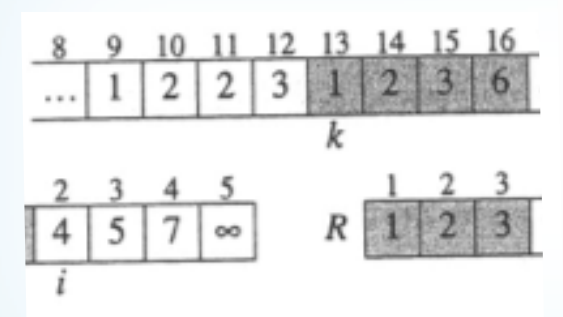




Algorithmen und Datenstrukturen
WS 2025/26

1

Donald Knuth



Knuth in 2005

Born

Donald Ervin Knuth

January 10, 1938 (age 88)

Milwaukee, Wisconsin, U.S.



Donald Knuth



Knuth in 2005

Born

Donald Ervin Knuth
January 10, 1938 (age 88)
[Milwaukee, Wisconsin, U.S.](#)

THE CLASSIC WORK
NEWLY UPDATED AND REVISED

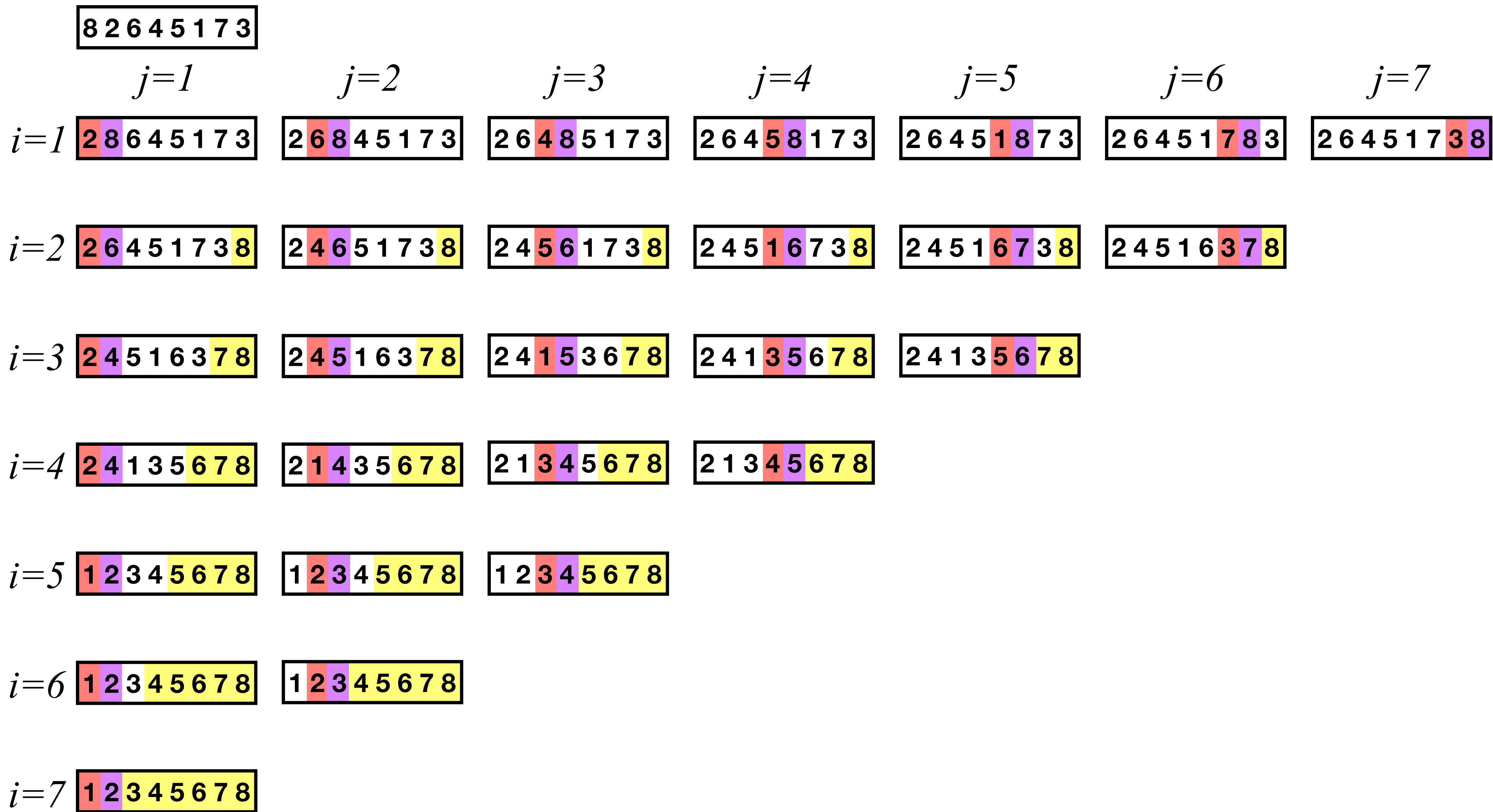
The Art of Computer Programming

VOLUME 3

Sorting and Searching
Second Edition

DONALD E. KNUTH

Bubblesort





Selectionsort

8 2 6 4 5 1 7 3

$j=2$

$j=3$

$j=4$

$j=5$

$j=6$

$j=7$

$j=8$

$i=1$

8 2 6 4 5 1 7 3

8 2 6 4 5 1 7 3

8 2 6 4 5 1 7 3

8 2 6 4 5 1 7 3

8 2 6 4 5 1 7 3

8 2 6 4 5 1 7 3

3 2 6 4 5 1 7 8

$i=2$

3 2 6 4 5 1 7 8

3 2 6 4 5 1 7 8

3 2 6 4 5 1 7 8

3 2 6 4 5 1 7 8

3 2 6 4 5 1 7 8

3 2 6 4 5 1 7 8

$i=3$

3 2 6 4 5 1 7 8

3 2 6 4 5 1 7 8

3 2 6 4 5 1 7 8

3 2 6 4 5 1 7 8

3 2 1 4 5 6 7 8

$i=4$

3 2 1 4 5 6 7 8

3 2 1 4 5 6 7 8

3 2 1 4 5 6 7 8

3 2 1 4 5 6 7 8

$i=5$

3 2 1 4 5 6 7 8

3 2 1 4 5 6 7 8

3 2 1 4 5 6 7 8

$i=6$

3 2 1 4 5 6 7 8

1 2 3 4 5 6 7 8

$i=7$

1 2 3 4 5 6 7 8

Insertionsort

8 2 6 4 5 1 7 3

$i=2$

8 2 6 4 5 1 7 3

2 8 6 4 5 1 7 3

$i=3$

2 8 6 4 5 1 7 3

2 6 8 4 5 1 7 3

$i=4$

2 6 8 4 5 1 7 3

2 6 4 8 5 1 7 3

2 4 6 8 5 1 7 3

$i=5$

2 6 8 4 5 1 7 3

2 4 6 5 8 1 7 3

2 4 5 6 8 1 7 3

$i=6$

2 4 5 6 8 1 7 3

2 4 5 6 1 8 7 3

2 4 5 1 6 8 7 3

2 4 1 5 6 8 7 3

2 1 4 5 6 8 7 3

1 2 4 5 6 8 7 3

$i=7$

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1 2 4 5 6 7 8 3

$i=8$

1 2 4 5 6 7 8 3

1 2 4 5 6 7 3 8

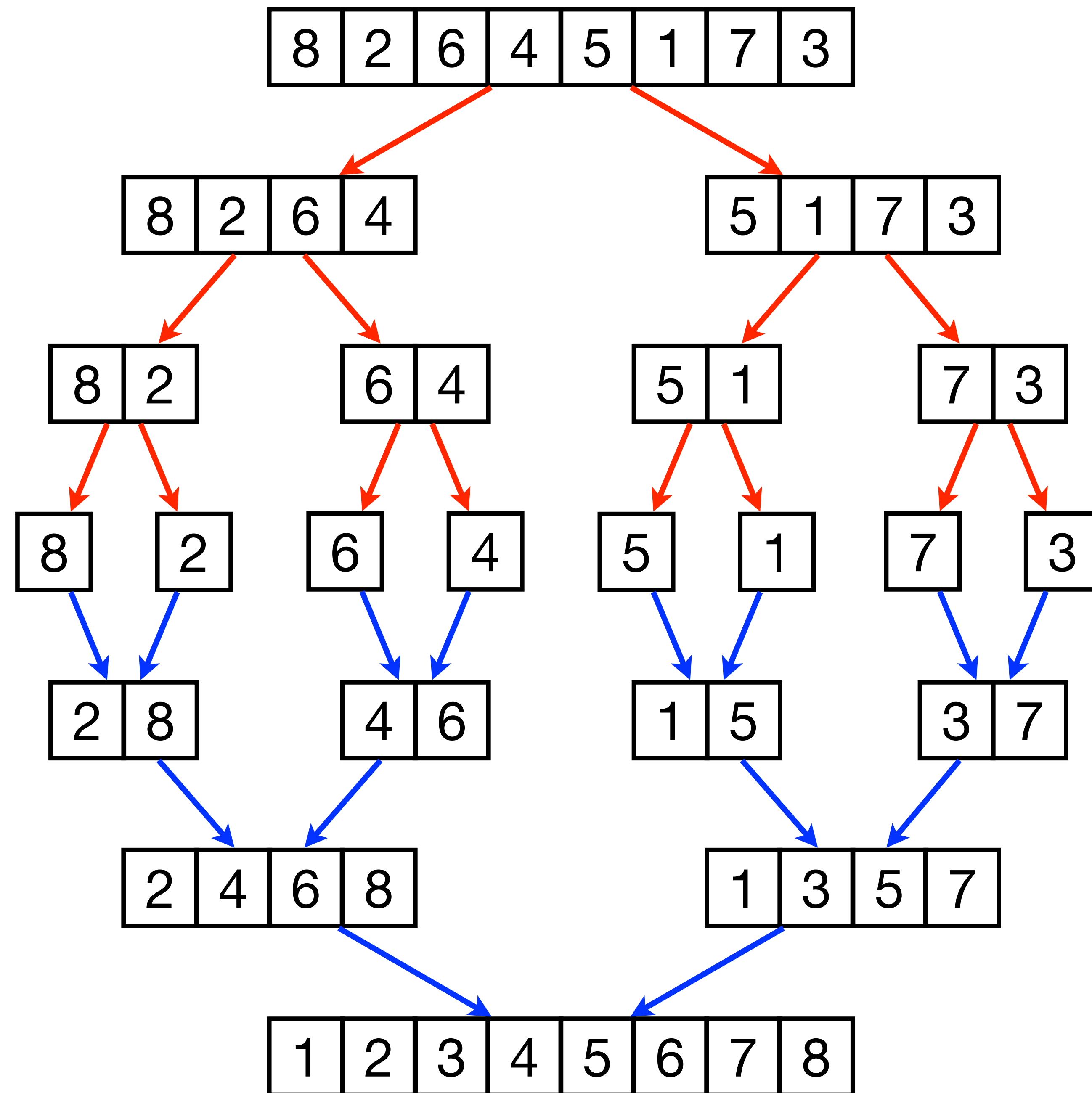
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1 2 4 5 3 6 7 8

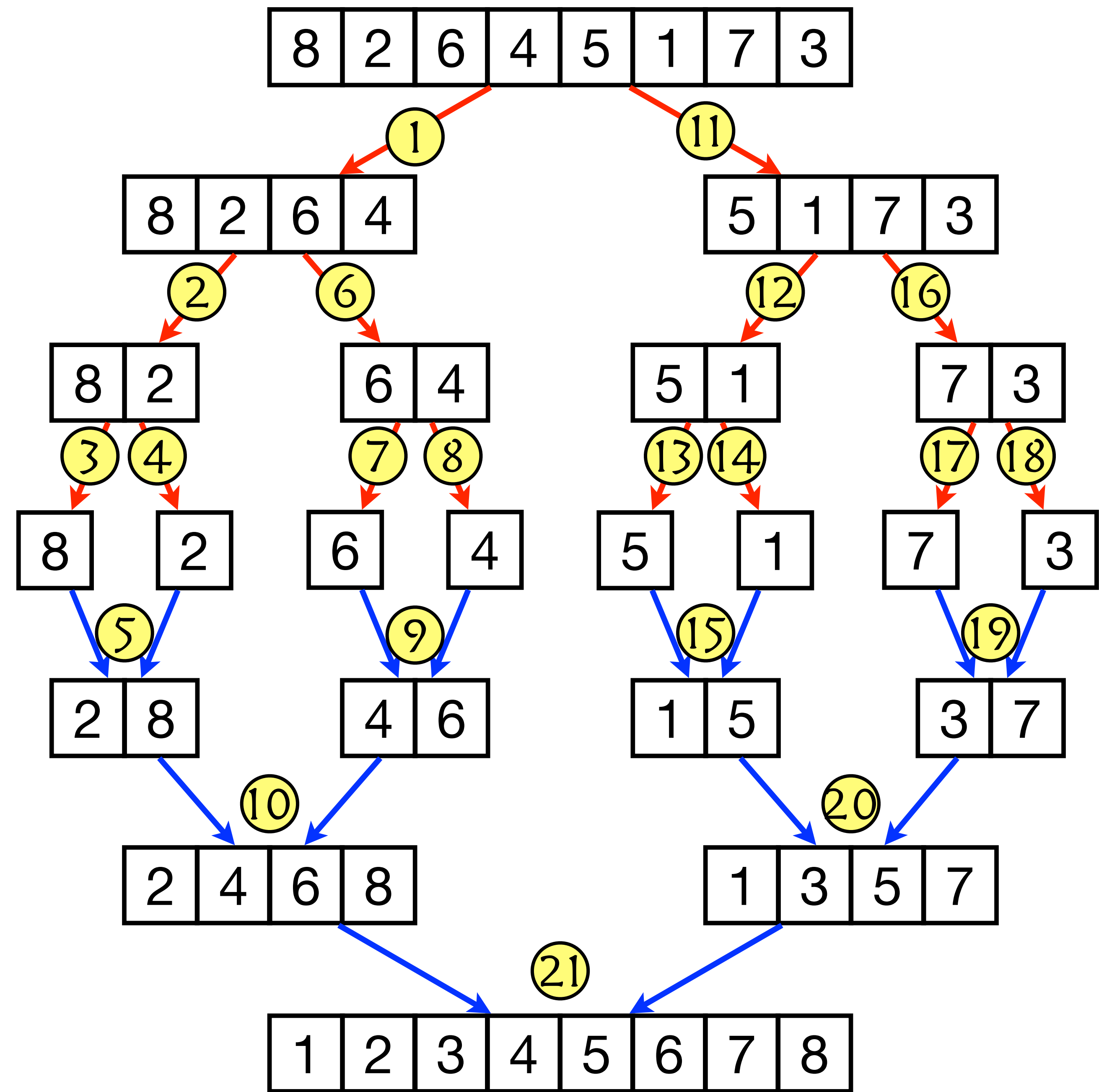
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1 2 3 4 5 6 7 8

