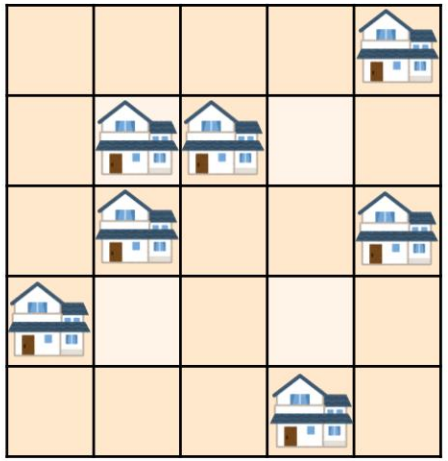
Navigation 2 Editorial

Editorial: E869120 (Masataka Yoneda)

1 Problem summary

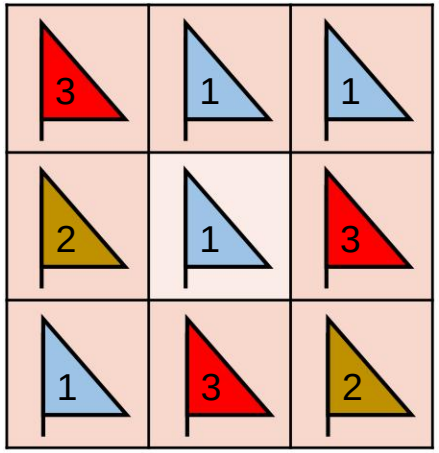
1



× on the square

I have a house

2



Anna is on the flag

can write integers

3

From square (,)

Bruno is the shortest distance

act like moving

Answer please

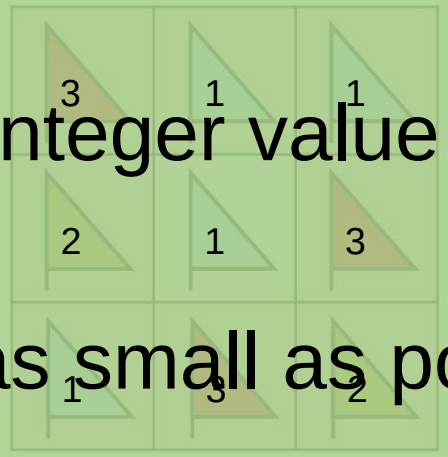
1Problem summary

1

× on the square

I have a house

2



Anna is on the flag

can write integers

3

From square (,)

Bruno is the shortest distance

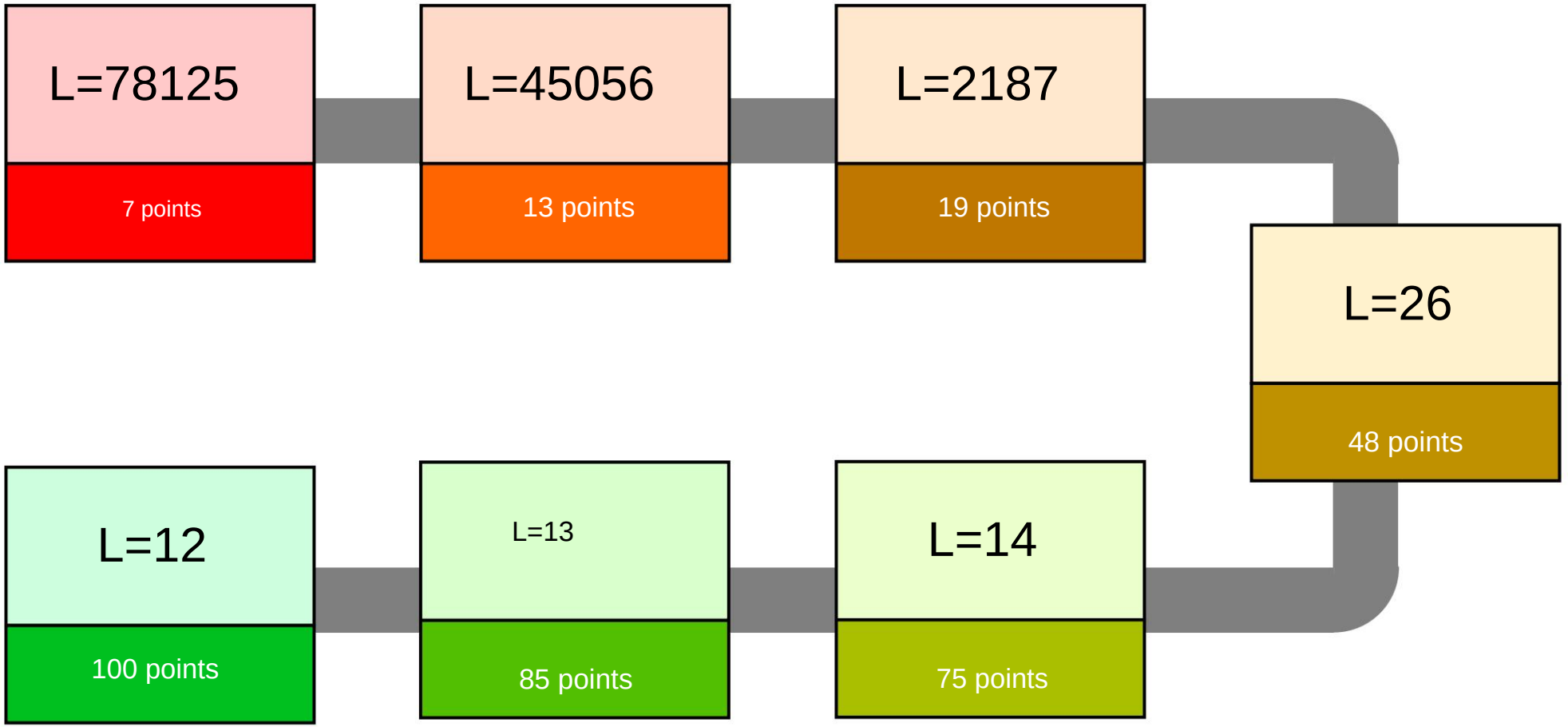
act like moving

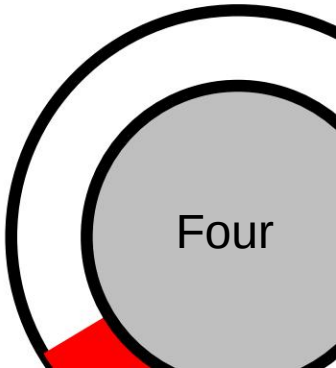
Answer please

The maximum integer value to write to the flag

please make it as small as possible

1Problem summary





L=78125

2 = 78125 (7 points)

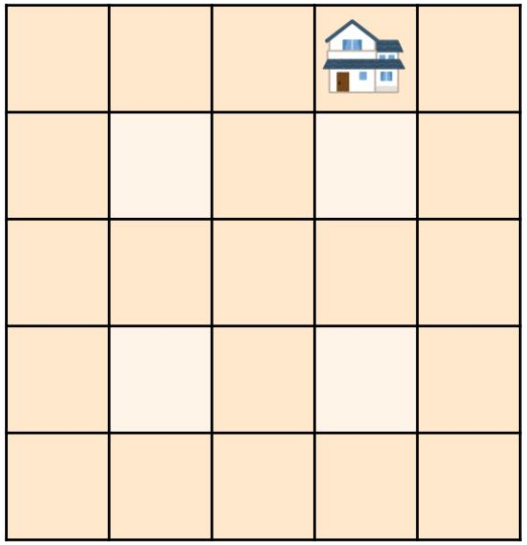
typical

= 1 and other special

consider the case

2 = 78125 (7 points)

Can't you solve it when = 1?



2 = 78125 (7 points)

Can't you solve it when = 1?

0 0 0			2
0 0 0 1 2			
0 0 0 1 2			
0 0 0 1 2			
0 0 0 1 2			

For each square,

``What action should I take when starting from that square?

Is that okay?”

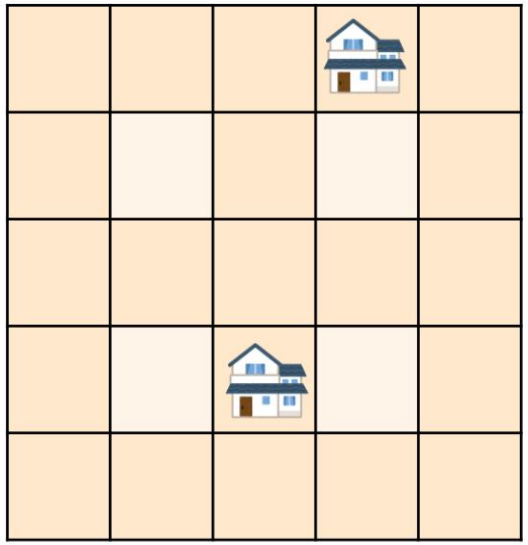
Just write it on the flag (= 5)

*Accurately, it is 1-indexed, so do not record 0.

*This explanation is 0-indexed for ease of understanding.

2 = 78125 (7 points)

Can't you solve it when it is general?



2 = 78125 (7 points)

Can't you solve it when it is general?

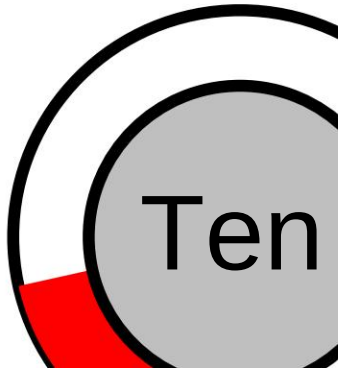
Let's consider the actions for each candidate.

0 0 0			2	
0 0 0 1 2				
0 0 0 1 2				
0 0 0 1 2				
0 0 0 1 2				

Action for candidate 0

0 0 3 2 2				
0 0 3 2 2				
0 0 3 2 2				
0 0		twenty two		
0 0 1 2 2				

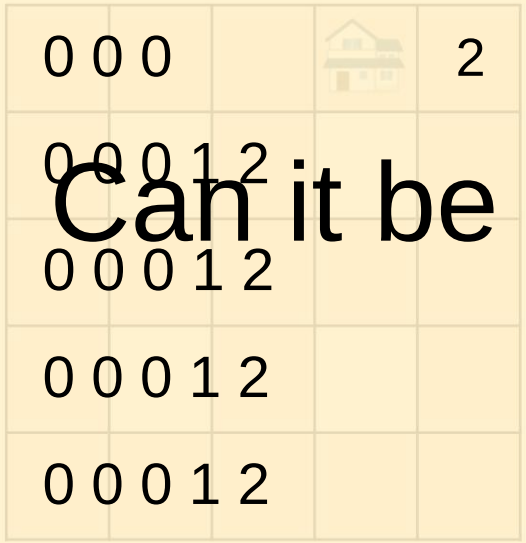
Action for candidate 1

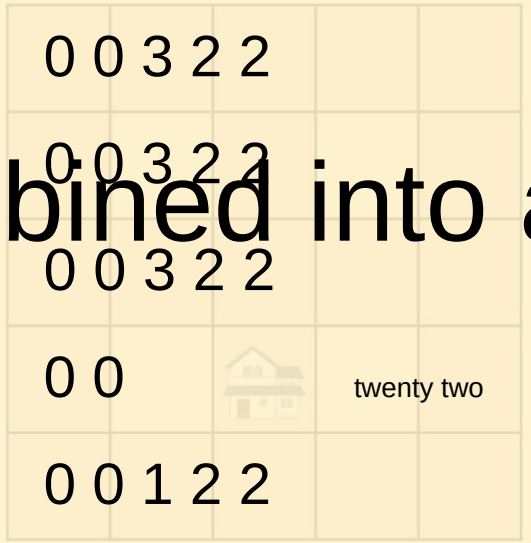


2 = 78125 (7 points)

Can't you solve it when it is general?

