CS50 for JDs

cs50.harvard.edu/hls

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Step 0 Look for your name tent, but aok to sit anywhere.
Step 1 Sign up for scratch.mit.edu/join.
Step 2 Submit cs50.ly/lecture0.
Step 3 Introduce self at cs50.ly/ed.

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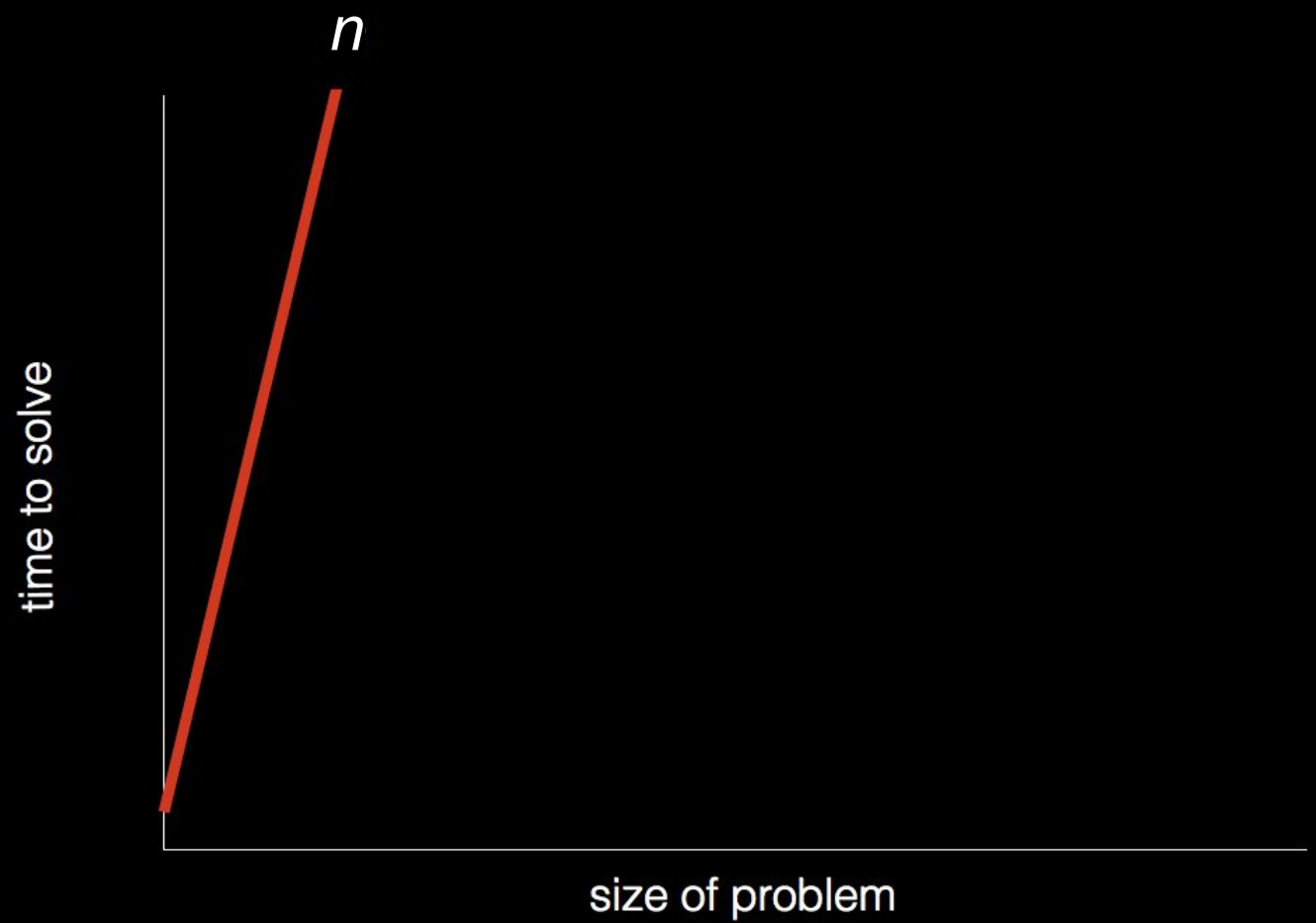
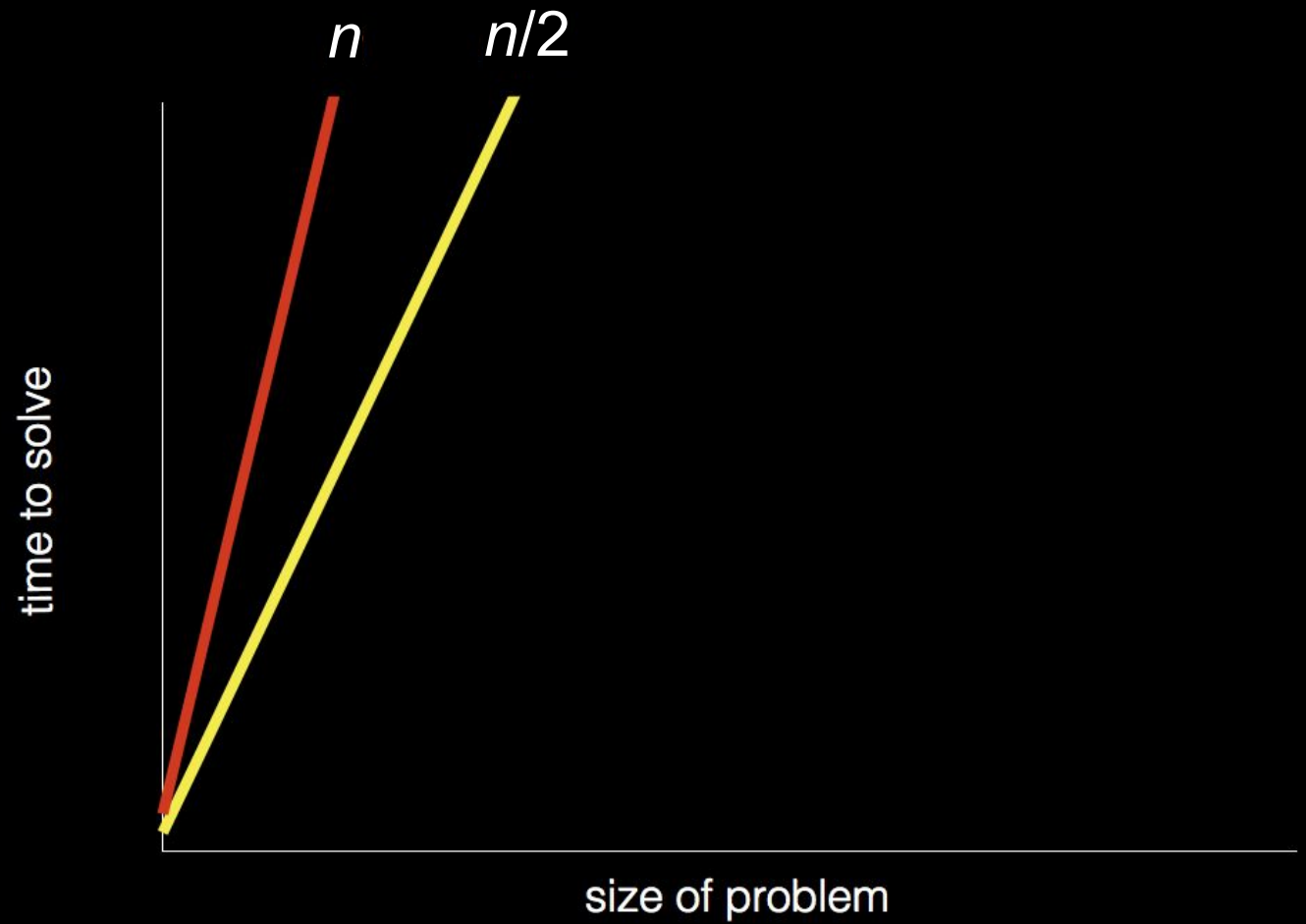
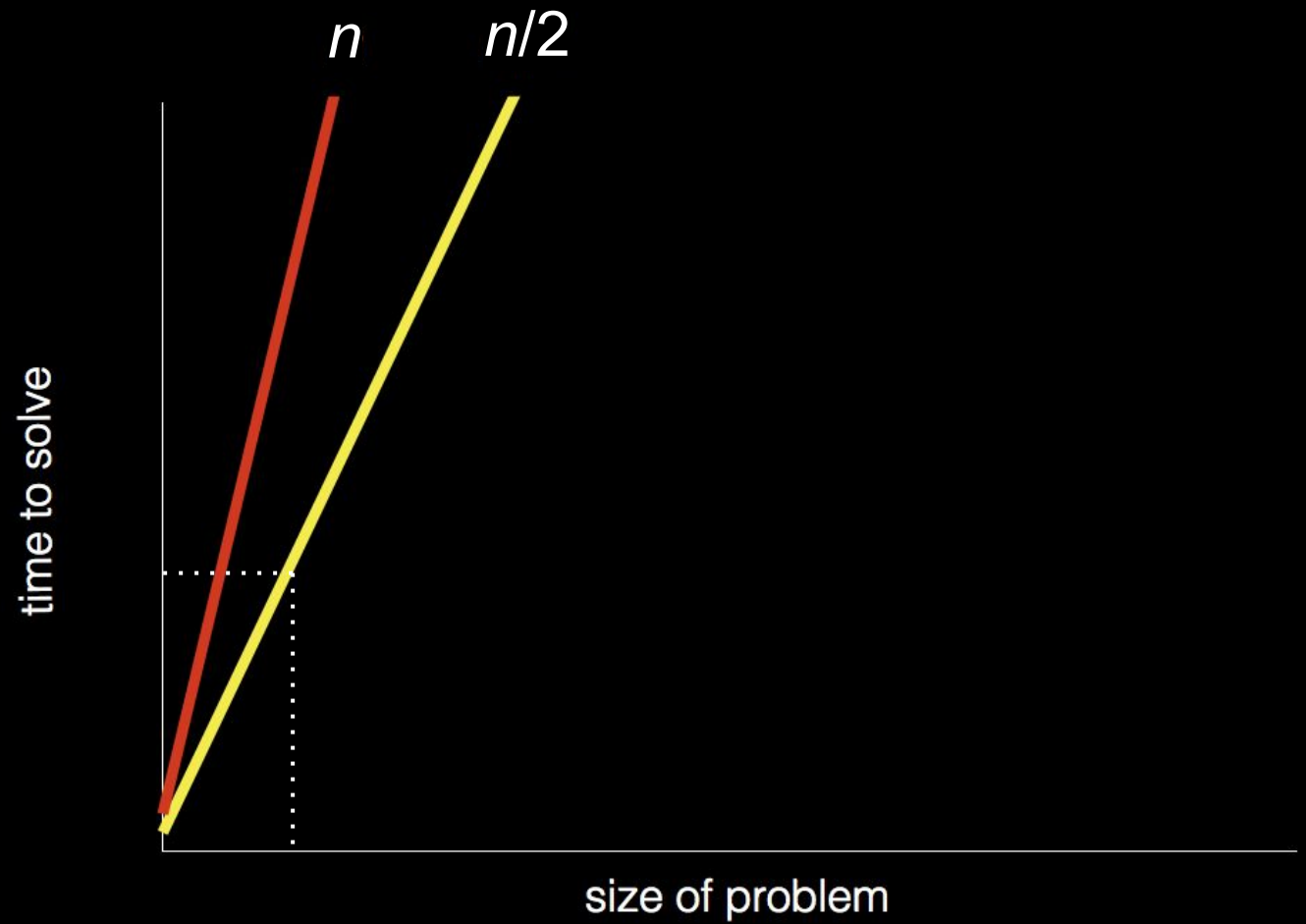
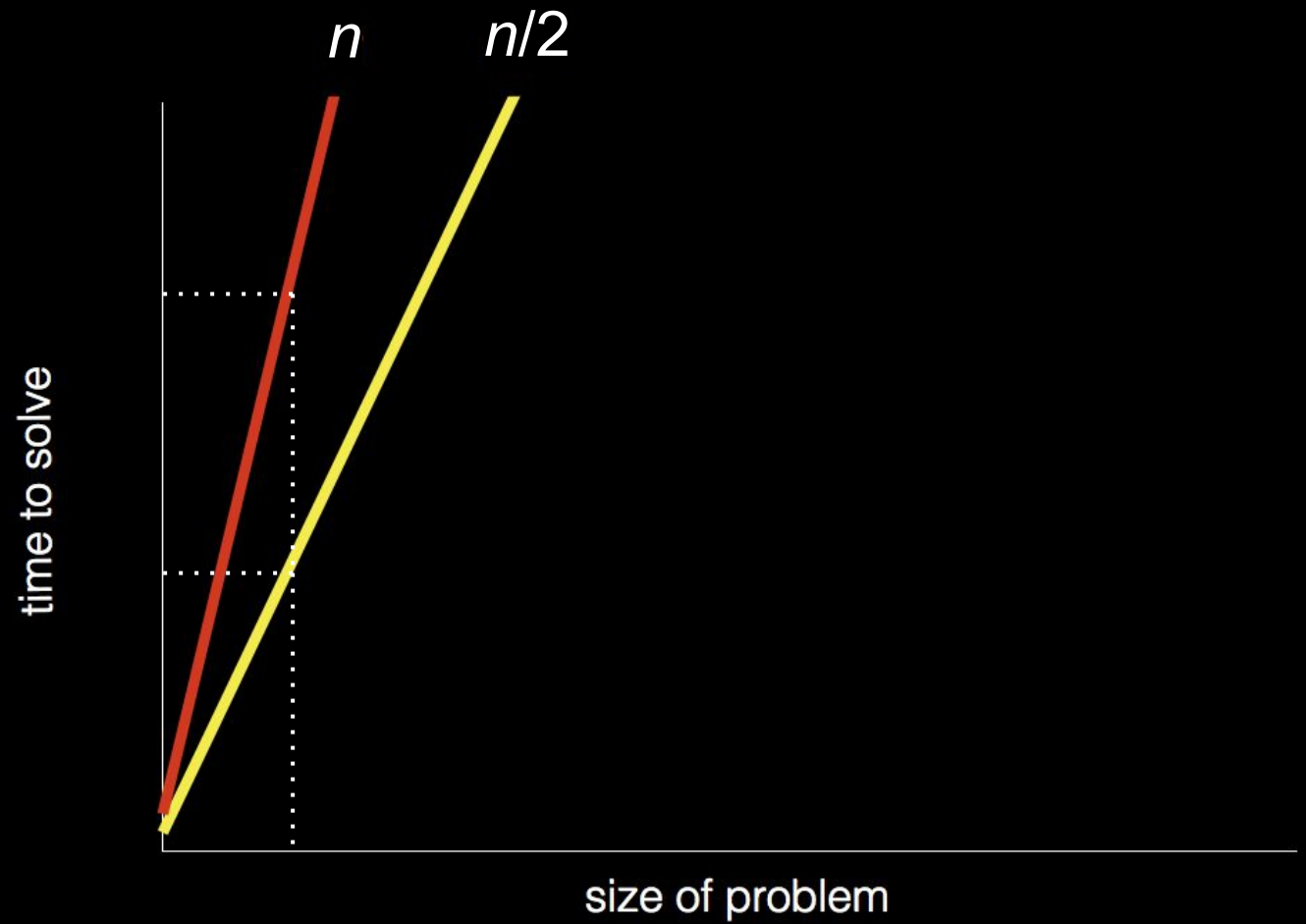
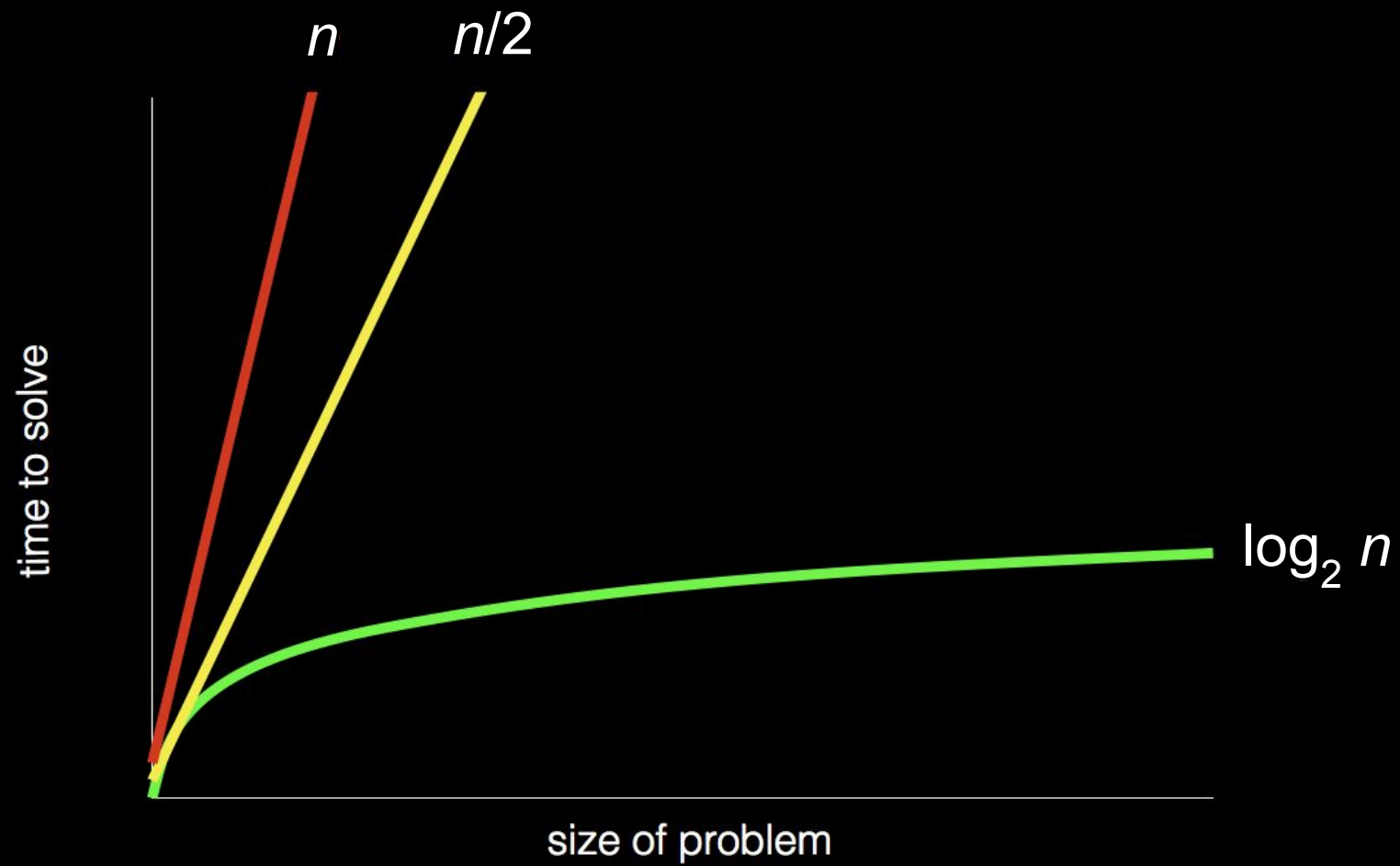

