Contexts of Computing Education: Graphics, Robots, Data, Information

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Bryn Mawr, PA

Collaborations

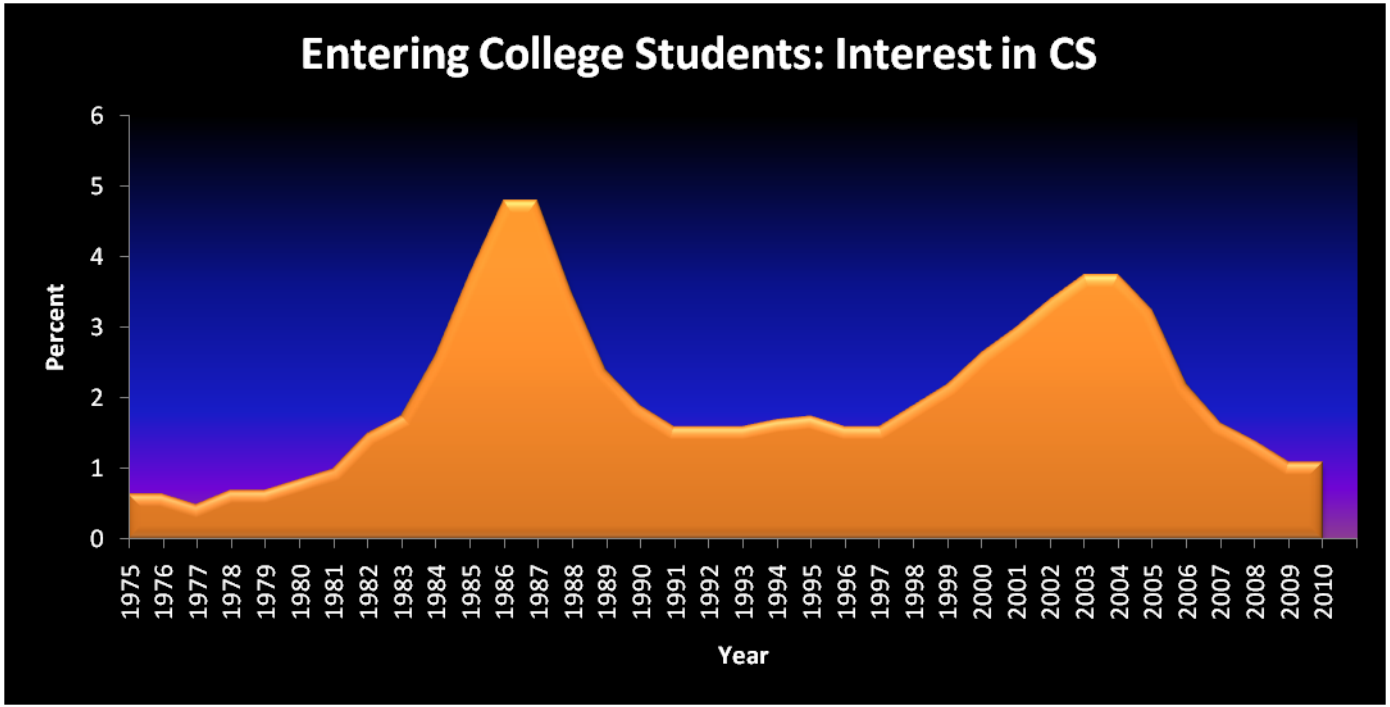
Bryn Mawr College,
Georgia Institute of Technology,
Microsoft Research

Bryn Mawr College,
Southern Methodist University,
Sidwell Friends School
Arlington Independent School District

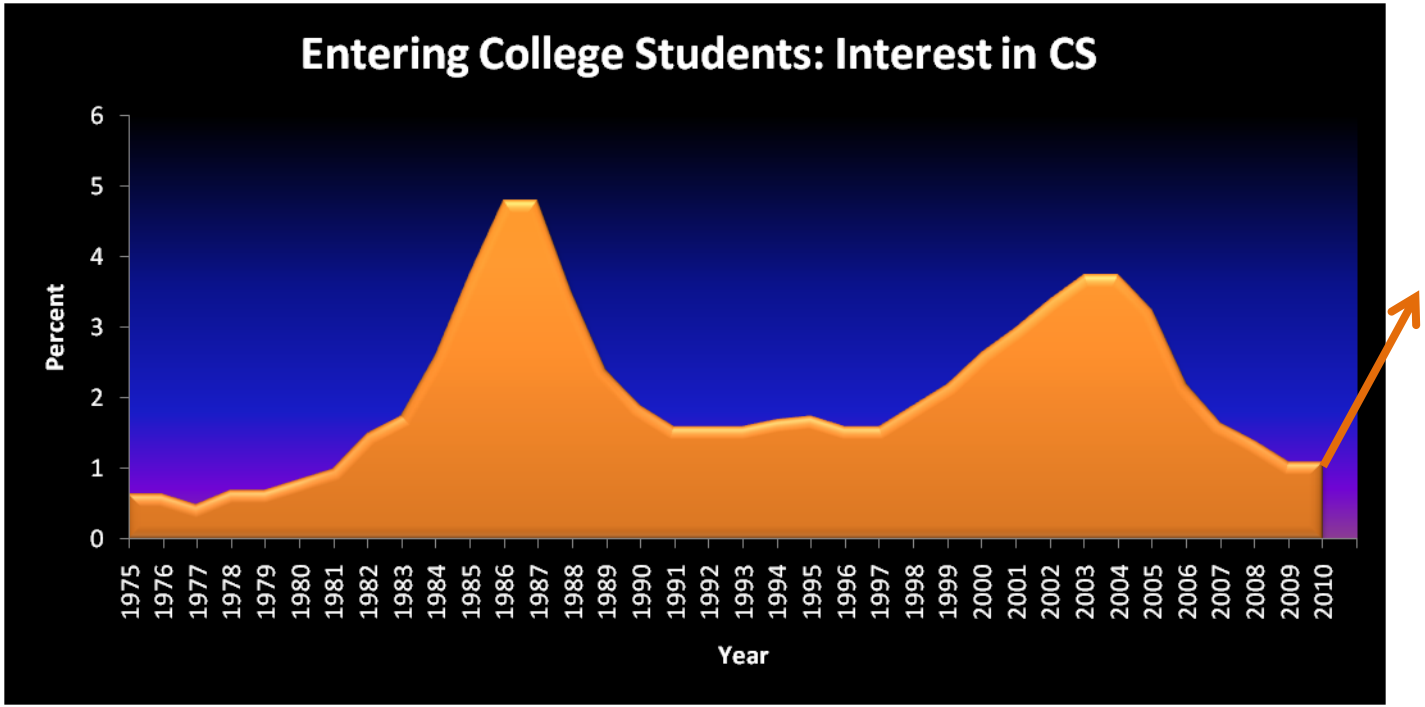
Bryn Mawr College, MIT, Princeton, Howard,
Purdue, Illinois, Texas A&M, UC-Berkeley,
Stanford, UC-San Diego, Hawai'i

Thanks!

