

Exploring Cybernetics in K-12 Classrooms with Scratch STEM

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Cybernetics

Study of systems

- Cybernetics is relevant in the study of systems: sets of interconnected elements for performing a function, solving a task
- The world in which we live is formed by systems: mechanical, physical, biological, social, abstract, natural and artificial systems, continuous, discrete, deterministic, probabilistic, etc.

K-12 Classrooms

- Cybernetics, however, is rarely mentioned or studied in the classroom.
- Is it possible to create an accessible environment where children and young adults could explore the world of cybernetics? With Scratch it is possible to create such environment.

Project Examples

1. Teach a butterfly to fly through a maze
2. Test different strategies to fly through all the rooms in a greenhouse
3. Analyze the impact of finding food in the life of a butterfly
4. Test different strategies of cooperation and reproduction
5. Study the behavior of a school of fish (as individuals and as a group) as they search for nourishment
6. Evaluate different strategies of playing tennis
7. Design a self-driving car that can optimize performance in multiple circuits

Cybernetics with Scratch

When K -12 students explore cybernetics with Scratch they:

- 1 – understand and develop the fundamental concepts of cybernetics, such as learning, adaptation, control, communication, and feedback.
- 2 – learn how to approach problems in other disciplines such as control engineering, biology, statistics and probability, vector geometry.
- 3 – learn how to solve complex problems (like the butterfly greenhouse) with simple, logical and complementary solutions that enable the student to structure simple and collaborative solutions to more complex problems.

Studio: 497 887

scratch.mit.edu/studios/497887/

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Cybernetics

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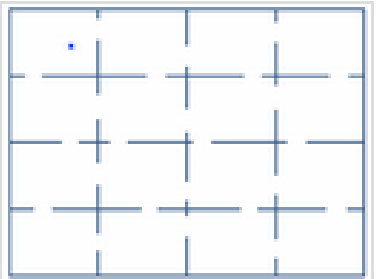
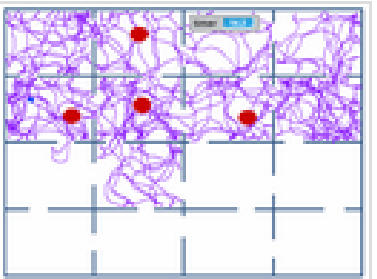
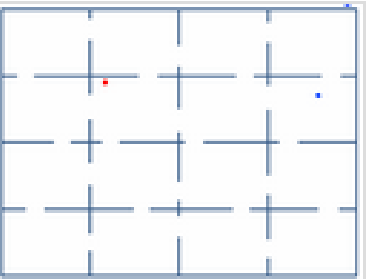
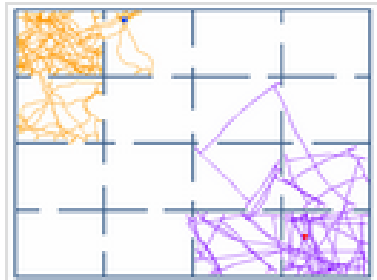
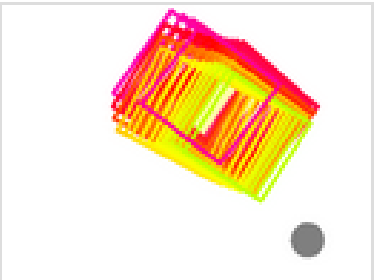
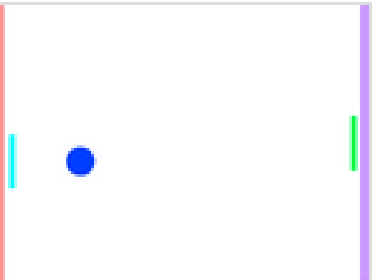
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Updated 31 Jul 2014

Cybernetics - STEM

Scratch@MIT 2014

LearnScratch.org

 <p>Self Driving Car - Design by LS_11</p>	 <p>Butterfly Generation 01 by LS_11</p>	 <p>Butterfly Generation ... by LS_11</p>	 <p>Butterfly Generation ... by LS_11</p>
 <p>Butterfly Generation ... by LS_11</p>	 <p>School of fish by LS_11</p>	 <p>Two Player Pong - Selection by LS_11</p>	

