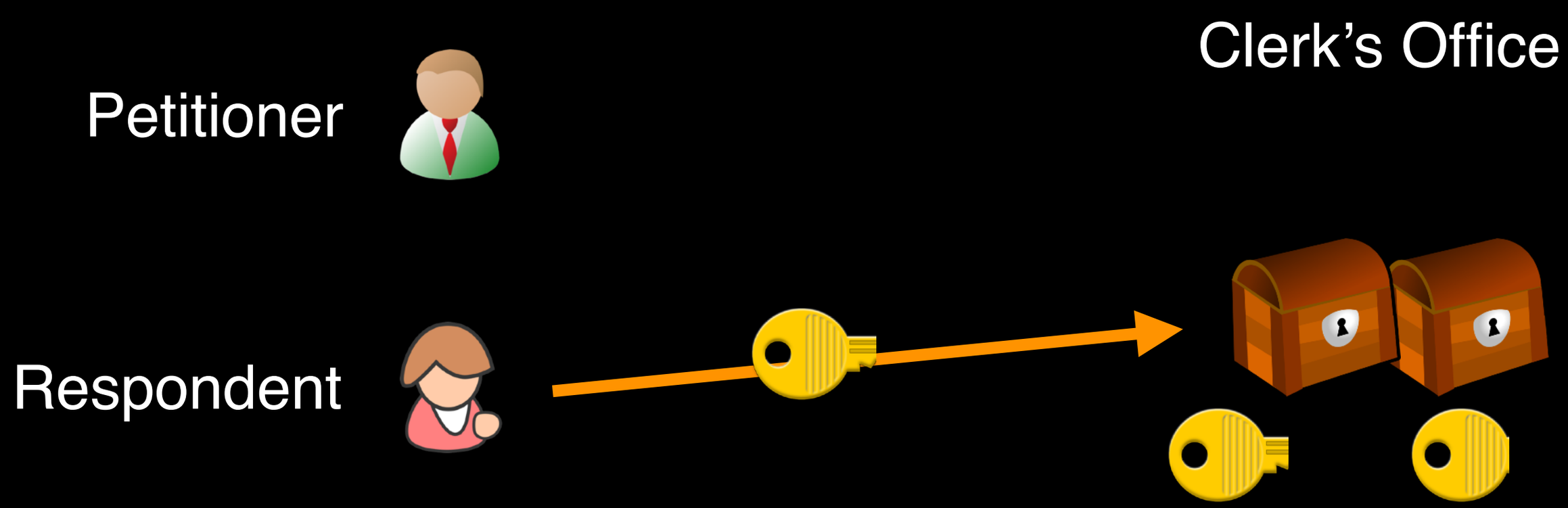

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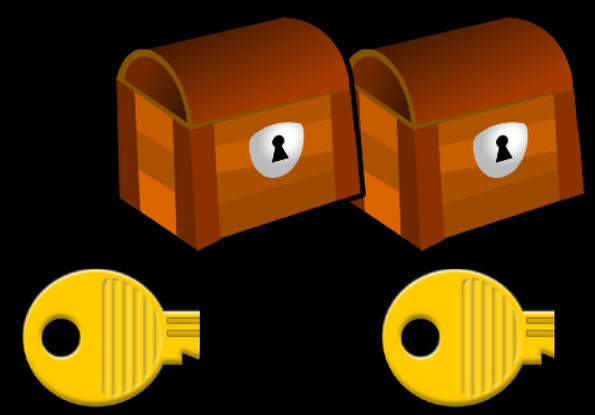

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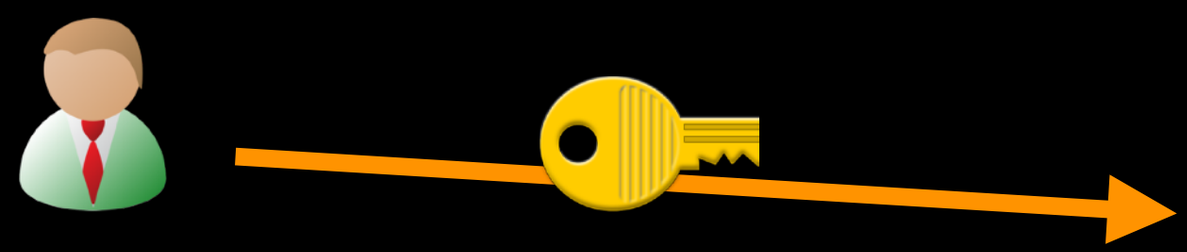

