

**Why should all kids  
learn programming?**

**@Feliene**



# How Do Kids Program in the Wild?

@Feliene



# Do Kids Program in the Wild?

@Feliene



**Do Kids Program  
in the Wild?**

**YES!**





Sign in



# An Hour of Code for every student.

285,943,838 served

Join us

Try it

Watch the video

13,480,772 student accounts on Code Studio

Every student in every school should have the opportunity to learn computer science

Take the diversity pledge

I agree

Join 2,233,252 others



### Hour of Code

Anybody can learn. Start today



### Students

Explore our courses



### Educators

Teach your students



### Advocates

Support diversity in computing



Create stories, games, and animations  
Share with others around the world



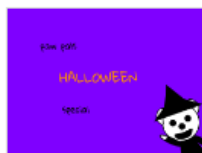
A creative learning community with **17.603.341** projects shared

OVER SCRATCH | VOOR ONDERWIJZERS | VOOR OUDERS

Uitgelichte projecten



Famous Scientists  
-Star-Dusty-



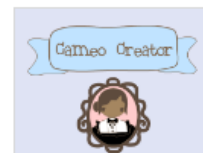
Paw Pals Halloween  
tinkerpixierule



Learning Mandarin | E  
amy482004



Web Hunt  
applepiesleth



Cameo Creator  
-little-

Uitgelichte studio's



Songs Made In Scratch N



Scratchers Around The W



Lyrics Taken Literally



Learn Creatively



Codeca

Projecten beheerd door Fuzzbutt

Meer leren

Just a toy?



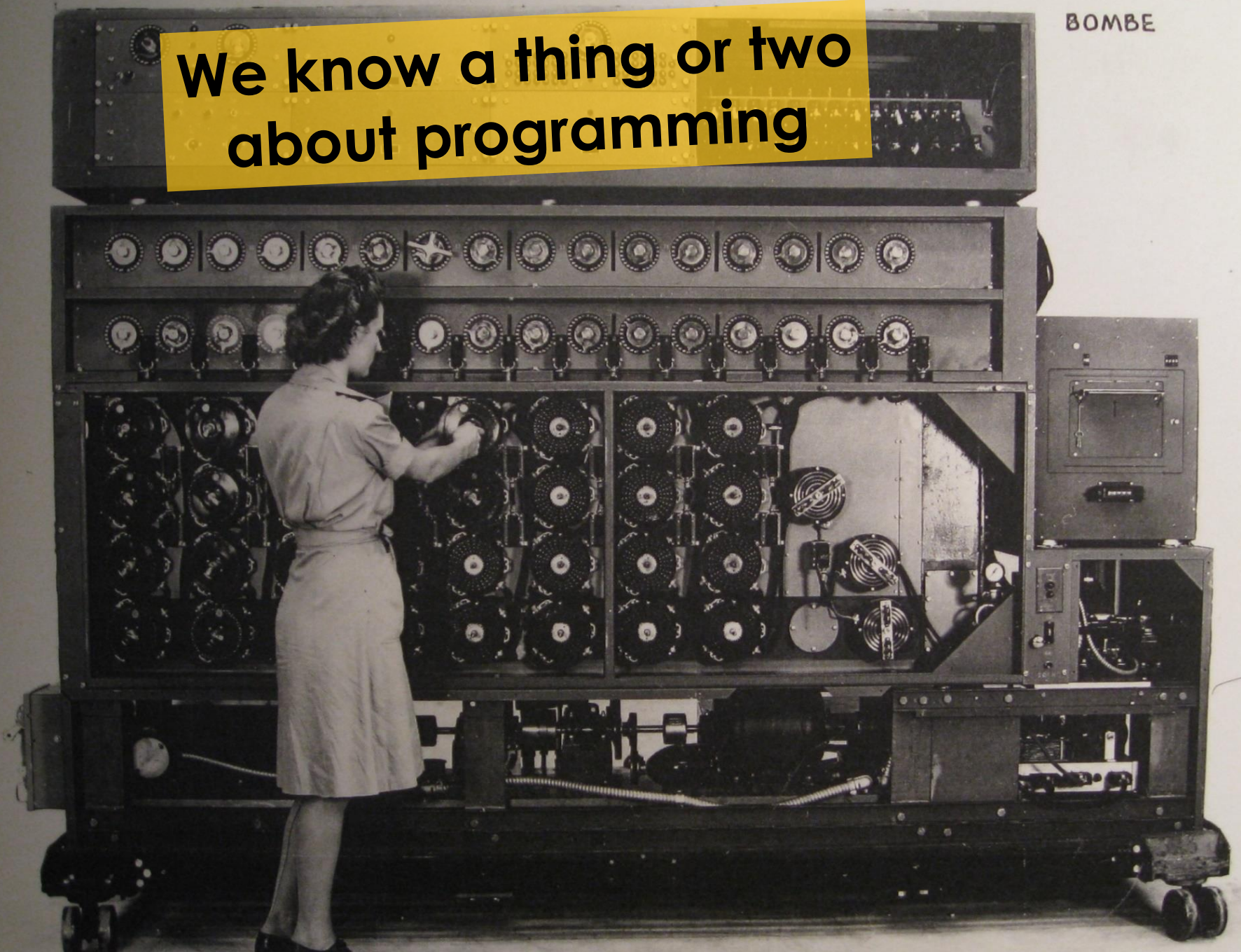
**Or do they write  
good code?**



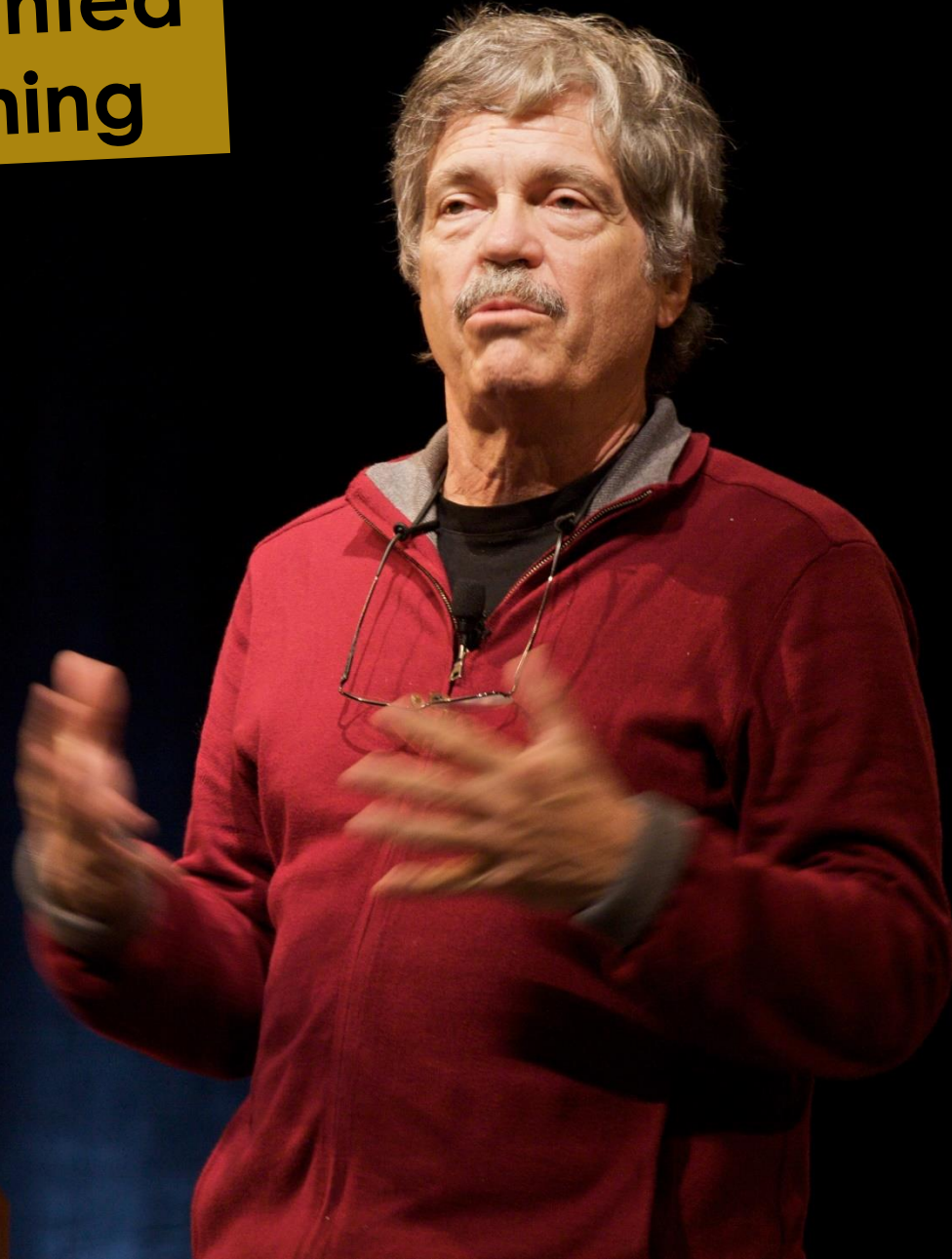


We know a thing or two  
about programming

BOMBE



# Object oriented programming



AWN  
TING



**Smells and  
refactorings**



**Does code  
smells matter?**

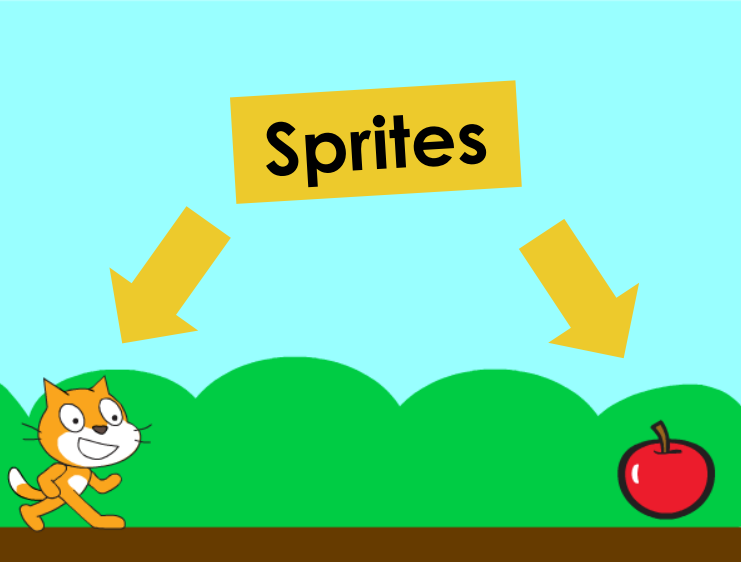
# The Scratch programming language

The screenshot displays the Scratch web editor interface. The browser address bar shows the URL `https://scratch.mit.edu/projects/107811926/#editor`. The project title is "Cat loves apple" by Felienne (unshared). The stage features a cat sprite and an apple on a green hill background. The code editor contains the following scripts:

- Script 1:** Triggered by "when space key pressed", it contains a "move 10 steps" block.
- Script 2:** Triggered by "when green flag clicked", it contains a sequence of blocks: "wait until touching Apple", "play sound meow", "say Hello! for 2 secs", "say Hello!", "think Hmm... for 2 secs", "think Hmm...", "show", "hide", "switch costume to costume2", "next costume", "switch backdrop to blue sky", "change color effect by 25", "set color effect to 0", "clear graphic effects", and "change size by 10".

The left sidebar shows the "Sprites" panel with "Cat" and "Apple" sprites. The "Backpack" panel is visible at the bottom.

Cat loves apple by Felienne (unshared)



X: 192 Y: -180

Sprites

New sprite: [Icons]

Stage  
2 backdrops

New backdrop: [Icons]

Cat Apple

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

```

say Hello! for 2 secs
say Hello!
think Hmm... for 2 secs
think Hmm...
show
hide
switch costume to costume2
next costume
switch backdrop to blue sky
change color effect by 25
set color effect to 0
clear graphic effects
change size by 10
  
```

```

when space key pressed
  move 10 steps

when clicked
  wait until touching Apple ?
  play sound meow
  
```

x: -185 y: -109

Backpack

Cat loves apple on Scratch | x

https://scratch.mit.edu/projects/107811926/#editor

SCRATCH File Edit Tips About

Cat loves apple  
by Felienne (unshared)

Scripts

Motion Looks Sound Pen Data Events Control Sensing Operators More Blocks

when space key pressed  
move 10 steps

when clicked  
wait until touching Apple ?  
play sound meow

say Hello! for 2 secs  
say Hello!  
think Hmm... for 2 secs  
think Hmm...  
show  
hide  
switch costume to costume2  
next costume  
switch backdrop to blue sky  
change color effect by 25  
set color effect to 0  
clear graphic effects  
change size by 10

Scripts

X: 192 Y: -180

Sprites  
New sprite: [ ] [ ] [ ] [ ]

Stage  
2 backdrops

New backdrop: [ ] [ ] [ ] [ ]

Cat  
Apple

Backpack

Cat loves apple on Scratch | x

https://scratch.mit.edu/projects/107811926/#editor

SCRATCH File Edit Tips About

Cat loves apple  
by Felienne (unshared)

Share See project page

Scripts Costumes Sounds

Motion Looks Sound Pen Data Events Control Sensing Operators More Blocks

when clicked  
wait until touching Cat ?  
say You found me!

say Hello! for 2 secs  
say Hello!  
think Hmm... for 2 secs  
think Hmm...  
show  
hide  
switch costume to apple  
next costume  
switch backdrop to blue sky  
change color effect by 25  
set color effect to 0  
clear graphic effects  
change size by 10

Stage  
2 backdrops

New backdrop:

Sprites  
New sprite: [ ] [ ] [ ]

Cat Apple

x: -215 y: -180

x: 190 y: -120

Each sprite can have scripts





**Do code smells  
matter to kids?**



A simple game

One 'good' version

**Scratch Editor Interface:**

- Project Name:** PongN (v446) by Felienne (shared)
- URL:** <https://scratch.mit.edu/projects/96072836/#editor>
- Canvas:** Shows a Pong game scene with a red brick wall, a yellow ball, and a blue paddle. A score indicator shows 'punten' with a value of 2.
- Scripts Area:**
  - Script 1 (Motion):** when green flag clicked → go to x: 25 y: 152 → point in direction 150 → move 10 steps → turn 15 degrees → turn 15 degrees → point in direction 90 → point towards → go to x: 137 y: 110 → go to mouse-pointer → glide 1 secs to x: 137 y: 110 → change x by 10 → set x to 0 → change y by 10 → set y to 0
  - Script 2 (Motion):** when green flag clicked → go to x: 25 y: 152 → point in direction 150 → forever loop: wait until touching Batje? → play sound pop → point in direction 180 - direction → move 10 steps → change punten by 1
  - Script 3 (Motion):** when green flag clicked → forever loop: if on edge, bounce → move 10 steps
  - Script 4 (Control):** when green flag clicked → forever loop: wait until punten = 5 → say Gefeliciteerd! for 1 secs → play sound cheer until done → set punten to 0
- Sprites Panel:** Shows 'Bal' (yellow ball) and 'Batje' (blue paddle) as available sprites. A yellow arrow points from the paddle in the canvas to the 'Batje' sprite.
- Backpack:** Shows 'Stage' (1 backdrop) and 'New backdrop' options.