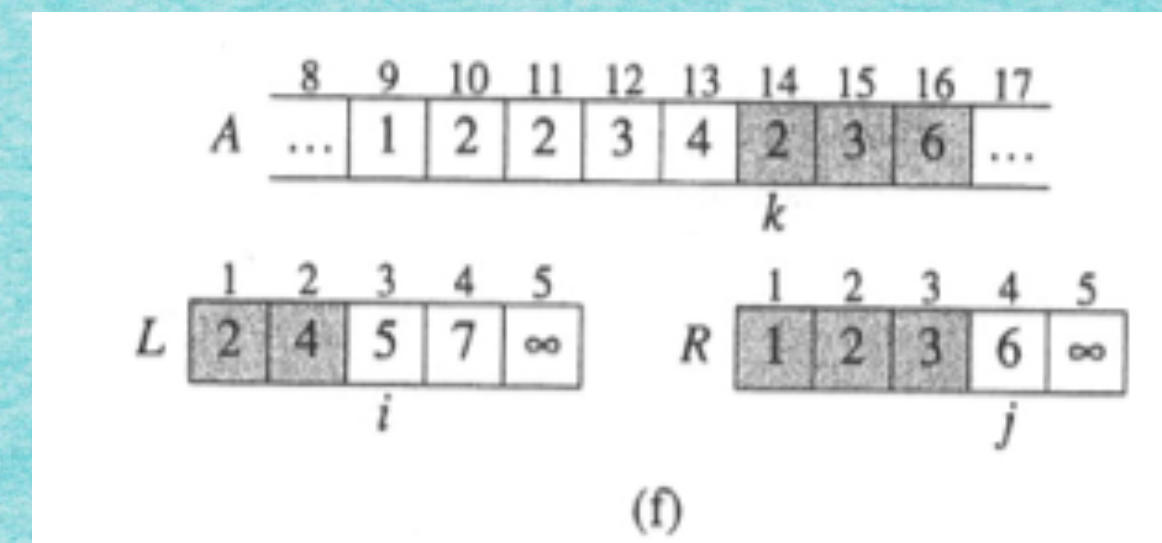
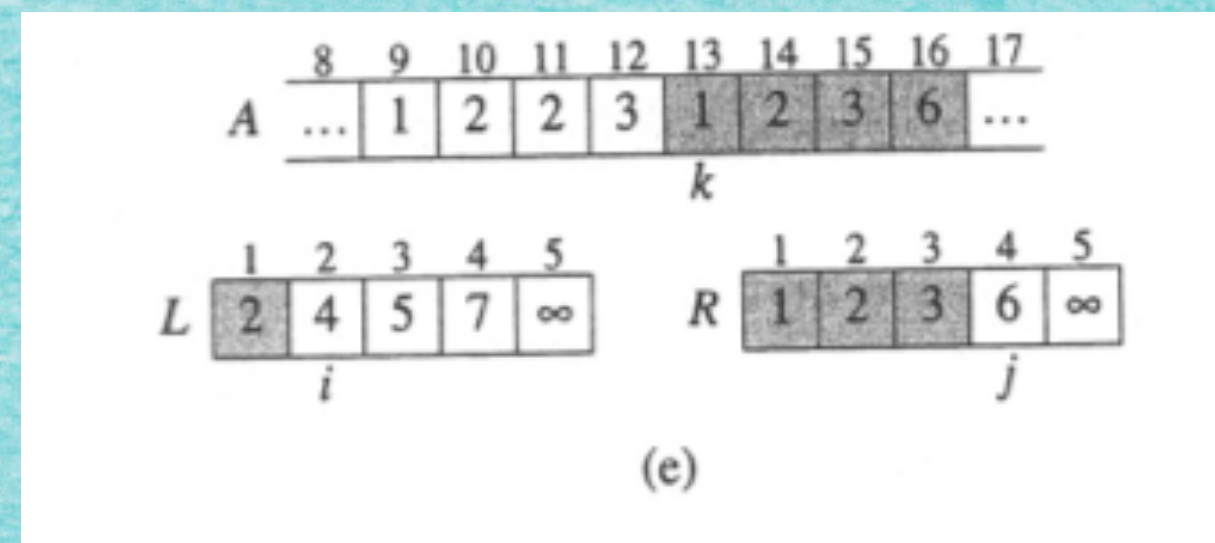
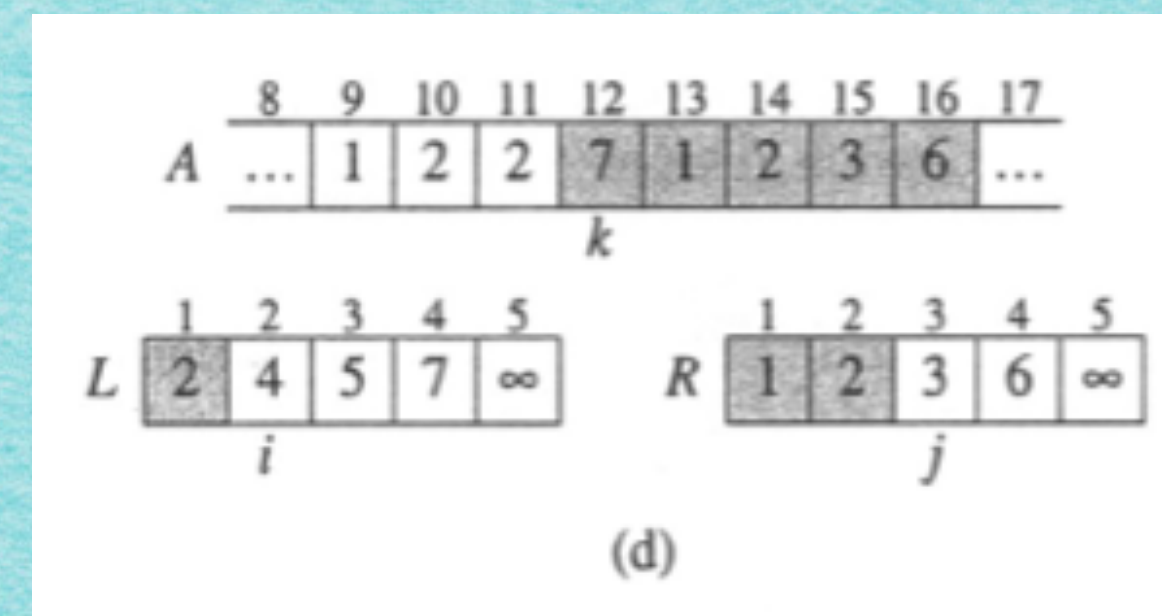
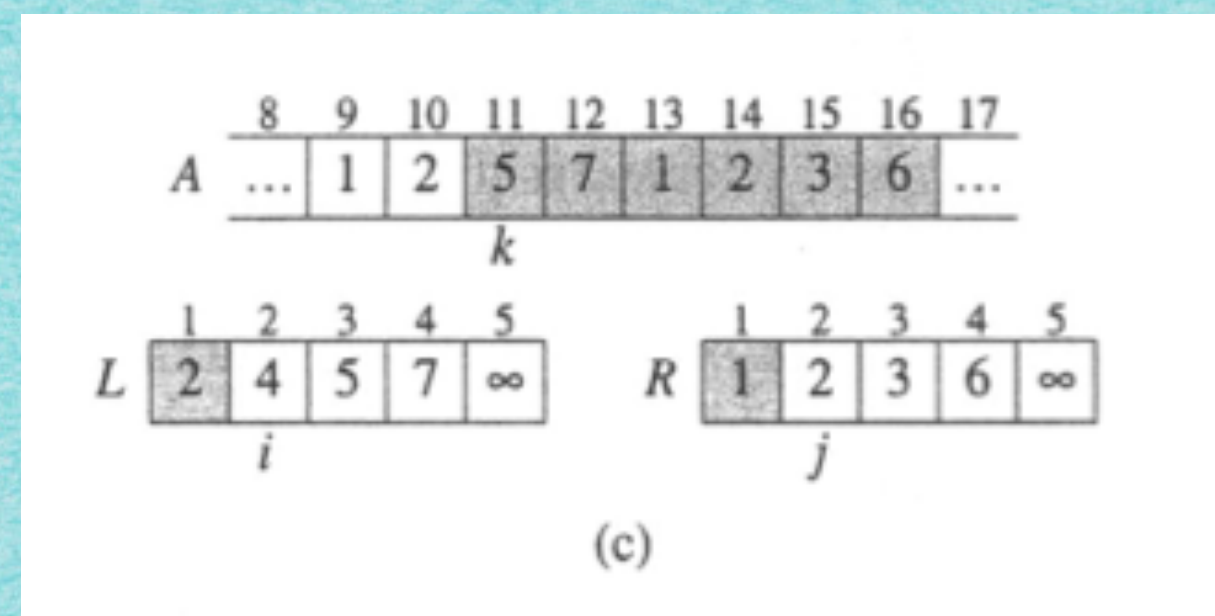
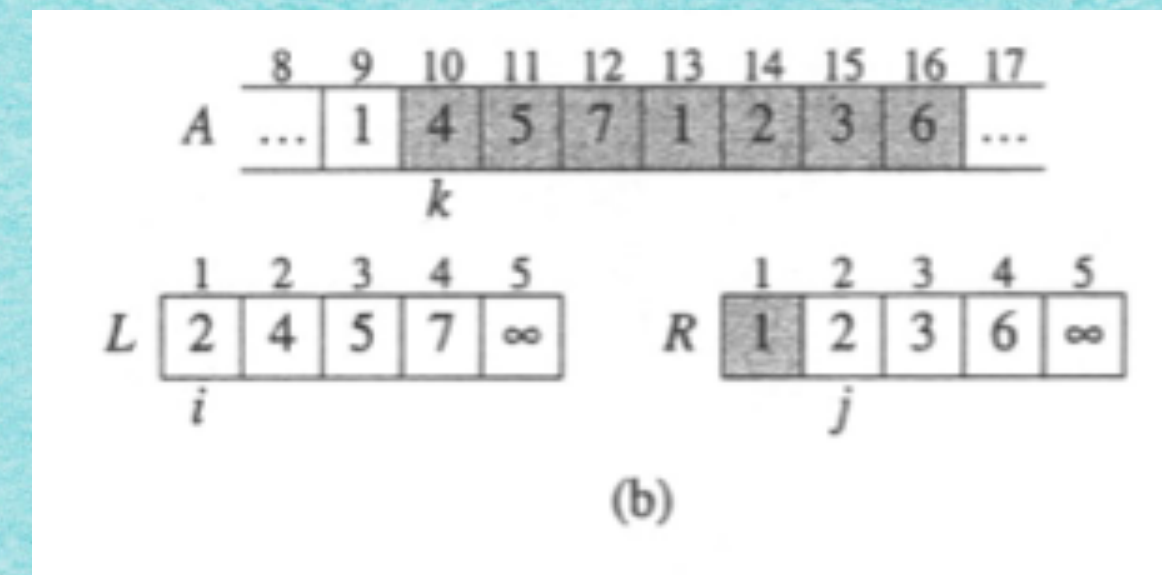
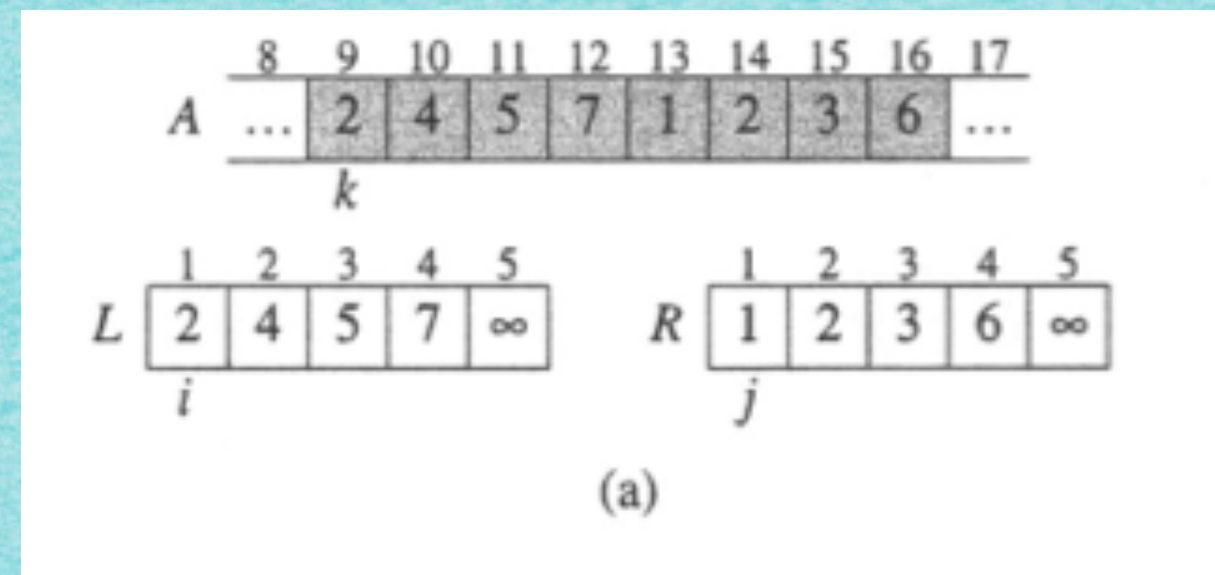
Mergesort