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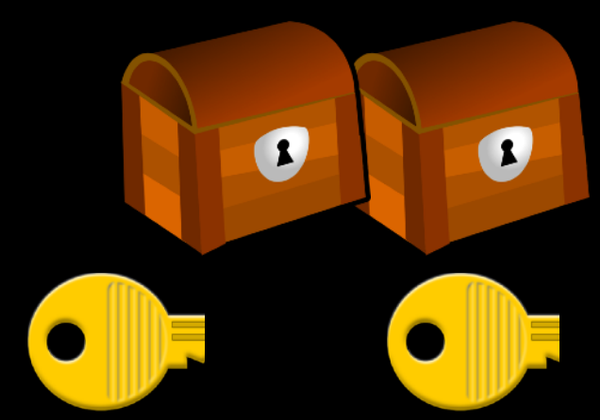

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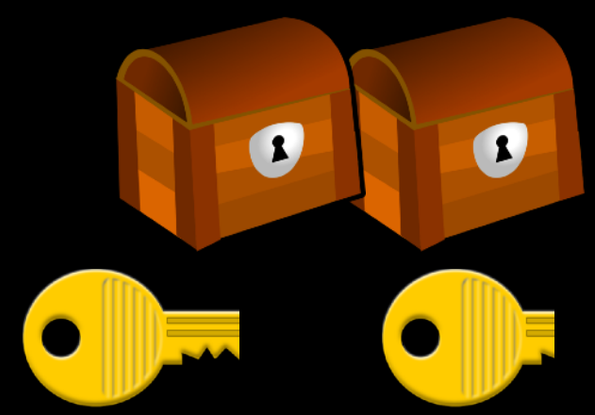

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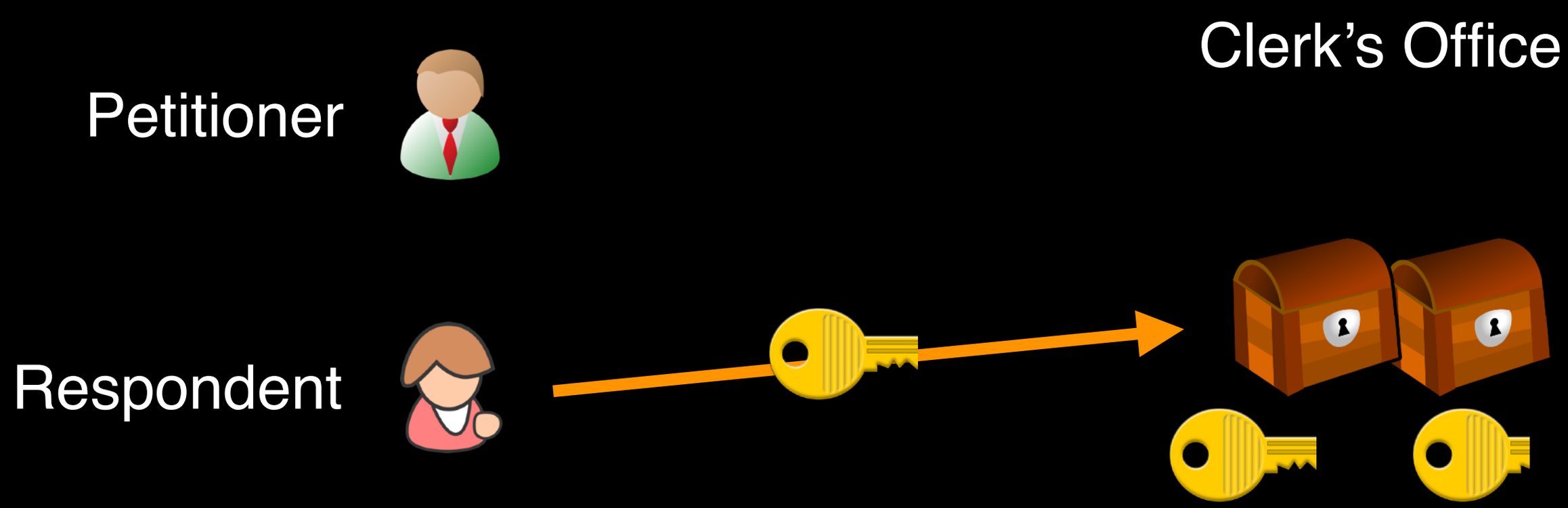

