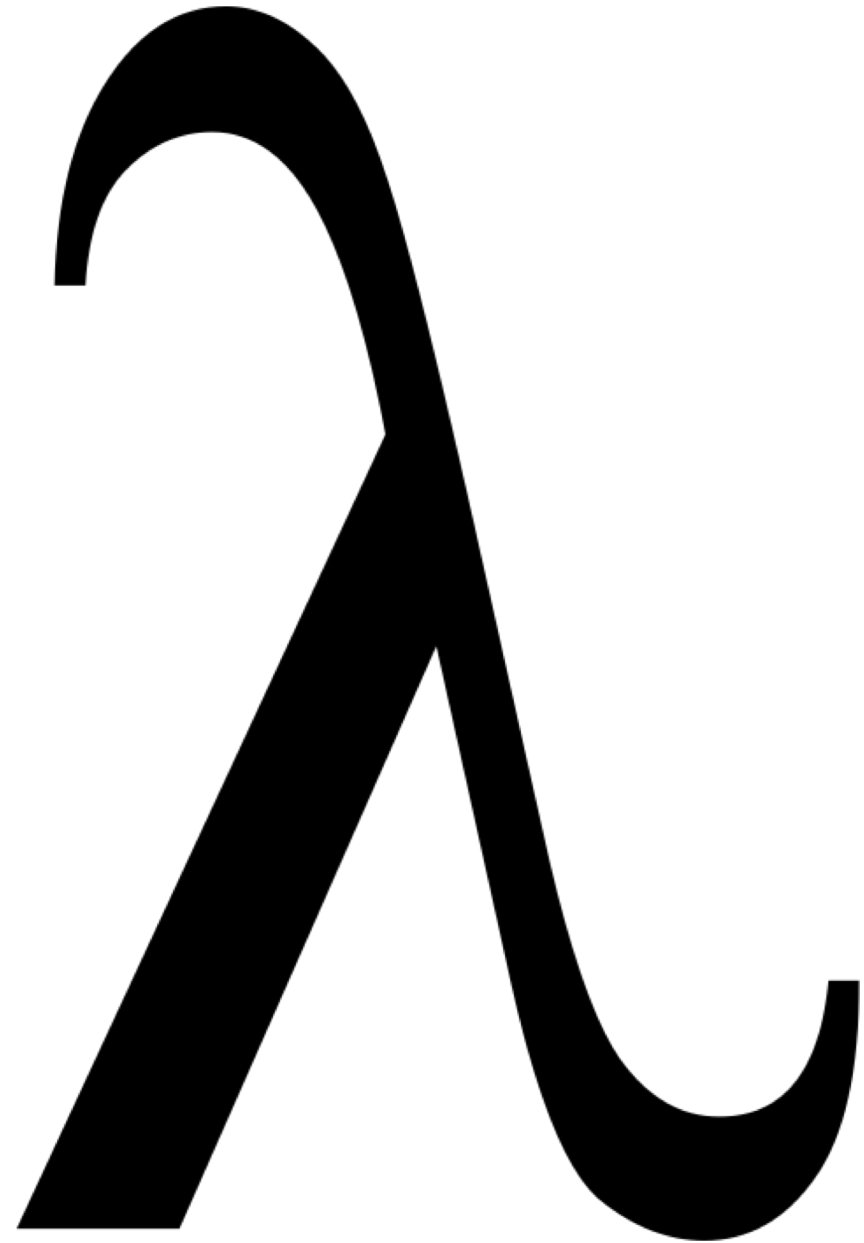


How to Teach Programming to Your Loved Ones

Michael Sperber
@sperbsen

Me, Teaching

- AP Computer Science 1987/1988
Radford High School
- Intro Programming for CS Students 1999-2011
University of Tübingen
- Intro Programming for Humanities Majors 1997-1999
- Training for Active Group 2012-
- Coworkers, friends, relatives







Untitled-4
by ihaveamac (unshared)




Scripts Costumes Sounds

Motion
 Looks
 Sound
 Pen
 Data

Events
 Control
 Sensing
 Operators
 More Blocks

Share See project page

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



Sprites

New sprite: [Icons]