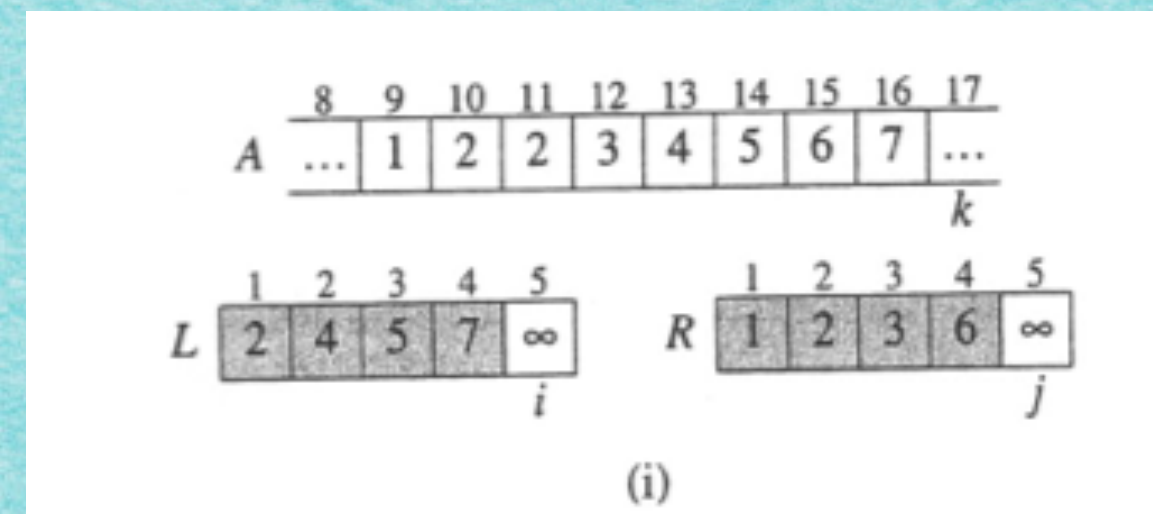
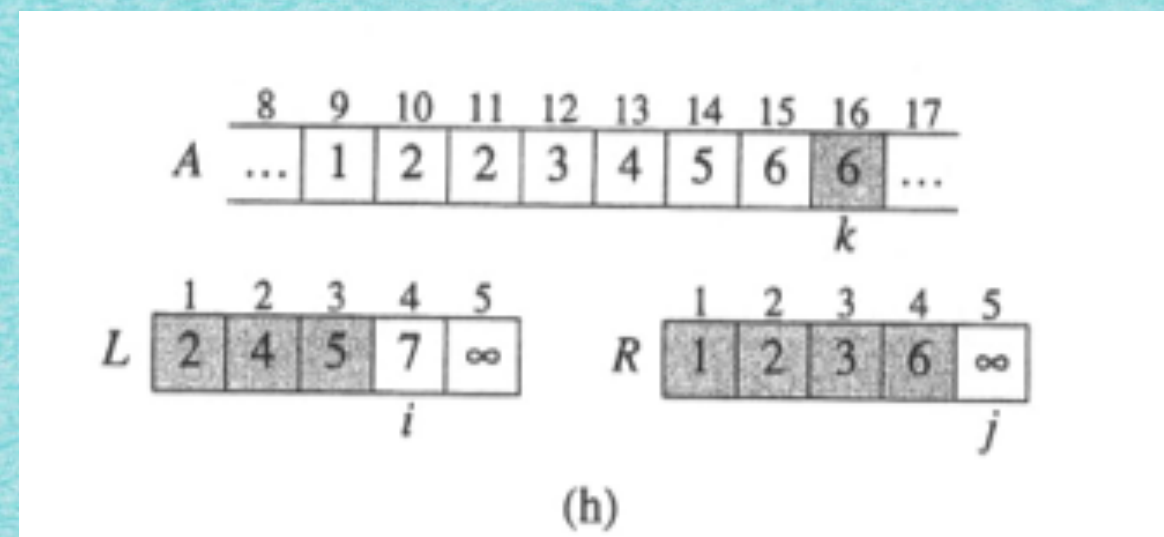
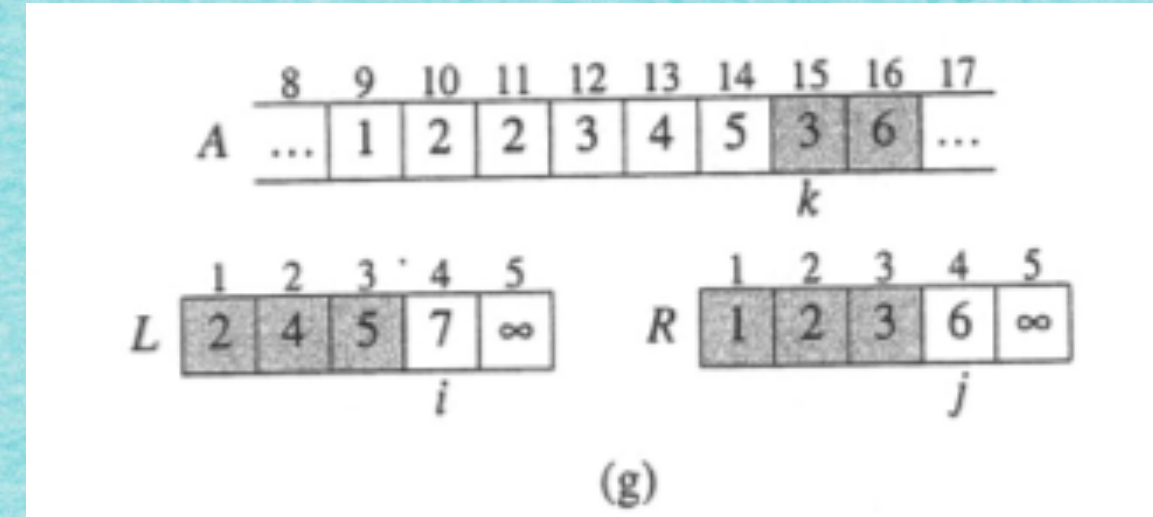
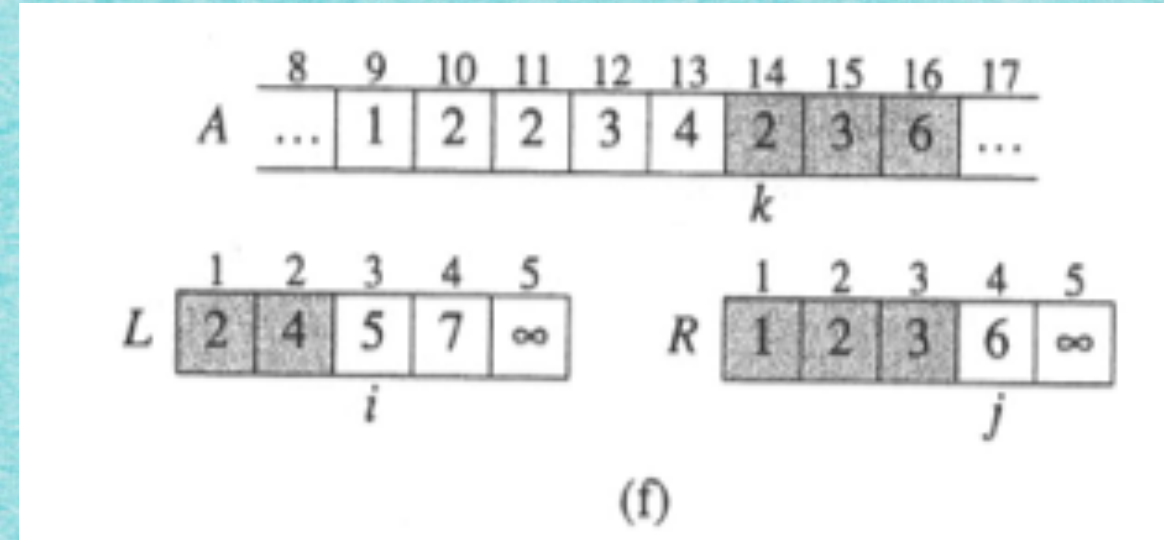

```
1  if  $p < r$ 
2      then  $q \leftarrow \lfloor (p + r) / 2 \rfloor$ 
3           MERGE-SORT( $A, p, q$ )
4           MERGE-SORT( $A, q + 1, r$ )
5           MERGE( $A, p, q, r$ )
```



5.1 Mergesort

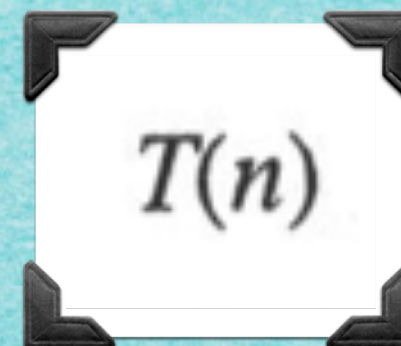


5.1 Mergesort



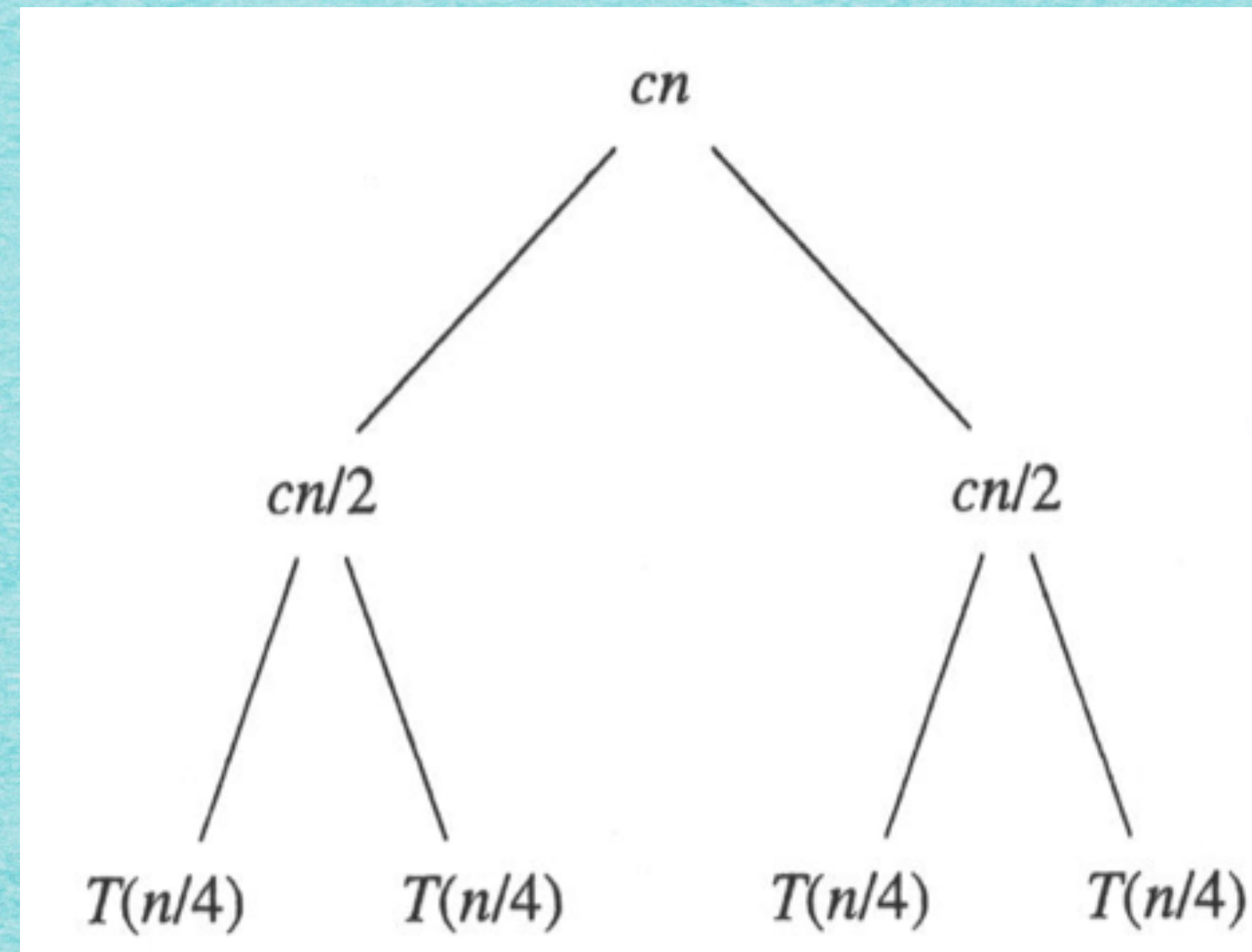
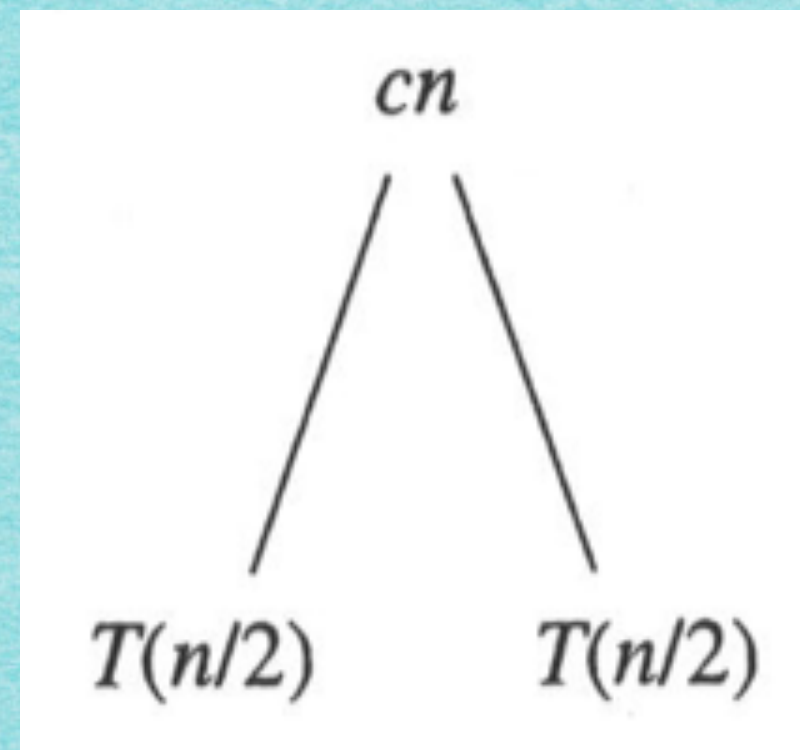
5.1.3 Laufzeit von Mergesort

Wie viele Schritte benötigt Merge-Sort für einen Array der Länge n ?