**Two 'smelly'  
versions**



A black and white striped skunk is shown in a grassy field. The skunk's body is black with a prominent white stripe running down its back and another stripe on its face. It is surrounded by green grass and some brown leaves. Three yellow text boxes are overlaid on the image: one in the top right, one in the bottom left, and one in the bottom right.

**Two 'smelly'  
versions**

**Long method**

**Duplicated code**

# Version N

The image shows the Scratch editor interface for a project titled "PongN". The browser address bar shows the URL: <https://scratch.mit.edu/projects/96072836/#editor>. The project is shared by Felienne.

**Stage:** The stage features a red brick wall backdrop and a grey floor. A yellow ball is positioned on the floor. A score variable "punten" is shown with a value of 2. A blue bat is visible on the floor. The ball's coordinates are X: -8, Y: -180.

**Scripts Area:**

- Script 1:** When green flag clicked, go to x: 25 y: 152, point in direction 150.
- Script 2:** When green flag clicked, move 10 steps, turn 15 degrees, turn 15 degrees, point in direction 90, point towards, go to x: 137 y: 110, go to mouse-pointer, glide 1 secs to x: 137 y: 110, change x by 10, set x to 0, change y by 10, set y to 0.
- Script 3:** When green flag clicked, forever loop: if on edge, bounce, move 10 steps.

**Code Editor (Right):**

- Script 1:** When green flag clicked, go to x: 25 y: 152, point in direction 150.
- Script 2:** When green flag clicked, forever loop: wait until touching Batje?, play sound pop, point in direction 180 - direction, move 10 steps, change punten by 1.
- Script 3:** When green flag clicked, forever loop: wait until punten = 5, say Gefeliciteerd! for 1 secs, play sound cheer until done, set punten to 0.

**Sprites Area:** The "Sprites" panel shows three sprites: "Bal" (a yellow ball), "Batje" (a blue bat), and "Lijn" (a horizontal line). A yellow arrow points from the ball in the stage to the "Bal" sprite.

# Version D

The image shows the Scratch editor interface for a project titled "PongD" by Felienne. The stage features a red brick wall backdrop and a yellow ball sprite. A score variable "punten" is set to 0. The sprites panel shows three sprites: "Bal" (a yellow circle), "Batje" (a blue paddle), and "Lijn" (a horizontal line). The code editor contains three scripts:

- Script 1:** Starts with "when green flag clicked", followed by "go to x: 25 y: 152", "point in direction 150", "move 10 steps", "turn 15 degrees", "turn 15 degrees", "point in direction 90", "point towards", "go to x: -188 y: 40", "go to mouse-pointer", and "glide 1 secs to x: -188 y: 40".
- Script 2:** Starts with "when green flag clicked", followed by "forever" loop containing "if on edge, bounce" and "move 10 steps".
- Script 3:** Starts with "when green flag clicked", followed by "forever" loop containing "wait until punten = 5" (highlighted with a yellow arrow), "say Gefeliciteerd! for 1 secs", "when green flag clicked", "forever" loop containing "wait until touching Batje?", "point in direction 180 - direction", and "change punten by 1".

# Version D

The image shows the Scratch editor interface for a Pong game. The main workspace displays a ball and a paddle on a brick wall background. A score counter labeled "punten" is set to 0. A script area is highlighted with a black box, containing the following code:

```
when clicked
forever
  wait until punten = 5
  say Gefeliciteerd! for 1 secs
```

A yellow arrow points from this script to a "punten = 5" block in the code area. Another yellow arrow points from the "Sprites" panel to the "Bal" sprite. The "Sprites" panel shows "Bal", "Batje", and "Lijn".



# Version D

The image shows the Scratch editor interface for a project titled "PongD" by Felienne. The stage features a red brick wall backdrop and a yellow ball. A blue bat sprite is positioned at the bottom center. The sprites panel shows the bat sprite selected. The code editor contains the following blocks:

- when left arrow key pressed**: change x by -15
- when right arrow key pressed**: change x by 15
- when clicked**: forever loop containing:
  - wait until punten = 5
  - play sound cheer
- when clicked**: forever loop containing:
  - wait until touching Bal ?
  - play sound pop

Additional code blocks in the Scripts area include: move 10 steps, turn 15 degrees, point in direction 90, go to x: 75 y: -157, glide 1 secs to x: 75 y: -157, change x by 10, set x to 0, change y by 10, and set y to 0.

# Version D

The image shows the Scratch editor interface for a project titled "PongD" by Felienne. The browser address bar shows the URL <https://scratch.mit.edu/projects/96144981/#editor>. The game scene displays a ball and a paddle on a brick wall background. The score is shown as "punten 0".

The script area contains the following code:

```
when clicked  
forever  
  wait until punten = 5  
  play sound cheer
```

The sprites panel shows the "Batje" sprite selected. The "wait until" block in the script is highlighted with a yellow box, and a yellow arrow points to it from the right. Another yellow arrow points from the "Batje" sprite in the sprites panel to the "wait until" block.

# Version D

The image shows the Scratch editor interface for a project titled "PongD". The browser address bar shows the URL <https://scratch.mit.edu/projects/96144981/#editor>. The Scratch logo and navigation menu are visible at the top.

The stage area displays a Pong game scene with a red brick wall, a grey floor, a yellow ball, and a blue paddle. A score counter labeled "punten" shows a value of 0. A yellow arrow points to the paddle.

The Sprites panel at the bottom left shows the following assets:

- Stage (1 backdrop)
- Bal (yellow circle)
- Batje (blue paddle)
- Lijn (grey line)

The Scripts area on the right contains two scripts:

**Script 1:**

- when green flag clicked
- forever loop:
  - wait until punten = 5 (highlighted with a yellow arrow)
  - set punten to 0
  - play sound cheer until done

**Script 2:**

- when green flag clicked
- forever loop:
  - wait until touching Bal ?
  - set punten to 0
  - play sound buzzer

The code editor on the right shows the following code blocks:

- move 10 steps
- turn 15 degrees
- turn 15 degrees
- point in direction 90
- point towards
- go to x: -4 y: 25
- go to mouse-pointer
- glide 1 secs to x: -4 y: 25
- change x by 10
- set x to 0
- change y by 10
- set y to 0

The Backpack area at the bottom is currently empty.

# Version D

The image shows the Scratch editor interface for a project named "PongD". The browser address bar displays <https://scratch.mit.edu/projects/96144981/#editor>. The project title is "PongD" by Felienne (shared). The main workspace shows a Pong game scene with a ball and a score counter labeled "punten" with a value of 0. The script area contains the following code:

```
when clicked clicked
forever
  wait until punten = 5
  set punten to 0
  play sound cheer until done
```

A yellow box highlights this script. A yellow arrow points from the highlighted script to the "wait until punten = 5" block in the main script area. Another yellow arrow points from the highlighted script to the "Sprites" panel at the bottom left, which shows a "Bal" sprite selected.

# Version N

The image shows the Scratch editor interface for a Pong game. The stage displays a red brick wall backdrop, a yellow ball, and a blue paddle. The score is shown as 'punten 2'. The code editor contains several scripts:

- Script 1:** when green flag clicked, go to x: 25 y: 152, point in direction 150.
- Script 2:** when green flag clicked, move 10 steps, turn 15 degrees, turn 15 degrees, point in direction 90, point towards, go to x: 137 y: 110, go to mouse-pointer, glide 1 secs to x: 137 y: 110, change x by 10, set x to 0, change y by 10, set y to 0.
- Script 3:** when green flag clicked, forever loop: wait until touching Batje?, play sound pop, point in direction 180 - direction, move 10 steps, change punten by 1.
- Script 4:** when green flag clicked, forever loop: if on edge, bounce, move 10 steps.
- Script 5:** when green flag clicked, forever loop: wait until punten = 5, say Gefeliciteerd! for 1 secs, play sound cheer until done, set punten to 0.

The sprites panel shows the 'Bal' sprite selected. The backpack is visible at the bottom.

# Version N

The image shows a Scratch editor window for a project named "PongN" by Felienne. The URL is <https://scratch.mit.edu/projects/96072836/#editor>. The project has a score of 2 points. The main workspace shows a brick wall backdrop and a car sprite. A code block is highlighted in a box, containing the following script:

```
when clicked clicked
forever
  wait until punten = 5
  say Gefeliciteerd! for 1 secs
  play sound cheer until done
  set punten to 0
```

Two yellow arrows point to the highlighted code block from the left and right sides. The interface includes a top navigation bar with "File", "Edit", "Tips", and "About" menus. The toolbar contains icons for saving, undo, redo, and help. The sprites panel shows "Bal", "Batje", and "Lijn" sprites. The script area shows a "when clicked" event and a "forever" loop with the highlighted code block. The bottom panel shows the "Backpack" area with various code blocks.

# Version L

PongS on Scratch

https://scratch.mit.edu/projects/96201509/#editor

SCRATCH

File Edit Tips About

PongS v446 by Feliene (shared)

punten 0

Scripts Costumes Sounds

**Motion**

- move 10 steps
- turn 15 degrees
- turn 15 degrees
- point in direction 90
- point towards
- go to x: 167 y: -41
- go to mouse-pointer
- glide 1 secs to x: 167 y: -41
- change x by 10
- set x to 0
- change y by 10
- set y to 0

Events

- when green flag clicked

Control

- forever

Sensing

- if on edge, bounce
- if touching Batje ? then
- if touching Lijn ? then
- if punten = 5 then

Operators

- point in direction 150
- point in direction 180 - direction
- change punten by 1
- set punten to 0
- set punten to 0

More Blocks

- play sound pop
- play sound buzzer
- say Gefeliciteerd! for 1 secs
- play sound cheer until done

Stage

1 backdrop

New backdrop:

Sprites

New sprite:

Bal Batje Lijn

x: 166 y: -40

See project page



**Do code smells  
matter to kids?**





tl;dr  
Yes



**tl;dr  
Yes**

**Kids performed  
significantly better  
on the non-smelly  
program**



tl;dr  
Yes

**But, differences tasks are impacted differently**



**Let's take a  
closer look!**



**Let's take a closer look!**

**Understanding seems affected more by the Long Method smell**



**Let's take a closer look!**

**Modification is hampered most by Duplication**

**Smells are bad!  
(also for kids)**



**Smells are bad!  
(also for kids)**

**Are smells  
common?**





**Thanks MIT**





Create

Explore

Discuss

About

Help

Search



Felienne

### Community statistics at a glance

- 16,622,772 projects shared,
  - 13,415,350 users registered,
  - 89,208,180 comments posted,
  - 2,865,297 studios created
- ...and growing!

