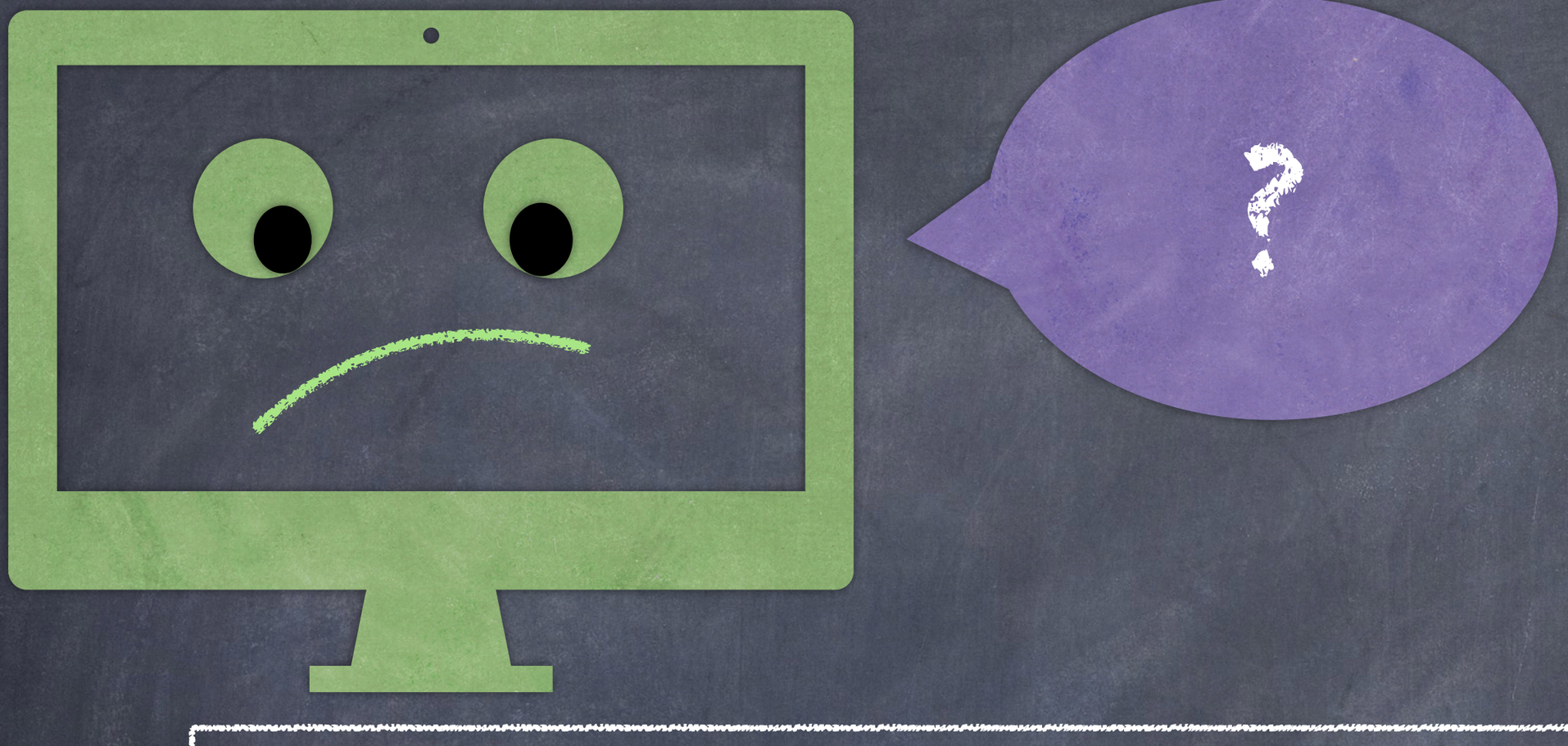


Can computers do everything???

Prerona Chatterjee

STCS @ TIFR

Hogwarts School of Puzzles



Hogwarts School of Puzzles



Welcome to Hogwarts...



Dumbledore

Hogwarts School of Puzzles





Harry

Welcome to Hogwarts...



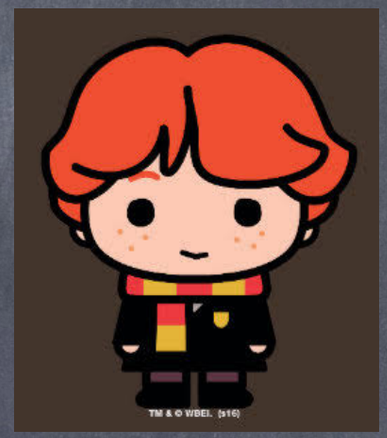
Dumbledore

Hogwarts School of Puzzles





Harry



Ron

Welcome to Hogwarts...



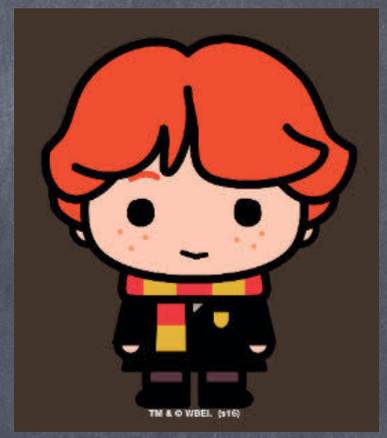
Dumbledore

Hogwarts School of Puzzles

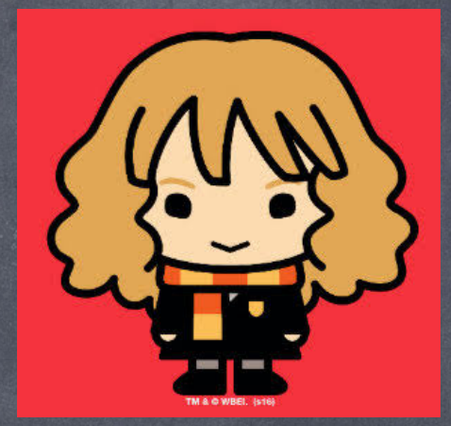




Harry



Ron



Hermione

Welcome to Hogwarts...



Dumbledore

a

ab



Input:

{ | b | a | ca | abc |
| --- | --- | --- | --- |
| ca | ab | a | c |

}



Input:

b	a	ca	abc
ca	ab	a	c



Output:

2	1	3	2	4
a	b	ca	a	abc
ab	ca	a	ab	c

Input:



{ abc, ab } { ca, a } { acc, ba }

Input:



{ abc, ca, acc }

{ ab, a, ba }

Output: Not possible





1.

2.

.

.

.

.

50.







1.

2.

.

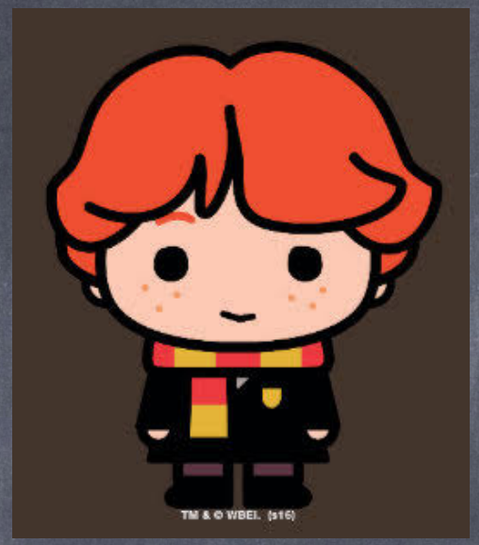
.

.

.

50.

Ron's program



Ron's program





Ron's program





{ ab a } { bab ba } { bbba bab }

1.

Ron's program

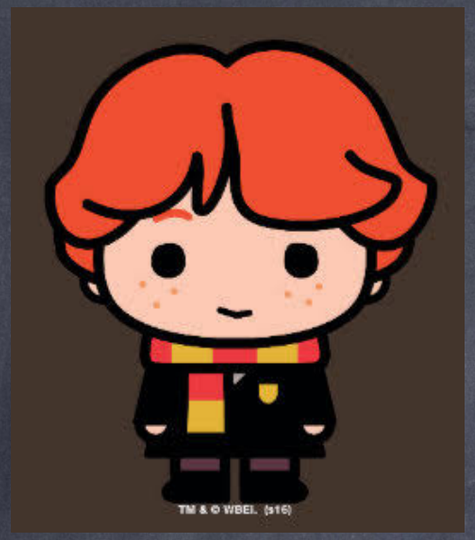




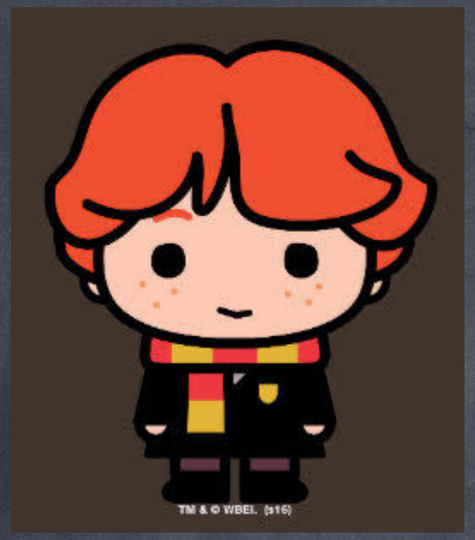
ab	bab	bbba
a	ba	bab



Output: Not possible


TM & © WBEL (s16)

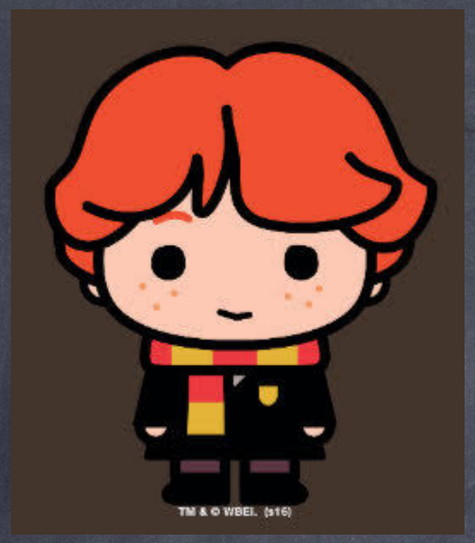






{ aa aaa | bb bba | aaa a }

2.



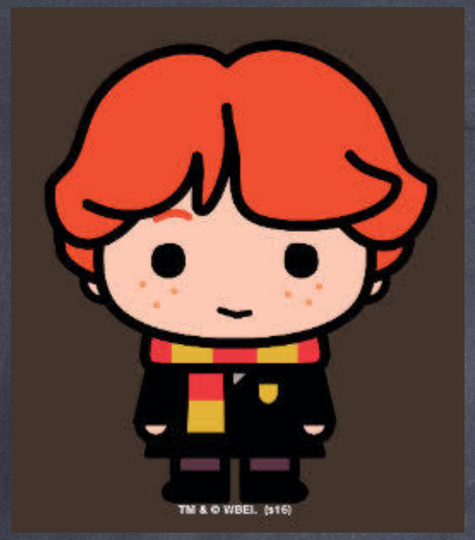


aa	bb	aaa
aaa	bba	a

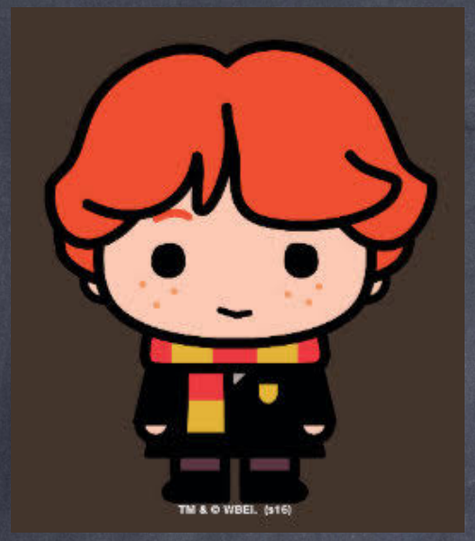
Output:

2	1	3
bb	aa	aaa
bba	aaa	a



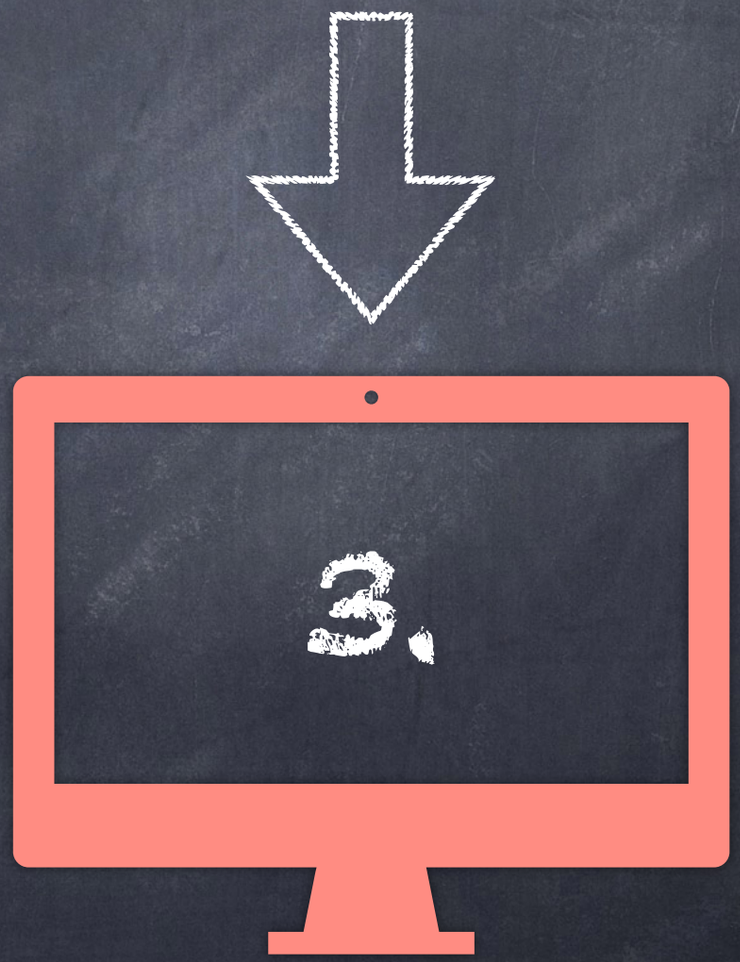

TM & © WBEL (s16)