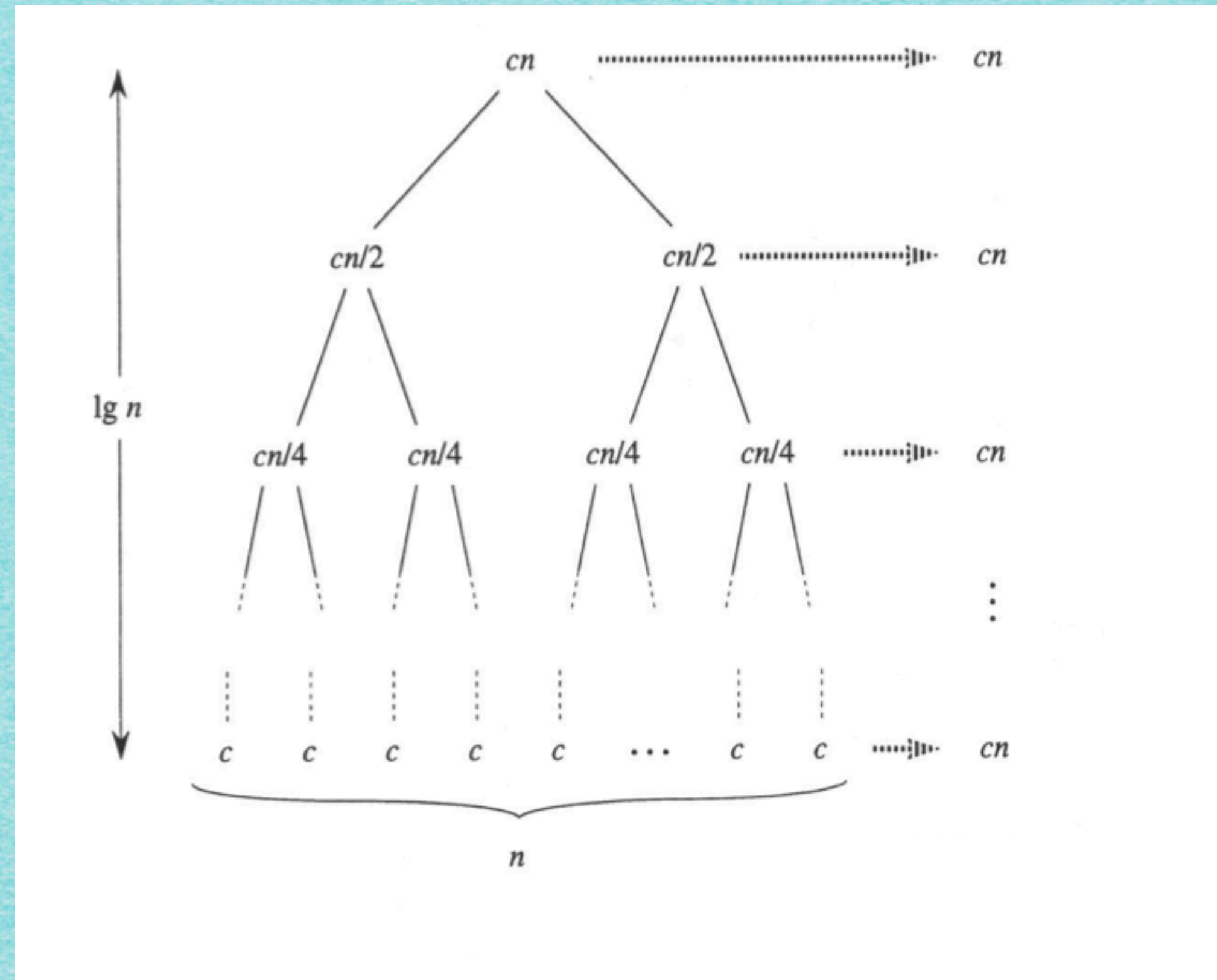
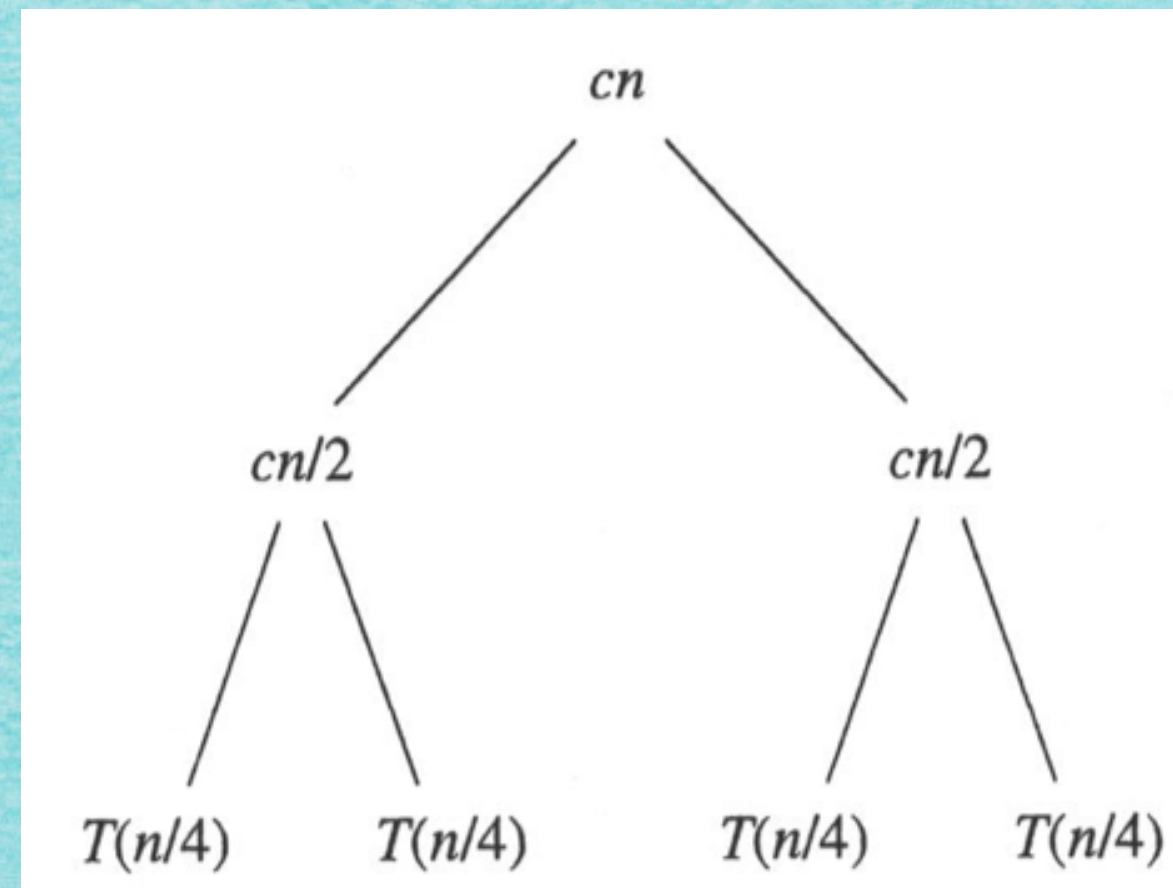

$$T(n)$$

5.1.3 Laufzeit von Mergesort

$T(n)$



5.1.3 Laufzeit von Mergesort



5.1.3 Laufzeit von Mergesort

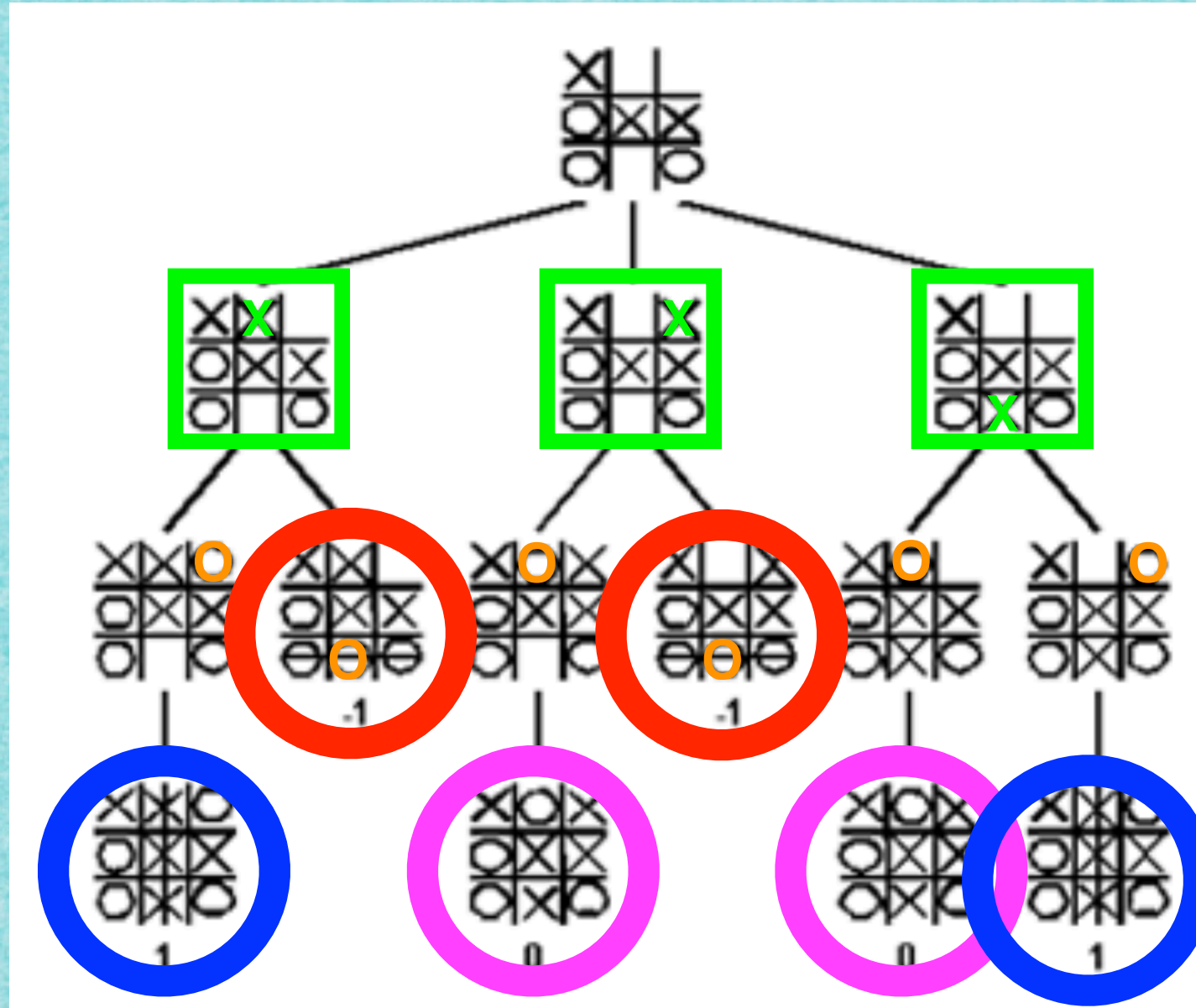
Satz 5.3 (Komplexität von Mergesort)
Für einen n -elementigen Array A hat Mergesort eine Laufzeit von $O(n \log n)$.