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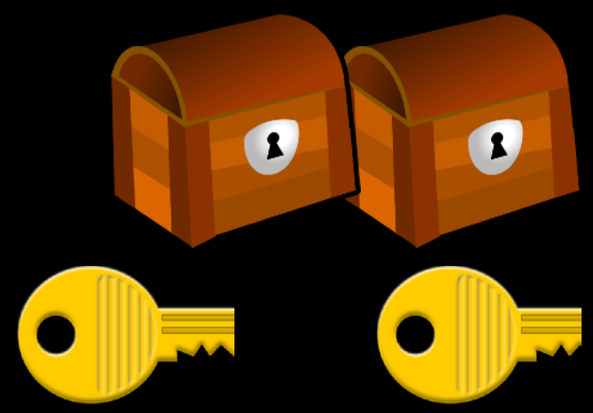

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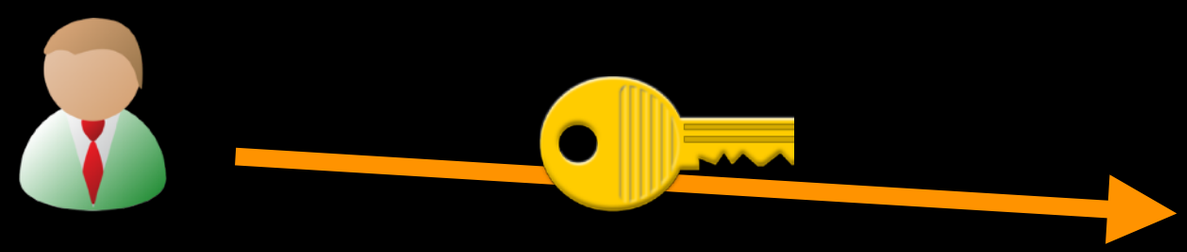

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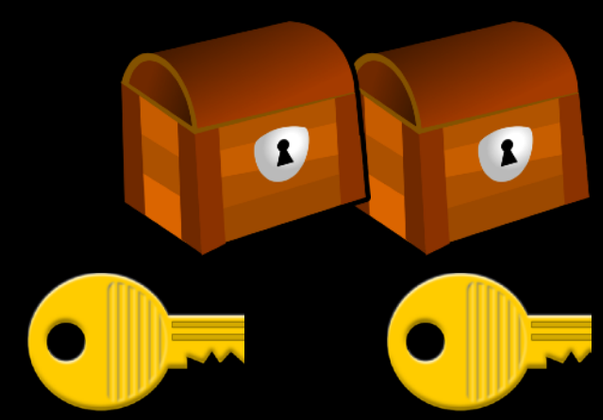

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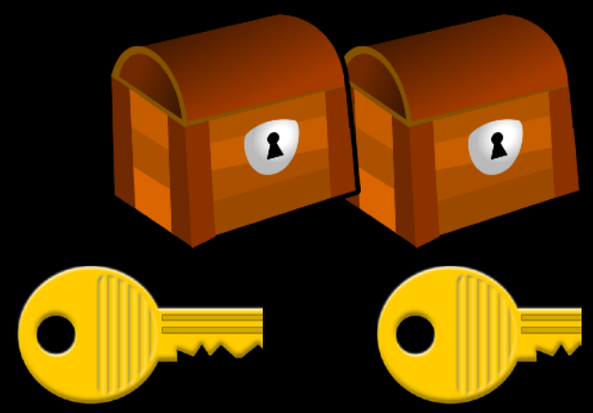