Let's consider the actions for each candidate.





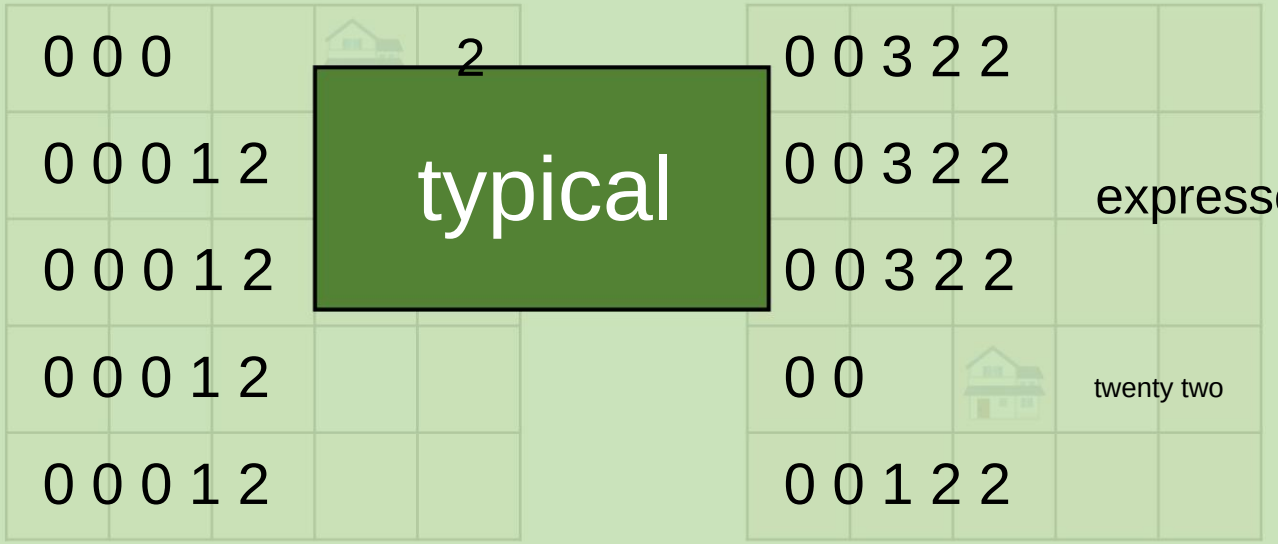
Can it be combined into a single integer?

Action for candidate 0 Action for candidate 1

2 = 78125 (7 points)

Can't you solve it when it is general?

Let's consider the actions for each candidate.



Action for candidate 0 Action for candidate 1

2 = 78125 (7 points)

Can't you solve it when it is general?

Let's combine two tables using quintal numbers!

0 0 0			2
0 0 0 1 2			
0 0 0 1 2			
0 0 0 1 2			
0 0 0 1 2			

0 0 3 2 2			
0 0 3 2 2			
0 0 3 2 2			
0 0		twenty two	
0 0 1 2 2			

0 0 15 14 12			
0 0 15 11 12			
0 0 15 11 12			
0 0 20 11 12			
0 0 5 11 12			

Action for candidate 0 Action for candidate 1

2 = 78125 (7 points)

Can't you solve it when it is general?

Anna: Let's combine two tables using quintal numbers!

0 0 0			2
0 0 0 1 2			
0 0 0 1 2			
0 0 0 1 2			
0 0 0 1 2			

0 0 3 2 2		
0 0 3 2 2		
0 0 3 2 2		
0 0 	twenty two	
0 0 1 2 2		

0 0 15 14 12					
0 0 15 11 12					
0 0 15 11 12					
0 0 20 11 12					
0 0 5 11 12					

Action for candidate 0 Action for candidate 1

2 = 78125 (7 points)

Can't you solve it when it is general?

× + =

ÿ11 recorded

Anna: Let's combine two tables using quintal numbers!

0 0 0			2
0 0 0 1 2			
0 0 0 1 2			
0 0 0 1 2			
0 0 0 1 2			

0 0 3 2 2		
0 0 3 2 2		
0 0 3 2 2		
0 0 	twenty two	
0 0 1 2 2		

0 0 15 14 12		
0 0 15 11 12		
0 0 15 11 12		
0 0 20 11 12		
0 0 5 11 12		

Action for candidate 0 Action for candidate 1

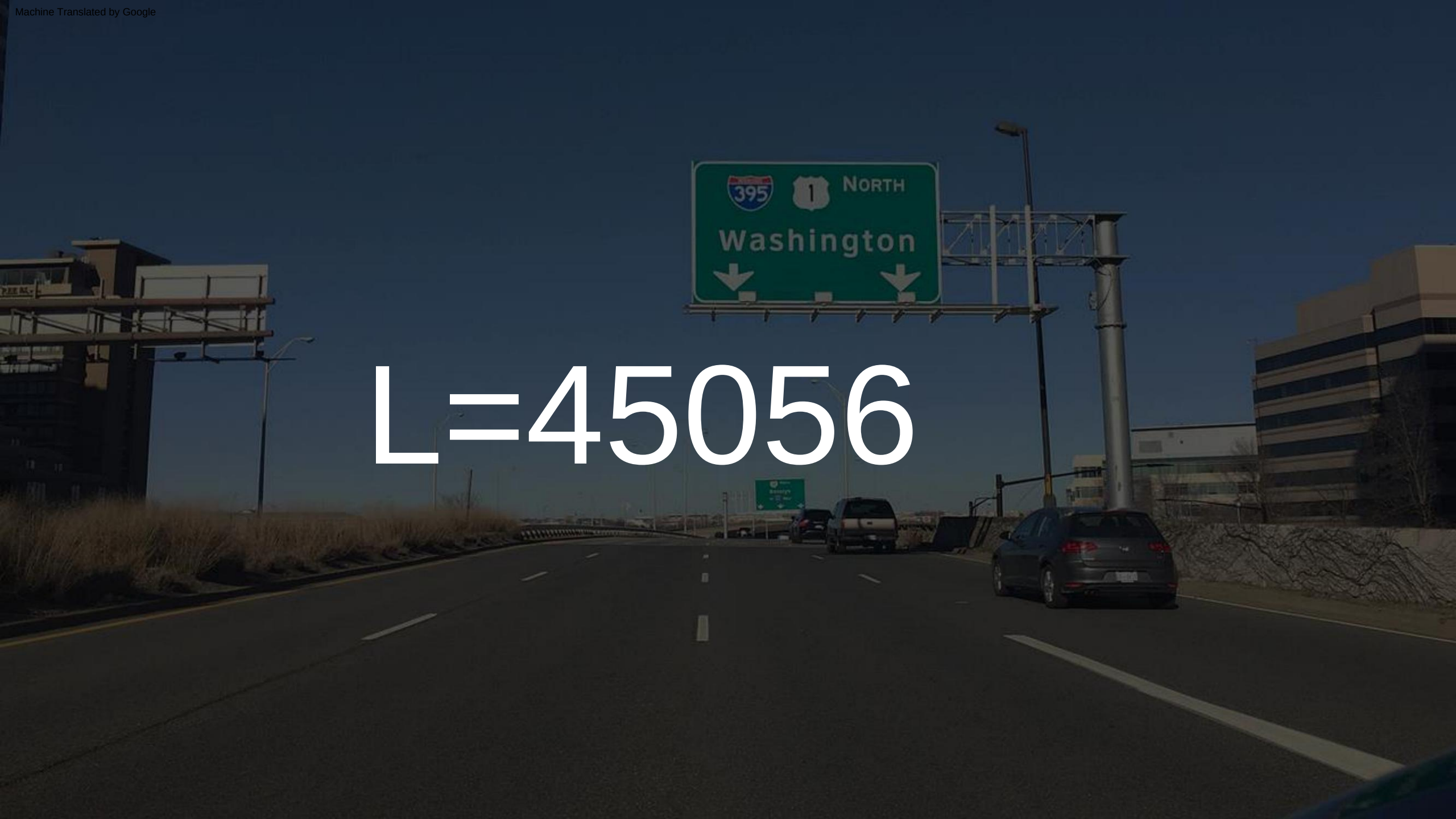
2 = 78125 (7 points)

What is the value of ?

It will be a 7-digit quintal integer, so the maximum value is

=

You can get 7 points so far .



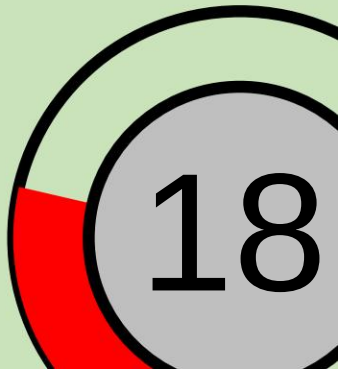
L=45056

2 = 78125 (7 points)

typical

the number of possible states

estimate



2 = 45056 (13 points)

Do the following cases exist?

Candidate 0: Act on square (,) 4

Candidate 1: Act on square (,)

4 Candidate 2: Act on square (,) 4

:

Candidate 6: Act on square (,) 4

2 = 45056 (13 points)

Do the following cases exist?

Candidate 0: Act on square (,) 4 ÿ (0, 0) = (,)

Candidate 1: Act on square (,) 4 ÿ (1, 1) = (,)

Candidate 2: Act on square (,) 4 ÿ (twenty two) = (,)

:

Candidate 6: Act on square (,) 4 ÿ (6, 6) = (,)

2 = 45056 (13 points)

Do the following cases exist?

Candidate 0: Act on square (,) 4 ÿ (0, 0) = (,)

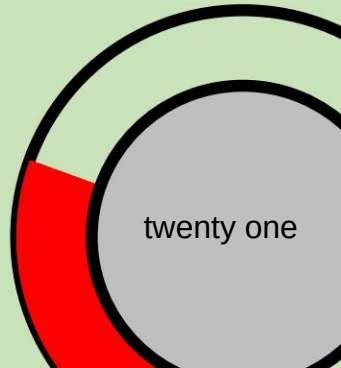
Candidate 1: Act on square (,) 4 ÿ (1, 1) = (,)

Candidate 2: Act on square (,) 4 ÿ (twenty two) = (,)

Since (,) ÿ (,)

Such a case does not exist!

Candidate 6: Act on square (,) 4 ÿ (6, 6) = (,)



2 = 45056 (13 points)

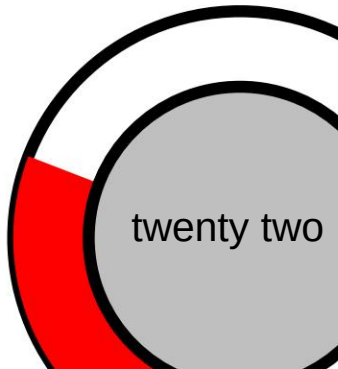
Basically, action 4 never appears more than once.