5.1.3 Laufzeit von Mergesort

Fragen:

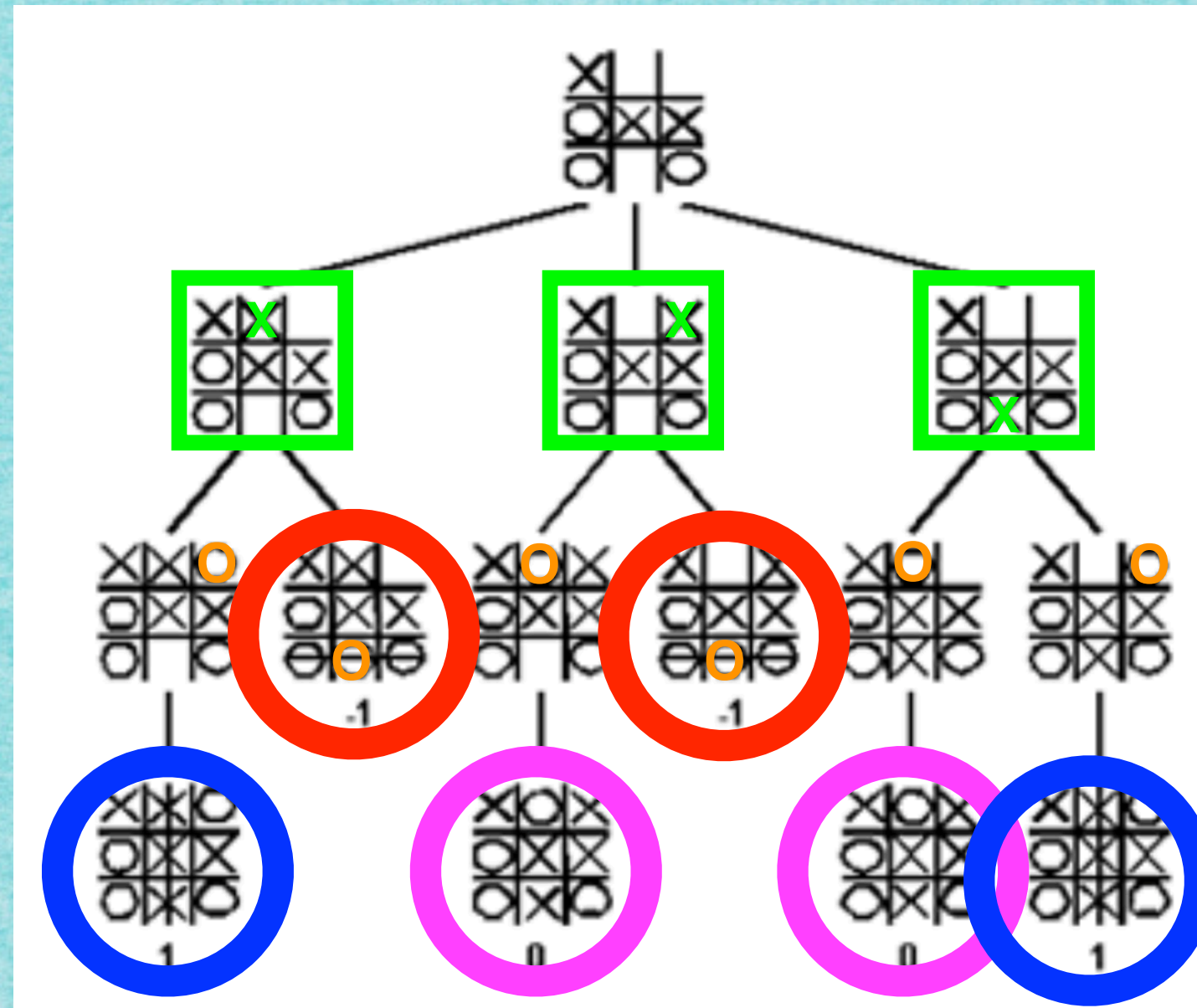
- Geht's noch schneller?
- Wie kann man sonst mit Rekursionen umgehen?

5.2 Schranken: Entscheidungsbäume

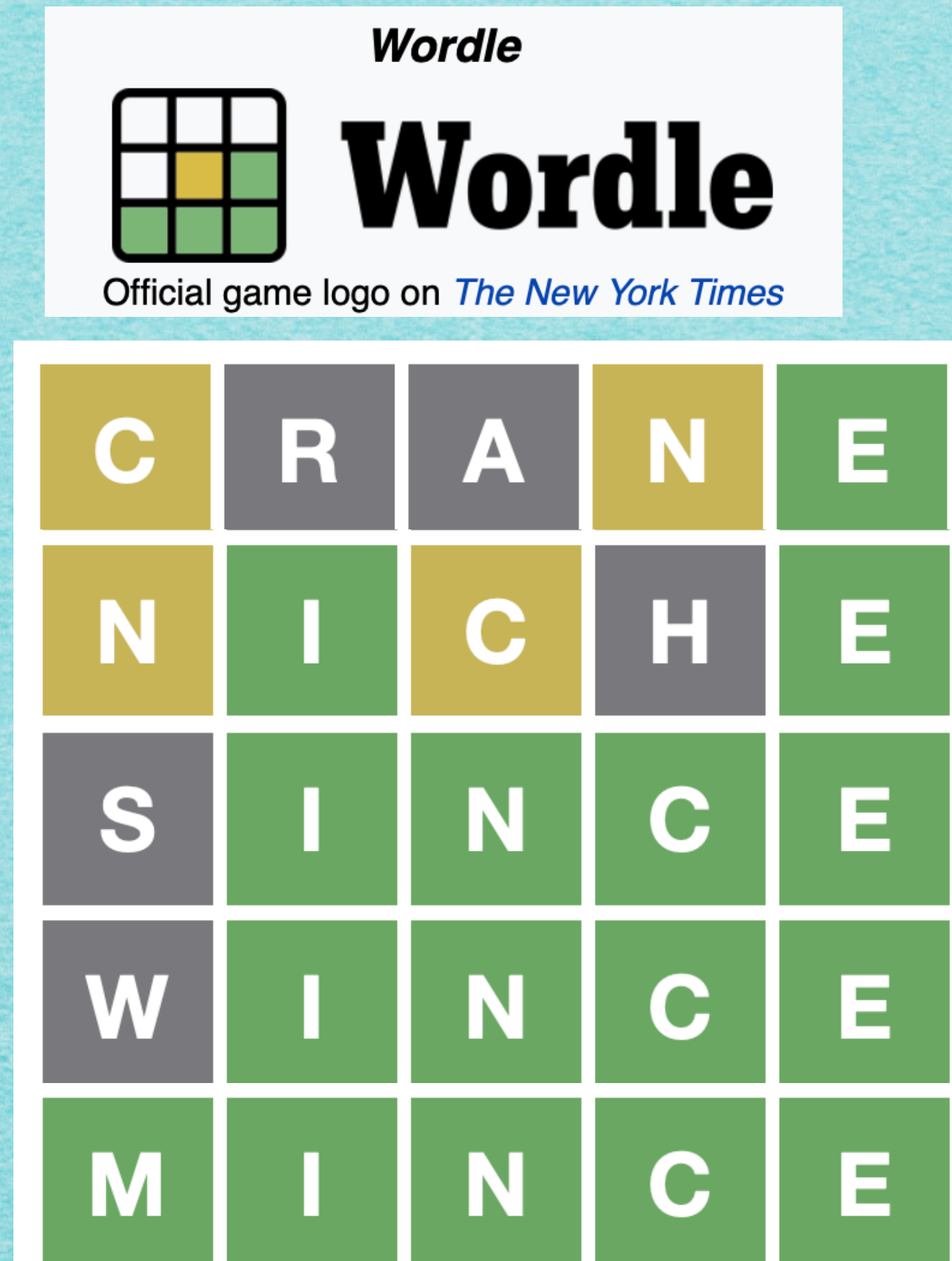


Magnus Carlsen – Photo Lennart Ootes

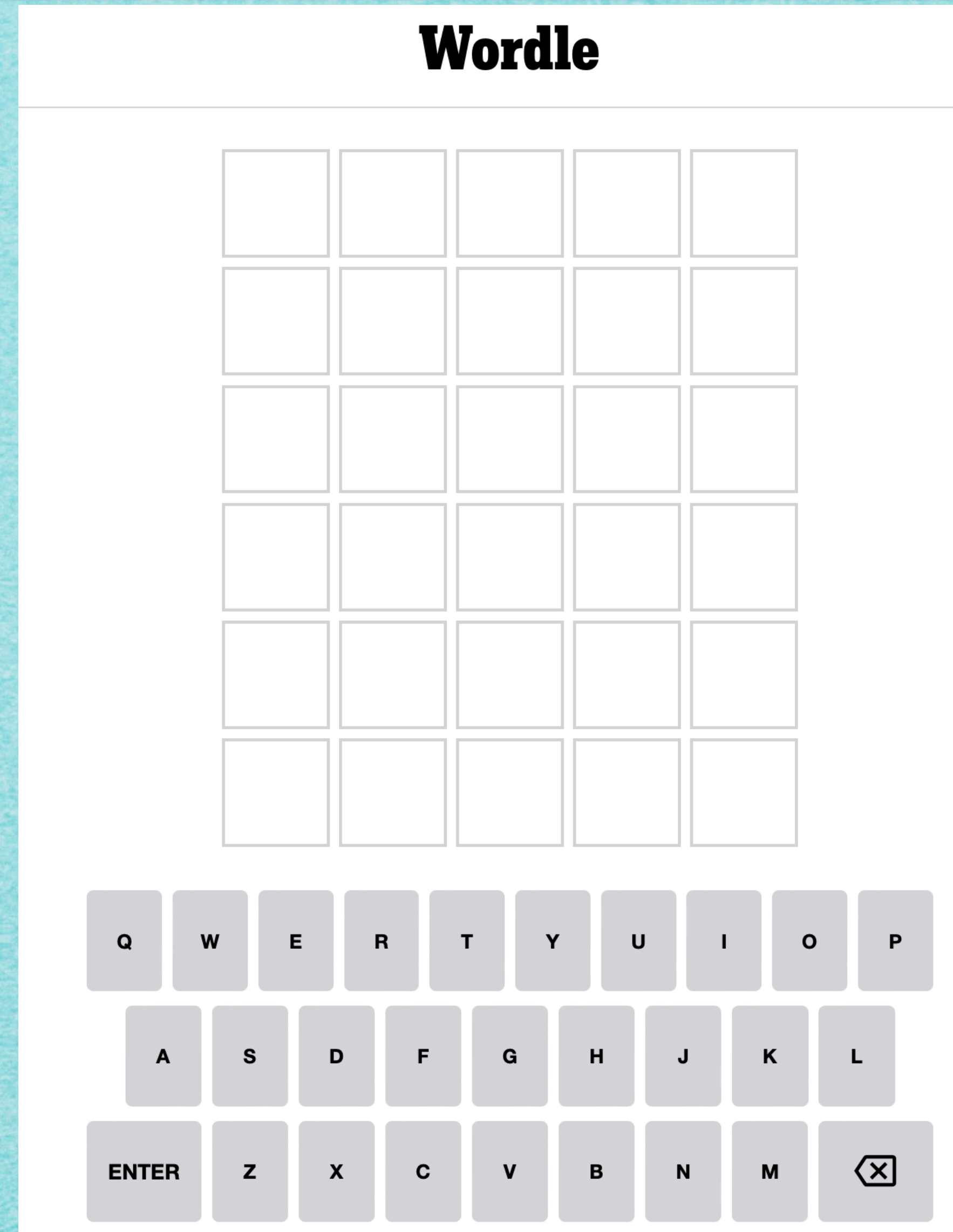
5.2 Schranken: Entscheidungsbäume



5.2 Schranken: Entscheidungsbäume

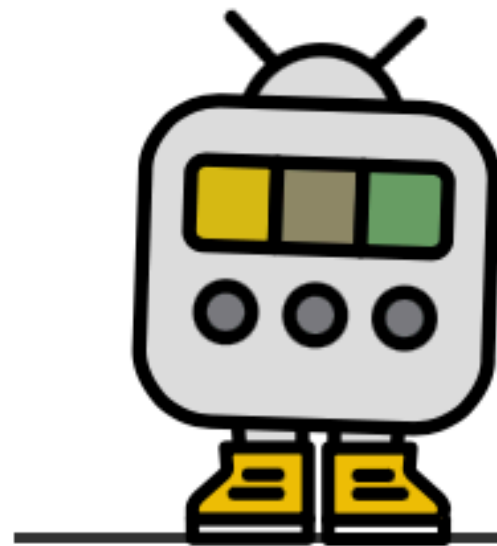


14.04.22



WordleBot: Improve Your Wordle Strategy

By Josh Katz and Matthew Conlen



What would you like to do?

WordleBot: I

C	R	A	N	E
N	I	C	H	E
S	I	N	C	E
W	I	N	C	E
M	I	N	C	E



What would

The New York Times

YOUR GROUPS,
WITH NICHE

Pattern	Chance solution is among these words
	36%
FENCE	9.2%
OUNCE	9.2%
PENCE	9.2%
DUNCE	8.2%
	27%
SINCE	9.2%
WINCE	9.1%
MINCE	9%
	9%
UNCLE	9%
	9%
NICHE	9%
	9%
NIECE	9%
	9%
HENCE	9%

MY GROUPS,
WITH HUMPS

Pattern	Chance solution is among these words
	28%
FENCE	9.2%
NIECE	9.2%
WINCE	9.1%
	17%
OUNCE	9.2%
DUNCE	8.2%
	9%
SINCE	9%
	9%
UNCLE	9%
	9%
NICHE	9%
	9%
HENCE	9%
	9%
PENCE	9%
	9%
MINCE	9%

WordleBot: In

C	R	A	N	E
N	I	C	H	E
S	I	N	C	E
W	I	N	C	E
M	I	N	C	E



What would

The New York Times

Your Solution

5 steps

C	R	A	N	E
N	I	C	H	E
S	I	N	C	E
W	I	N	C	E
M	I	N	C	E

49 luck

UNCLE 9%
NICHE 9%
NIECE 9%
HENCE 9%

My Solution

3 steps

C	R	A	N	E
H	U	M	P	S
M	I	N	C	E

80 luck

UNCLE 9%
NICHE 9%
HENCE 9%
PENCE 9%
MINCE 9%

5.2 Schranken:

HOWDY



C	R	A	N	E
H	O	W	D	Y
C	Y	B	E	R

YOUR GROUPS, WITH HOWDY	Chance solution is among these words	MY GROUPS, WITH WOULD	Chance solution is among these words
Pattern		Pattern	
██████	25%	██████	26%
CLERK	13%	CHEER	13%
CUTER	11.8%	CYBER	12.8%
CURER	<0.1%		
█ █ █ █	13%	█ █ █ █	13%
COVER	13%	COVER	13%
CORER	0.2%	CORER	0.2%
██████	13%	██████	12%
CIDER	12.9%	CUTER	11.8%
CURED	<0.1%	CURER	<0.1%
█ █ █ █	11%	██████	13%
CODER	11.3%	CLERK	13%
CORED	<0.1%		
██████	13%	██████	13%
CHEER	13%	CIDER	13%
██████	13%	██████	12%
CYBER	13%	COWER	12%
██████	12%	█ █ █ █	11%
COWER	12%	CODER	11%
		█ █ █ █	<1%
		CORED	<1%
		██████	<1%
		CURED	<1%

05.01.25

The opening move of a Wordle genius, **CRANE** is my favorite opening word of them all. On average, I can solve a Wordle in 3.5 steps when I start by guessing **CRANE**.

