CS50 for MBAs

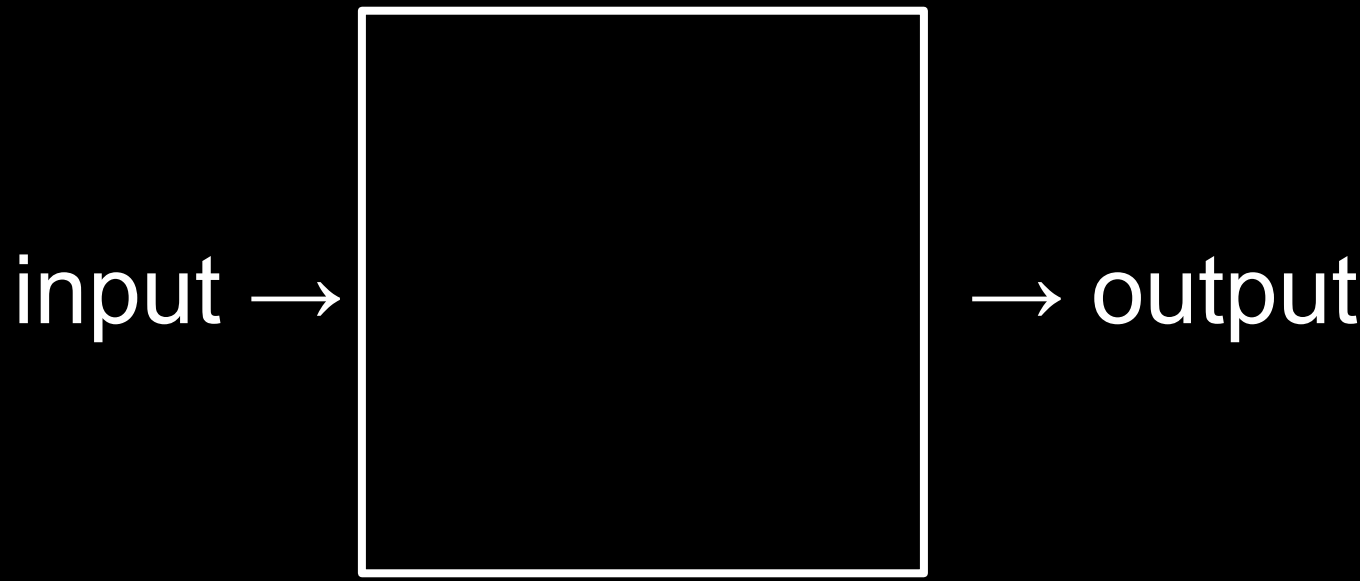
cs50.harvard.edu/hbs

Lectures

- Computational Thinking
- Algorithms
- Python
- Data Structures
- Internet Technologies
- Web Development
- SQL
- Databases
- Cloud Computing
- Privacy, Security
- Artificial Intelligence
- Software Engineering
- Technology Stacks

CS50 for MBAs

Computational Thinking


input →
→ output

representation

decimal

base-10

0 1 2 3 4 5 6 7 8 9

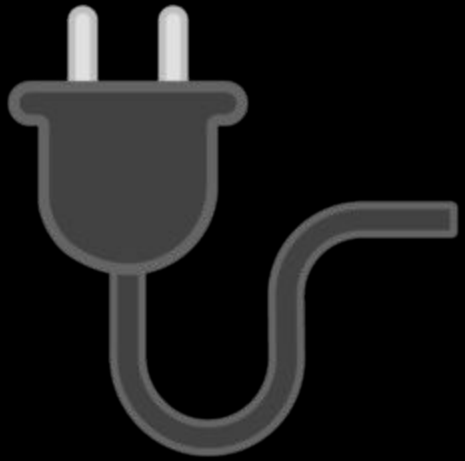
0 1

base-2

binary

0 1

bits



1

0 1

0 1 2 3 4 5 6 7 8 9

123

123

10 1

123

100 10 1

123

100 10 1

123

100 × 1

100 10 1

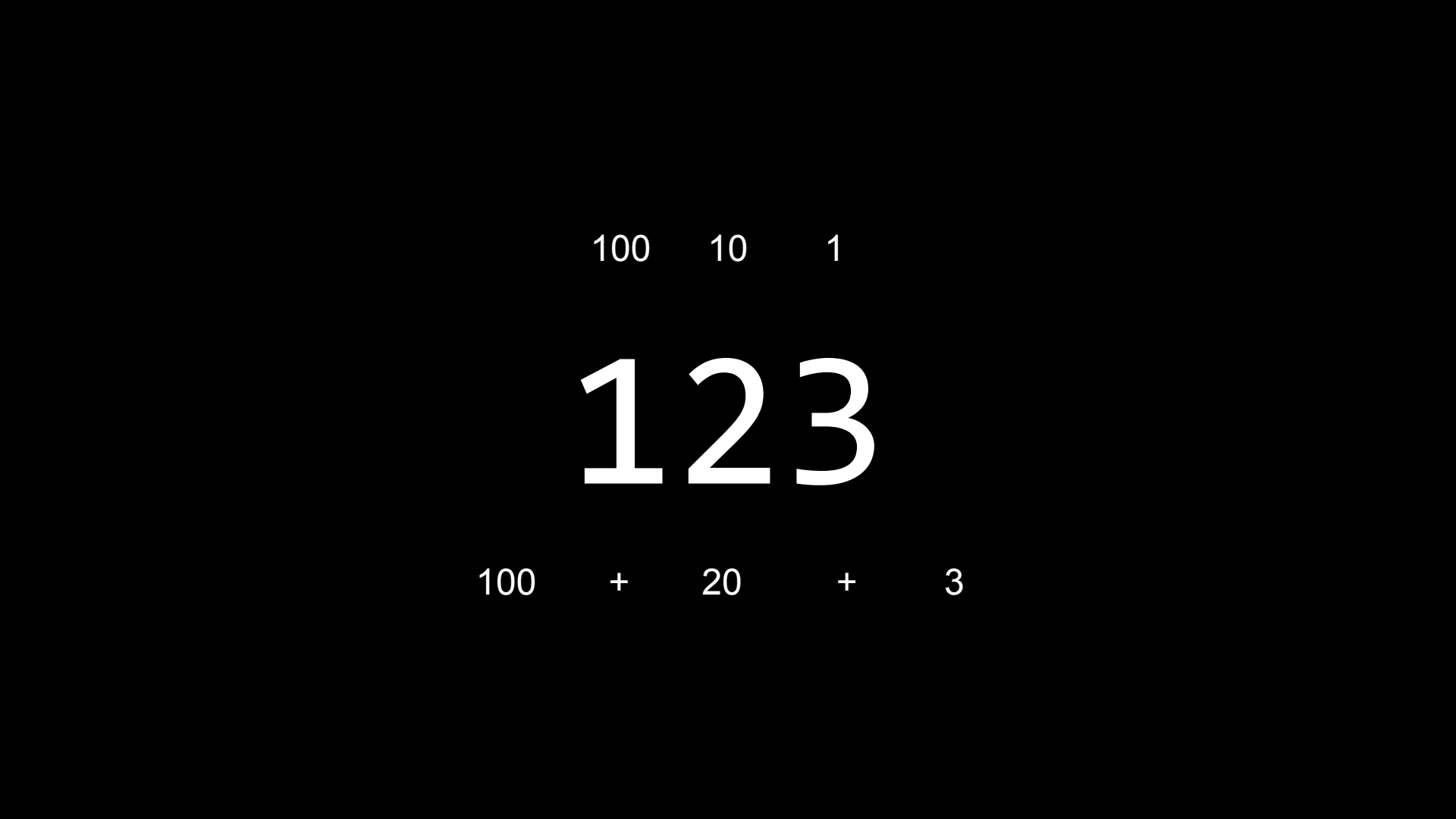
123

100 × 1 + 10 × 2

100 10 1

123

100 × 1 + 10 × 2 + 1 × 3


100 10 1
123
100 + 20 + 3

123

100 10 1

###

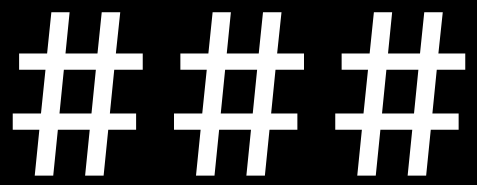
10^2 10^1 10^0

###

2^2 2^1 2^0

###

4 2 1




4 2 1
000

4 2 1

001

4 2 1

010

4 2 1

011

4 2 1

100

4 2 1

101

4 2 1

110

4 2 1

111

This is CS50

A

65

01000001

ASCII

...	A	B	C	D	E	F	G	H	I	...
...	65	66	67	68	69	70	71	72	73	...

72 73 33

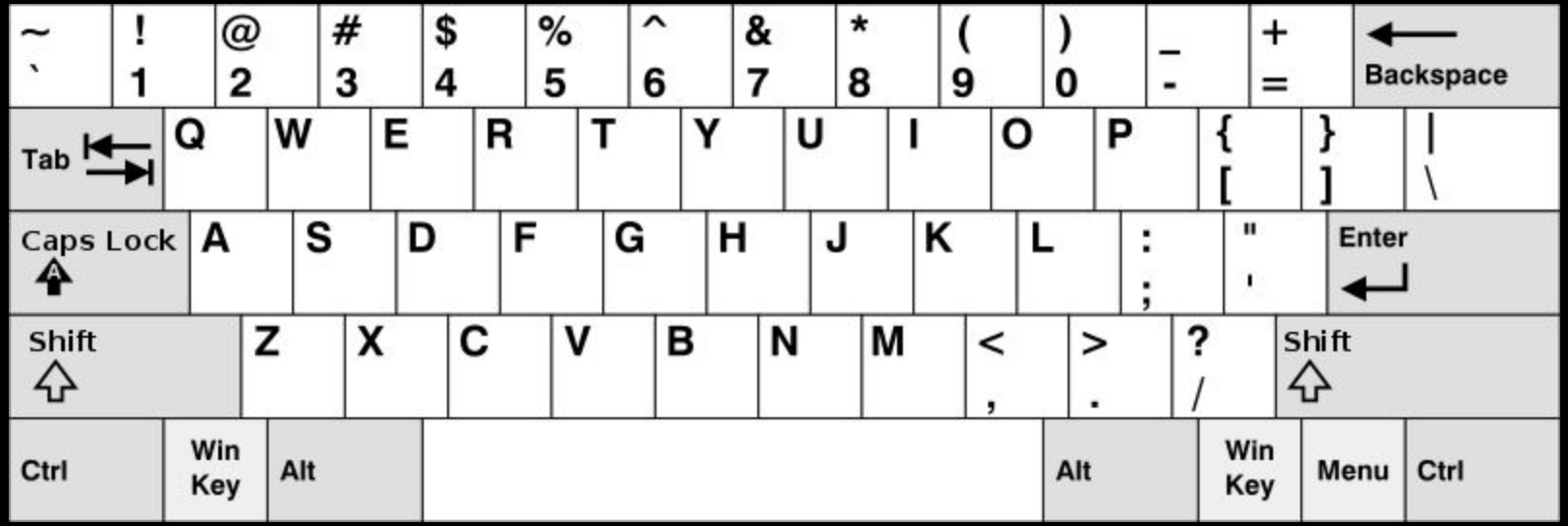
H	I	
72	73	33

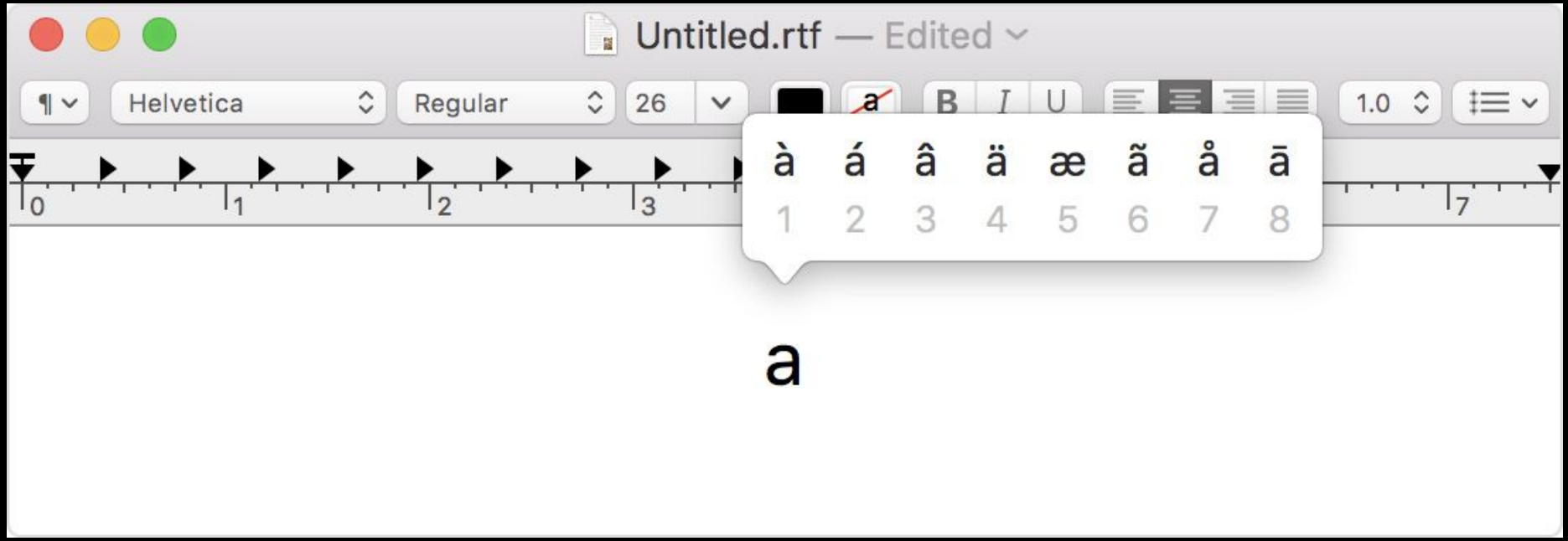
0	NUL	16	DLE	32	SP	48	0	64	@	80	P	96	`	112	p
1	SOH	17	DC1	33	!	49	1	65	A	81	Q	97	a	113	q
2	STX	18	DC2	34	"	50	2	66	B	82	R	98	b	114	r
3	ETX	19	DC3	35	#	51	3	67	C	83	S	99	c	115	s
4	EOT	20	DC4	36	$	52	4	68	D	84	T	100	d	116	t
5	ENQ	21	NAK	37	%	53	5	69	E	85	U	101	e	117	u
6	ACK	22	SYN	38	&	54	6	70	F	86	V	102	f	118	v
7	BEL	23	ETB	39	'	55	7	71	G	87	W	103	g	119	w
8	BS	24	CAN	40	(	56	8	72	H	88	X	104	h	120	x
9	HT	25	EM	41	)	57	9	73	I	89	Y	105	i	121	y
10	LF	26	SUB	42	*	58	:	74	J	90	Z	106	j	122	z
11	VT	27	ESC	43	+	59	;	75	K	91	[	107	k	123	{
12	FF	28	FS	44	,	60	<	76	L	92	\	108	l	124	|
13	CR	29	GS	45	-	61	=	77	M	93	]	109	m	125	}
14	SO	30	RS	46	.	62	>	78	N	94	^	110	n	126	~
15	SI	31	US	47	/	63	?	79	O	95	_	111	o	127	DEL