n
time to solve
size of problem


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

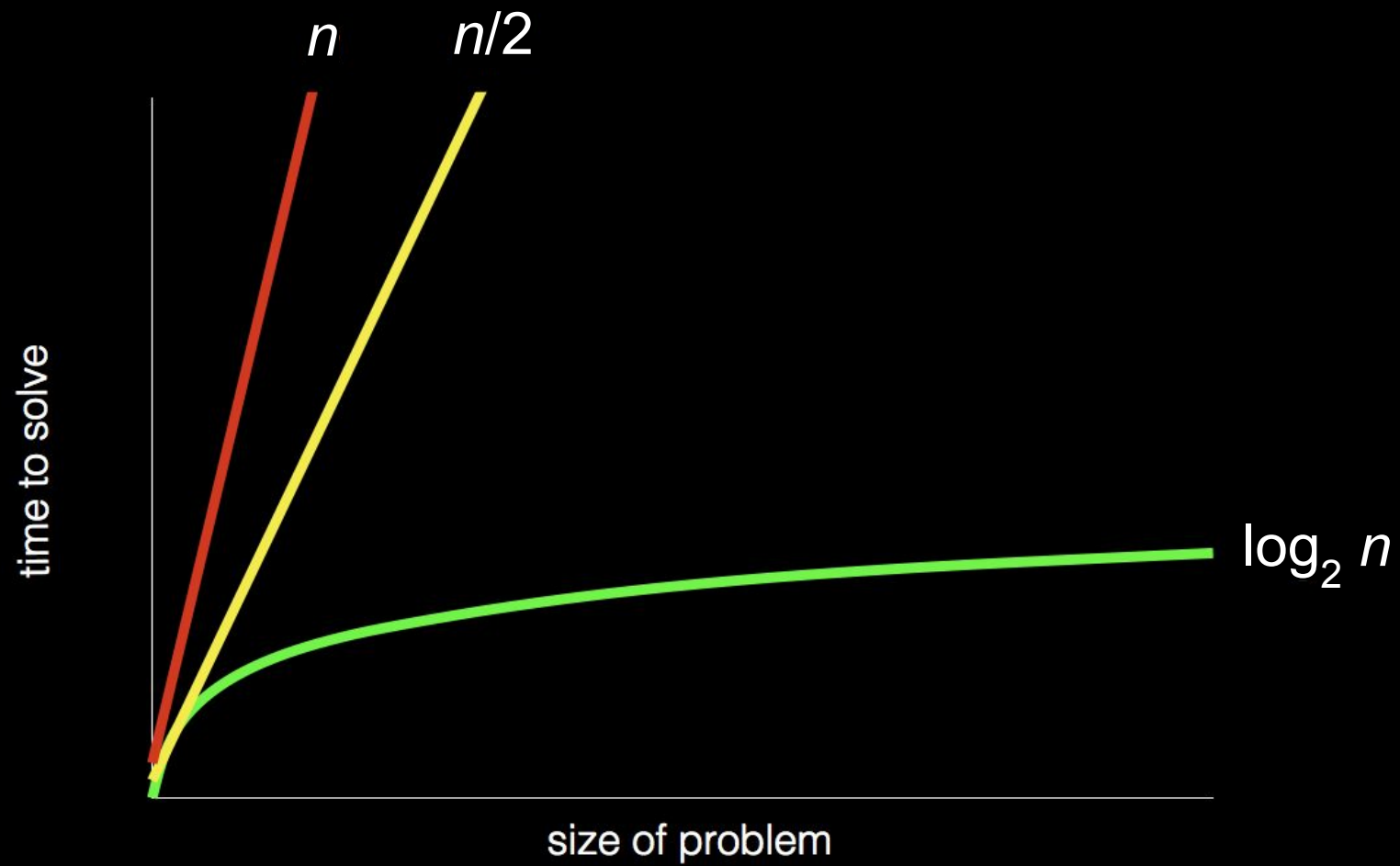

n
n/2
time to solve
log2 n
size of problem

1. Stand up and think of the number 1.

1. Stand up and think of the number 1.
2. Pair off with someone standing, add their number to yours, and remember the sum.

1. Stand up and think of the number 1.
2. Pair off with someone standing, add their number to yours, and remember the sum.
3. One of you should then sit down.

1. Stand up and think of the number 1.
2. Pair off with someone standing, add their number to yours, and remember the sum.
3. One of you should then sit down.
4. If still standing, go back to step 2.


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

CS50 for JDs

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Lectures

- Computational Thinking
- Python
- Algorithms, Data Structures
- SQL
- Internet Technologies, Cloud Computing
- Web Development
- Privacy, Security
- Artificial Intelligence

Labs

- Python
- SQL
- HTML, CSS, JavaScript

Seminars

- Innovative Algorithms and Their Applications
- Data Visualization for Better or Worse
- Will the FCC’s Net Neutrality Pendulum Ever Stop?
- Git, GitHub, Software Licences, and the World of Open-Source Software
- The Painters Who Passed the Turing Test: History and Impact of AI Art

Office Hours

cs50.harvard.edu/hls/2023/winter/hours

Teaching Staff

- Carter Zenke, **Preceptor**
- Sophia Cho, **Head Teaching Fellow**
- Catherine Deskur, **Teaching Fellow**
- Inno Munai, **Teaching Fellow**
- Michael Hu, **Teaching Fellow**
- Patrick Thornton, **Teaching Fellow**
- Varsha Venkatasubramanian, **Teaching Fellow**

CS50 for JDs

Computational Thinking

Mr. Pichai

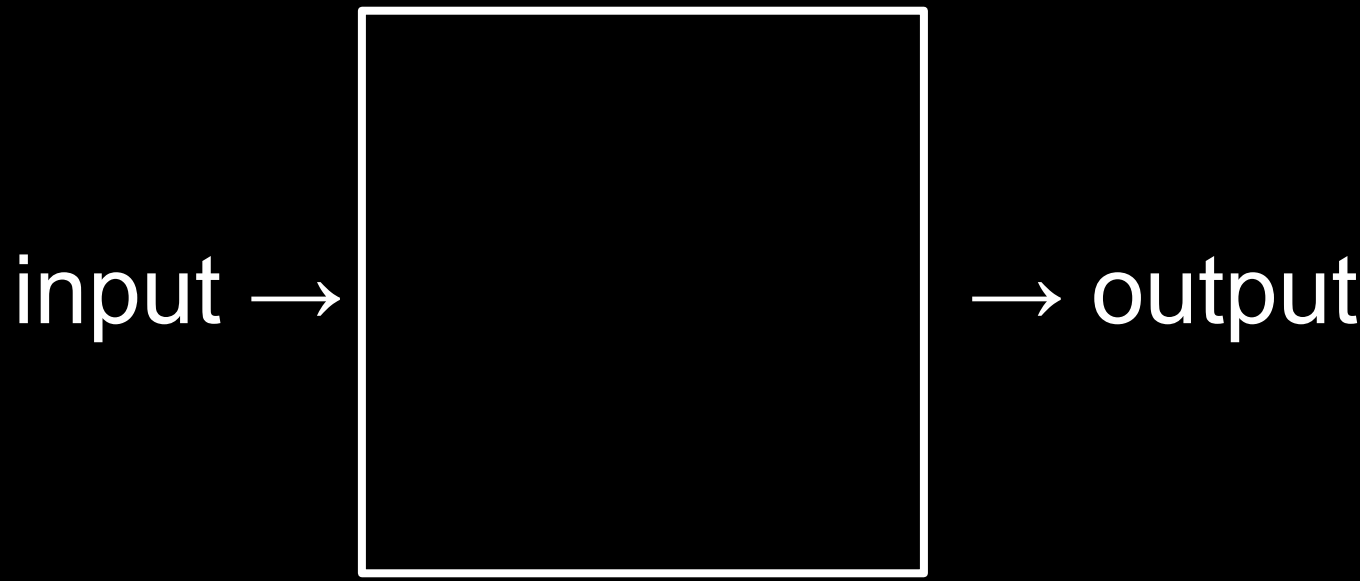
c|net
MS. ESHOO
CALIFORNIA

I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.

computer science

computational thinking

problem solving


input →
→ output

representation

unary

base-1

binary

binary digit

bi t

bit

1

000

001

010

011

100

101

110

111

base-2

base-10

decimal

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

4 2 1
000

8 4 2 1

1000

4 2 1
000

byte

00000000

11111111

A

65

01000001

ASCII

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

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

01001000 01001001 00100001

72 73 33

H I

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

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
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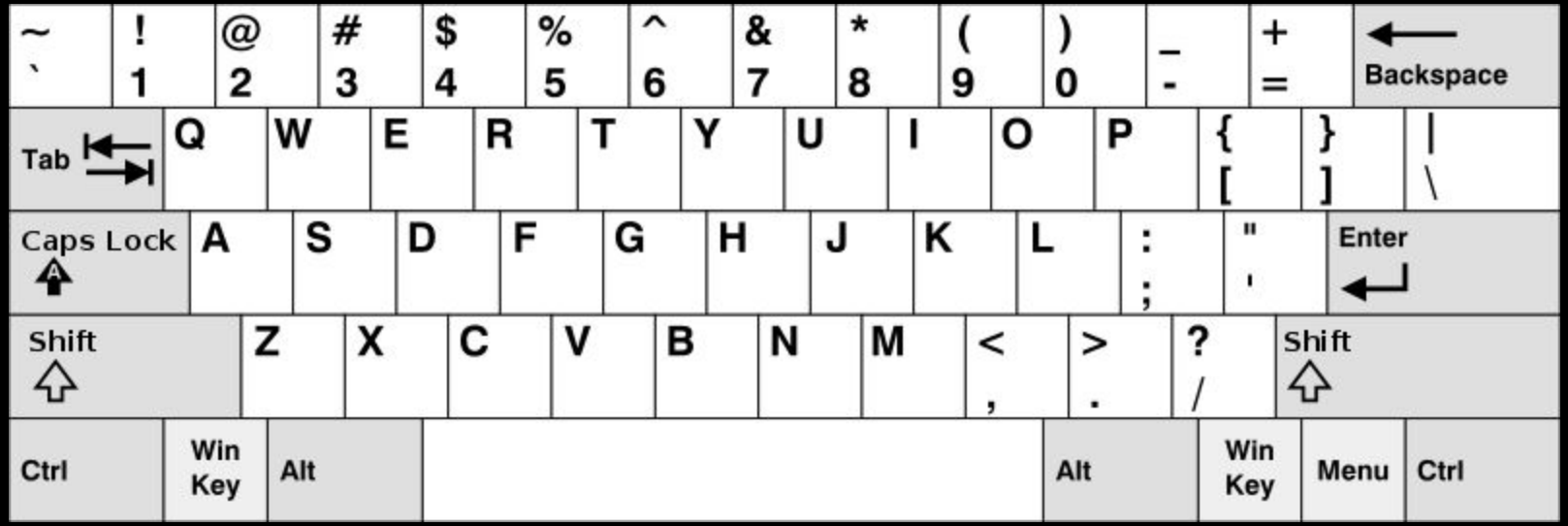
7	BEL	23	ETB	39	'	55	7	71	G	87	W	103	g	119	w
8	BS	24	CAN	40	(	56	8	72	H	88	X	104	h	120	x
9	HT	25	EM	41	)	57	9	73	I	89	Y	105	i	121	y
10	LF	26	SUB	42	*	58	:	74	J	90	Z	106	j	122	z
11	VT	27	ESC	43	+	59	;	75	K	91	[	107	k	123	{
12	FF	28	FS	44	,	60	<	76	L	92	\	108	l	124	|
13	CR	29	GS	45	-	61	=	77	M	93	]	109	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


~ `
! 1
@ 2
# 3
$ 4
% 5
^ 6
& 7
* 8
(9
) 0
_ -
+ =
Backspace
Tab
Q
W
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R
T
Y
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{ [
}]
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Caps Lock
A
S
D
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: ;
" '
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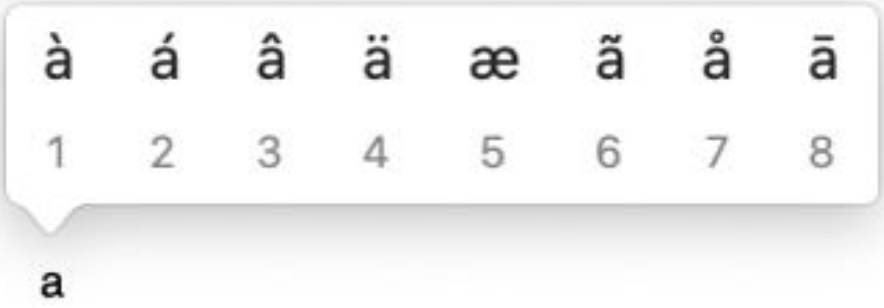
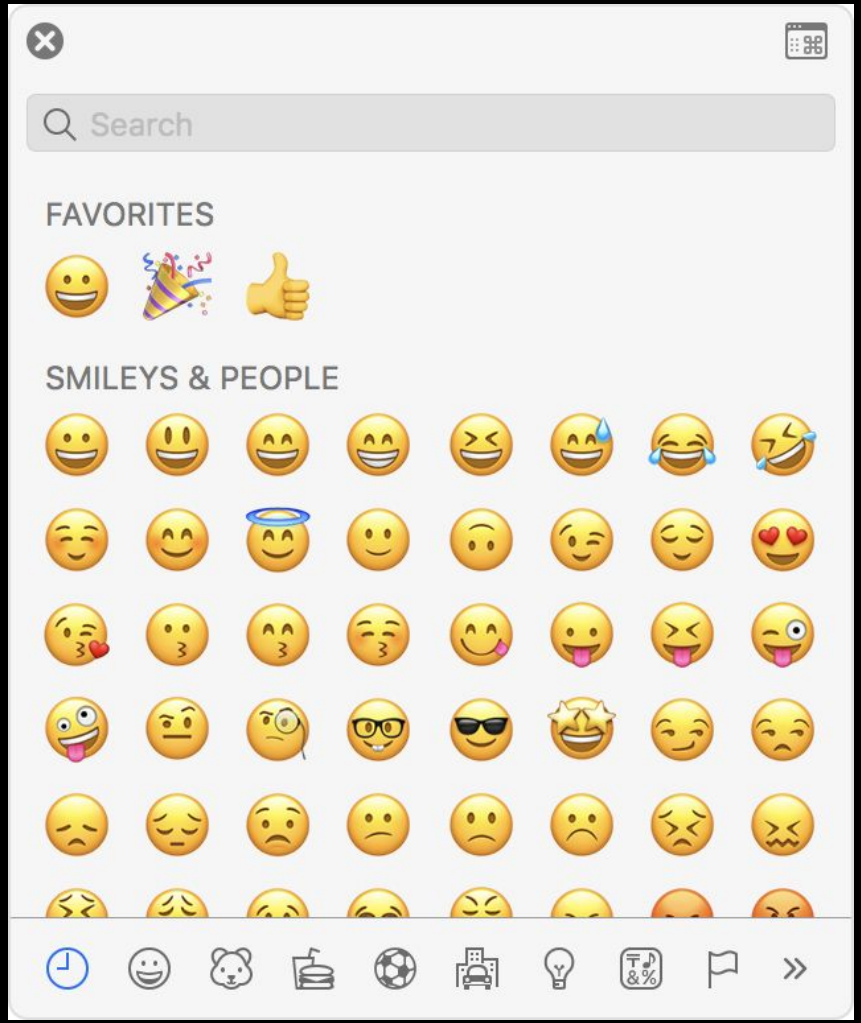
? /
Shift
Ctrl
Win Key
Alt
Alt
Win Key
Menu
Ctrl