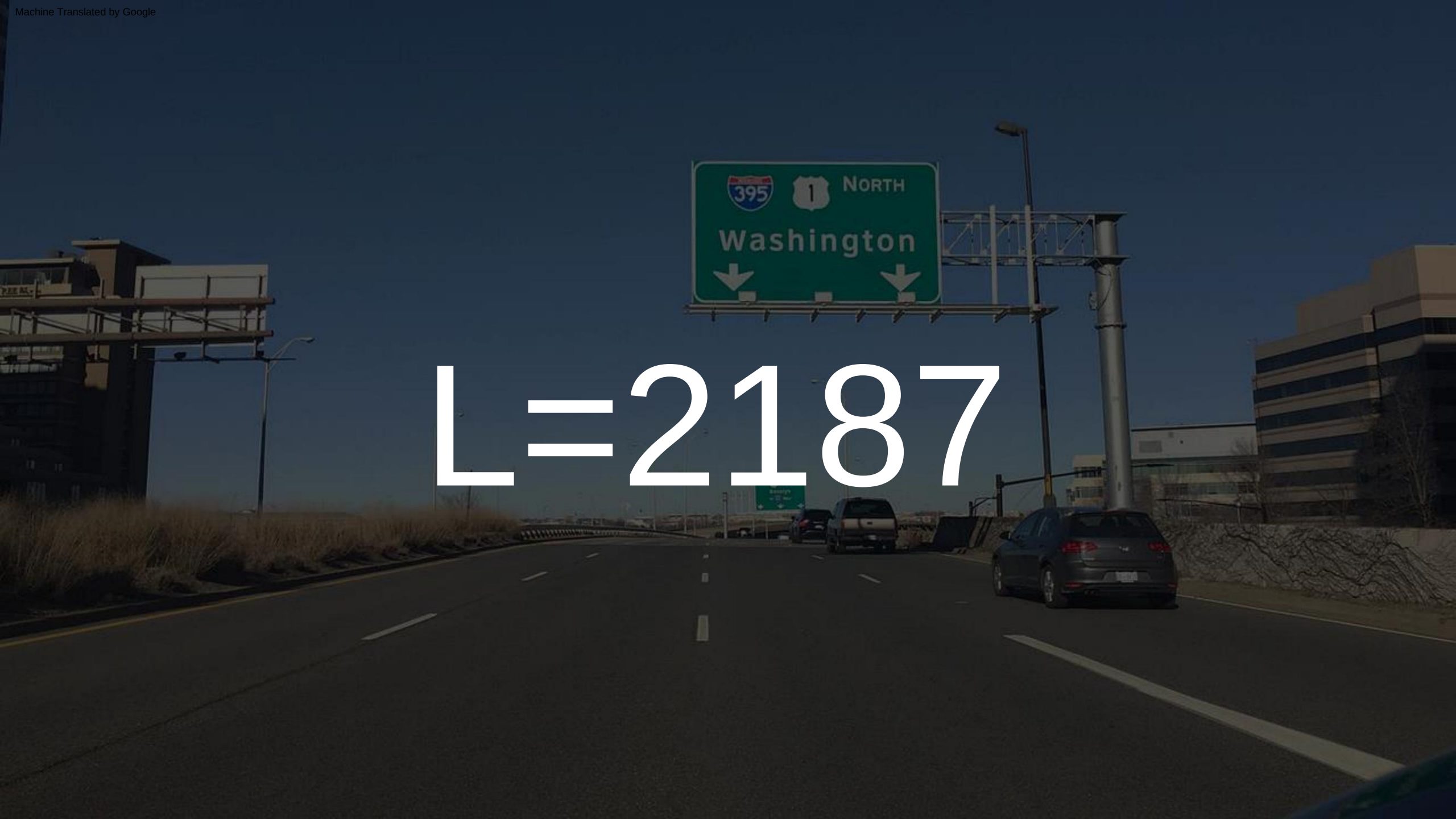
Therefore, we need to find a number such that 0 ÿ ÿ 4 and there are no more than 2 such that = 4.

The number of ways in column (0, 1, …, 6) is 45056 ways

ÿ If you assign an ID to each number sequence in advance,

= 45056 (scores 13 points)





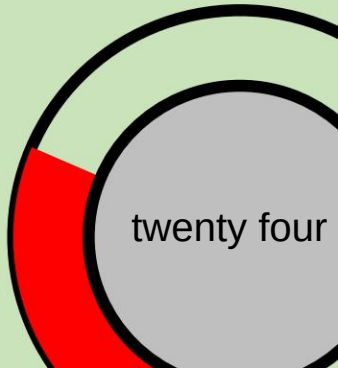
L=2187

3 = 2187 (19 points)

typical

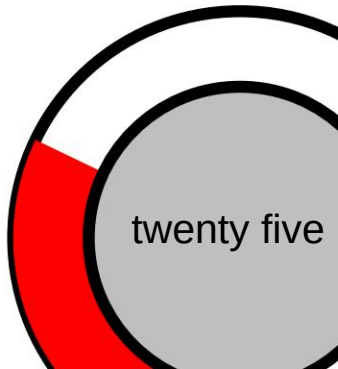
= 1 and other special

consider the case



3 = 2187 (19 points)

If = 1, can you solve it by = 3 ?

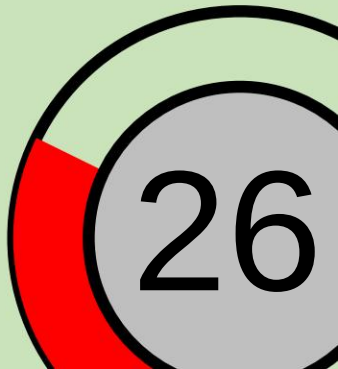


3 = 2187 (19 points)

typical

Record distance mod 3

* JOI 2020 “Stray Cat” 15 points solution



3 = 2187 (19 points)

Consider writing the shortest distance 3 from the candidate house.

2 1 0 1 2				
1 0 2 0 1				
0 2 1 2 0				
twenty one			1 2	
0 2 1 2 0				

Integer written by Anna

3 = 2187 (19 points)

Consider writing the shortest distance 3 from the candidate house.

2	1	0	1	2
1	0	2	0	1
0	2	1	2	0
twenty one			1	2
0	2	1	2	0

An integer written by Anna

2	1	0	1	2
1	0	2	0	1
0	2	1	2	0
2	1	0	1	2
0	2	1	2	0

An integer seen by Bruno

There are four adjacent integers: (1, 0, 0, 0). The shortest distance is 3

If 2 ÿ 1, the distance

is smaller, so the one with 1

Move in the direction.

3 = 2187 (19 points)

Finally, as with the 7-point solution method, think in ternary numbers, and then put an integer on the flag.

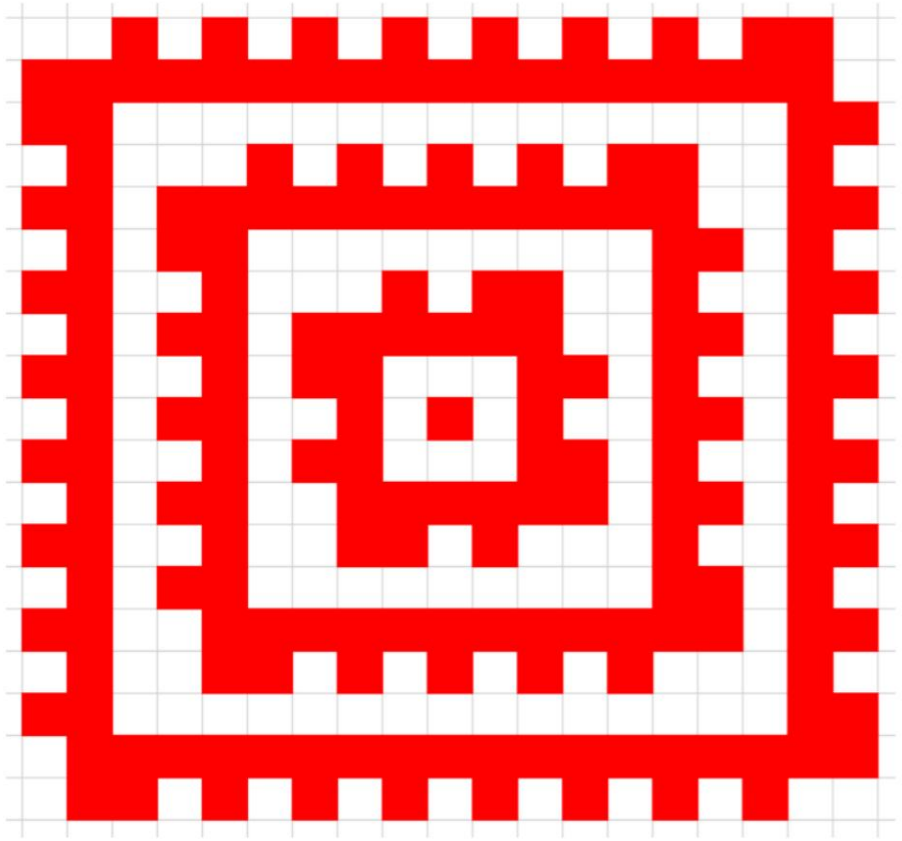
Think about writing. At that time, the value of is

=

You can get 19 points so far.

L=128

4 = 128 (39 points)



Record the number on the flag as shown on the left.

and solve for = 2 when = 1

can do

Then convert it to binary notation

$= 2^{7} = 128$

L=14

5 = 14 (75 points)

In the previous solution method, each square was recorded, but only one square was recorded.

It seems obvious that it would be wasteful to record information on

ÿ “What information should be recorded” for each square

Can't you separate the roles?

5 = 14 (75 points)

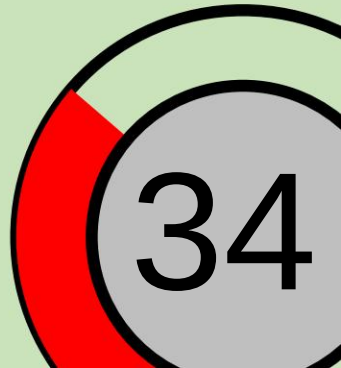
In the previous solution method, each square was recorded, but only one square was recorded.