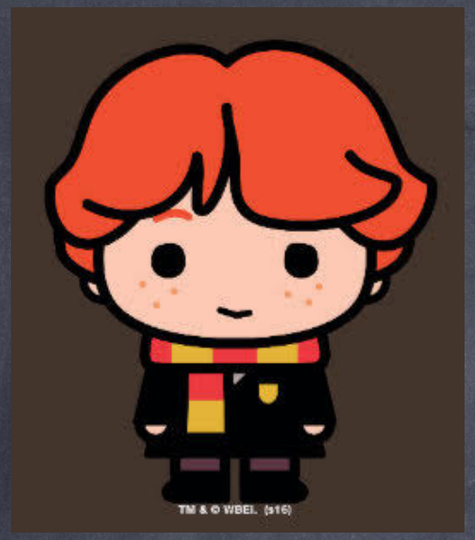






{ b, baa } { ab, aa } { bba, bb }





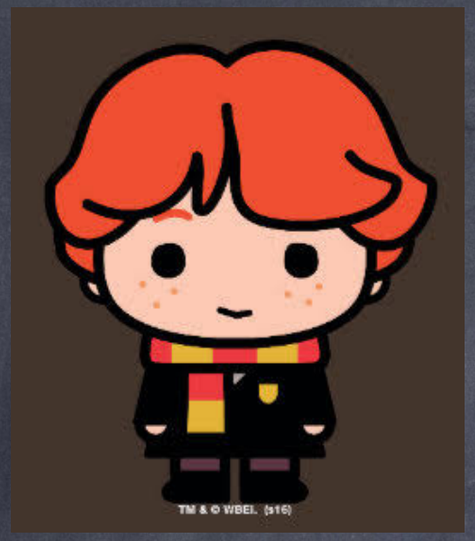


{ b | ab | bba
baa | aa | bb }







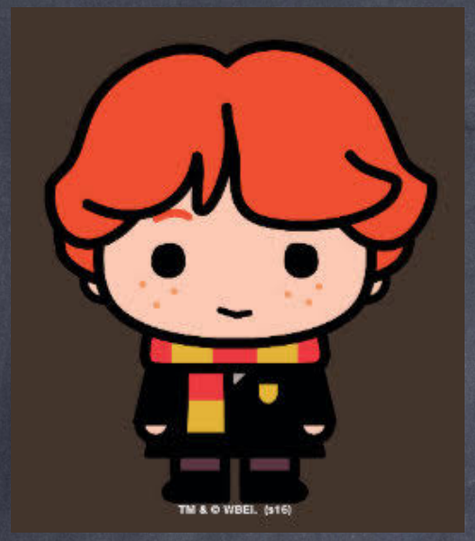




{ b | ab | bba
baa | aa | bb }

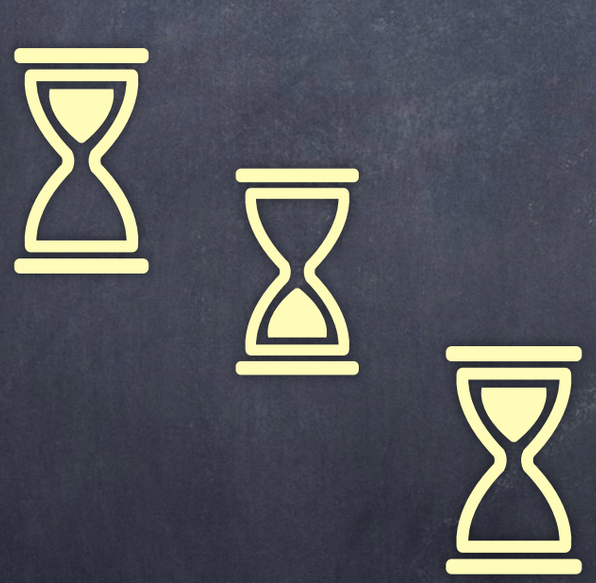


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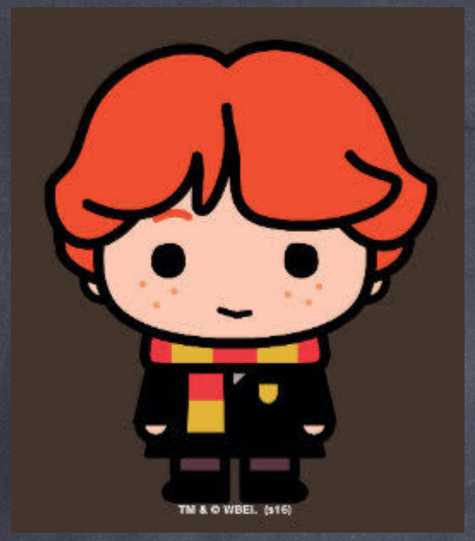




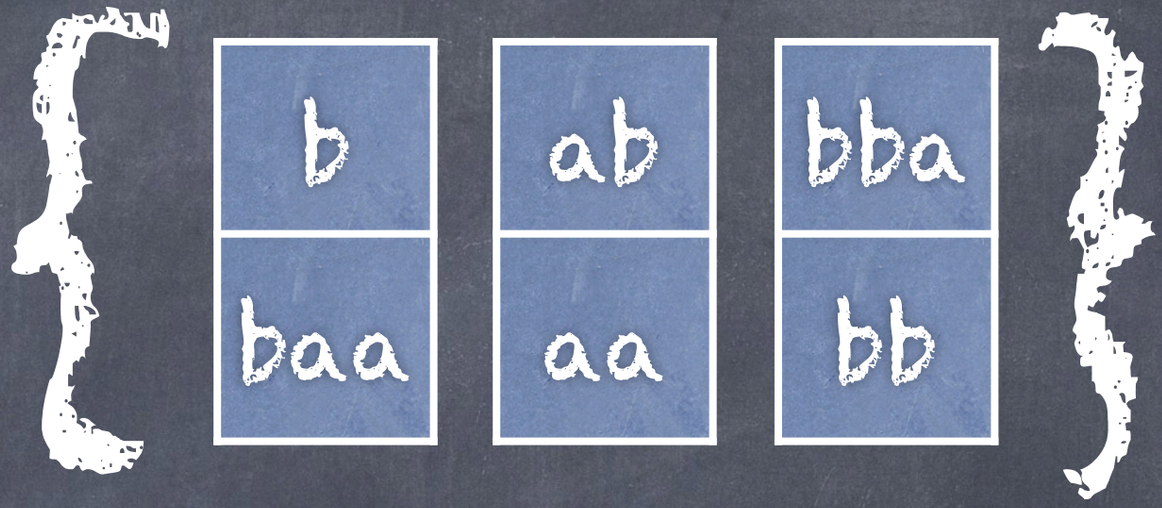
{ b | ab | bba
baa | aa | bb }



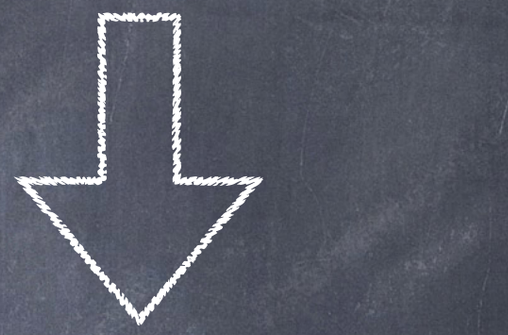
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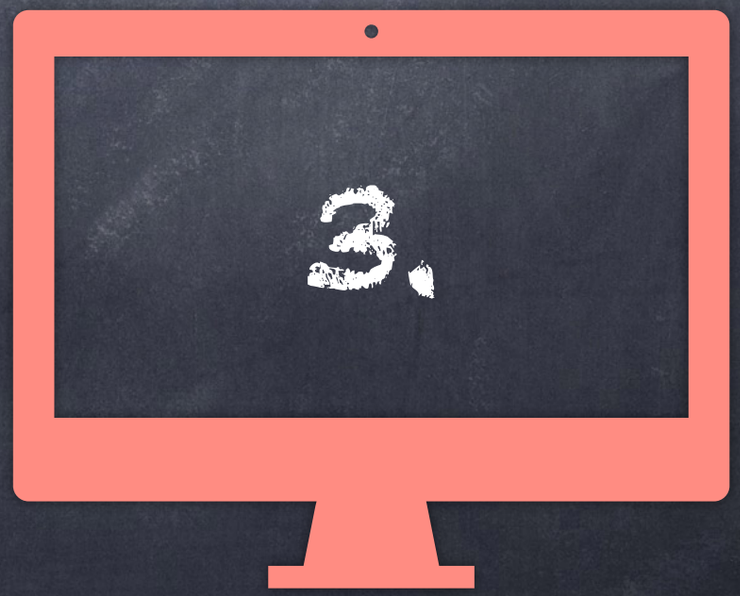

TM & © WBEL (s16)

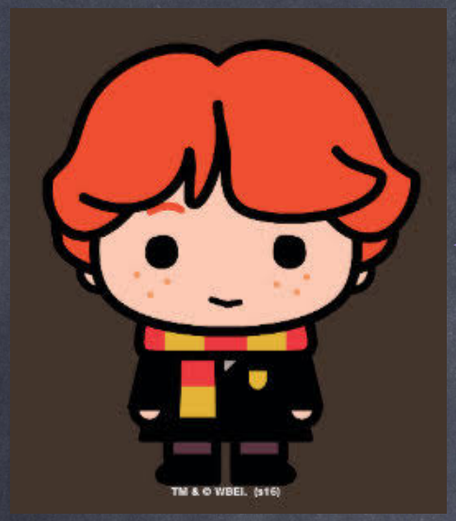



b
ab
bba
baa
aa
bb

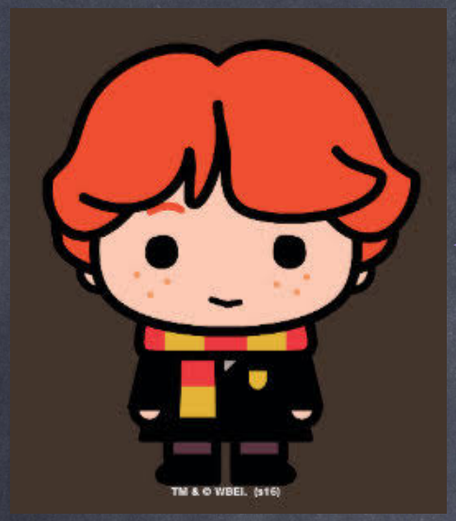





3.


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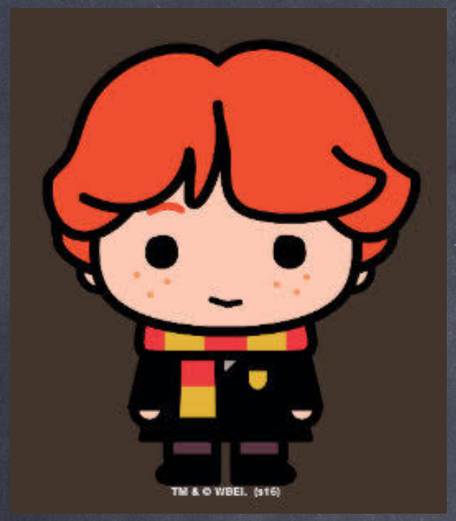



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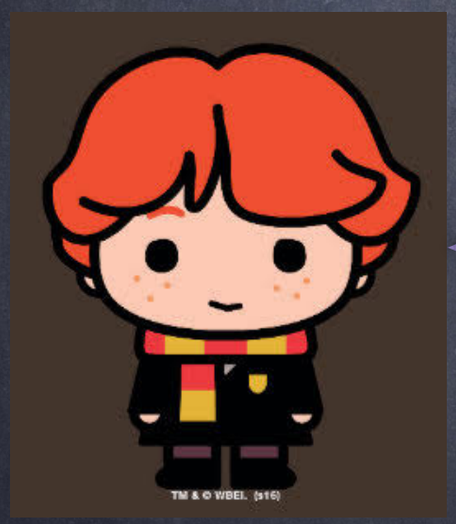



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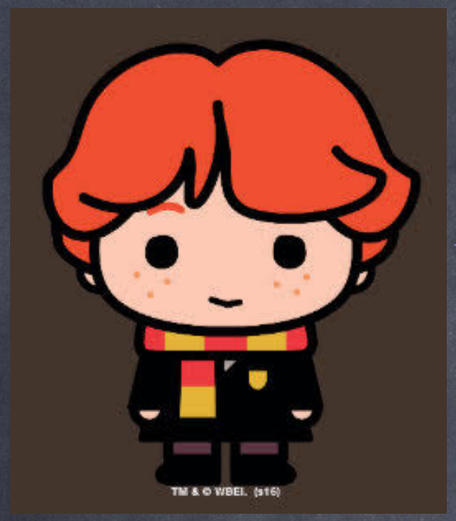







TM & © WBEI. (s16)

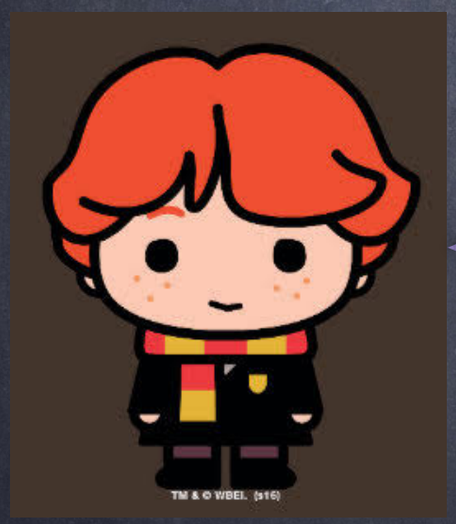



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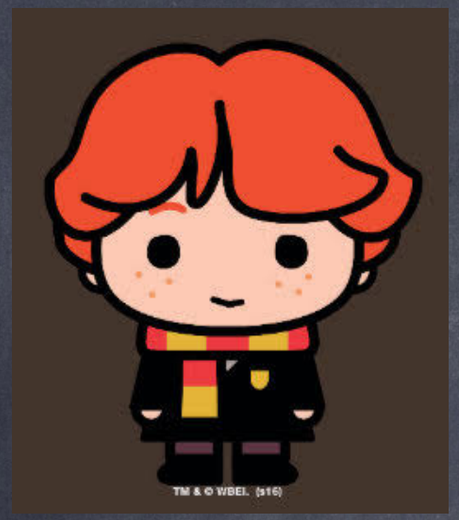


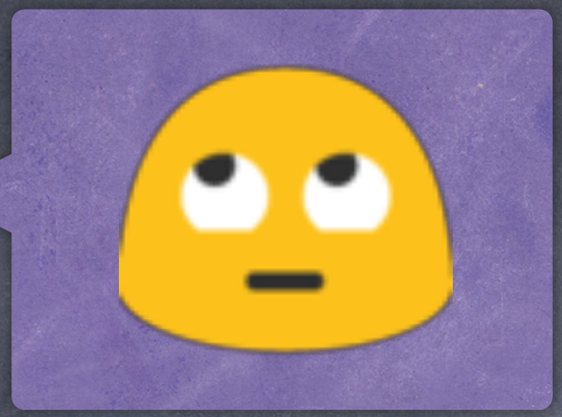

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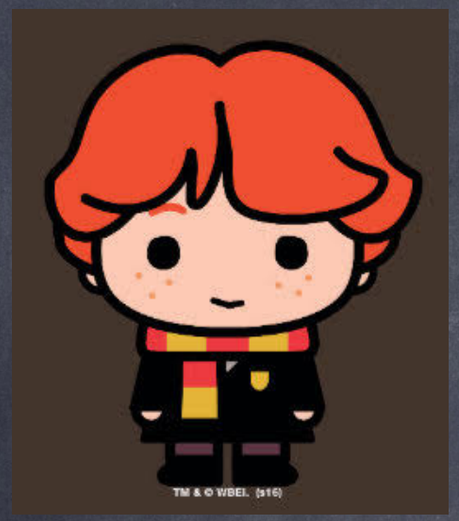