à á â ä æ ã å ā
1 2 3 4 5 6 7 8
a


Search
FAVORITES
SMILEYS & PEOPLE

Unicode

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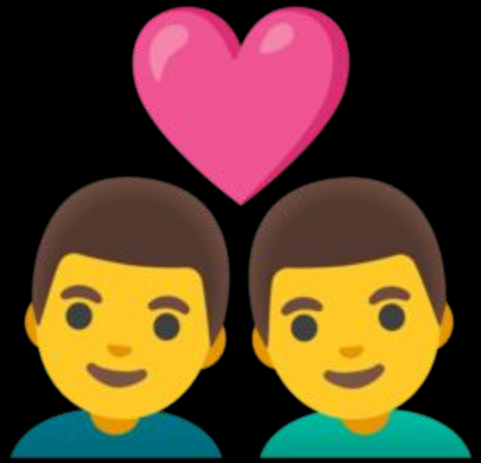
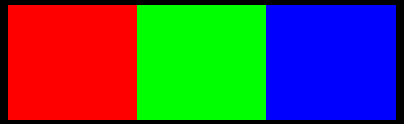
4036991106

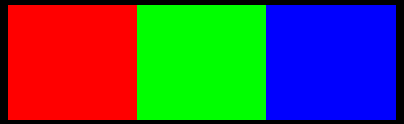


RGB



72 73 33

72
73
33



face-with-tears-of-joy_1f602.png

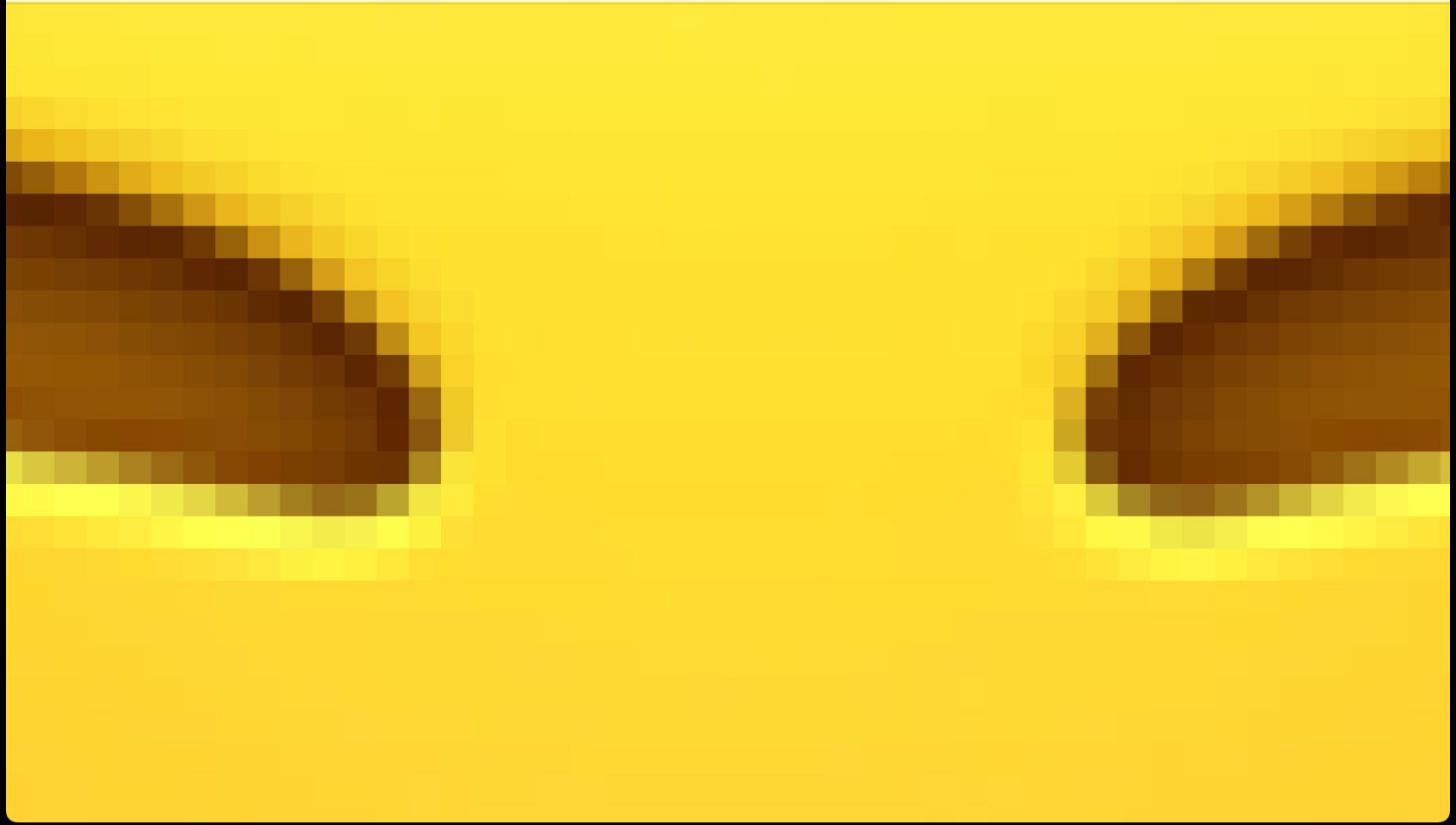
Search

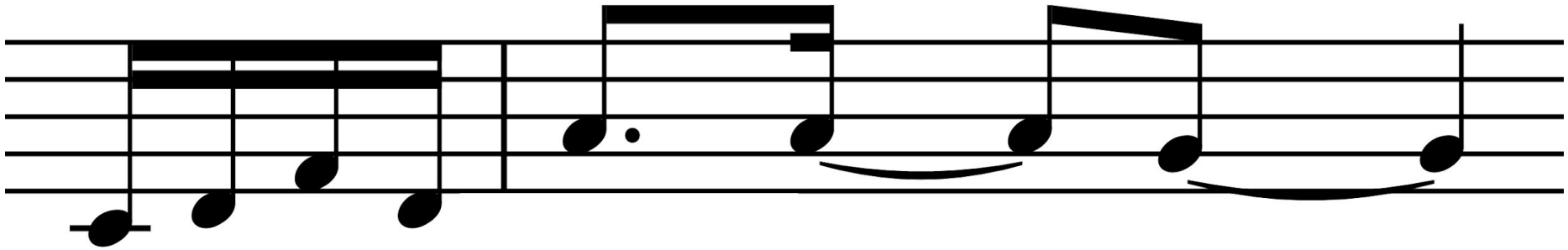
face-with-tears-of-joy_1f602.png

Search

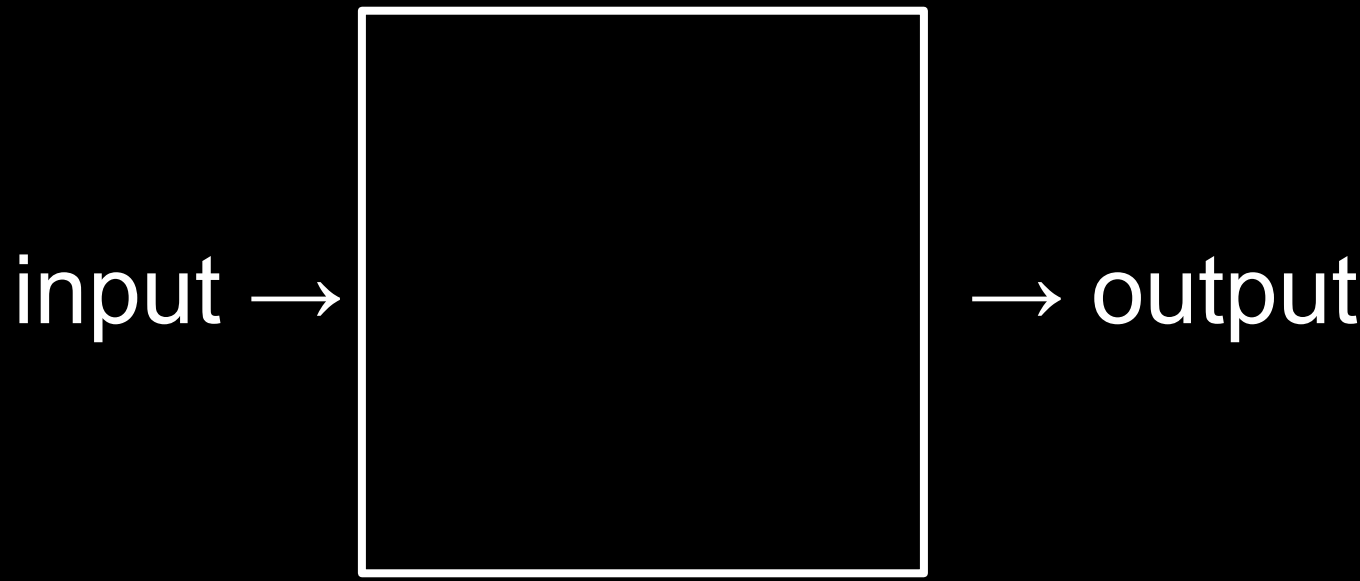
face-with-tears-of-joy_1f602.png

Search

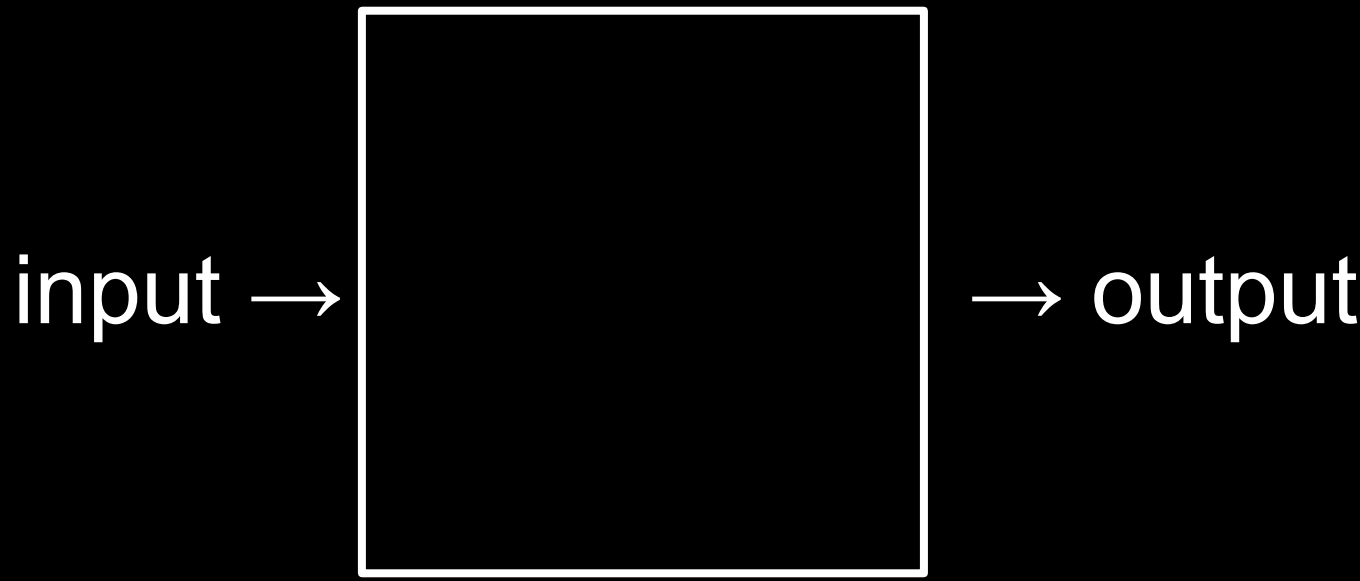


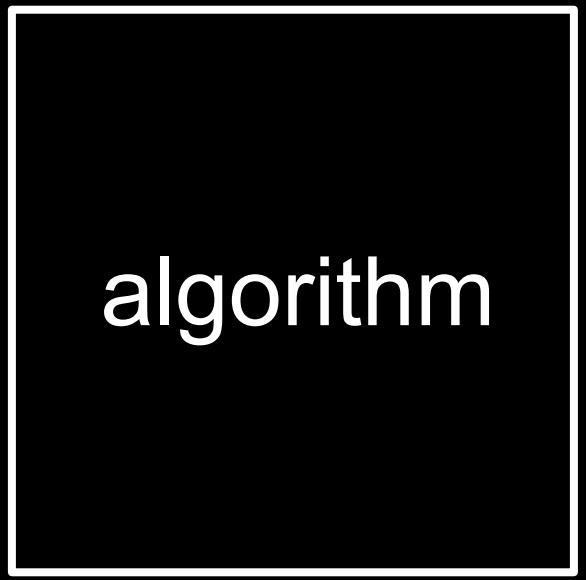


```
144 60 64
128 60 64
144 62 64
128 62 64
144 65 64
128 65 64
144 62 64
128 62 64
144 69 64
128 69 64
144 69 64
128 69 64
144 67 64
128 67 64
```