Butterfly Generation 01
v421 by LS_11 (shared)

X: 240 Y: -180

Sprites

New sprite:

Stage
3 backdrops

New backdrop:

B-1

Scripts | Costumes | Sounds

Motion

- move 10 steps
- turn 15 degrees
- turn 15 degrees
- point in direction 90
- point towards
- go to x: -150 y: 125
- go to mouse-pointer
- glide 1 secs to x: -150 y: 125
- change x by 10
- set x to 0
- change y by 10
- set y to 0
- if on edge, bounce
- set rotation style left-right
- x position

Events

Control

Sensing

Operators

More Blocks

when clicked

- set size to 50 %
- go to x: -150 y: 125
- clear
- pen down

when space key pressed

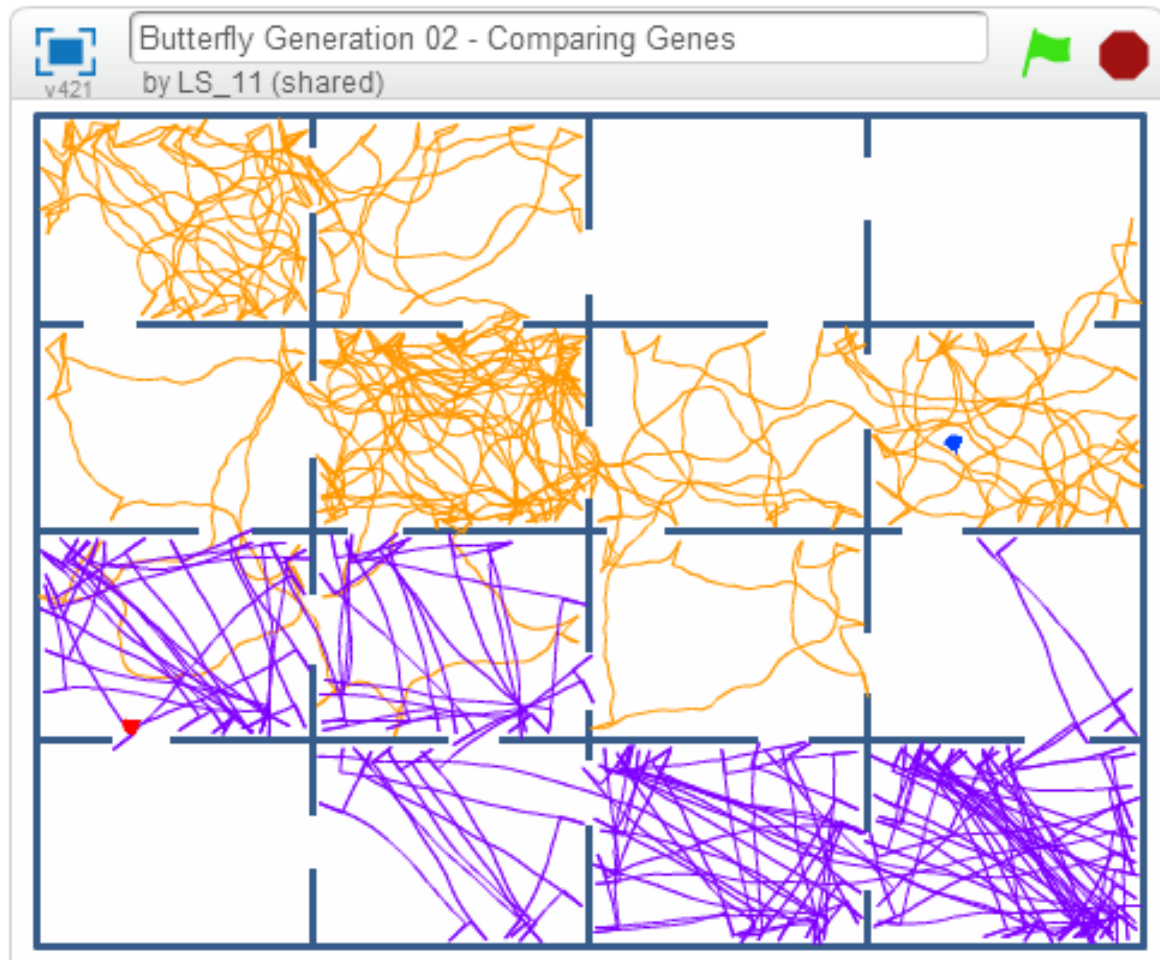
- forever
 - move 4 steps
 - turn pick random -30 to 30 degrees

when space key pressed

- forever
 - set pen color to timer

when space key pressed

- forever
 - if touching color ? then
 - move -10 steps
 - turn 90 degrees



x: 240 y: -58

Sprites New sprite:

Stage 3 backdrops

New backdrop:

B-1 B-2

Scripts | Costumes | Sounds

- Motion
- Looks
- Sound
- Pen
- Data
- Events
- Control
- Sensing
- Operators
- More Blocks

```
move 10 steps
turn 15 degrees
turn 15 degrees
point in direction 90
point towards
go to x: -150 y: 125
go to mouse-pointer
glide 1 secs to x: -150 y: 125
change x by 10
set x to 0
change y by 10
set y to 0
if on edge, bounce
set rotation style left-right
x position
```

```
when clicked
set size to 50 %
go to x: -150 y: 125
clear
set pen color to 20
pen down

when space key pressed
forever
  move 4 steps
  turn pick random -30 to 30 degrees

when space key pressed
forever
  if touching color ? then
    move -10 steps
    turn 90 degrees
```

Butterfly Generation 03 - Finding Food
by LS_11 (shared)

v421

timer 33.9

X: 240 Y: 54

Sprites

New sprite:

Stage
3 backdrops

New backdrop:

B-1 Food 1 Food 2 Food 3 Food 4

Scripts Costumes Sounds

Motion

- Events
- Control
- Sensing
- Operators
- More Blocks

Looks

Sound

Pen

Data

move 10 steps

turn 15 degrees

turn 15 degrees

point in direction 90

point towards

go to x: -173 y: -23

go to mouse-pointer

glide 1 secs to x: -173 y: -23

change x by 10

set x to 0

change y by 10

set y to 0

if on edge, bounce

set rotation style left-right

x position

when clicked

- set size to 50 %
- go to x: -150 y: 125
- clear
- set pen color to 150
- pen down

when space key pressed

- forever
 - if touching color ? then
 - move -10 steps
 - turn 90 degrees

when space key pressed

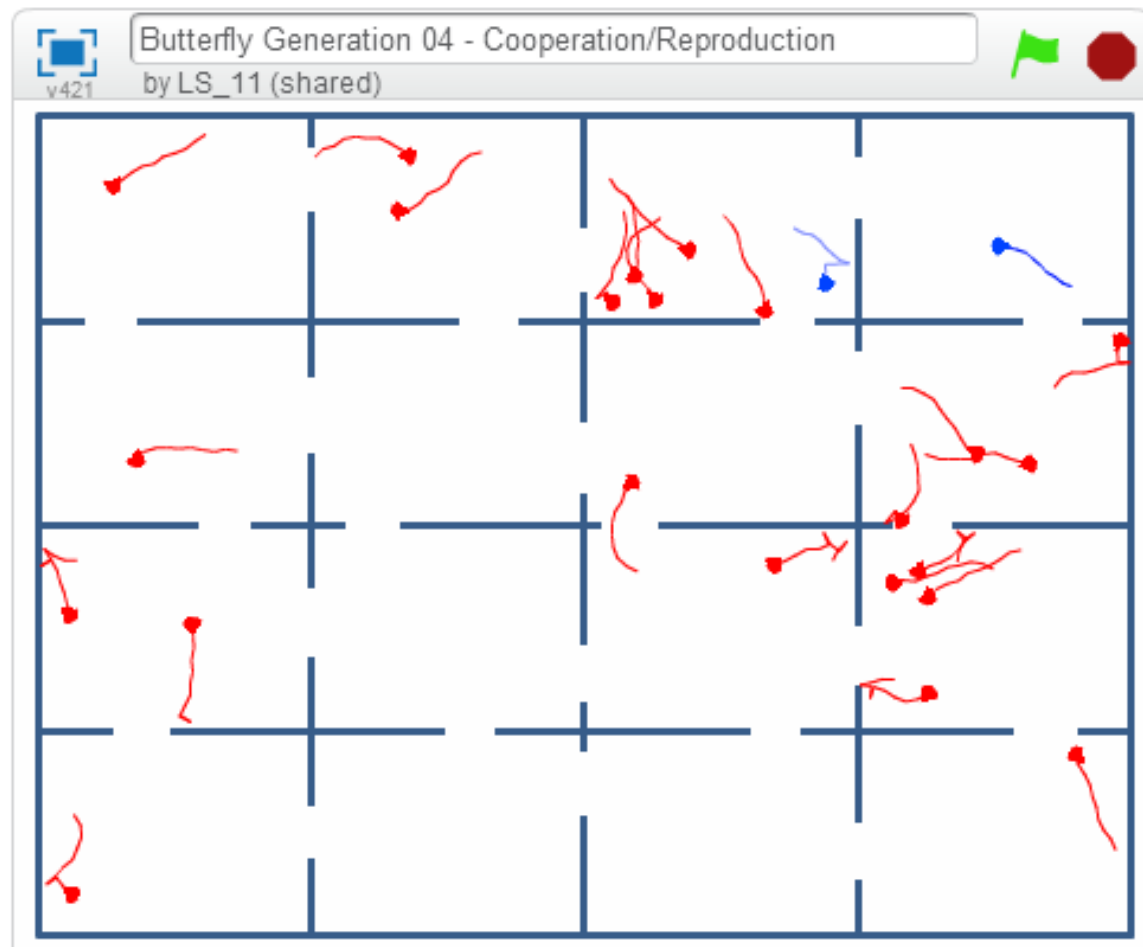
- reset timer
- forever
 - move 4 steps
 - turn pick random -30 to 30 degrees