5.2 Schranken:

HOWDY



Here's how I would have solved it on my own. You solved it faster than I did!
Well done.

Your Solution
3 steps

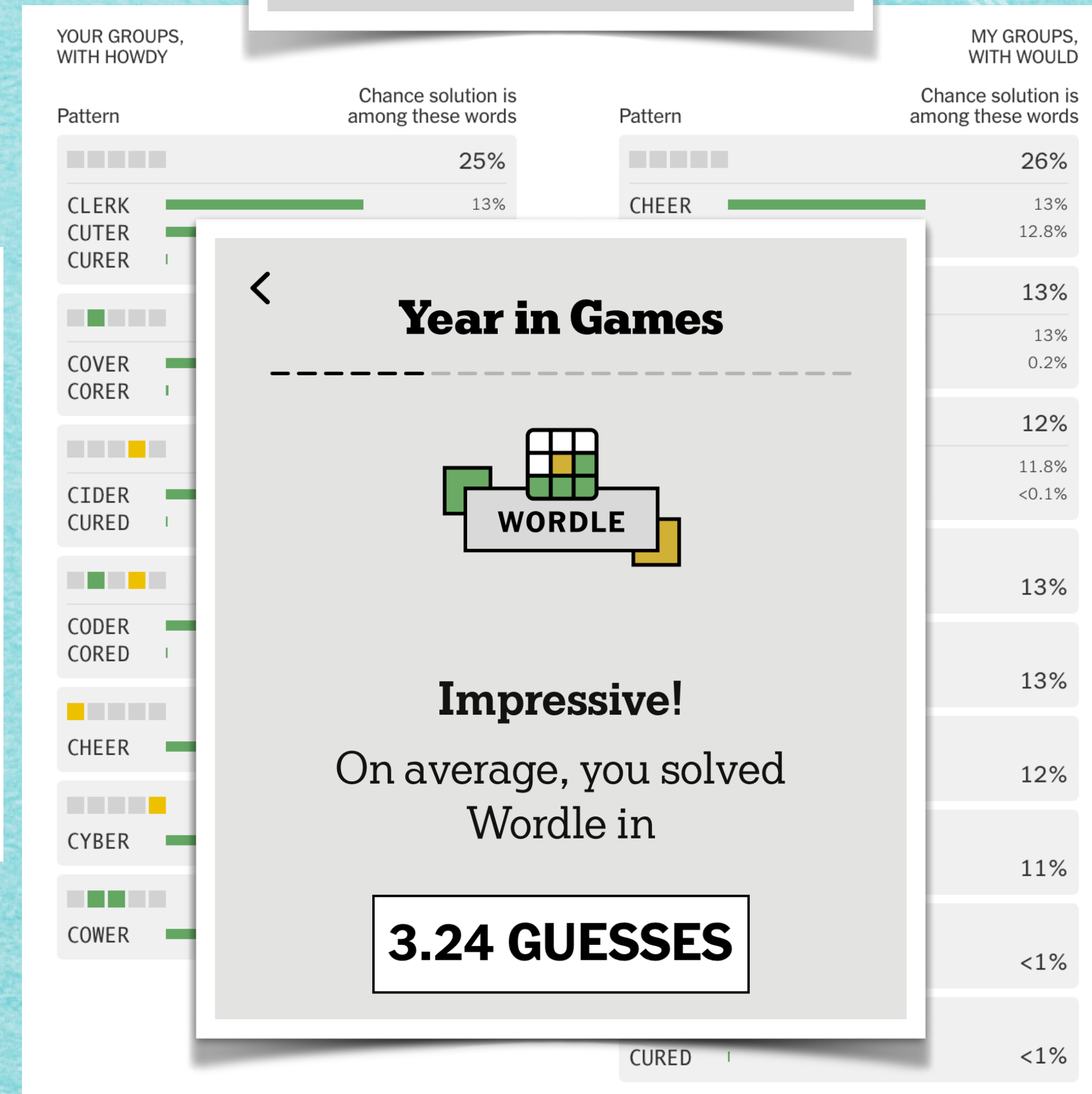
C	R	A	N	E
H	O	W	D	Y
C	Y	B	E	R

79 luck

My Solution
4 steps

C	R	A	N	E
W	O	U	L	D
C	H	E	E	R
C	Y	B	E	R

43 luck



05.01.25

The opening move of a Wordle genius, **CRANE** is my favorite opening word of them all. On average, I can solve a Wordle in 3.5 steps when I start by guessing **CRANE**.



Wordle



12.01.26

Q	W	E	R	T	Y	U	I	O	P
	A	S	D	F	G	H	J	K	L
ENTER	Z	X	C	V	B	N	M	⌫	



Weekend Diversion: The Logic That Stumped Brooklyn Nine Nine



Ethan Siegel

Follow



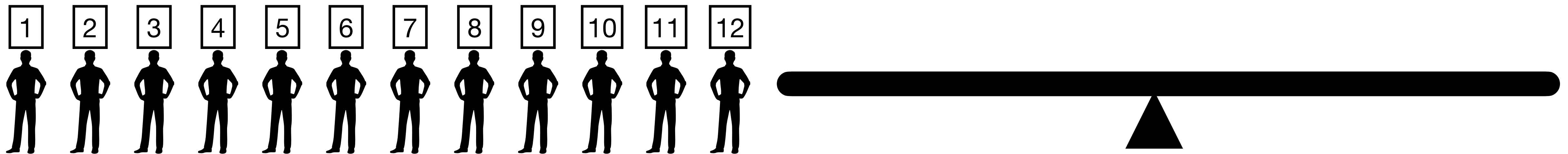
May 24, 2015 · 11 min read ★



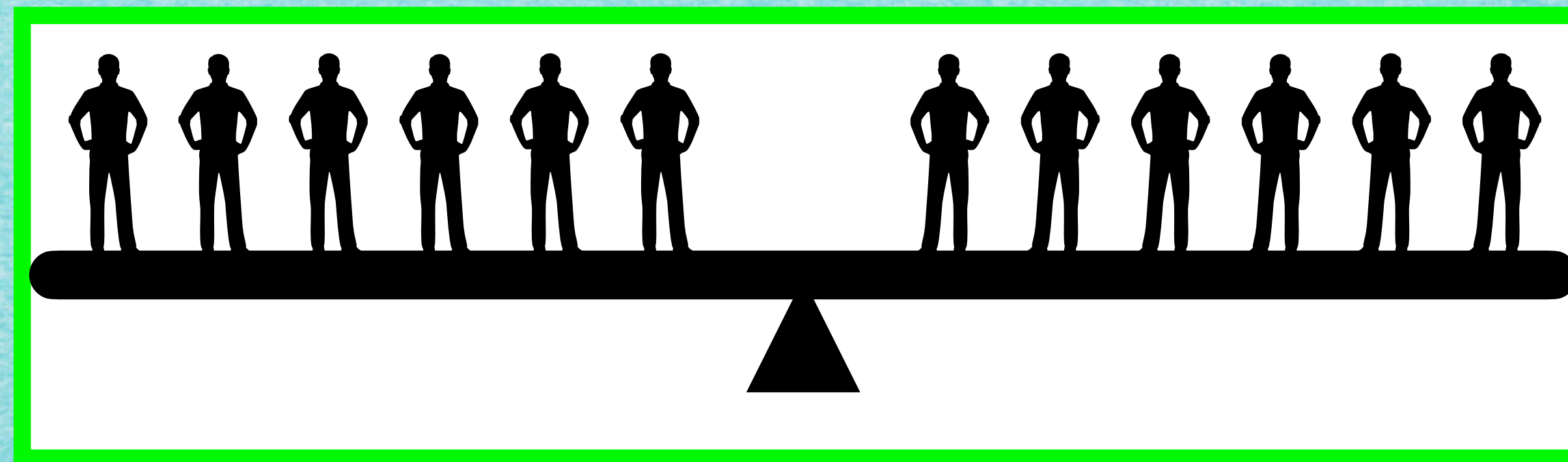
The most famous logic puzzle from the best police comedy on television,
and how to (finally) solve it!



"There are 12 men on an island. 11 weigh exactly the same amount, but one of them is slightly lighter or heavier. You must figure out which. The island has no scales, but there is a see-saw. The exciting catch? You can only use it three times."

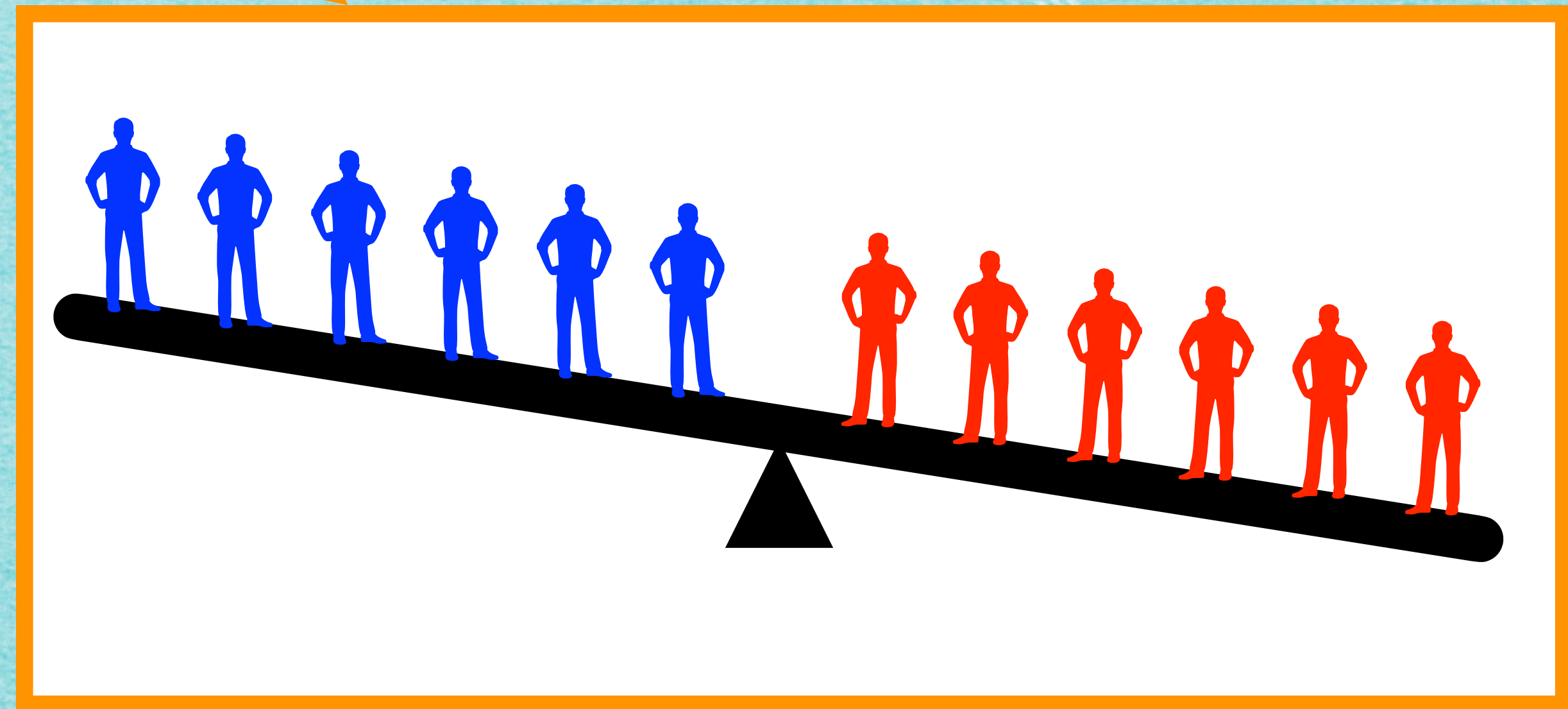
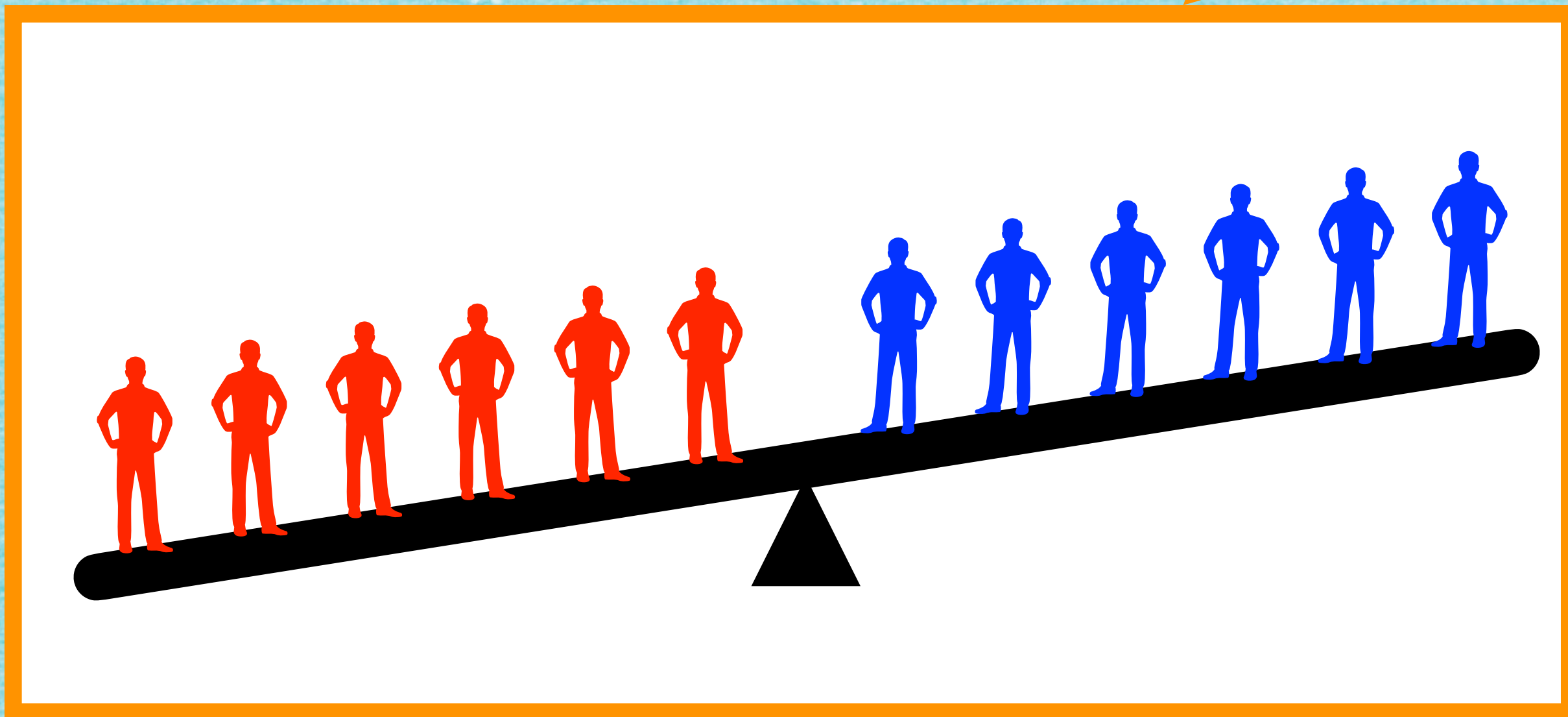
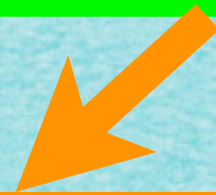
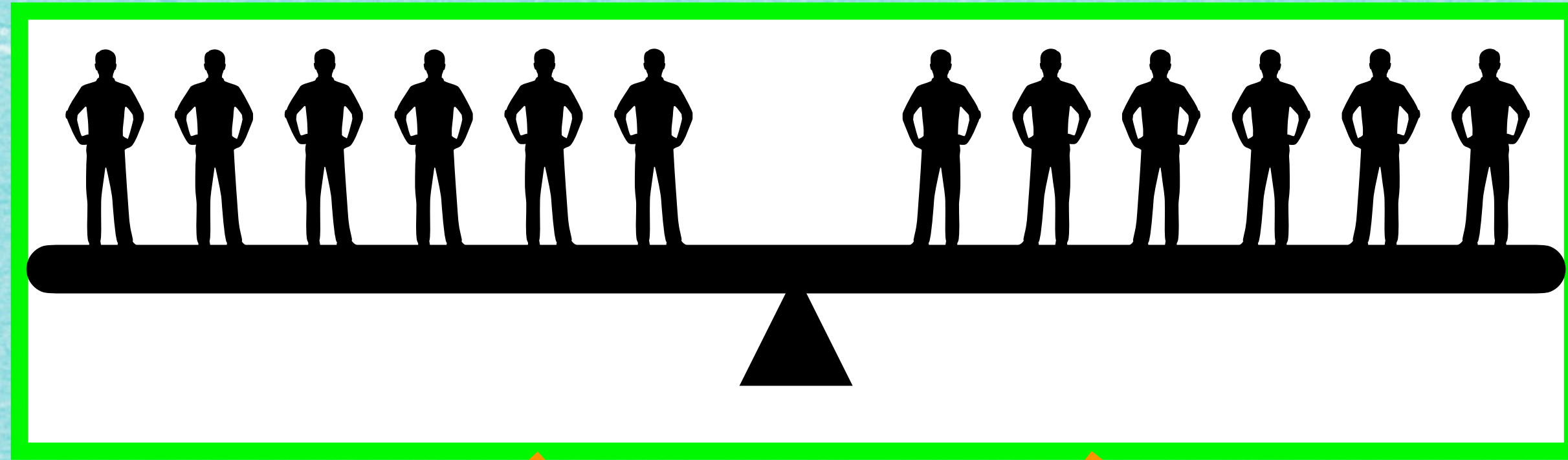