It seems obvious that it would be wasteful to record information on

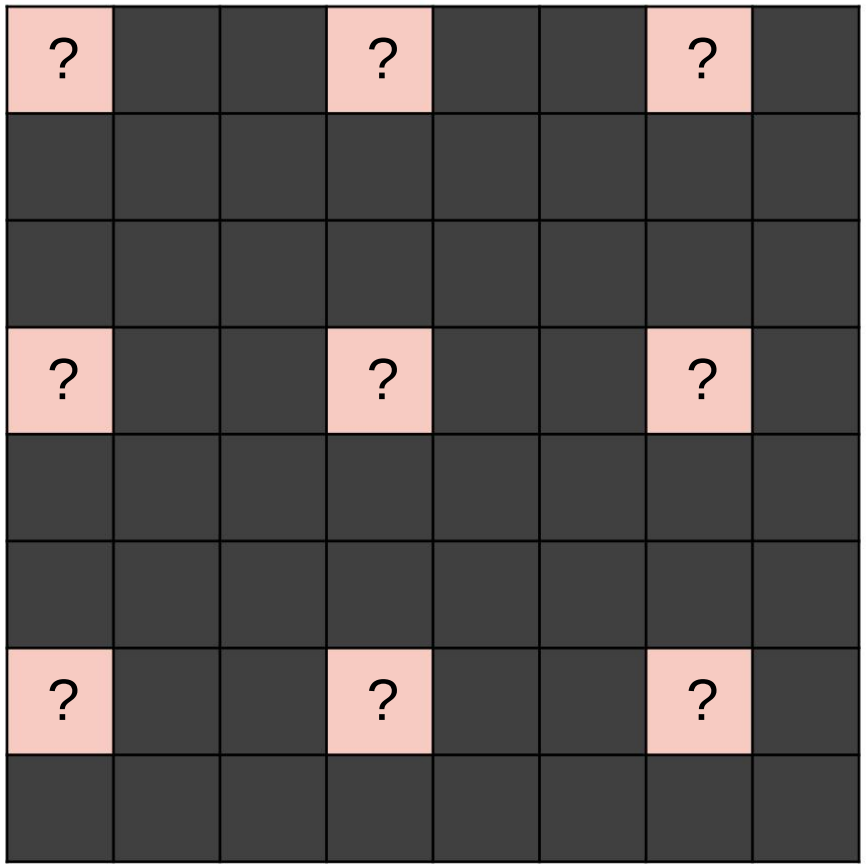
Typical = Special such as 1 ÿ “What information should be recorded” for each square

Can't you separate the roles?

consider the case



5 = 14 (75 points)



= 1, and if the squares are (,), the flags will , but

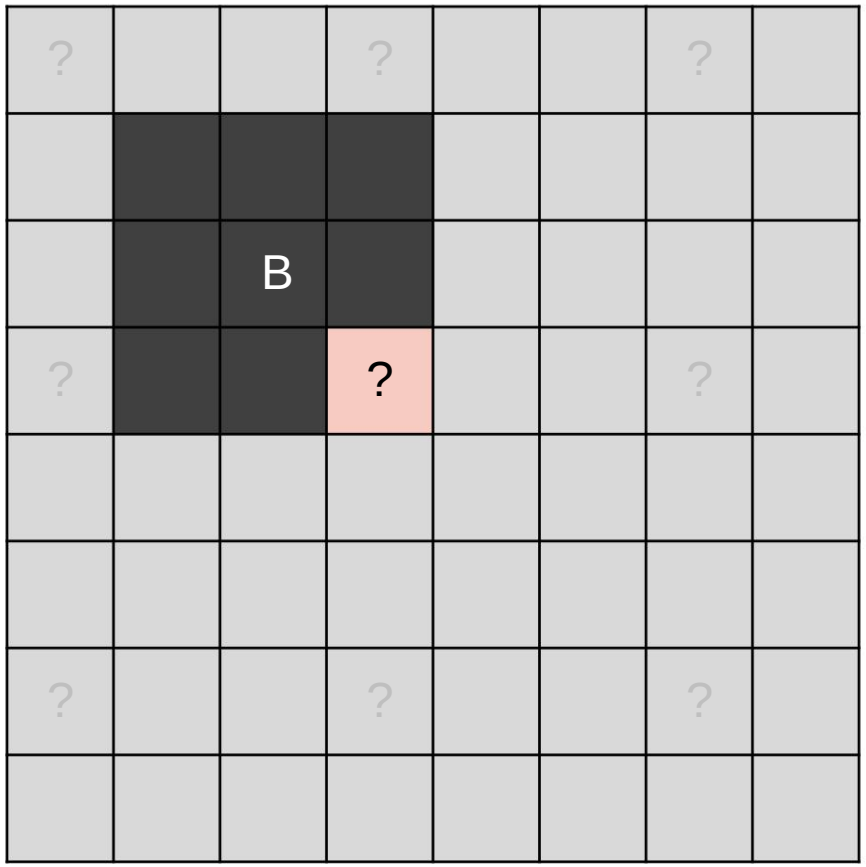
only be numbered in squares that are multiples of both 3 .

Consider a case where it is not possible to record

*The integers written on the flags of other squares are 0.

think as

5 = 14 (75 points)



At that time, Bruno always has one

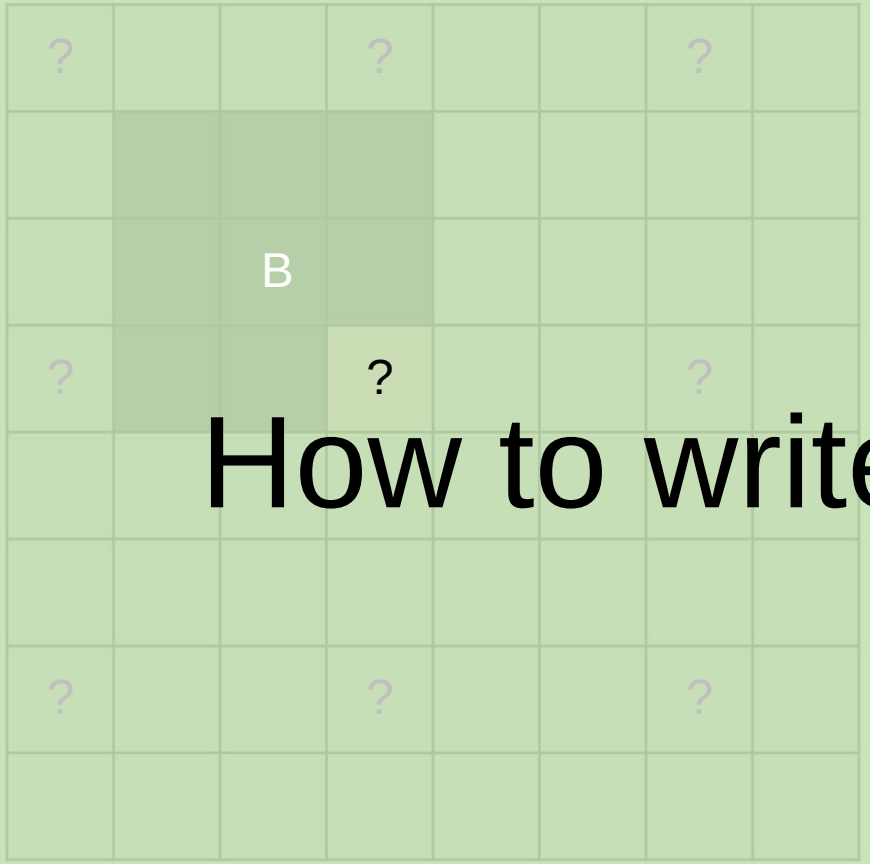
"A square with an integer written on the flag"

exists

Look only at the integer written on this square,

have to decide the answer

5 = 14 (75 points)



At that time, Bruno always has one

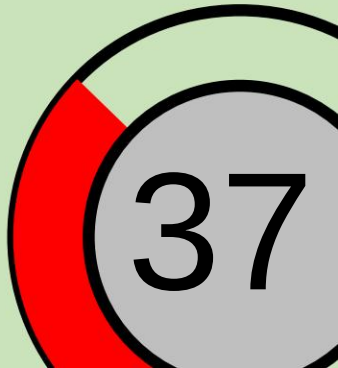
"A square with an integer written on the flag"

exists

How to write an integer to a flag?

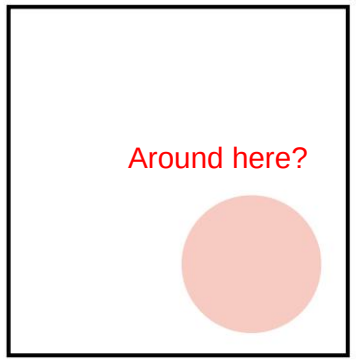
Look only at the integer written on this square,

have to decide the answer



5 = 14 (75 points)

feelings



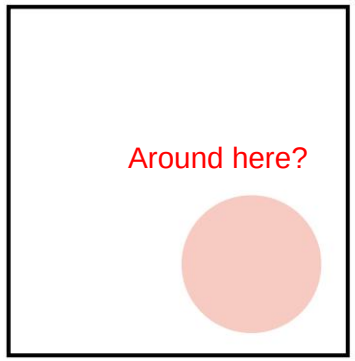
The approximate location of the candidate

It would be good if I knew

observation

5 = 14 (75 points)

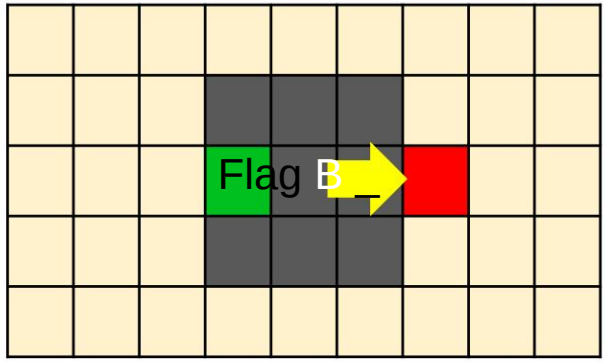
feelings



The approximate location of the candidate

It would be good if I knew

observation



If the coordinates are larger than 2

just go to the right

5 = 14 (75 points)

feelings

observation

Around here?

Flag

The part where the x-coordinate is larger than 2 is

Is it okay to record all the same integers?

The approximate location of the candidate

It would be good if I knew

If the coordinates are larger than 2

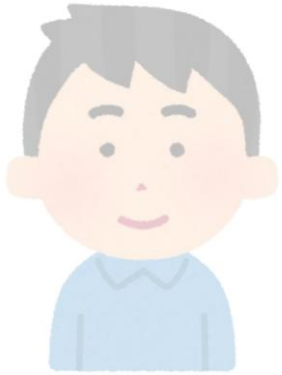
just go to the right

5 = 14 (75 points)