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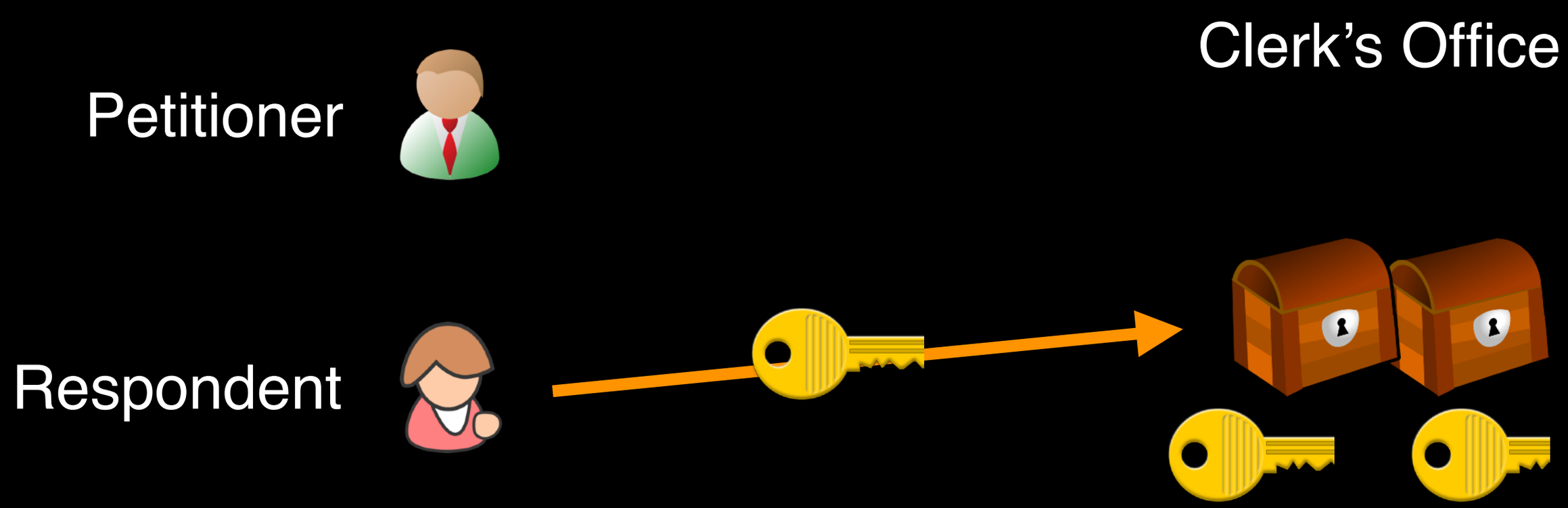

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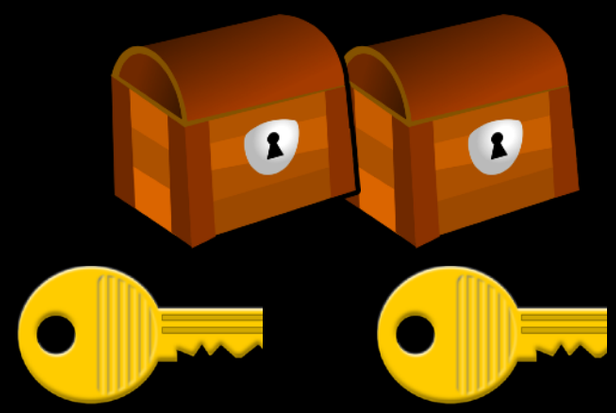

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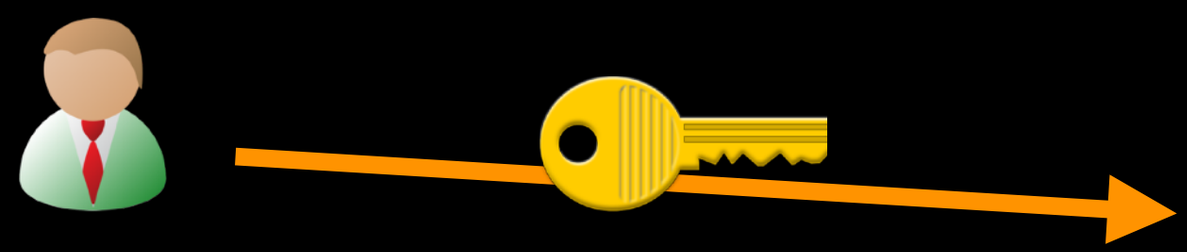