Amy Santiago: „Stop the clock!
We're here and we have the solution:
First, you weigh six versus six...”



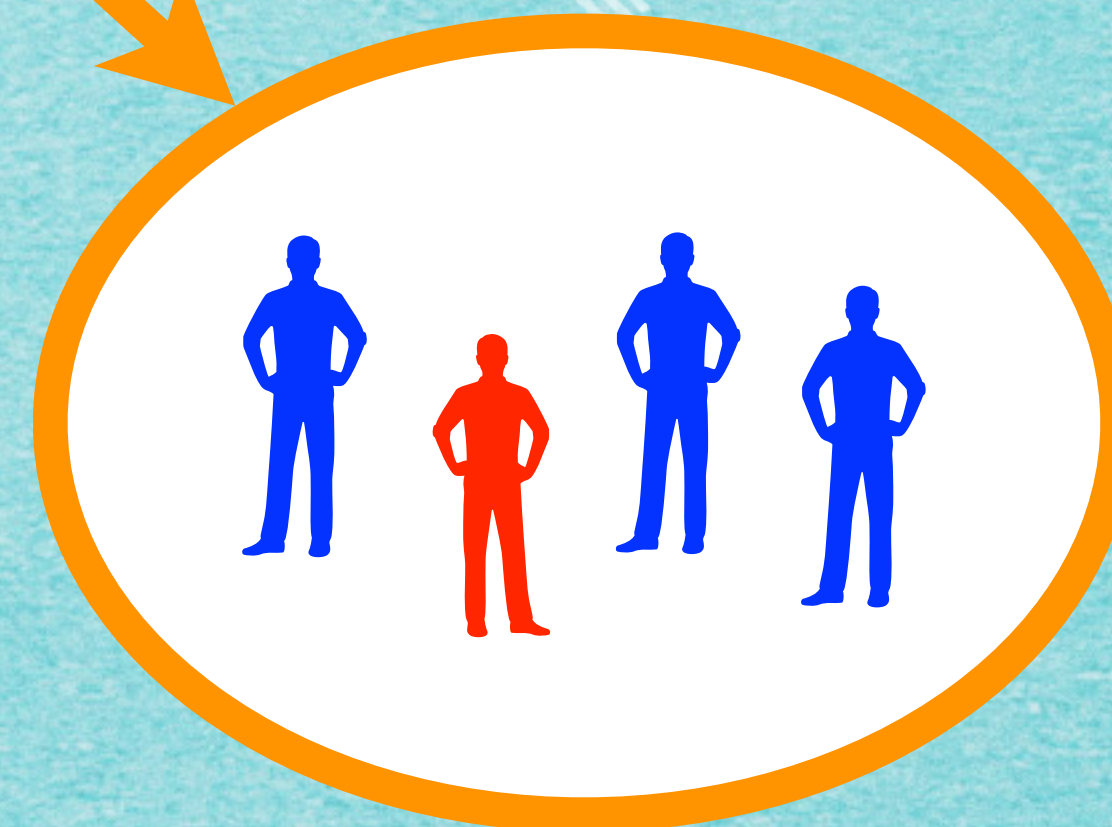
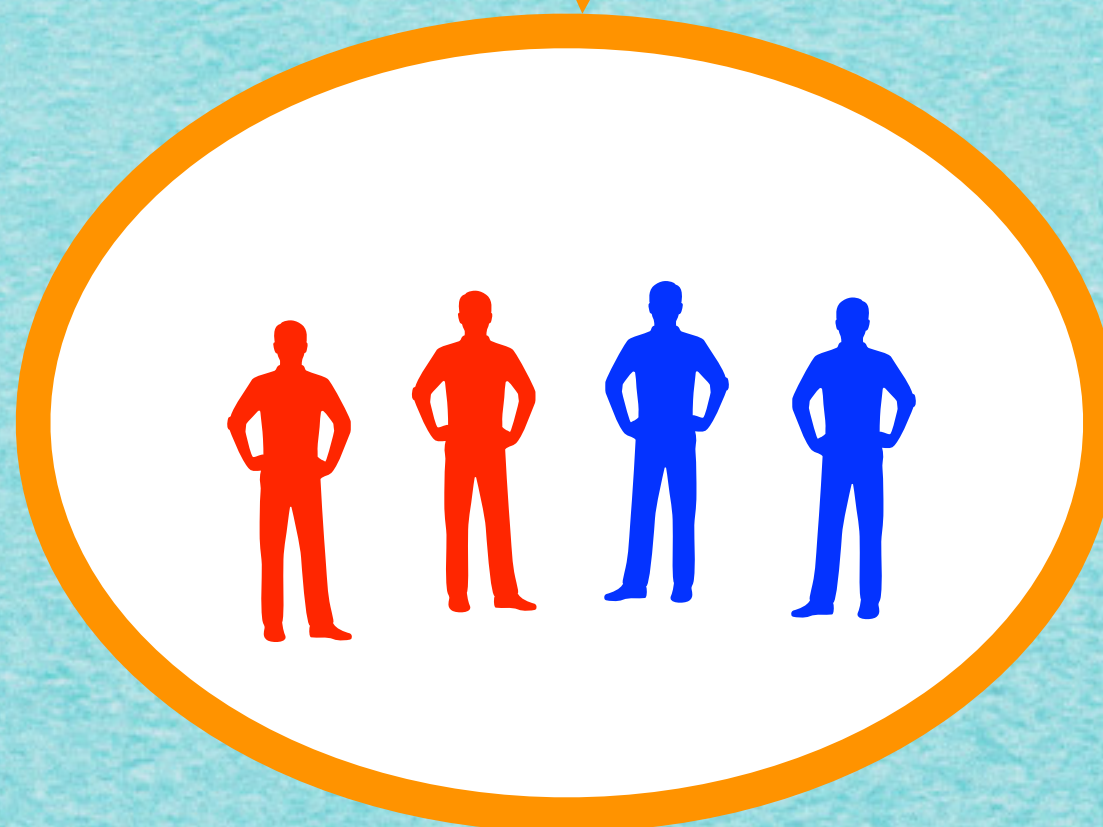
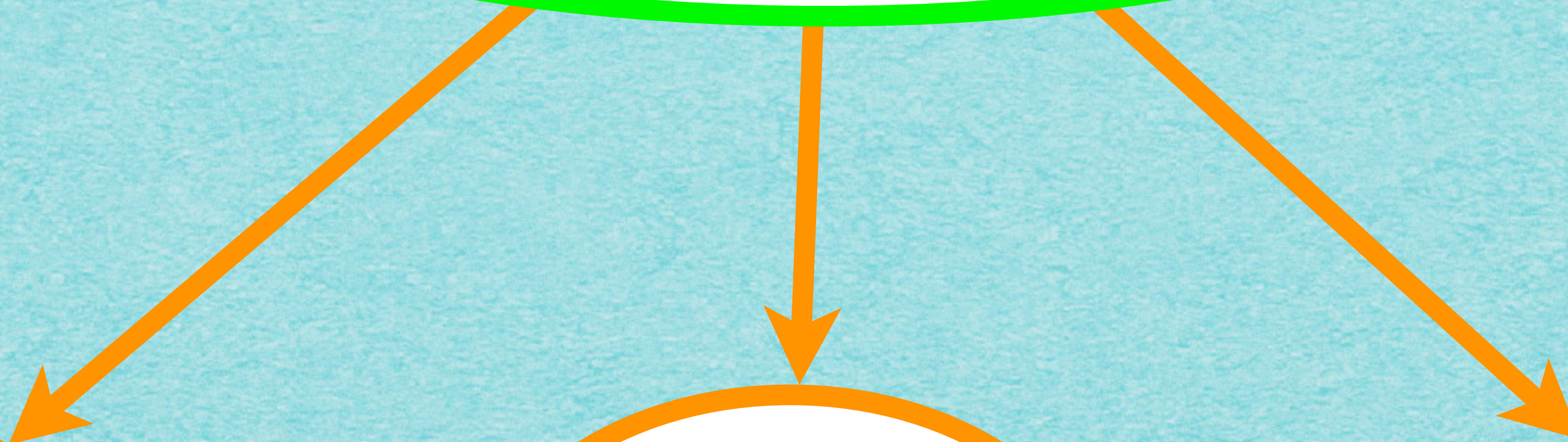
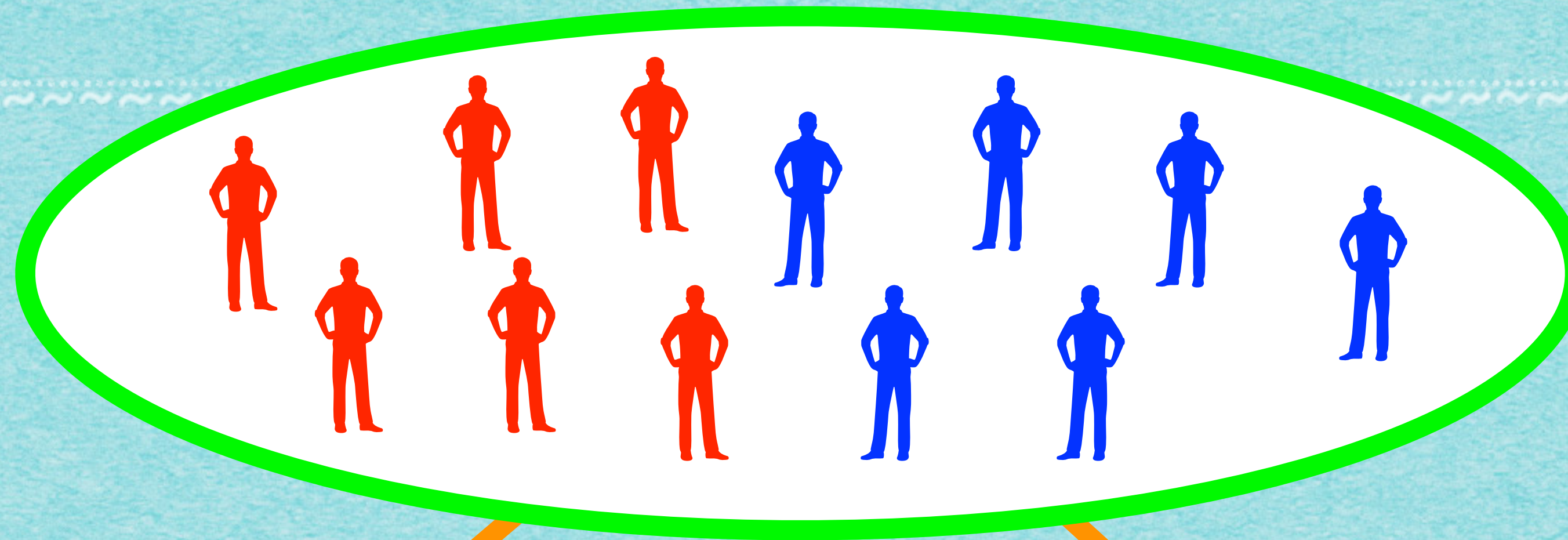
Captain Holt: „WRONG!
That'll never work!”