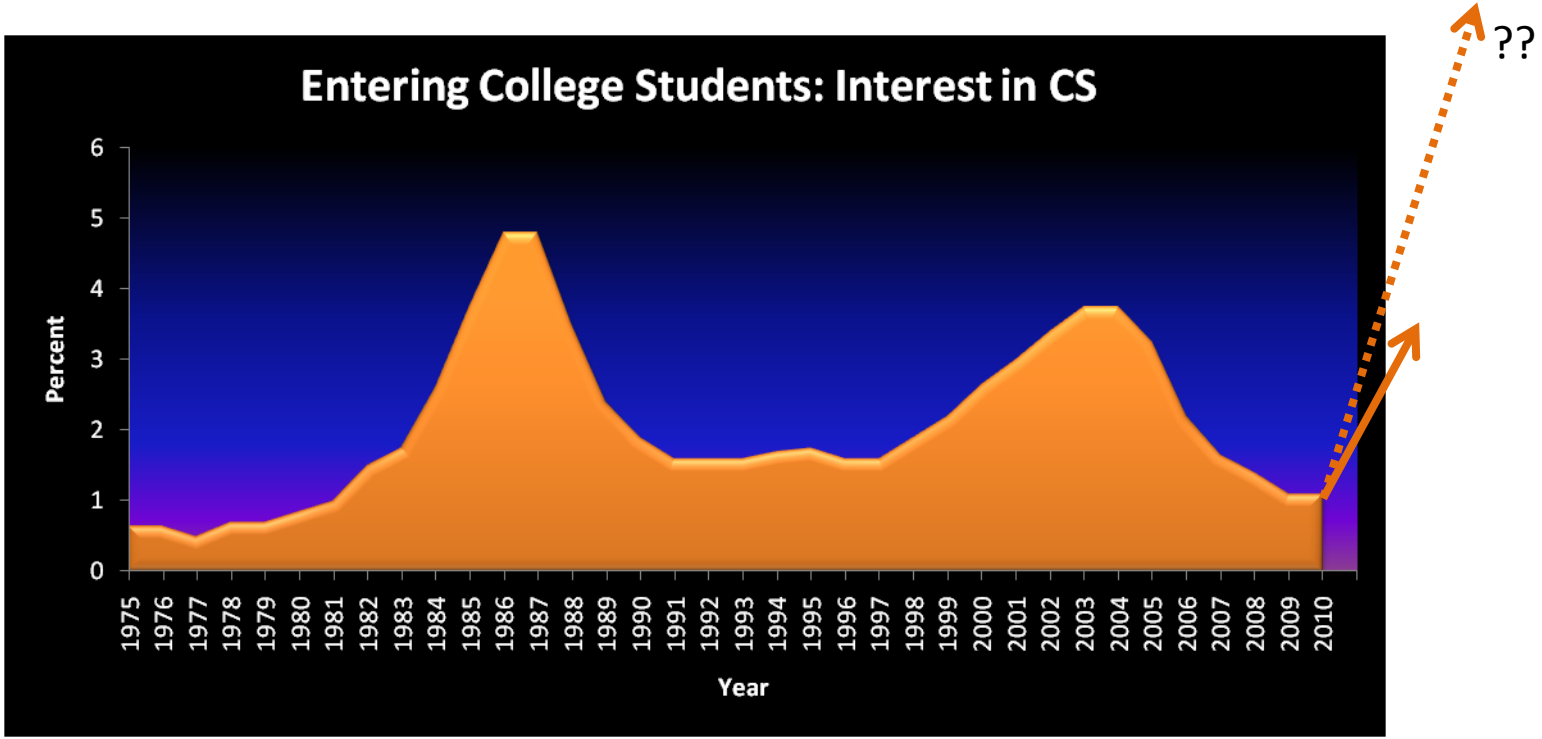
Enrollments in Computer Science



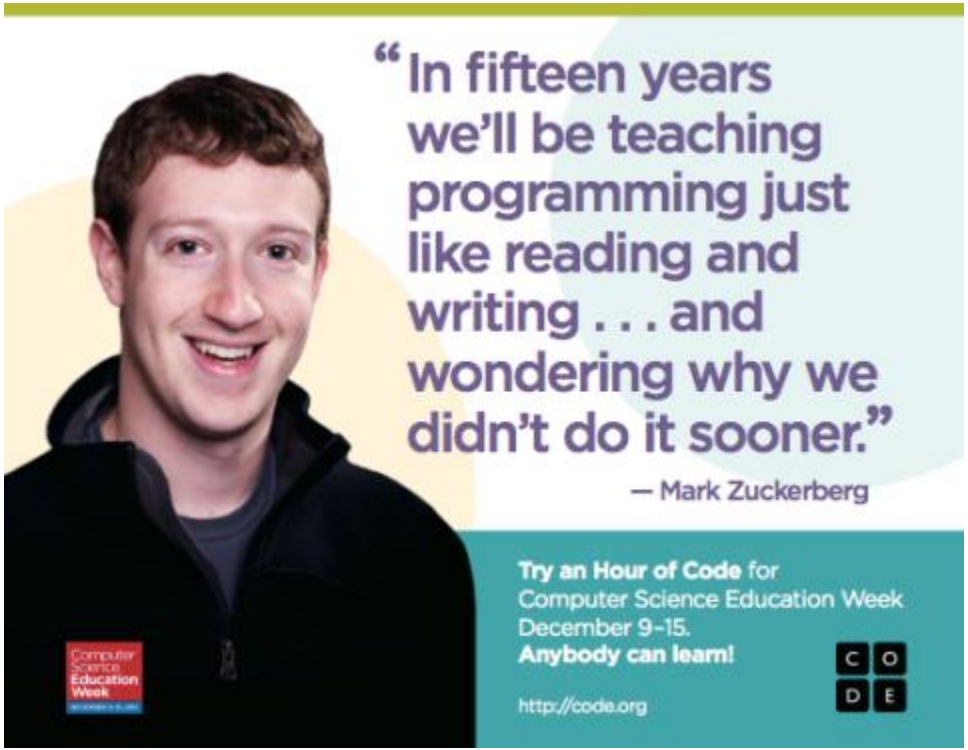
Enrollments in Computer Science



Enrollments in Computer Science

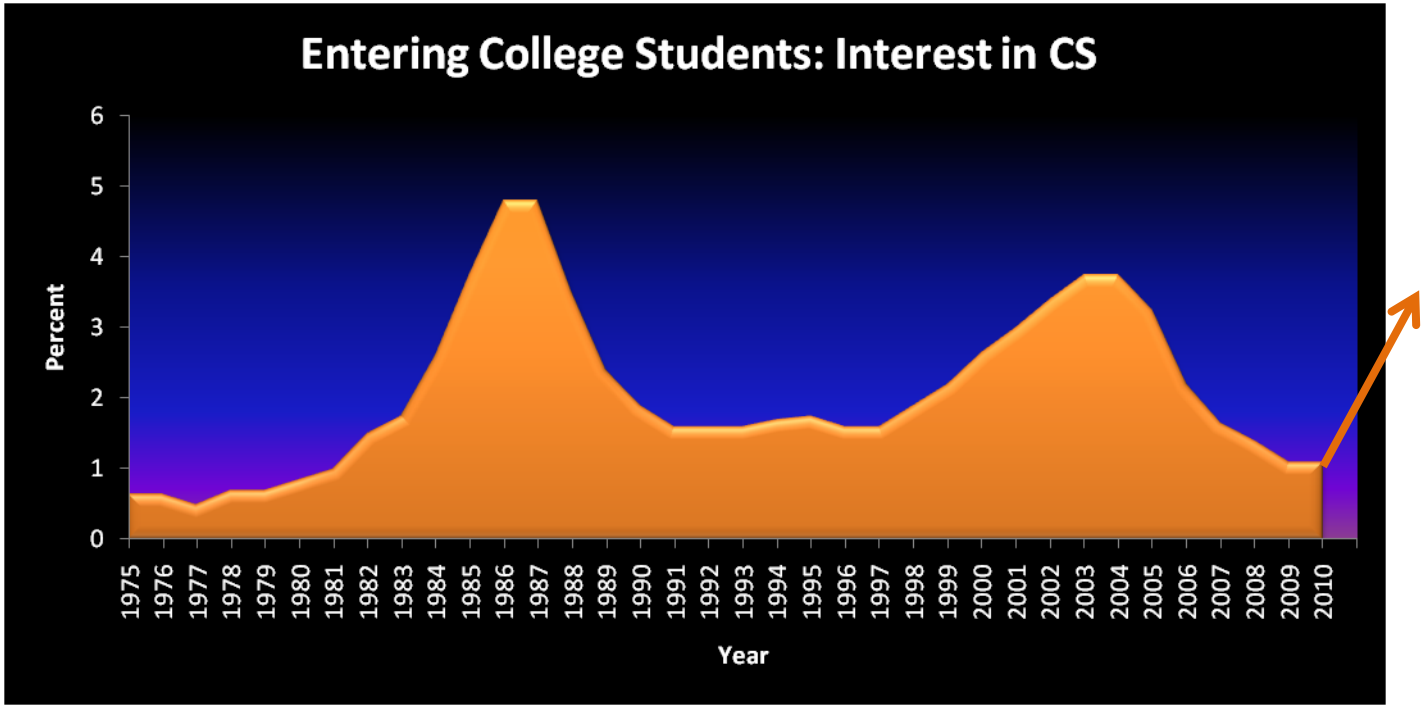


2013: Year of Code.org



2014: Hour of Code

Enrollments in Computer Science



Gender Inequity

While, 57% of bachelor's degrees are earned by women, **just 12% of computer science degrees** are awarded to women.

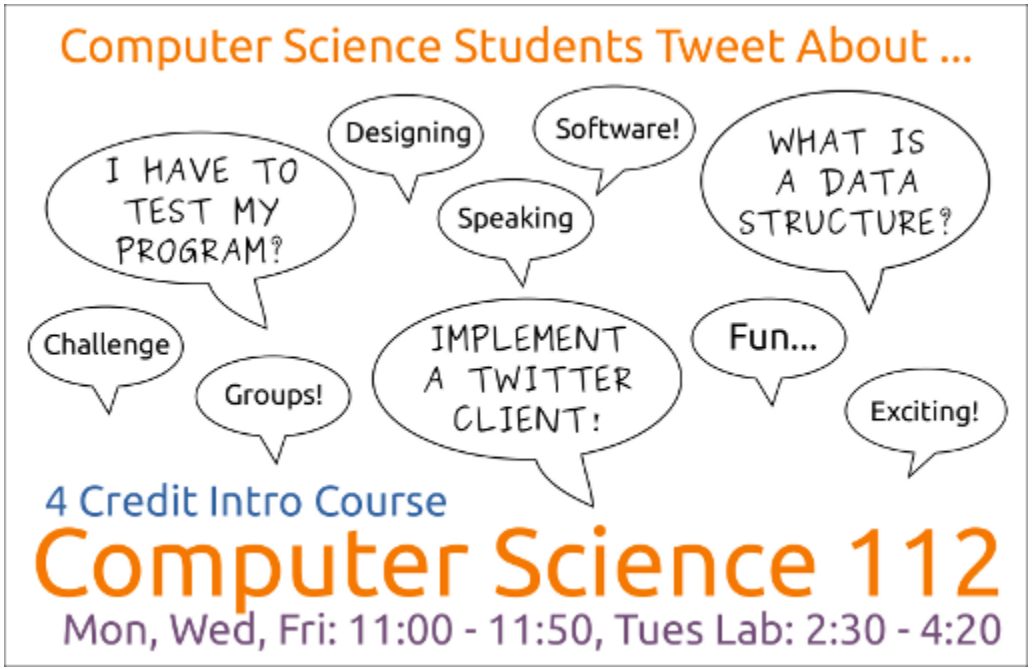
Source: Code.org

Key Issues

Diversity and broadening participation in computing curricula.