when space key pressed

- wait until timer > 30
- stop all

when space key pressed

- forever
 - wait until touching color ?
 - reset timer



X: 218 Y: -180

Sprites

New sprite:

Stage
3 backdrops

New backdrop:

B-1 B-3 B-2

Scripts Costumes Sounds

- Motion
- Looks
- Sound
- Pen
- Data
- Events
- Control
- Sensing
- Operators
- More Blocks

```

clear
stamp
pen down
pen up
set pen color to [red]
change pen color by 10
set pen color to 0
change pen shade by 10
set pen shade to 50
change pen size by 1
set pen size to 1
  
```

```

when clicked
set size to 50 %
go to x: -160 y: 120
pen down
clear
set pen color to 0
  
```

```

when 2 key pressed
forever
move 5 steps
turn [pick random -30 to 30] degrees
  
```

```

when 2 key pressed
forever
if touching color [red] ? then
move -5 steps
turn [90] degrees
  
```

```

when 2 key pressed
forever
if touching color [red] ? then
create clone of myself
wait 5 secs
  
```

```

when space key pressed
clear
  
```

```

when I start as a clone
forever
move 5 steps
turn [pick random -30 to 30] degrees
  
```

```

when I start as a clone
forever
if touching color [red] ? then
move -5 steps
turn [90] degrees
  
```

```

when I start as a clone
forever
if touching color [red] ? then
wait 5 secs
create clone of myself
  
```

Self Driving Car - Designed for Speed and Security
 v421 by LS_11 (shared)

v 12
 timer 12.1

x: 240 y: -97

Sprites

New sprite:

Stage
 4 backdrops

New backdrop:

car

Scripts Costumes Sounds

Motion
 Looks
 Sound
 Pen
 Data

Events
 Control
 Sensing
 Operators
 More Blocks

```

  move 10 steps
  turn 15 degrees
  turn 15 degrees
  point in direction 90
  point towards
  go to x: 55 y: -159
  go to mouse-pointer
  glide 1 secs to x: 55 y: -159

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

  if on edge, bounce
  set rotation style left-right
  
```

```

  when clicked
  reset timer
  point in direction 90
  go to x: 0 y: -150

  when space key pressed
  forever
  Move
  Turn Right
  Turn Left
  Speed Up
  Slow Down
  