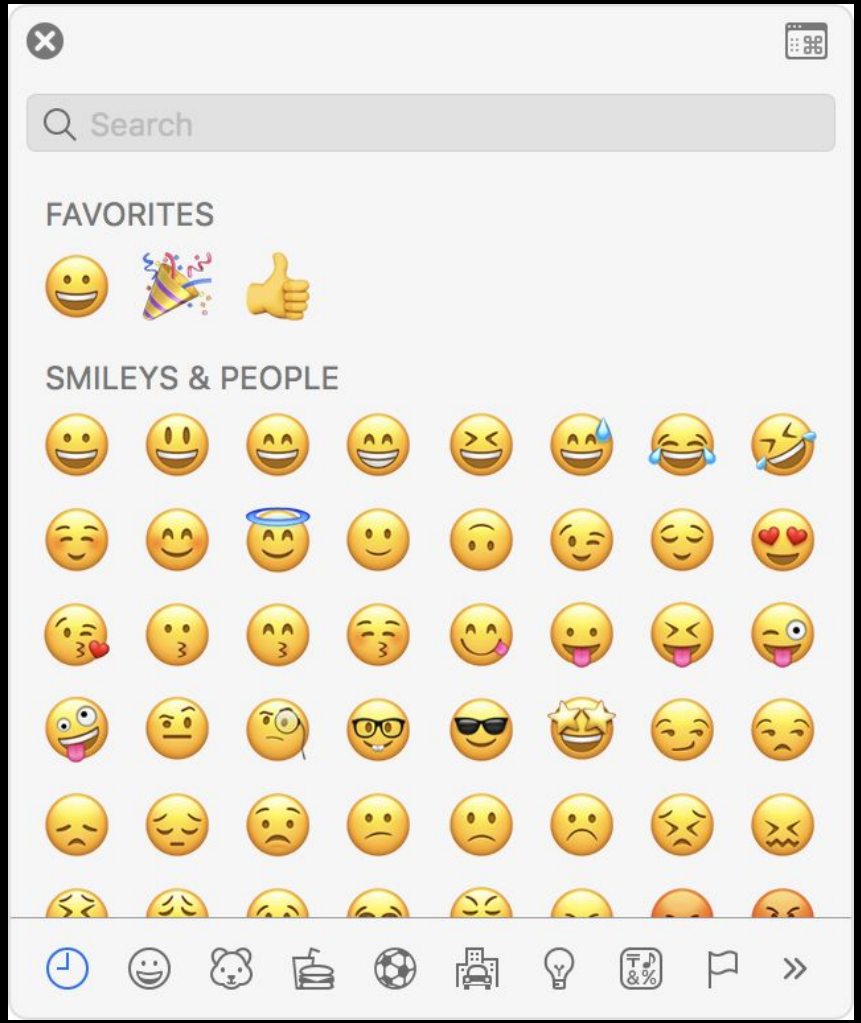
H	I	!
72	73	33

H	I	!
01001000	01001001	00100001

bytes


~ `
! 1
@ 2
# 3
$ 4
% 5
^ 6
& 7
* 8
(9
) 0
_ -
+ =
Backspace
Tab
Q
W
E
R
T
Y
U
I
O
P
{ [
}]
| \
Caps Lock
A
S
D
F
G
H
J
K
L
: ;
" '
Enter
Shift
Z
X
C
V
B
N
M
< ,
> .
? /
Shift
Ctrl
Win Key
Alt
Alt
Win Key
Menu
Ctrl