Key Issues

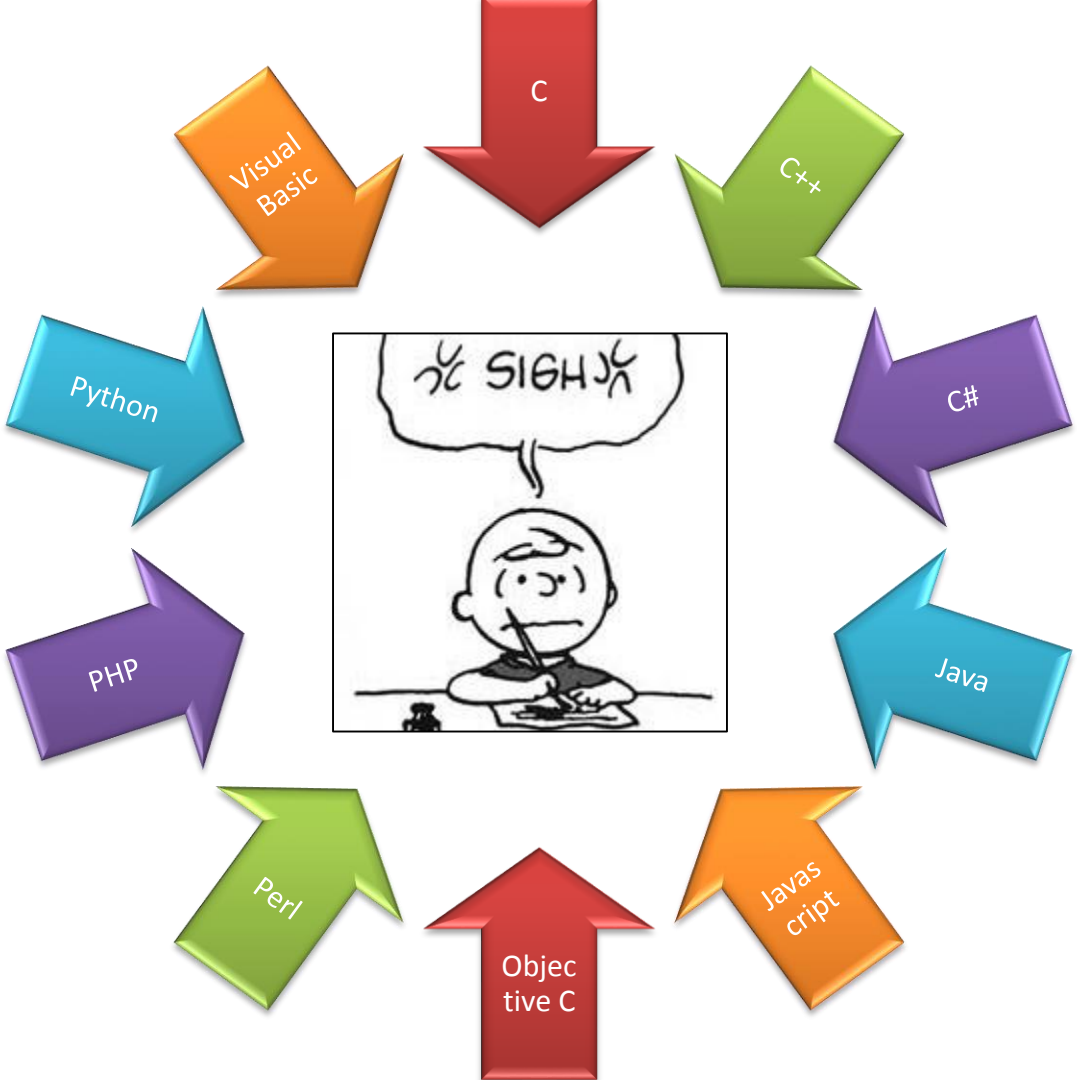
Much time and energy has been devoted to the design of introductory courses that serve as entry points into the programs.



From: cs.allegheny.edu

Language Wars


Language Wars
C
C++
C#
Java
Javas cript
Objec tive C
Perl
PHP
Python
Visual Basic
Haskell
Ruby
Lisp
Scala
SML
OCAML
Prolog
Erlang
Ada
Pascal
FORTRAN
Cobol
Modula2
PL/1
PL/1
ALGOL


C
C++
C#
Java
Javas cript
Objec tive C
Perl
PHP
Python
Visual Basic
SIGH


ipre
Institute
for Personal Robots
in Education
Personal
Robots
In education
click

Personal Robots

Mission
Explore making CS education more fun and effective through the context of a *personal robot*

Bryn Mawr College,
Georgia Institute of Technology,
Microsoft Research

Personal Robots

Introductory computing courses serve as a gateway into the CS curriculum.

Should provide interesting and diverse range of examples and exercises.

Alignment of course content to student interests to increase engagement can have a positive impact on students choosing to enter computing as a major in college.

Most tasks should be attainable and provide a basis for supportive and positive feedback to students.

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Microsoft Research

Personal Robots

CS ≠ Programming

Computing: *social activity*

Computing: *medium for creativity*

Performances *vs*. Competitions

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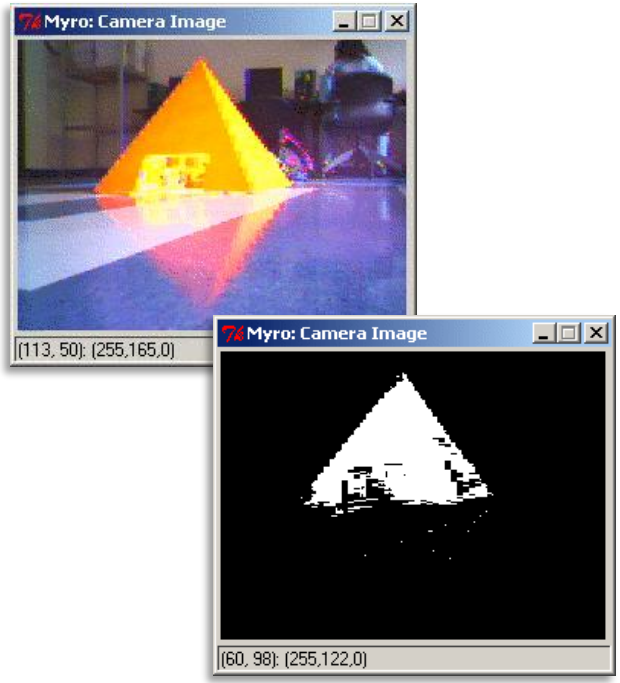
Microsoft Research

Personal Robots




```
pic = takePicture()
show(pic)     # top picture

for pixel in getPixels(pic):
   r, g, b = getRGB(pixel)
   if r > 250 and b < 100 and g > 130:
      setColor(pixel, white)
   else:
      setColor(pixel, black)

show(pic)     # bottom picture
```

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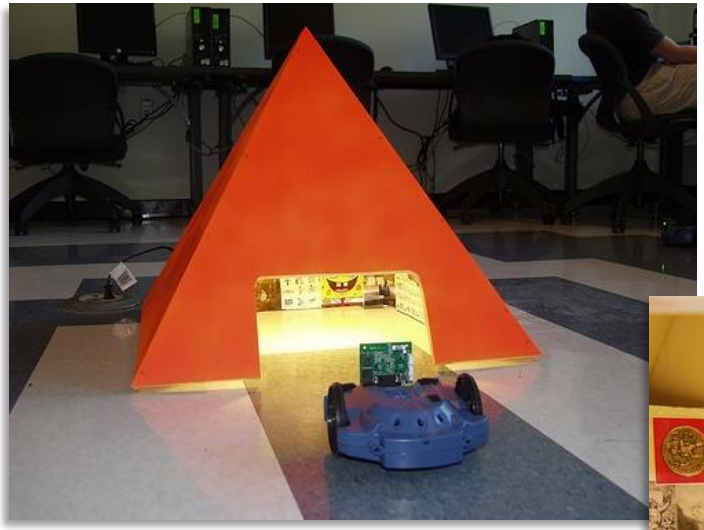
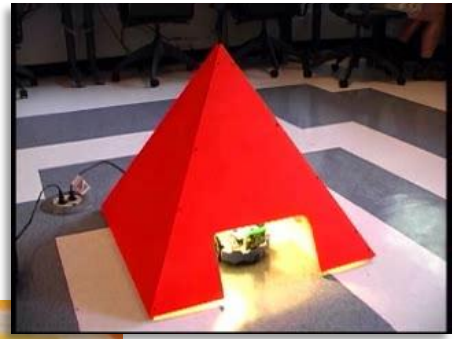
Georgia Institute of Technology,
Microsoft Research