### Website traffic last month

- 83,015,850 pageviews
- 13,843,300 visits
- 6,390,970 unique visitors

### Monthly Activity Trends





Create

Explore

Discuss

About

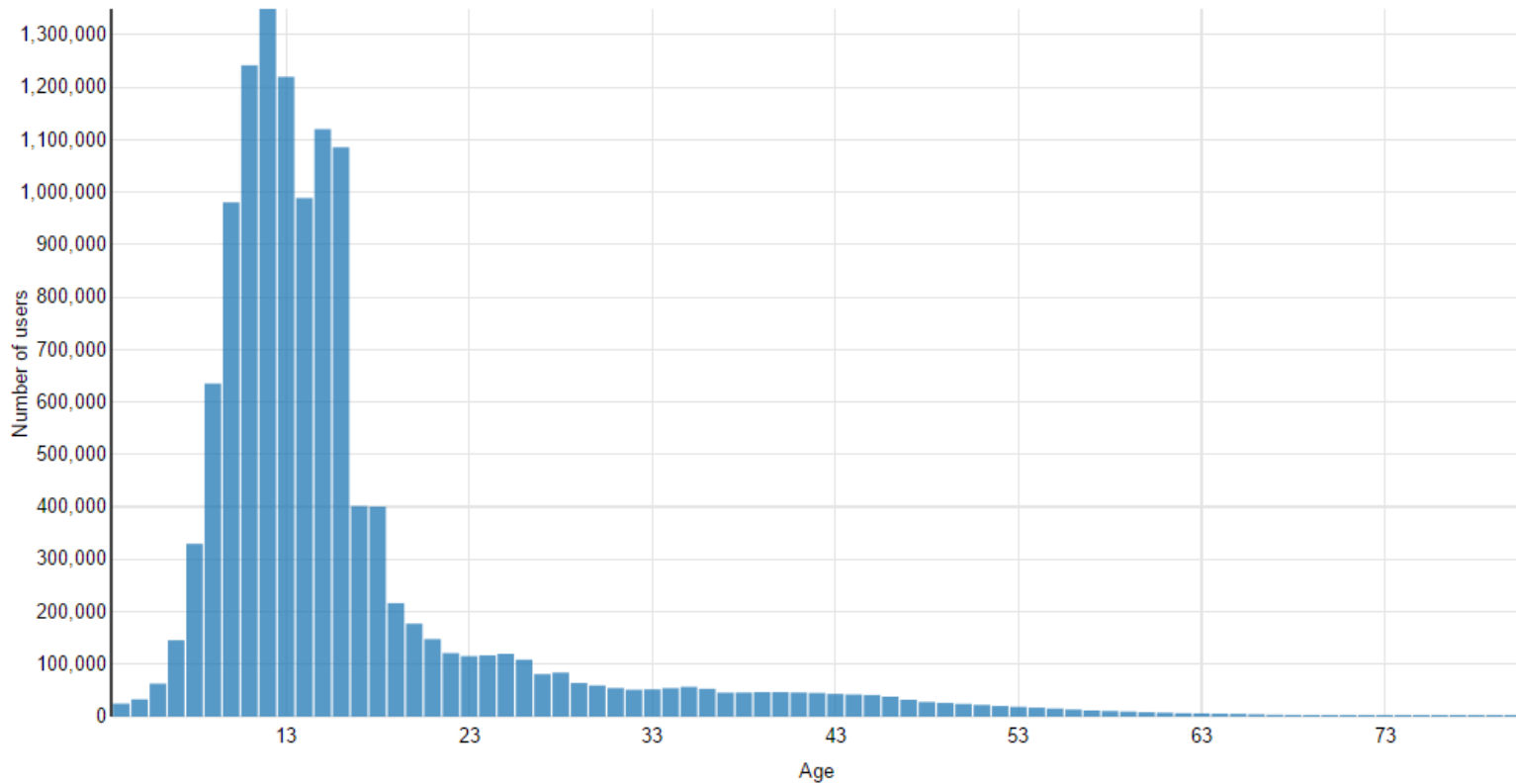
Help

Search



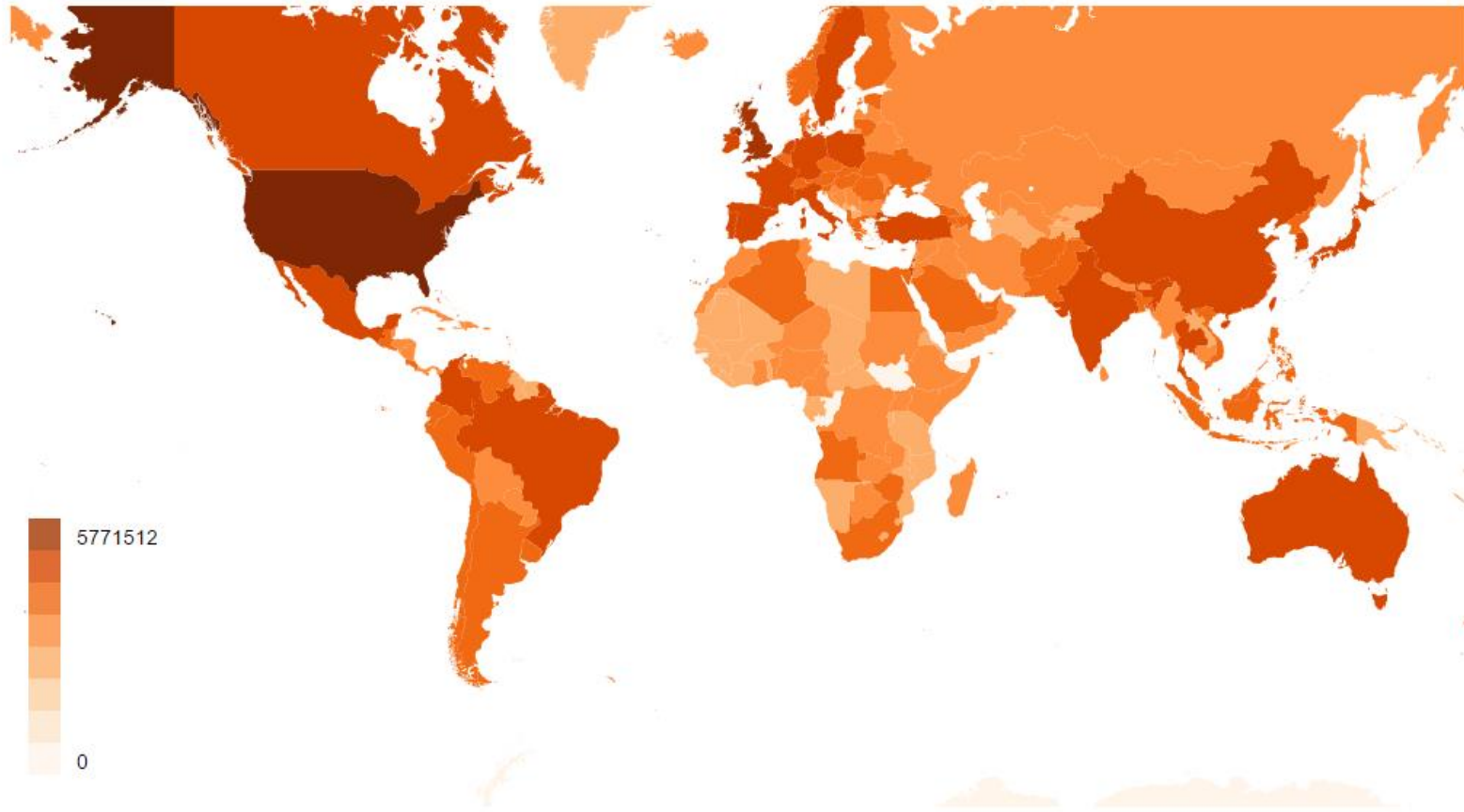
Felienne

### Age Distribution of New Scratchers



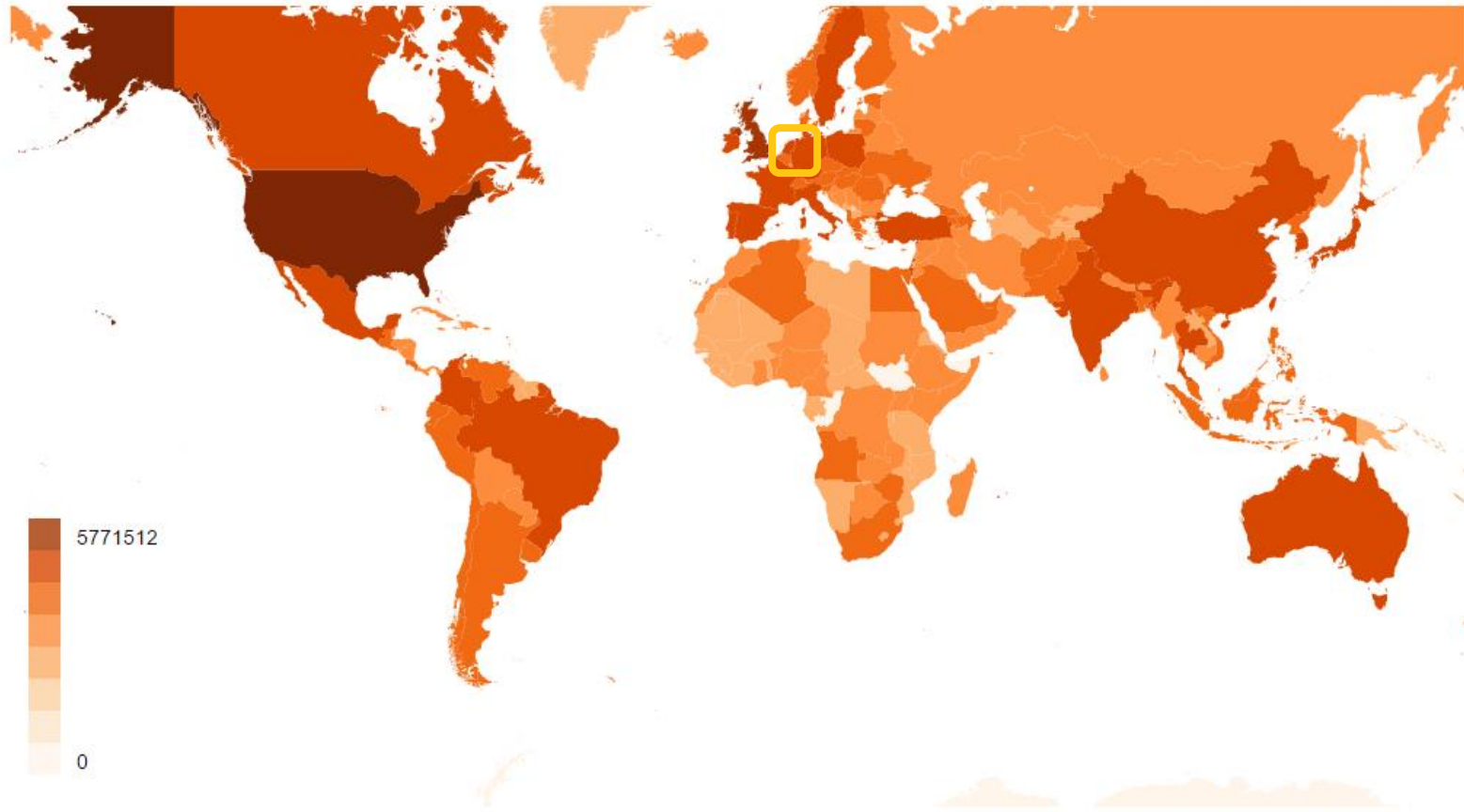
### Scratchers Worldwide

### Scratchers Worldwide



### Monthly Project Shares

### Scratchers Worldwide



### Monthly Project Shares

# What do kids do in Scratch?



Let's look at  
some programs!



**Downloaded all  
shared programs  
for 24 hours**





**250.000  
JSON files**

```
"scale": 0.30000000000000016,  
"direction": 74.99999999999999,  
"rotationStyle": "leftRight",  
"isDraggable": false,  
"indexInLibrary": 2,  
"visible": true,  
"spriteInfo": {  
  },  
},  
{  
  "objName": "Gerrie",  
  "scripts": [[284.35, 7.7, [{"whenKeyPressed", "left arrow"}, {"changeXposBy": -10}, {"lookLike": "links"}]],  
    [287.1, 108.05, [{"whenKeyPressed", "down arrow"}, {"changeYposBy": -10}],  
    [20.25, 5, [{"whenKeyPressed", "right arrow"}, {"changeXposBy": 10}, {"lookLike": "rechts"}]],  
    [20.2, 106.7, [{"whenKeyPressed", "up arrow"}, {"changeYposBy": 10}],  
    [19.95, 188.4, [{"whenIReceive", "hap"}, {"changeSizeBy": 10}],  
    [25.55,  
      280.5,  
      [{"whenGreenFlag"},  
        {"setSizeTo": 80},  
        {"doForever",  
          [{"doIf", [{"touching": "Fish3"}, [{"setSizeTo": 20}, {"broadcast": "raakRodeVis"}]}]]],  
    [268.45, 277.1, [{"whenIReceive", "hap"}, {"changeSizeBy": 10}, {"say:duration:elapsed:from": "Jammie", 1}],  
  "sounds": [{  
    "soundName": "pop",  
    "soundID": -1,  
    "md5": "83a9787d4cb6f3b7632b4ddfeb74367.wav",  
    "sampleCount": 258,  
    "rate": 11025,  
    "format": ""  
  }],  
  "costumes": [{  
    "costumeName": "rechts",  
    "baseLayerID": -1,  
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    "bitmapResolution": 1,  
    "rotationCenterX": 75,  
    "rotationCenterY": 75  
  },  
  {  
    "costumeName": "links",  
    "baseLayerID": -1,  
    "baseLayerMD5": "65dfdafb2f2156f86eab155f09b33ba9.svg",  
    "bitmapResolution": 1,  
    "rotationCenterX": 74,  
    ..  
  }  
}
```



```
10519701,68-60,0,sprite,"Sprite3",1,0,"whenIReceive","POWNE!!!!"
10519701,68-60,0,sprite,"Sprite3",1,1,"say:duration:elapsed:from:",,"its a magic powne flying through the sky on a magic program :D",10
10519701,68-60,0,sprite,"Sprite3",1,2,"broadcast:",,"SKY HIE!"
10519701,108-143,1,sprite,"Sprite4",1,0,"whenIReceive","SKY HIE!"
10519701,108-143,1,sprite,"Sprite4",1,1,"say:duration:elapsed:from:",,"Shoot it down!",5
10519701,108-143,1,sprite,"Sprite4",1,2,"wait:elapsed:from:",,1
10519701,108-143,1,sprite,"Sprite4",1,3,"nextCostume"
10519701,129-121,2,sprite,"Sprite1",1,0,"whenGreenFlag"
10519701,129-121,2,sprite,"Sprite1",1,1,"broadcast:",,"POWNE!!!!"
10541430,22-17,0,stage,"stage",1,0,"whenGreenFlag"
10541430,22-17,0,stage,"stage",1,1,"setVar:to:",,"x",0
10541430,22-17,0,stage,"stage",3,3,"changeVar:by:",,"x",-15
10541430,22-17,0,stage,"stage",1,2,"doForever"
10541430,21-14,1,sprite,"Tree_3",1,0,"whenGreenFlag"
10541430,21-14,1,sprite,"Tree_3",1,1,"show"
10541430,21-14,1,sprite,"Tree_3",1,2,"goBackByLayers:",,100
10541430,21-14,1,sprite,"Tree_3",1,3,"ypos:",,0
10541430,21-14,1,sprite,"Tree_3",1,4,"setSizeTo:",,100
10541430,21-14,1,sprite,"Tree_3",7,10,"readVariable",,"x"
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10541430,21-14,1,sprite,"Tree_3",5,8,"%",,800
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10541430,21-14,1,sprite,"Tree_3",1,5,"doForever"
10541430,21-14,2,sprite,"Tree_2",1,0,"whenGreenFlag"
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10541430,21-14,2,sprite,"Tree_2",5,8,"%",,3200
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10541430,21-14,2,sprite,"Tree_2",3,6,"xpos:"
10541430,21-14,2,sprite,"Tree_2",1,5,"doForever"
10541430,14-18,3,sprite,"Scratch Cat",1,0,"whenGreenFlag"
10541430,14-18,3,sprite,"Scratch Cat",3,2,"wait:elapsed:from:",,0.02
10541430,14-18,3,sprite,"Scratch Cat",3,3,"nextCostume"
10541430,14-18,3,sprite,"Scratch Cat",1,1,"doForever"
10541430,83-290,4,sprite,"Scratch Cat",1,0,"setSizeTo:",,50
10541430,83-290,4,sprite,"Scratch Cat",1,1,"gotoX:y:",,-195,-123
10541430,83-290,4,sprite,"Scratch Cat",1,2,"clearPenTrails"
10541430,83-290,4,sprite,"Scratch Cat",1,3,"lookLike:",,"Walk1"
10541430,83-290,4,sprite,"Scratch Cat",3,5,"stampCostume"
10541430,83-290,4,sprite,"Scratch Cat",3,6,"changeXposBy:",,55
10541430,83-290,4,sprite,"Scratch Cat",3,7,"nextCostume"
10541430,83-290,4,sprite,"Scratch Cat",1,4,"doRepeat",,8
10541430,83-290,4,sprite,"Scratch Cat",1,8,"setSizeTo:",,120
10541430,83-290,4,sprite,"Scratch Cat",1,9,"gotoX:y:",,0,55
10541430,21-14,5,sprite,"grass3",1,0,"whenGreenFlag"
10541430,21-14,5,sprite,"grass3",1,1,"ypos:",,0
10541430,21-14,5,sprite,"grass3",6,6,"readVariable",,"x"
```