Untitled.rtf — Edited
Helvetica
Regular
26
1.0
à á â ä æ ã å ā
1 2 3 4 5 6 7 8
a

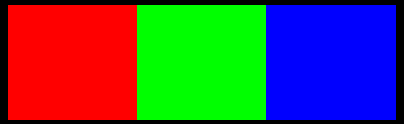

Search
FAVORITES
SMILEYS & PEOPLE

Unicode

128514

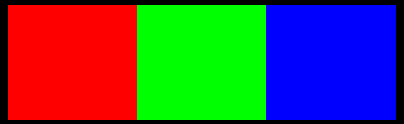
00000001111101100000010

RGB



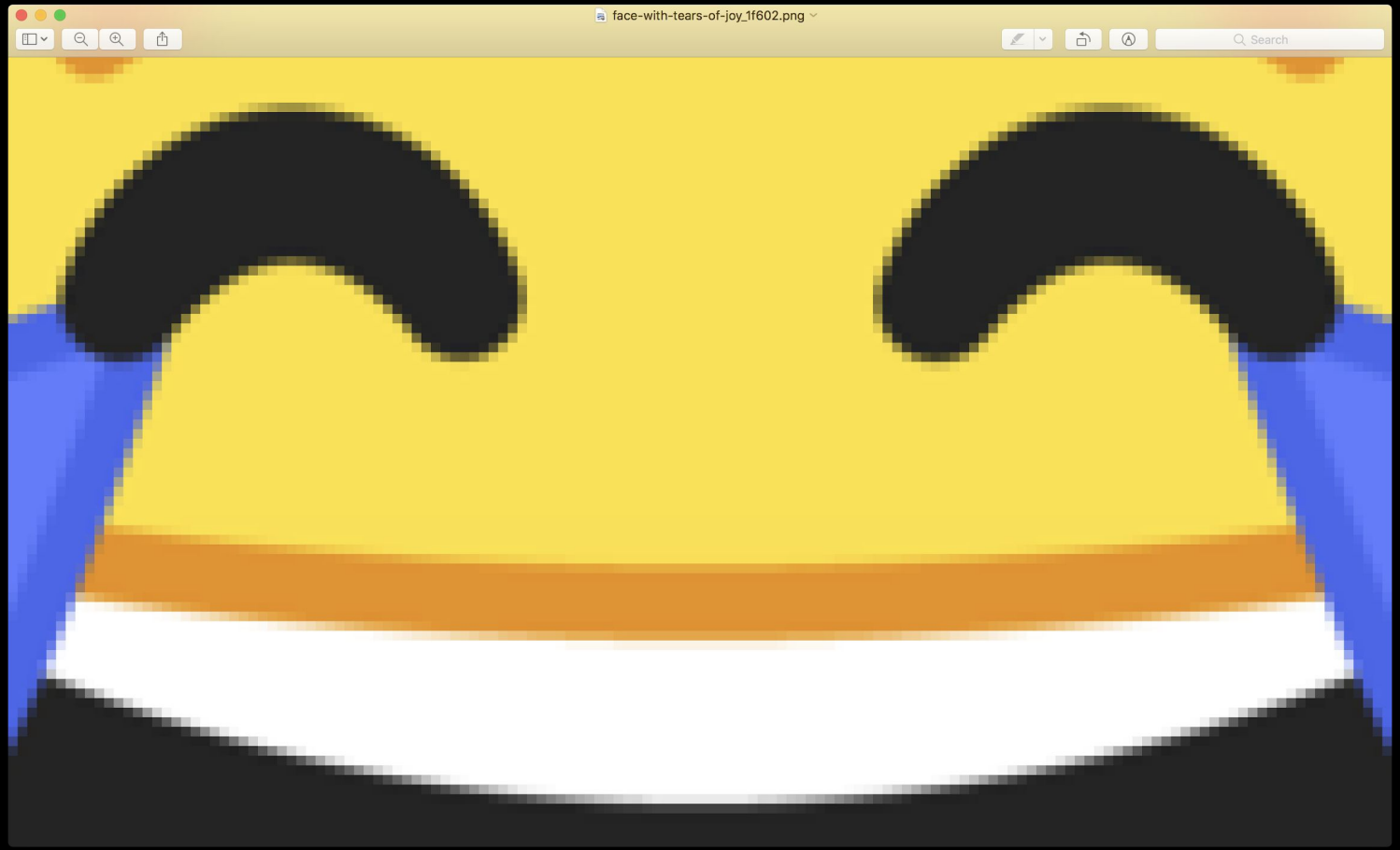
72 73 33

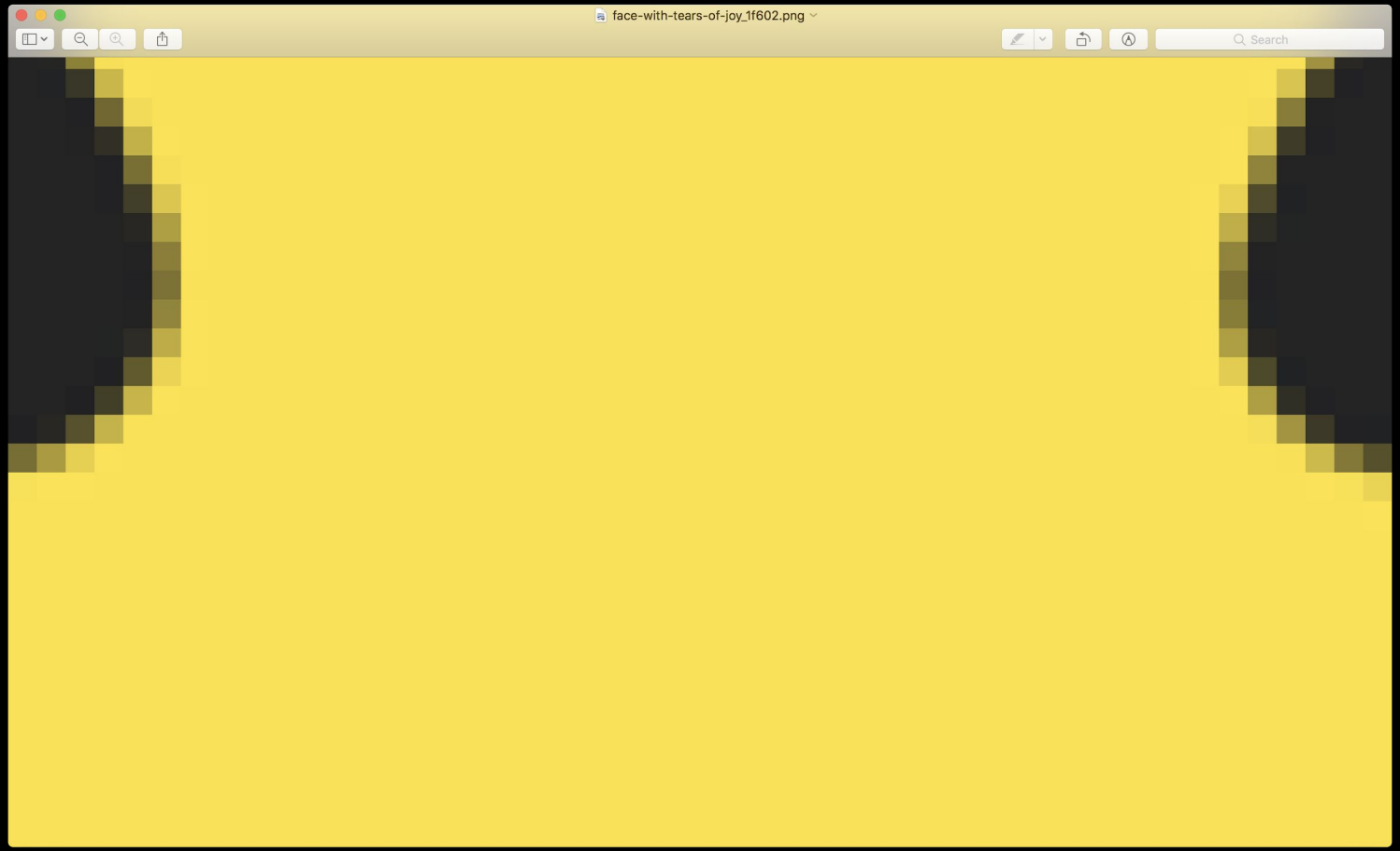

72
73
33

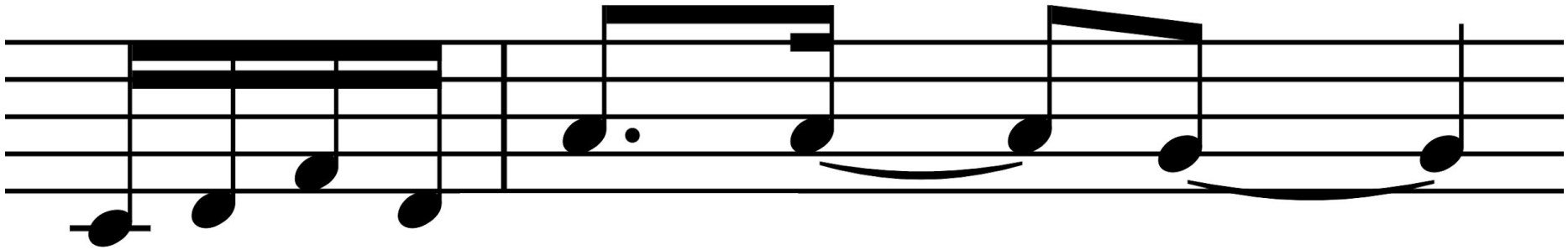


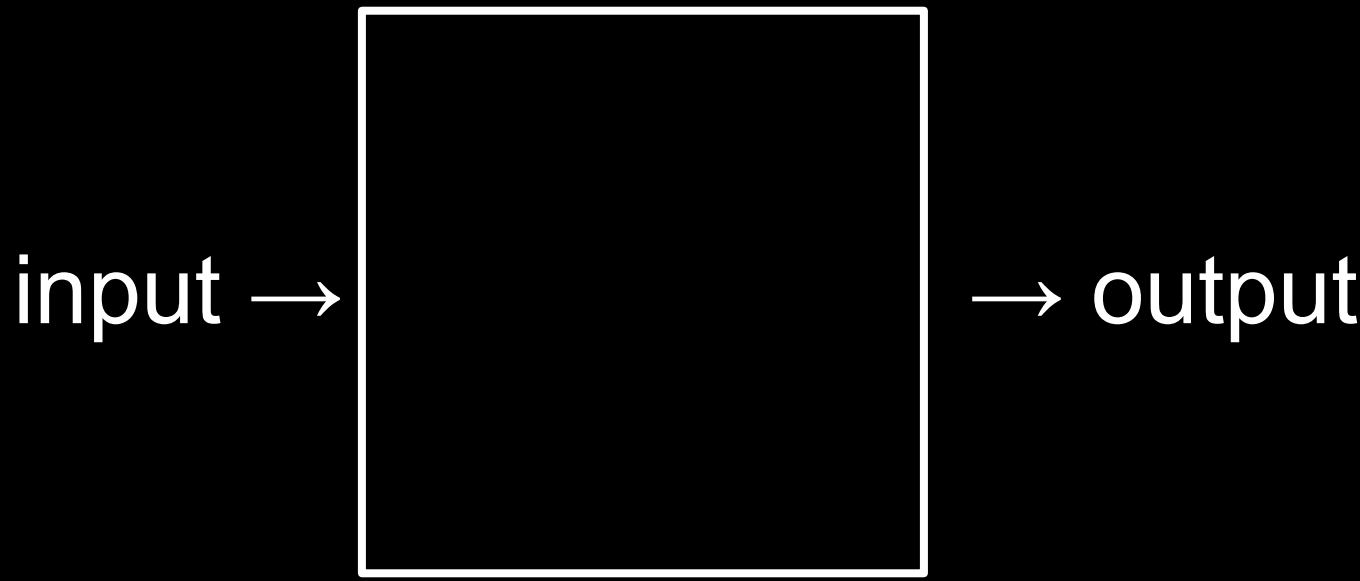
face-with-tears-of-joy_1f602.png

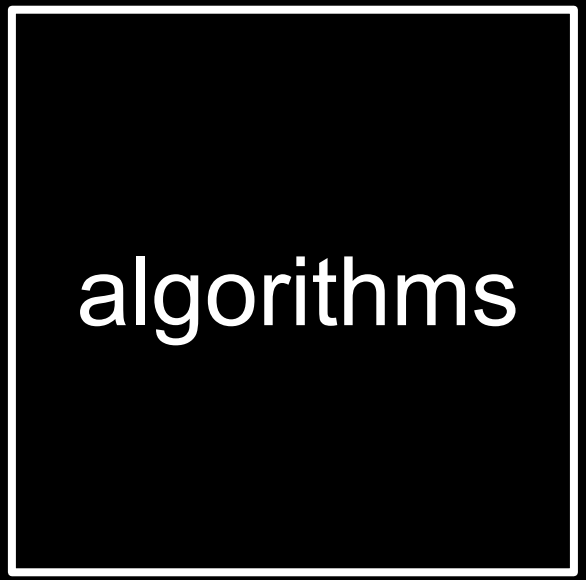