Personal Robots



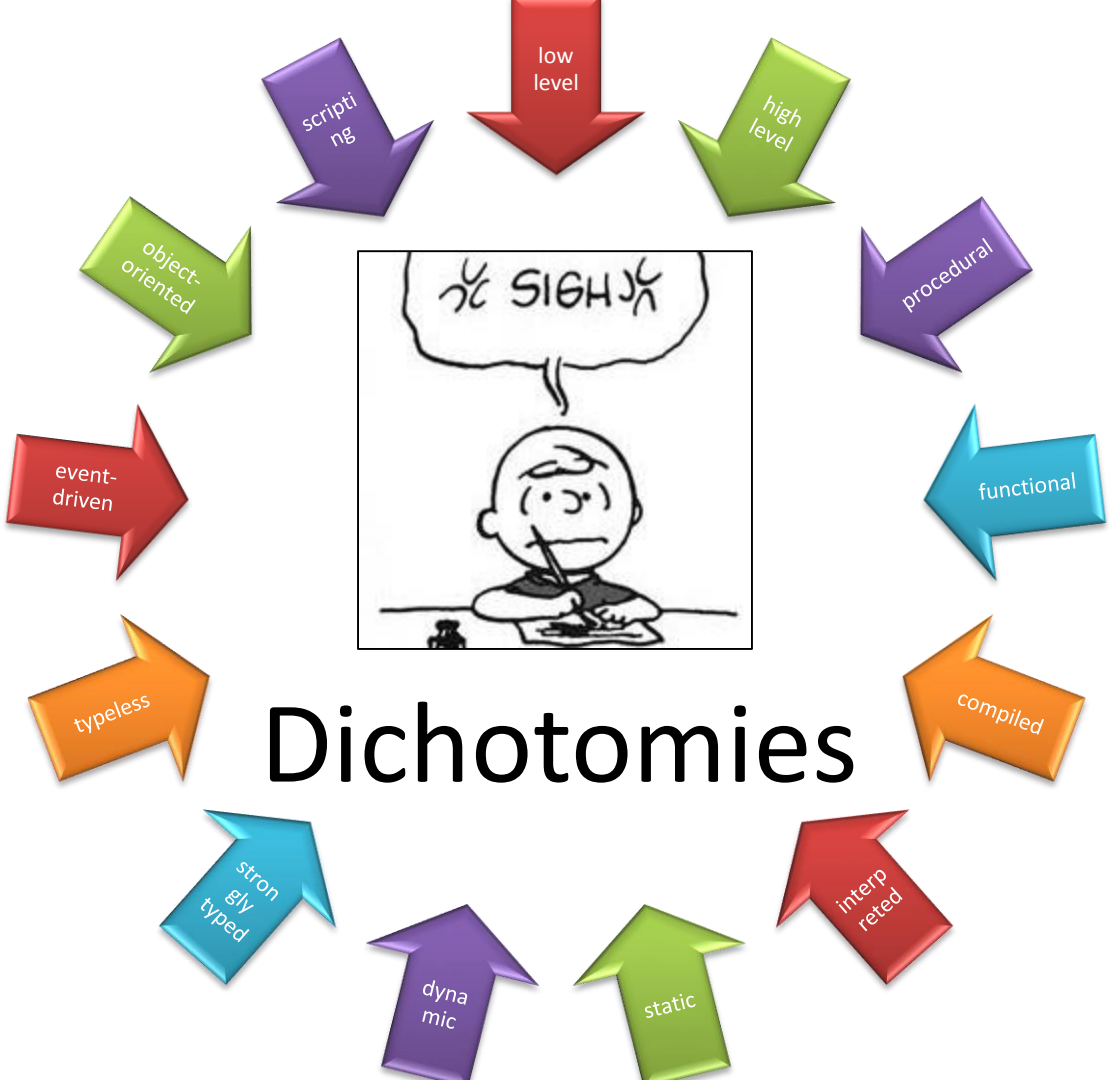


Personal Robots

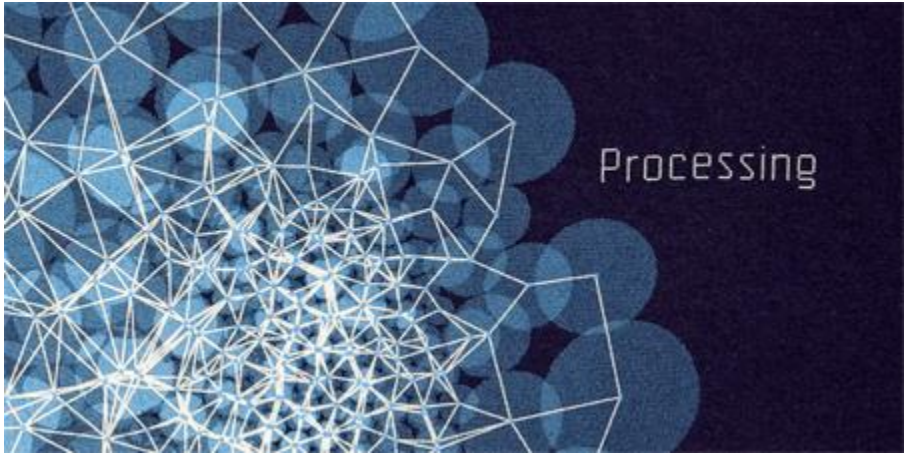
- Learned CS concepts through robots
- Robots made learning experience more hands-on, tangible, and exciting
- Most frustrating parts were dealing with robot hardware inconsistencies
- Viewed CS as a type of logic and problem solving; requiring patience & thought
- Discovered that CS and robots are applicable to the real world


More Dichotomies
low level
high level
procedural
functional
compiled
interpreted
static
dynamic
strongly typed
typeless
event-driven
object-oriented
scripting

Dichotomies



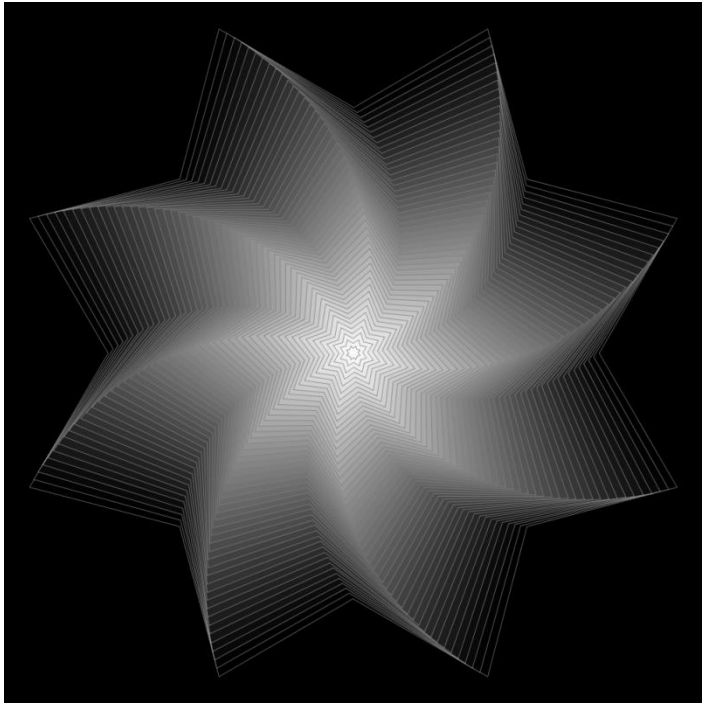

KEEP
RIGHT



processing.org

Graphics

Mission
Explore making CS education more fun and effective through the context of *creative computing*



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Sidwell Friends School
Arlington Independent School District

Graphics

Processing is a programming language based on Java.

Self Portrait
Ziting Shen

Graphics

Since 2001, processing has promoted software literacy within the visual arts and visual literacy within technology.

Bryn Mawr Minion
Yi Lin

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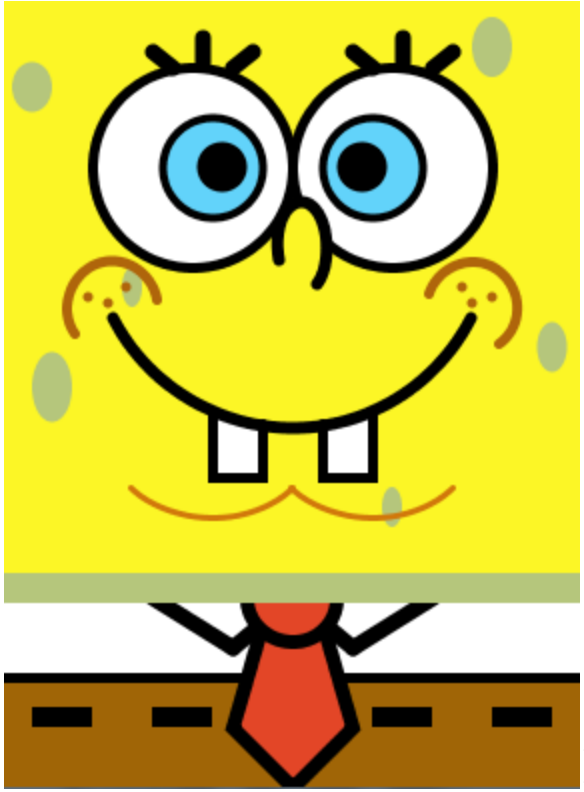
Sidwell Friends School
Arlington Independent School District

Graphics

Processing:
A software sketchbook to teach computer programming fundamentals within a visual context.



Sponge Bob
Shiyu Wang

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Clovers | Processing 2.2.1

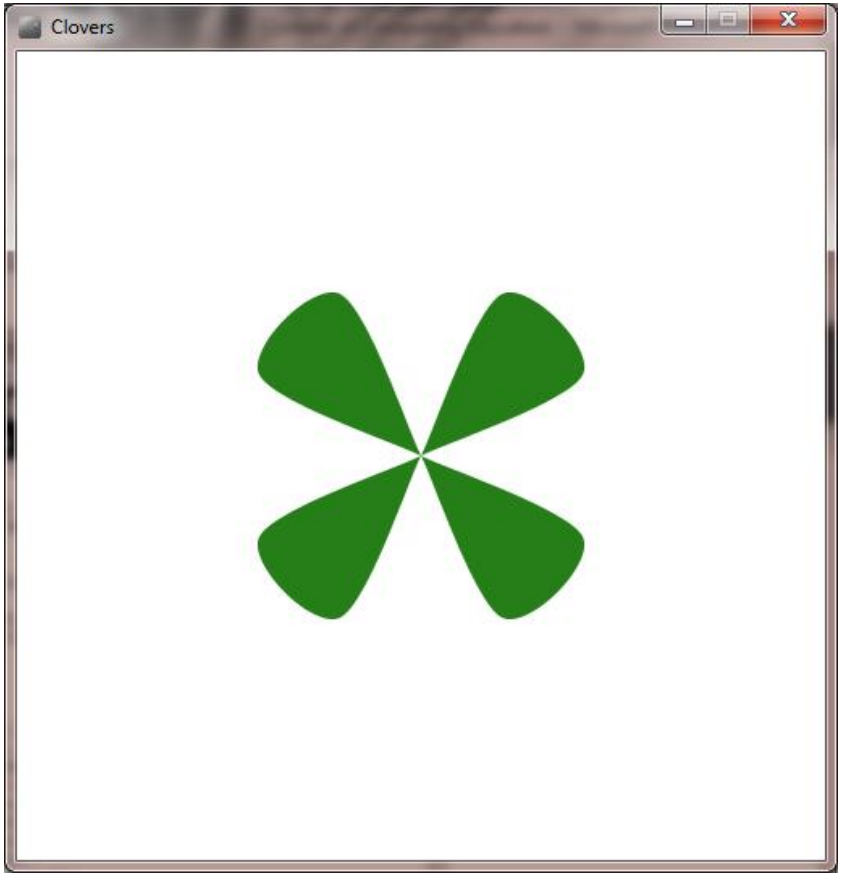
File Edit Sketch Tools Help

Java

Clovers

```
int x, y, w, h;

void setup(){
  size(500, 500);
  smooth();
  noLoop();
  background(255);

  x = width/2;
  y = height/2;
  w = 40;
  h = 40;
}

void draw() {
  noStroke();
  fill(#267E19);
  translate(width/2, height/2);
  clover(0, 0, w, h);
  rotate(PI/2);
  clover(0, 0, w, h);
  rotate(PI/2);
  clover(0, 0, w, h);
  rotate(PI/2);
  clover(0, 0, w, h);
} // draw()

void clover(int x, int y, int w, int h) {
```

34



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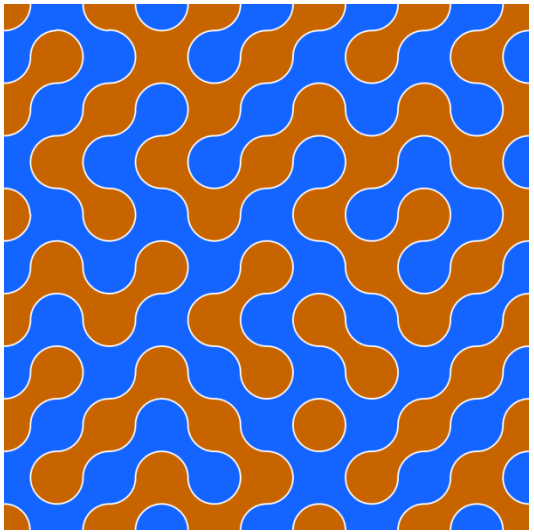
Creative Computing

Processing
Processing has evolved into a development tool for professionals artists.