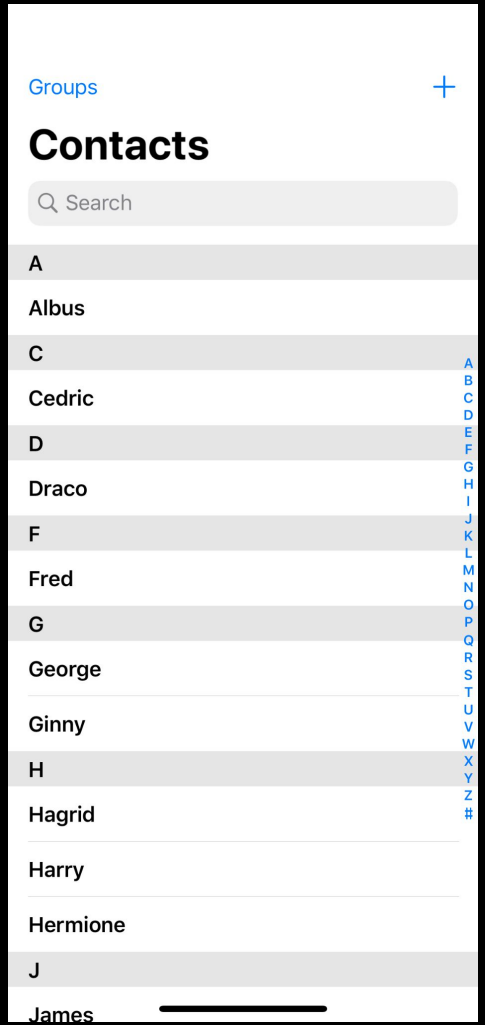

input →
→ output

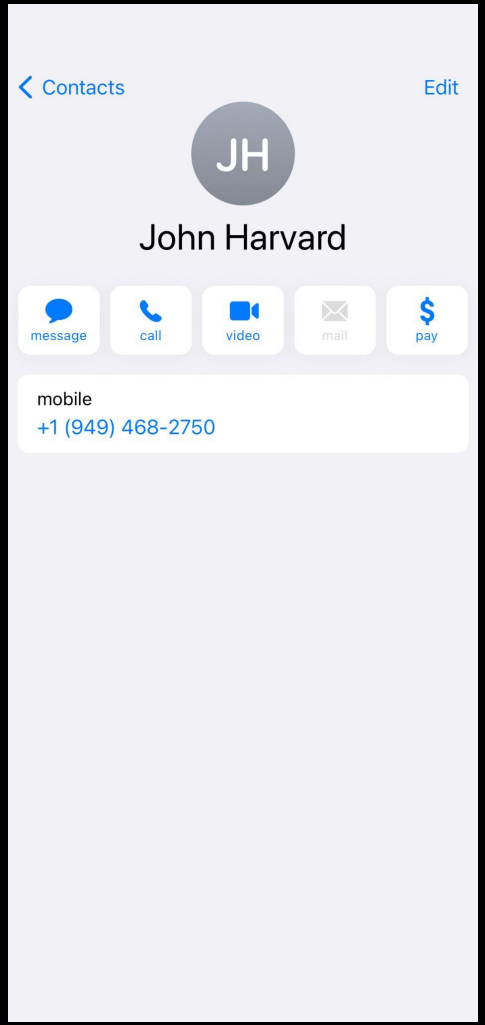
abstraction

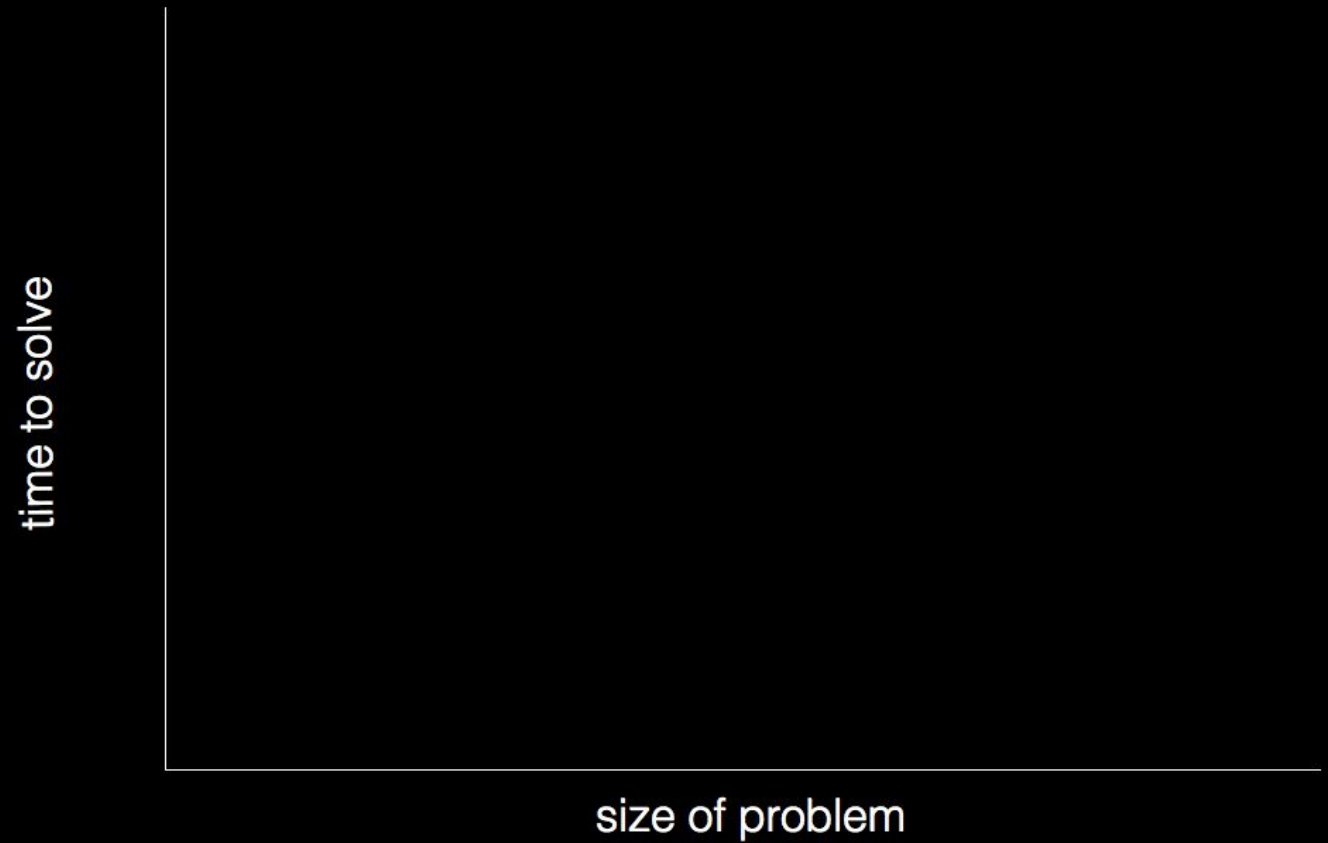

input →
→ output

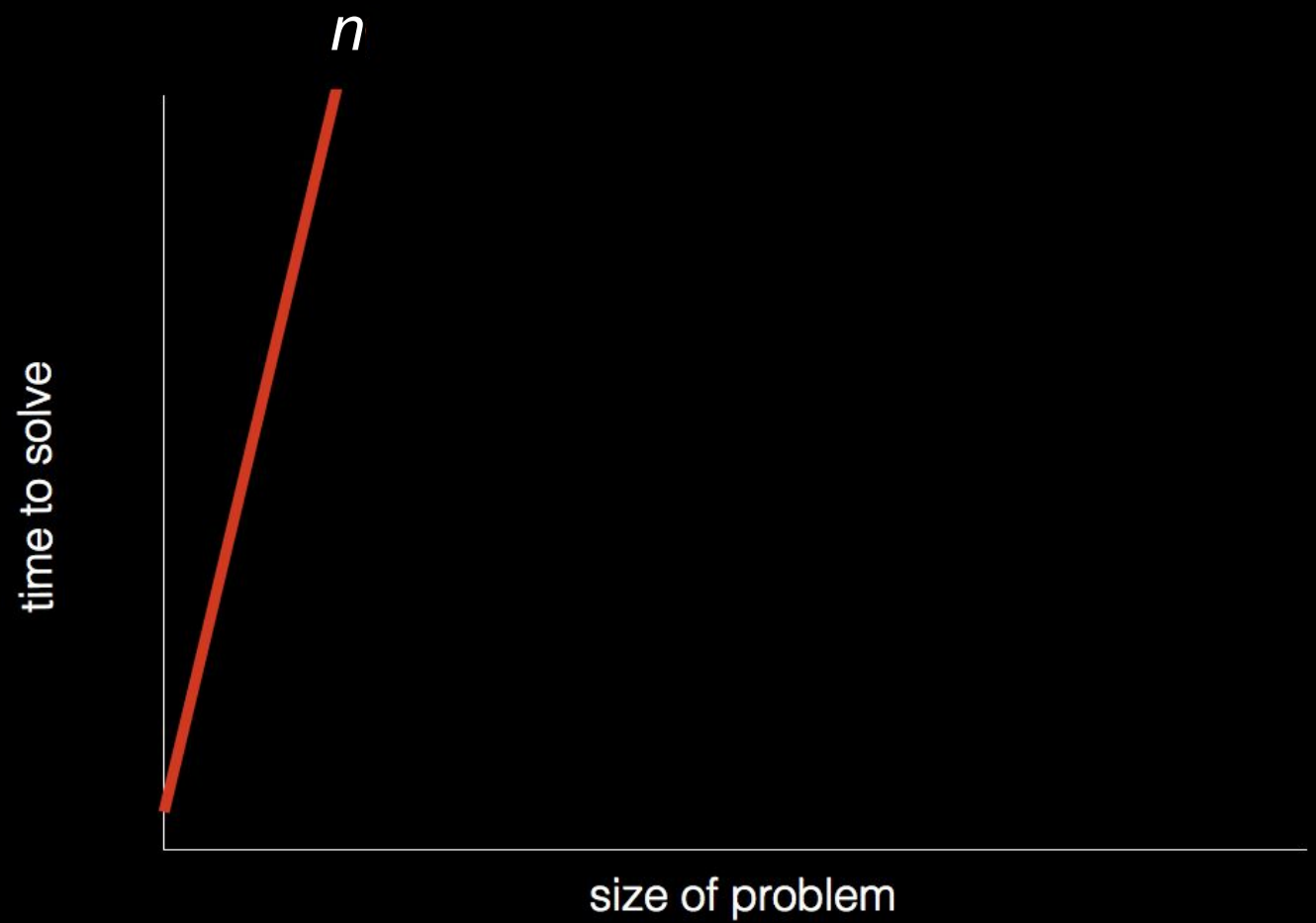

algorithm

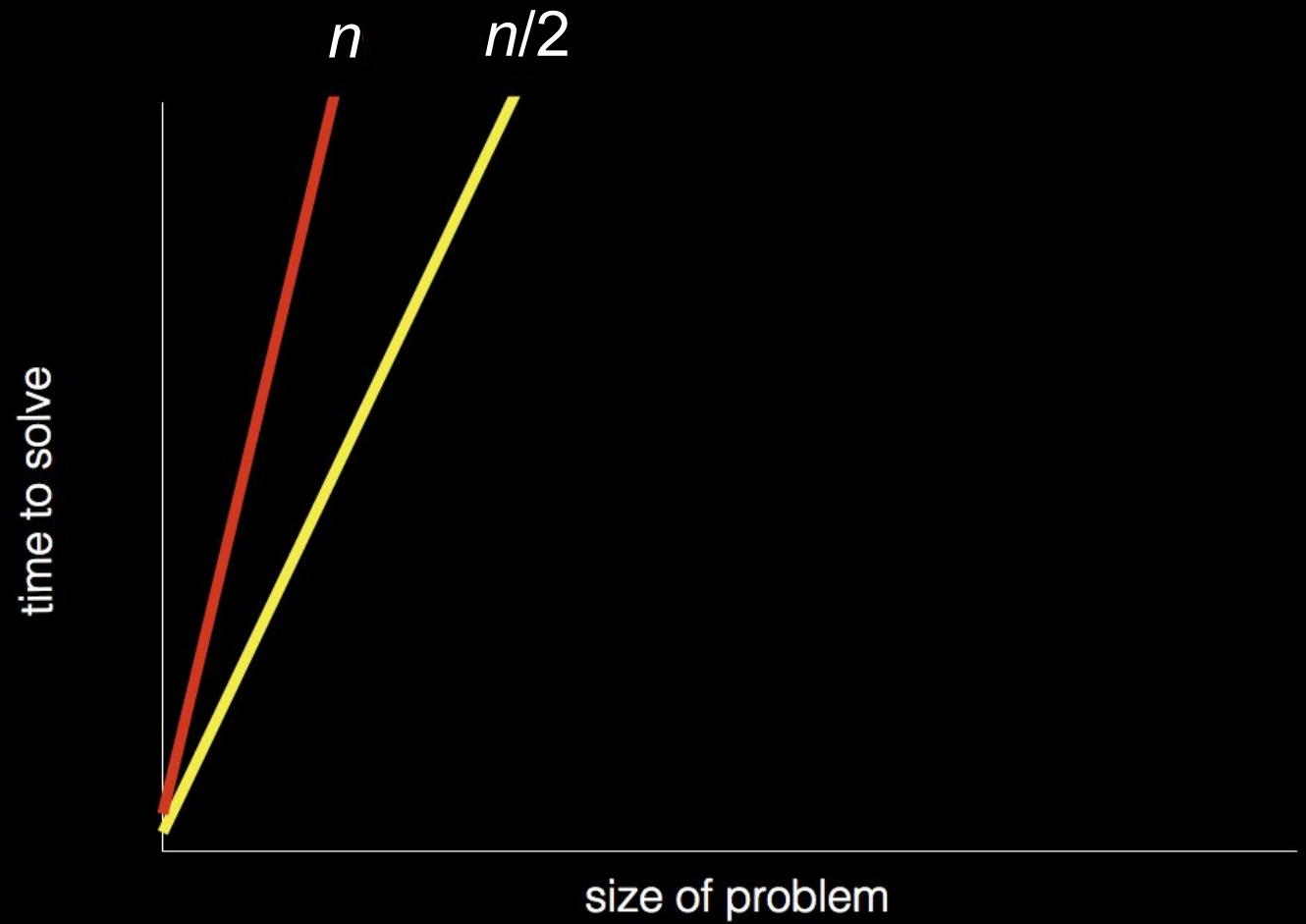
implementation details

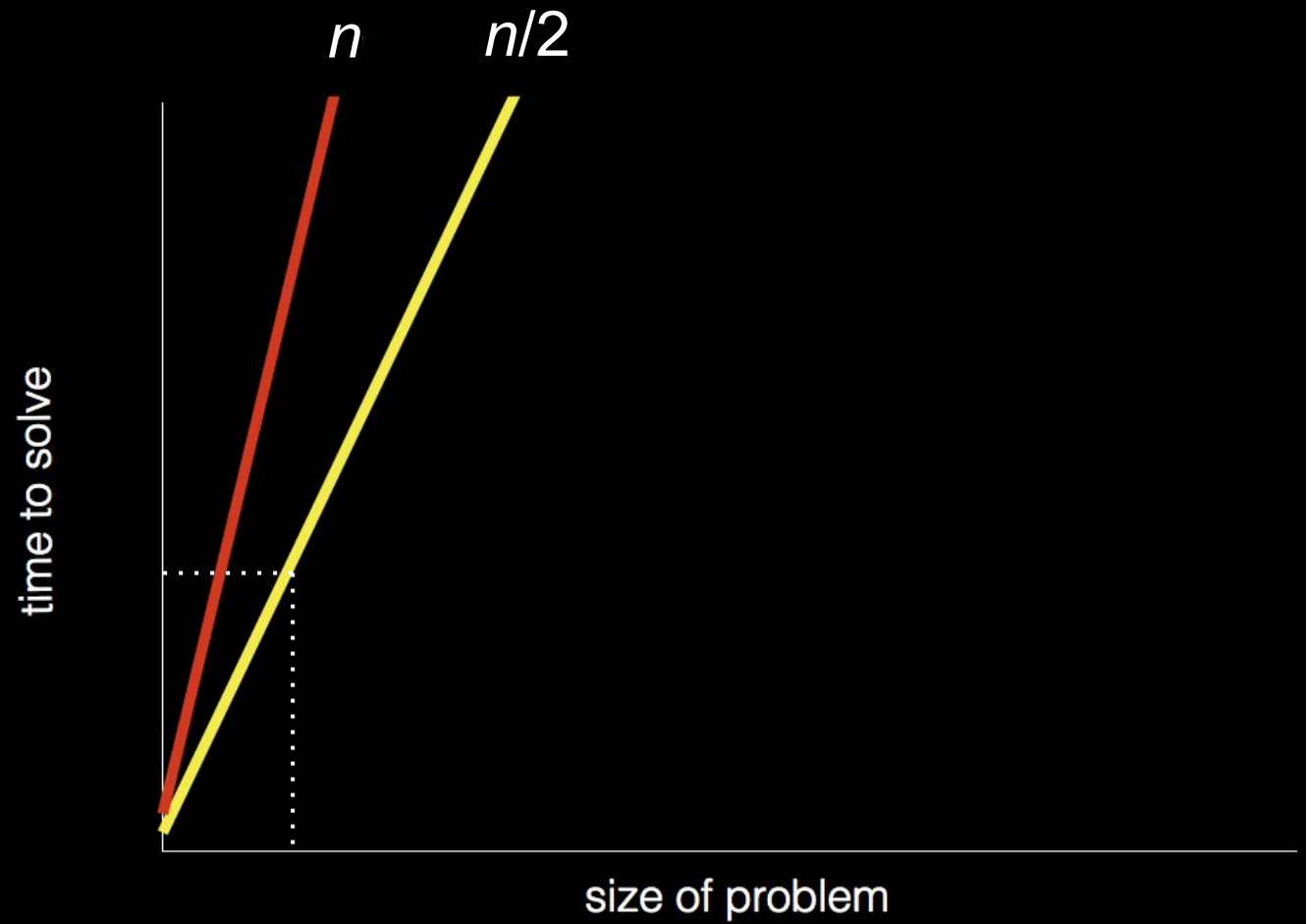

Groups
Contacts
Search
A
Albus
C
Cedric
D
Draco
F
Fred
G
George
Ginny
H
Hagrid
Harry
Hermione
J
James
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z #