face-with-tears-of-joy_1f602.png

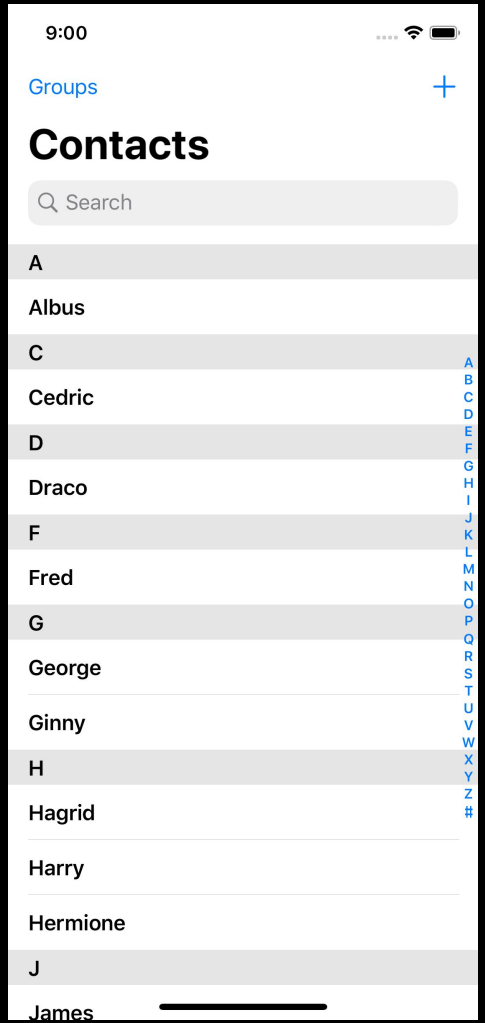

face-with-tears-of-joy_1f602.png
Search


face-with-tears-of-joy_1f602.png
Search

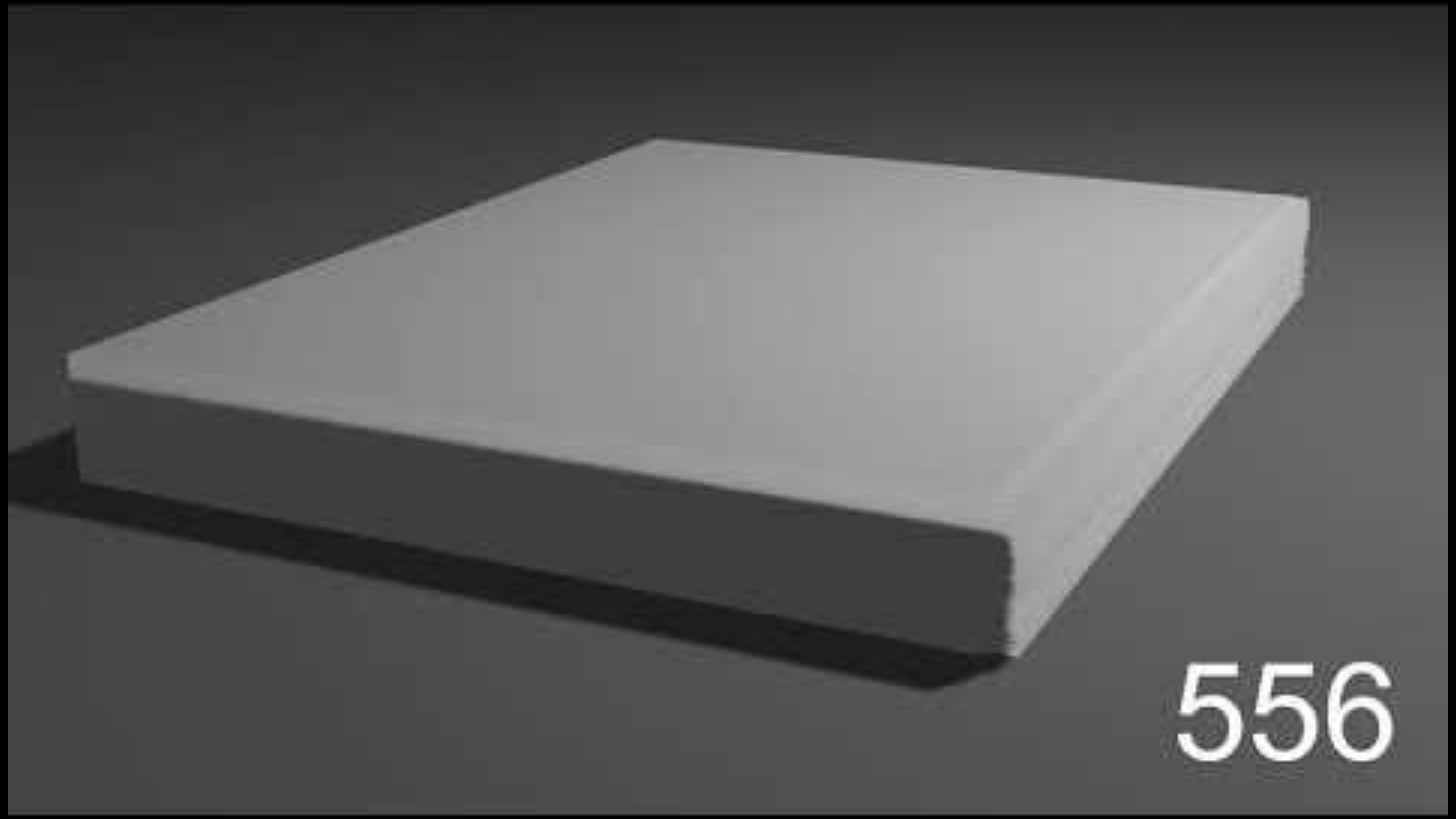


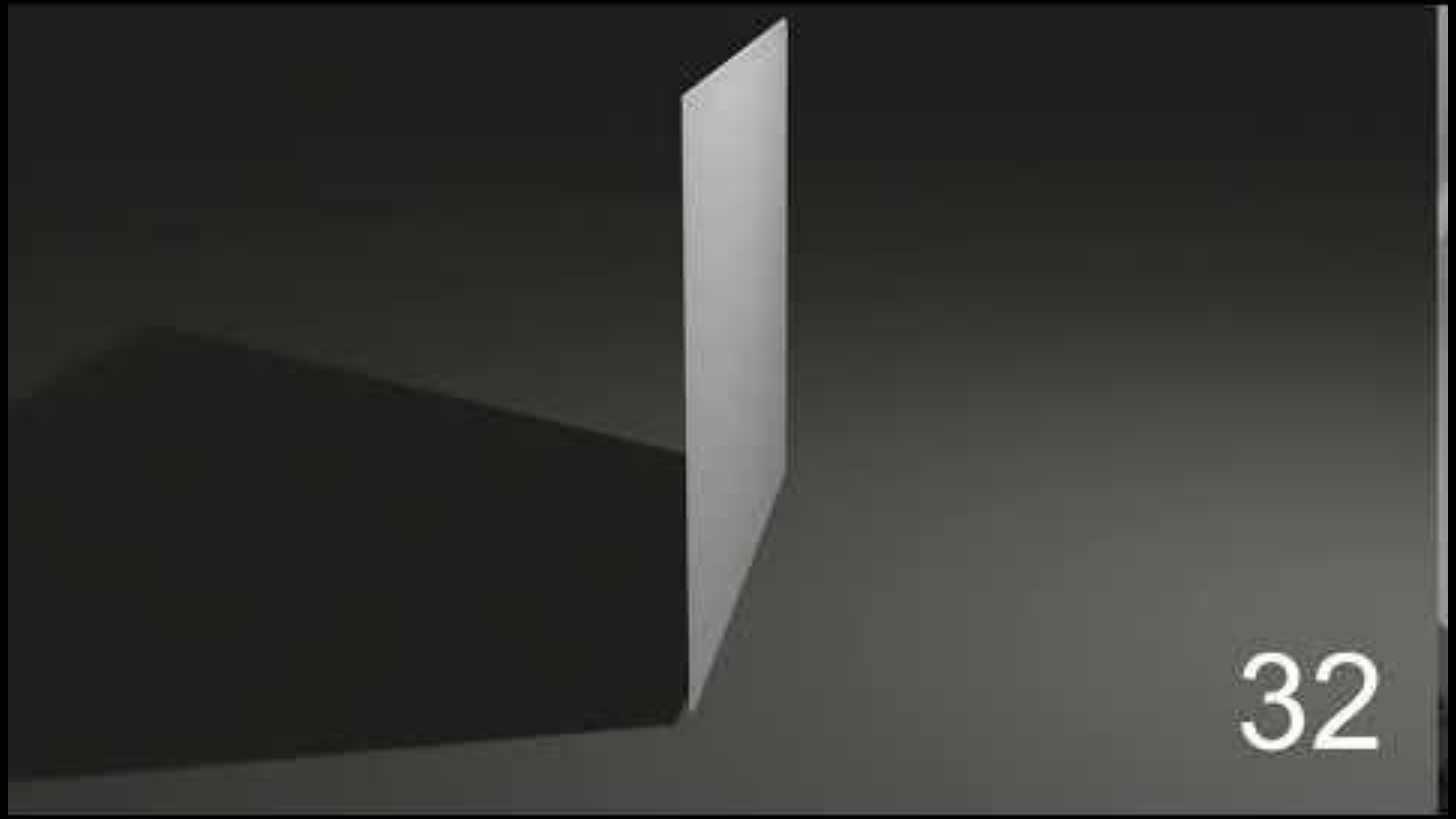

input →
→ output

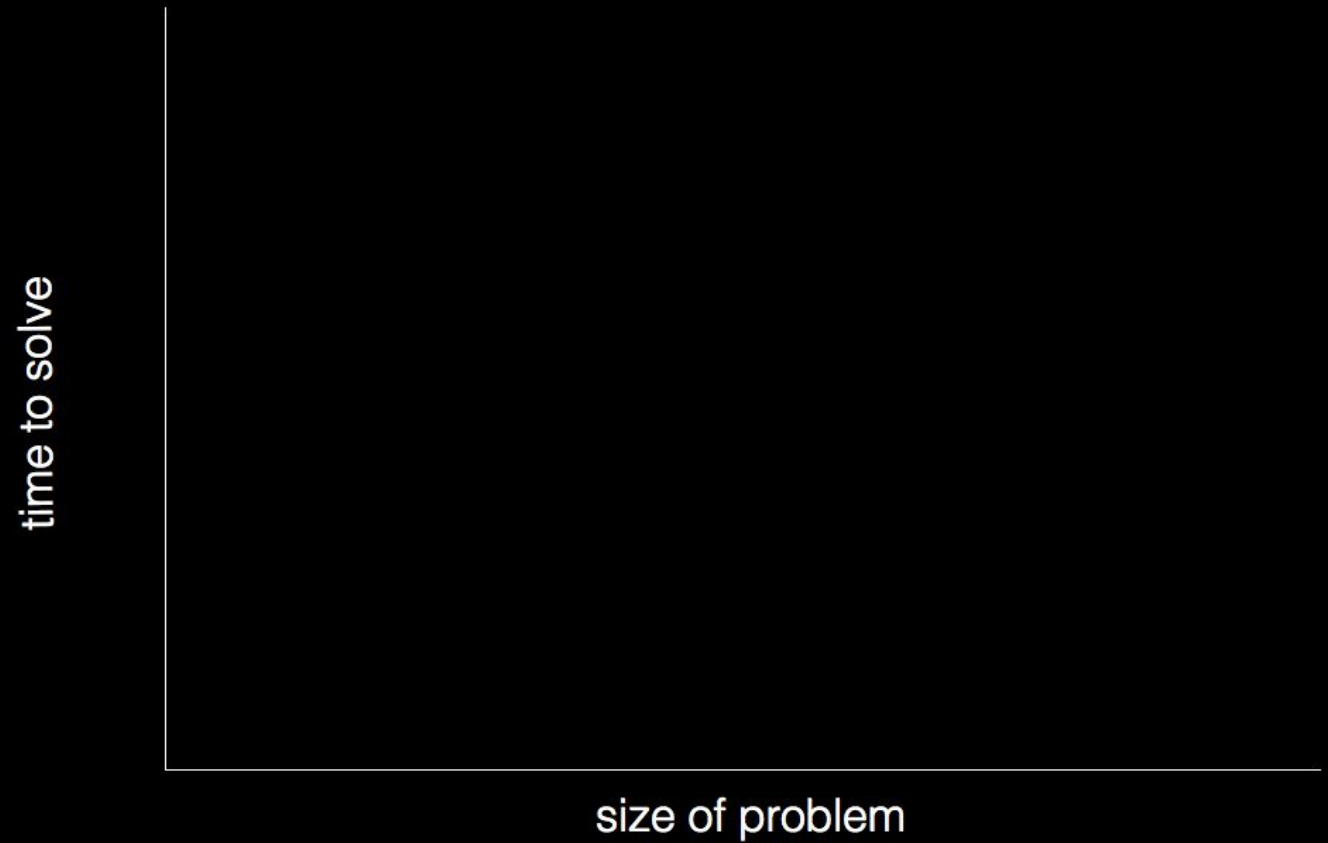

algorithms

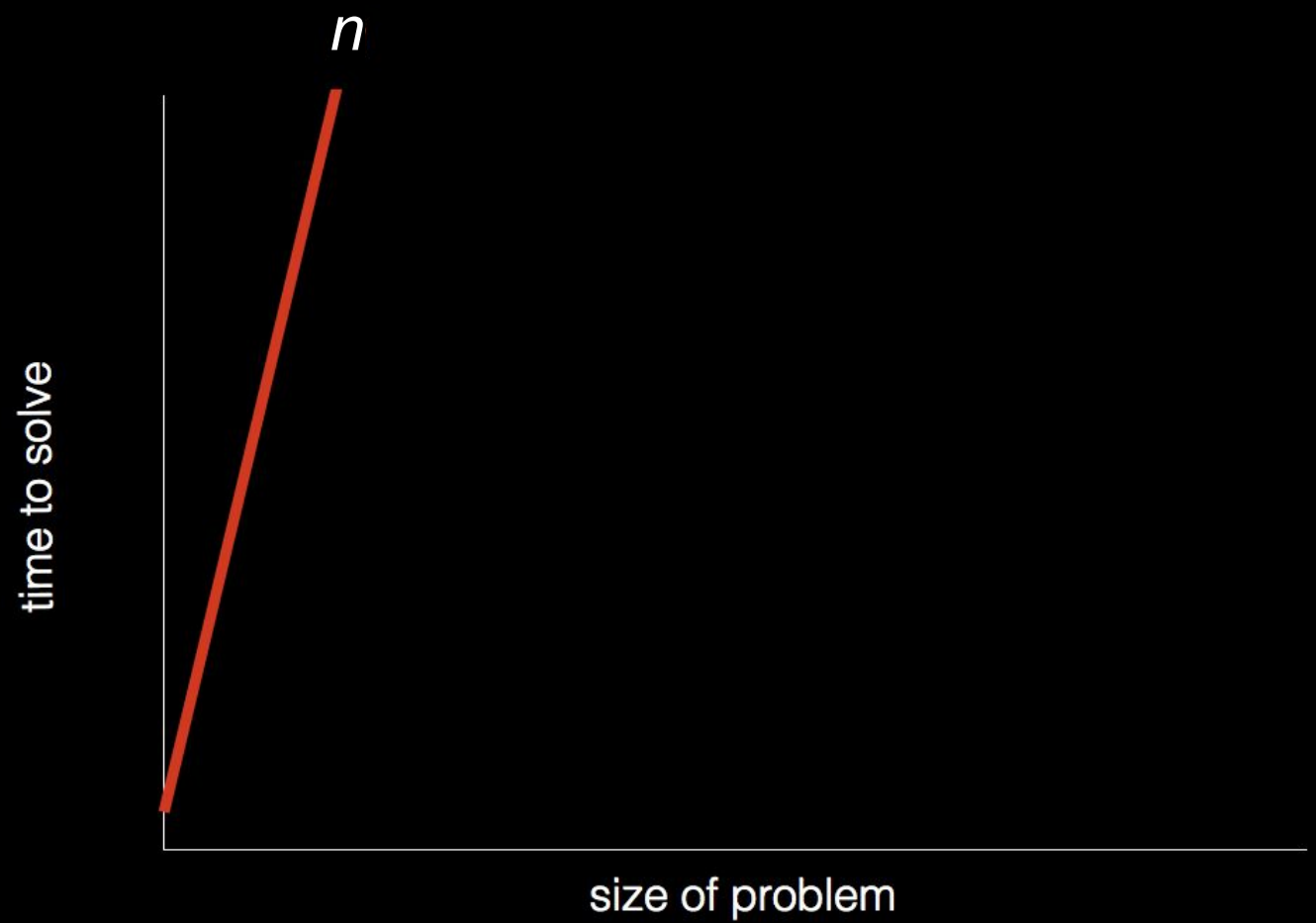

9:00
Groups
Contacts
Search
A
Albus
C
Cedric
D
Draco
F
Fred
G
George
Ginny
H
Hagrid
Harry
Hermione
J
James
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z #