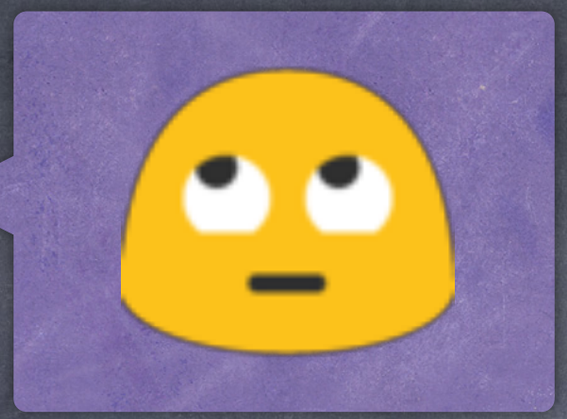





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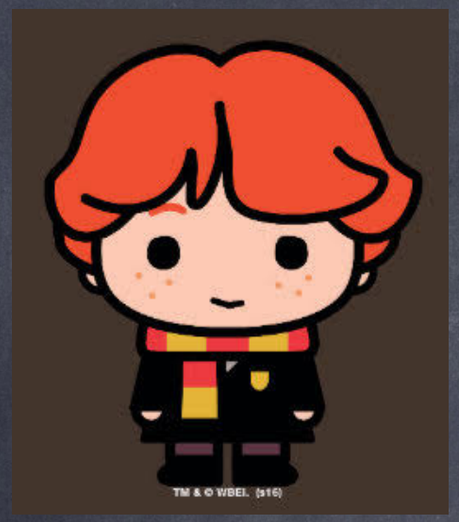