1



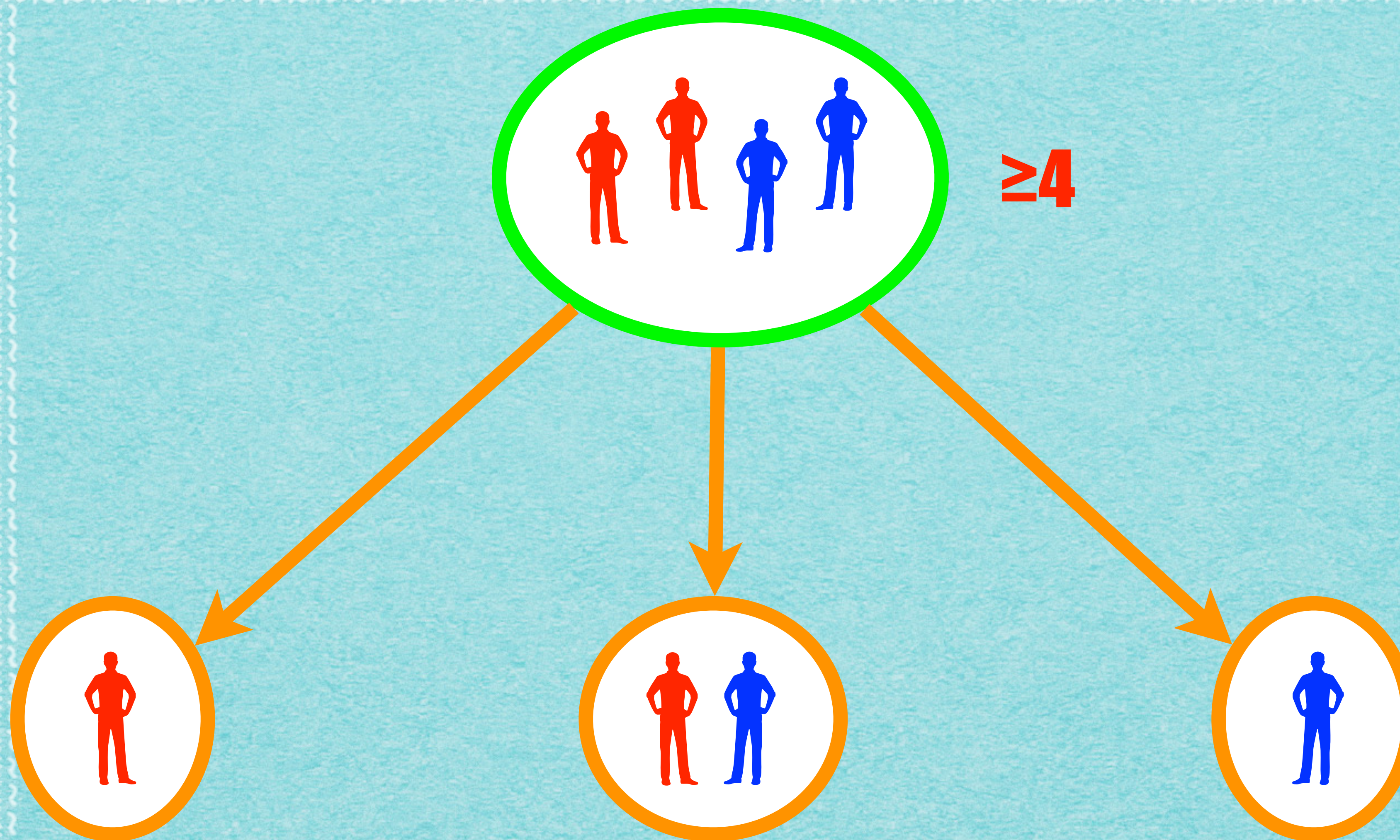
2

12



≥ 4

3



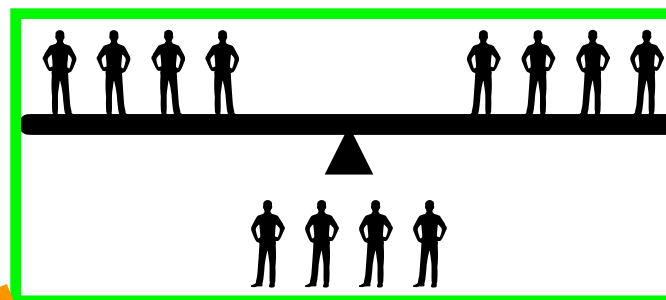
≥ 2

If you were able to solve it, you were able to do what Captain Holt, Amy Santiago, Terry Jeffords and the rest of the Nine-Nine couldn't do: avoid a tragic #nerdfail.

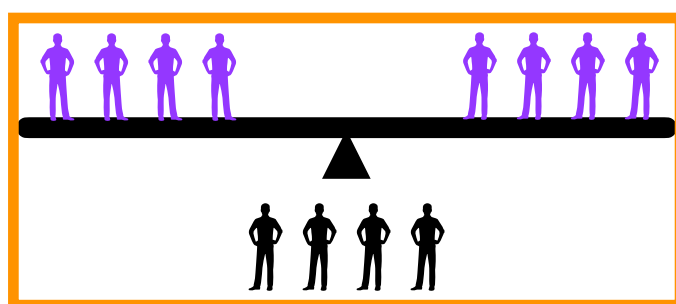


Image credit: Fox / Fremulon.

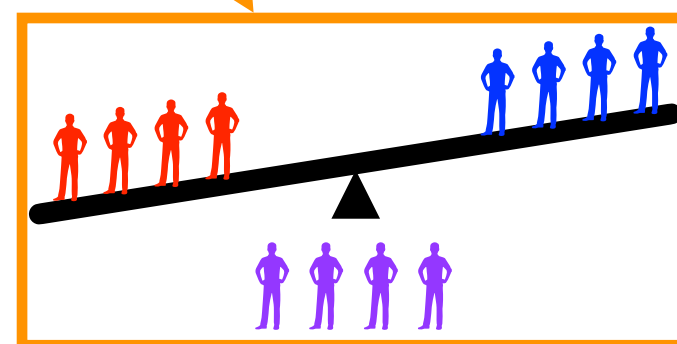
24



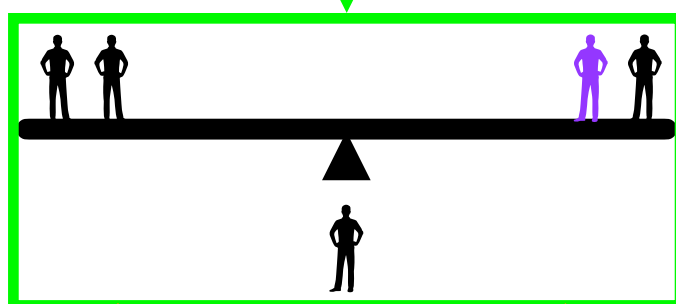
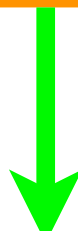
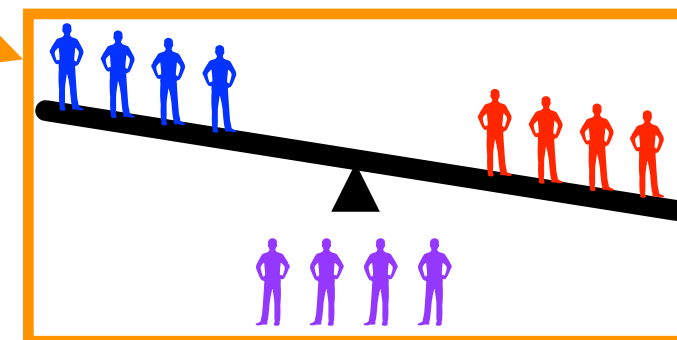
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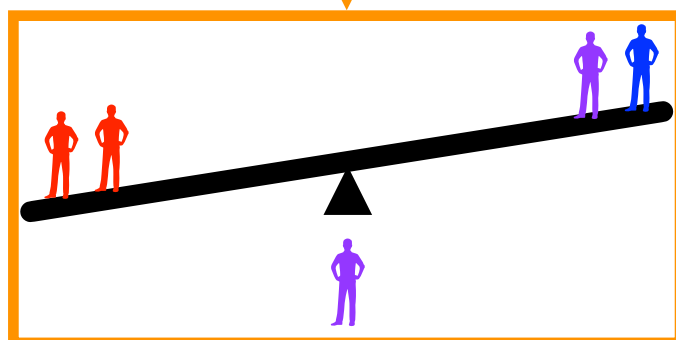
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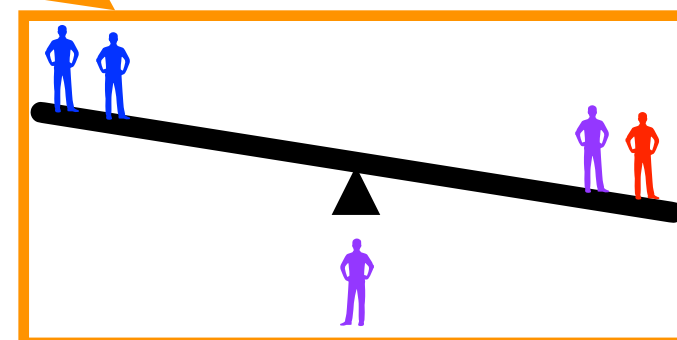
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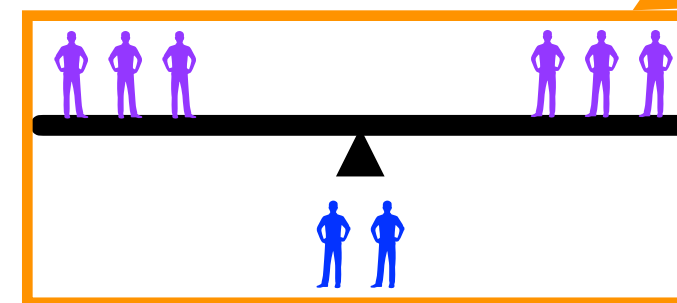
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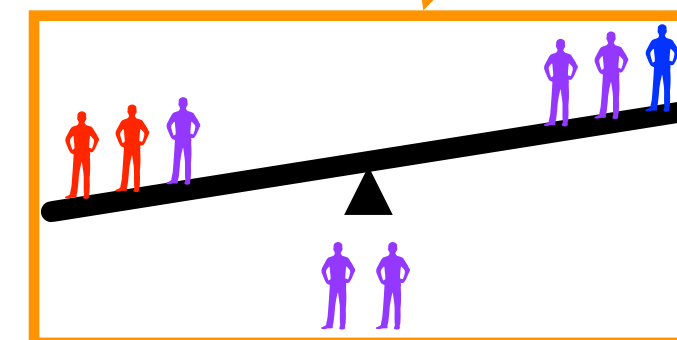
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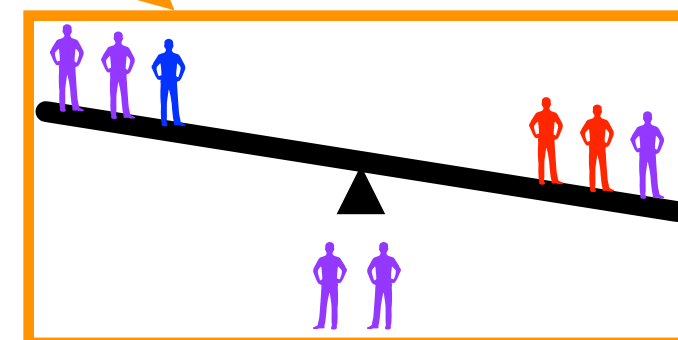
2



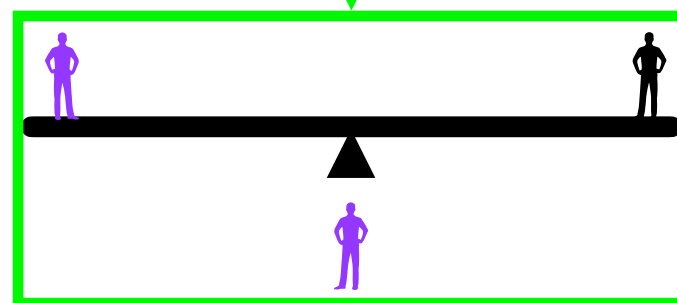
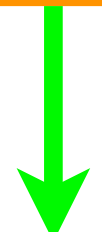
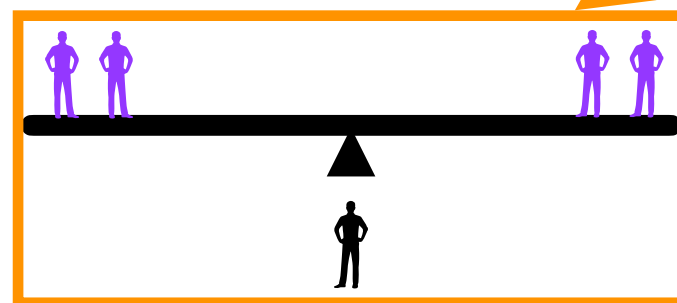
3



3



2



1

1

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Mehr an der Tafel!

s.fekete@tu-bs.de