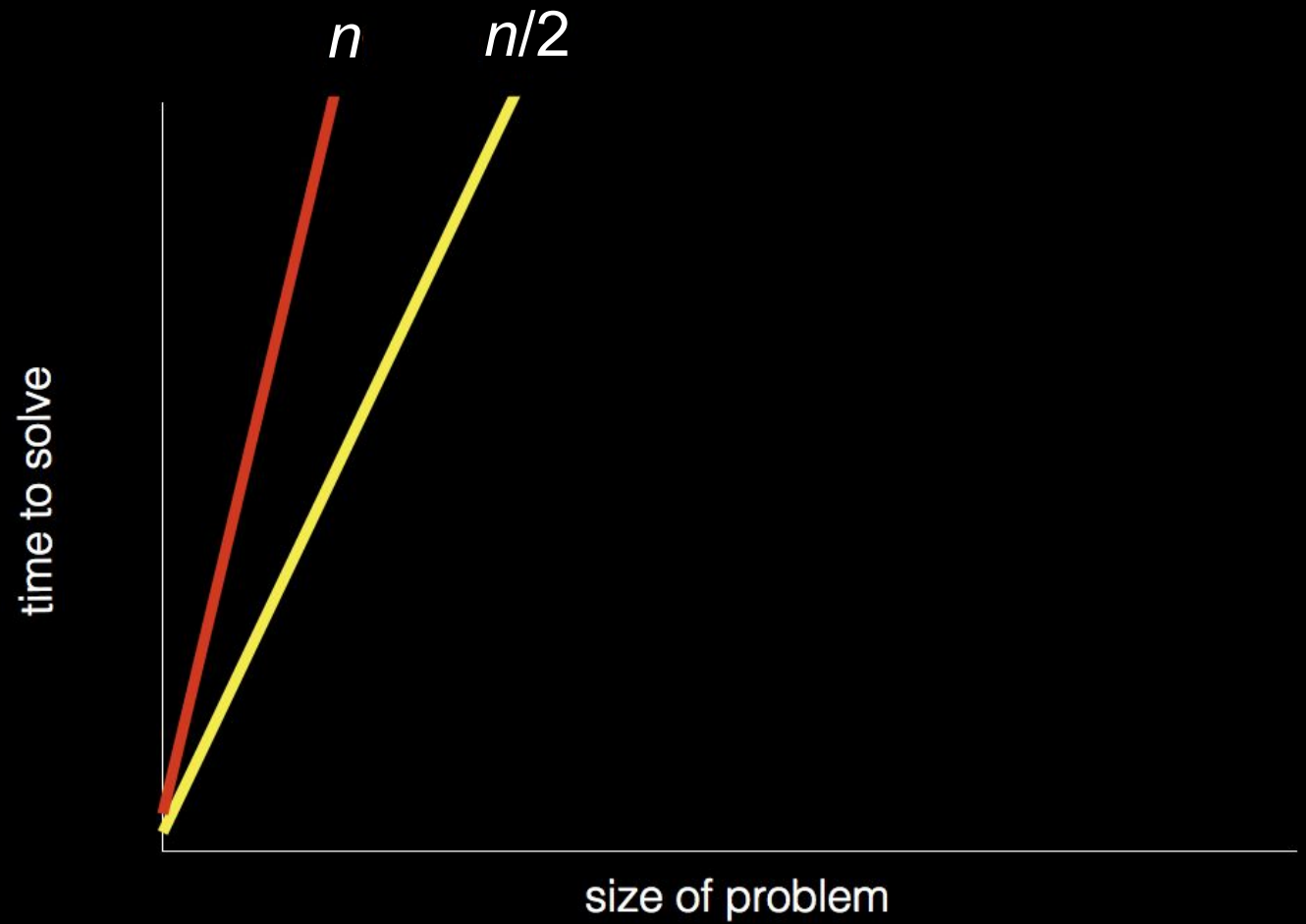
This is CS50

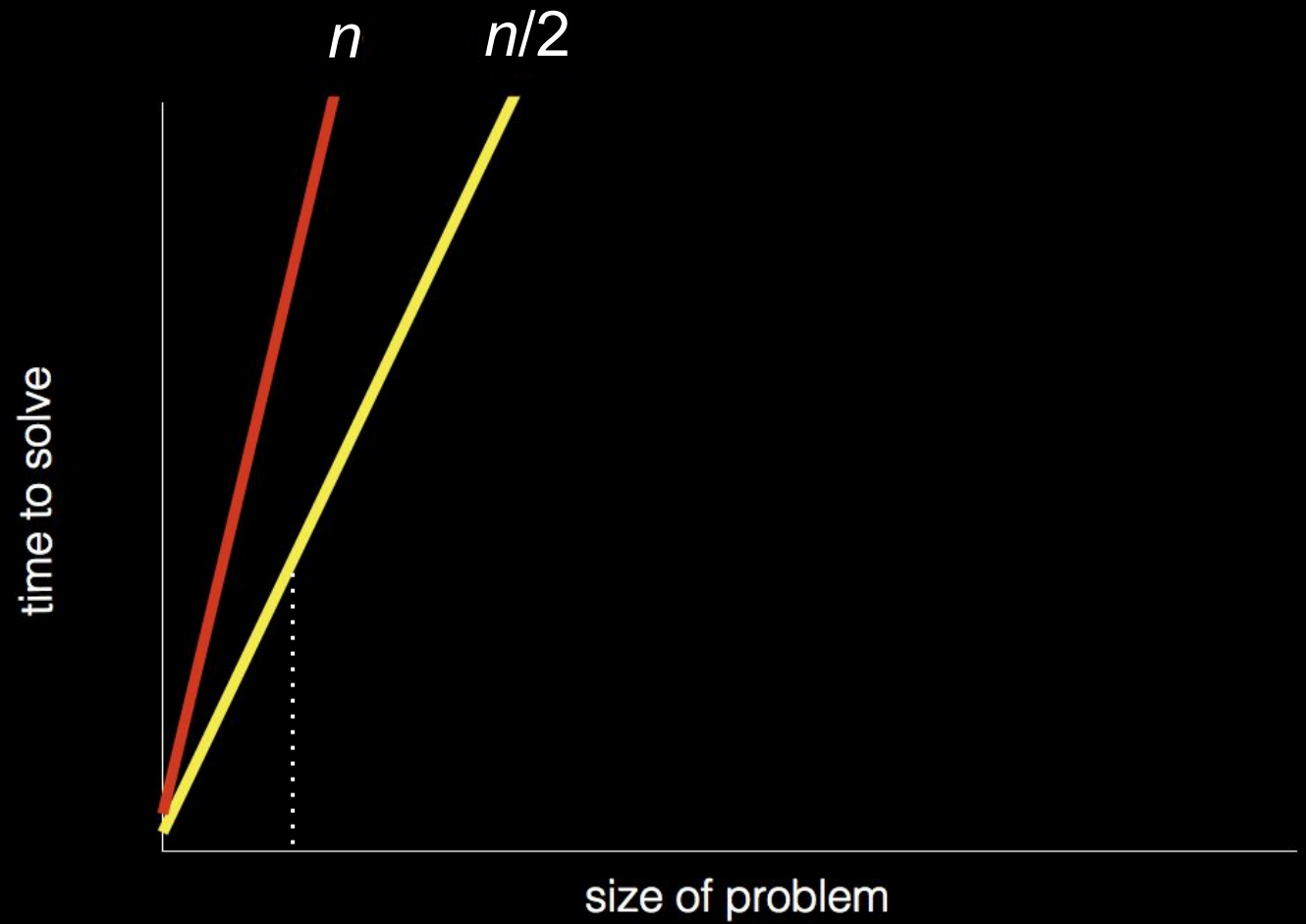

556

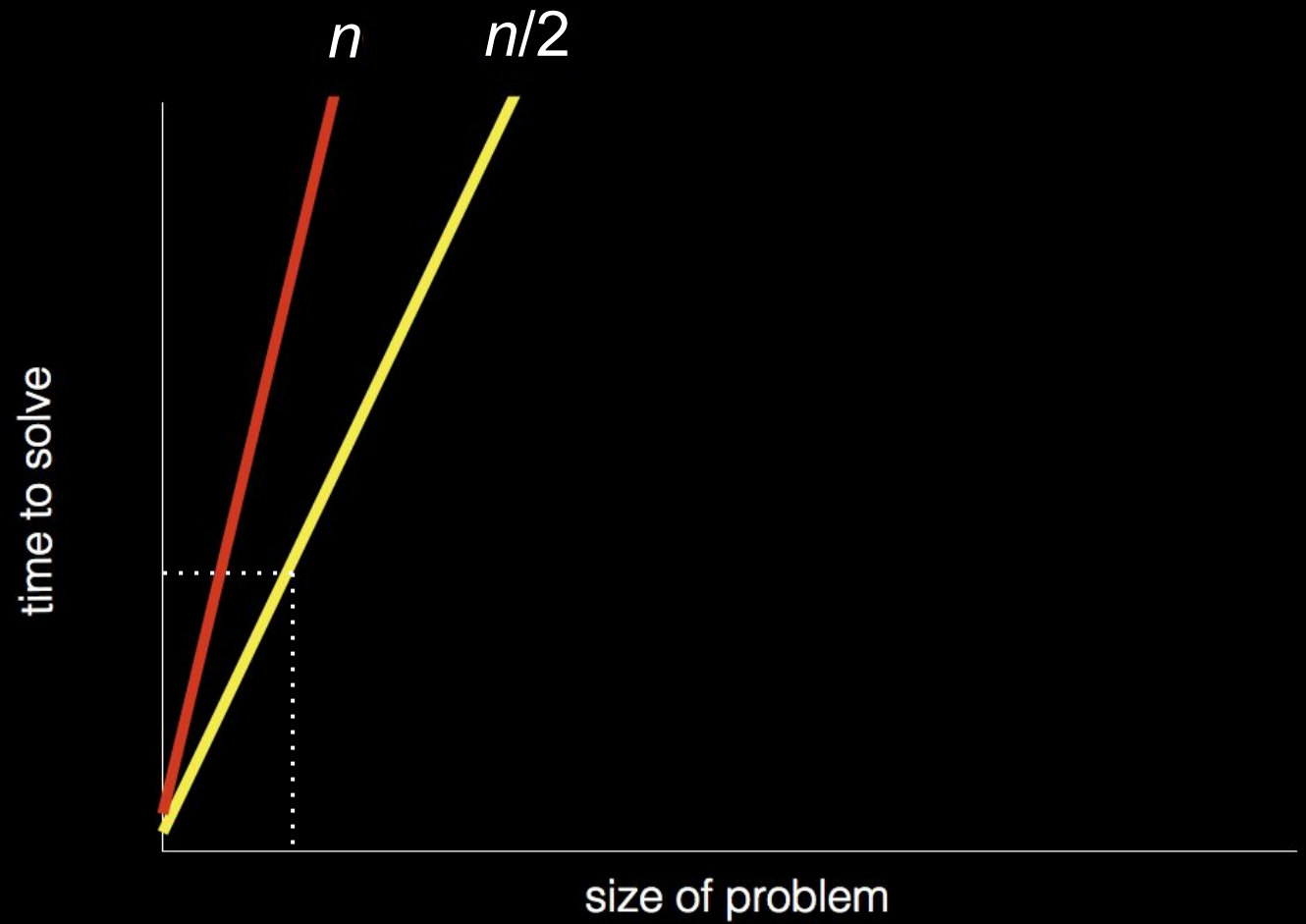

32

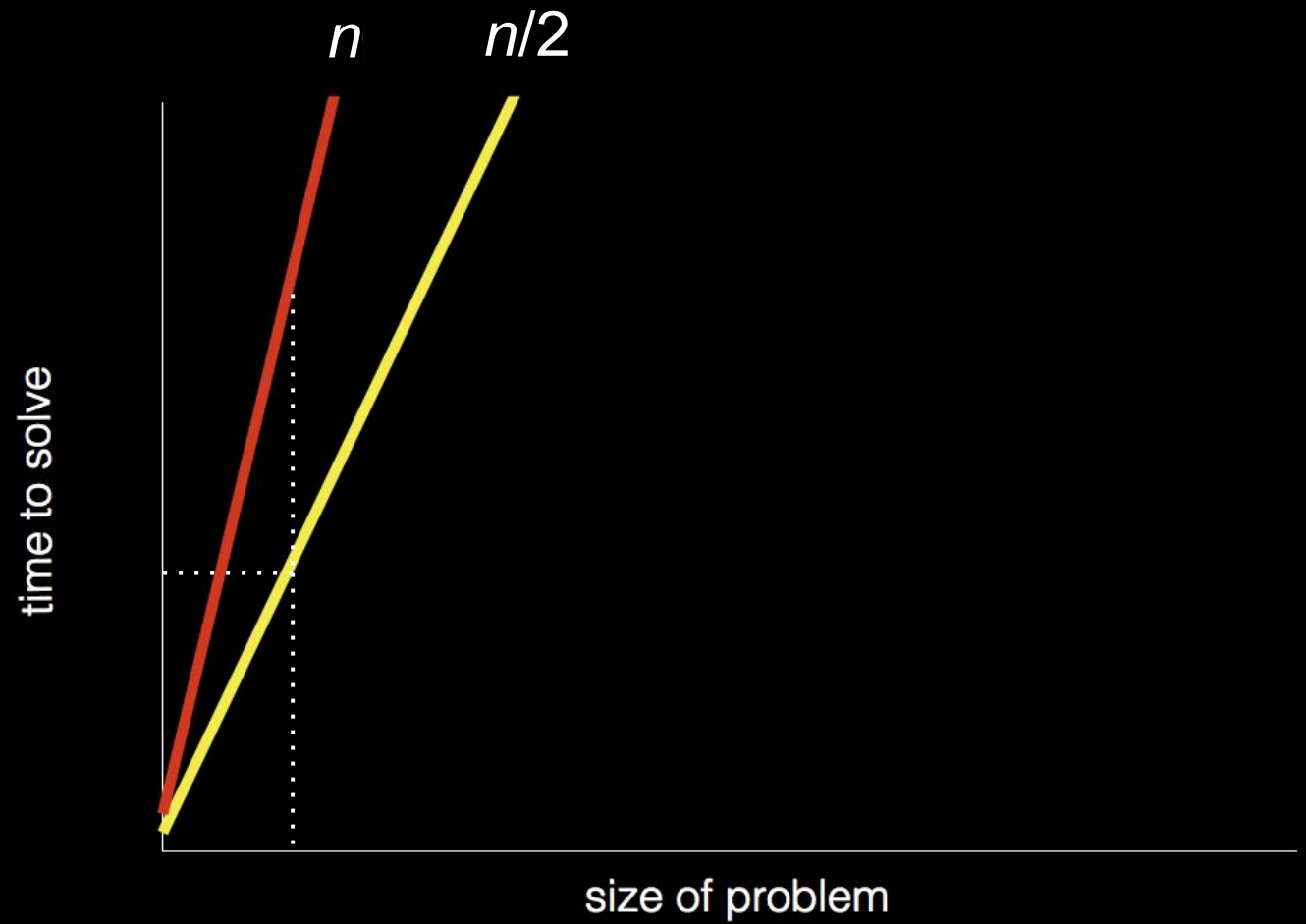

time to solve
size of problem

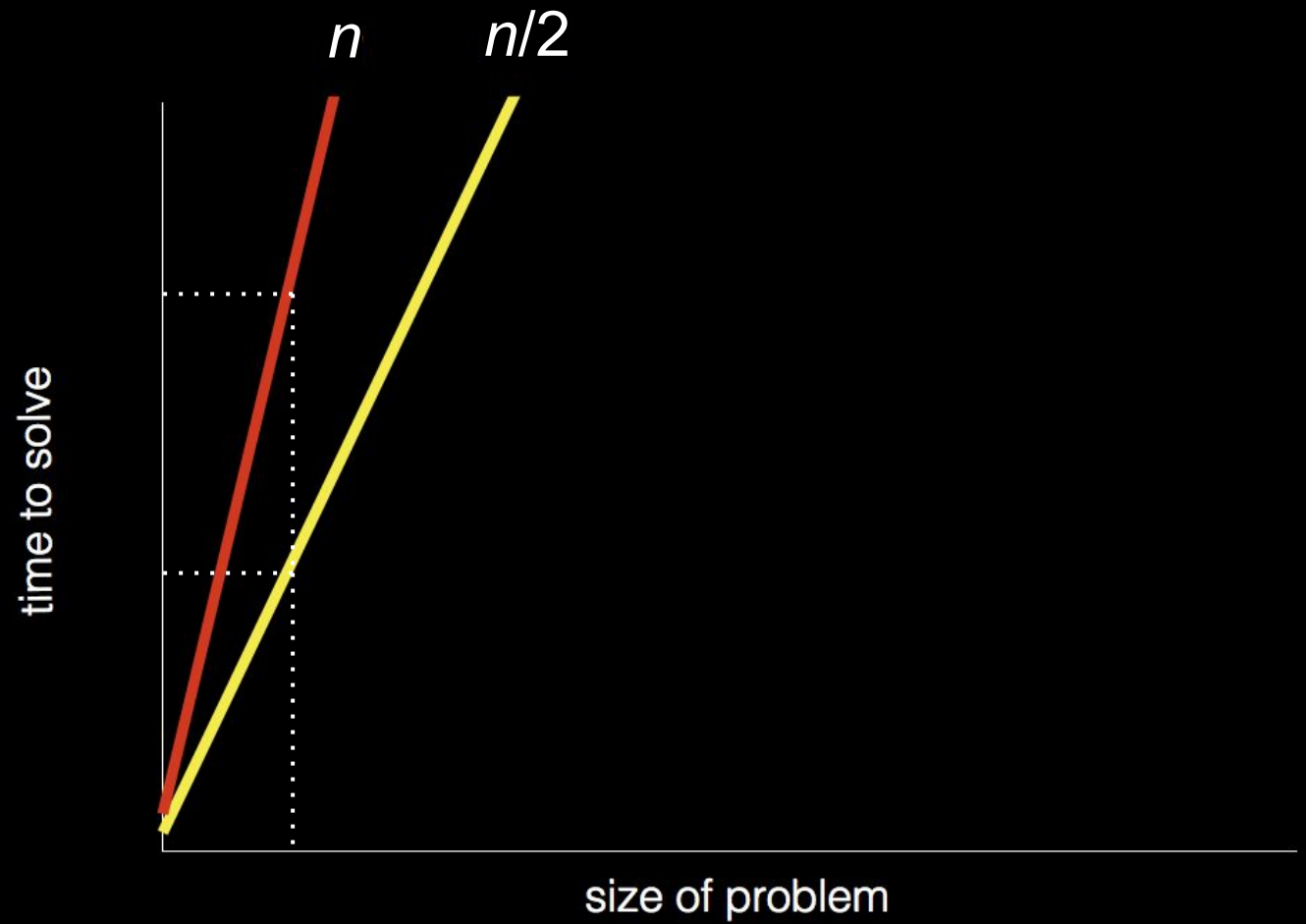

n
time to solve
size of problem

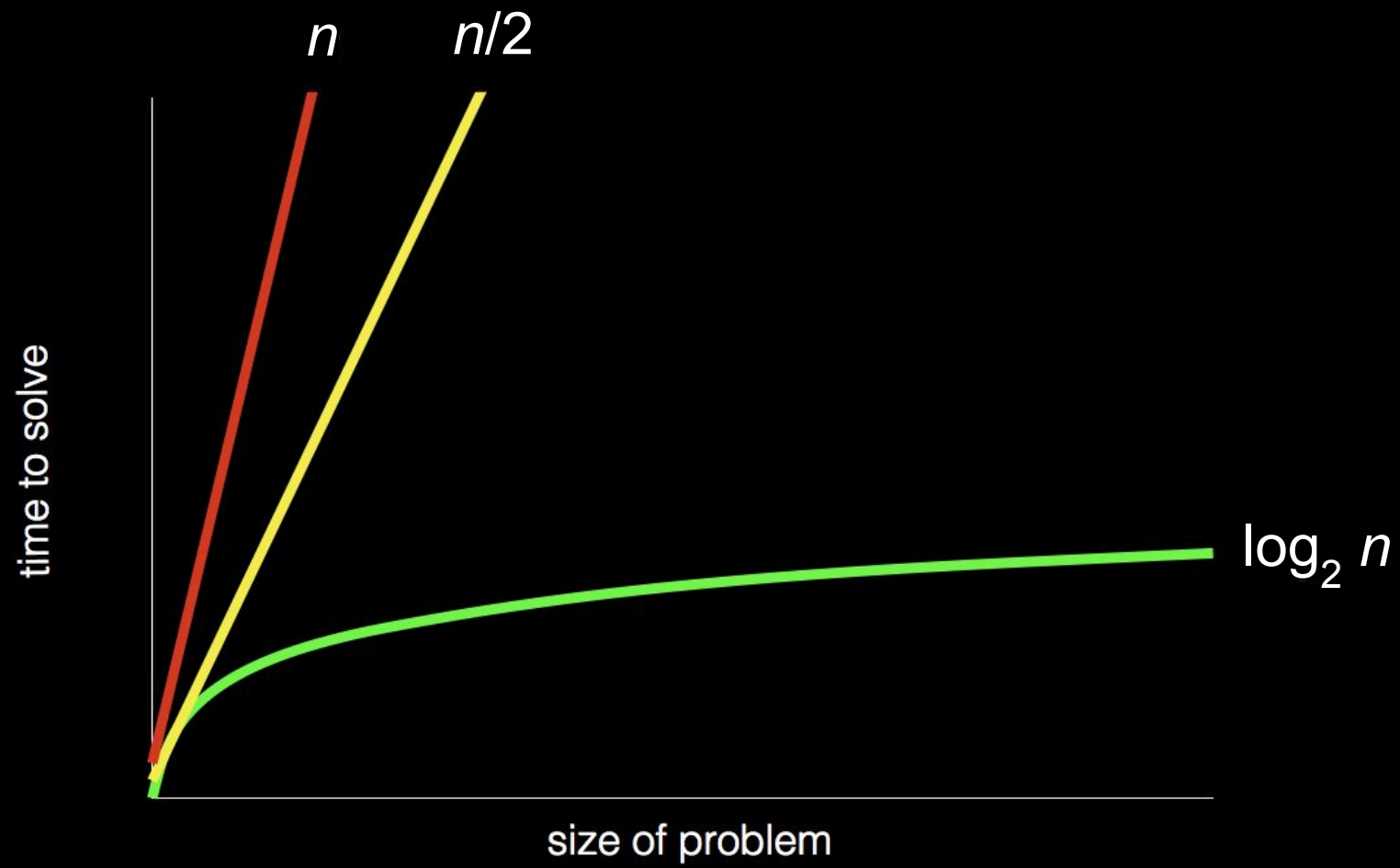

n
n/2
time to solve
size of problem


n
n/2
time to solve
size of problem


n
n/2
time to solve
size of problem


n
n/2
time to solve
size of problem


n
n/2
time to solve
size of problem


n
n/2
time to solve
log2 n
size of problem

pseudocode

```
1   Pick up phone book
2   Open to middle of phone book
3   Look at page
4   If person is on page
5       Call person
6   Else if person is earlier in book
7       Open to middle of left half of book
8       Go back to line 3
9   Else if person is later in book
10      Open to middle of right half of book
11      Go back to line 3
12  Else
13      Quit
```

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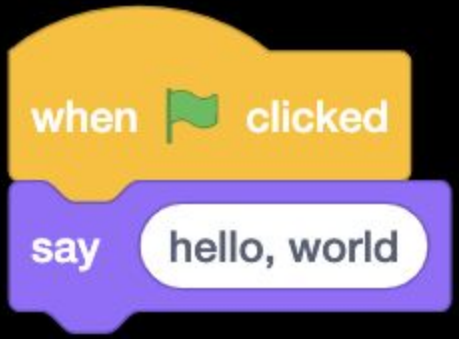
```

- functions
- conditions
- Boolean expressions
- loops

- functions
- conditions
- Boolean expressions
- loops
- variables
- threads
- events
- ...