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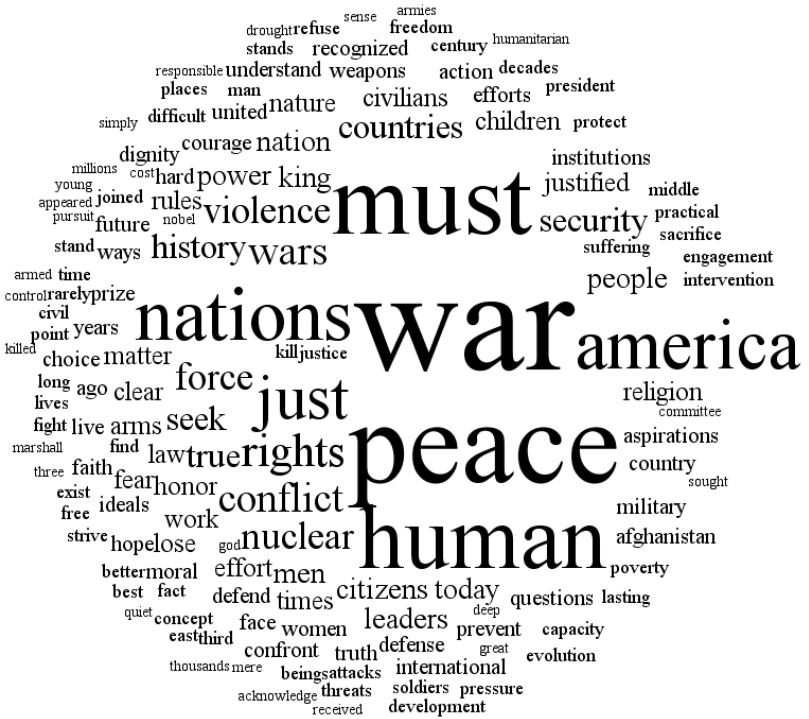
Data: Text

There are tens of thousands of students, artists, designers, researchers, and hobbyists who use Processing for learning, prototyping, and production.



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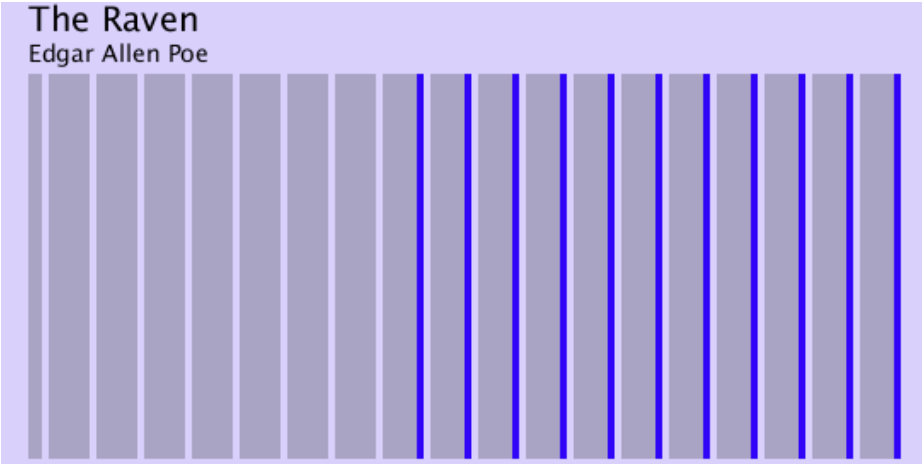
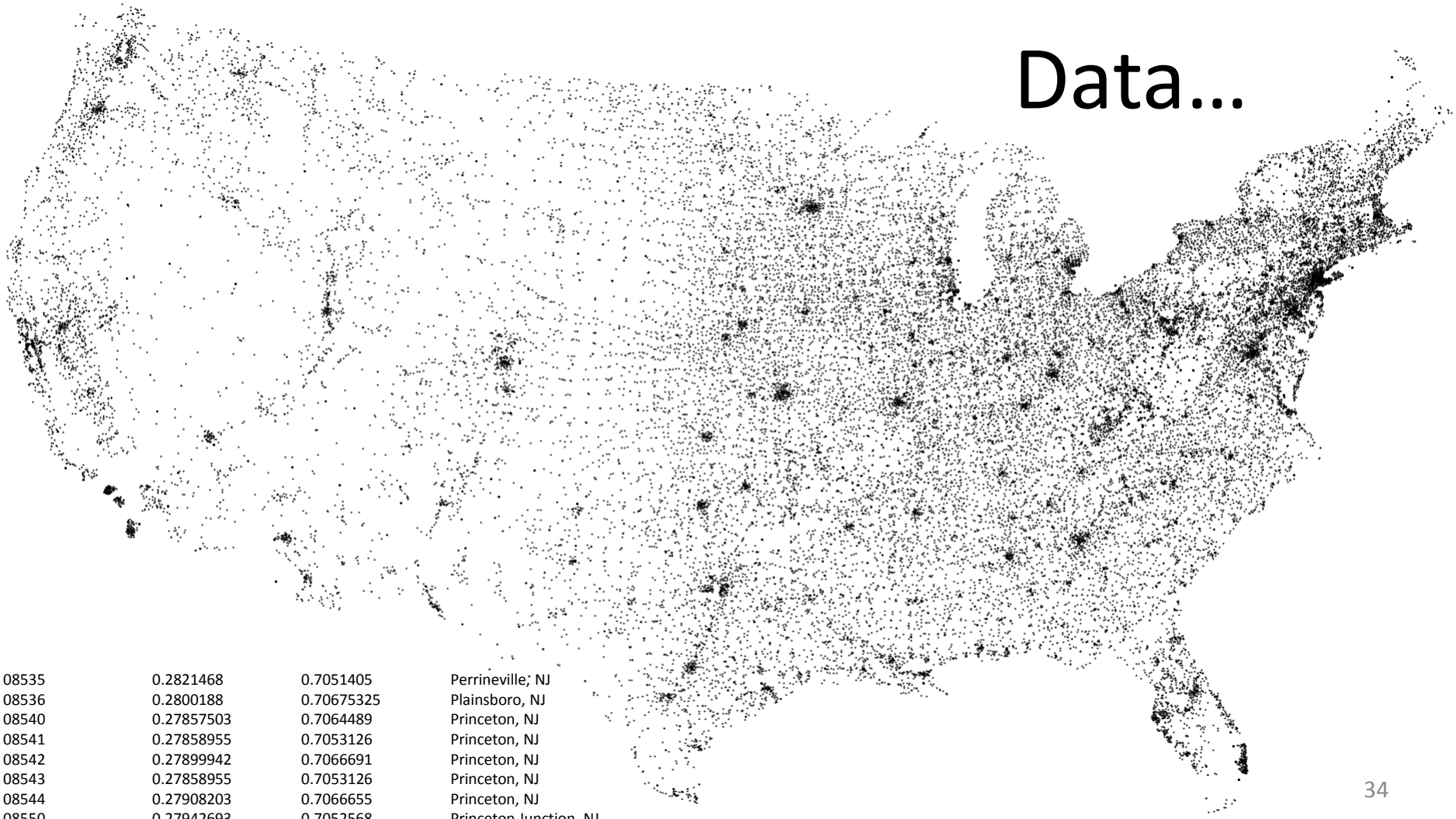
Data: Text


The Raven
Edgar Allen Poe

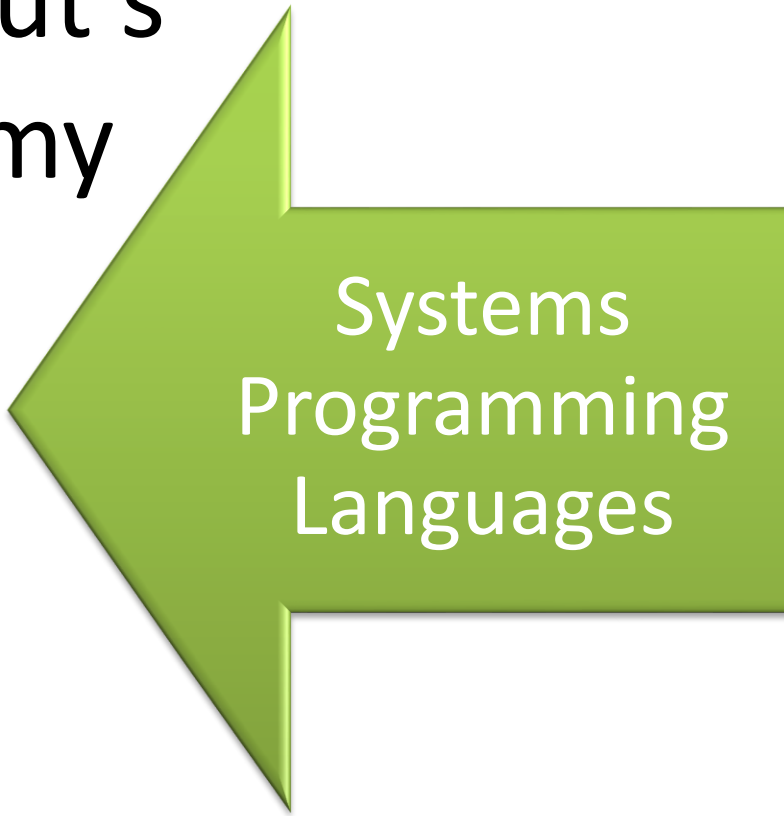

sorrow
maiden
tapping
quoth
floor
bust
raven
angels
heart
thee
soul
door
implore
lenore
spoken
tis
bird
chamber
word
thy
nevermore
sad
prophet
yore
rapping