```

```

  define Move
  if color is touching ? then
  move v steps
  
```

```

  define Turn Right
  if color is touching ? then
  turn 10 degrees
  
```

```

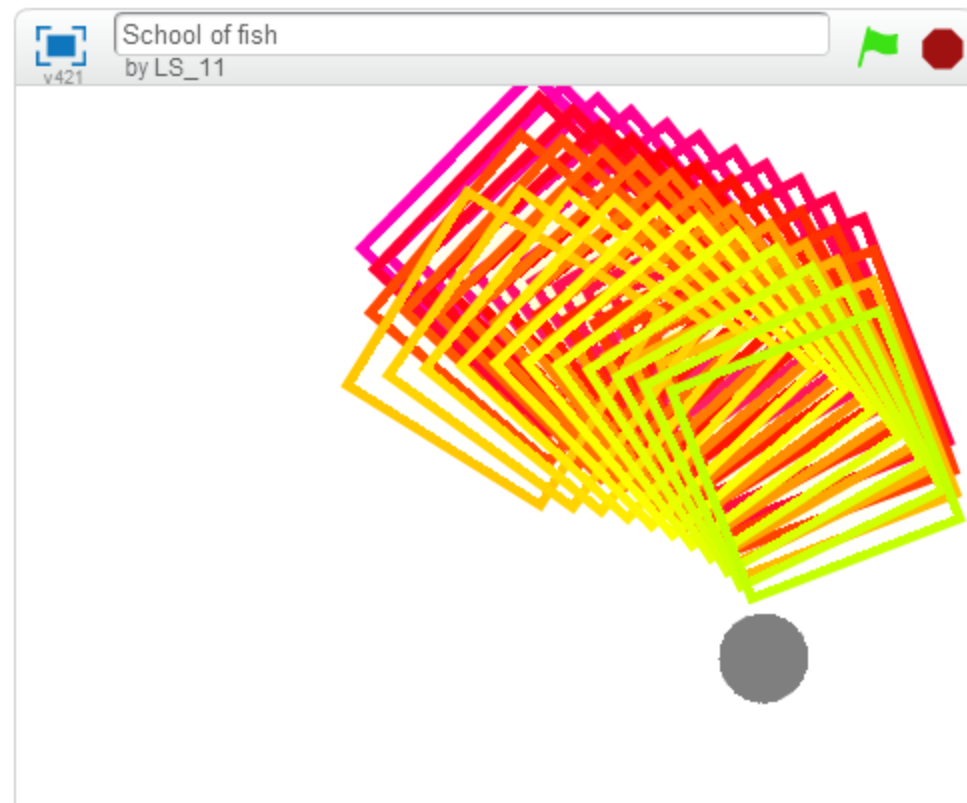
  define Turn Left
  if color is touching ? then
  turn 10 degrees
  
```

```

  define Speed Up
  if color is touching ? then
  set v to 12
  
```

```

  define Slow Down
  if color is touching ? then
  set v to 3
  
```



x: -83 y: -180

Sprites

New sprite:

Stage 1 backdrop

New backdrop:

Sprite1

Ball

Scripts

Costumes

Sounds

Motion

- move 10 steps
- turn 15 degrees
- turn 15 degrees
- point in direction 90
- point towards
- go to x: -210 y: -200
- go to mouse-pointer
- glide 1 secs to x: -210 y: -200
- change x by 10
- set x to 0
- change y by 10
- set y to 0
- if on edge, bounce
- set rotation style left-right
- x position