```c
#include <stdio.h>

int main(void)
{
    printf("hello, world\n");
}
```


when clicked
say
hello, world

Code Costumes Sounds

Motion
Looks
Sound
Events
Control
Sensing
Operators
Variables
My Blocks

Motion

move 10 steps
turn 15 degrees
turn 15 degrees

go to random position
go to x: 0 y: 0
glide 1 secs to random position
glide 1 secs to x: 0 y: 0

point in direction 90
point towards mouse-pointer

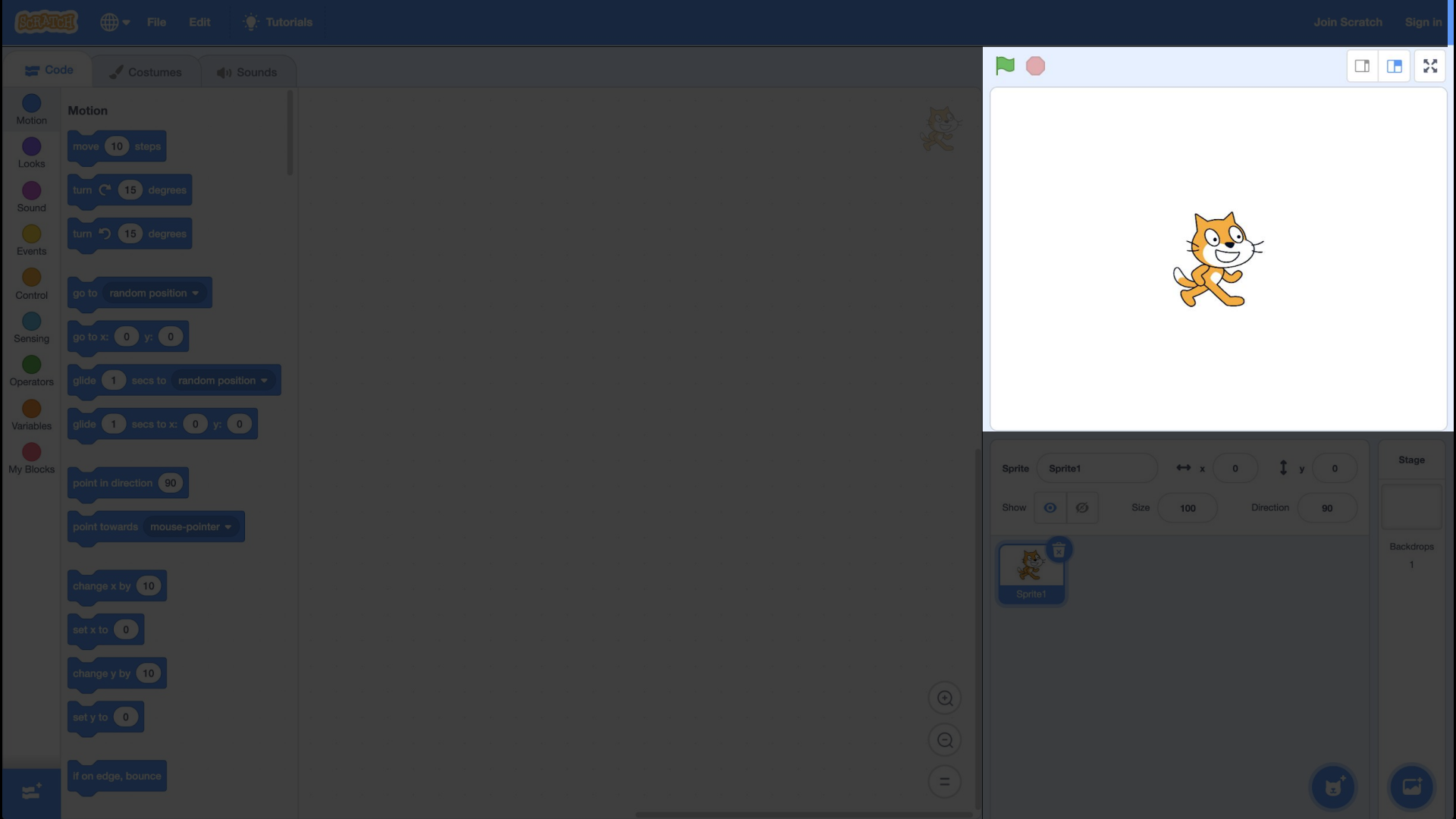
change x by 10
set x to 0
change y by 10
set y to 0

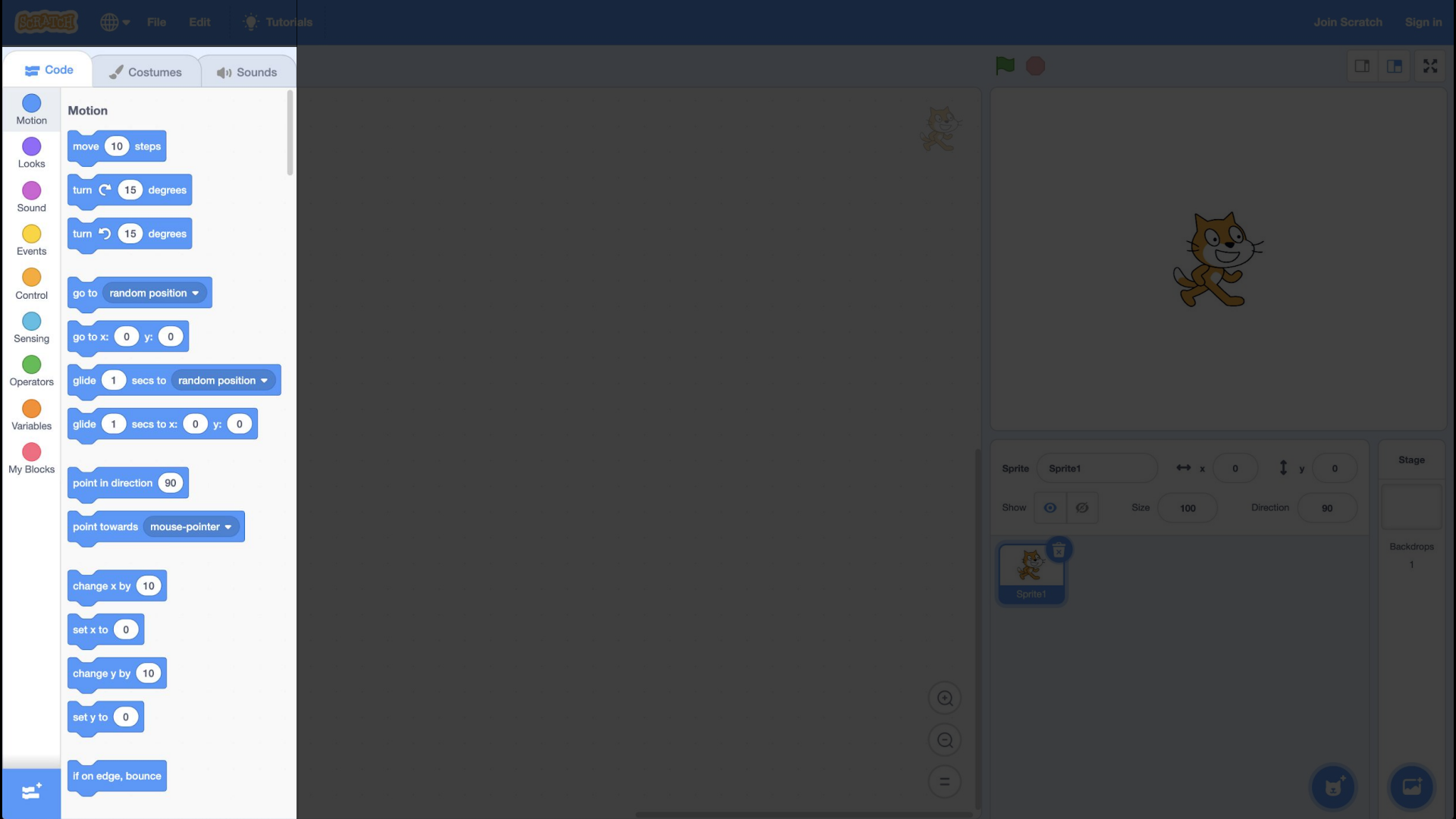
if on edge, bounce

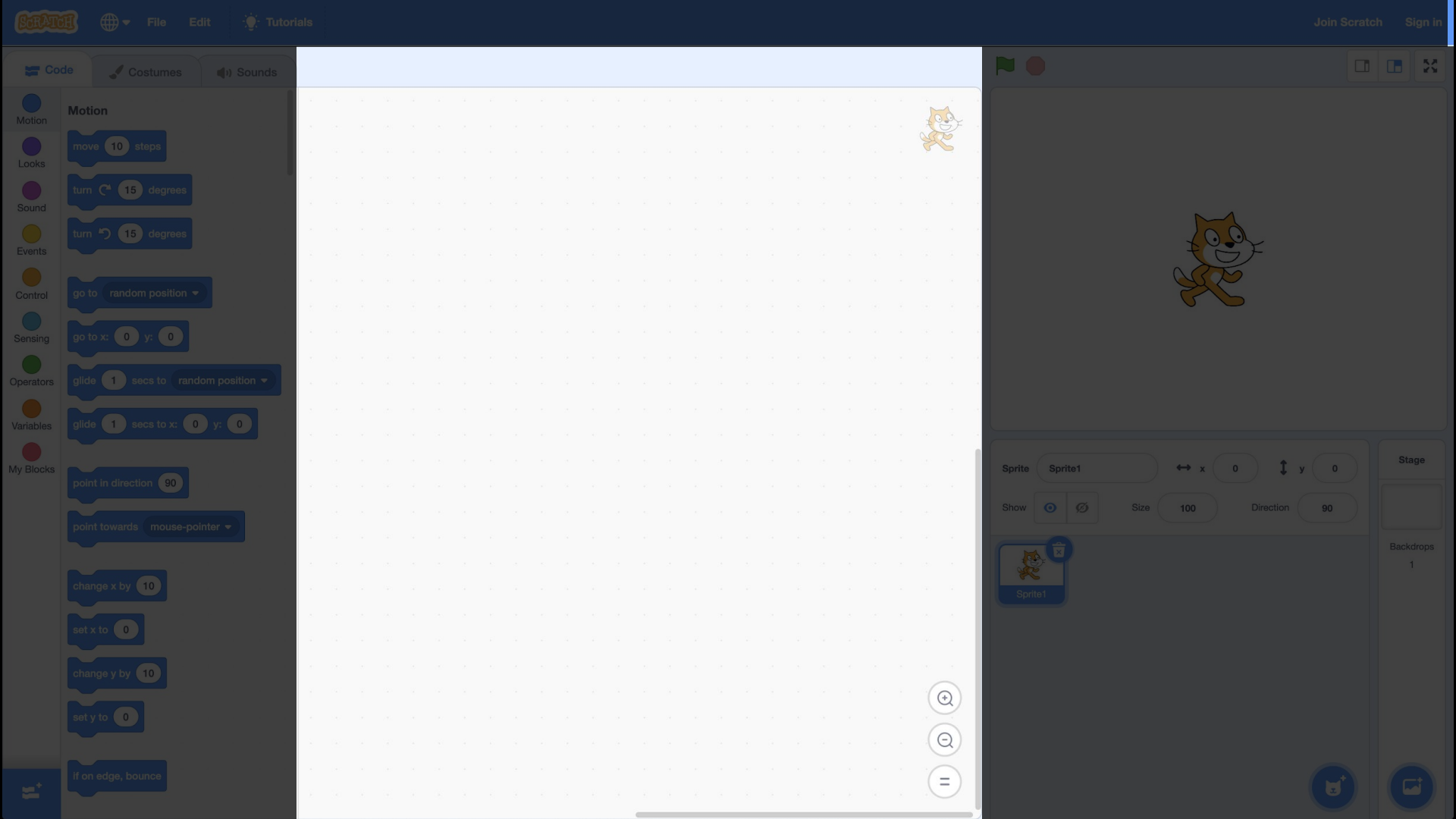
Sprite Sprite1 x 0 y 0
Show Size 100 Direction 90

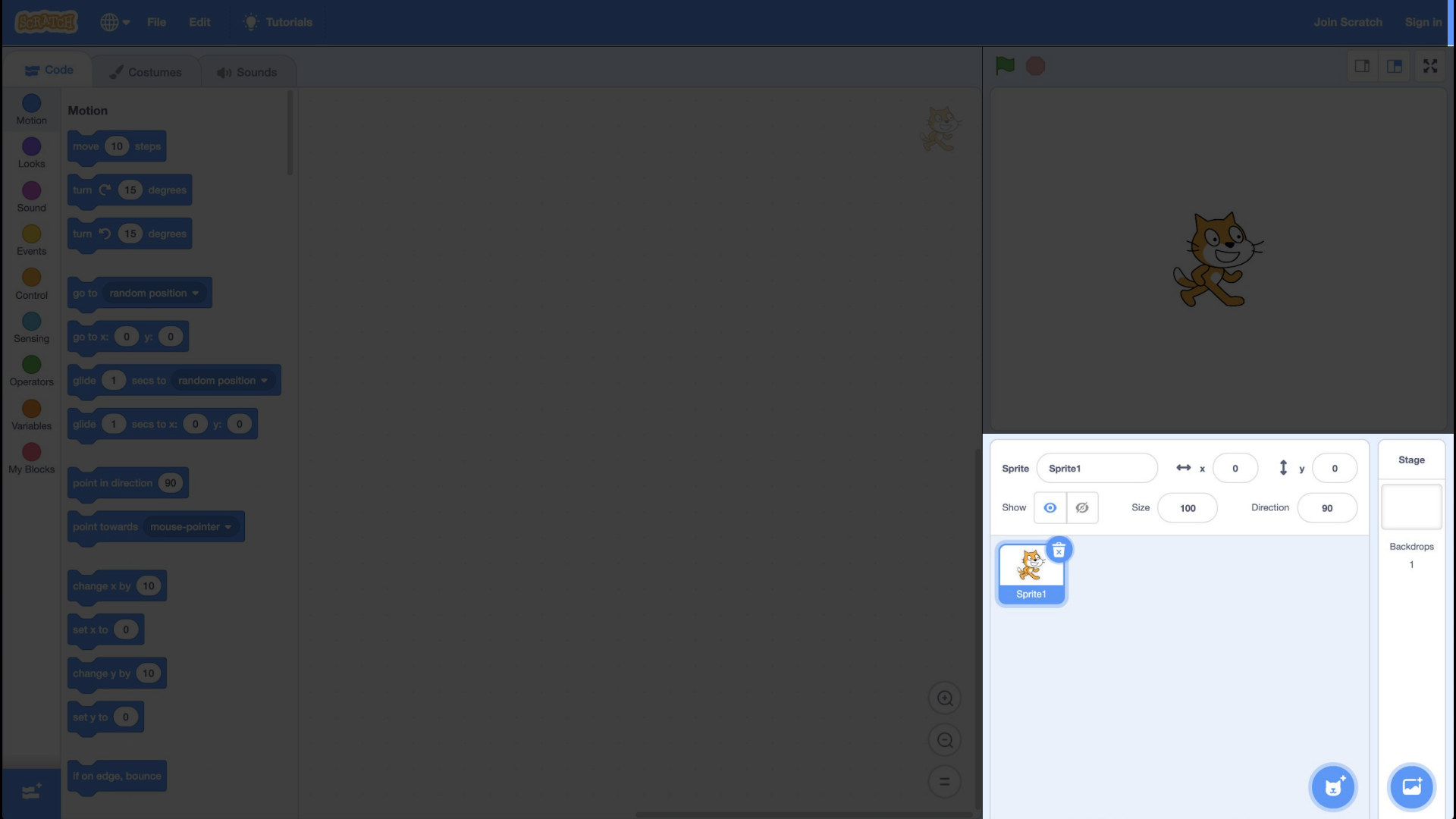

Sprite1

Stage
Backdrops 1


File
Edit
Tutorials
Join Scratch
Sign in
Code
Costumes
Sounds
Motion
Looks
Sound
Events
Control
Sensing
Operators
Variables
My Blocks
Motion
move 10 steps
turn 15 degrees
turn 15 degrees
go to random position
go to x: 0 y: 0
glide 1 secs to random position
glide 1 secs to x: 0 y: 0
point in direction 90
point towards mouse-pointer
change x by 10
set x to 0
change y by 10
set y to 0
if on edge, bounce
Sprite
Sprite1
x
0
y
0
Show
Size
100
Direction
90
Stage
Backdrops
1


File
Edit
Tutorials
Join Scratch
Sign in
Code
Costumes
Sounds
Motion
Looks
Sound
Events
Control
Sensing
Operators
Variables
My Blocks