Stage 1 backdrop

New backdrop: [Icons]

Sprite1

X: 240 Y: -180

Backpack



Medals



```
1 #include <BOB3.h>
2
3 void setup() {
4     delay(1000);
5
6     // Zähler um eins erhöhen und wieder speichern
7     int boot_counter = recall();
8     boot_counter = boot_counter+1;
9     remember(boot_counter);
10
11     for (int i=0; i<boot_counter; i++) {
12
13
14
15
16     }
17     delay(1000);
18 }
19 }
20
21
22 void loop() {
23     // bleibt erstmal leer...
24 }
25
```

__info__**The Sentinel** - der Wächter!

BOB3 soll mit dem Sentinel-Programm Dinge



bewachen können, zum Beispiel eine Packung Kekse, deine Zimmertür oder dein Smartphone...



Dazu beobachtet BOB3 mit seinem IR-Sensor den zu überwachenden Bereich: Immer wenn sich der Wert des IR-Sensors zu sehr ändert, schlägt BOB3 Alarm, indem er rot mit seinen Augen blinkt!



People are naturally curious,
but they are **not** naturally
good thinkers.

Daniel Willingham: *Why Don't Students Like School?* Jossey-Bass, John Wiley & Sons, 2009.

Factual knowledge
precedes skill.

Daniel Willingham: *Why Don't Students Like School?* Jossey-Bass, John Wiley & Sons, 2009.

Memory is the
residue of thought.

Daniel Willingham: *Why Don't Students Like School?* Jossey-Bass, John Wiley & Sons, 2009.

We understand new things in
the context of things we
already know.

Daniel Willingham: *Why Don't Students Like School?* Jossey-Bass, John Wiley & Sons, 2009.

Proficiency requires practice.

Daniel Willingham: *Why Don't Students Like School?* Jossey-Bass, John Wiley & Sons, 2009.

Cognition is fundamentally
different early and late in
training.

Daniel Willingham: *Why Don't Students Like School?* Jossey-Bass, John Wiley & Sons, 2009.

Children are more alike than
different in terms of learning.

Daniel Willingham: *Why Don't Students Like School?* Jossey-Bass, John Wiley & Sons, 2009.

Intelligence can be changed
through sustained hard work.

Daniel Willingham: *Why Don't Students Like School?* Jossey-Bass, John Wiley & Sons, 2009.

Teaching, like any complex cognitive skill, must be practiced to be improved.

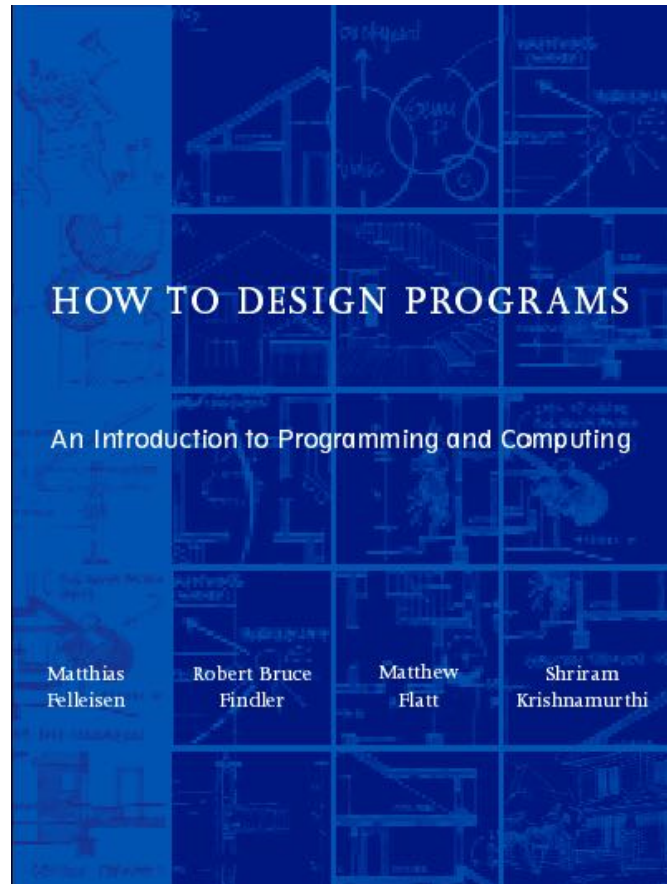
Daniel Willingham: *Why Don't Students Like School?* Jossey-Bass, John Wiley & Sons, 2009.