Data…

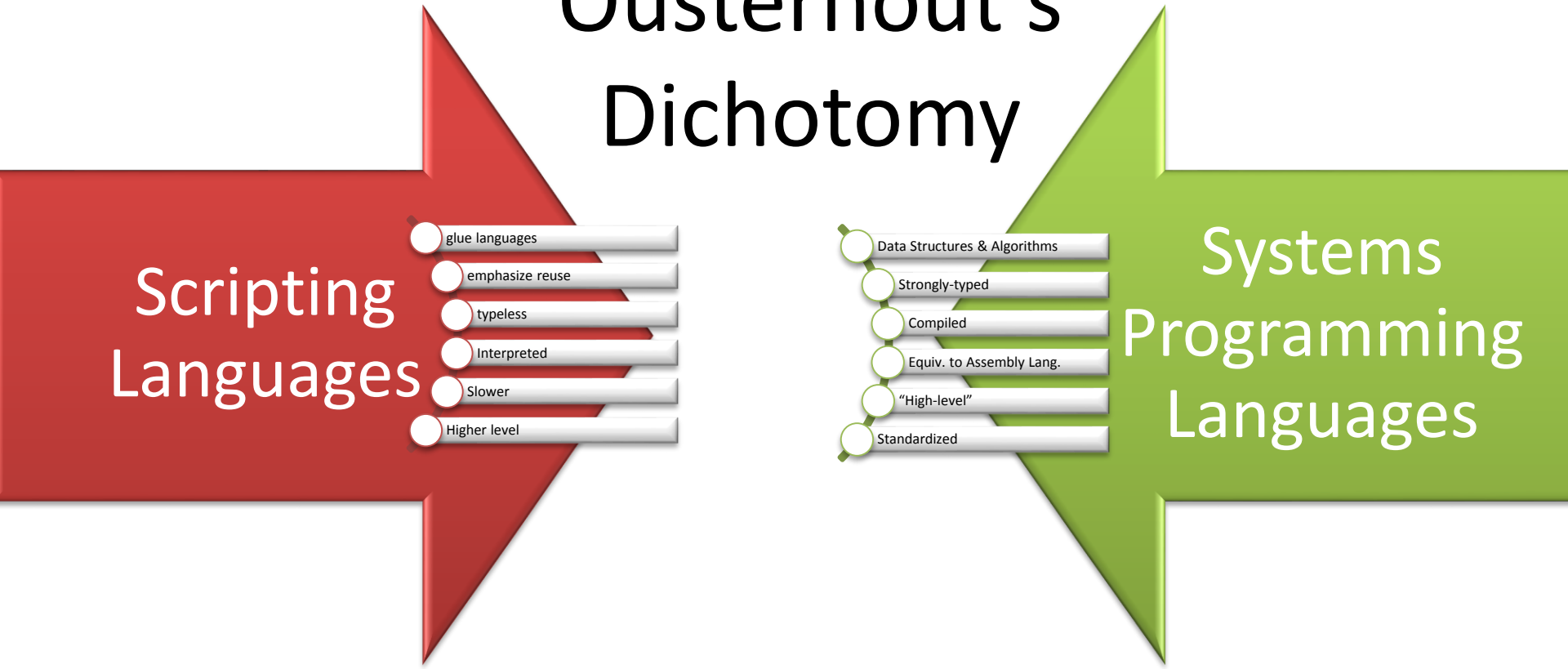


08535	0.2821468	0.7051405	Perrineville, NJ
08536	0.2800188	0.70675325	Plainsboro, NJ
08540	0.27857503	0.7064489	Princeton, NJ
08541	0.27858955	0.7053126	Princeton, NJ
08542	0.27899942	0.7066691	Princeton, NJ
08543	0.27858955	0.7053126	Princeton, NJ
08544	0.27908203	0.7066655	Princeton, NJ
08550	0.27942693	0.7052568	Princeton Junction, NJ