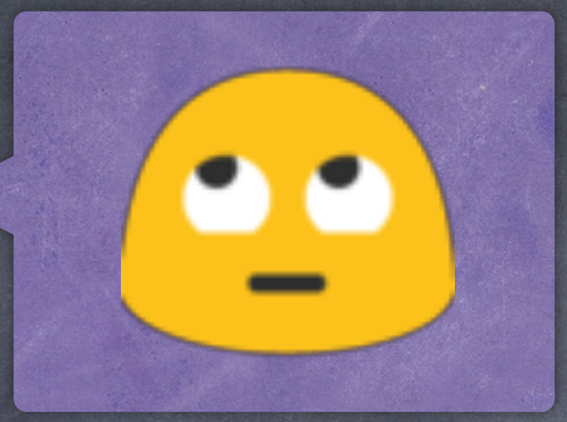




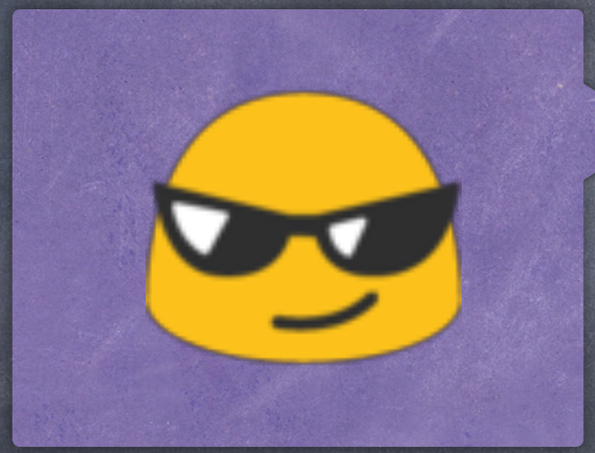
Harry's program

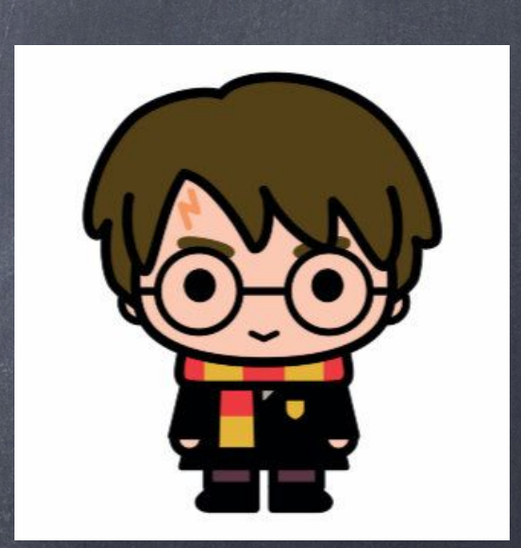


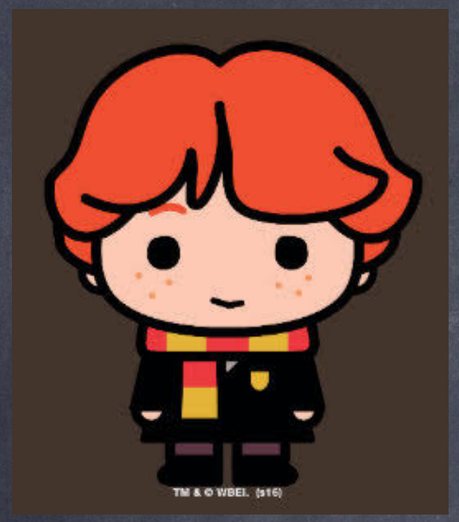


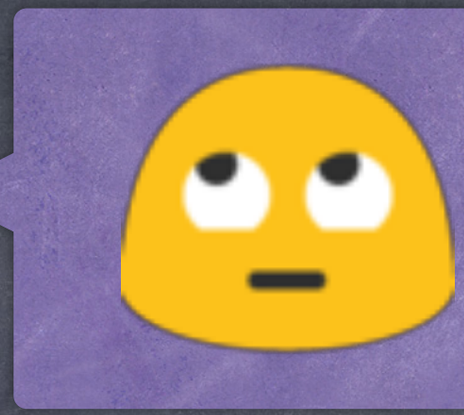


Harry's program





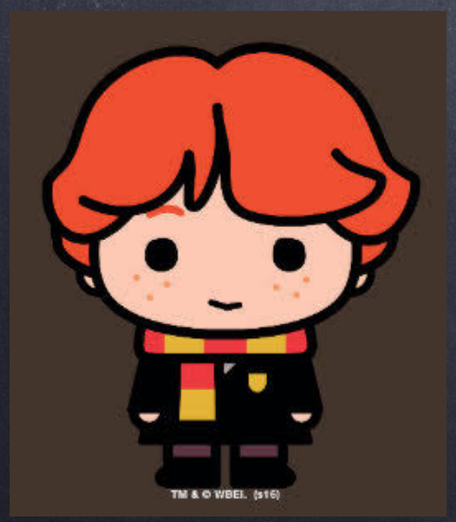




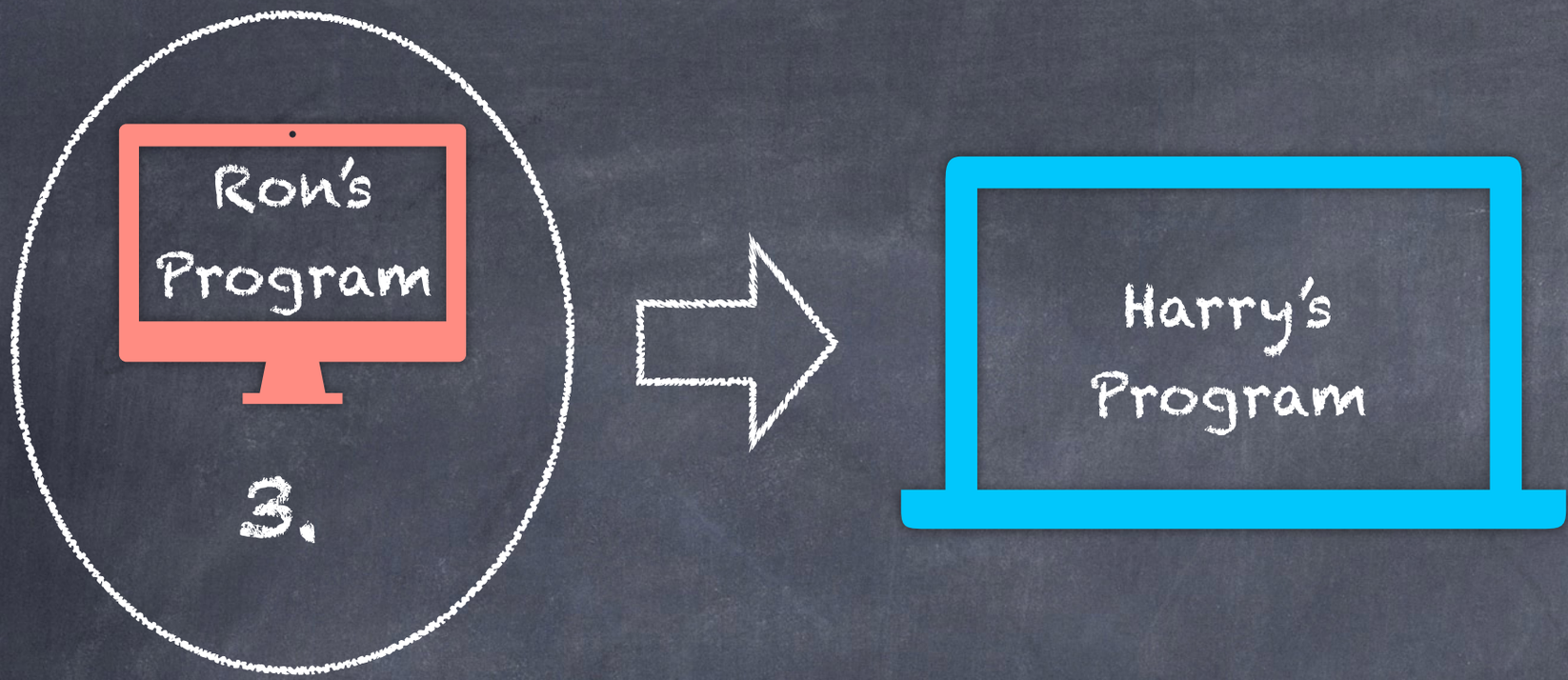
Harry's program

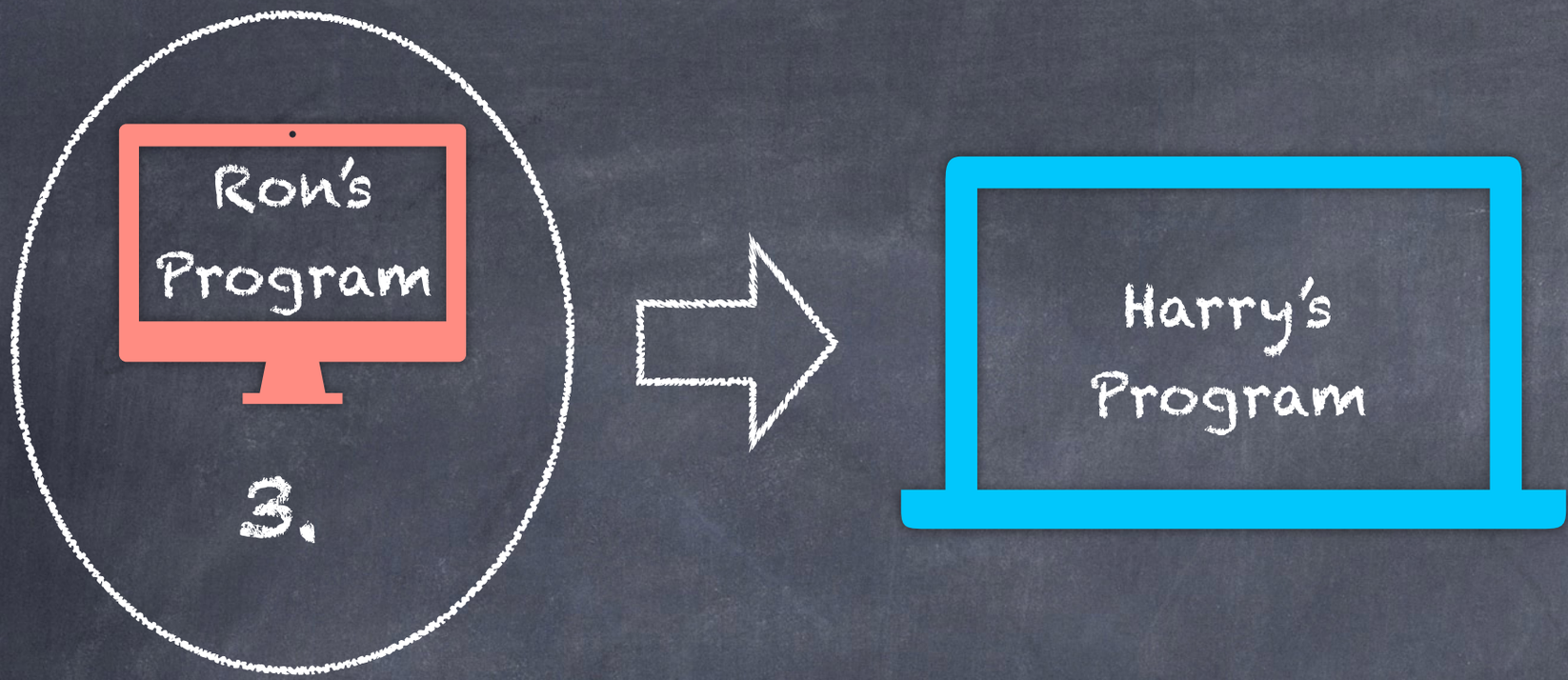


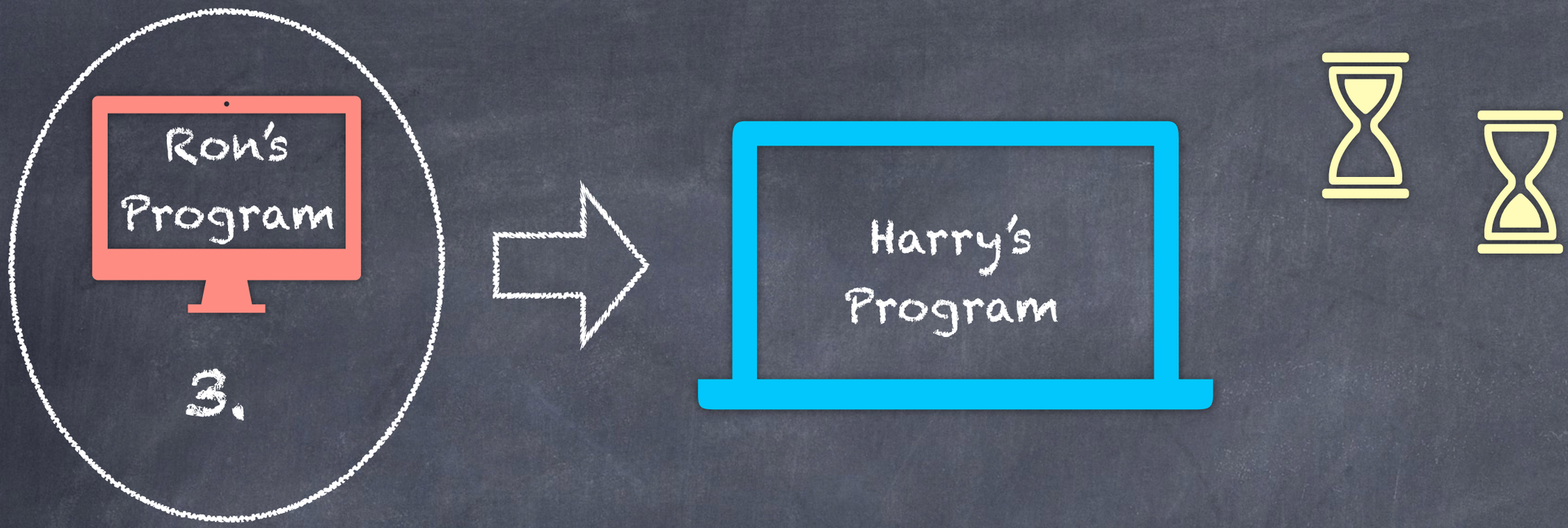


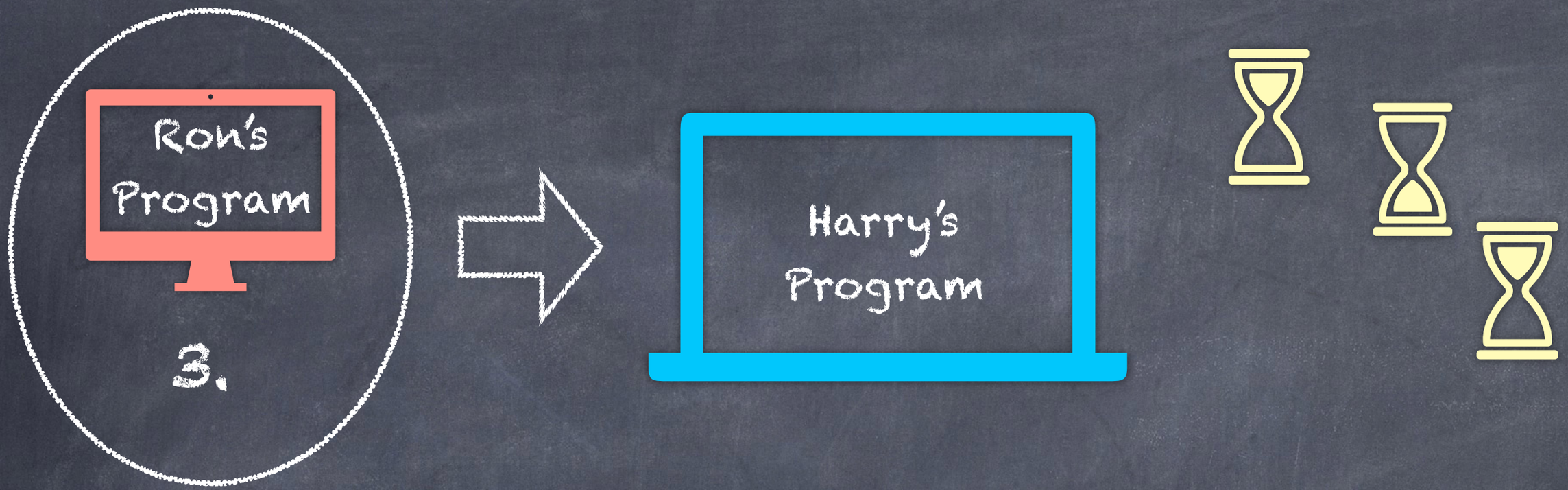


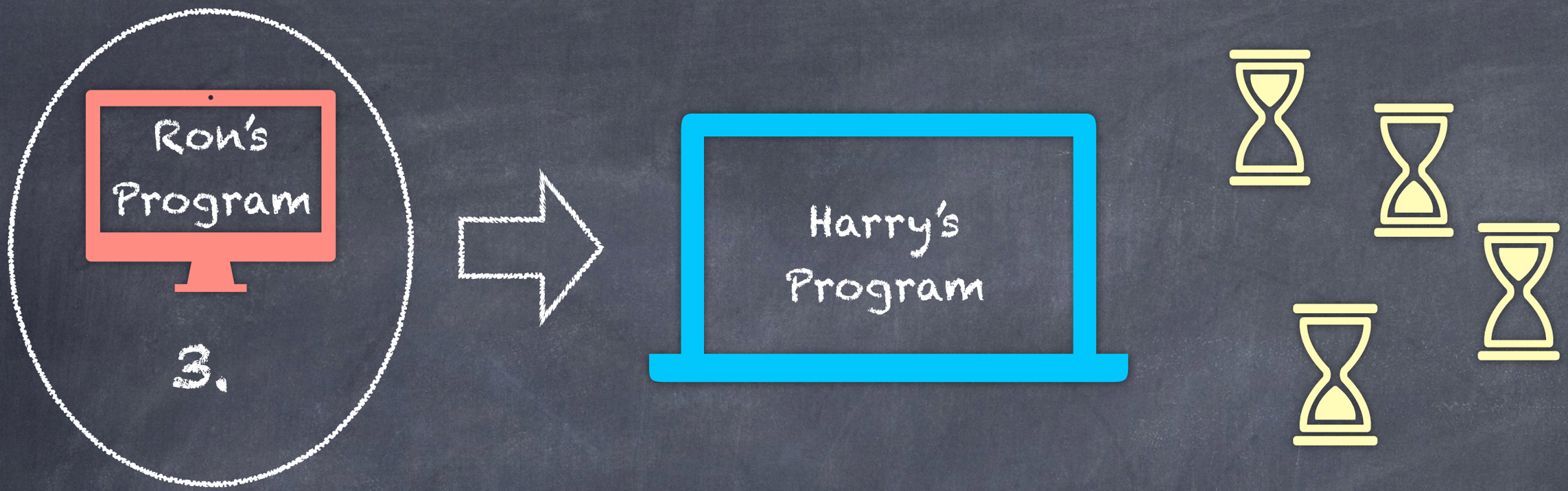



Ron's
Program
3.
Harry's
Program


Ron's
Program
3.
Harry's
Program


Ron's Program
3.
Harry's Program


Ron's Program
3.
Harry's Program

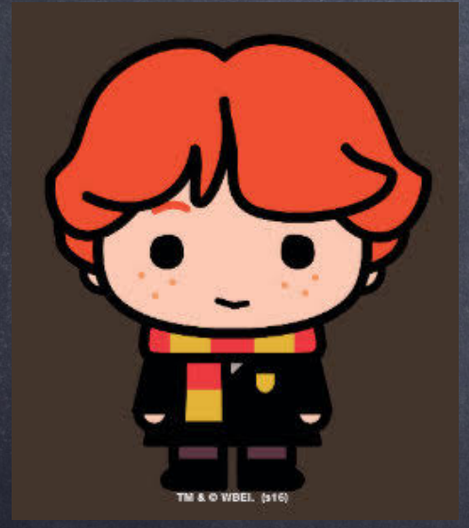

Ron's Program
3.
Harry's Program

Ron's Program

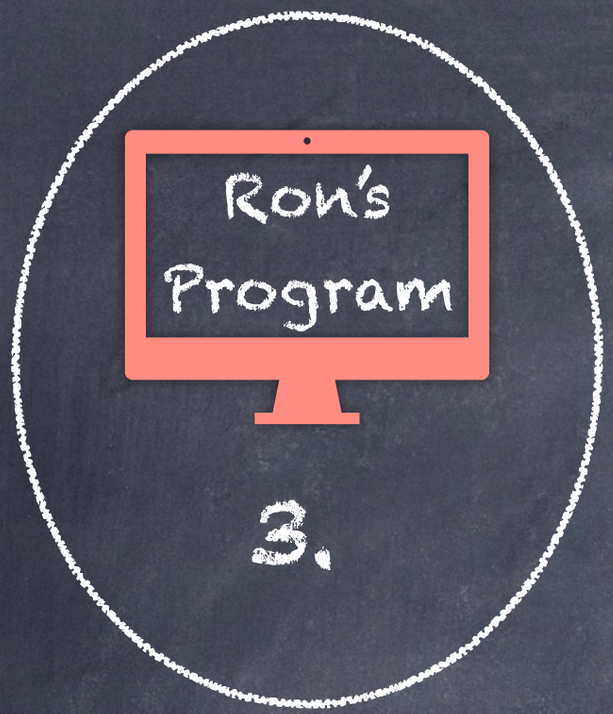
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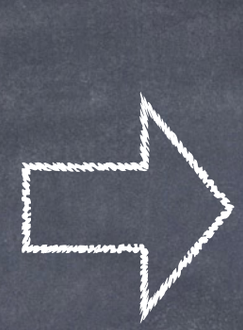
Harry's Program





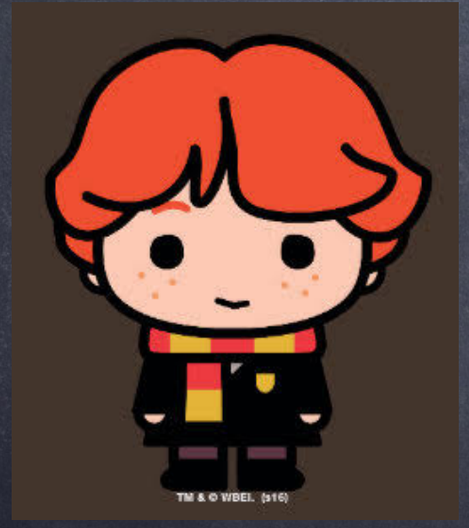



Ron's
Program
3.




Harry's
Program



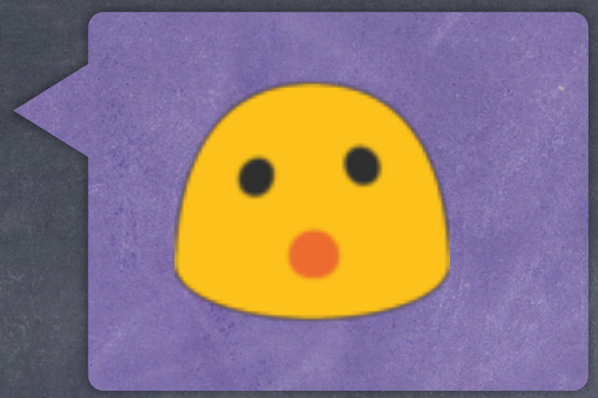

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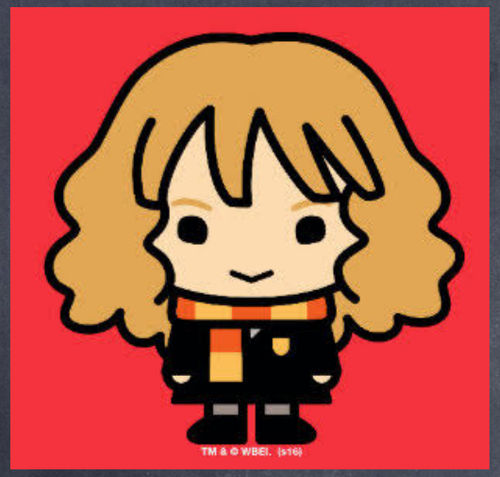


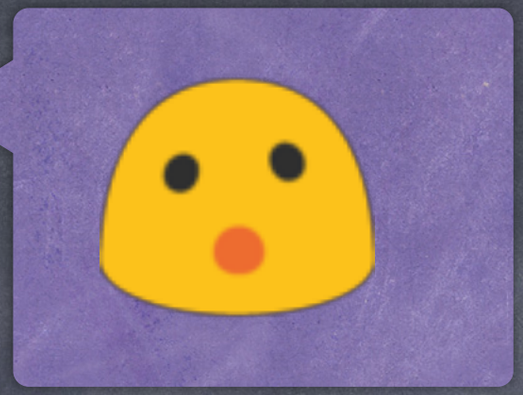





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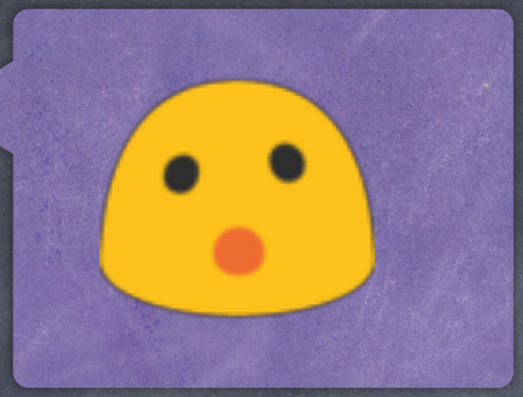

TM & © WBEI. (s16)





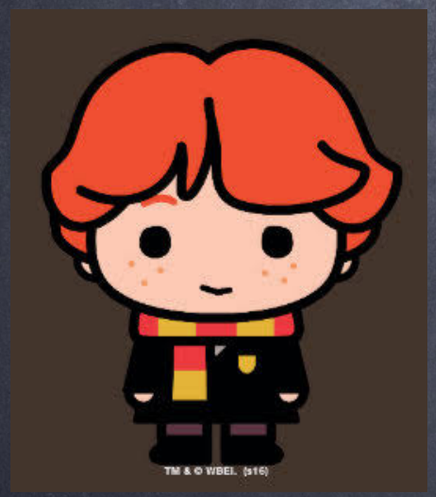



TM & © WBEI. (s16)



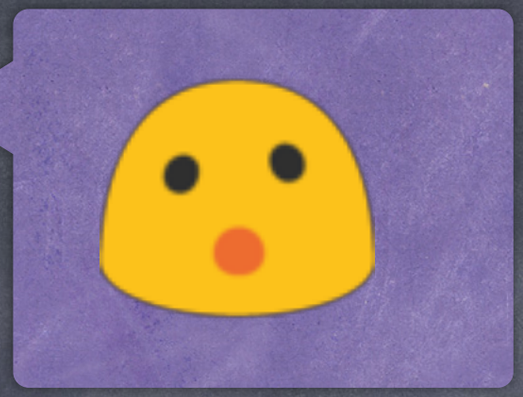





TM & © WBEI. (s16)




TM & © WBEI. (s16)








TM & © WBEI. (s16)






TM & © WBEI. (s16)



Harry's
Program



A: Any program
I: Any "text"

Program
A

Input I

Harry's
Program



A: Any program
I: Any "text"

Program A

Input I

Harry's Program

A gives an answer on I

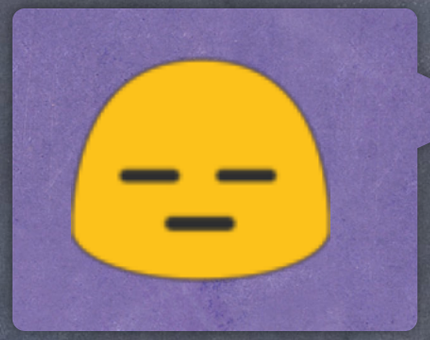
A does not give an answer on I


TM & © WBEI. (s16)




TM & © WBEI. (s16)

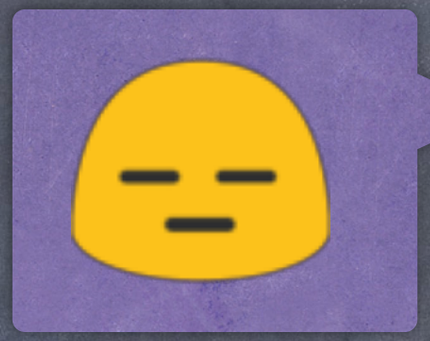




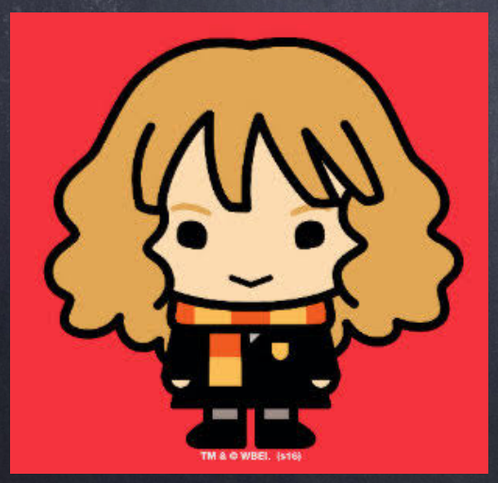












Harry's program

Input 1

Input 2

. . .