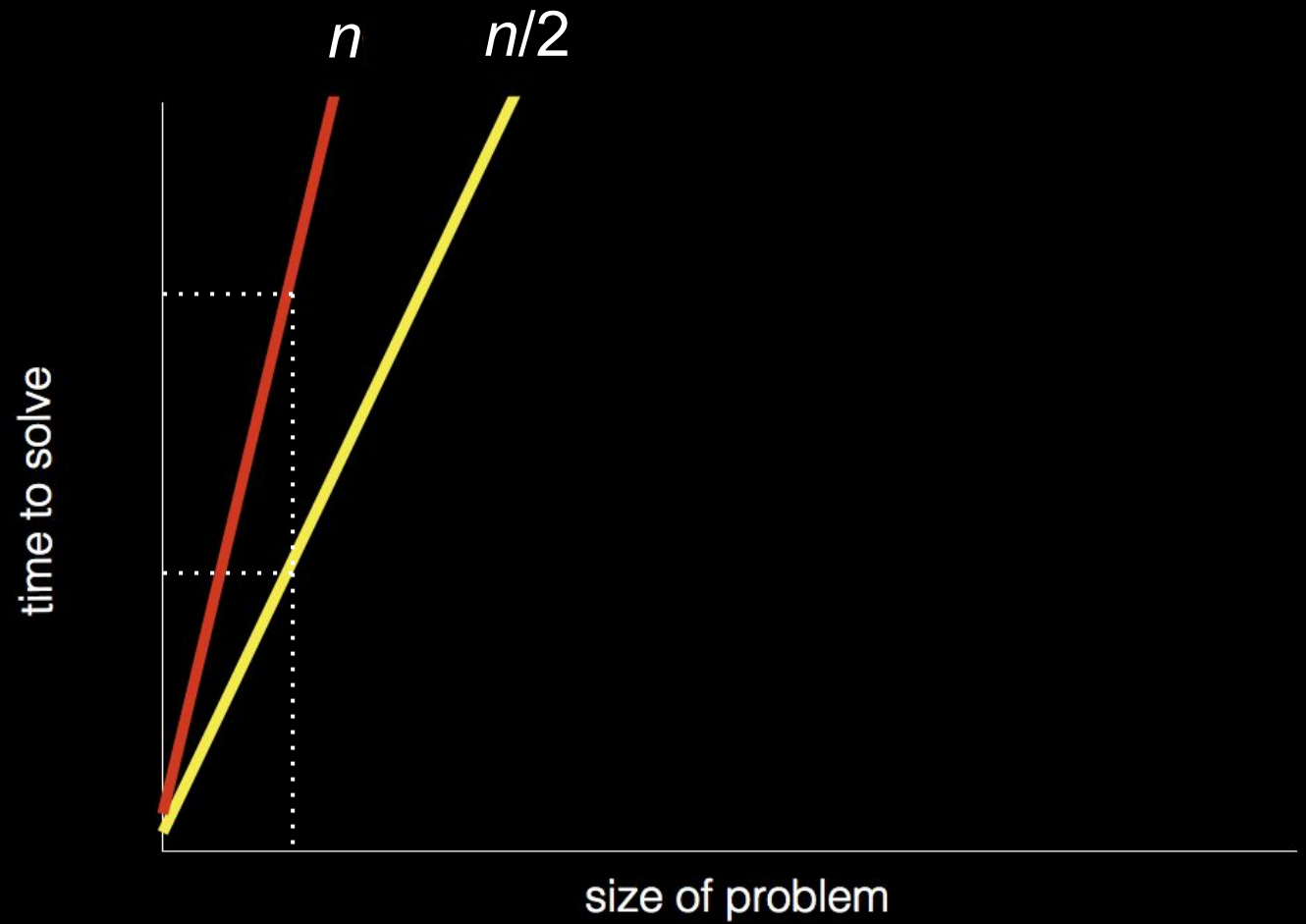

Contacts
Edit
JH
John Harvard
message
call
video
mail
pay
mobile
+1 (949) 468-2750

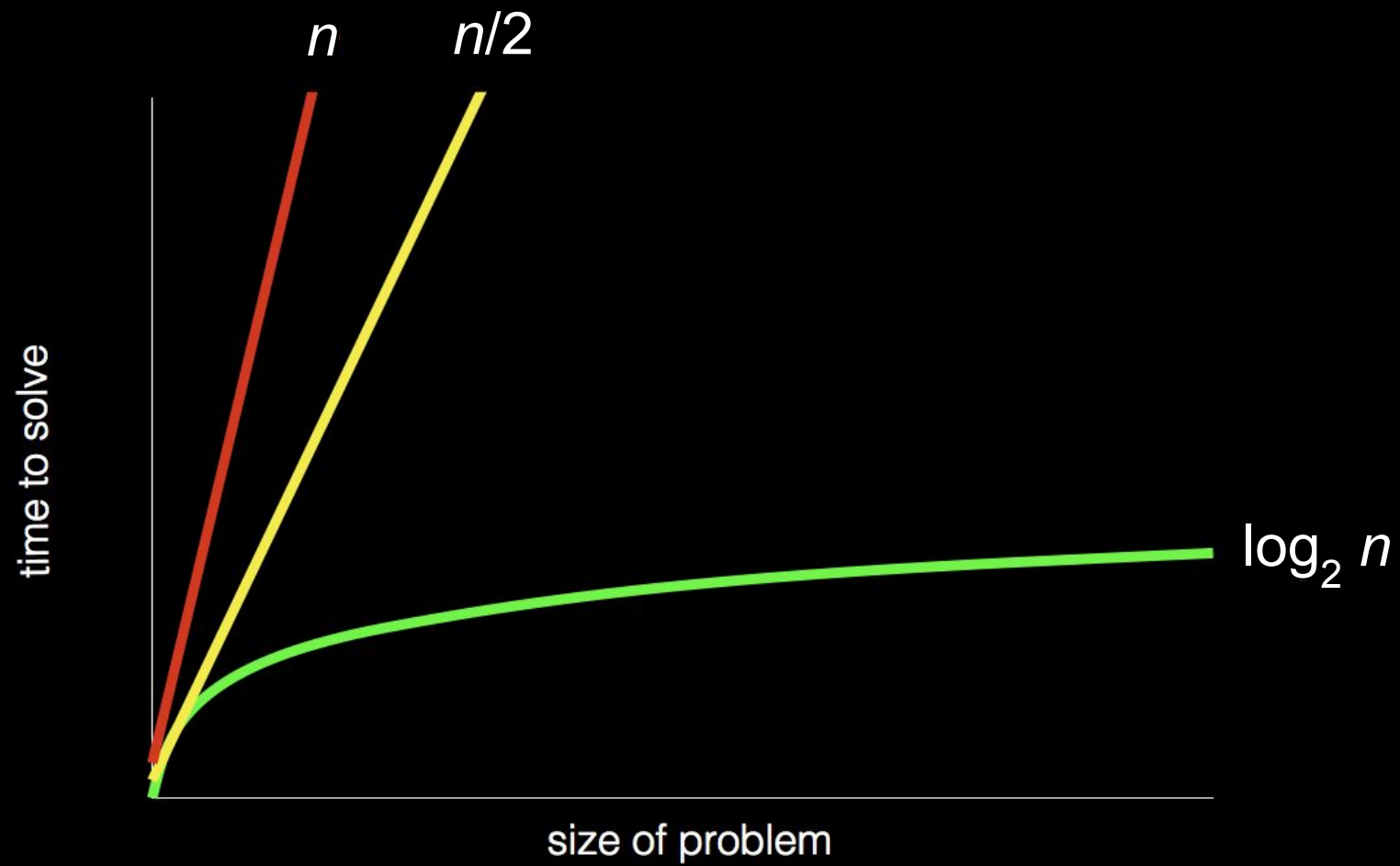

time to solve
size of problem


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
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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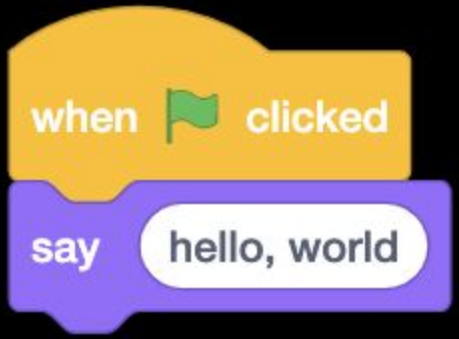
13      Quit
```

```
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
```

- functions
  - arguments, return values
- conditionals
- Boolean expressions
- loops
- variables
- ...

01111111010001010100110001000110000001000000010000000100000000000000000000000000000000000000000000
00000000000000000000000000000000010000000001111000000000000001000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000001010000000000100000000000000000000000000000000000000000000000000000000000000000000000
00000000100000000000000000000000000000000000000000100000000000000001010000000000000001000000
00010101010100100010001001111001010100100010000111110110000010000011000111000000100010011100011101001
10001011111000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000100100010111111000000000000000000000000000000000000000000000000000
0000000001001000...01111111010001010100110001000110000001000000010000000100000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000001100000000001111000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000