Flattened  
into csv



```
10519701,68-60,0,sprite,"Sprite3",1,0,"whenIReceive","POWNE!!!!"
10519701,68-60,0,sprite,"Sprite3",1,1,"say:duration:elapsed:from:",,"its a magic powne flying through the sky on a magic program :D",10
10519701,68-60,0,sprite,"Sprite3",1,2,"broadcast:",,"SKY HIE!"
10519701,108-143,1,sprite,"Sprite4",1,0,"whenIReceive","SKY HIE!"
10519701,108-143,1,sprite,"Sprite4",1,1,"say:duration:elapsed:from:",,"Shoot it down!",5
10519701,108-143,1,sprite,"Sprite4",1,2,"wait:elapsed:from:",,1
10519701,108-143,1,sprite,"Sprite4",1,3,"nextCostume"
10519701,129-121,2,sprite,"Sprite1",1,0,"whenGreenFlag"
10519701,129-121,2,sprite,"Sprite1",1,1,"broadcast:",,"POWNE!!!!"
10541430,22-17,0,stage,"stage",1,0,"whenGreenFlag"
10541430,22-17,0,stage,"stage",1,1,"setVar:to:",,"x",0
10541430,22-17,0,stage,"stage",3,3,"changeVar:by:",,"x",-15
10541430,22-17,0,stage,"stage",1,2,"doForever"
10541430,21-14,1,sprite,"Tree_3",1,0,"whenGreenFlag"
10541430,21-14,1,sprite,"Tree_3",1,1,"show"
10541430,21-14,1,sprite,"Tree_3",1,2,"goBackByLayers:",,100
10541430,21-14,1,sprite,"Tree_3",1,3,"ypos:",,0
10541430,21-14,1,sprite,"Tree_3",1,4,"setSizeTo:",,100
10541430,21-14,1,sprite,"Tree_3",7,10,"readVariable","x"
10541430,21-14,1,sprite,"Tree_3",6,9,"x",0.1
10541430,21-14,1,sprite,"Tree_3",5,8,"%",800
10541430,21-14,1,sprite,"Tree_3",4,7,"+",-400
10541430,21-14,1,sprite,"Tree_3",3,6,"xpos:"
10541430,21-14,1,sprite,"Tree_3",1,5,"doForever"
10541430,21-14,2,sprite,"Tree_2",1,0,"whenGreenFlag"
10541430,21-14,2,sprite,"Tree_2",1,1,"show"
10541430,21-14,2,sprite,"Tree_2",1,2,"goBackByLayers:",,100
10541430,21-14,2,sprite,"Tree_2",1,3,"ypos:",,800
10541430,21-14,2,sprite,"Tree_2",1,4,"setSizeTo:",,307.692
10541430,21-14,2,sprite,"Tree_2",7,10,"readVariable","x"
10541430,21-14,2,sprite,"Tree_2",6,9,"x",0.6
10541430,21-14,2,sprite,"Tree_2",5,8,"%",3200
10541430,21-14,2,sprite,"Tree_2",4,7,"+",-1600
10541430,21-14,2,sprite,"Tree_2",3,6,"xpos:"
10541430,21-14,2,sprite,"Tree_2",1,5,"doForever"
10541430,14-18,3,sprite,"Scratch Cat",1,0,"whenGreenFlag"
10541430,14-18,3,sprite,"Scratch Cat",3,2,"wait:elapsed:from:",,0.02
10541430,14-18,3,sprite,"Scratch Cat",3,3,"nextCostume"
10541430,14-18,3,sprite,"Scratch Cat",1,1,"doForever"
10541430,83-290,4,sprite,"Scratch Cat",1,0,"setSizeTo:",,50
10541430,83-290,4,sprite,"Scratch Cat",1,1,"gotoX:y:",,-195,-123
10541430,83-290,4,sprite,"Scratch Cat",1,2,"clearPenTrails"
10541430,83-290,4,sprite,"Scratch Cat",1,3,"lookLike:",,"Walk1"
10541430,83-290,4,sprite,"Scratch Cat",3,5,"stampCostume"
10541430,83-290,4,sprite,"Scratch Cat",3,6,"changeXposBy:",,55
10541430,83-290,4,sprite,"Scratch Cat",3,7,"nextCostume"
10541430,83-290,4,sprite,"Scratch Cat",1,4,"doRepeat",,8
10541430,83-290,4,sprite,"Scratch Cat",1,8,"setSizeTo:",,120
10541430,83-290,4,sprite,"Scratch Cat",1,9,"gotoX:y:",,0,55
10541430,21-14,5,sprite,"grass3",1,0,"whenGreenFlag"
10541430,21-14,5,sprite,"grass3",1,1,"ypos:",,0
10541430,21-14,5,sprite,"grass3",6,6,"readVariable","x"
```

**Flattened  
into csv**

**Available on GitHub!**

<https://github.com/TUdelftScratchLab/ScratchDataset>

What we found...



**Many programs  
are small...**



# Median program

Scratch editor interface for a project titled "Drawing for dummies #2". The main workspace shows a drawing of a flower with a red outline and a cyan fill. The script area contains the following code:

```
when clicked clicked
hide

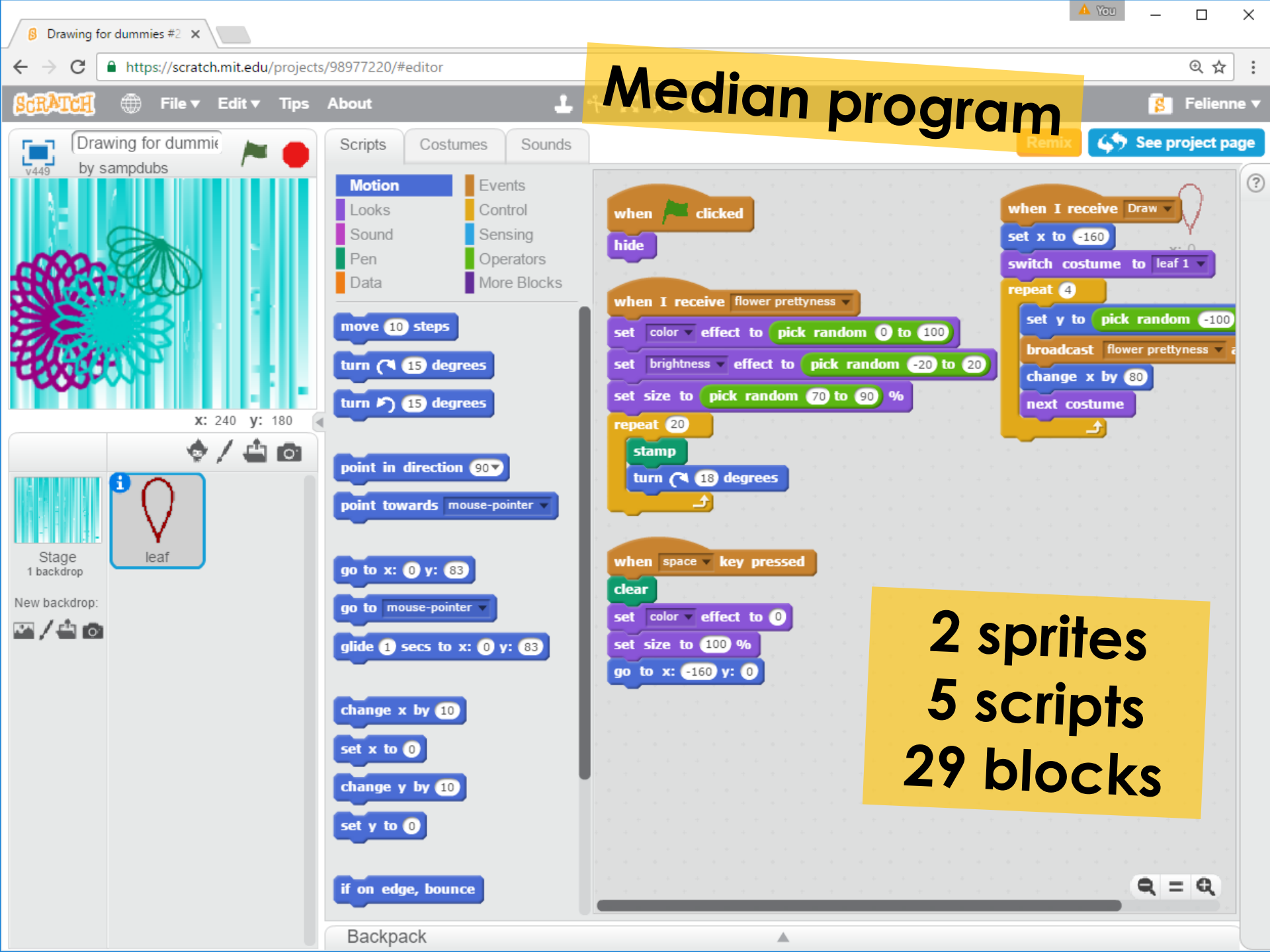
when I receive flower prettyness
set color effect to pick random 0 to 100
set brightness effect to pick random -20 to 20
set size to pick random 70 to 90 %
repeat 20
stamp
turn 18 degrees

when space key pressed
clear
set color effect to 0
set size to 100 %
go to x: -160 y: 0

when I receive Draw
set x to -160
switch costume to leaf 1
repeat 4
set y to pick random -100
broadcast flower prettyness
change x by 80
next costume
```

The left sidebar shows the "Scripts" tab with various block categories: Motion, Looks, Sound, Pen, Data, Events, Control, Sensing, Operators, and More Blocks. The "Backpack" area shows a costume named "leaf" with a red outline.

# Median program



2 sprites  
5 scripts  
29 blocks

Most programs  
are simple...

```
when green flag clicked
  set x to 0
  set y to 0
```

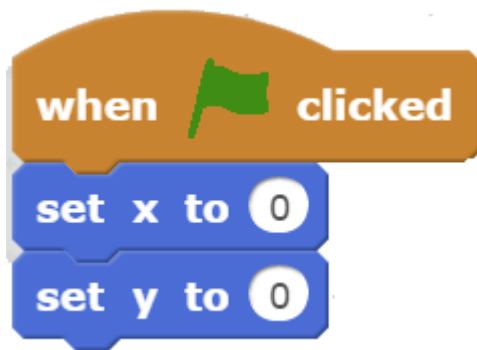
Cyclomatic  
complexity: 1

```
when green flag clicked
  if touching edge ? then
    set x to 0
  set y to 0
```

Cyclomatic  
complexity: 2



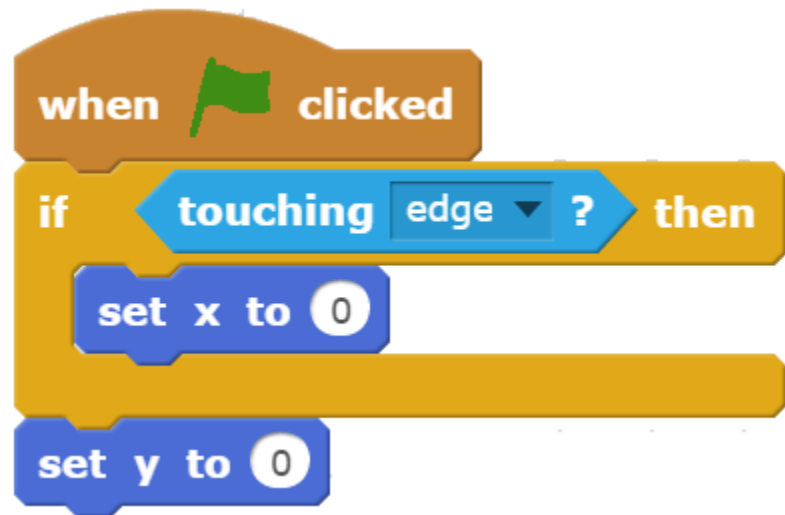
Most programs  
are simple...



```
when green flag clicked
  set x to 0
  set y to 0
```

78%

Cyclomatic  
complexity: 1



```
when green flag clicked
  if touching edge ? then
    set x to 0
  set y to 0
```

Cyclomatic  
complexity: 2

# Loops



# Loops



in 77% of projects

# Loops

```
repeat until touching edge ?  
  move 10 steps
```

12%

52%

```
forever  
  move 10 steps
```

```
repeat 10  
  move 10 steps
```

36%

# Interaction

when  key pressed

when this sprite clicked

key  pressed?

ask  and wait

mouse down?

mouse x

mouse y

when  >

video  on

# Interaction

In 56% of projects



```
when space key pressed
when this sprite clicked
key space pressed?
ask What's your name? and wait
mouse down?
mouse x
mouse y
when loudness > 10
video motion on this sprite
```

# Variables

```
set x to 0
```

```
if x = 0 then
```

```
change x by 1
```

```
show variable x
```

```
hide variable x
```

# Variables

set  to

if  =  then

change  by

show variable

hide variable

In 33% of projects

>4 in 7% of projects



# Procedures

```
when space key pressed  
  countdown
```

```
define countdown  
  set y to 10  
  repeat 10  
    say y for 1 secs  
    change y by -1
```

# Procedures

In 8% of projects




```
when space key pressed  
  countdown
```



```
define countdown  
  set y to 10  
  repeat 10  
    say y for 1 secs  
    change y by -1
```

# Procedures

In 8% of projects



```
when space key pressed  
  countdown
```

62% only invoked once



```
define countdown  
  set y to 10  
  repeat 10  
    say y for 1 secs  
    change y by -1
```

**Many programs  
are small & simple**



**But....**



300 variables  
300 procedures  
100 events

transparent paper i  
by Shuyan121

New Game  
Load Game  
Example Worlds  
Help...?

WASD Move, Jump and Switch  
Space Place or Dig blocks  
Click to destroy or Check  
Set the seed here.  
Space Dropping blocks from a stack  
Enter ID Save the game  
to paste object to instance.  
? Mouse click looking for tools or formula view  
the mouse cursor over it and press E.

Credits: This is a fan made OC. Microsoft, Game, all original artwork and concepts belong to Mojang.  
Images that are played by this in the code development of Scratch that people might be introduced to  
the Minecraft world, all you like, and please note that please refer to minecraft.net.

x: 240 y: 180

Stage  
1 backdrop

New backdrop:

selected Creative...  
Menu1 Splash\_s...  
Menu2 Save Game  
Random!  
Commands Pseudora...  
Stage Sn snow

Scripts Costumes Sounds

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

Make a Block

- Save Basic Player Data
- Get Level Stats
- Save Inventory
- Save Containers
- Load Inventory 1 1
- Load Containers 1
- Read String
- Clear Down Level
- Get Save Level Chunk Index
- Restore Level Chunk
- Save Level Chunk
- Save Game
- Read Raw
- Load Basic Player Data
- Load Preset World

```

when I receive Green Flag
  go to x: 0 y: 0
  hide list _SAVE_LIST
  delete all of SaveChunks
  Show Example World List
  hide

when I receive Load Game
  Load Game

when I receive Save Game
  wait until not key pressed?
  Save Game
  switch costume to Saved
  wait until key pressed?
  delete all of _SAVE_LIST
  hide list _SAVE_LIST
  hide
  wait until not key pressed?

when I receive Load Example
  Load Game not

hide list DEBUG

delete all of DEBUG
show list DEBUG

define Save Game
  if _CHUNK_SEED > 0 then
    Save Level Chunk
  switch costume to Saving
  show
  to front
  
```

**And what  
about smells?**



# Duplicated Code

```
when this sprite clicked
  show
  repeat 3
    switch costume to fish - open
    wait 1 secs
    switch costume to fish - closed
  move 5 steps
```

```
when I receive start
  play sound chomp
  if mouse down? then
    show
    repeat 2
      switch costume to fish - closed
      wait 0.3 secs
      switch costume to fish - open
    move 5 steps
```



# Duplicated Code

```
when this sprite clicked
  show
  repeat 3
    switch costume to fish - open
    wait 1 secs
    switch costume to fish - closed
  move 5 steps
```

```
when I receive start
  play sound chomp
  if mouse down? then
    show
    repeat 2
      switch costume to fish - closed
      wait 0.3 secs
      switch costume to fish - open
    move 5 steps
```

# Duplicated Code

```
when this sprite clicked
  show
  repeat 3
    switch costume to fish - open
    wait 1 secs
    switch costume to fish - closed
  move 5 steps
```

```
when I receive start
  play sound chomp
  if mouse down? then
    show
    repeat 2
      switch costume to fish - closed
      wait 0.3 secs
      switch costume to fish - open
    move 5 steps
```