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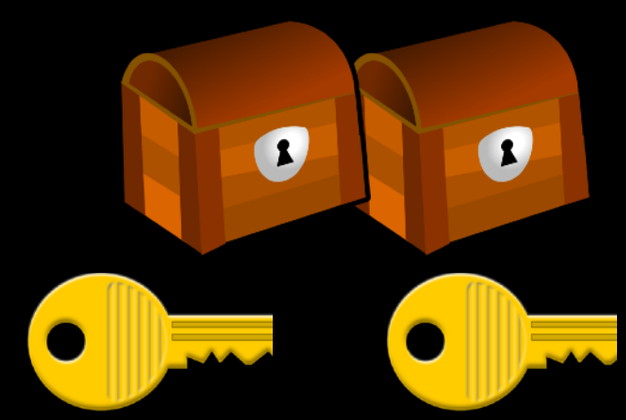

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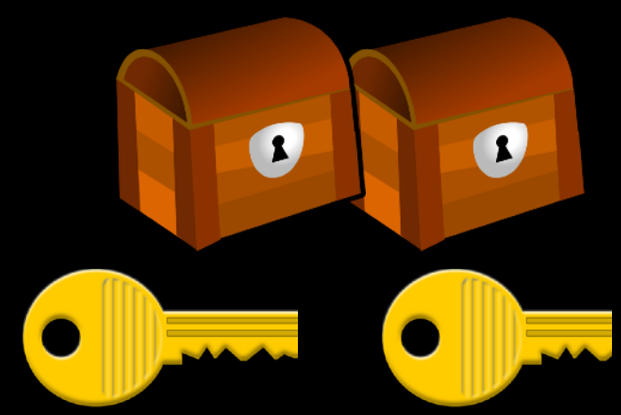

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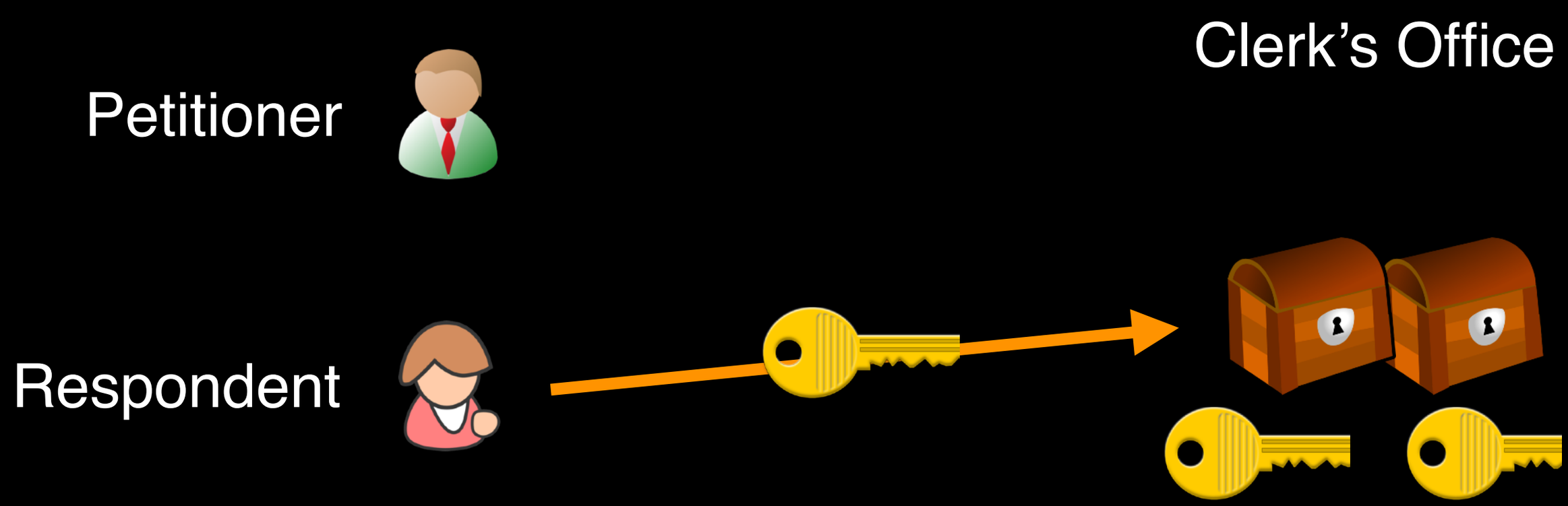