```
print("hello, world")
```


when clicked
say
hello, world

Scratch

scratch.mit.edu

Code Costumes Sounds

Motion
Looks
Sound
Events
Control
Sensing
Operators
Variables
My Blocks

Motion

move 10 steps
turn 15 degrees
turn 15 degrees

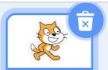
go to random position
go to x: 0 y: 0
glide 1 secs to random position
glide 1 secs to x: 0 y: 0

point in direction 90
point towards mouse-pointer

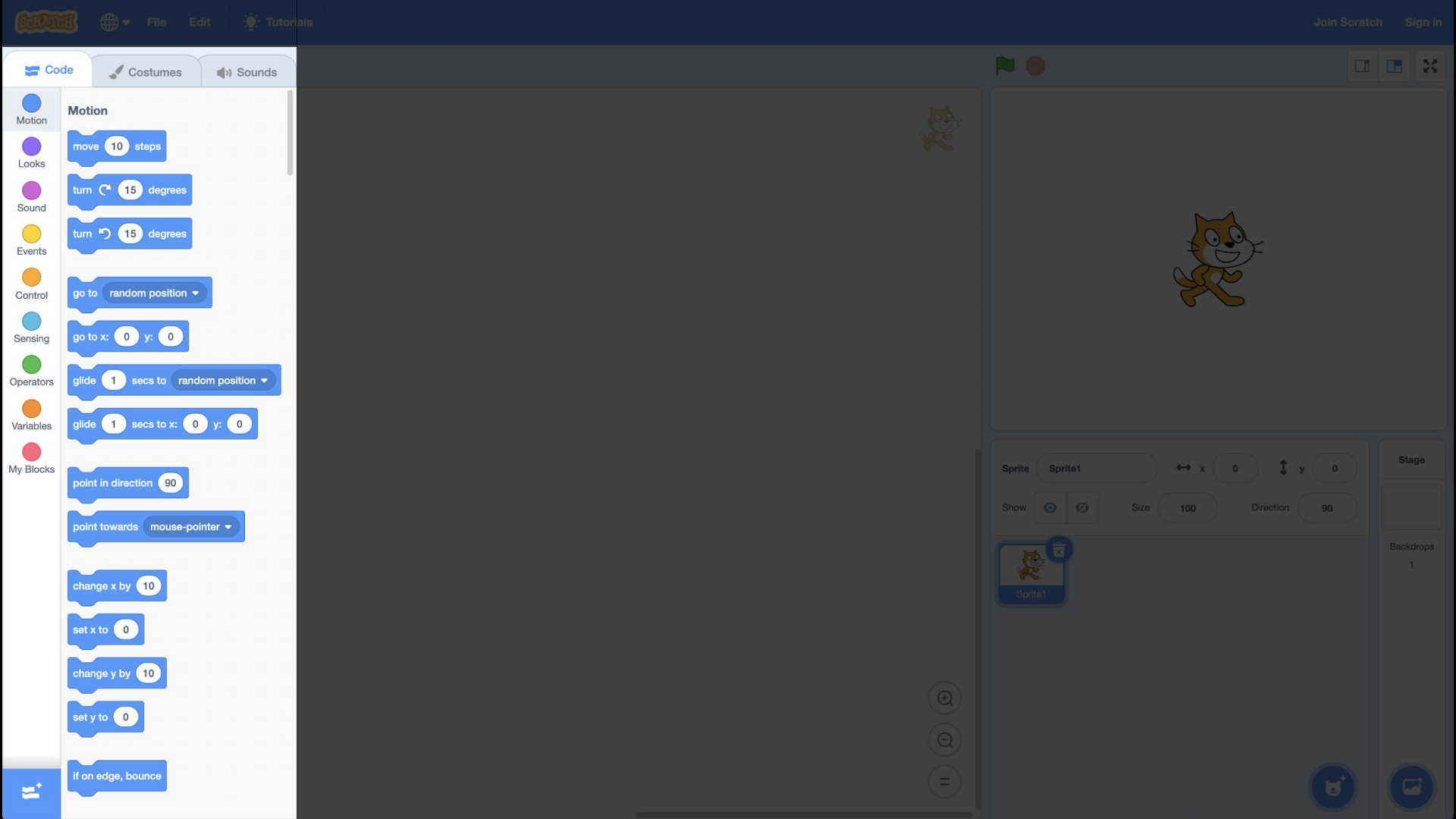
change x by 10
set x to 0
change y by 10
set y to 0

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
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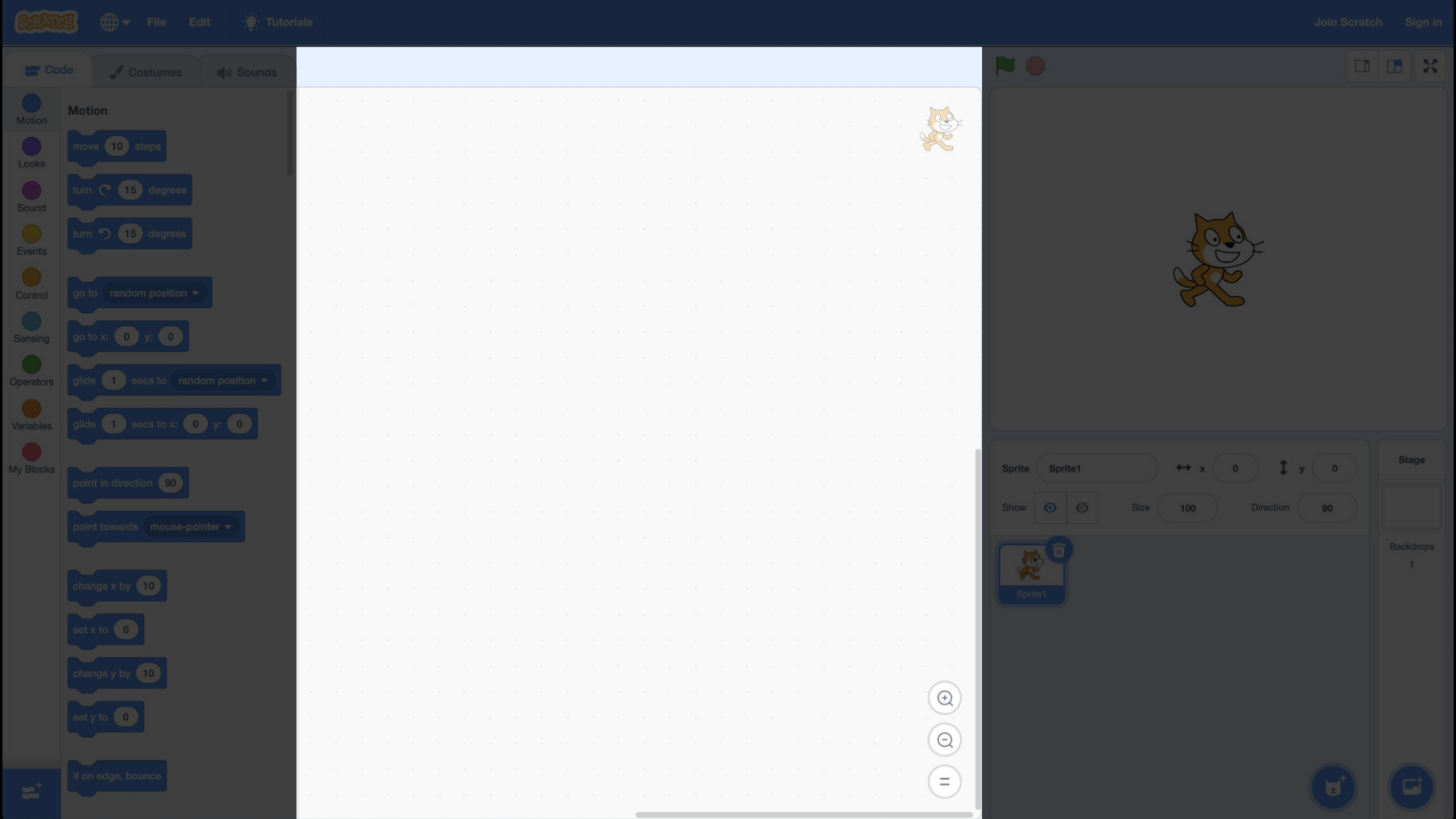
glide 1 secs to x: 0 y: 0
point in direction 90
point towards mouse-pointer
change x by 10
set x to 0
change y by 10
set y to 0
if on edge, bounce
Sprite
Sprite1
x 0
y 0
Show
Size 100
Direction 90
Stage
Backdrops 1
Sprite1


File
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Tutorials
Join Scratch
Sign in
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Costumes
Sounds
Motion
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Sound