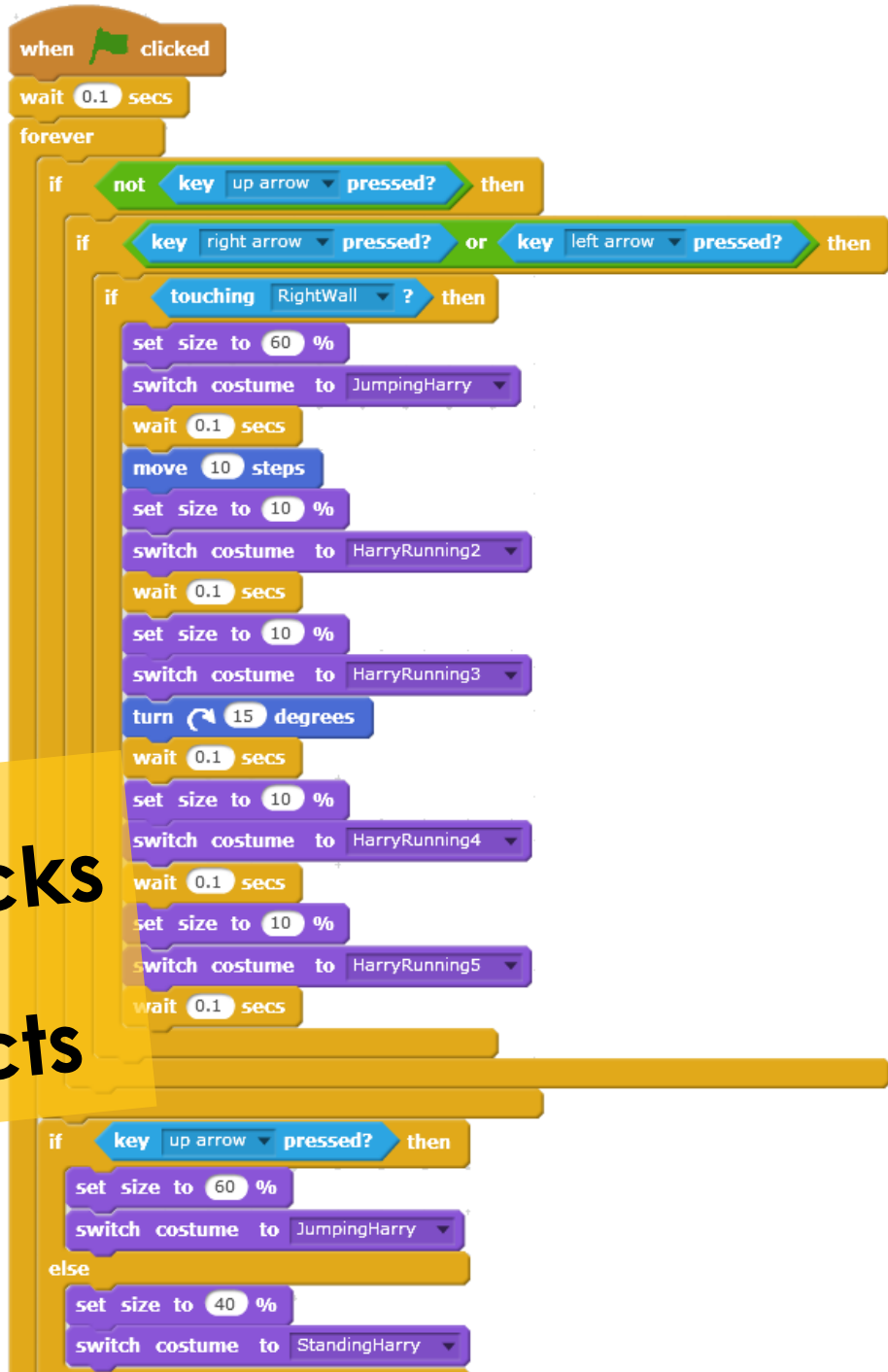
Across sprites: in **26%** of the projects  
Within sprites: in **10%** of the projects

# Large Script

```
when clicked
  wait 0.1 secs
  forever
    if not key up arrow pressed? then
      if key right arrow pressed? or key left arrow pressed? then
        if touching RightWall ? then
          set size to 60 %
          switch costume to JumpingHarry
          wait 0.1 secs
          move 10 steps
          set size to 10 %
          switch costume to HarryRunning2
          wait 0.1 secs
          set size to 10 %
          switch costume to HarryRunning3
          turn 15 degrees
          wait 0.1 secs
          set size to 10 %
          switch costume to HarryRunning4
          wait 0.1 secs
          set size to 10 %
          switch costume to HarryRunning5
          wait 0.1 secs
        else
          if key up arrow pressed? then
            set size to 60 %
            switch costume to JumpingHarry
          else
            set size to 40 %
            switch costume to StandingHarry
```

# Large Script

scripts with  $>18$  blocks  
in 30% of the projects



```
when clicked
wait 0.1 secs
forever
  if not key up arrow pressed? then
    if key right arrow pressed? or key left arrow pressed? then
      if touching RightWall ? then
        set size to 60 %
        switch costume to JumpingHarry
        wait 0.1 secs
        move 10 steps
        set size to 10 %
        switch costume to HarryRunning2
        wait 0.1 secs
        set size to 10 %
        switch costume to HarryRunning3
        turn 15 degrees
        wait 0.1 secs
        set size to 10 %
        switch costume to HarryRunning4
        wait 0.1 secs
        set size to 10 %
        switch costume to HarryRunning5
        wait 0.1 secs
      else
        set size to 40 %
        switch costume to StandingHarry
    else
      set size to 60 %
      switch costume to JumpingHarry
```

The image shows a Scratch script starting with a 'when clicked' event. It includes a 0.1-second wait block, followed by a 'forever' loop. Inside the loop, there are several nested 'if' statements. The first 'if' checks if the 'up arrow' key is not pressed. If true, it enters another 'if' block that checks if either the 'right arrow' or 'left arrow' key is pressed. This second 'if' block contains a third 'if' block that checks if the character is touching a 'RightWall'. If touching, it performs a sequence of actions: set size to 60%, switch to 'JumpingHarry' costume, wait 0.1s, move 10 steps, set size to 10%, switch to 'HarryRunning2' costume, wait 0.1s, set size to 10%, switch to 'HarryRunning3' costume, turn 15 degrees, wait 0.1s, set size to 10%, switch to 'HarryRunning4' costume, wait 0.1s, set size to 10%, switch to 'HarryRunning5' costume, and wait 0.1s. If not touching the wall, it sets size to 40% and switches to 'StandingHarry' costume. If the 'up arrow' key is pressed, it sets size to 60% and switches to 'JumpingHarry' costume.

# Dead Code

1

```
if key space pressed? then
  broadcast start
```

2

```
when space key pressed
```

3

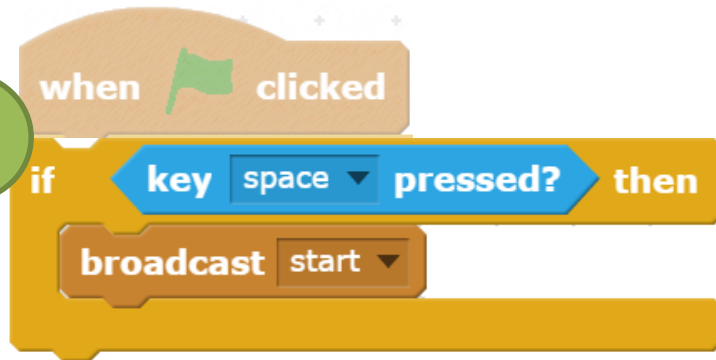
```
define init
  set y to 0
  set y to 0
```

4

```
when I receive gameOver
  say 2 slides to go!
```

# Dead Code

1



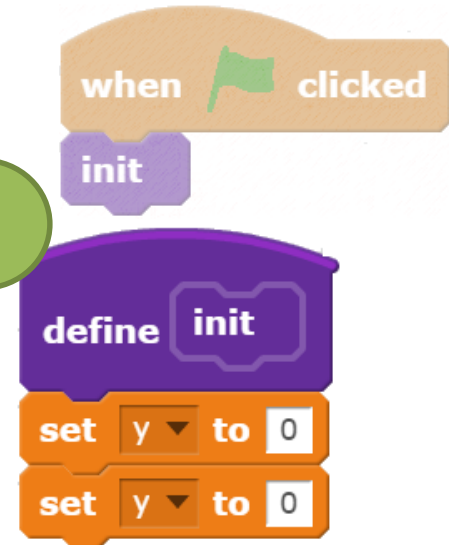
```
when clicked
if key space pressed? then
  broadcast start
```

2



```
when space key pressed
  move 10 steps
```

3



```
when clicked
  init
define init
  set y to 0
  set y to 0
```

4



```
when this sprite clicked
  broadcast gameOver
when I receive gameOver
  say 2 slides to go!
```

# Dead Code

24%

1

```
if key space pressed? then
  broadcast start
```

1%

3

```
define init
  set y to 0
  set y to 0
```

24%

2

```
when space key pressed
```

8%

4

```
when I receive gameOver
  say 2 slides to go!
```

# Dead Code

Any: 28% of the projects

24%

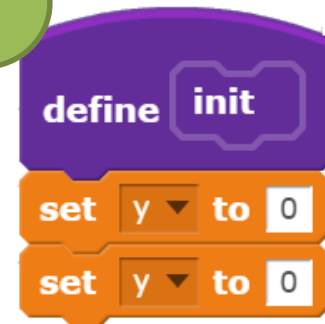
1



```
if key space pressed? then  
  broadcast start
```

1%

3



```
define init  
  set y to 0  
  set y to 0
```

24%

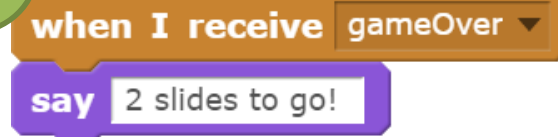
2



```
when space key pressed
```

8%

4



```
when I receive gameOver  
  say 2 slides to go!
```



In summary...



x: 240 y: -180

Stage 1 backdrop

New backdrop: Ladybug2 GAME OVER

Giga Muur

Scripts

move 10 steps

turn 15 degrees

turn 15 degrees

point in direction 90

point towards mouse-pointer

go to x: -120 y: -173

go to mouse-pointer

glide 1 secs to x: -120 y: -173

change x by 10

set x to 0

change y by 10

set y to 0

if on edge, bounce

when green flag clicked

forever

if key right arrow pressed? then

if touching Muur? and y position < -120 then

play sound pop

else

if x position > 0 then

broadcast schuiven maar

else

change x by 3

point in direction 90

when I receive giga is if

stop all

Programs are simple

**But....**



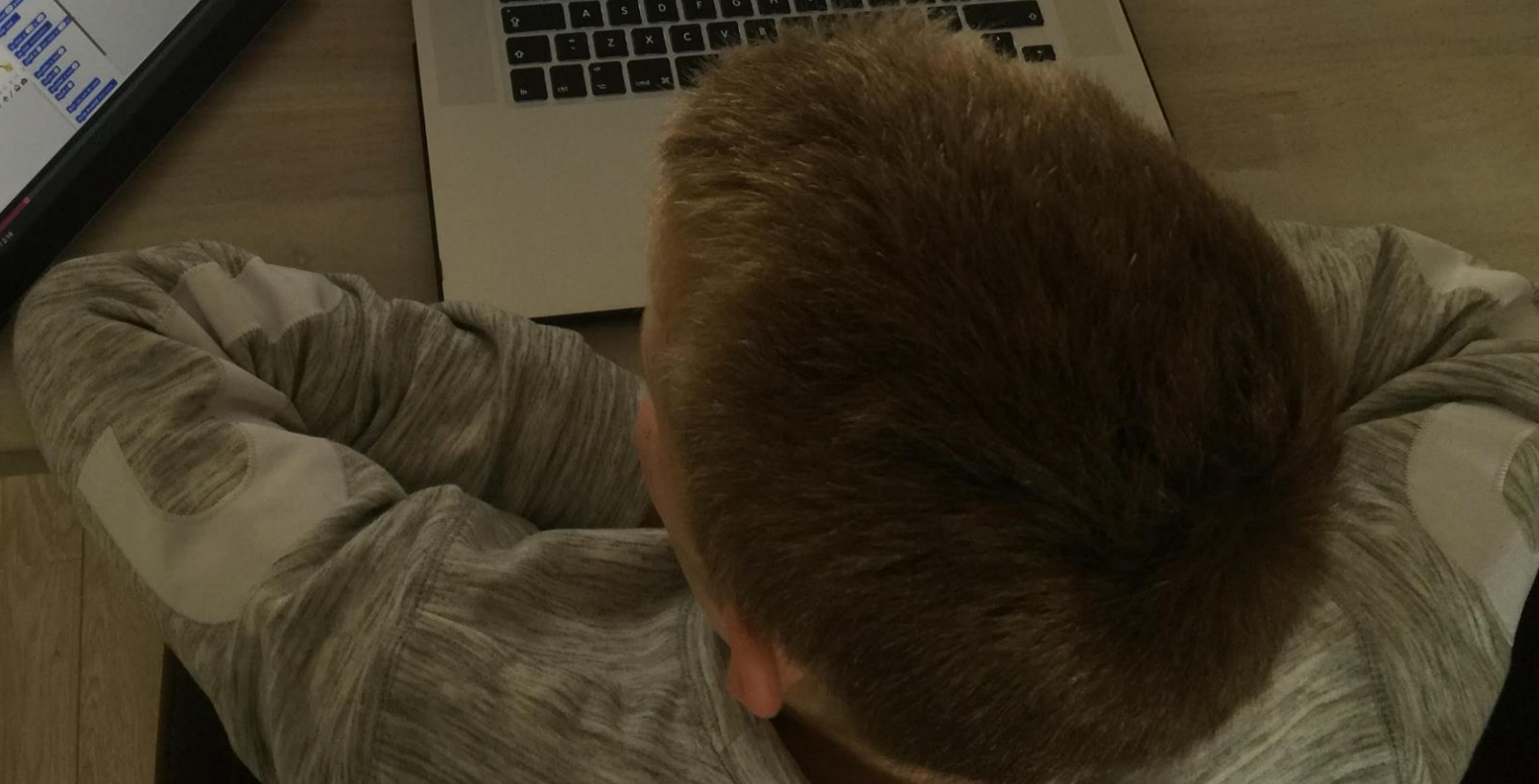
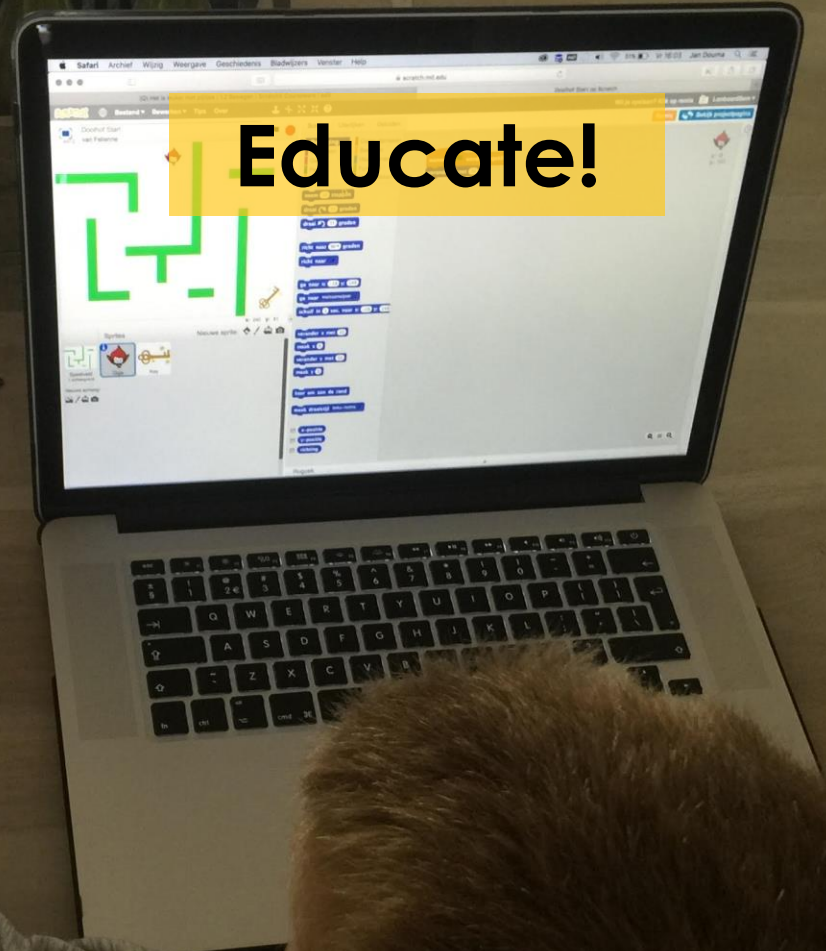
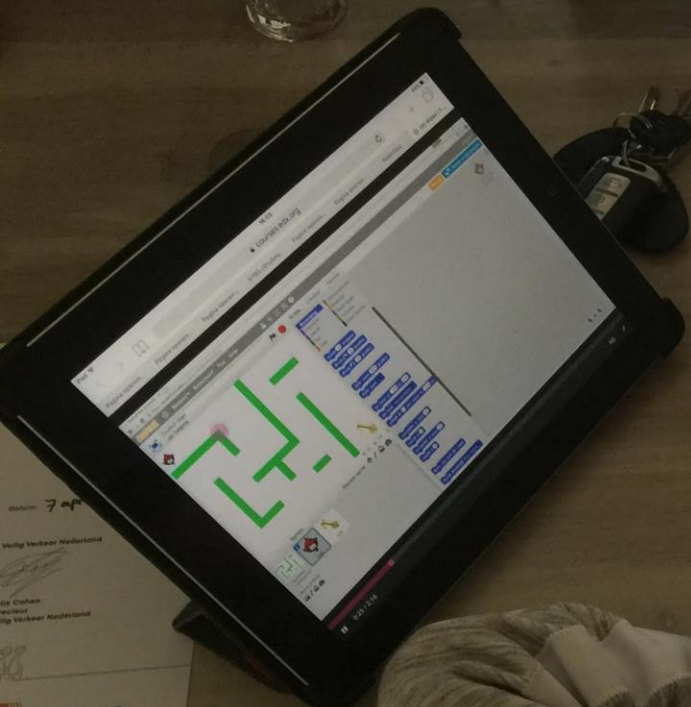
**Smells are common**



**Now what?**



Educate!