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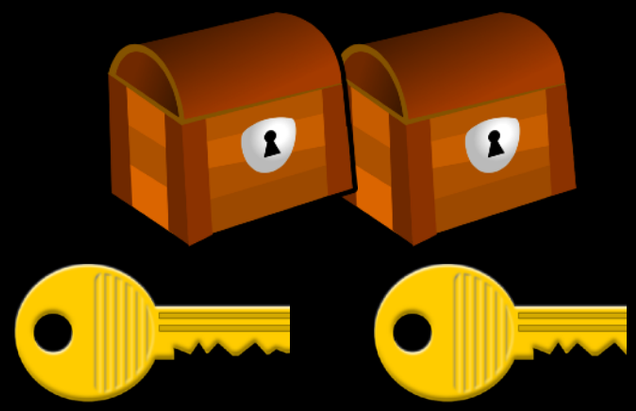

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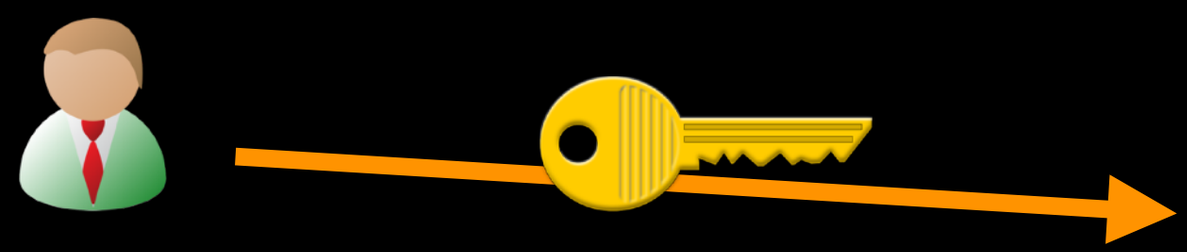

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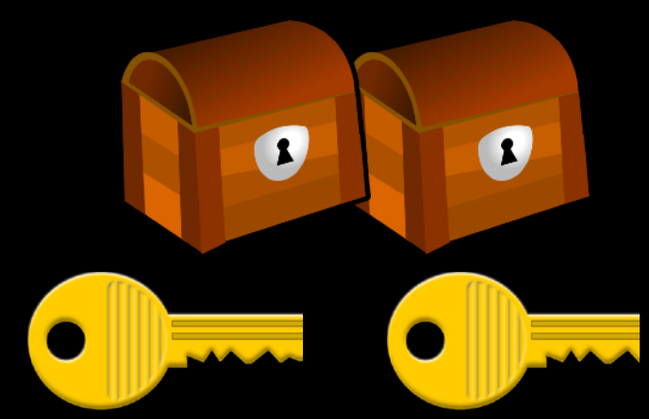

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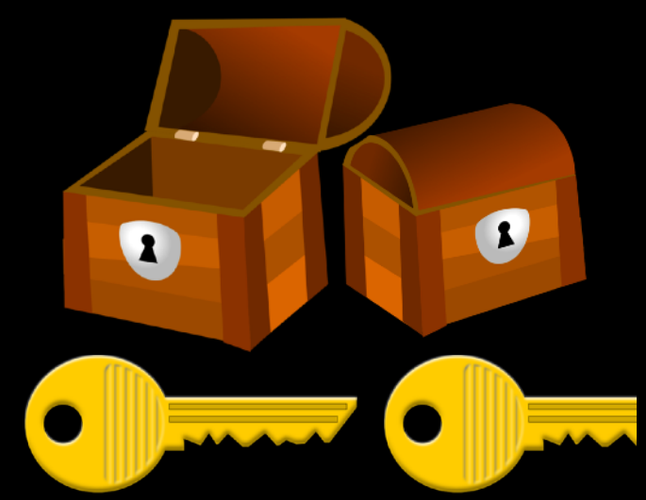