1

Anna's implementation

2



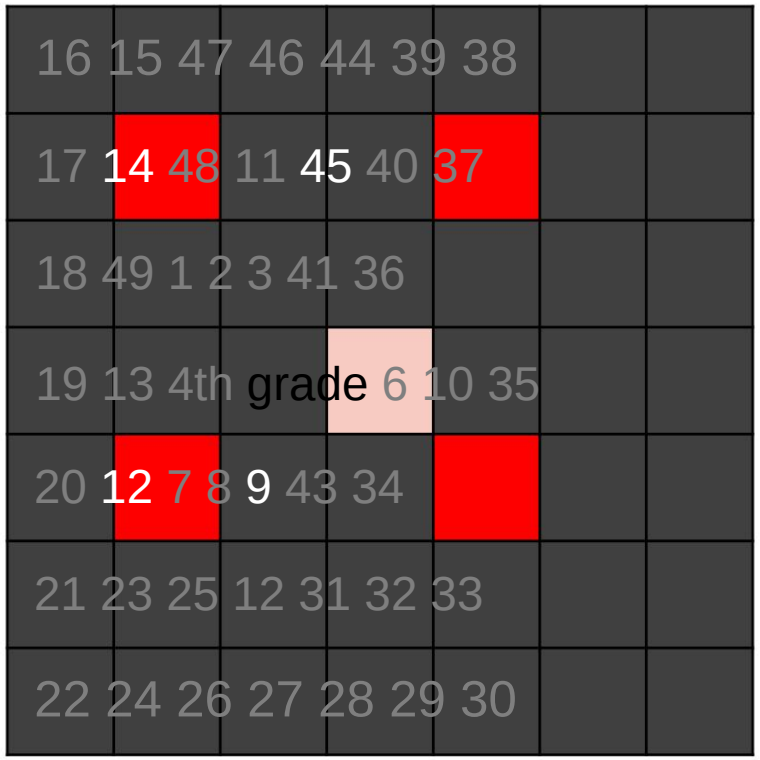
Bruno implementation

3

generalized to = 7

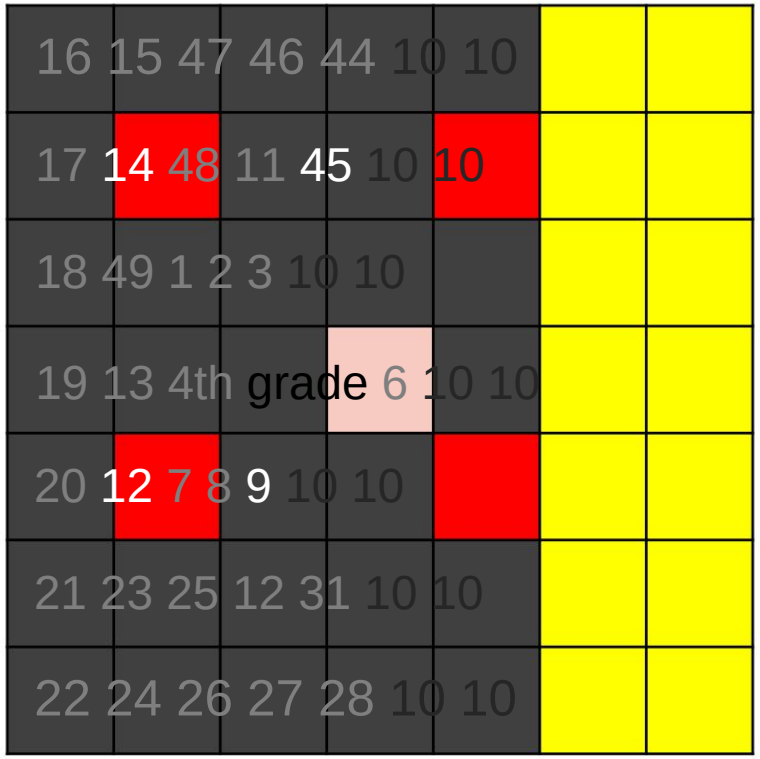
5 = 14 (75 points) Anna

If we record separate values with = 1, we get:



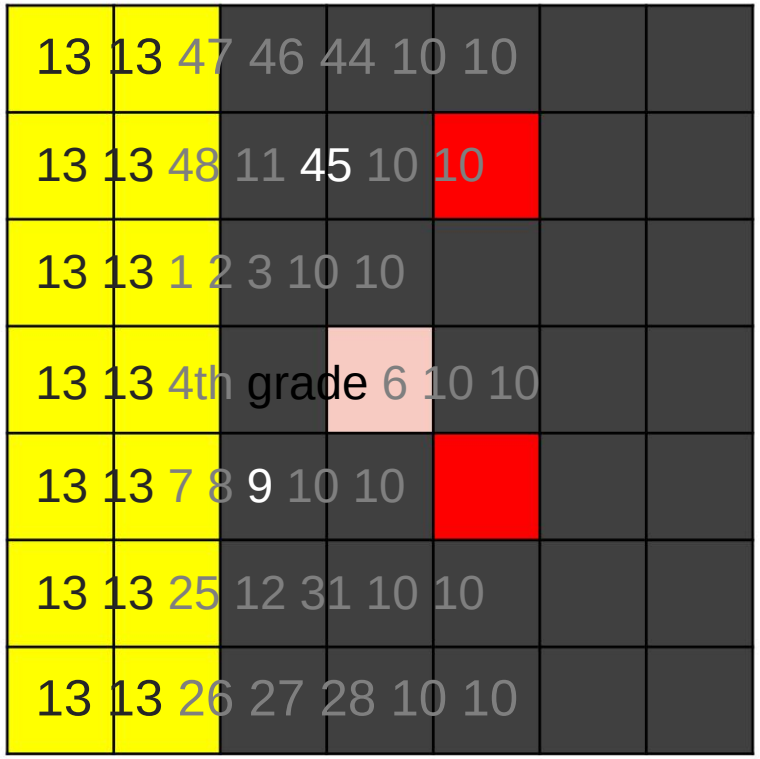
5 = 14 (75 points) Anna

If the coordinates are greater than 2, use the same number



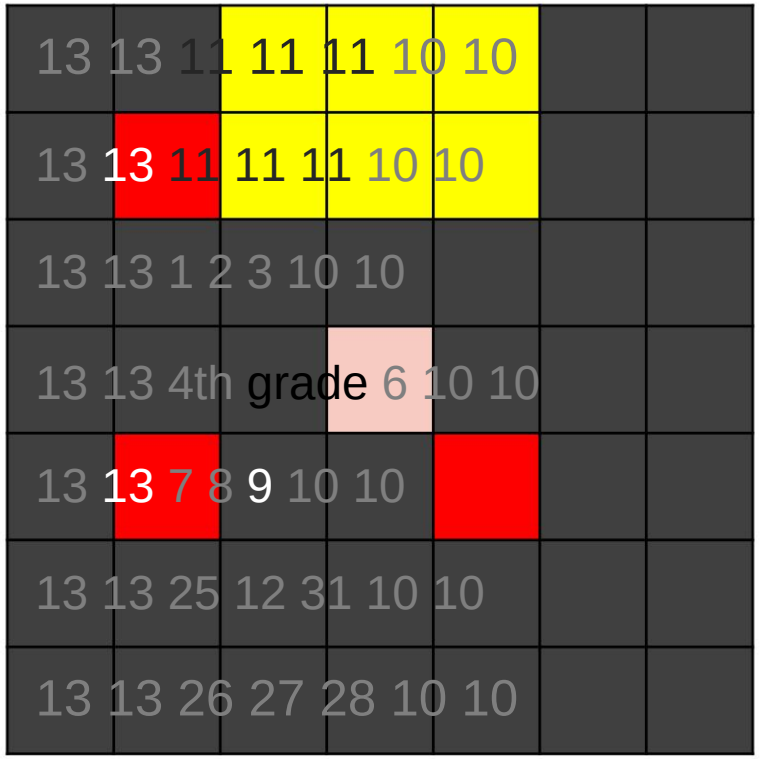
5 = 14 (75 points) Anna

If the coordinates are smaller than 2, use the same number



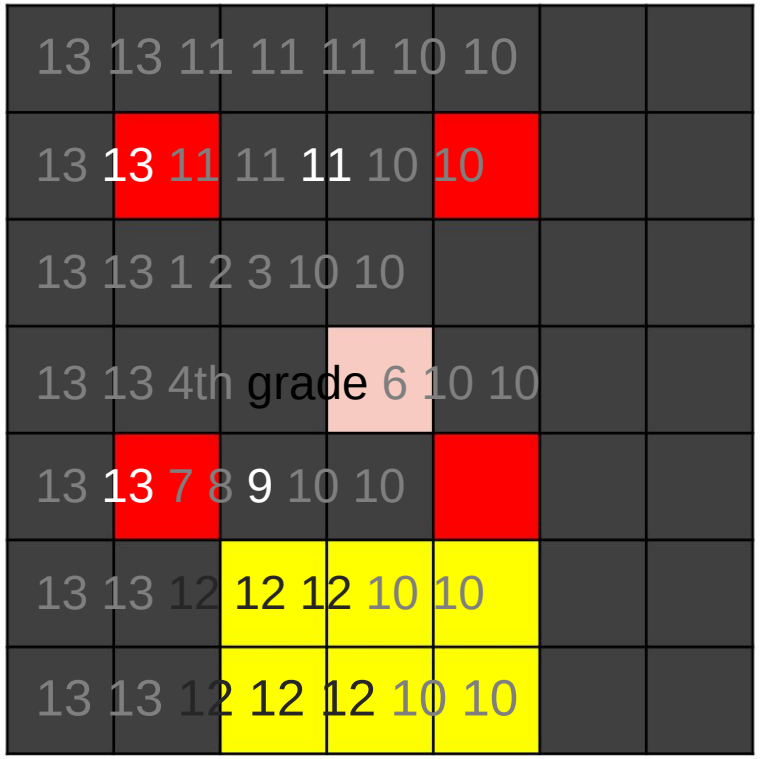
5 = 14 (75 points) Anna

If the coordinates are greater than 2, use the same number



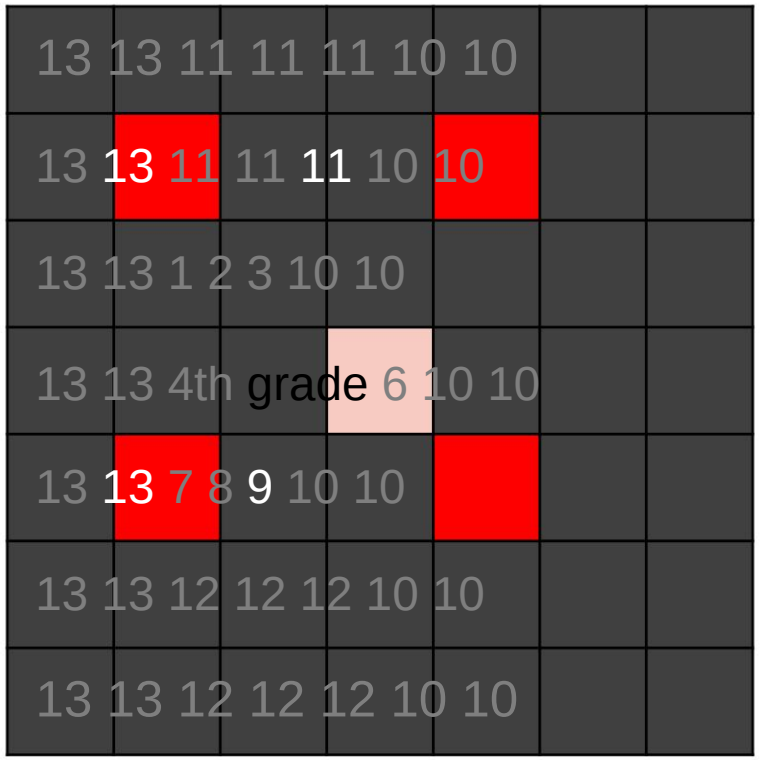
5 = 14 (75 points) Anna

If the coordinates are smaller than 2, use the same number



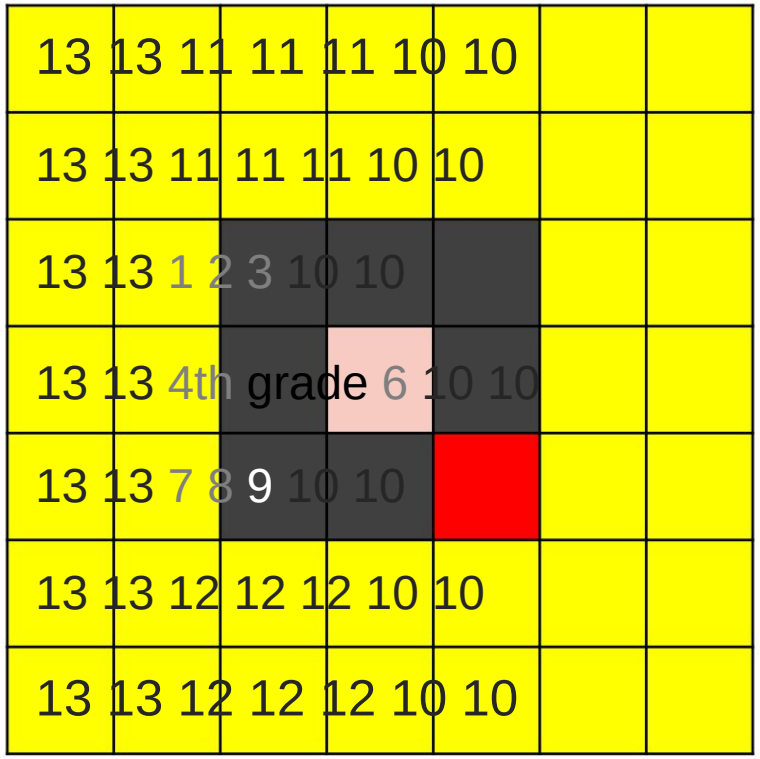
5 = 14 (75 points) Anna

In the end, Anna can just write an integer like this (if the candidate is in the middle)