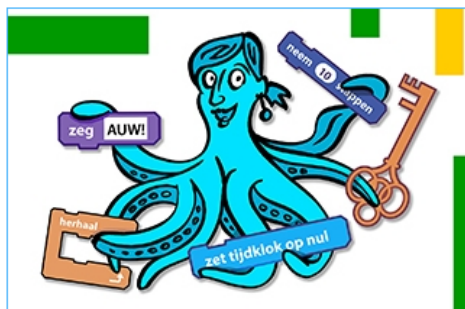


7  
Vrijl. Verkeer Nederland  
Eis Cohen  
Verkeer  
Vrij Verkeer Nederland  
GVERKEER





Home &gt; All Subjects &gt; Computer Science &gt; Scratch: Programmeren voor kinderen (8+)



## Scratch: Programmeren voor kinderen (8+)

In deze gratis cursus leer je spelenderwijs programmeren. Maak je eigen games met Scratch, terwijl je leert hoe je op een nette manier programmeert



Self-Paced

[Enroll Now](#)

- I would like to receive email from Delft University of Technology (TU Delft) and learn about other offerings related to Scratch: Programmeren voor kinderen (8+).

### About this course

1 Reviews 4.5/5 ★★★★★

Programmeren is steeds belangrijker in onze wereld. En jong geleerd is oud gedaan. Deze MOOC bevat filmpjes en opdrachten waarmee kinderen zelf kunnen leren programmeren.

Iedere week maken we samen een game: een doolhof, een aquarium, een Flappy Bird spel en een soort Super Mario

[See more](#)

### What you'll learn

- Programmeren in Scratch
- Algemene programmeerconcepten (lussen, variabelen, datastructuren)

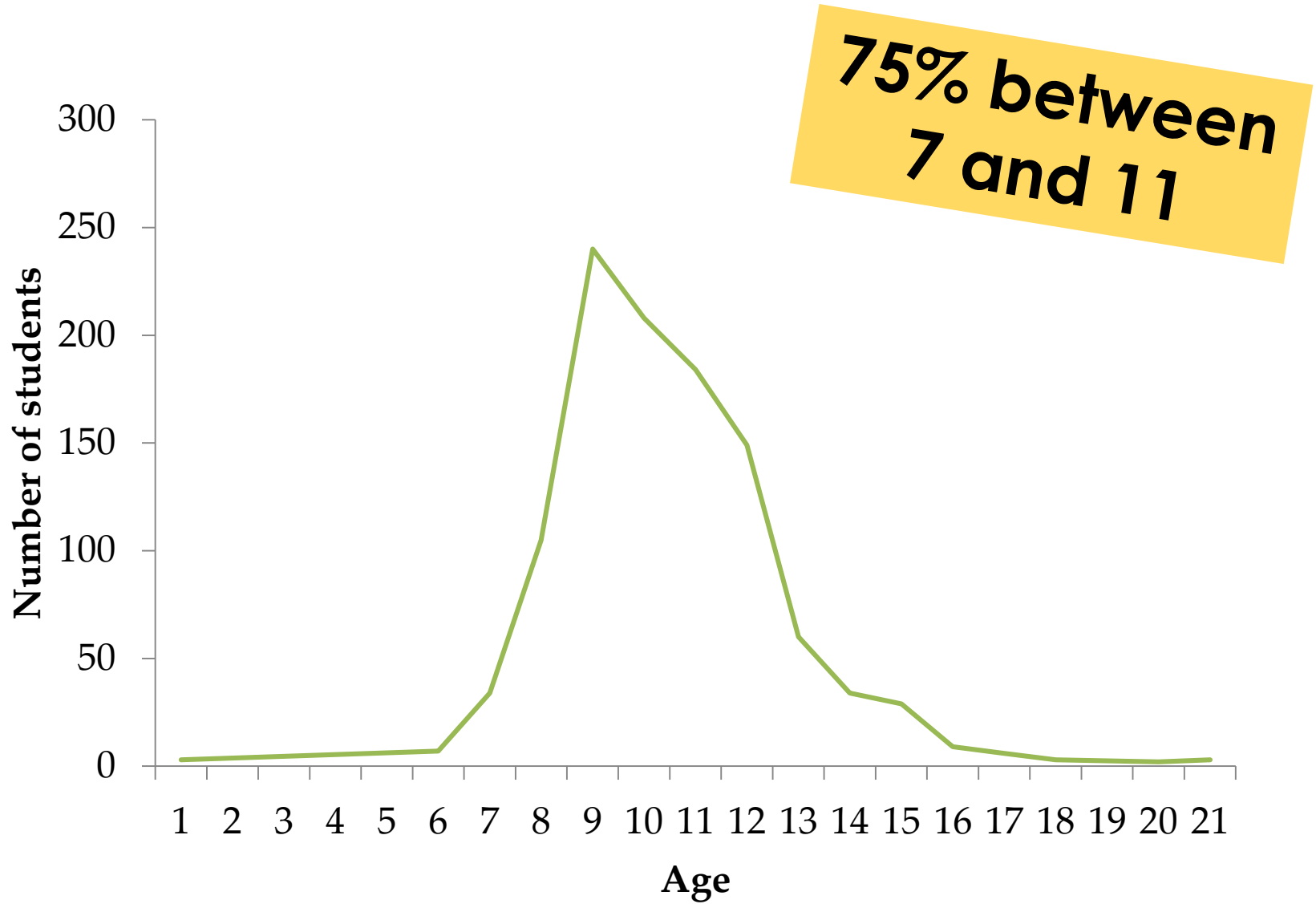
### Meet the instructor

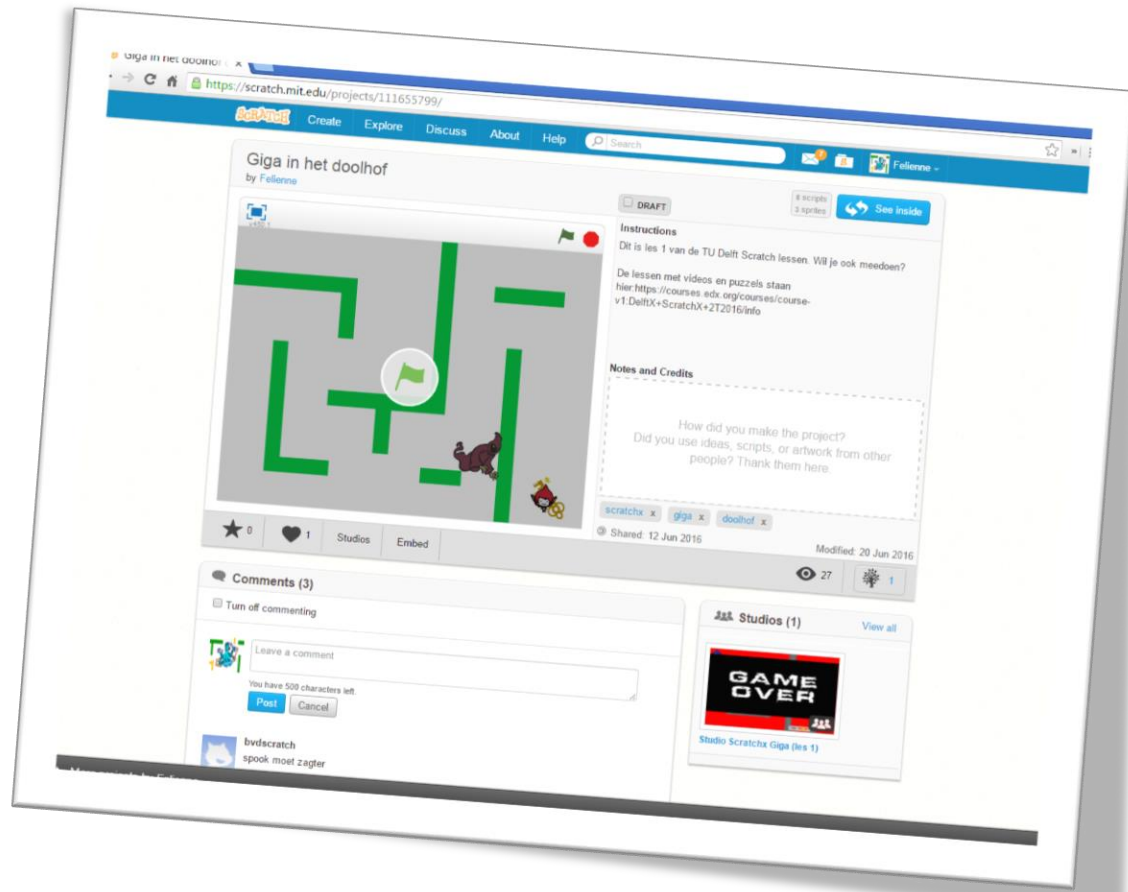
**Over 3000  
kids enrolled**

🕒 Length:	6 weken
🕒 Effort:	2-6 uur per week
🏛️ Institution:	DelftX
🎓 Subject:	Computer Science
⚙️ Level:	Introductory
🗨️ Languages:	Nederlands
📄 Video Transcripts:	Nederlands

Share this course with a friend

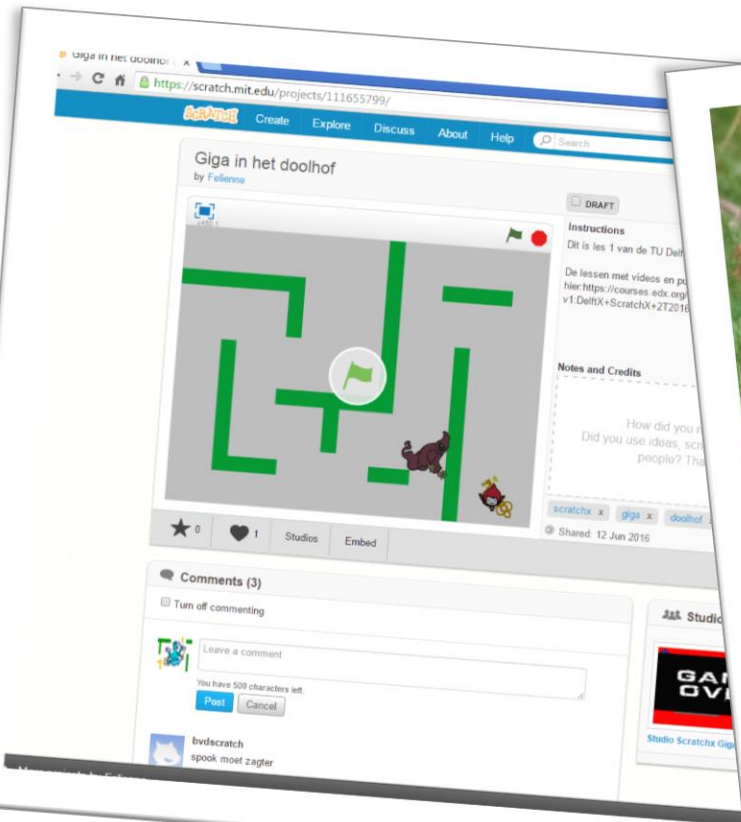
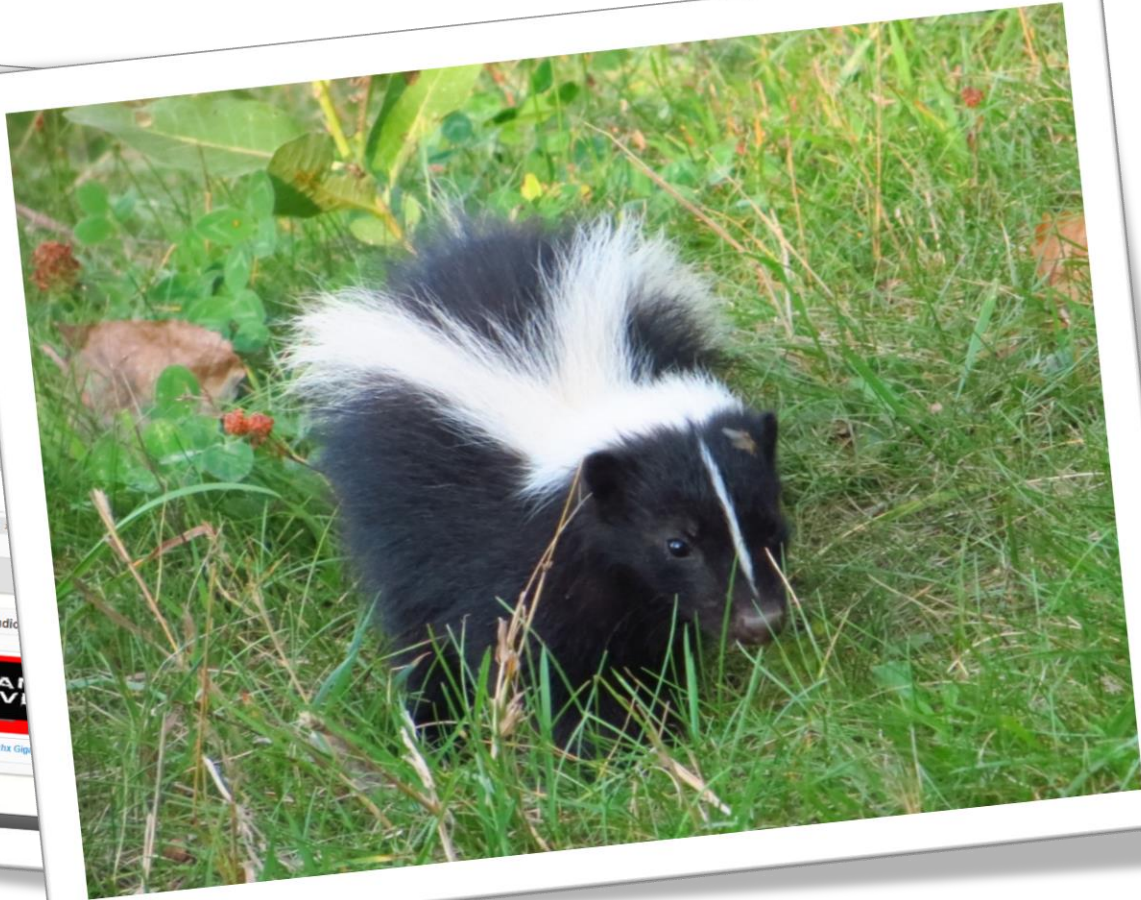






**What kids thought  
they learned**





**What they  
really learned**

# The course includes tests



## Deel 4

[VIEW UNIT IN STUDIO](#)

[Bookmark this page](#)

### Vraag 20

1/1 point (graded)

Kijk naar dit programma:



Je duwt op de groene vlag. Wat is de x op het einde van het programma?