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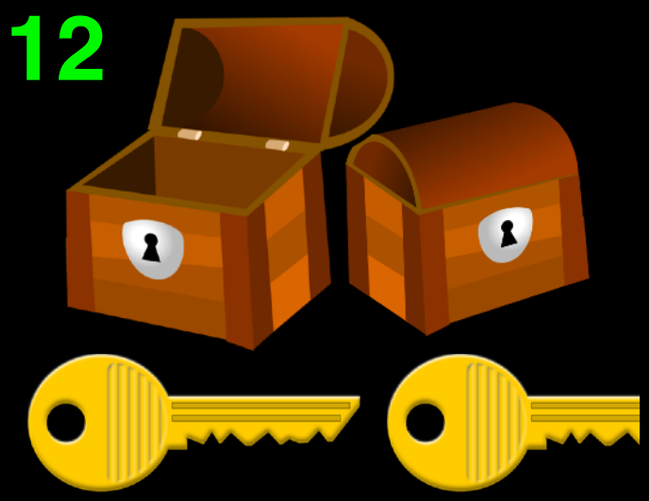
12



Respondent

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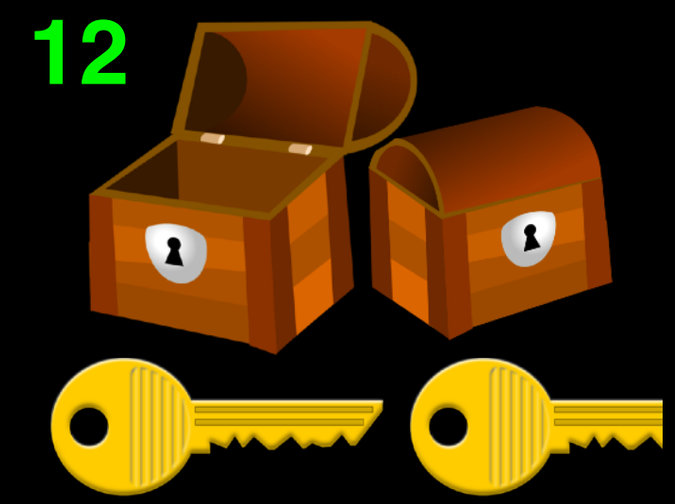
I lost my key!

Let's start over.

Respondent



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Petitioner 

Respondent 

12

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12

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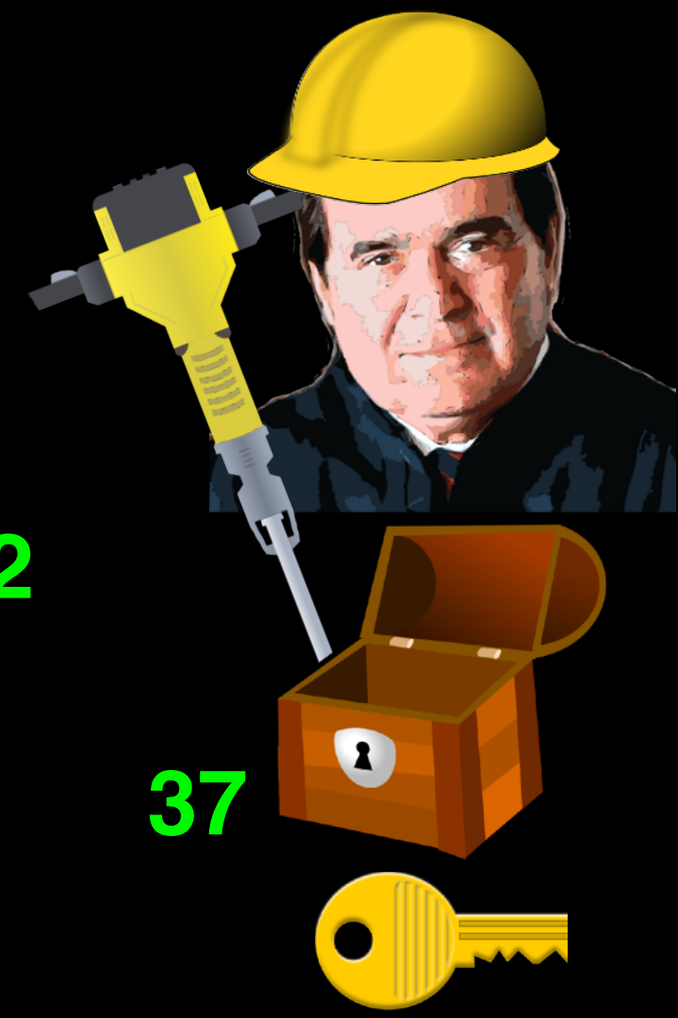