5 = 14 (75 points) Anna

If the coordinates are smaller than 2, use the same number



5 = 14 (75 points)

1

Anna's implementation

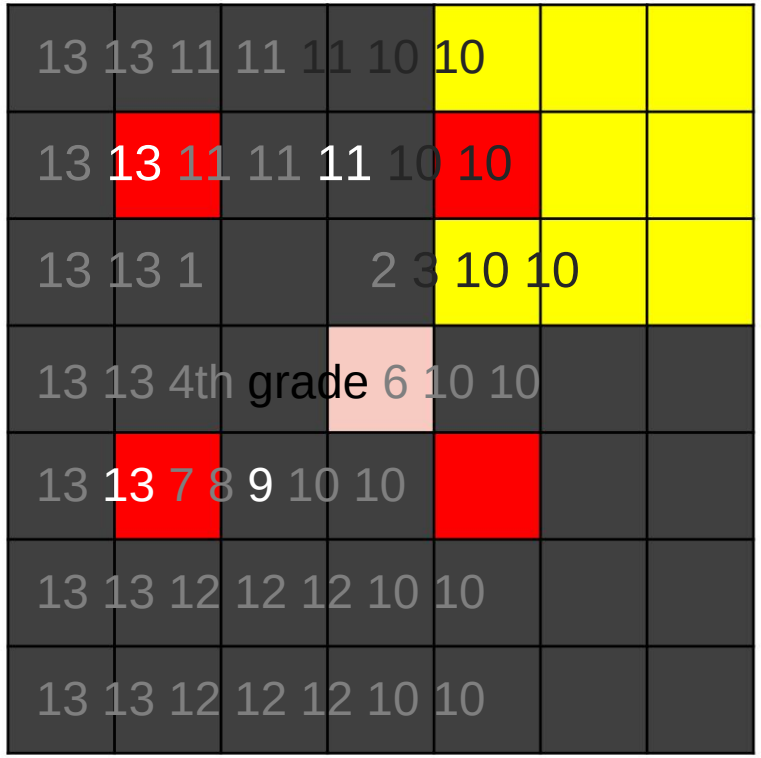
2

Bruno implementation

3

generalized to = 7

5 = 14 (75 points) Bruno

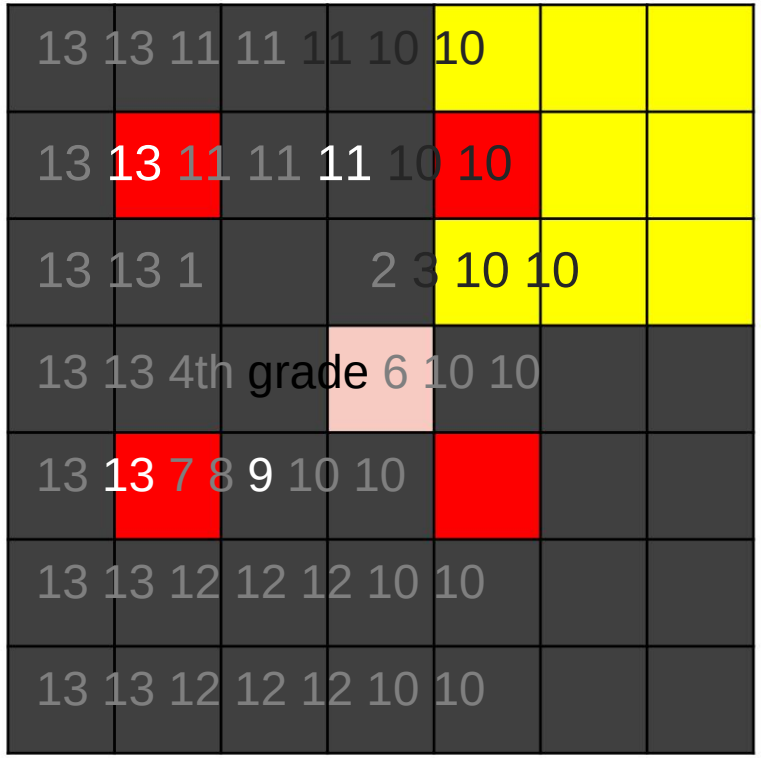


Finally, Bruno's implementation is as follows:

Ten	always go to the right
11	always go left
12	definitely go down
13	definitely go to the top
other	Position relative to the flag

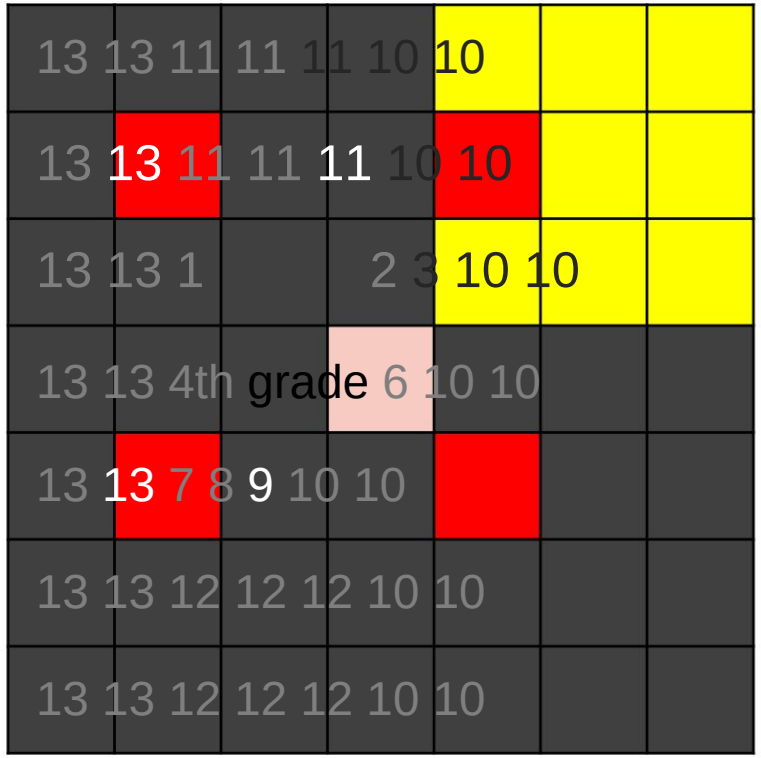
Calculate and judge from

5 = 14 (75 points) Bruno



For example, if B(uno) is on 1, 5

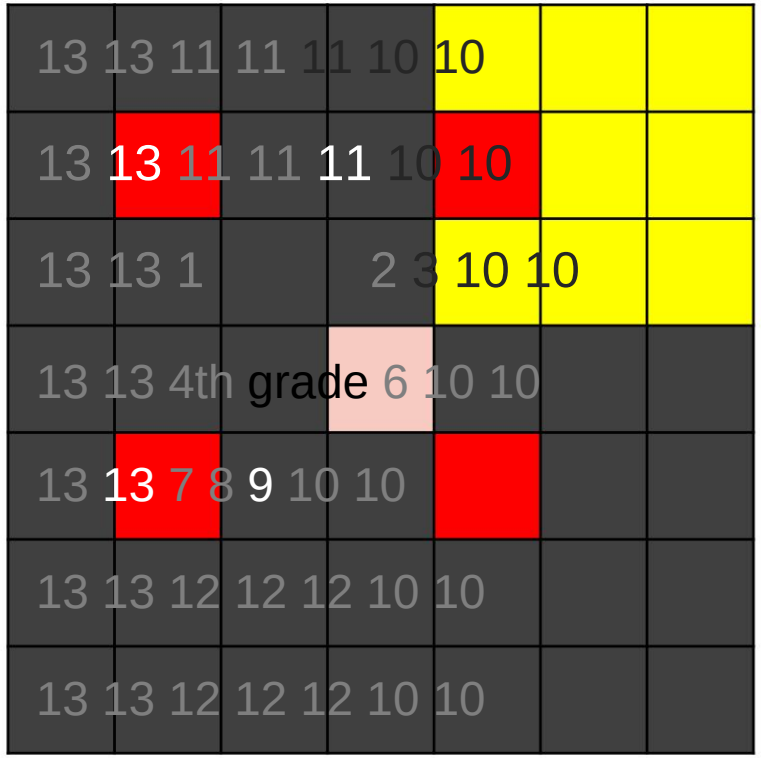
5 = 14 (75 points) Bruno



For example, if Bruno (is on) 1, 5

You can see a flag with the integer 11 written on it.

5 = 14 (75 points) Bruno

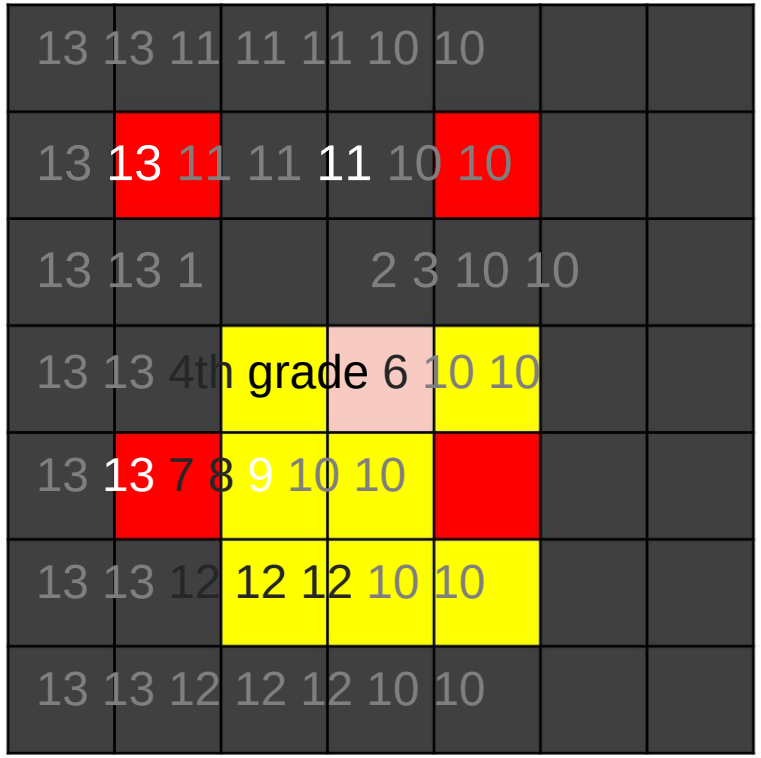


For example, if Bruno (is on) 1, 5

You can see a flag with the integer 11 written on it.