Program 1

Program 2

.

.

.

I 1 I 2 . . . I 987 . . .

1

2

.

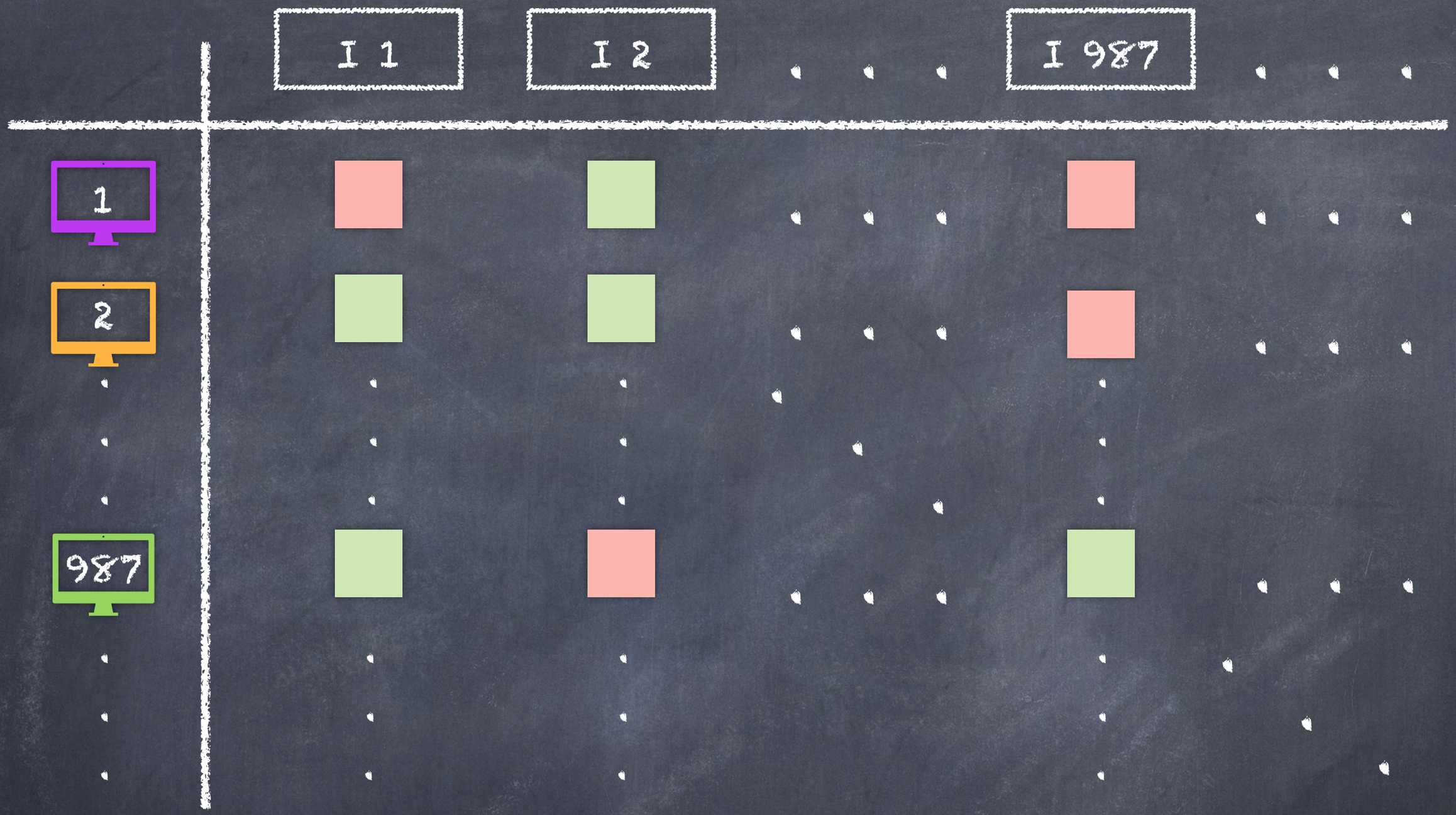
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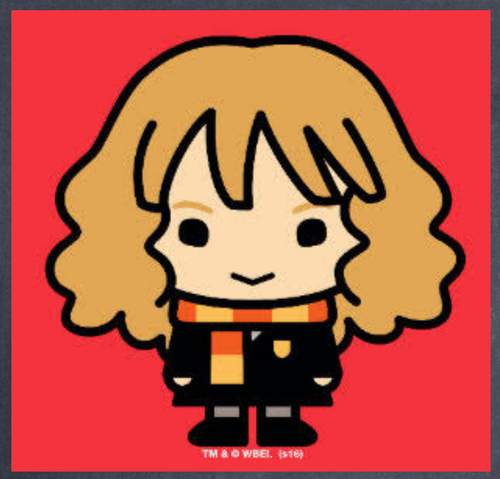
987



Harry's Program : Use to fill the table

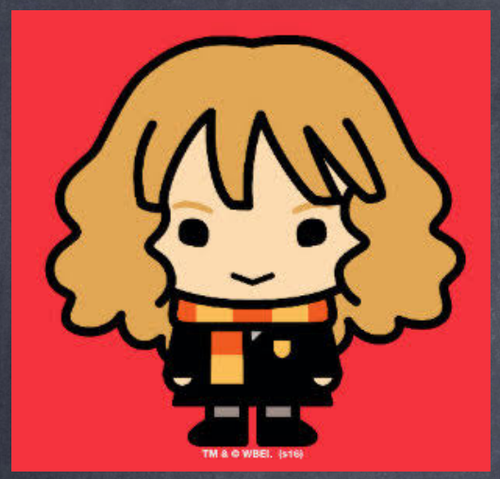


Harry's Program : Use to fill the table



Harry's program

Hermione's Program



Hermione's Program

is not in the list

Harry's program

Hermione's Program



That is clearly not possible



That is clearly not possible





Harry's program

Hermione's Program

using only a simple modification



Harry's program

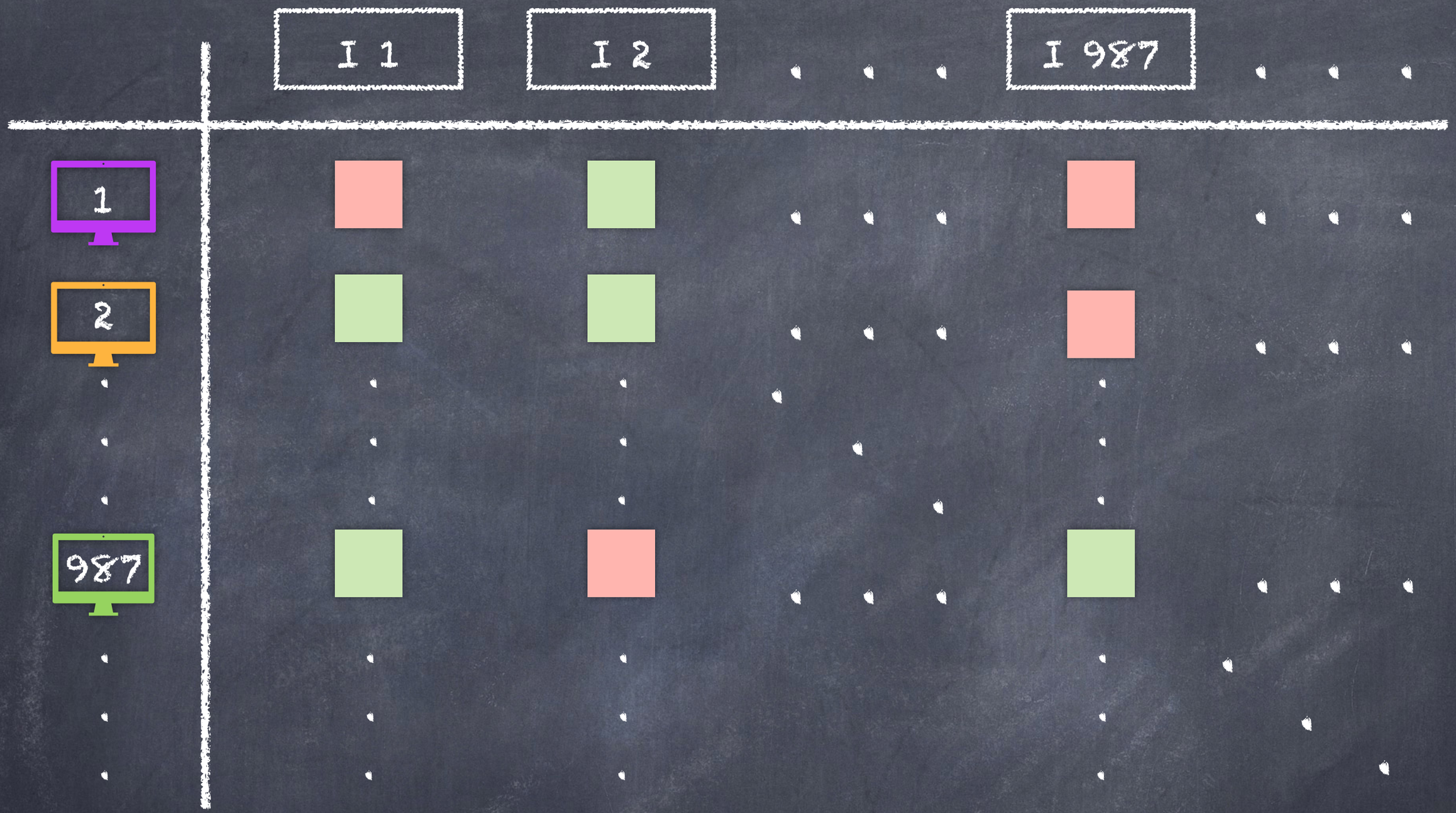
using only a simple modification

Hermione's Program

such that

Hermione's Program

is not in the list



Row

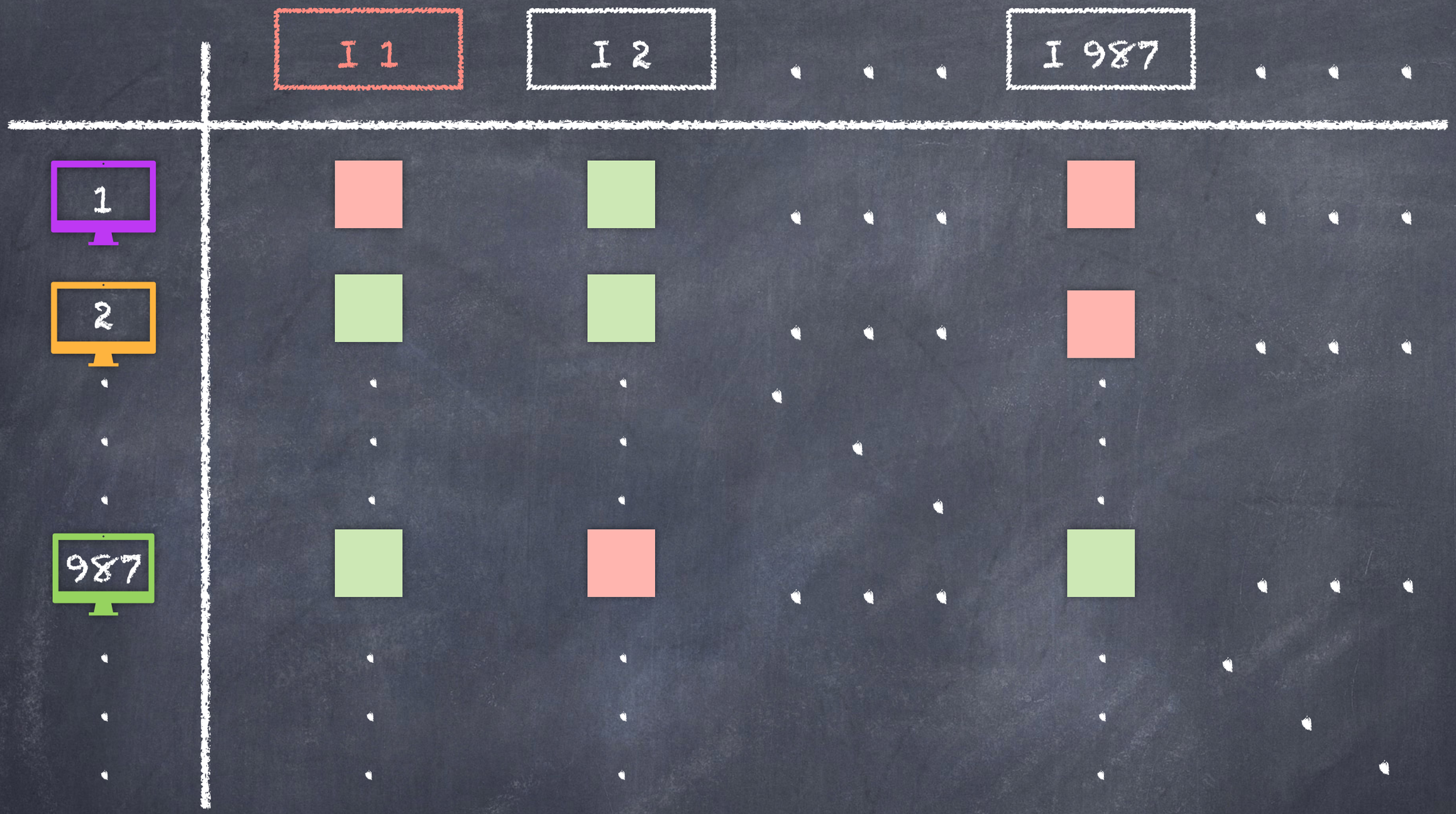
I 1 | I 2 | . . . | I 987 | . . .