Motion
move 10 steps
turn 15 degrees
turn 15 degrees
go to random position
go to x: 0 y: 0
glide 1 secs to random position
glide 1 secs to x: 0 y: 0
point in direction 90
point towards mouse-pointer
change x by 10
set x to 0
change y by 10
set y to 0
if on edge, bounce
Sprite
Sprite1
x
0
y
0
Show
Size
100
Direction
90
Stage
Backdrops
1
Sprite1


File
Edit
Tutorials
Join Scratch
Sign in
Code
Costumes
Sounds
Motion
Looks
Sound
Events
Control
Sensing
Operators
Variables
My Blocks
Motion
move 10 steps
turn 15 degrees
turn 15 degrees
go to random position
go to x: 0 y: 0
glide 1 secs to random position
glide 1 secs to x: 0 y: 0
point in direction 90
point towards mouse-pointer
change x by 10
set x to 0
change y by 10
set y to 0
if on edge, bounce
Sprite
Sprite1
x 0
y 0
Show
Size 100
Direction 90
Stage
Backdrops 1


File
Edit
Tutorials
Join Scratch
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Code
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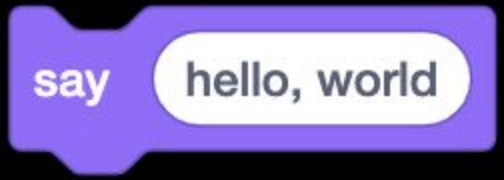
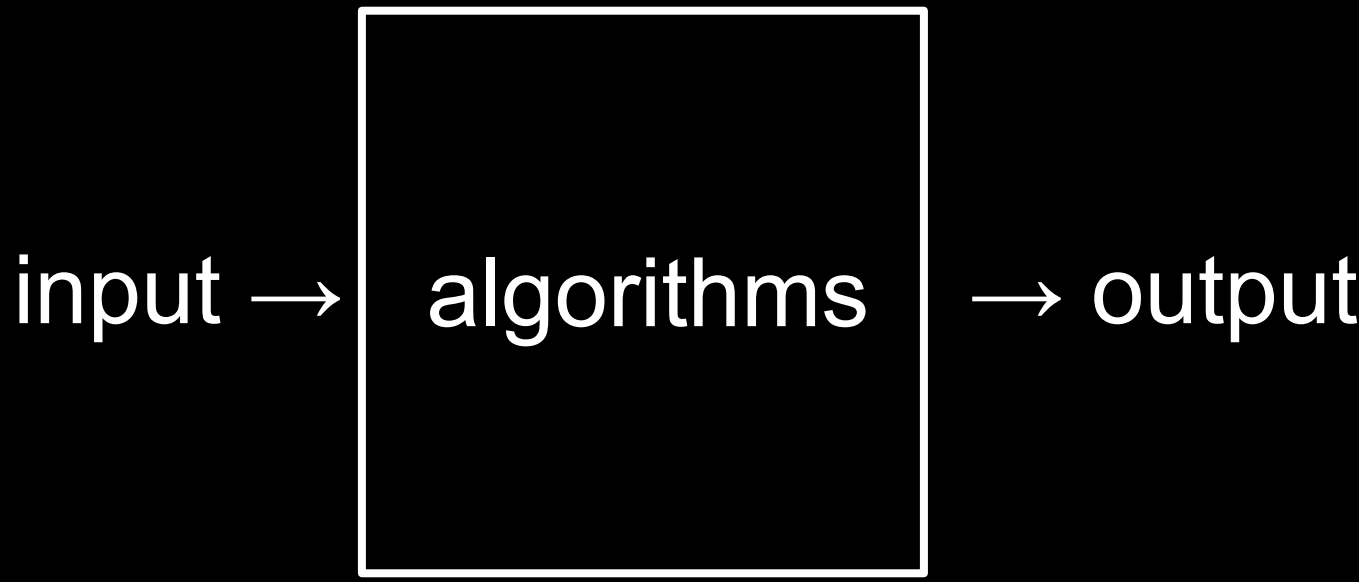
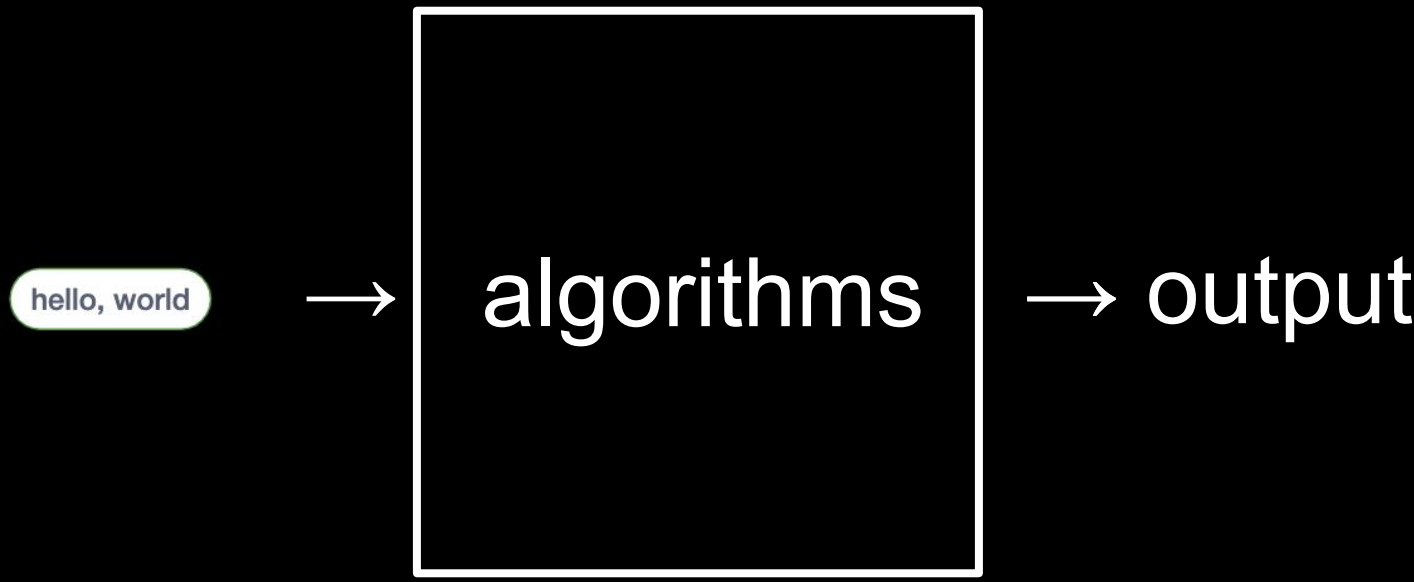
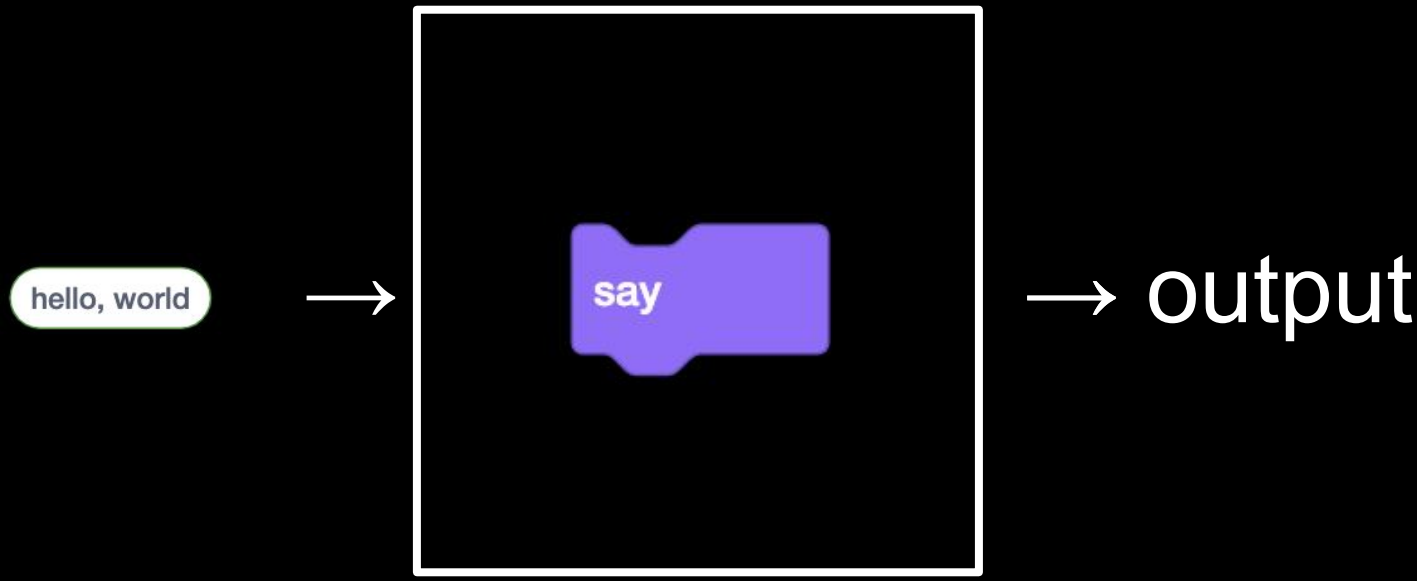
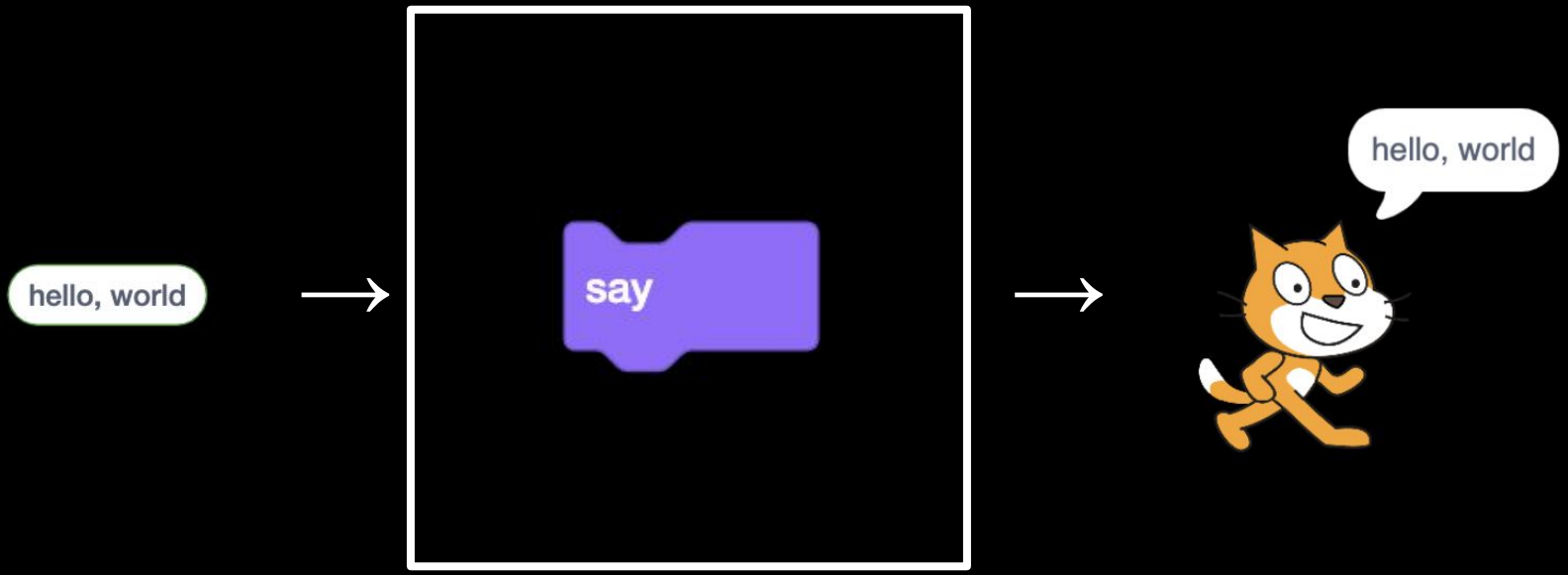
Motion
Looks
Sound
Events
Control
Sensing
Operators
Variables
My Blocks
Motion
move 10 steps
turn 15 degrees
turn 15 degrees
go to random position
go to x: 0 y: 0