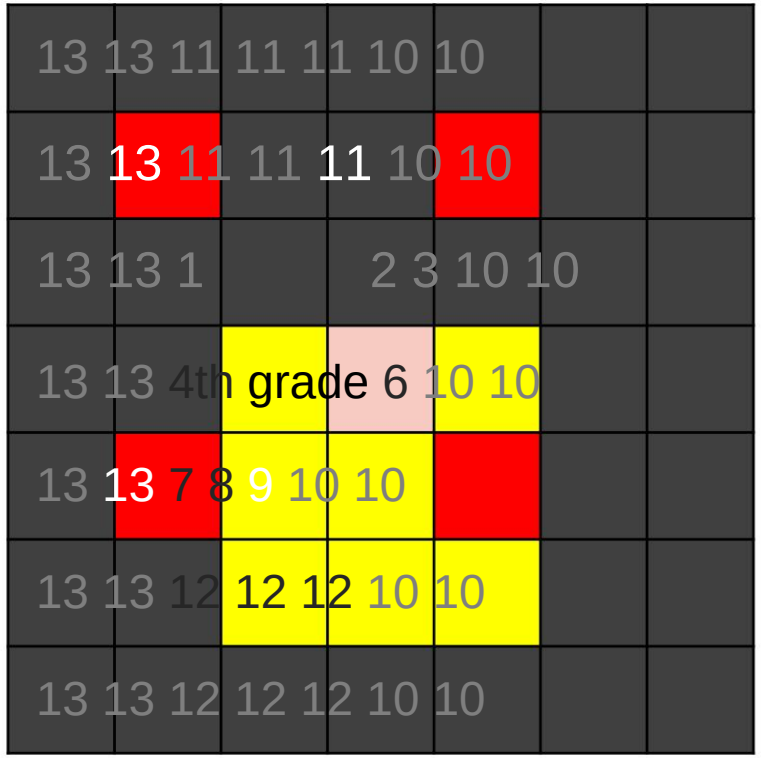
I know I should go below.

5 = 14 (75 points) Bruno



For example, if Bruno is on 4, 3

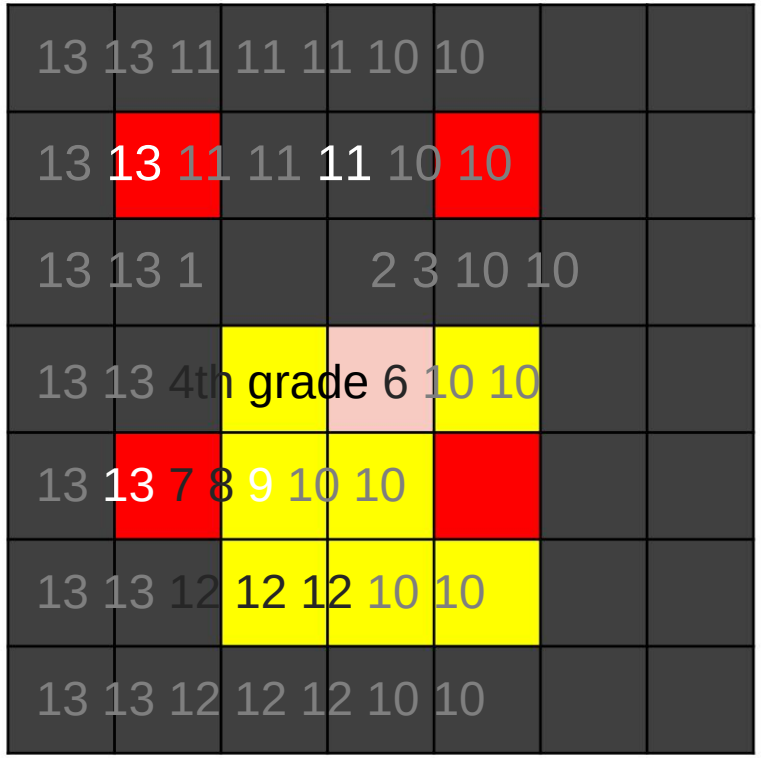
5 = 14 (75 points) Bruno



For example, if Bruno is on (1, 4), (3, 3)

You can see a flag with the integer 9 written on it.

5 = 14 (75 points) Bruno



For example, if Bruno (is on) 4, 3

You can see a flag with the integer 9 written on it.

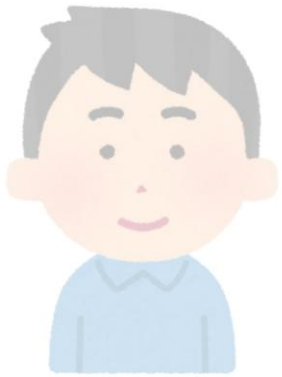
Since the flag is at (+1, ±0) from Bruno's point of view, the candidate should move upwards at (0, ÿ1) from Bruno's point of view.

5 = 14 (75 points)

1

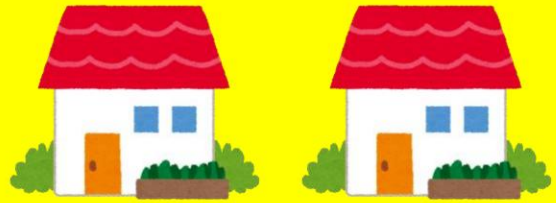
Anna's implementation

2



Bruno implementation

3



generalized to = 7

5 = 14 (75 points) when K=7

If = 7

Consider recording candidate information as shown in the table below.

Candidate 0	Candidate 1	Candidate 2	Candidate 0	Candidate 1	Candidate 2	Candidate 0	Candidate 1
Candidate 3	Candidate 4	Candidate 5	Candidate 3	Candidate 4	Candidate 5	Candidate 3	Candidate 4
Candidate 6			Candidate 6			Candidate 6	
Candidate 0	Candidate 1	Candidate 2	Candidate 0	Candidate 1	Candidate 2	Candidate 0	Candidate 1

5 = 14 (75 points) when K=7

Every 3×3 square contains all information for candidates 0 to 6.

Bruno can answer correctly because

Candidate 0	Candidate 1	Candidate 2	Candidate 0	Candidate 1	Candidate 2	Candidate 0	Candidate 1
Candidate 3	Candidate 4	Candidate 5	Candidate 3	Candidate 4	Candidate 5	Candidate 3	Candidate 4
Candidate 6			Candidate 6			Candidate 6	
Candidate 0	Candidate 1	Candidate 2	Candidate 0	Candidate 1	Candidate 2	Candidate 0	Candidate 1

5 = 14 (75 points) when K=7

Record an integer between 1 and 13 in squares 0 to 6.

You can do this by recording 14 on one of the empty squares.

(Depending on the location of the empty squares, which squares contain information about which candidates.

(you can see if there is)

You can get 75 points so far.

Candidate 0	Candidate 1	Candidate 2
Candidate 3	Candidate 4	Candidate 5
Candidate 6		14

L=13

6 = 13 (85 points)

feelings

candidate 0	candidate 1	candidate 2
candidate 3	candidate Four	candidate Five
candidate 6-		(13)

one square is used

It seems like a waste without it

observation

6 = 13 (85 points)

feelings

candidate 0	candidate 1	candidate 2
candidate 3	candidate Four	candidate Five
candidate 6-		(13)

one square is used

It seems like a waste without it

observation

1 3 5 7 ~~6~~ 9

~~2~~ 4 8

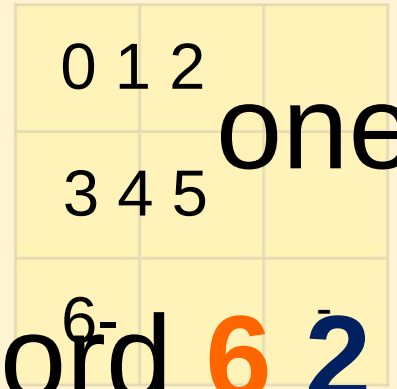
An integer between 1 and 9 **that is not used as a whole.**

There are two or more different integers

*For each candidate, integers less than or equal to 9 are written only once.

6 = 13 (85 points)

feelings



two squares are used

It seems like a waste without it

observation

1 3 5 7 9

An unused integer between 1 and 9.

There are two or more

Can one of the empty squares be used to record 6 2 8 4 "unused integers"?

*For each candidate, integers less than or equal to 9 are written only once.

64

6 = 13 (85 points)

If you record an "unused integer" in an empty square...

- Let the unused integer be
- At that time, all integers greater than or equal to + 1 are decreased by 1.

6 = 13 (85 points)

If you record an "unused integer" in an empty square...

- Let the unused integer be
- At that time, all integers greater than or equal to + 1 are decreased by 1.

1 9 11		
8 5 12		
4-13		

If = 7

6 = 13 (85 points)

If you record an "unused integer" in an empty square...

- Let the unused integer be
- At that time, all integers greater than or equal to + 1 are decreased by 1.

1	9	11
8	5	12
4	-13	

If = 7

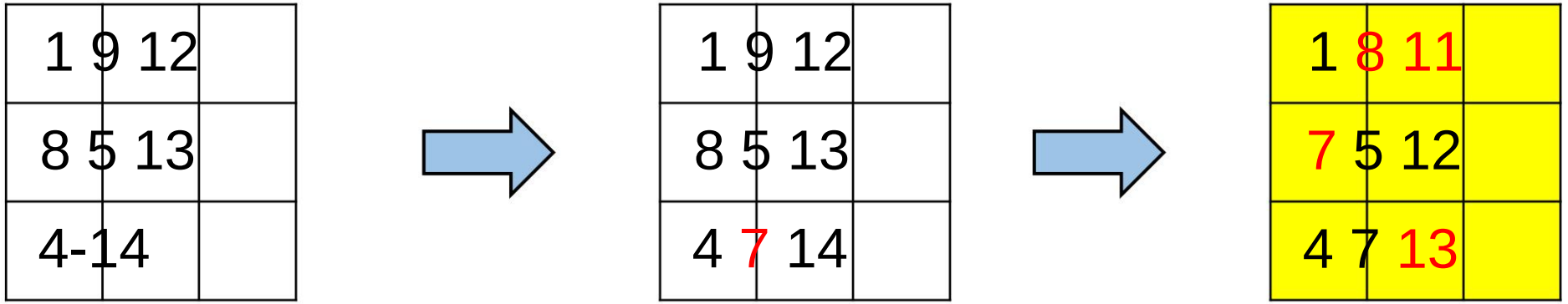
1	9	11
8	5	12
4	7	13

Record 7 in an empty square

6 = 13 (85 points)

If you record an "unused integer" in an empty square...

- Let the unused integer be
- At that time, all integers greater than or equal to + 1 are decreased by 1.



6 = 13 (85 points)

The position of the empty square is the position of the square written as "13".

You can understand it by referring to it.