1

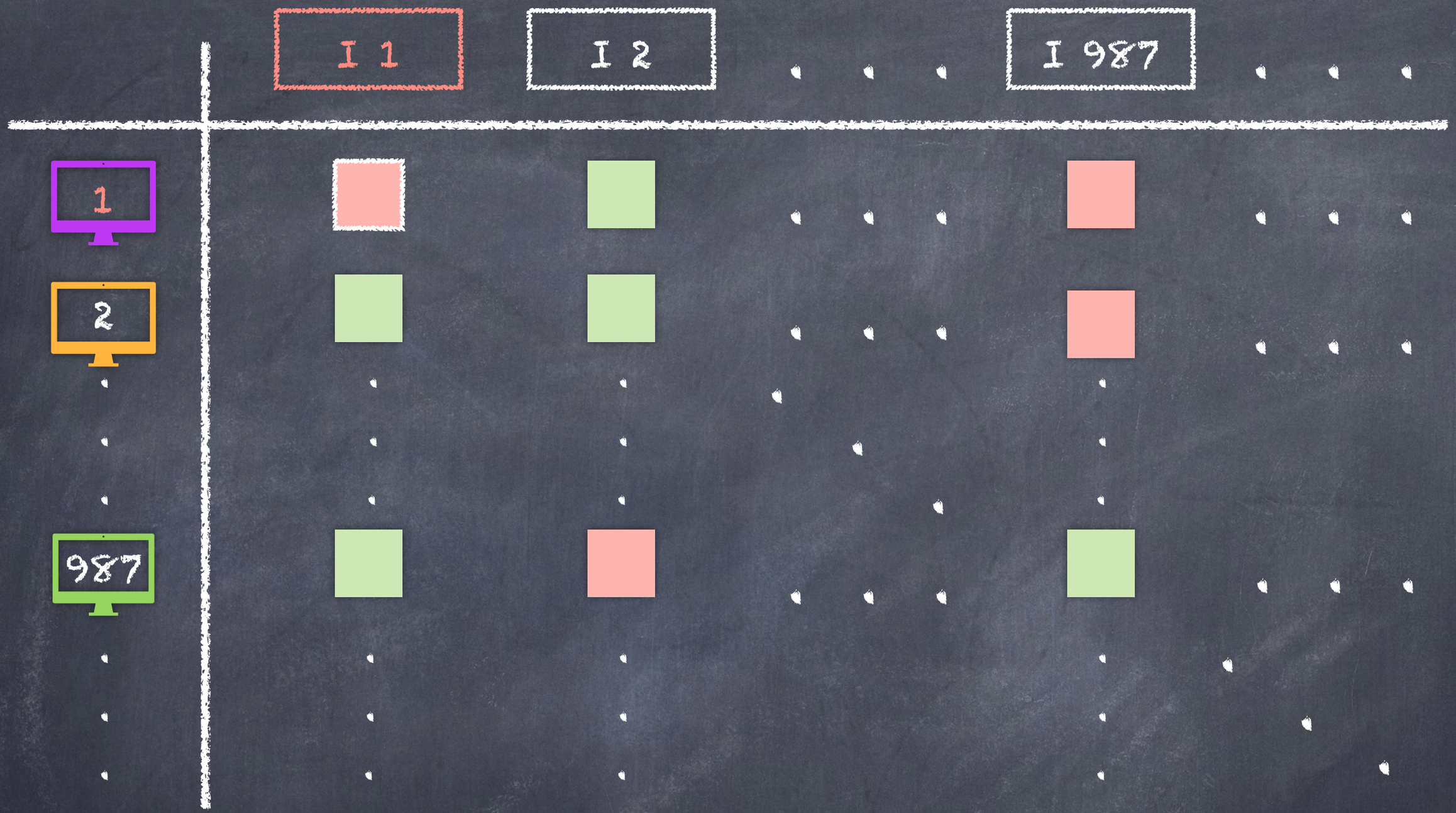
2

987

Row



Row



Row

	I 1	I 2	. . .	I 987	. . .
1			. . .		. . .
2			. . .		. . .
.	.	.	. . .	.	. . .
.	.	.	. . .	.	. . .
.	.	.	. . .	.	. . .
987			. . .		. . .

Row	

I 1

I 2

. . .

I 987

. . .

1

2

.

.

.

987

Row

I 1

I 2

. . .

I 987

. . .

1

2

.

.

.

987

Row

I 1

I 2

. . .

I 987

. . .

1

2

987

Row

I 1

I 2

. . .

I 987

. . .

1

2

.

.

.

987

Row

I 1

I 2

I 987

1

2

987

Row

I 1

I 2

I 987

1

2

987

Row

I 1

I 2

I 987

1

2

987

Row

I 1

I 2

. . .

I 987

. . .

1

2

987

Row

I 1

I 2

I 987

1

2

987

Row

I 1

I 2

I 987

1

2

987

Row

I 1

I 2

I 987

1

2

987

NONE OF THESE

Row



Harry's program

Hermione's Program

using only a simple modification such that



Harry's program



Hermione's Program

using only a simple modification such that

row of Hermione's Program = Row

Input: A number

Hermione's Program



I 1

I 2

I 987

1

2

987

Input: A number

Hermione's Program



The Program

1. Find Input I with this serial number

I 1

I 2

I 987

1

2

987

Input: A number

Hermione's Program



The Program

1. Find Input I with this serial number
2. Find Program P with the serial number

I 1

I 2

I 987

1

2

987

Input: A number





The Program

1. Find Input I with this serial number
2. Find Program P with the serial number
3. Run Harry's program on (P, I)

I 1

I 2

I 987

1

2

987

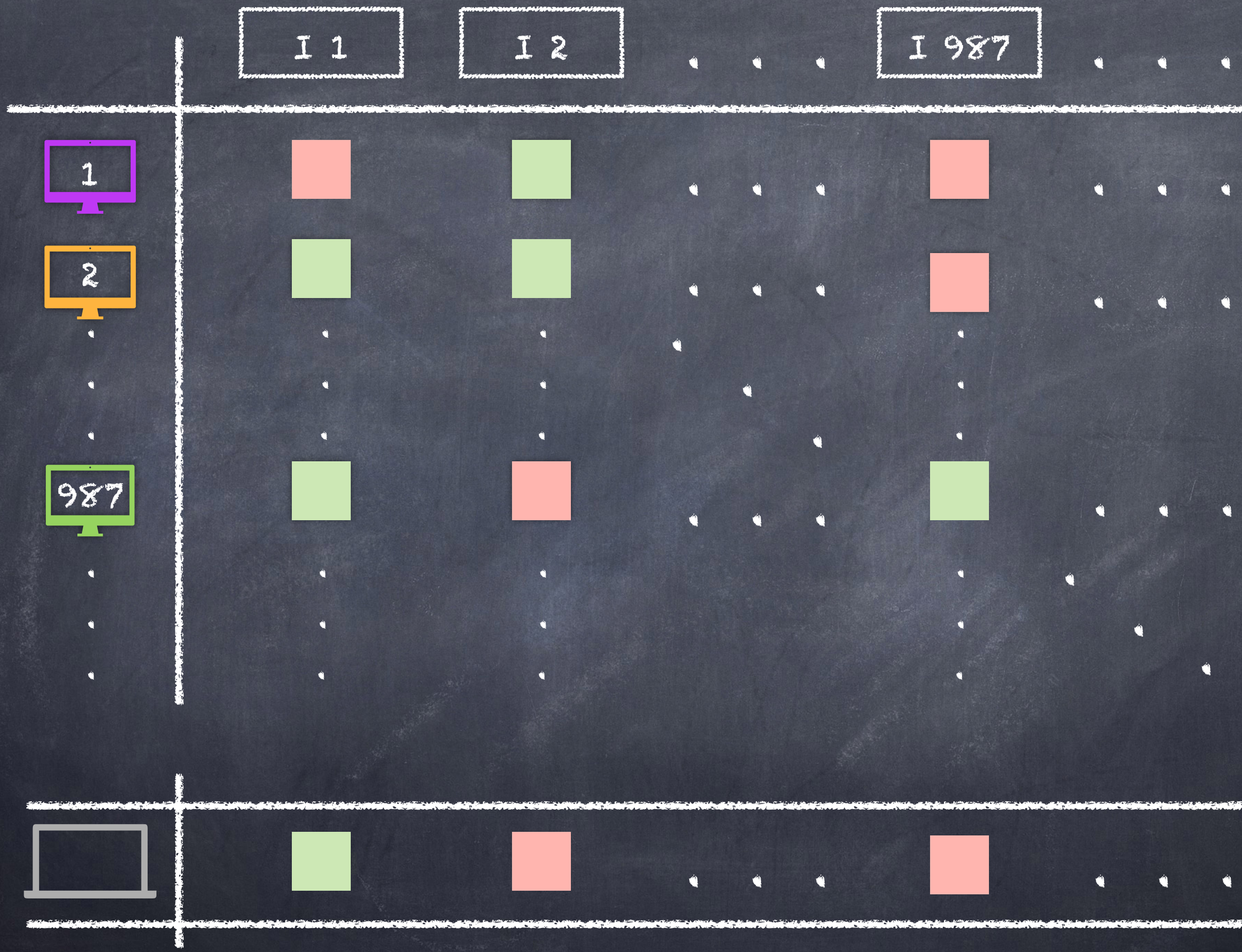
Input: A number

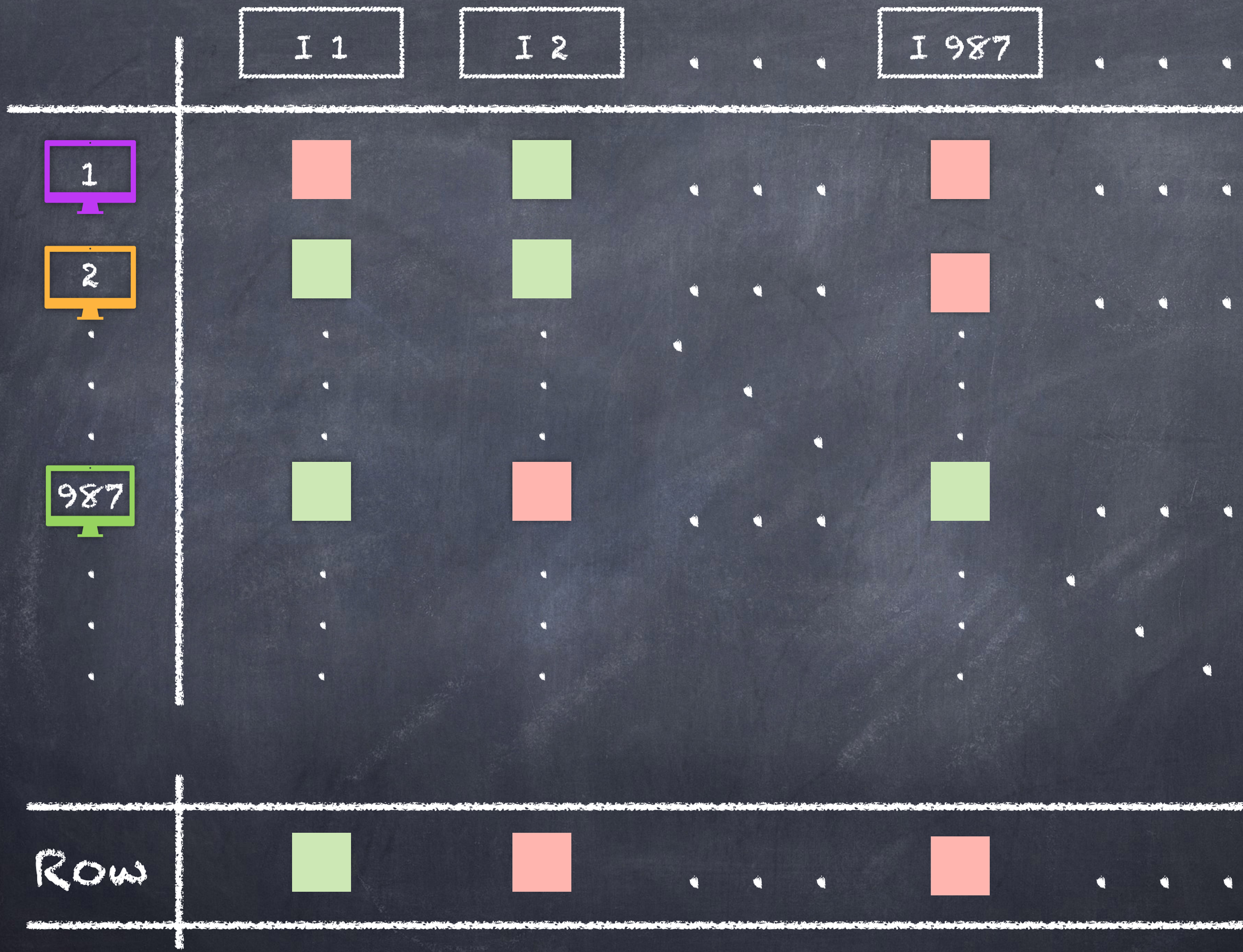
Hermione's Program



The Program

1. Find Input I with this serial number
2. Find Program P with the serial number
3. Run Harry's program on (P, I)
4. Do the opposite of what it says


I 1
I 2
I 987
1
2
987


I 1
I 2
I 987
1
2
987
Row

I 1

I 2

I 987

1

2

987

NONE OF THESE

Row

I 1

I 2

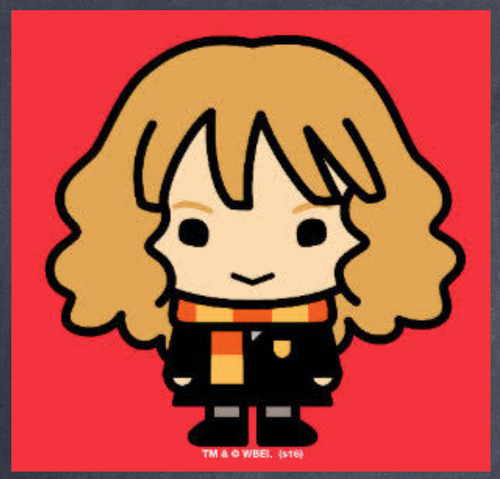
I 987

1

2

987

NONE OF THESE



Hermione's Program

is not in the list

Harry's program



Hermione's Program

Input: A number

Hermione's Program



The Program

1. Find Input I with this serial number
2. Find Program P with the serial number
3. Run Harry's program on (P, I)
4. Do the opposite of what it says

Input: A number

Hermione's Program



The Program

1. Find Input I with this serial number
2. Find Program P with the serial number
3. Run Harry's program on (P, I)
4. Do the opposite of what it says



Hermione's Program

is not in the list





A: Any program
I: Any "text"

Program A

Input I

Harry's Program

Yes, A stops on I /
No, A doesnt stop on I



A: Any program
I: Any "text"