Events

- when green flag clicked

Control

- repeat 4
- repeat 11
- forever

Sensing

- point towards Ball

Operators

- change color effect by 1.5
- create clone of myself
- change size by 0.5

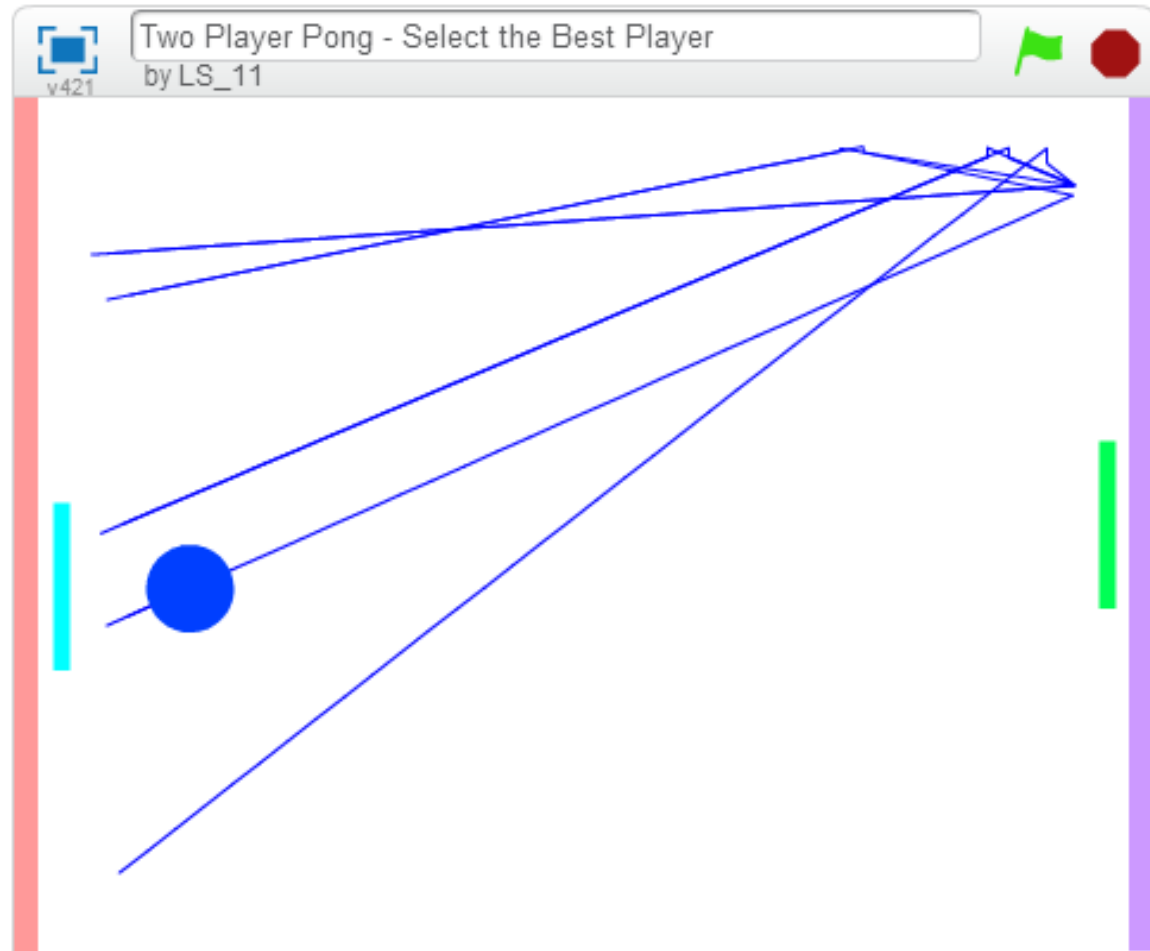
More Blocks

when green flag clicked

- show
- go to x: -210 y: 120
- point in direction 90
- set rotation style all around
- repeat 4
 - repeat 11
 - change color effect by 1.5
 - create clone of myself
 - move 40 steps
 - set x to -210
 - change y by -80
- hide

when I start as a clone

- forever
 - point towards Ball
 - move 1 steps
 - change size by 0.5



Sprites

New sprite:

Stage
2 backdrops

New backdrop:

ball Sue Alex

X: 190 Y: 27

Scripts Costumes Sounds

Motion

- Looks
- Sound
- Pen
- Data

Events

- Control
- Sensing
- Operators
- More Blocks

move 10 steps

turn 15 degrees

turn 15 degrees

point in direction 90

point towards

go to x: -133 y: -23

go to mouse-pointer

glide 1 secs to x: -133 y: -23

change x by 10

set x to 0

change y by 10

set y to 0

if on edge, bounce

set rotation style left-right

x position

y position

when clicked

1_start

when clicked

2_move

when clicked

3_hit_Sue

when I receive update_ball

4_hit_Alex

define 1_start

go to x: 0 y: 0

point in direction pick random 45 to 135

define 3_hit_Sue

forever

if touching Sue ? then

turn 180 degrees

move 10 steps

define 2_move

forever

move 15 steps

if on edge, bounce

define 4_hit_Alex

point in direction dir

move 10 steps

when up arrow key pressed

pen up

clear

when down arrow key pressed

pen down