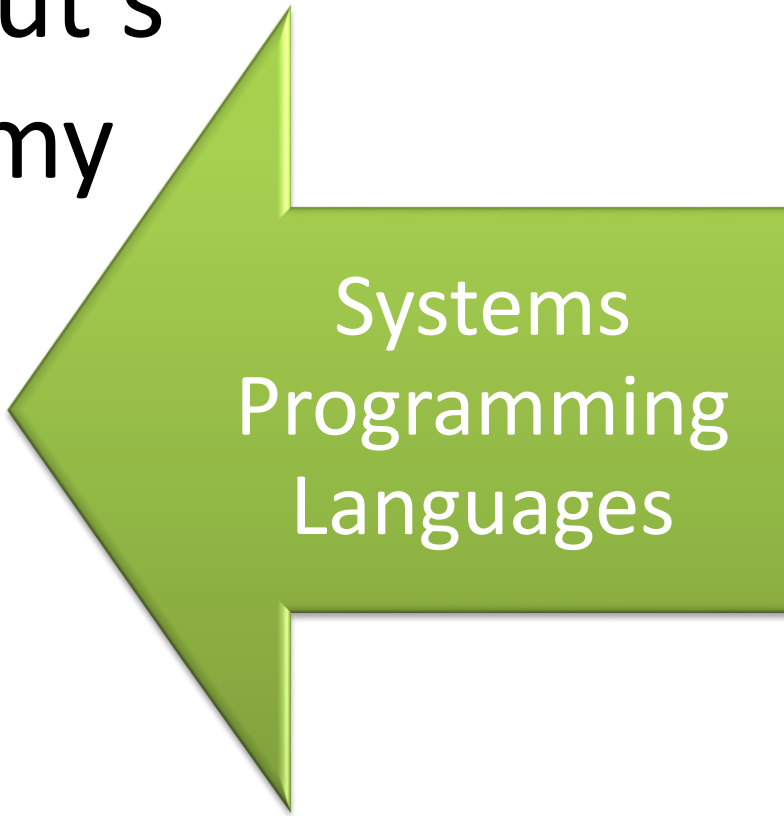
Ousterhout's Dichotomy



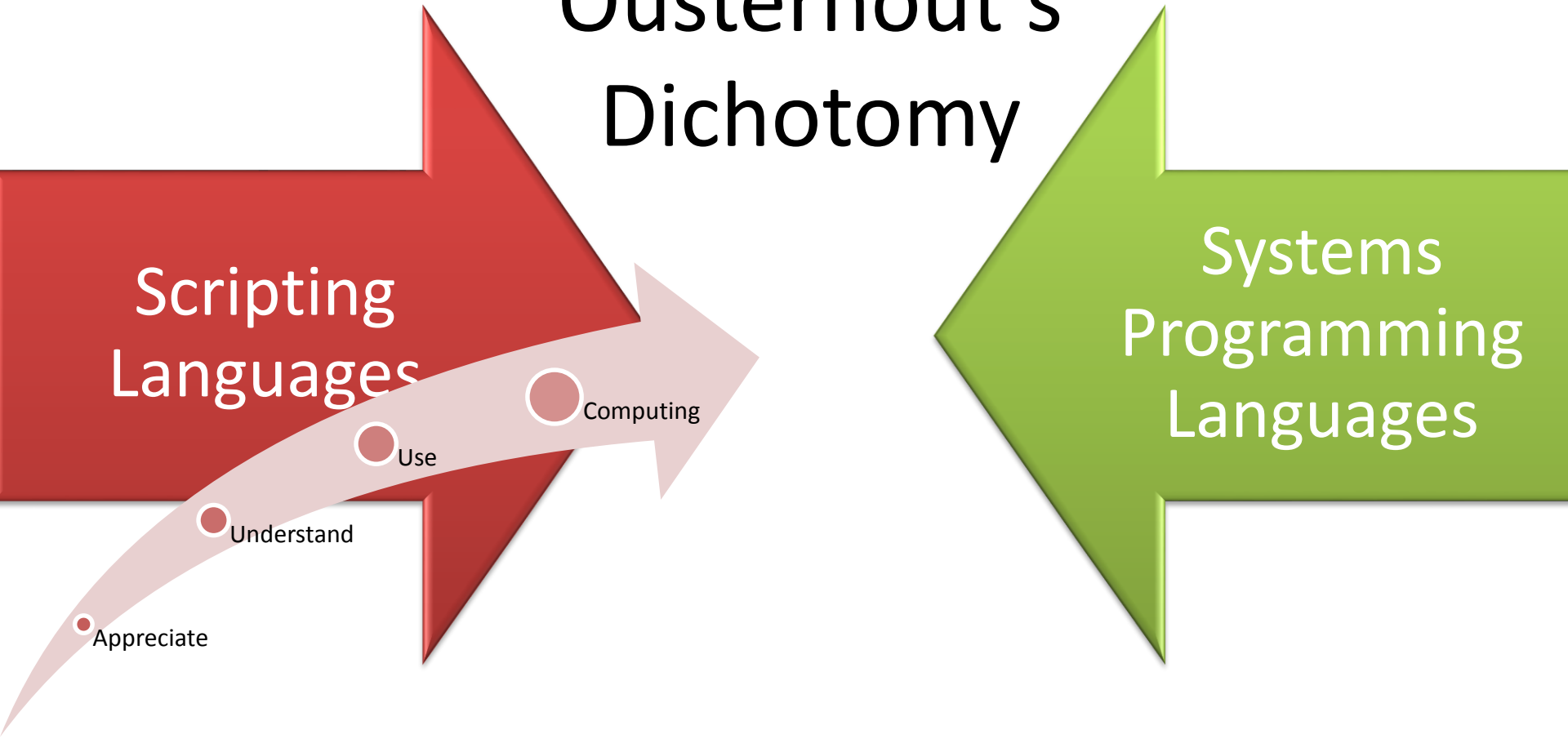
Ousterhout's Dichotomy



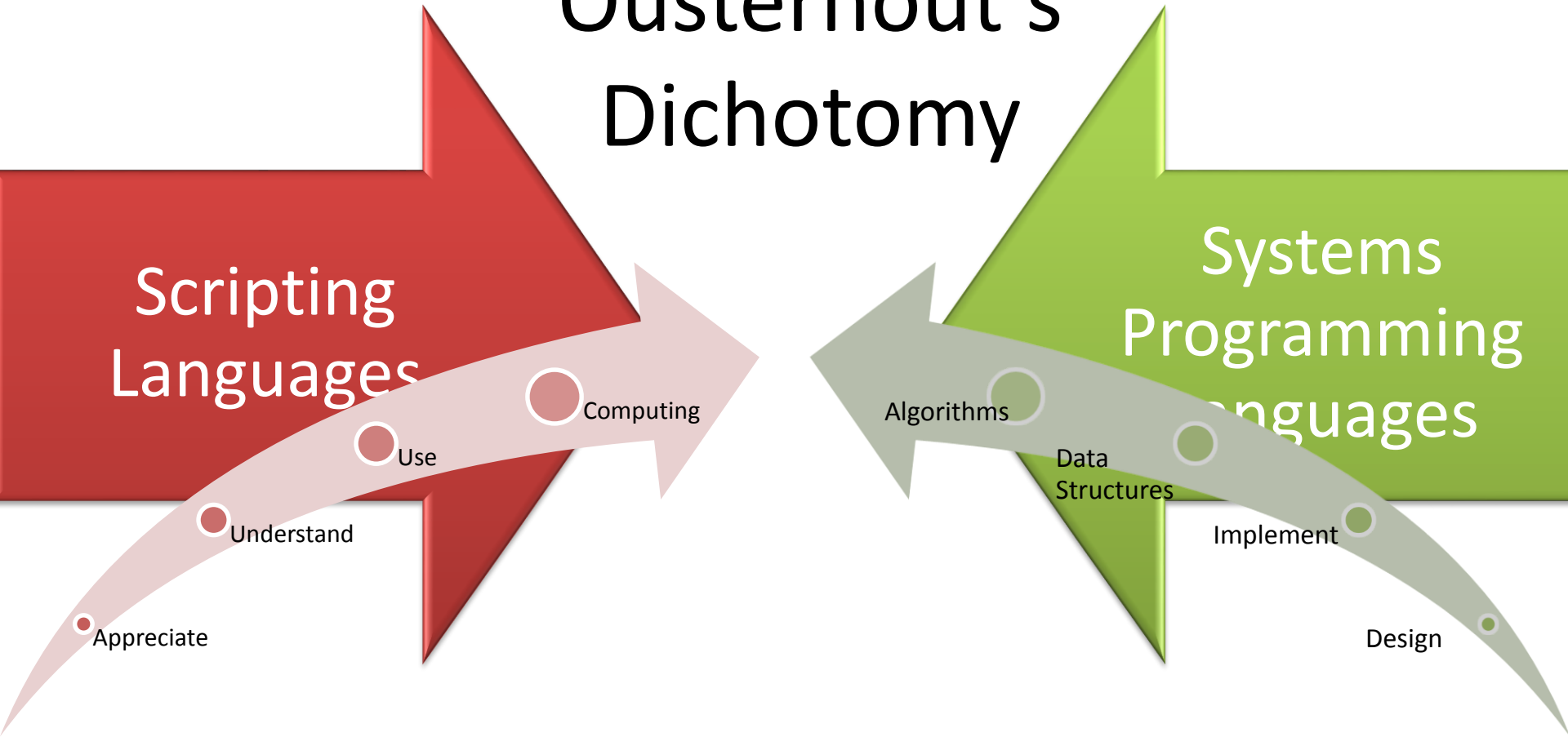
Ousterhout's Dichotomy



Ousterhout's Dichotomy



Ousterhout's Dichotomy



Ousterhout's Dichotomy

Scripting Languages

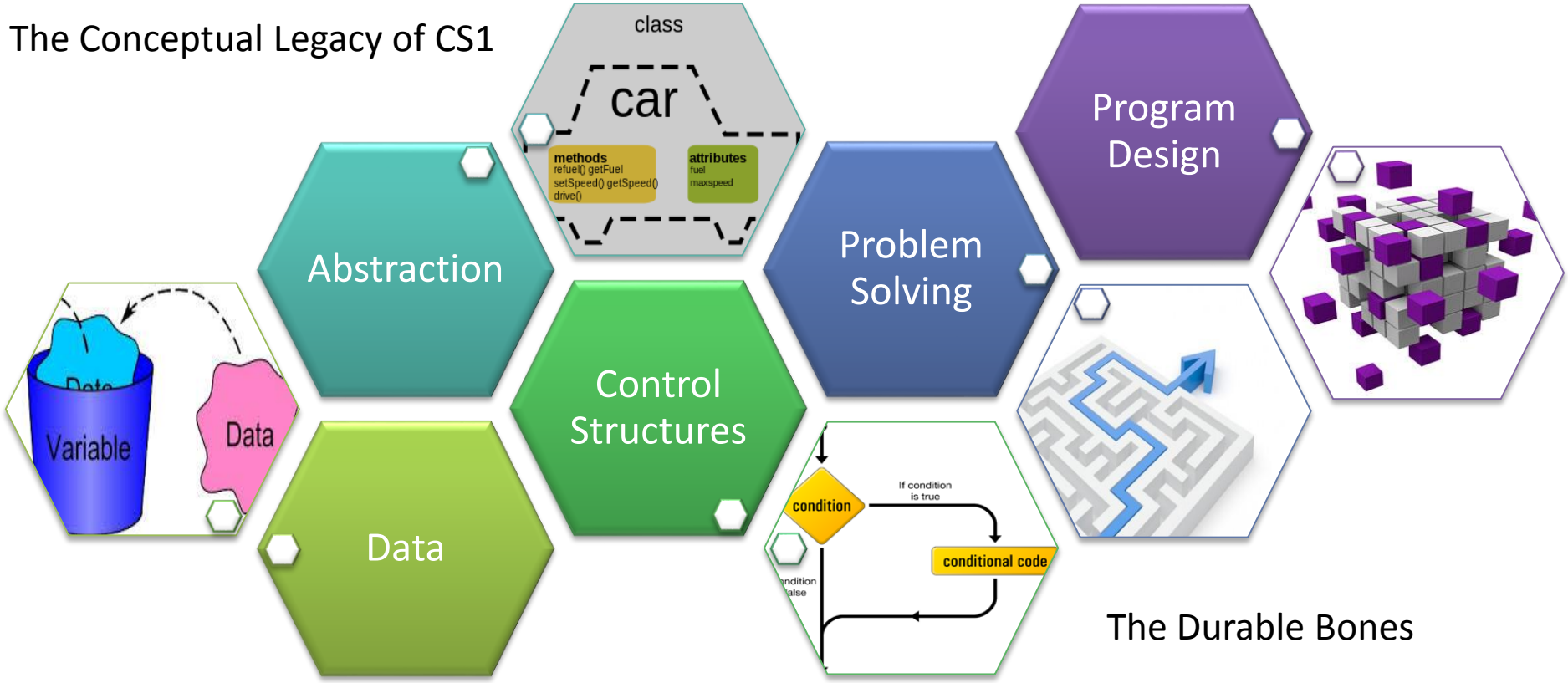
- Appreciate
- Understand
- Use
- Computing

Systems Programming Languages

- Design
- Implement
- Data Structures
- Algorithms

<Coding is Fun>

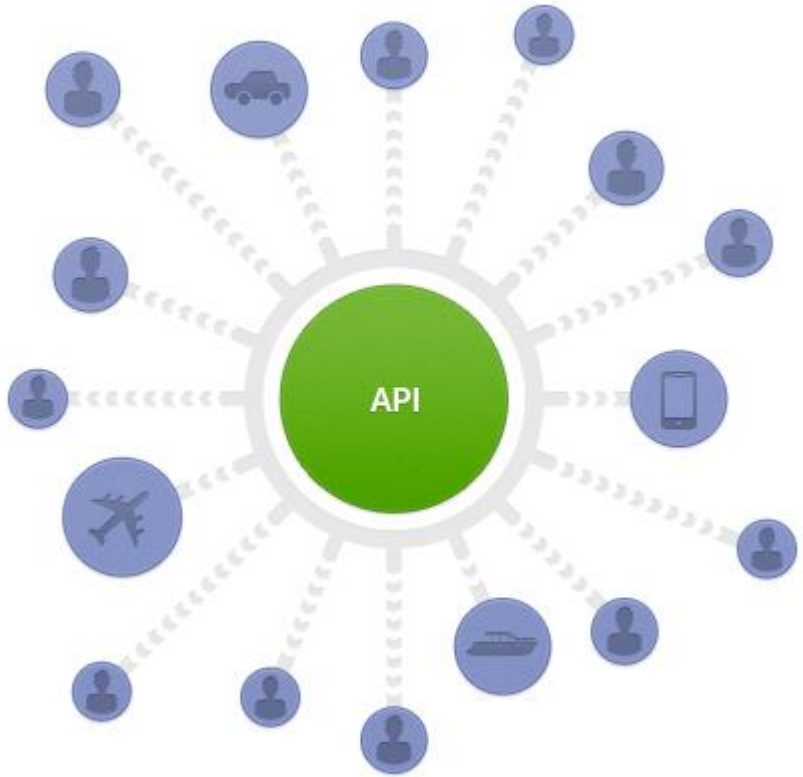
The Conceptual Legacy of CS1



The Durable Bones

Contexts

By placing early learning of computing in more engaging and creative contexts, it's possible to make the discipline and its practice more appealing and intellectually fascinating.