10

100

110 ✓

# About programming and smells!

# The course includes tests

SUBMISSION HISTORY

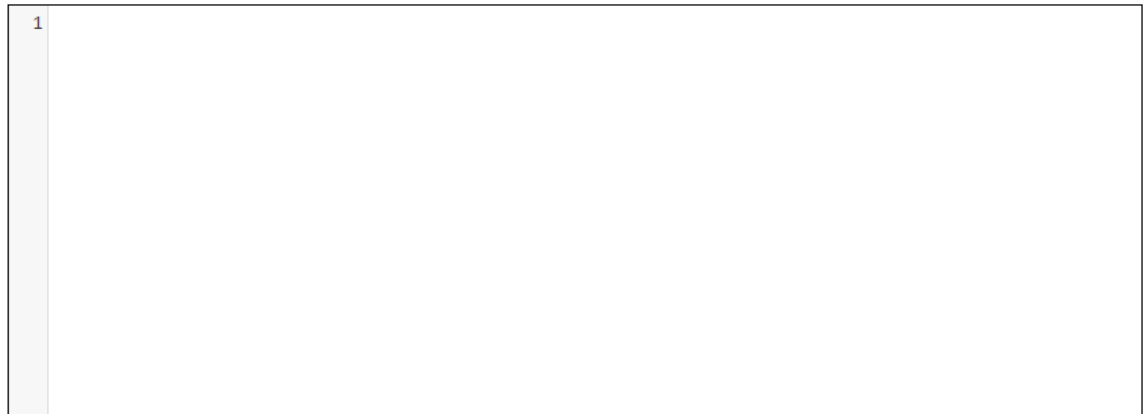
STAFF DEBUG INFO

En wat moet er af?

1 point possible (graded)

Maar, je kunt ook een blokje weghalen. Welk blokje en waar?

1



Press ESC then TAB or click outside of the code editor to exit

Unanswered

Submit

Show Answer

# About programming *and smells!*

**Are smells harder  
to learn?**



**Are smells harder  
to learn?**

**Nope!**



# Smells are not harder than Coding!

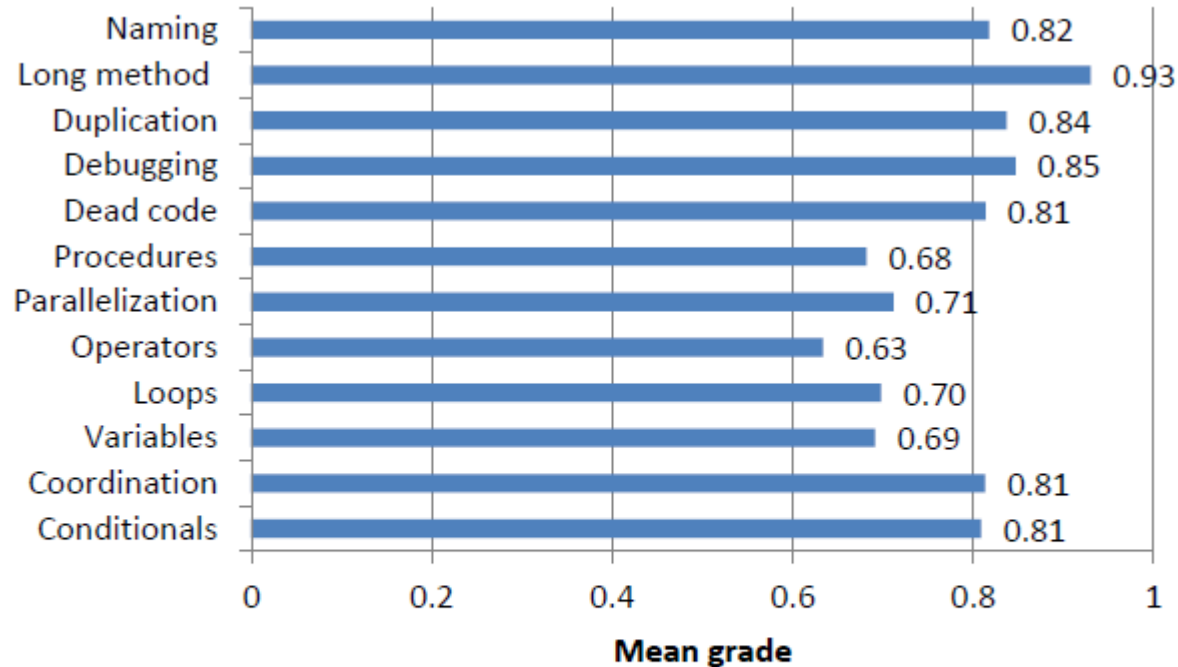


Fig. 4. Mean grade of all student answers (first attempts) to all questions corresponding to different programming and software engineering concepts

# Smells are not harder than Coding!

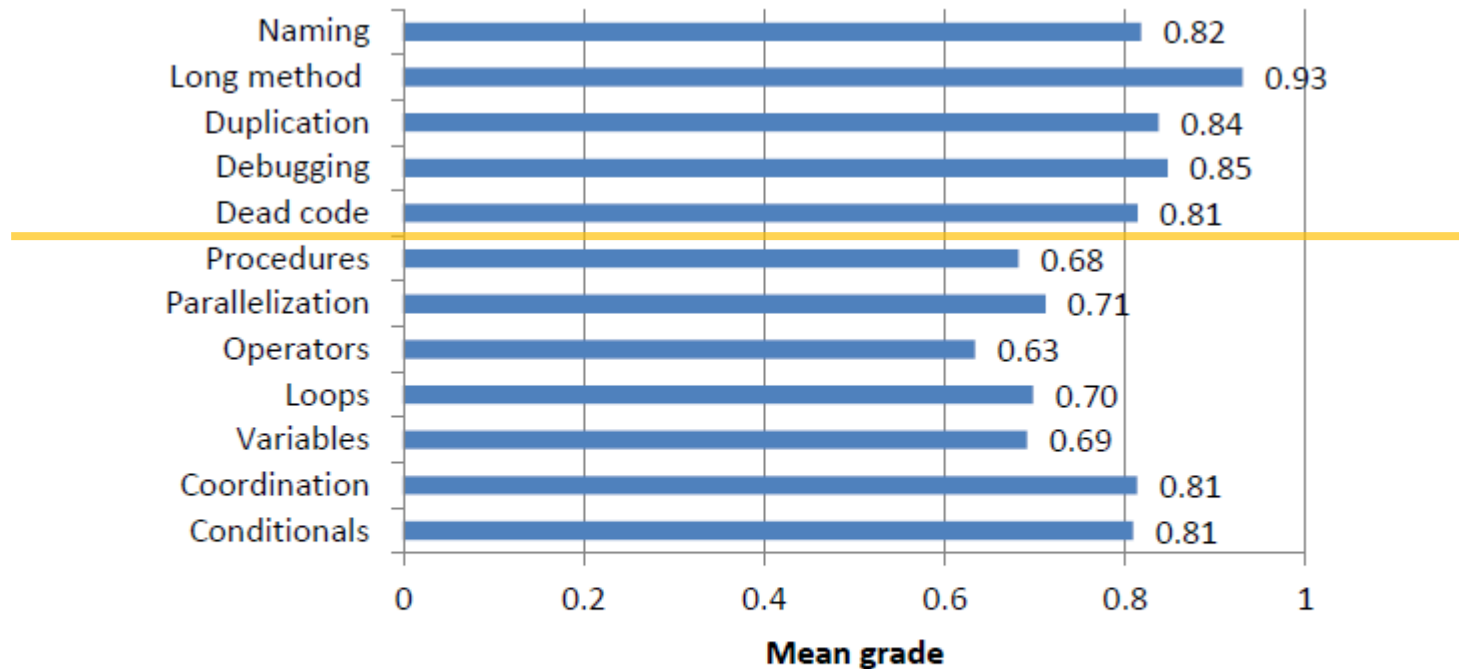
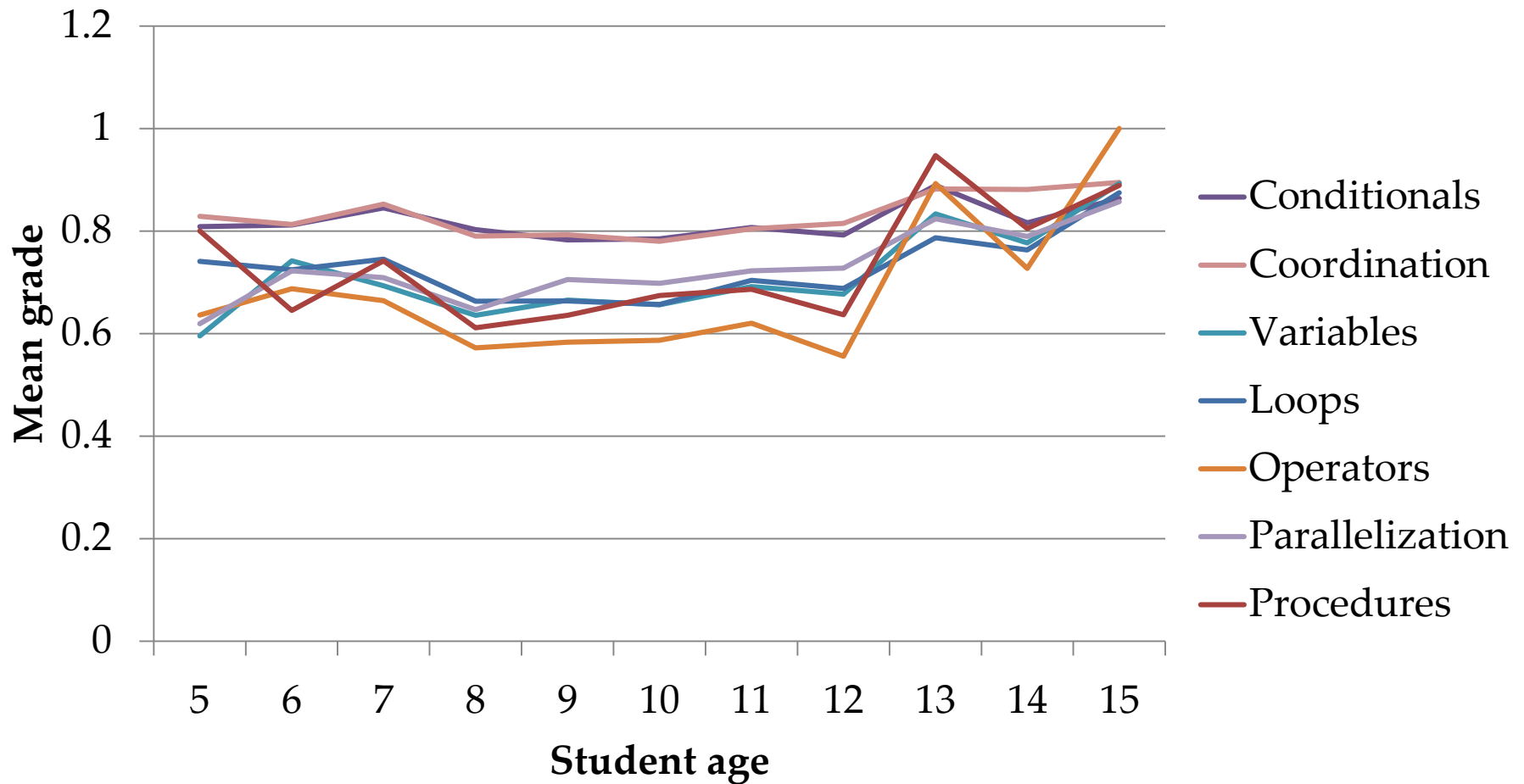


Fig. 4. Mean grade of all student answers (first attempts) to all questions corresponding to different programming and software engineering concepts

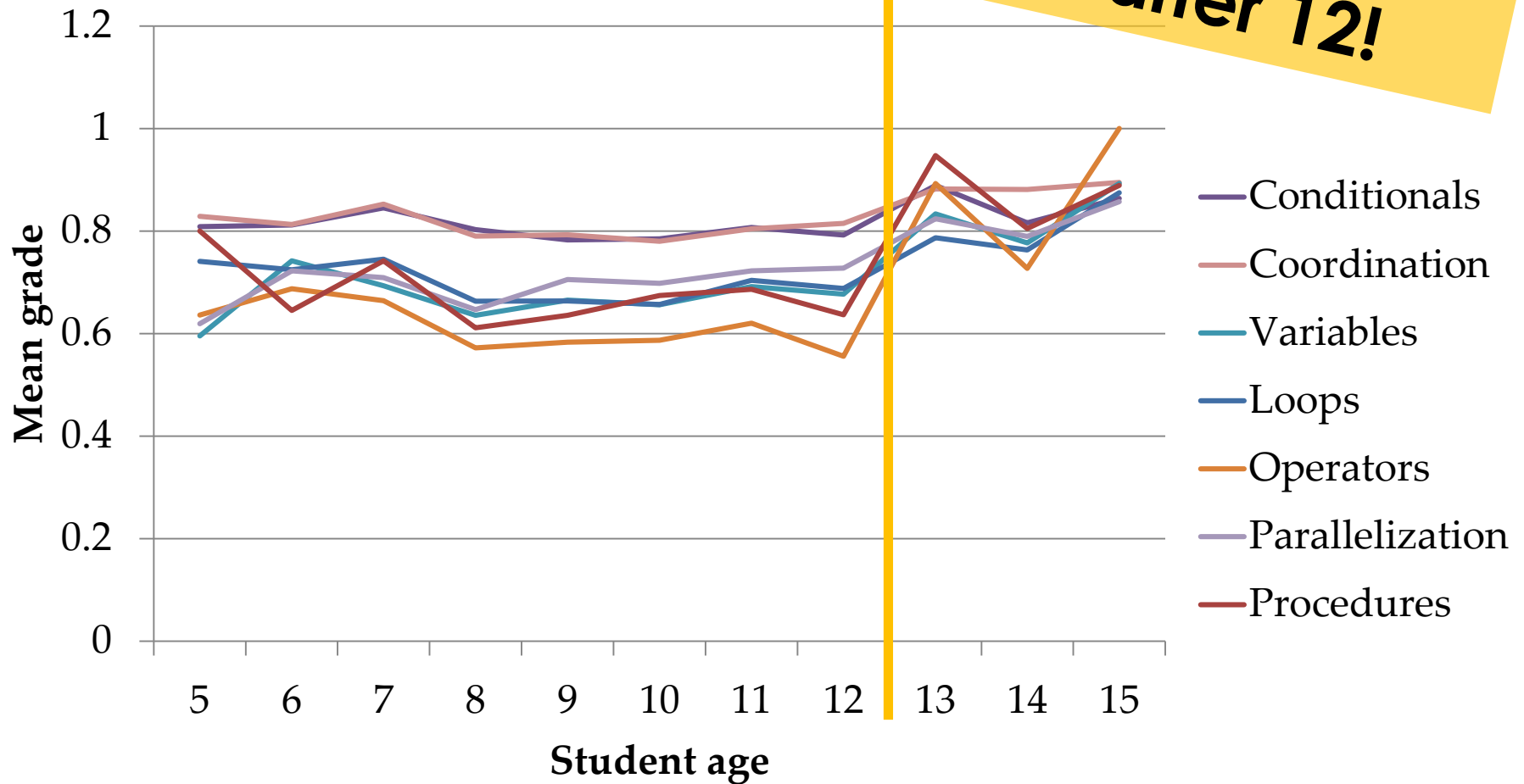
# Some coding concepts are harder though