Program A

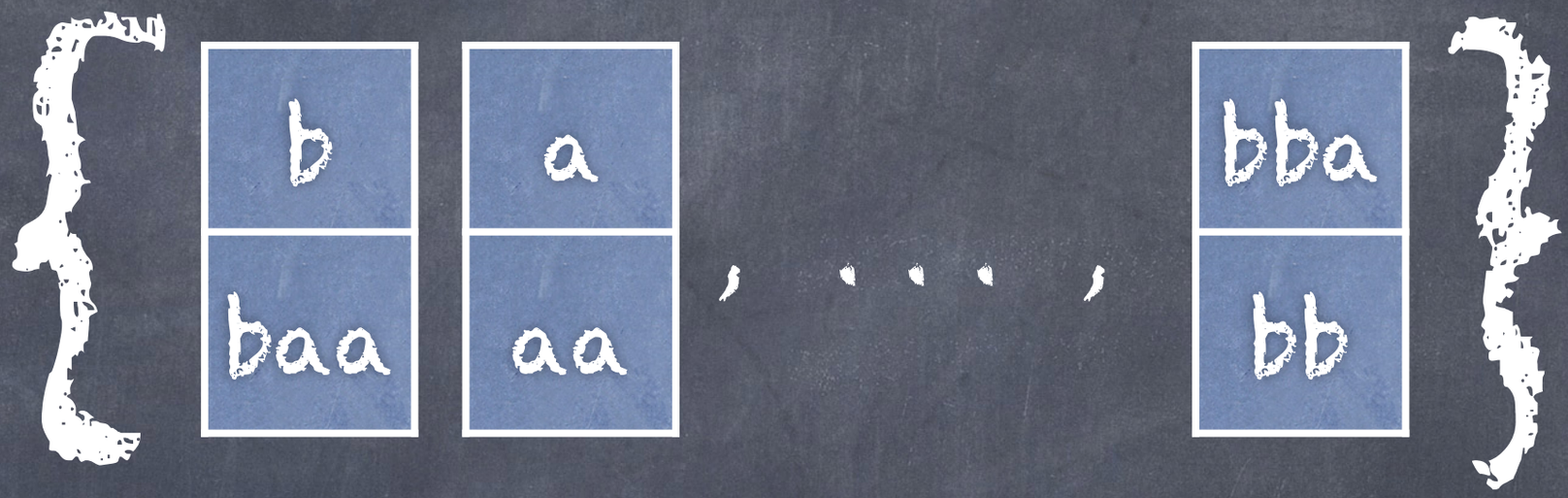
Input I

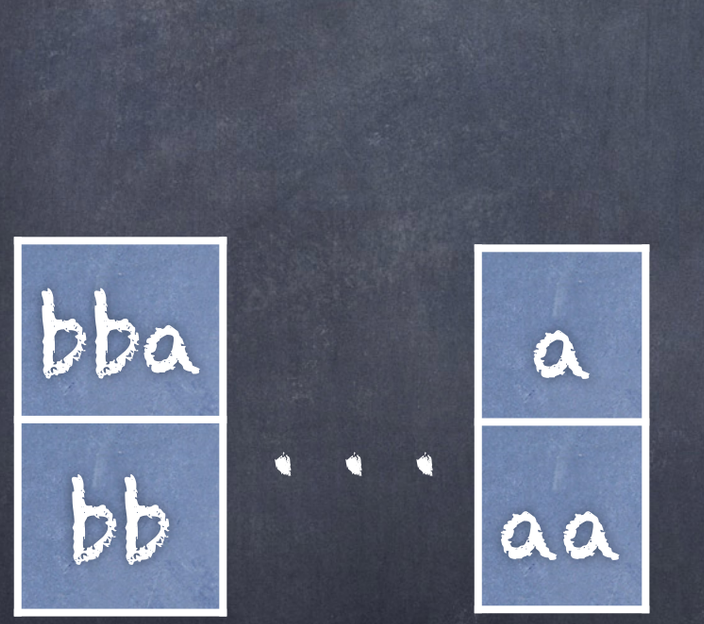
NOT POSSIBLE

Harry's Program

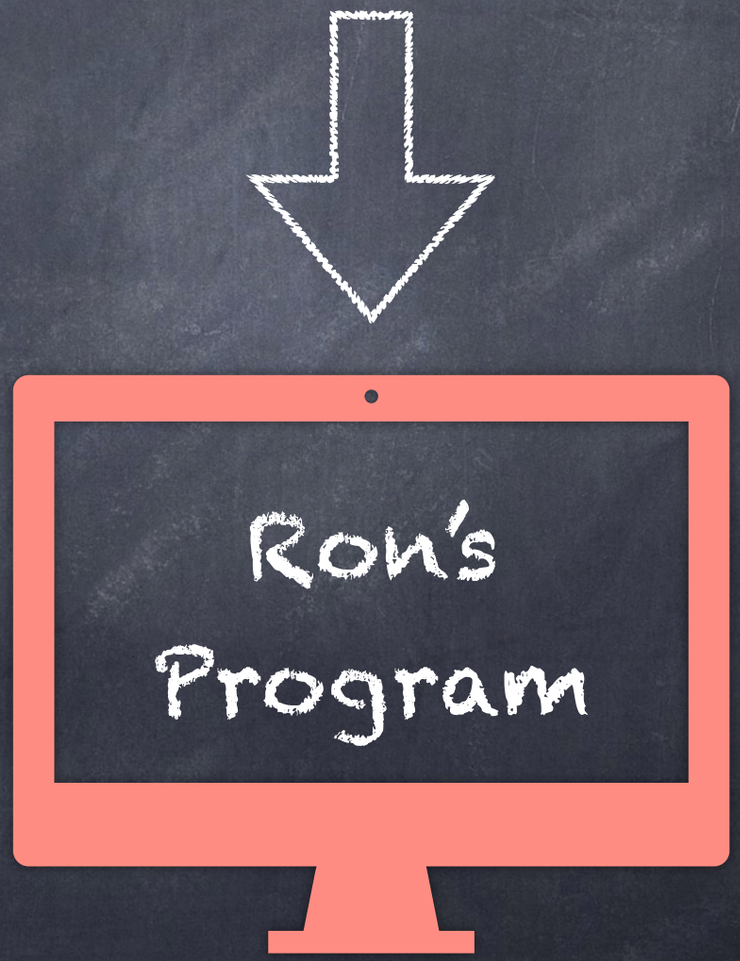
Yes, A stops on I /
No, A doesn't stop on I







Not possible





{ b / baa | a / aa | bba / bb }

possible...

bba / bb | a / aa

...NOT

Not possible

Ron's Program

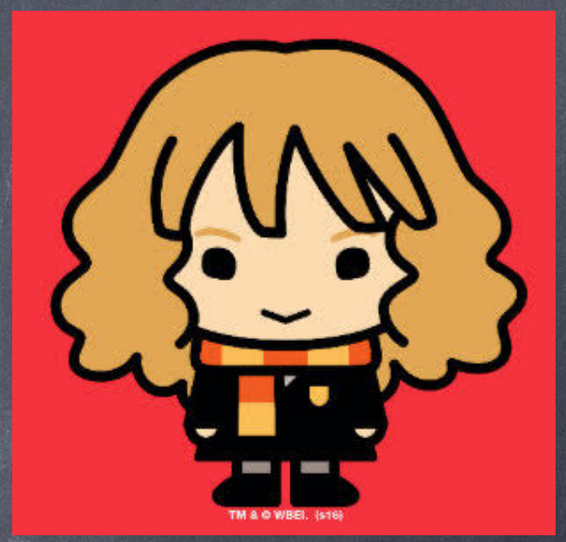








Yes, in fact, there are scientists who devote their entire career to prove interesting things like this !!

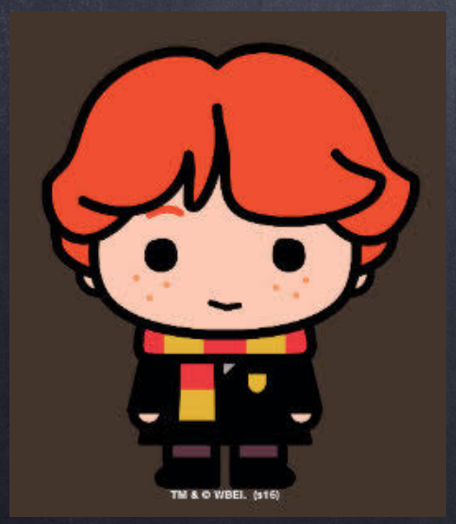






Yes, in fact, there are scientists who devote their entire career to prove interesting things like this !!







Complexity Theory

Problem

Easy?

Hard?

Complexity Theory

Problem

Easy? Hard?

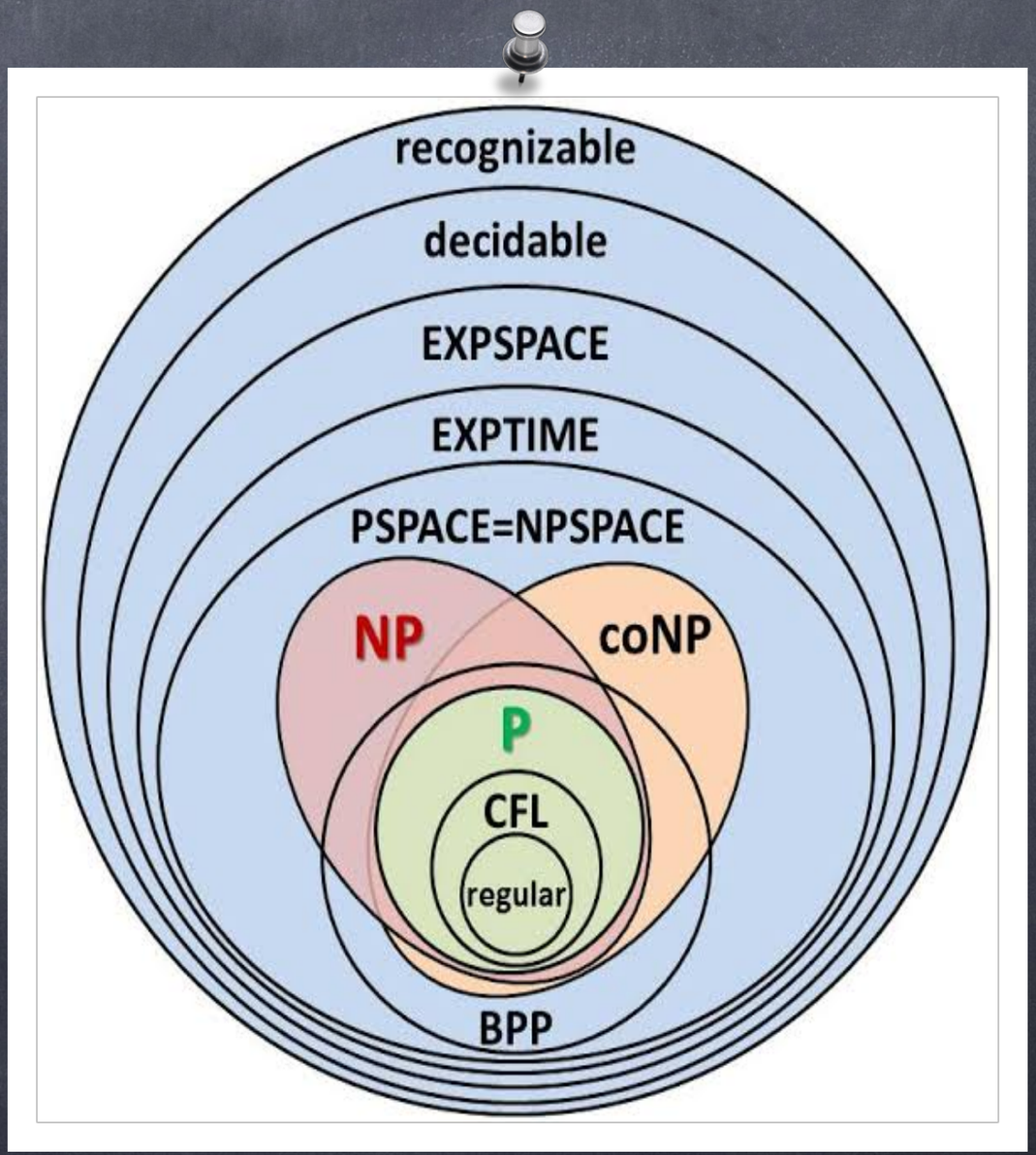
- Time required?
- Memory required?

Complexity Theory

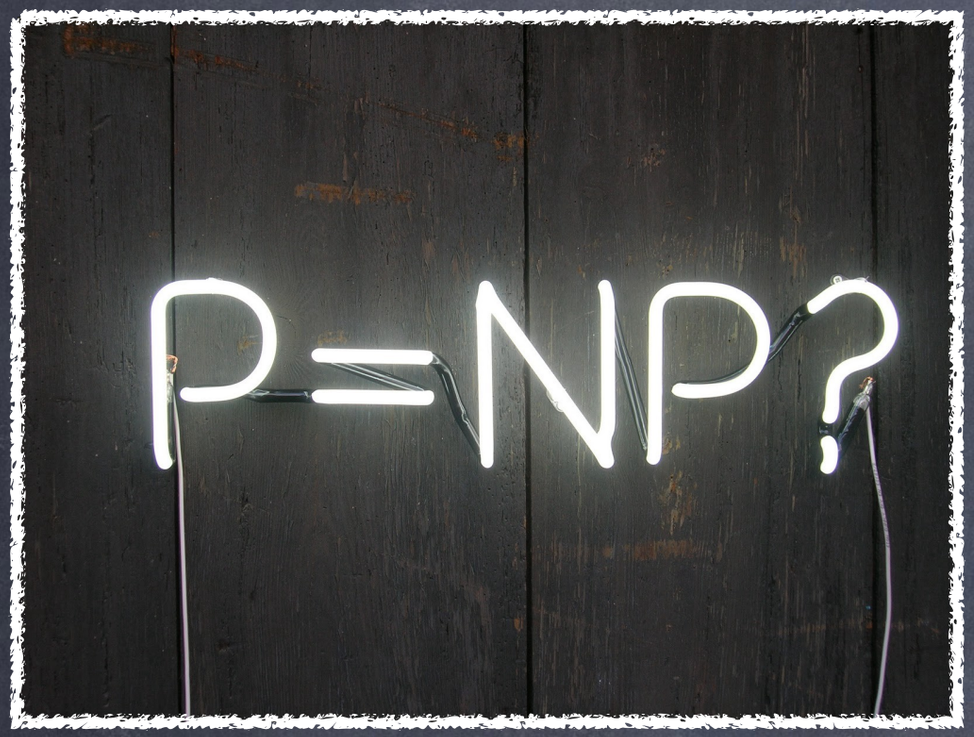
Problem

Easy? Hard?