glide 1 secs to random position
glide 1 secs to x: 0 y: 0
point in direction 90
point towards mouse-pointer
change x by 10
set x to 0
change y by 10
set y to 0
if on edge, bounce
Sprite
Sprite1
x
0
y
0
Show
Size
100
Direction
90
Sprite1
Stage
Backdrops
1

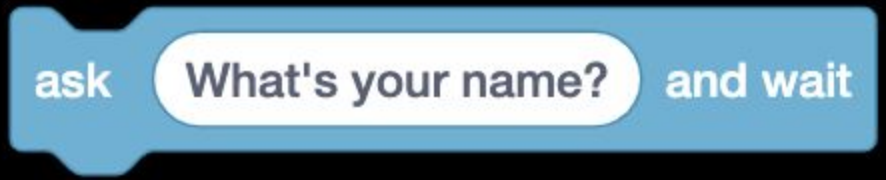

say
hello, world

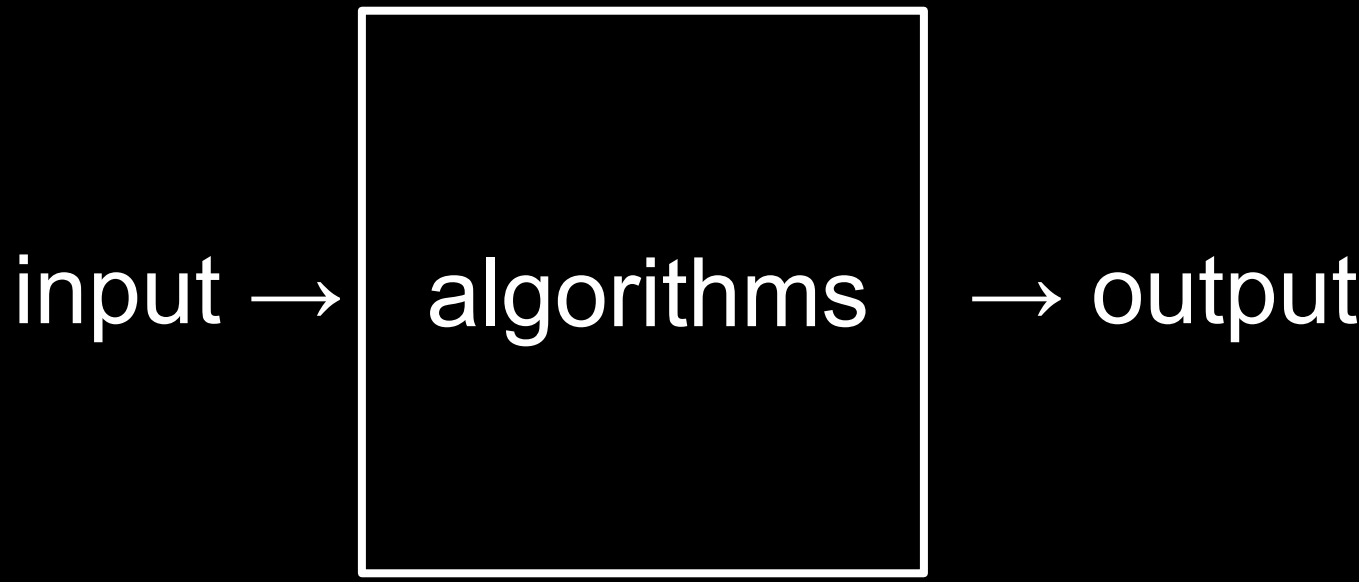

input →
algorithms
→ output

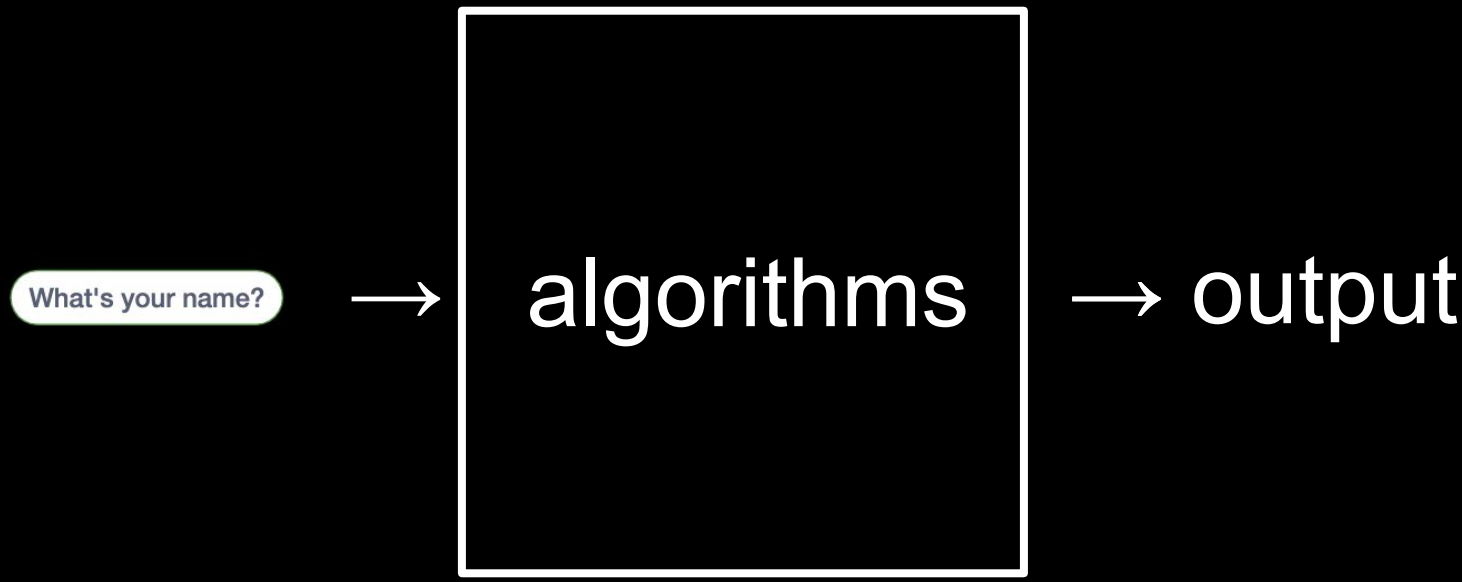

hello, world
algorithms
output

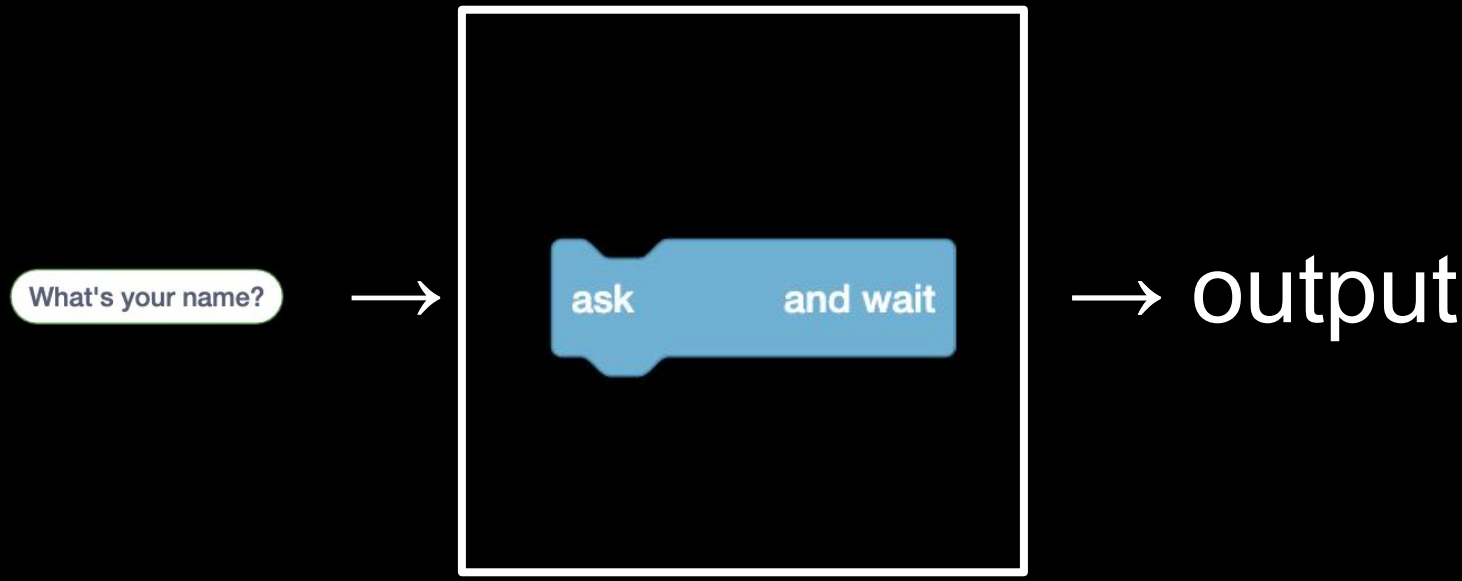

hello, world
say
output

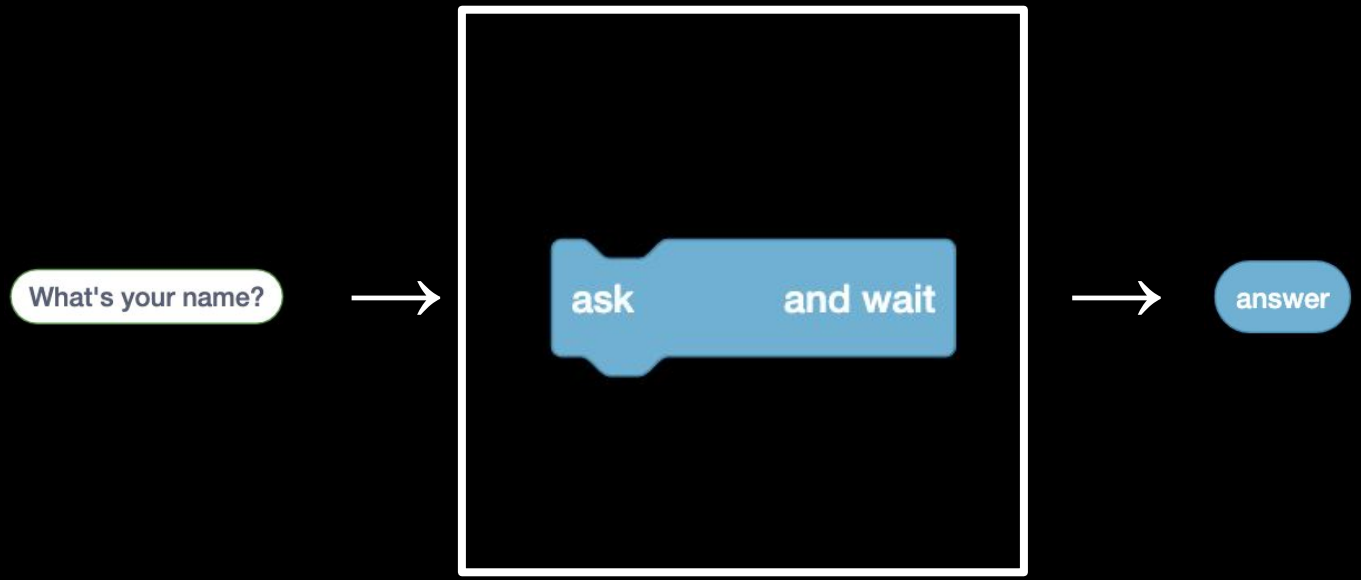

hello, world
say
hello, world

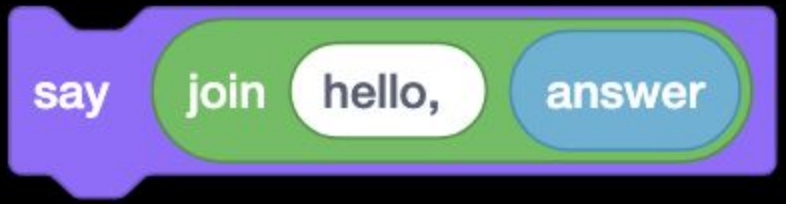

ask
What's your name?
and wait

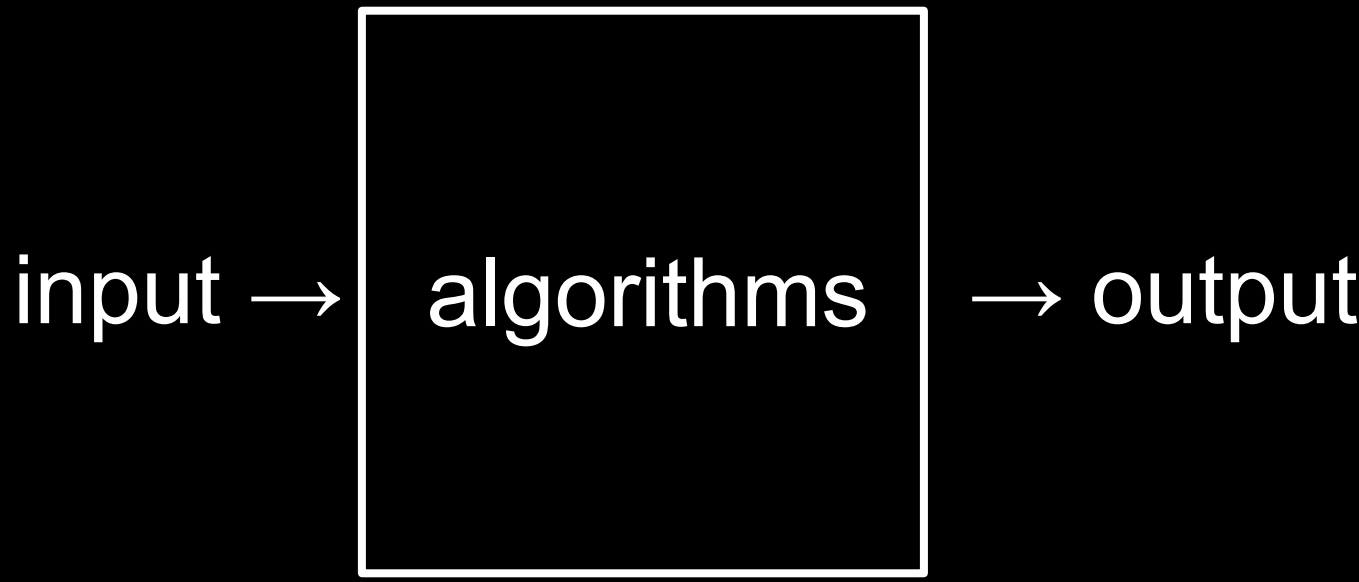

input →
algorithms
→ output

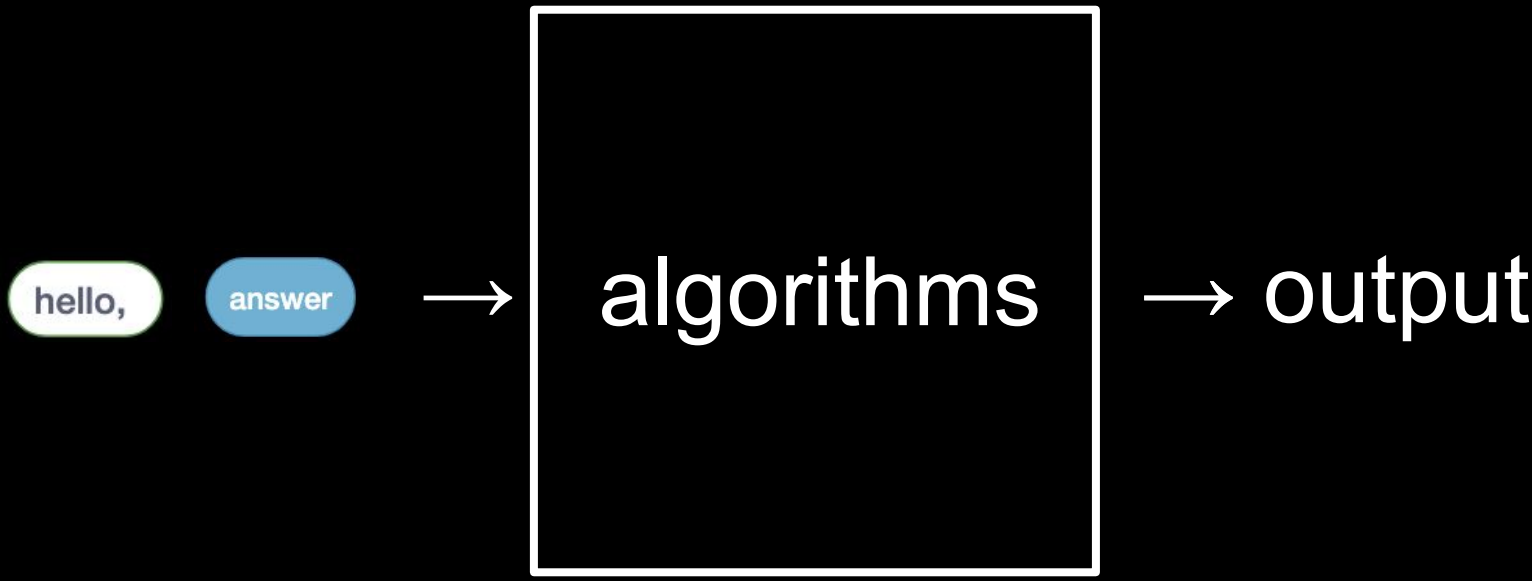

What's your name?
algorithms
output

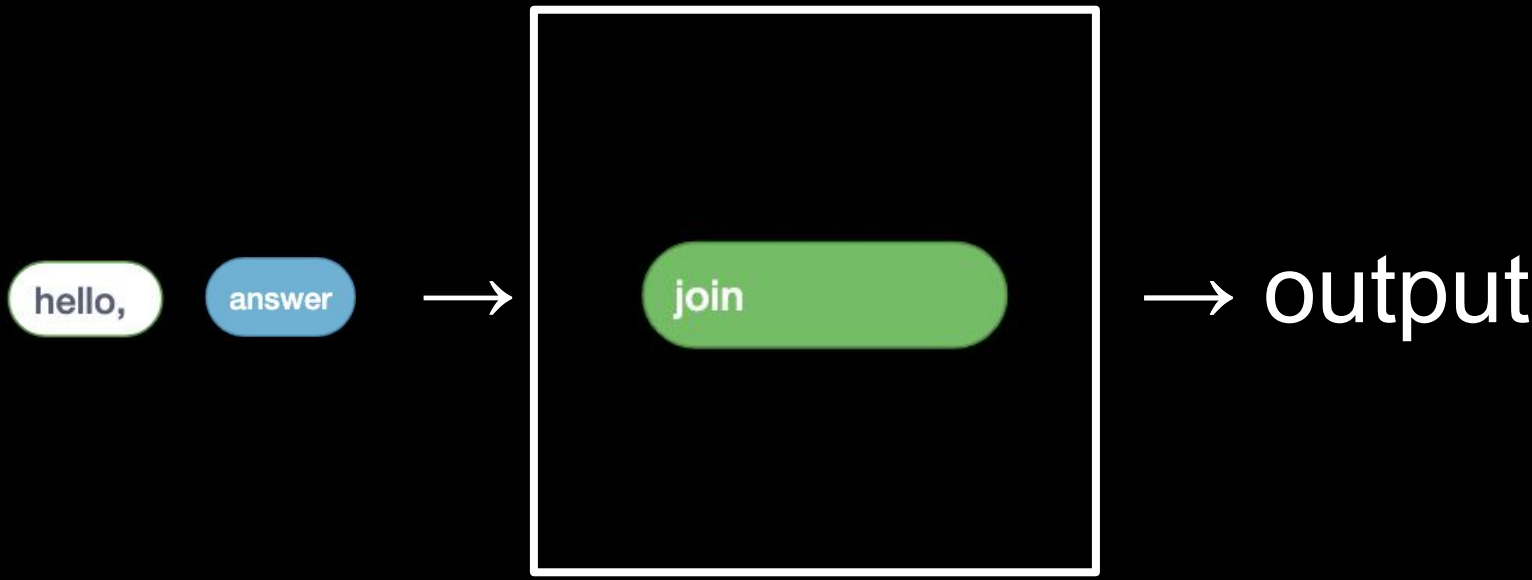

What's your name?
ask
and wait
output

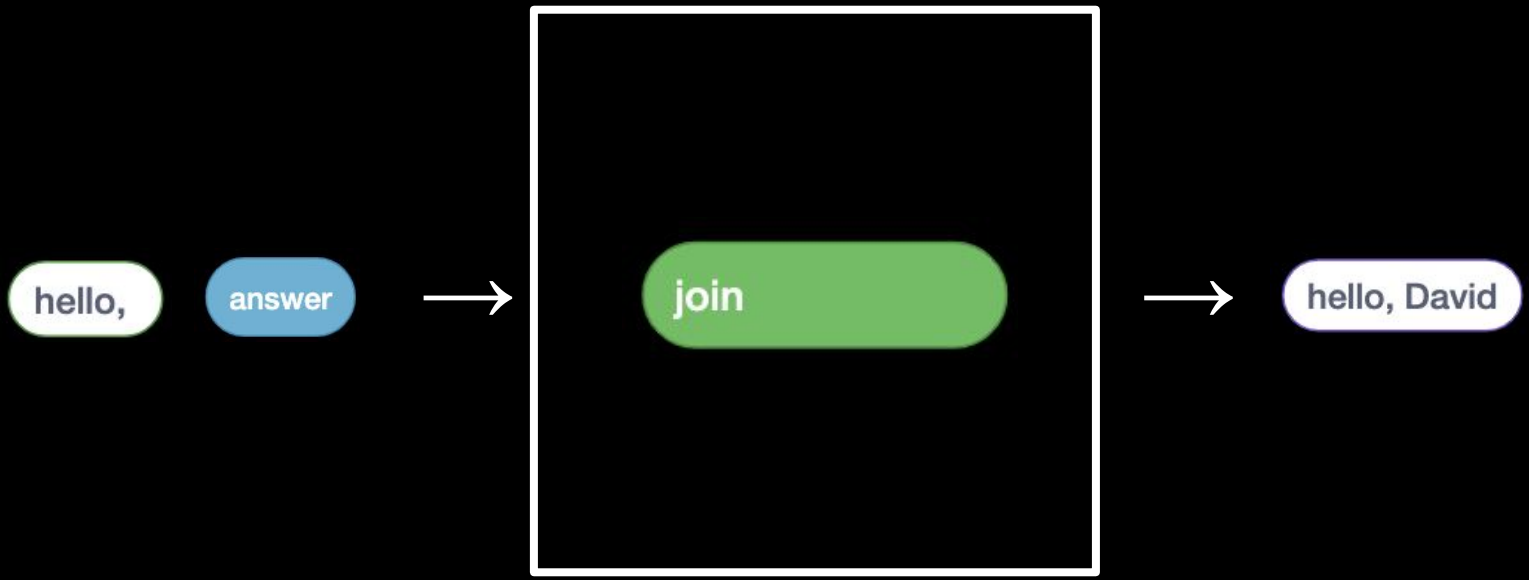

What's your name?
ask
and wait
answer


say
join
hello,
answer


input →
algorithms
→ output

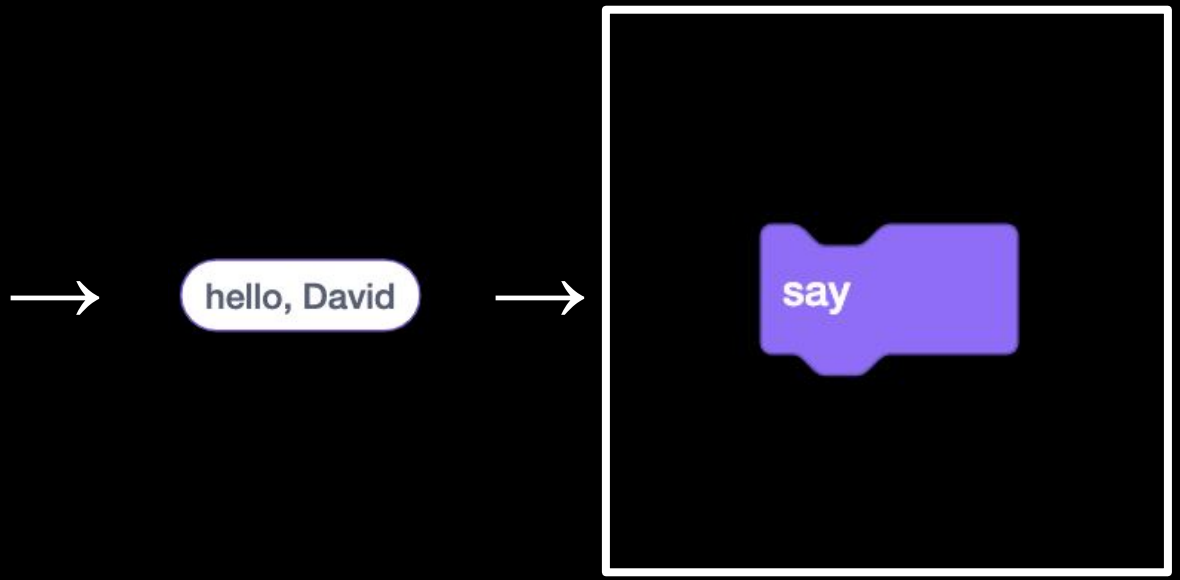

hello,
answer
algorithms
output


hello,
answer
join
output


hello,
answer
join
hello, David


hello, David


hello, David


hello, David
say


hello, David
say
hello, David

Assignment 0

Office Hours

CS50 for MBAs

Computational Thinking