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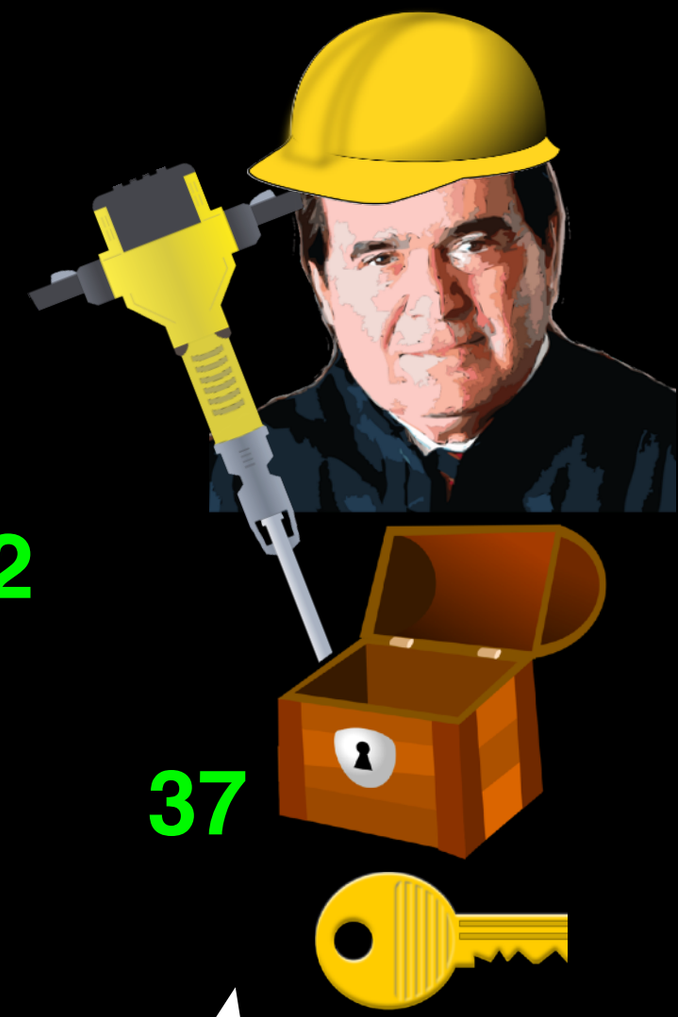

You get panel number
12 + 37 = **49**.

Three Cryptographic Ideas

1. Coin-Flipping Protocols
2. **Fair Exchange**
3. Randomness Beacons

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Tool 3: Randomness Beacon

[Rabin 1983]

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- Using a public randomness source allows <u>anyone</u> to verify the correct use of randomness.

Three Cryptographic Ideas

1. Coin-Flipping Protocols
2. Fair Exchange
3. Randomness Beacons

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Maybe not…

– The software that runs our government is rarely open to public scrutiny.
– There is an incentive problem: codifying procedures removes flexibility.
  See: Kroll et al. *Accountable Algorithms*. 165 U. Pa. L. Rev. (2017).

Conclusions

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The legal system, like everything else, is increasingly computerized.

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Help out!

Do you know anyone who could help us get access to the code used to generate panel assignments in the Courts of Appeals? Email us!

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