How Kids Code and How We Know

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

TRY IT OUT
SEE EXAMPLES
JOIN SCRATCH (it's free)

A creative learning community with 16,266,327 projects shared

ABOUT SCRATCH | FOR EDUCATORS | FOR PARENTS

Featured Projects

Pointillism: an Introduction and Tutorial
Pixel Level Maker!
Illusyum (v1.0.3)
Pinboard About Me
Lost Boy MAP
Fish Chomp - Starter Project
by mchung

Sprites

when flag clicked
switch costume to fish - open
forever
if distance to mouse-pointer > 10 then
point towards mouse-pointer
move 5 steps

when I receive got-me
play sound chomp
repeat 2
switch costume to fish - closed
wait 0.3 secs
switch costume to fish - open

change x by 10
cat x to 0
change y by 10
set y to 0
if on edge, bounce
Fish Chomp - Starter Project
by mchung

Scripts

when green flag clicked
switch costume to fish-open
forever
if distance to mouse-pointer > 10 then
  point towards mouse-pointer
  move 5 steps
end if
play sound chomp
repeat 2
  switch costume to fish-closed
  wait 0.3 secs
  switch costume to fish-open
end repeat

when I receive got-me
change x by 10
change y by 10
if on edge, bounce

change x by 10
cat x to 0
change y by 10
set y to 0
Community statistics at a glance

28,408,573 projects shared,
24,785,274 users registered,
142,624,859 comments posted,
4,117,795 studios created

...and growing!
How do kids code in Scratch?
How do kids code in Scratch?

Size & complexity

Concepts & features

Code smells
How do we find out?
Getting the projects data

Scratch web interface

Scrape

JSON files of 250K projects

Parse

CSV files of 247K projects

Scratch web interface

JSON files of 250K projects

CSV files of 247K projects
What we found

Size & complexity

Concepts & features

Code smells
Most programs are small...
Most programs are small...

75%
Up to:
5 sprites
12 scripts
76 blocks

233K non-empty projects
Median program

2 sprites
5 scripts
29 blocks
Most programs are simple...
Most programs are simple...

Cyclomatic complexity: 1

Cyclomatic complexity: 2

78%
But....
Large and complex projects exist!  
Top 5%: 20-500 sprites  
500-34K blocks
What we found

Size & complexity

Concepts & features

Code smells
in 40% of the projects
Loops

in 77% of the projects
Loops

in 77% of the projects
in 32% of the projects

>4 in 7% of the projects
in 8% of the projects
But....
Very sophisticated projects exist! Up to:
- 850 procedures
- 340 variables
- 6K conditional blocks
- 2.5K event blocks

recursive procedure calls
What we found

Size & complexity

Concepts & features

Code smells
Across sprites: in **26%** of the projects

Within sprites: in **10%** of the projects
scripts with >18 blocks in 30% of the projects
Dead code

1. if key space pressed? then
   broadcast start

2. define init
   set y to 0
   set y to 0

3. when space key pressed

4. when I receive gameOver
   say 2 slides to go!
Do smells matter to kids?
A simple game
One ‘good’ version
Two ‘smelly’ versions
Two ‘smelly’ versions

Long method

Duplicated code
Long Method Version
Do code smells matter to kids?
Kids performed significantly better on the non-smelly program.
But, differences in tasks are impacted differently.
“When have you won the game?”
“When have you won the game?”
“Make the game go to 10 points”
F. Hermans and E. Aivaloglou, Do code smells hamper novice programming? A controlled experiment on Scratch programs, *2016 IEEE 24th International Conference on Program Comprehension (ICPC)*
Smells are bad! (also for kids)

Smells are common
Educate!
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.

TU Delft

About this course

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.

What you’ll learn

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

Meet the instructor

Over 3000 kids enrolled
student profile

8 years old

Male (65%)

No programming experience (60%)

With parent
What kids thought they learned
What they really learned
http://www.katyjordan.com/MOOCproject.html
WHY, though?
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Quantile</th>
<th>Mean</th>
<th>Median</th>
<th>Quant_95</th>
<th>Histogram</th>
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<tbody>
<tr>
<td>gender</td>
<td>The gender declared in the student profile questionnaire</td>
<td>A0.00</td>
<td>2.88</td>
<td>2.00</td>
<td>7.00</td>
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<td>age</td>
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<td>alone</td>
<td>Is the student alone?</td>
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<td>-</td>
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<td>experience</td>
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<td>joined_calendar_week</td>
<td>Which week was the course in when the student first became active</td>
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<td>2.00</td>
<td>7.00</td>
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<td>forum_searches</td>
<td>Number of searches in the discussion forum in the 1st course week</td>
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<td>0.00</td>
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<td>Time the discussion forum was accessed in the 1st week</td>
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<td>0.00</td>
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<td>0.00</td>
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<td>Different 1st week videos watched</td>
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<td>0.00</td>
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<td>pre_videos_watched</td>
<td>Percentage of 1st week videos watched</td>
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<td>0.20</td>
<td>0.00</td>
<td>0.00</td>
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<td>skipped_video</td>
<td>Did the student skip any of the 1st week videos?</td>
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<td>-</td>
<td>-</td>
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<td>total_watches</td>
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<td>0.00</td>
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<td>0.00</td>
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<td>0.00</td>
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<td>0.00</td>
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<td>3.83</td>
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<td>Mean submissions per 1st week question</td>
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<td>0.38</td>
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<td>Did the student fail in any of the 1st week questions?</td>
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<td>-</td>
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</tbody>
</table>
Follow the course with a parent
Late in joining
To do (1st week!)

- Try all questionnaires
- Get a good grade
- Have a failed answer
Nothing to do with Gender Age
64 quizzes
2 tests
smells +
programming
concepts
Paper VS Computer
Points

 Wouldn't it be nice if we could keep track of the score of the game? For this we will use a "variable". Remember you saw them before? We used this:

```
points
```

When you write
set: points to 3
The variable becomes 3, like this:

```
points
3
```

http://csunplugged.org/

8 weeks
Future work

• How do Scratch programs evolve? Complexity, sophistication and smells
• Comparison between different environments (Minecraft, Mindstorms)
• How to teach the “hard” concepts
• Early introduction to programming, self-efficacy and career orientation

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