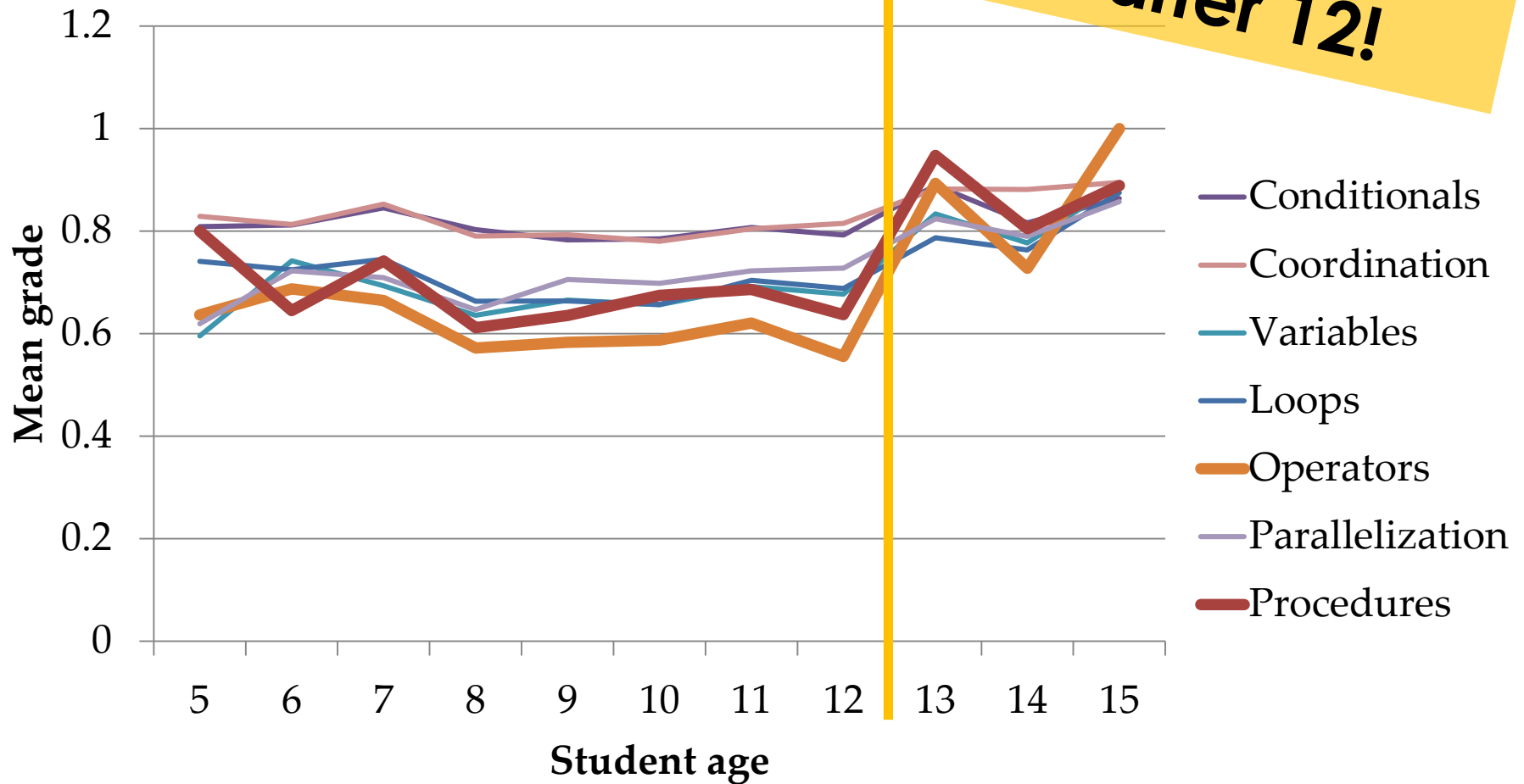
**Some coding concepts  
are harder though**

**Get easier  
after 12!**



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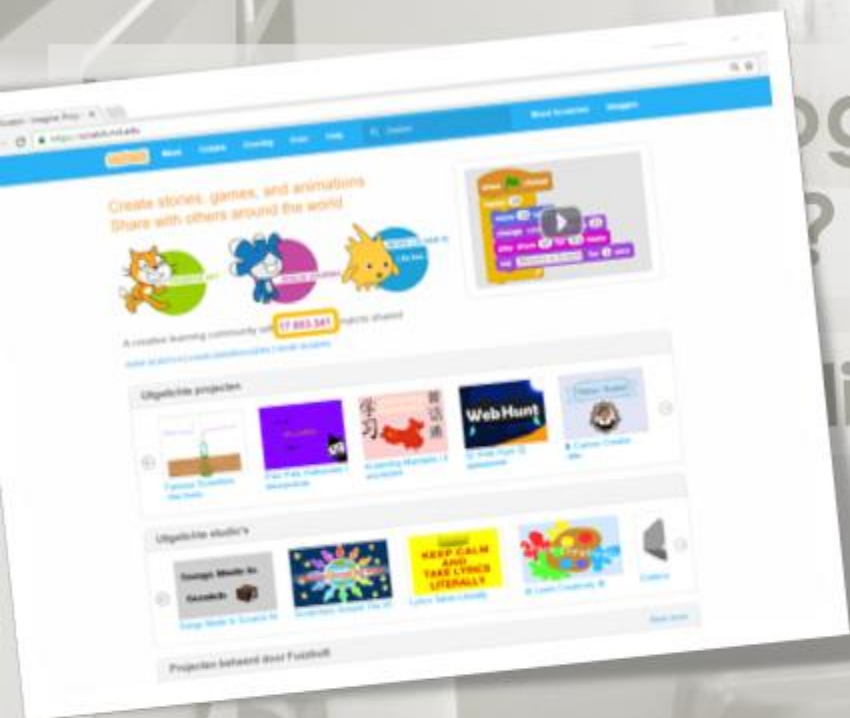
**Get easier  
after 12!**



# How Do Kids Program in the Wild?

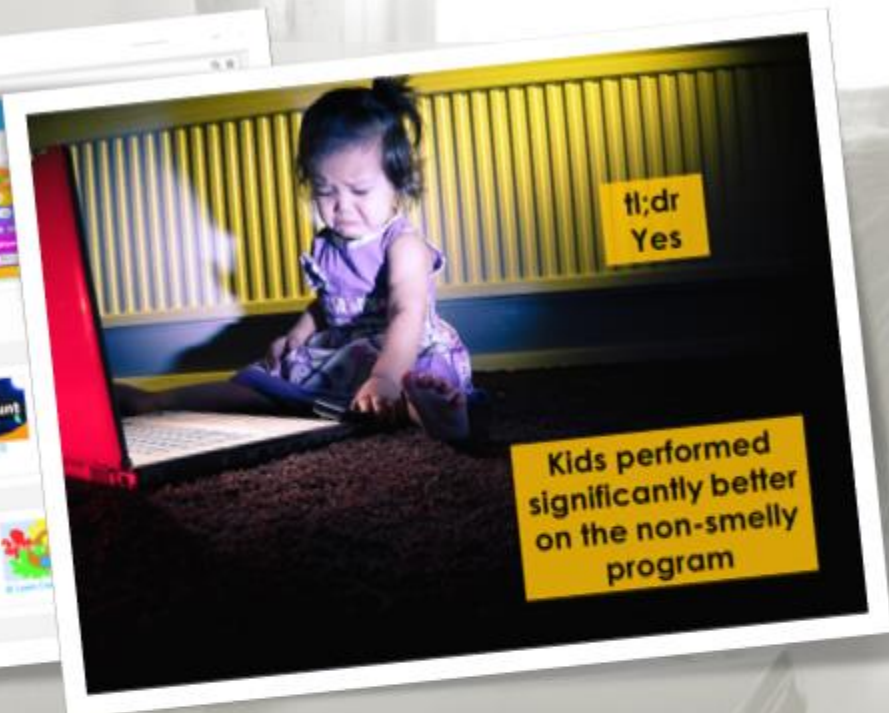
@Feliienne





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# How do kids program in the wild?

@Felienne

## More info?

- [www.felienne.com/onderzoek-naar-scratch](http://www.felienne.com/onderzoek-naar-scratch)
- [github.com/TUDELFTScratchLab](https://github.com/TUDELFTScratchLab)

## Want to connect?

- [mail@felienne.com](mailto:mail@felienne.com)

Many programs are small...

Smells are common

Smells are not harder than Coding!



Fig. 4. Mean grade of all student answers (first attempts) to all questions corresponding to different programming and software engineering concepts



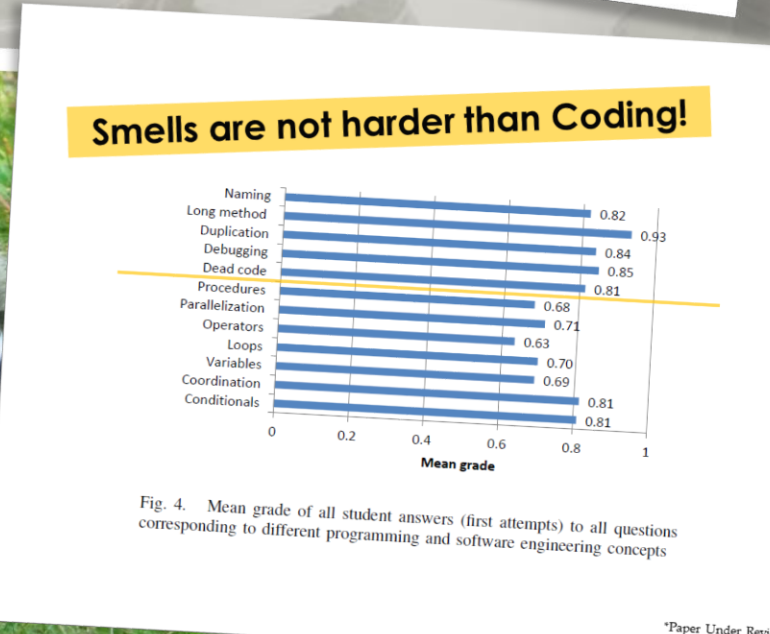
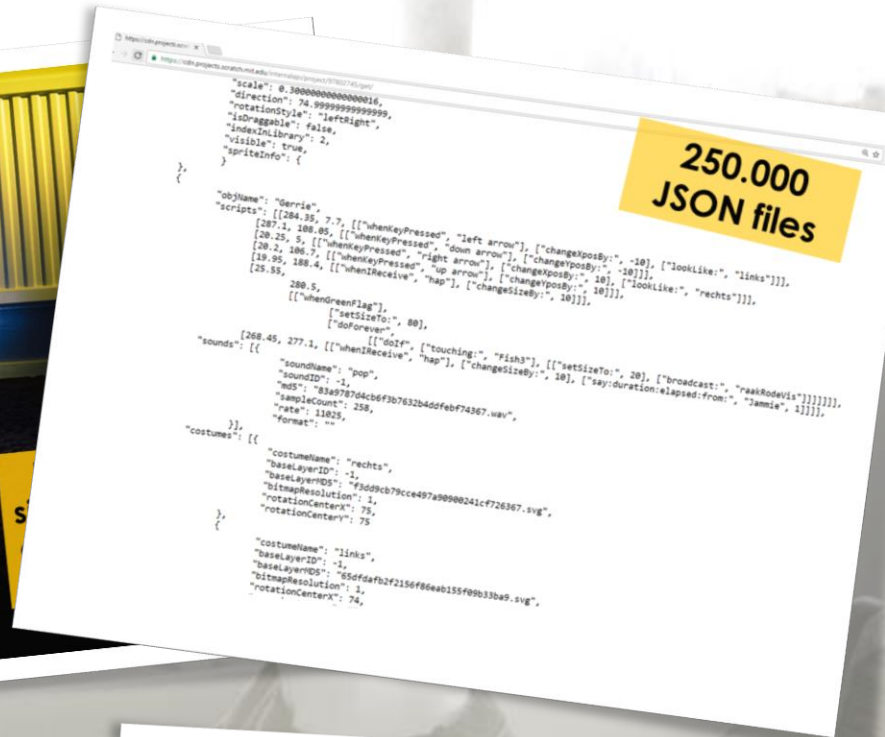
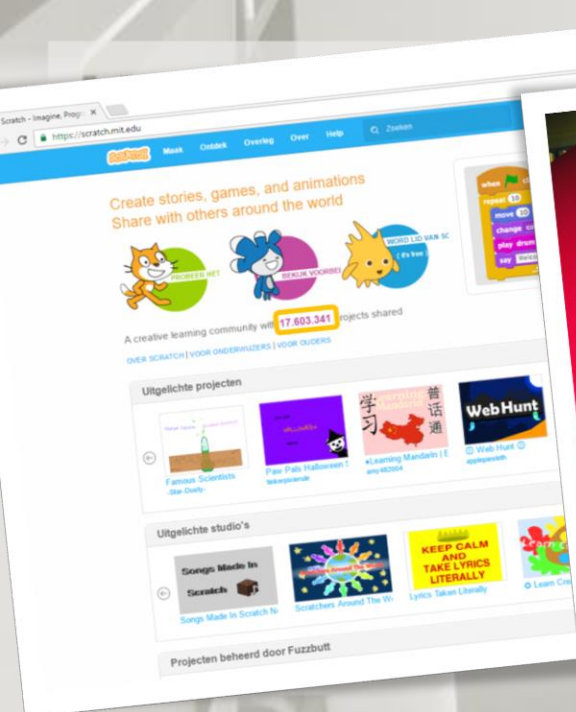


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