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Control
Sensing
Operators
Variables
My Blocks
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set y to 0
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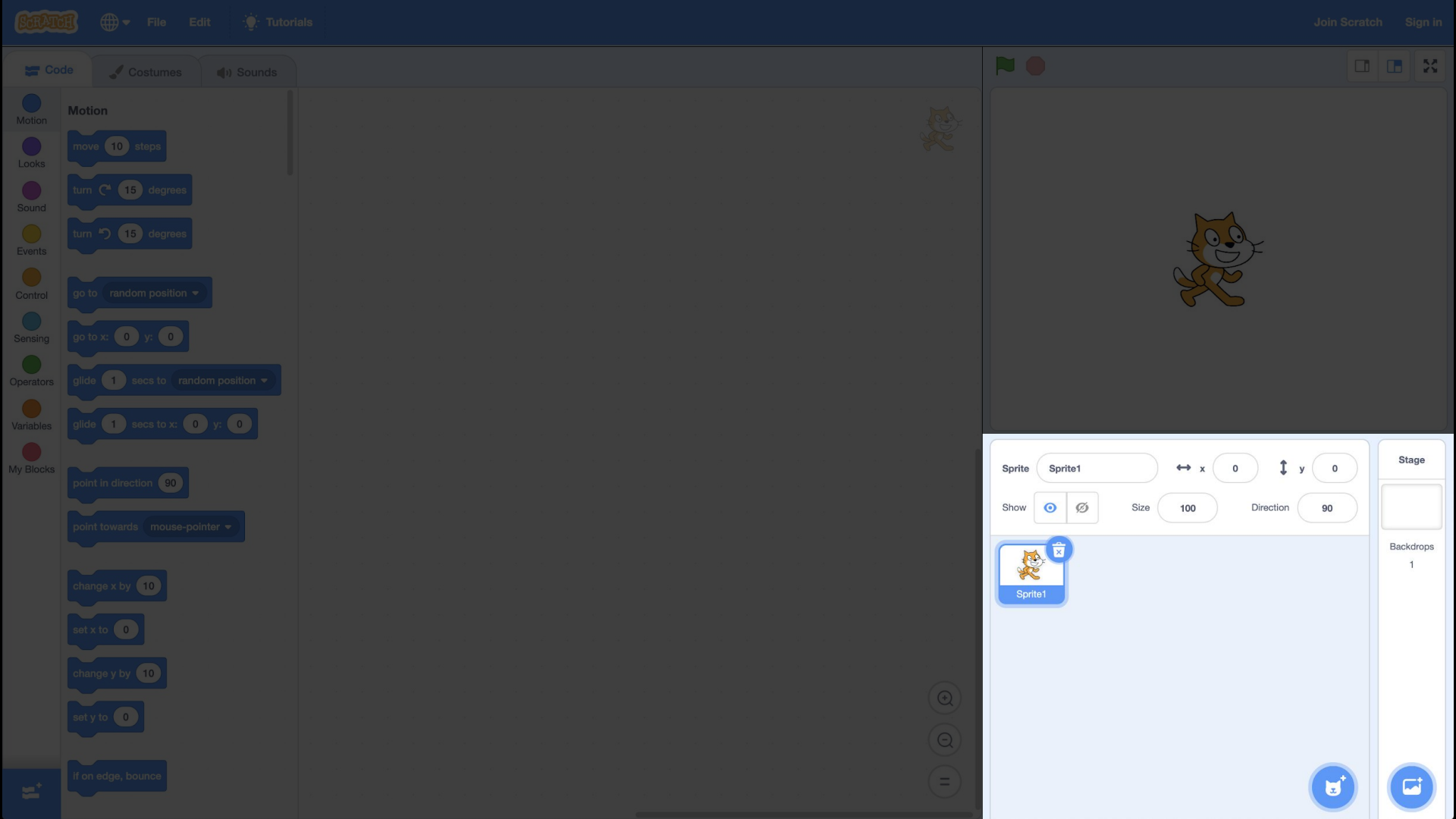
Sprite
Sprite1
x 0
y 0
Show
Size 100
Direction 90
Stage
Backdrops 1


File
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Join Scratch
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Sounds
Motion
Looks
Sound
Events
Control
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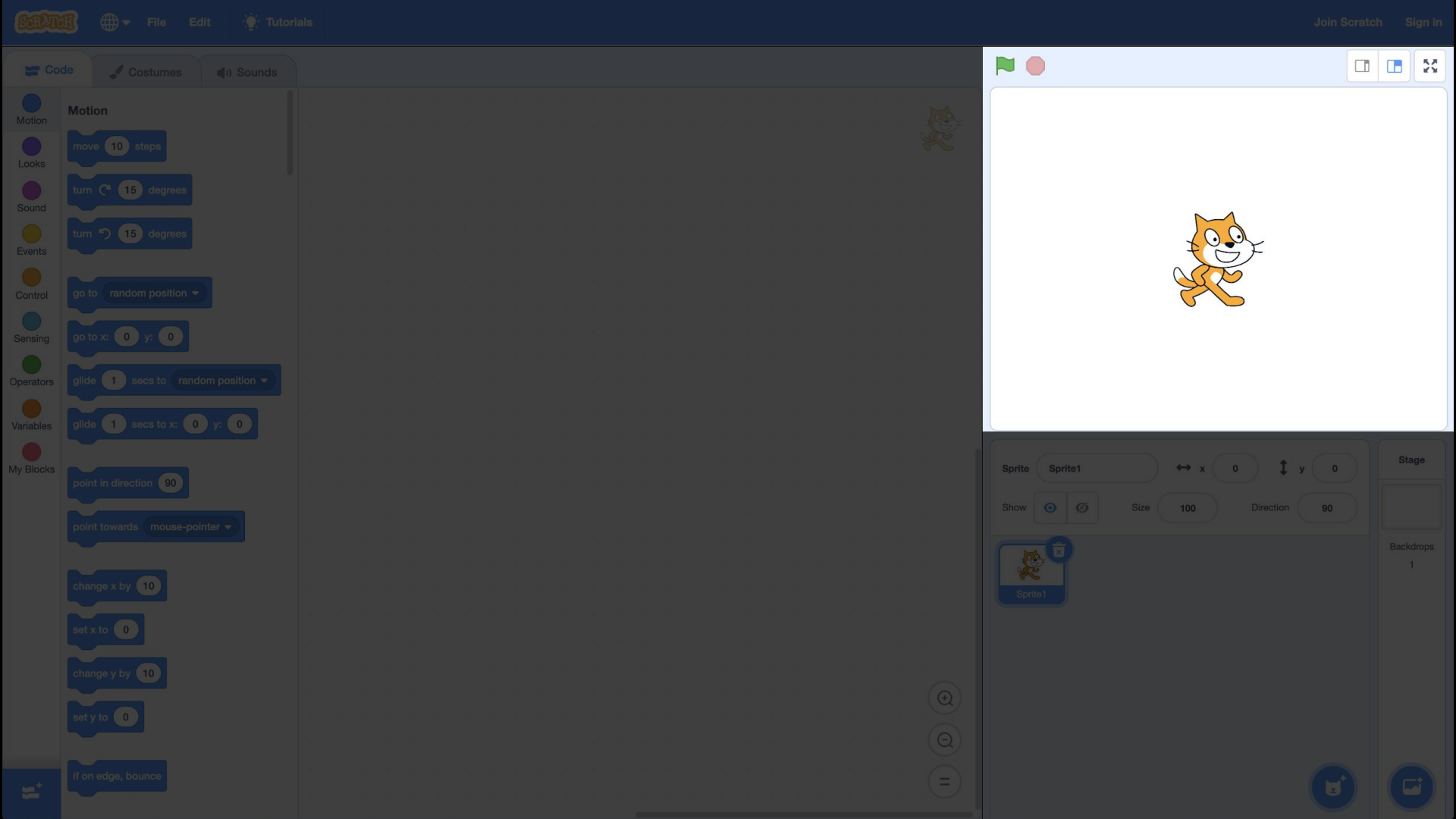
if on edge, bounce
Sprite
Sprite1
x
0
y
0
Show
Size
100
Direction
90
Sprite1
Stage
Backdrops
1


File
Edit
Tutorials
Join Scratch
Sign in
Code
Costumes
Sounds
Motion
Looks
Sound
Events
Control
Sensing
Operators
Variables
My Blocks
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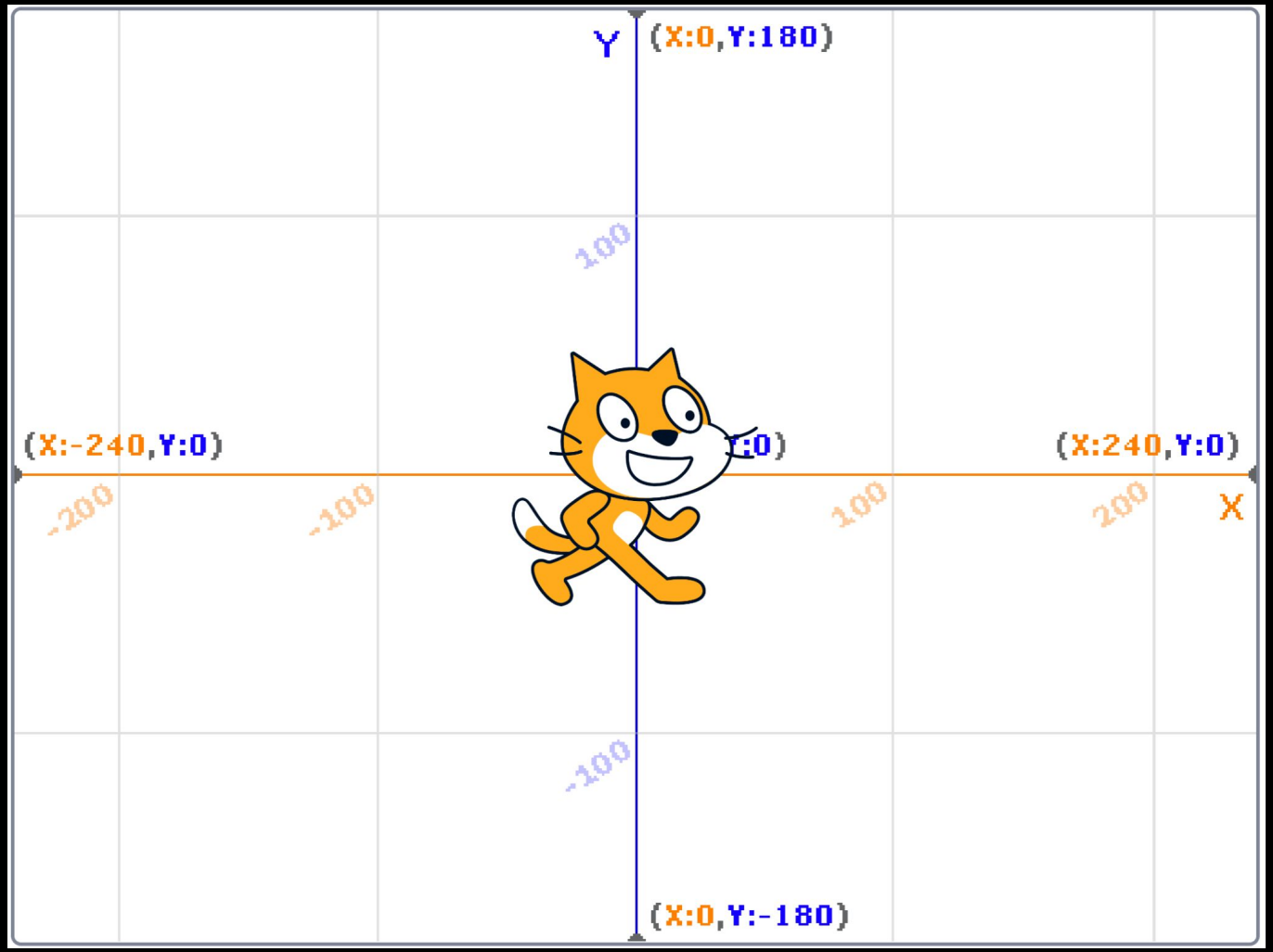
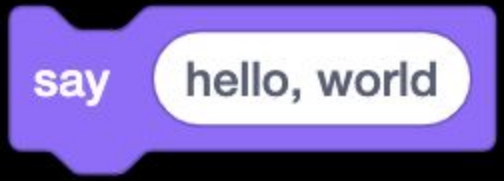
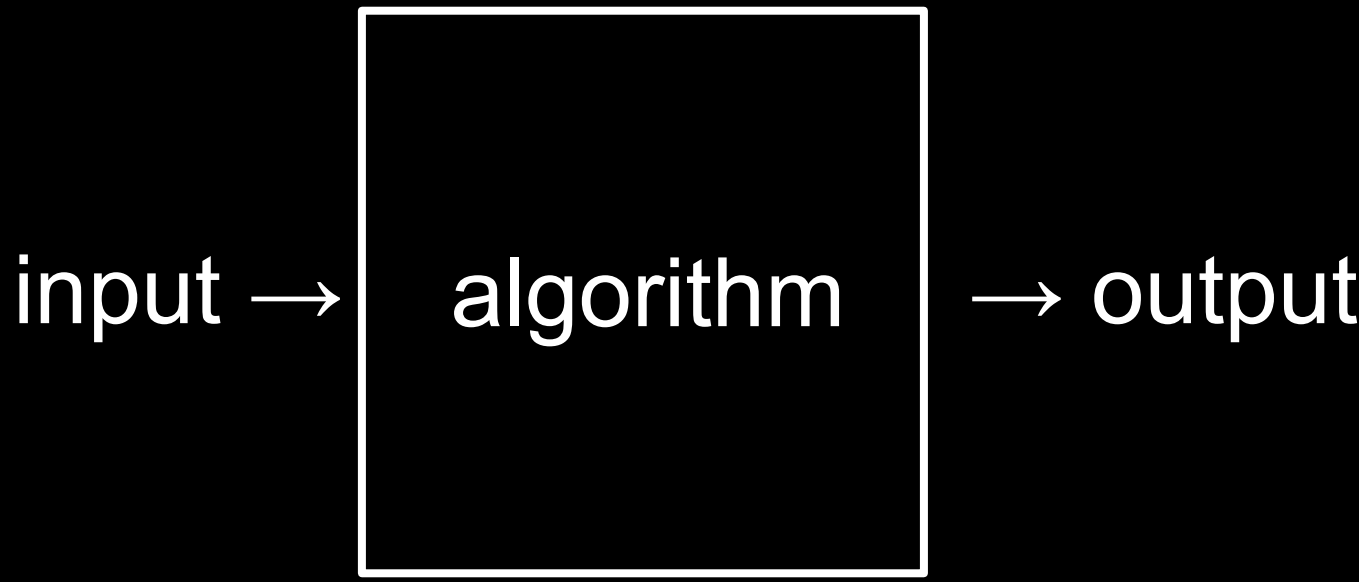
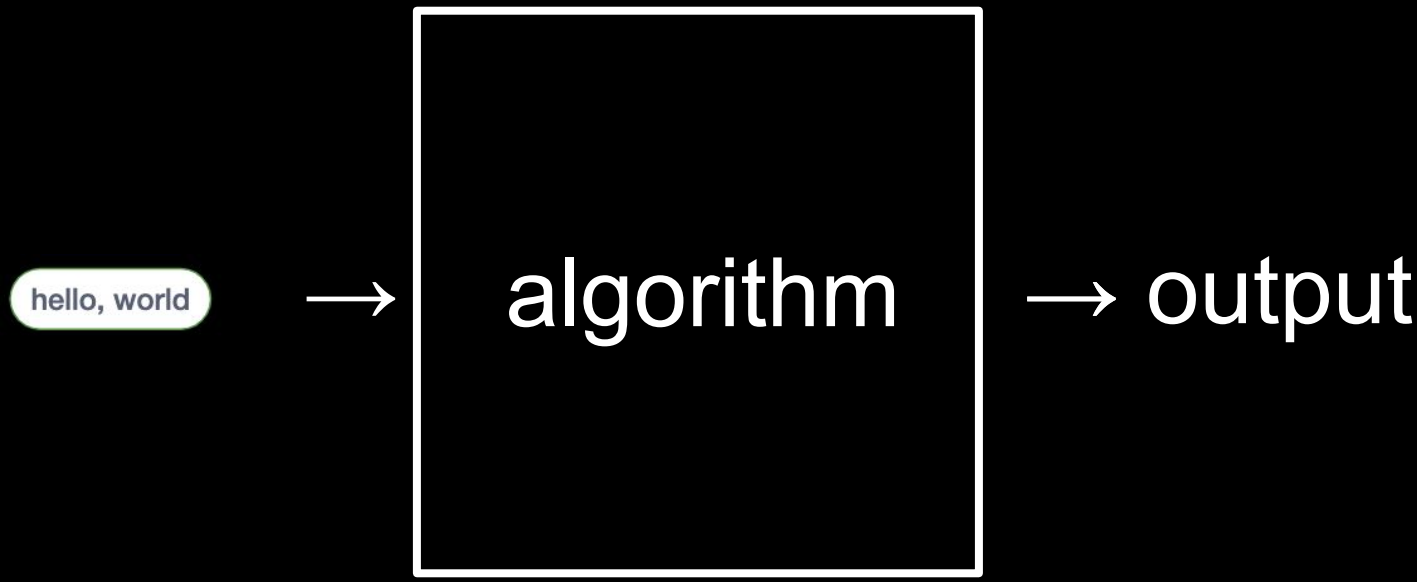
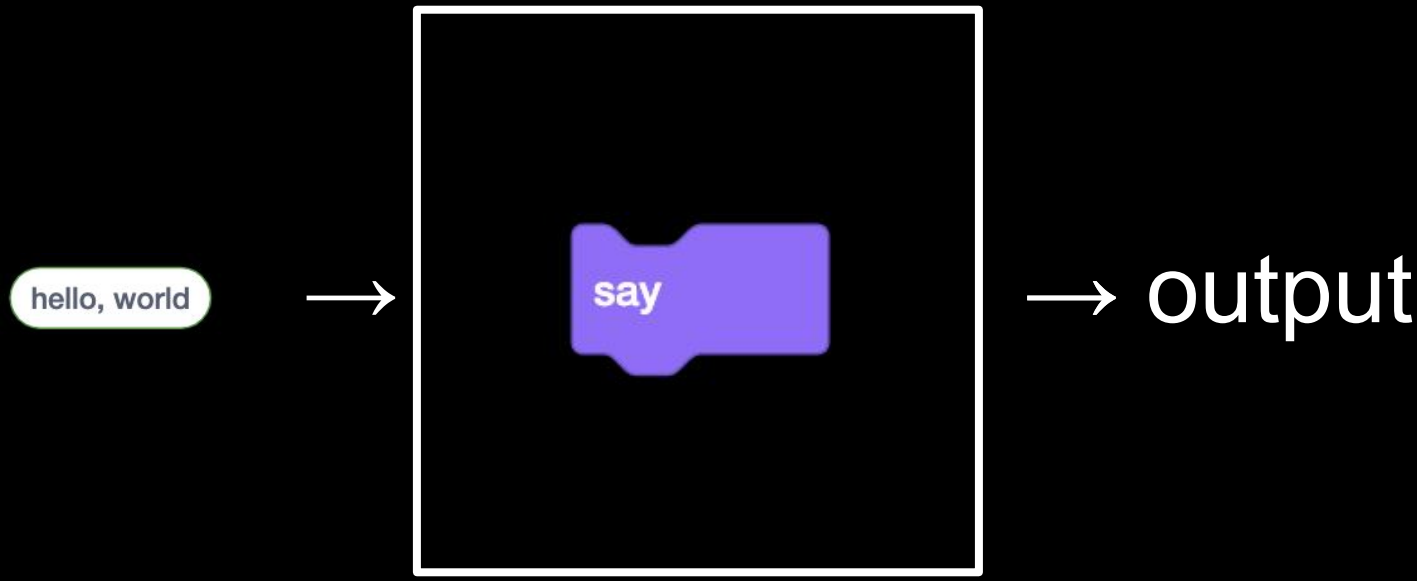
Sprite
Sprite1
x
0
y
0