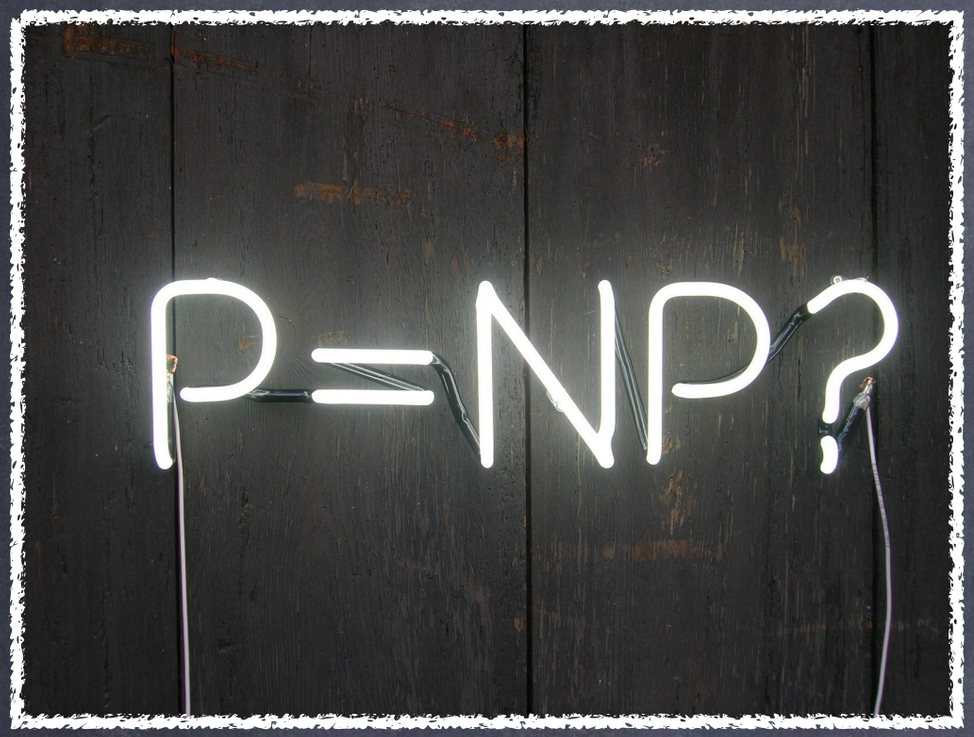
- Time required?
- Memory required?



Theoretical Computer Science

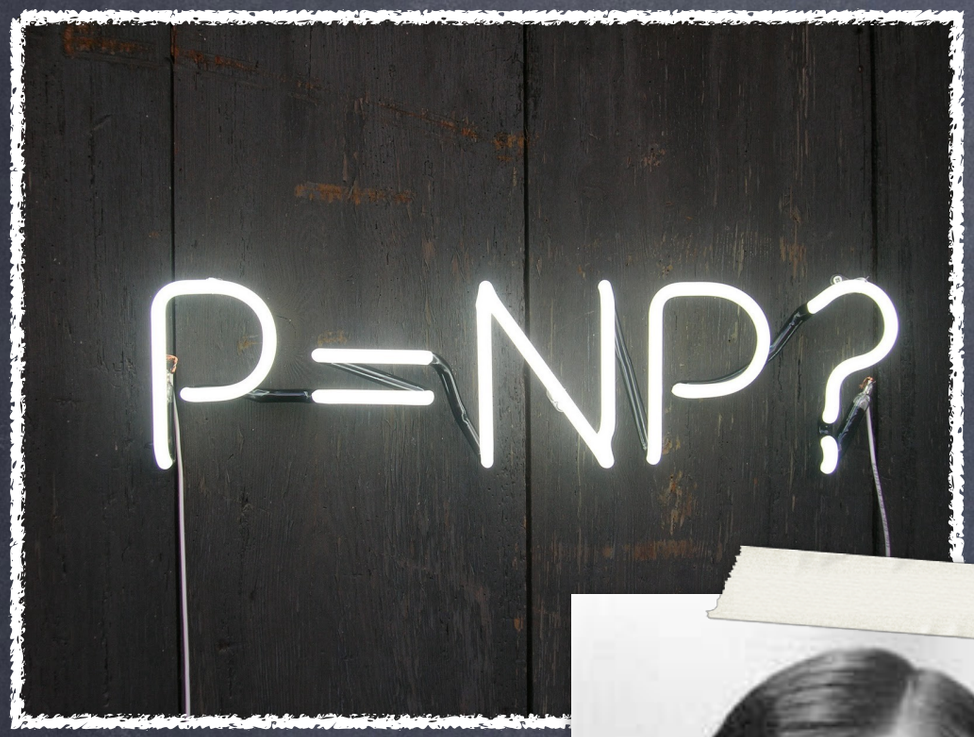


Theoretical Computer Science

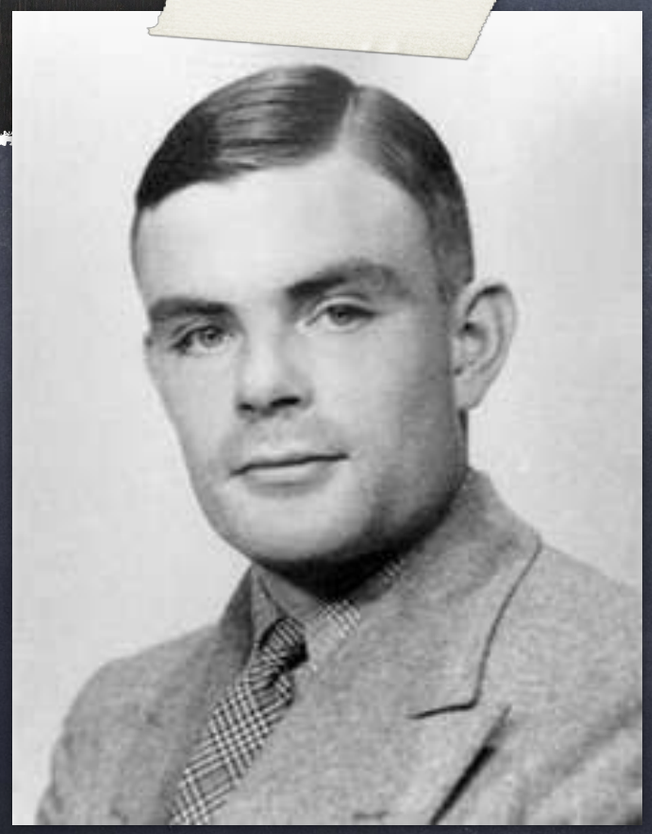


Million Dollars

Theoretical Computer Science

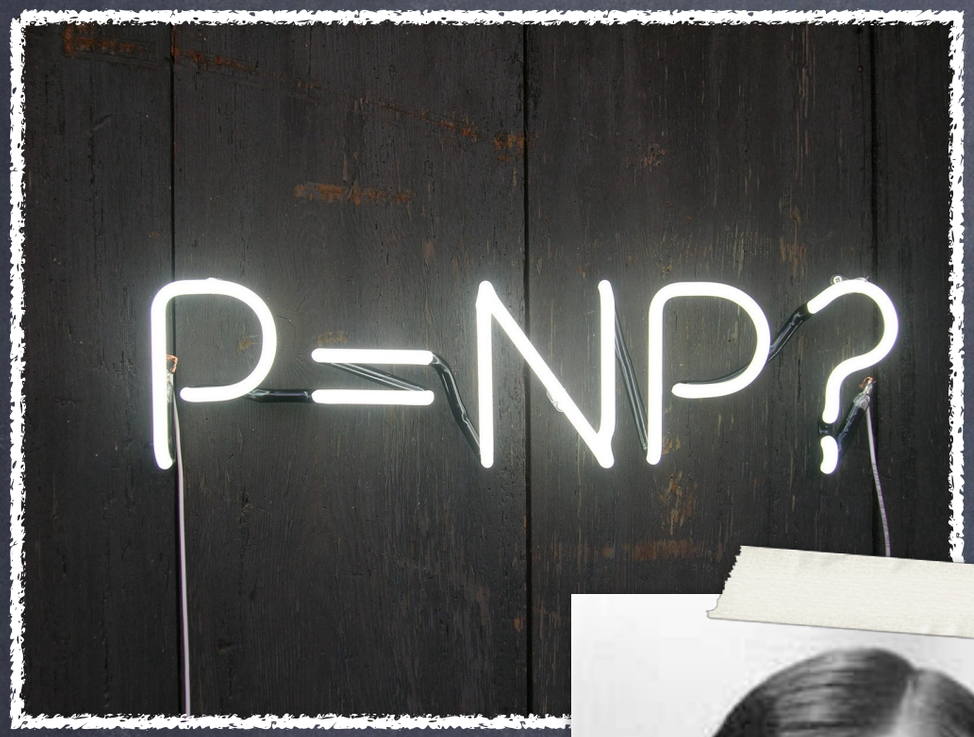


Million Dollars

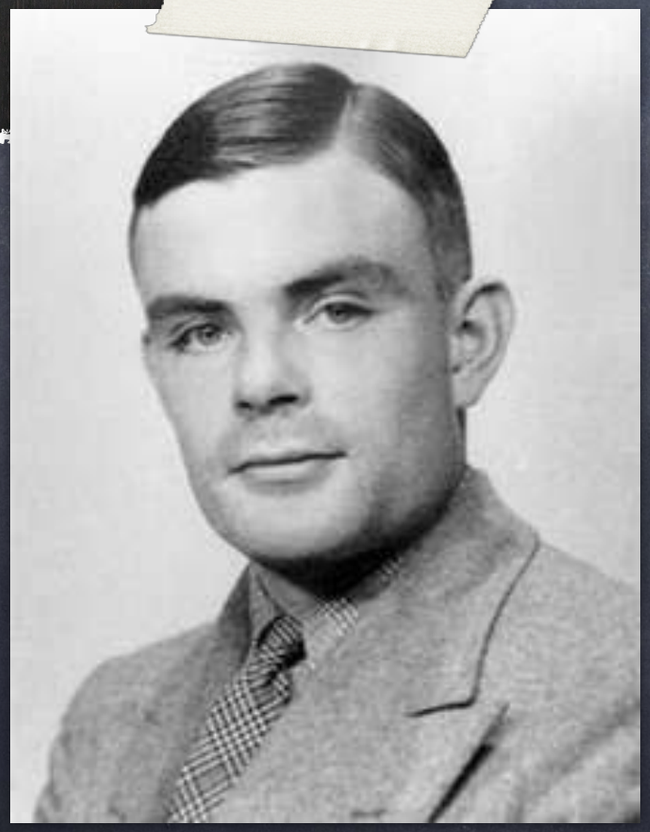


Alan Turing

Theoretical Computer Science



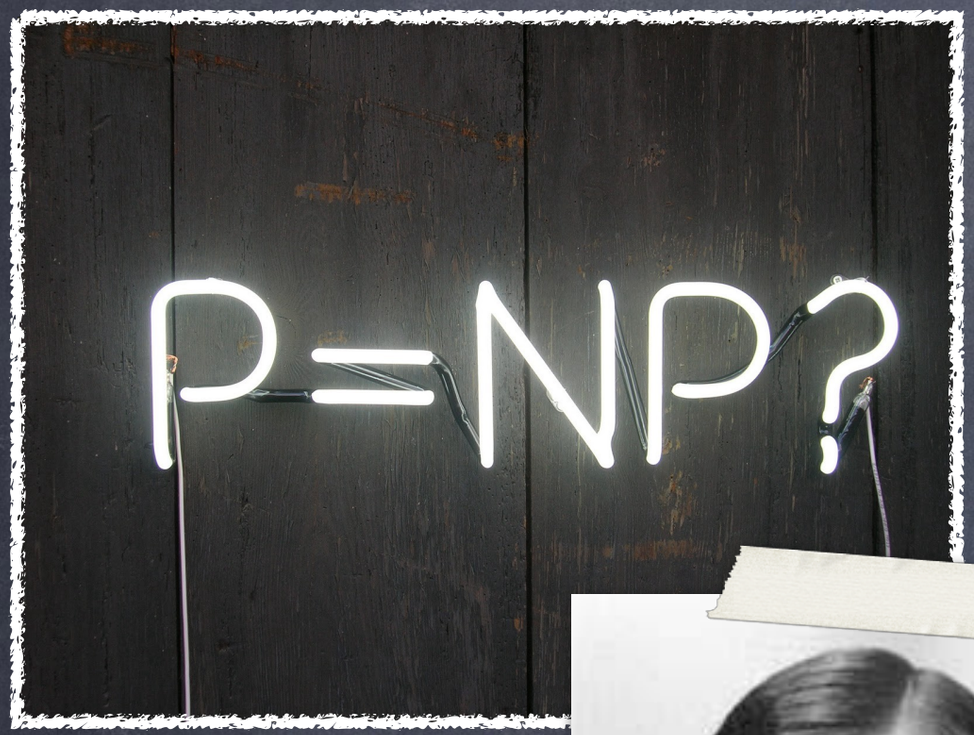
Million Dollars



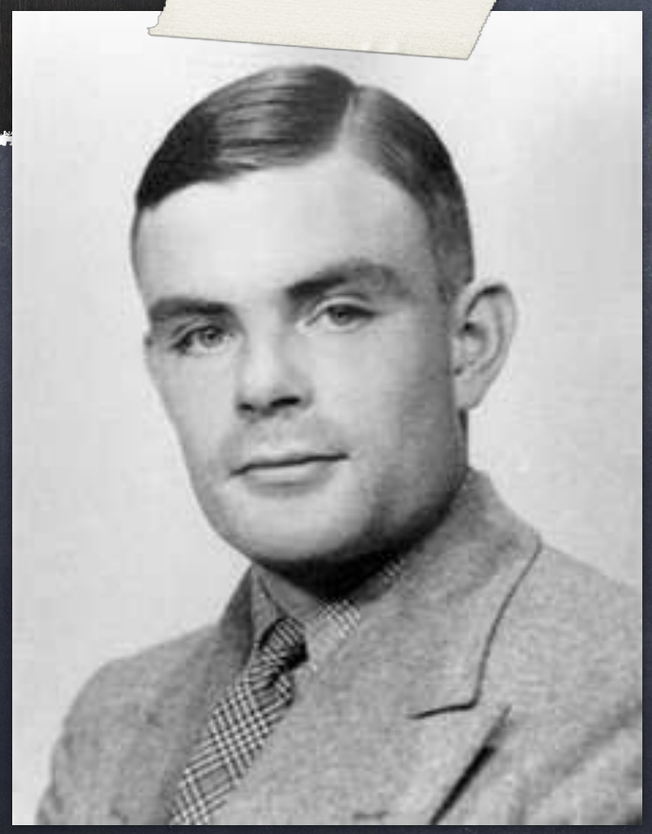
Alan Turing

Existed before real computers were built

Theoretical Computer Science



Million Dollars



Alan Turing

Existed before real computers were built

Many applications to real world problems



Special thanks to:
Meena Mahajan (IMSc)

Also thanks to:
Kshitij Gajjar
Suhail Sherif
Anamay Tengse

Thank you !!!

Any questions about the talk?

Any questions on Maths or CS?

Any questions about higher studies in Mathematical Sciences?

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Email ID: prerona.chatterjee@tifr.res.in

Why Maths is easy

1. To us, other sciences are difficult

Email ID: prerona.chatterjee@tifr.res.in

Why Maths is easy

1. To us, other sciences are difficult

2. Questions are well formed

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Why Maths is easy

1. To us, other sciences are difficult
2. Questions are well formed
3. Statements are either true or false

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5. Girls think differently

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5. Girls think differently
6. Cool people

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