Target audiences

- children
- high-school students
- university students
- professional developers



Systematic Methods



dein PROGRAMM

DeinProgramm ist ein Projekt zur Anfängerausbildung im Programmieren, das seit 1999 an der Universität Tübingen und anderswo entwickelt wird. Die entstandenen didaktischen Konzepte, Software und Materialien wurden in zahlreichen Anfängerausbildungen erprobt und kontinuierlich verbessert.



- Impact
- Districts
- Workshops
- Courses

BOOTSTRAP

Equity • Scale • Rigor

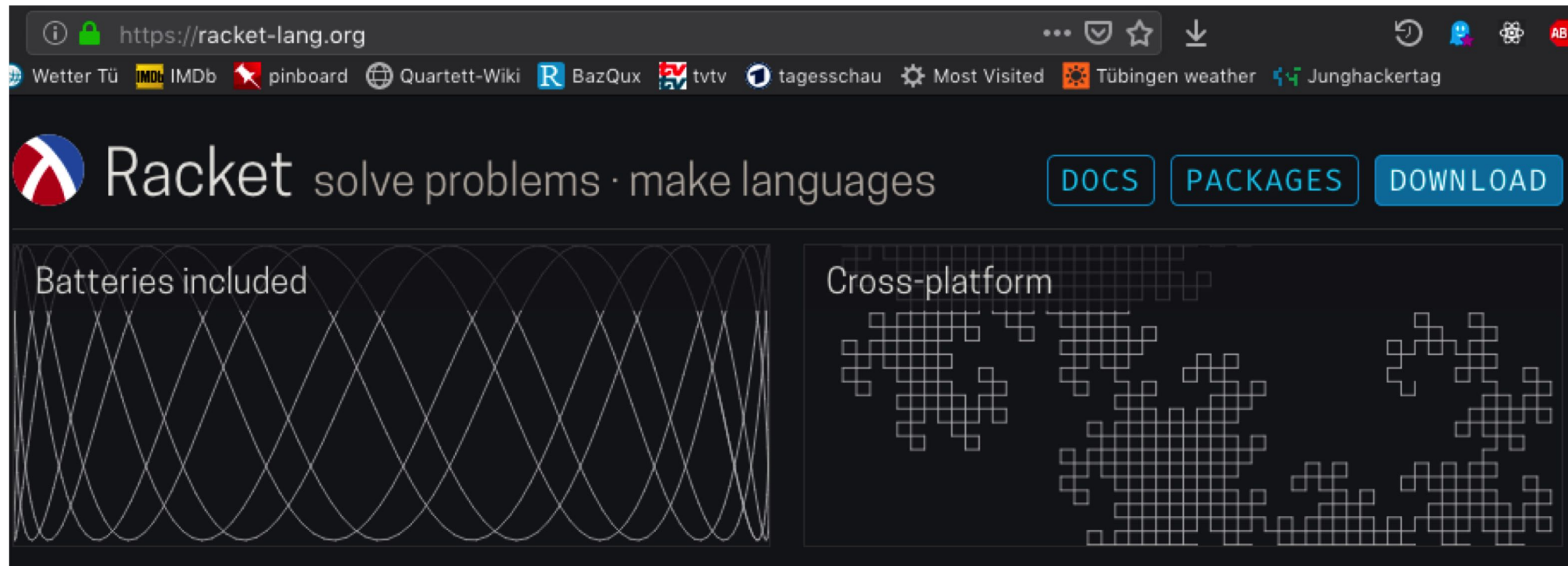
Computational modeling in Algebra, Physics & Data Science, for all students.