Show
Size
100
Direction
90
Stage
Backdrops
1

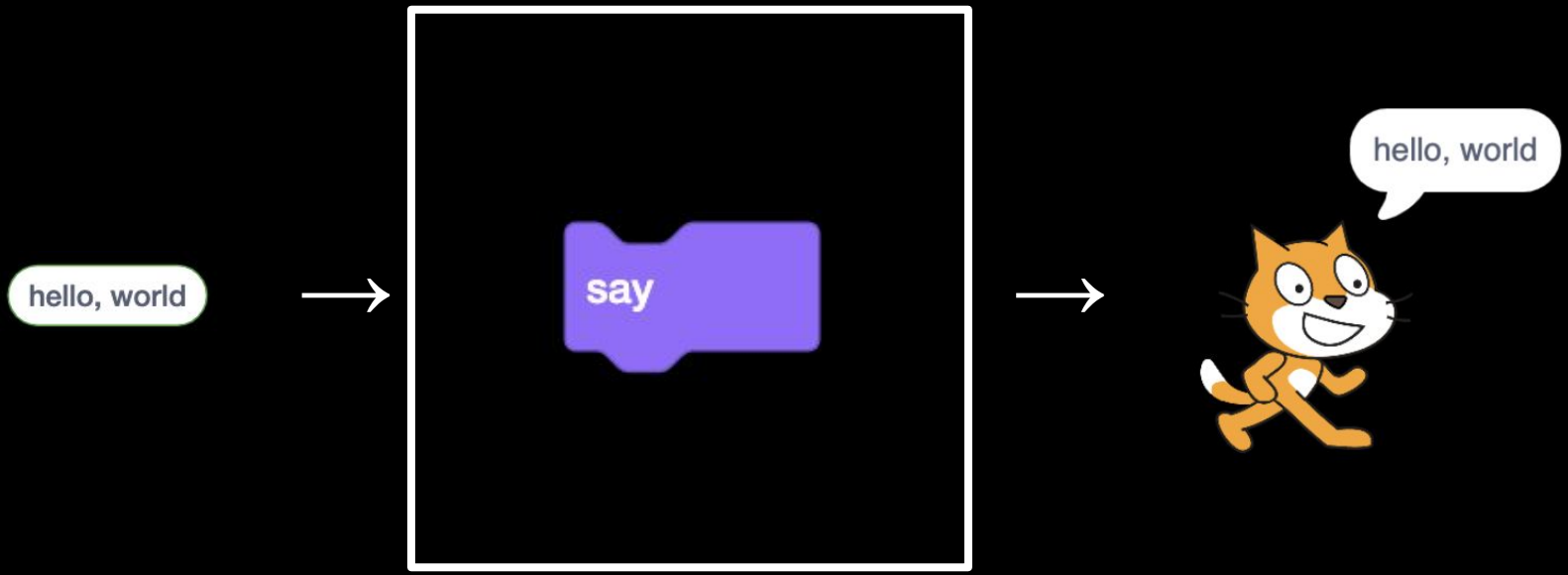

Y
(X:0,Y:180)
100
(X:-240,Y:0)
:0)
(X:240,Y:0)
-200
-100
100
200
X
-100
(X:0,Y:-180)

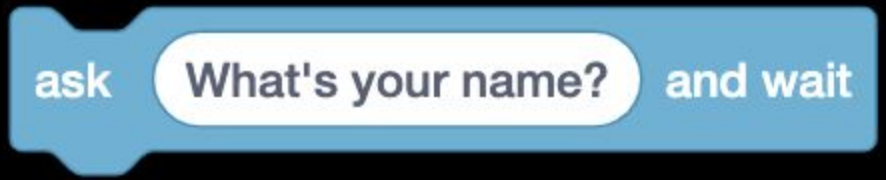

say
hello, world

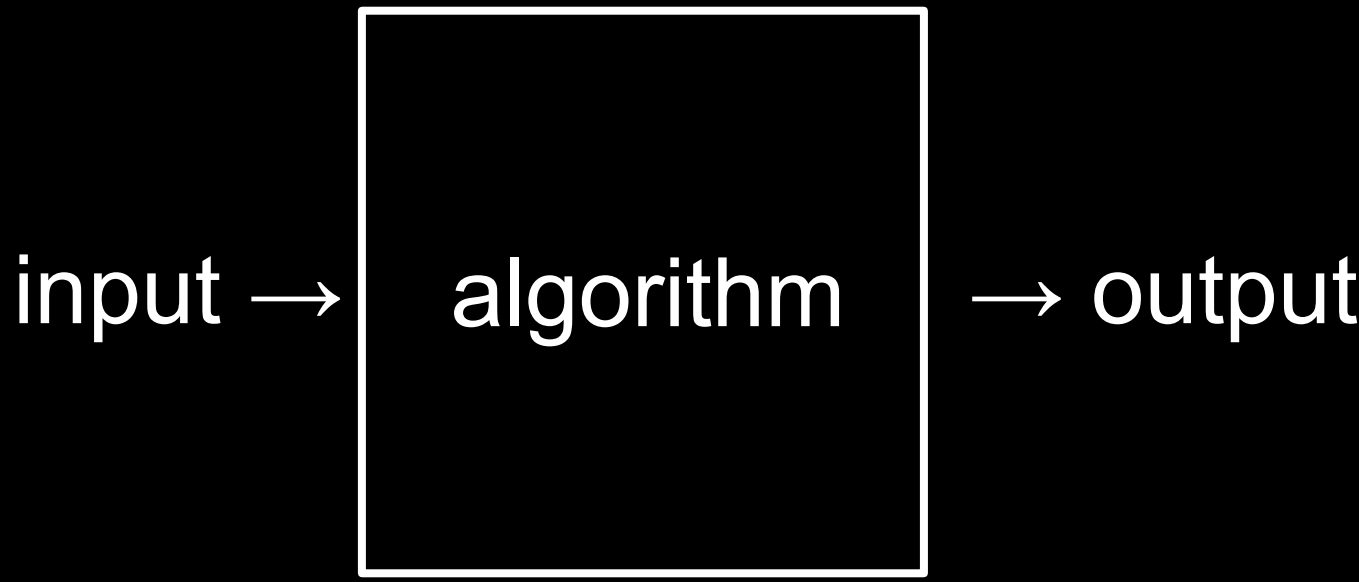

input →
algorithm
→ output

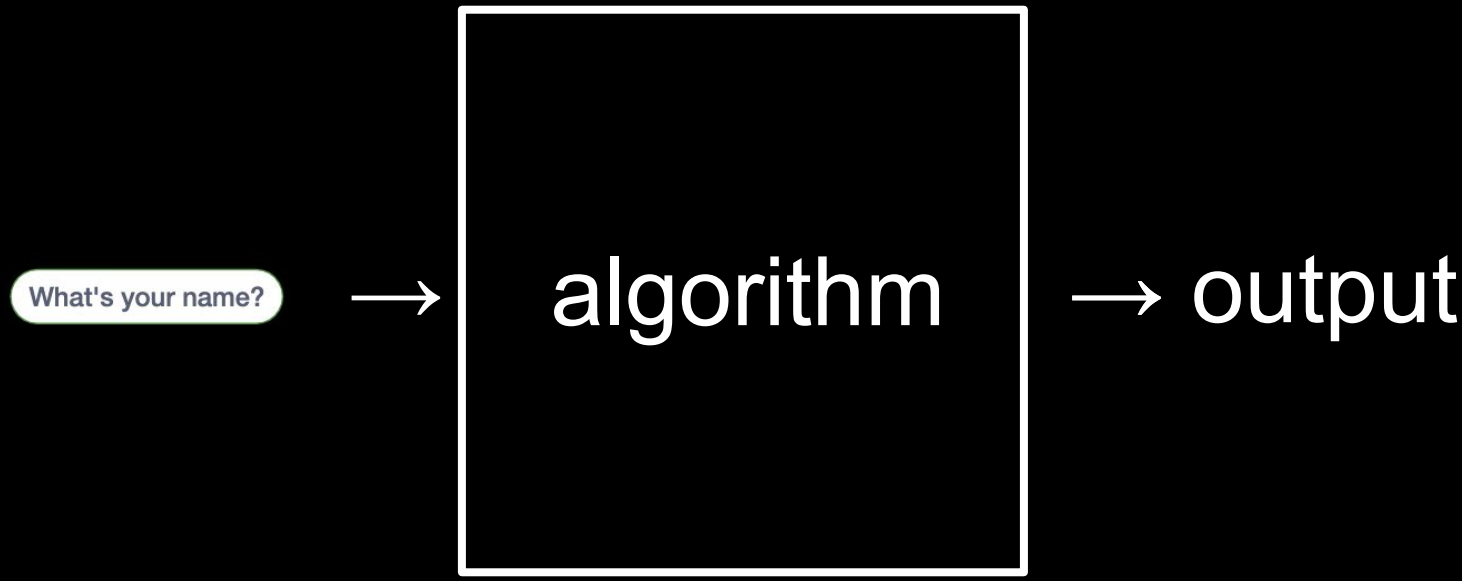

hello, world
algorithm
output

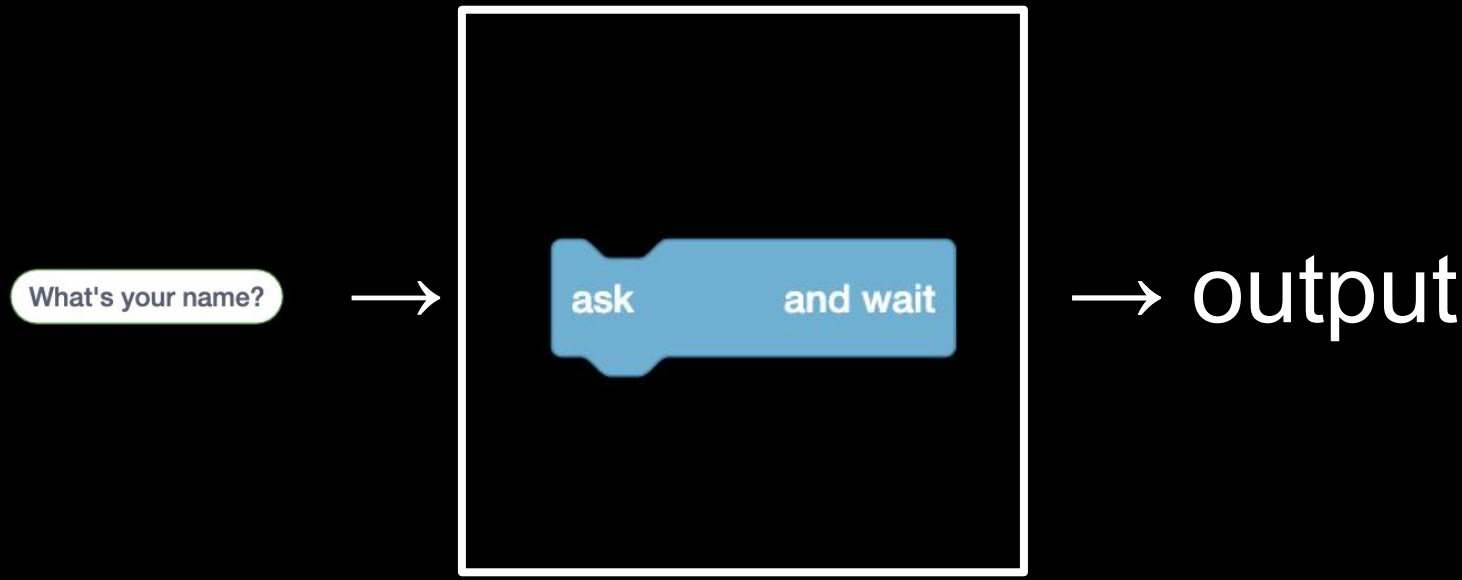

hello, world
say
output

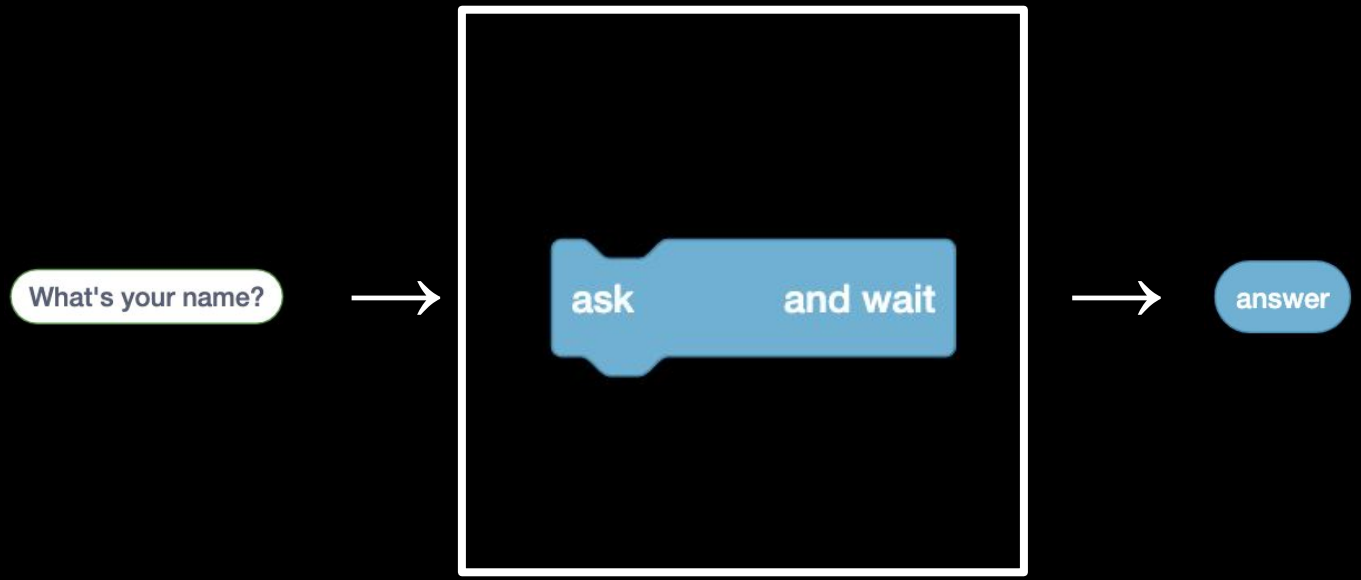

hello, world
say
hello, world

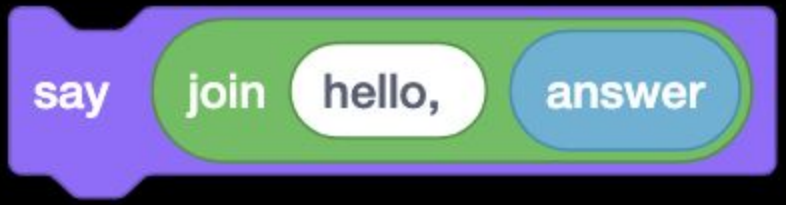

ask
What's your name?
and wait

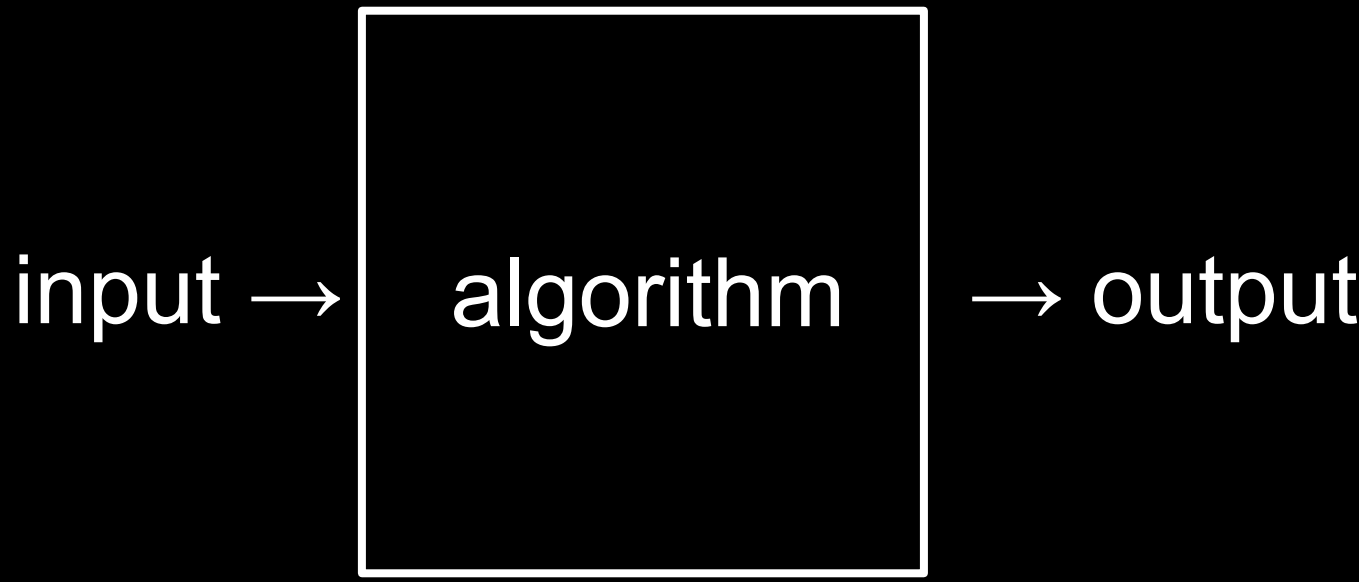

input →
algorithm
→ output

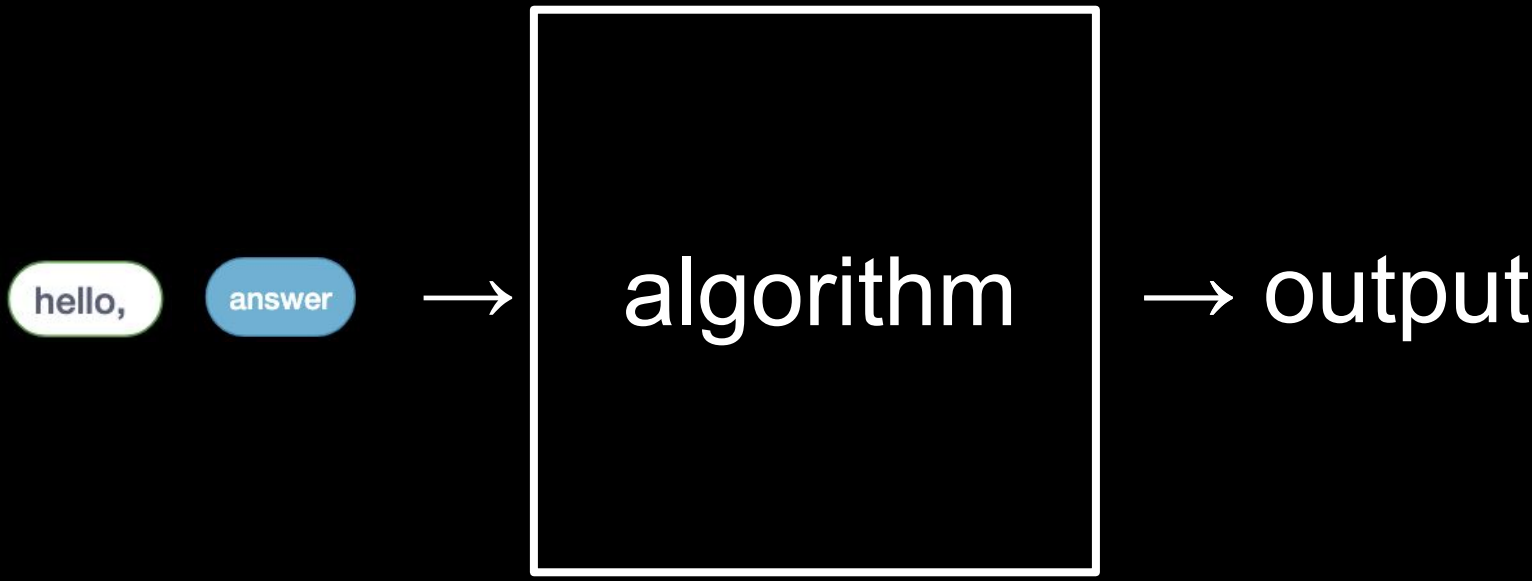

What's your name?
algorithm
output

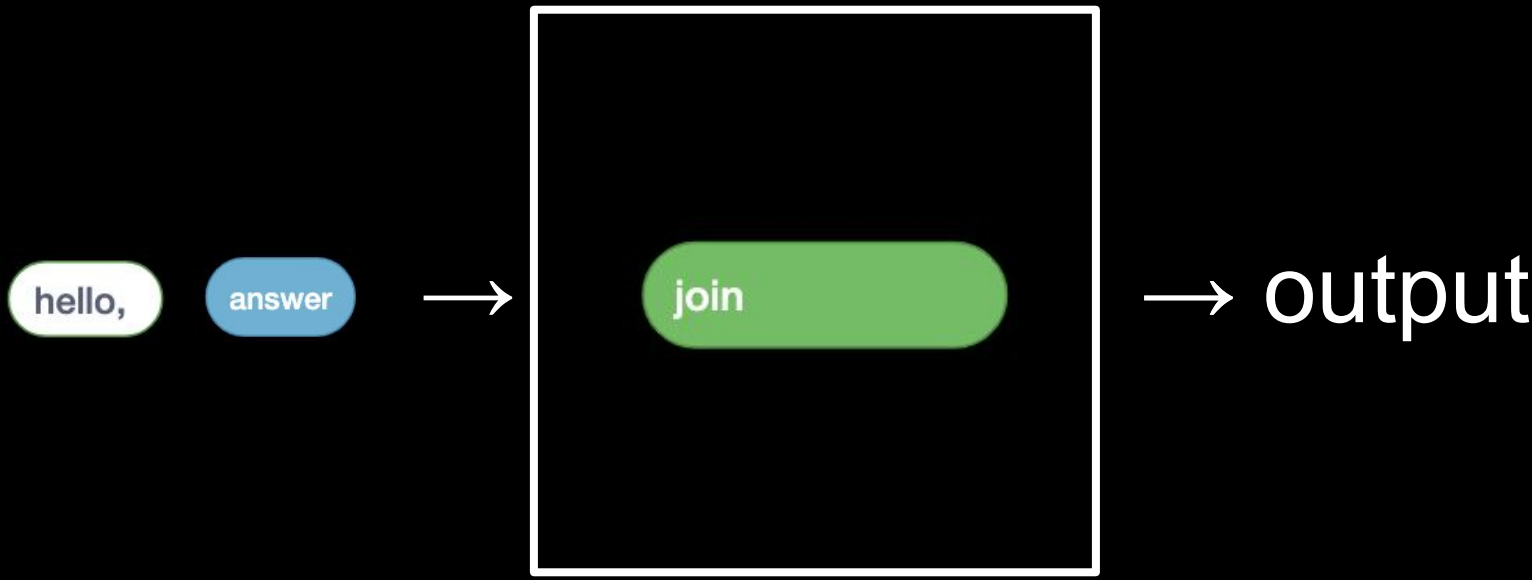

What's your name?
ask
and wait
output

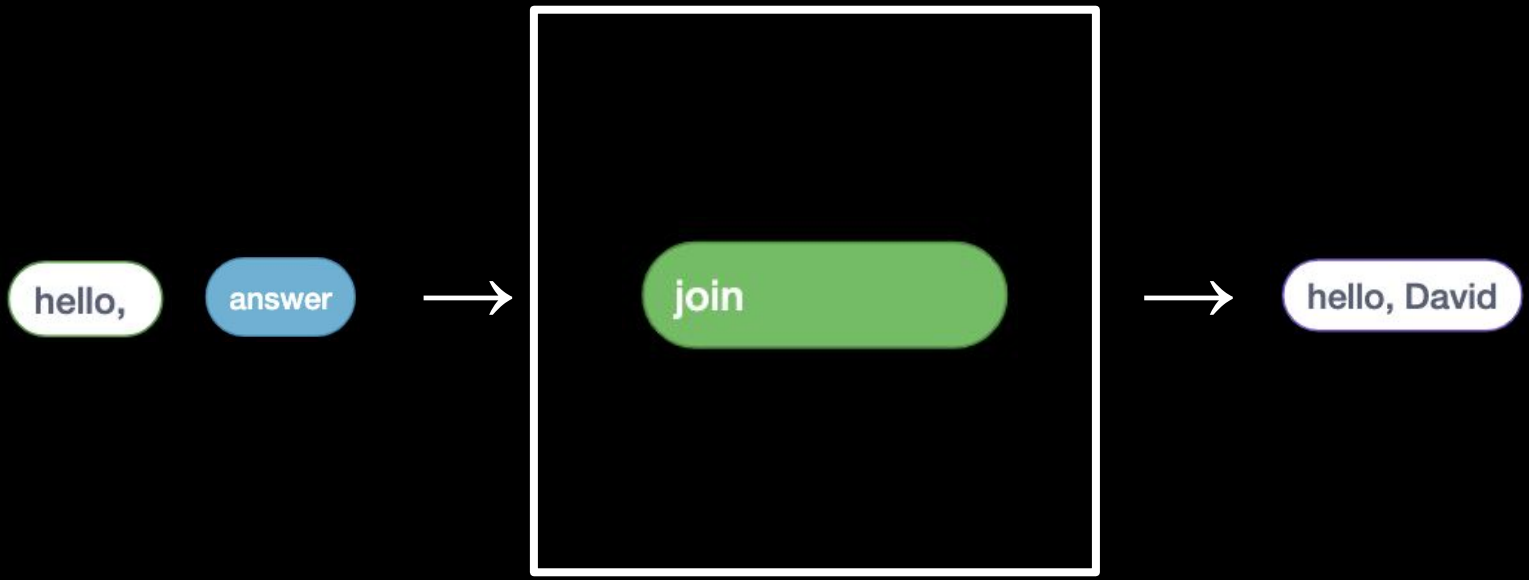

What's your name?
ask
and wait
answer


say
join
hello,
answer


input →
algorithm
→ output

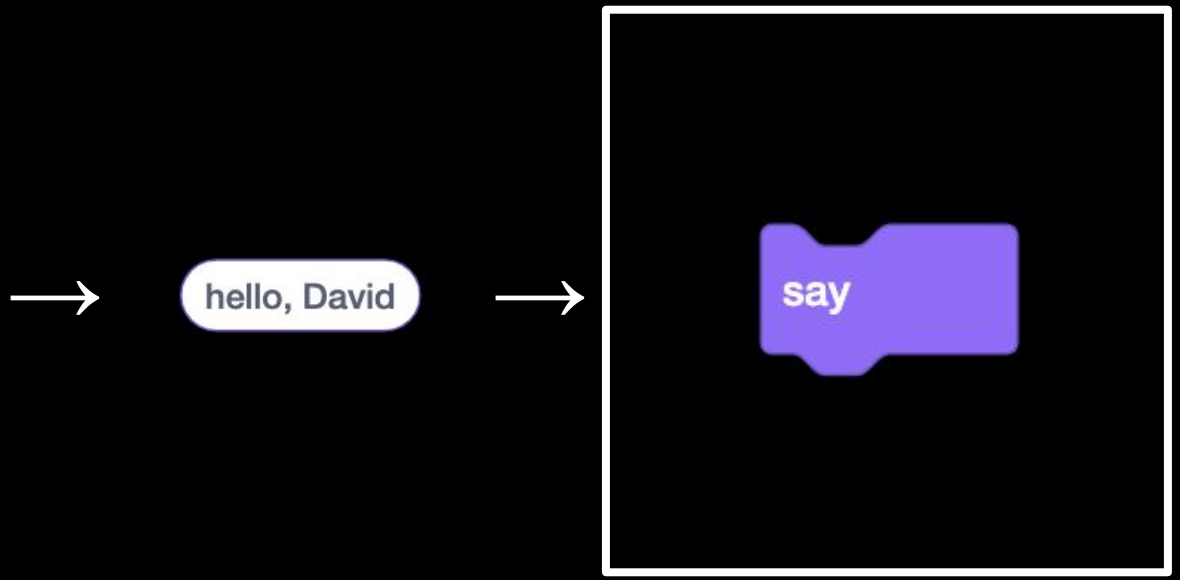

hello,
answer
algorithm
output


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 JDs

Computational Thinking