ÿ 8, the maximum value 14 will always decrease by 1 to 13

You can get 85 points so far.

L=12

7 = 12 (100 points)

feelings

1 3 9 5 7 2 6 8 4 

unused integer

Can I use a second one?

observation

7 = 12 (100 points)

feelings

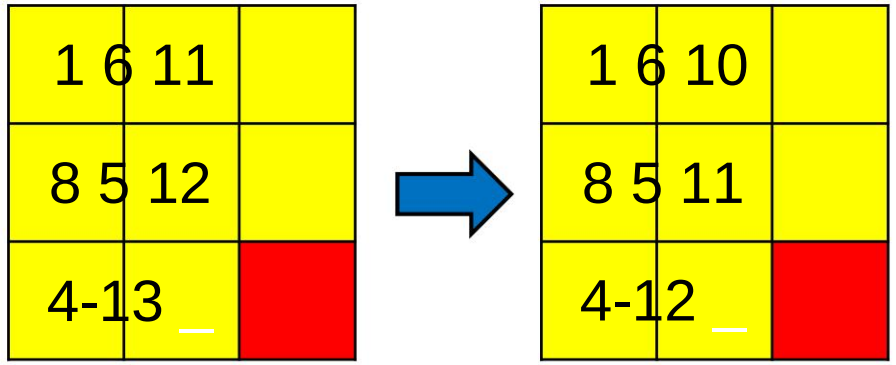
1 3 9 5 7 2 6 8 4 ✓

✗

unused integer

Can I use a second one?

observation



9 is guaranteed not to be used

In special cases, it can be reduced by one.

7 = 12 (100 points)

feelings

1 3 5 2 4

6 9

7 8

unused integer

Can I use a second one?

9 Don't force someone to use

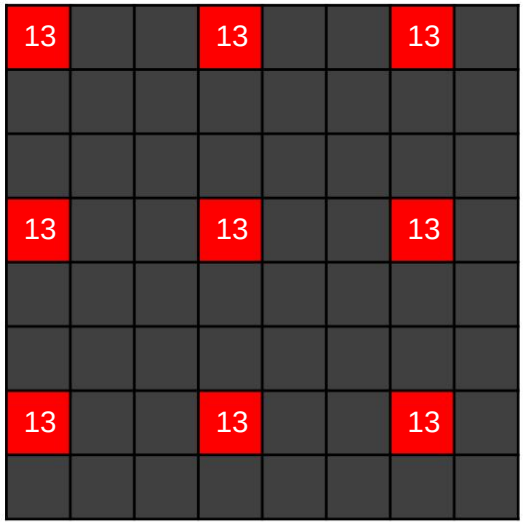
9 Is there a method?

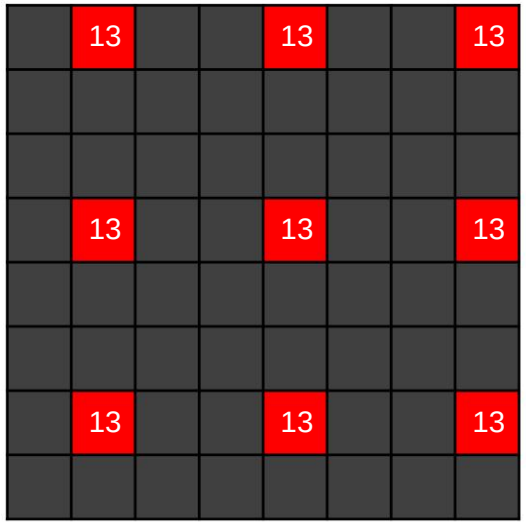
observation

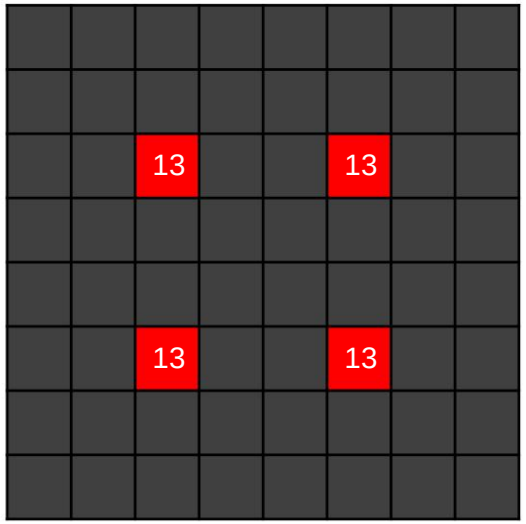
9 is guaranteed not to be used

In special cases, it can be reduced by one.

7 = 12 (100 points)







When we perform a full search for the position that records the maximum value (13 in the 85-point solution method),

9 is not used in at least 2 out of 9 ways

7 = 12 (100 points)

Therefore, the maximum value of 12 can be achieved with the following steps

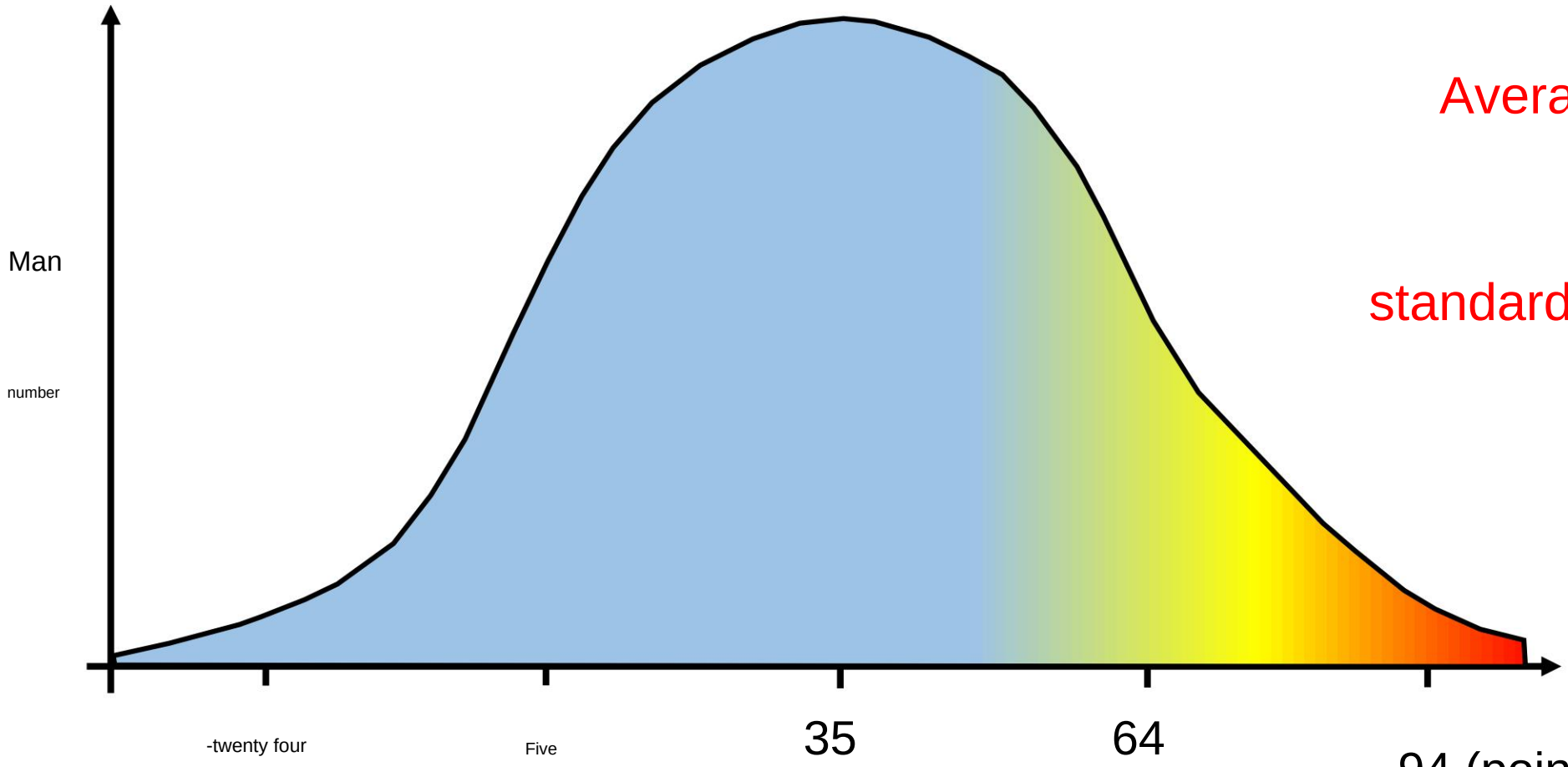
Search all 9 ways and find a way to write it that doesn't use "9"

Then, you can configure a maximum value of 13 (=14-1).

Then, reduce it by 1 again according to the 85-point solution method.

Score Distribution

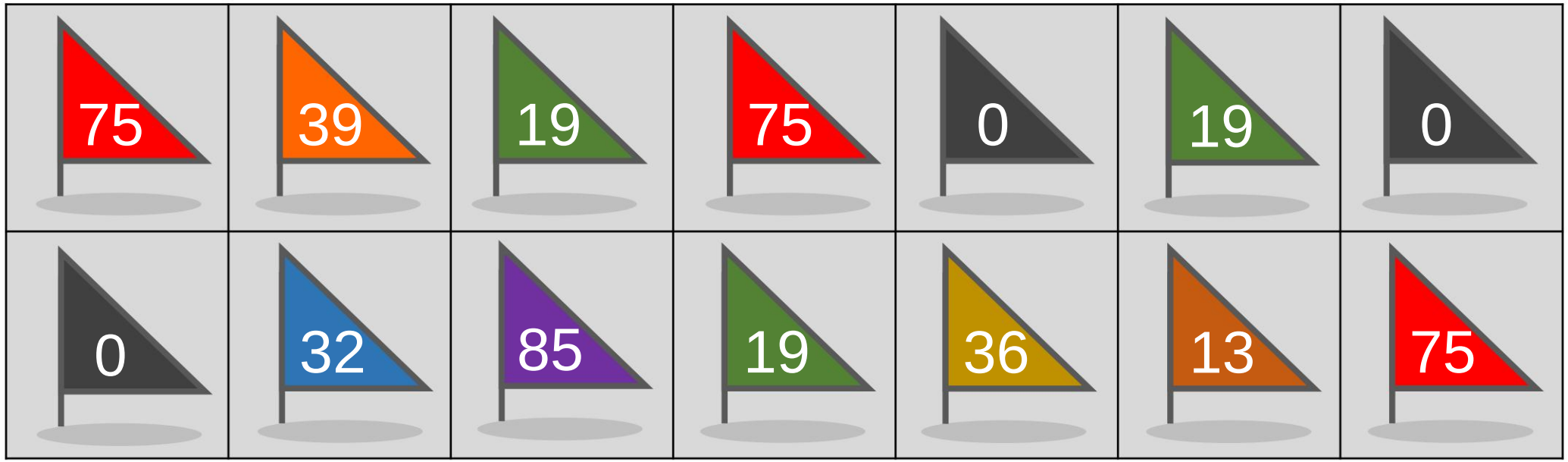
8 score distribution (normal distribution)



Average score 34.8

standard deviation 29.6

8 point distribution



Thank you for your attention