We craft research-based curricular modules for grades 6-12. Our materials reinforce core concepts from mainstream subjects like Math, Physics and more, enabling non-CS teachers to adopt our introductory materials while delivering **rigorous and engaging computing content drawn from CS classes at universities like Brown, WPI, and Northeastern.**

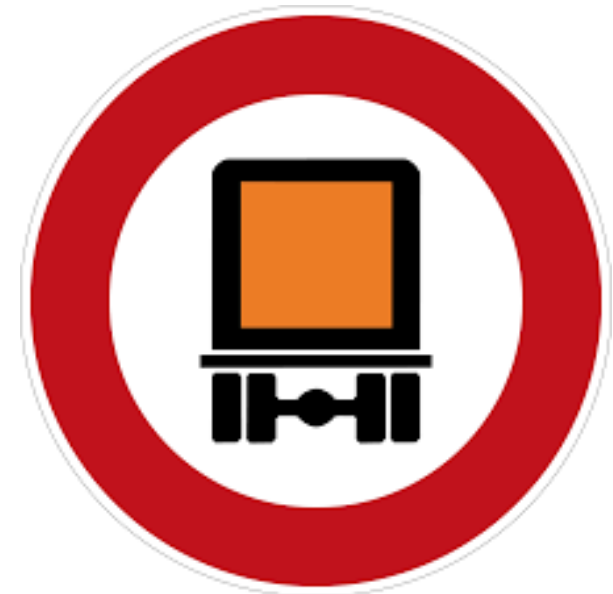
By leveraging the existing networks of Math, Social Studies, and Physics teachers, nationwide, **Bootstrap is built to scale.** We work with school districts across the country, reaching hundreds of teachers and thousands of students each year. Most of our teachers have also attended a **Bootstrap Workshop**, where they received specialized training to deliver the class.

Ingredients

- programming environment for learners
- programming languages for learners
- design recipes for systematic program construction



Straßenverkehrsordnung



Categorize German traffic violations!

- red-light violation, has place and duration (seconds)
- speeding violation, has place and km/h over

Write functions for:

- yielding the place of a violation
- classifying a violation as serious or not.

Overall Design Recipe

- short description
- data analysis
- signature
- tests
- skeleton
- template
- body
- check

Data Analysis: Compound Data

- recognize by **consists of** or **has**
- write **data definition** of that form
- **count** ingredients
- write **record definition**
- ensure counts match

Function accepting compound data

```
(define f  
  (lambda (c)  
    ... (sel1 c) ... (sel2 c) ...))
```

Mixed Data

- recognize by **or** or **one of**
- write **data definition** of that form
- count alternatives
- write **signature definition**
- ensure counts match

Function accepting mixed data

```
(define f
  (lambda (m)
    (cond
      ((p1? m) ...)
      ((p2? m) ...)
      ...)))
```

Principles

- don't do examples whose construction you cannot explain
- name every technique
- reward every step
- insist on form
- measure success
- improve continuously

Creativity

- “Before you can think out of the box, you have to start with a box”
- “Destiny, quite often, is a determined parent. Mozart was hardly some naive prodigy who sat down at the keyboard and, with God whispering in his ears, let music flow from his fingertips. It's a nice image for selling tickets to movies, but whether or not God has kissed your brow, you still have to work. Without learning and preparation, you won't know how to harness the power of that kiss.”

Twyla Tharp: *The Creative Habit*. Simon & Schuster, 2006.

For whom does this work?

- children ≥ 11 years
- beginning programmers
- programmers with pre-existing conditions
- professional developers

Program by Design

Program by Design is an innovative project for computing education that combines motivation with principles. On the surface we use engaging contexts—our “hello world” program is an animation, and students have the opportunity to program games, mashups, phones, etc.—while teaching a principled and scalable approach to computing. We have spent over fifteen years developing this curriculum, and have offerings at the middle-school, high-school and university levels (roughly, ages 10 and above). Our material is even used for in-house corporate training. As we discuss **in more depth**, we set out to address fundamental problems that students face. This has led to a series of innovations in programming environments, programming methodology, and programming languages.

- more material: <https://programbydesign.org/>
- links & publications
- software
- book (English) „How to Design Programs“
(print version MIT Press)

dein

programm

- more material: <http://www.deinprogramm.de/>
- links & publications
- software
- book (German) „Schreibe Dein Programm!“
(in development, free, in print 2019)