Contexts

APIs are influencing a transformation in computing education.

Contexts

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APIs enable access to different contexts in computing.

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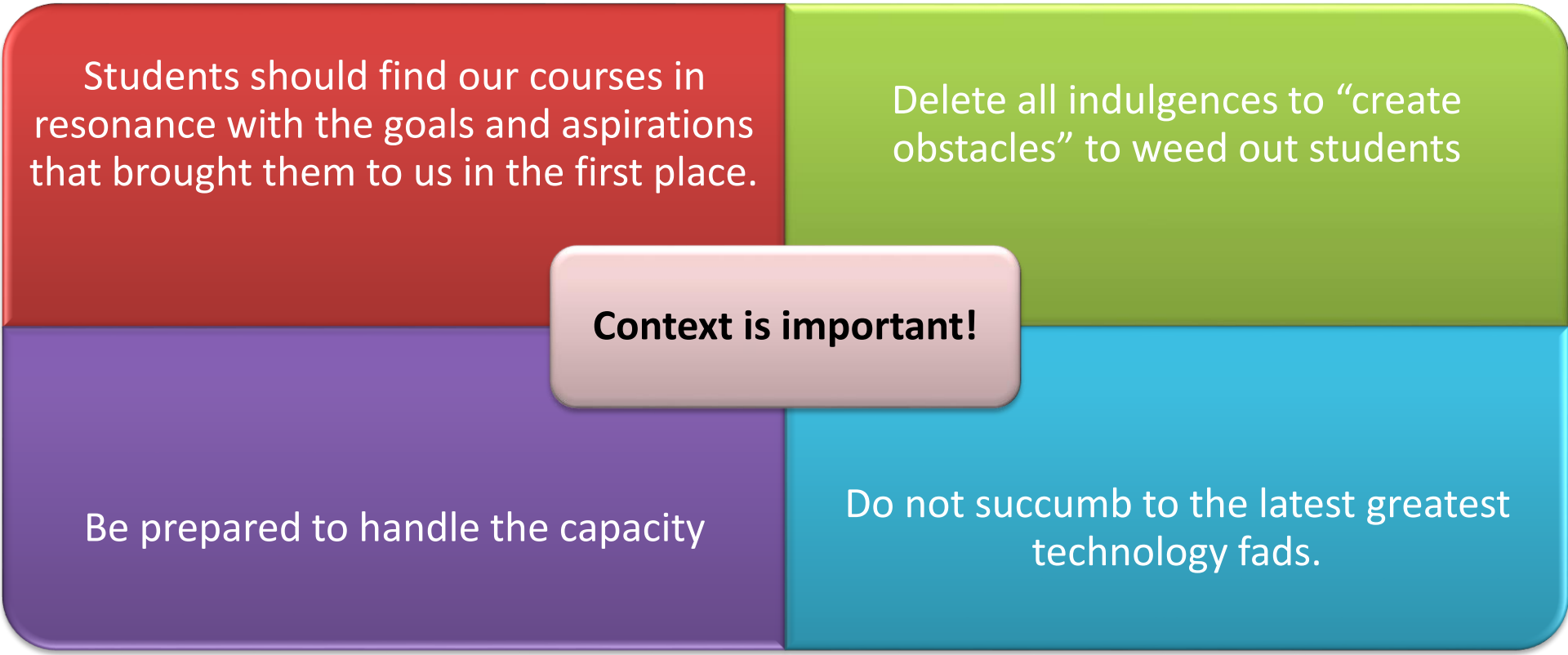
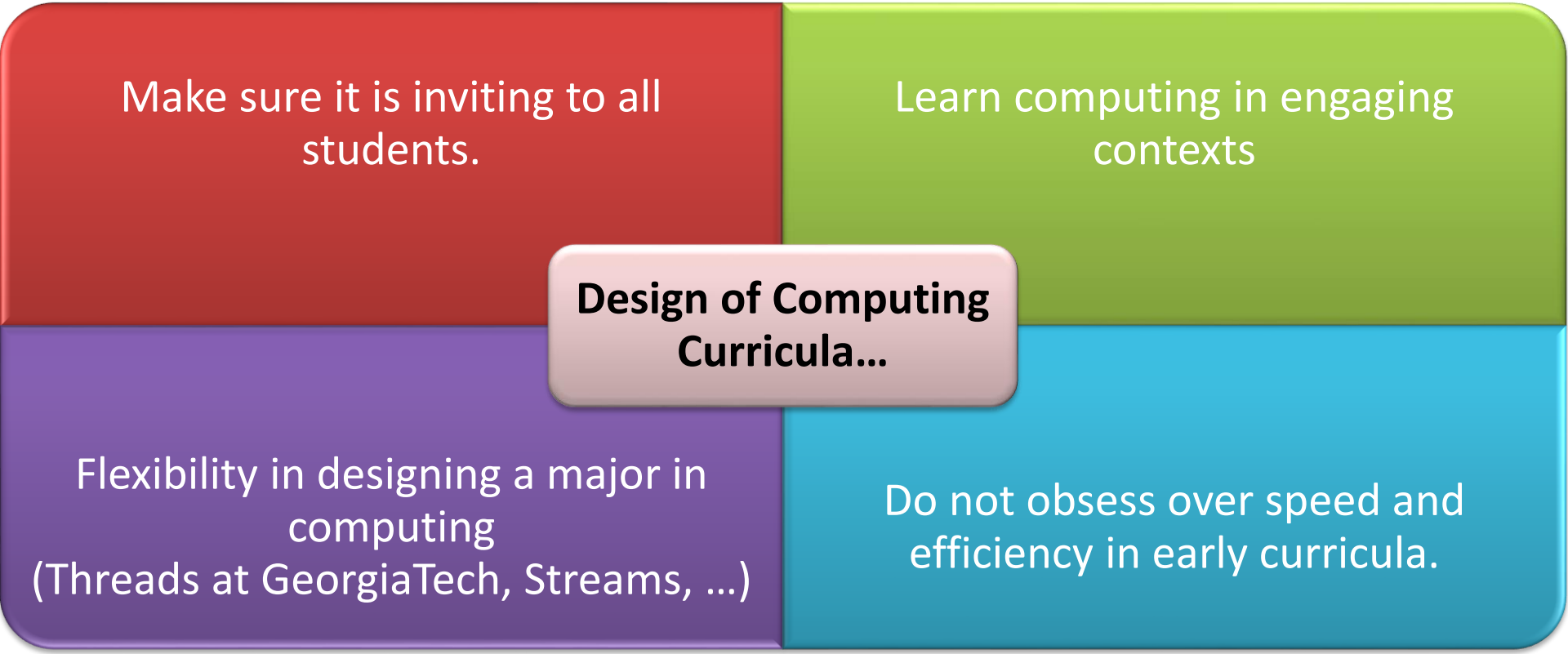
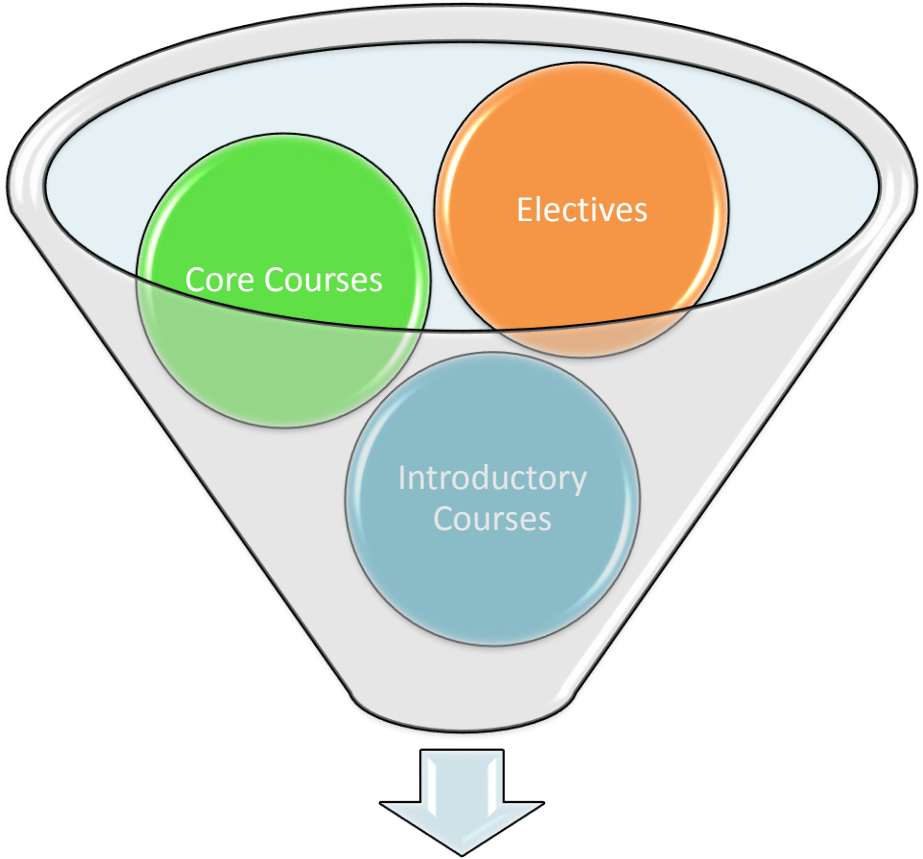
APIs are influencing a transformation in computing education.

APIs enable access to different contexts in computing.

Success relies on the ability to offer effective APIs.


Students should find our courses in resonance with the goals and aspirations that brought them to us in the first place.
Delete all indulgences to “create obstacles” to weed out students
Context is important!
Be prepared to handle the capacity
Do not succumb to the latest greatest technology fads.


Make sure it is inviting to all students.
Learn computing in engaging contexts
Design of Computing Curricula…
Flexibility in designing a major in computing
(Threads at GeorgiaTech, Streams, …)
Do not obsess over speed and efficiency in early curricula.



Computer Science: Curriculum (Re-Focus)

Elective Courses

Soihub.org

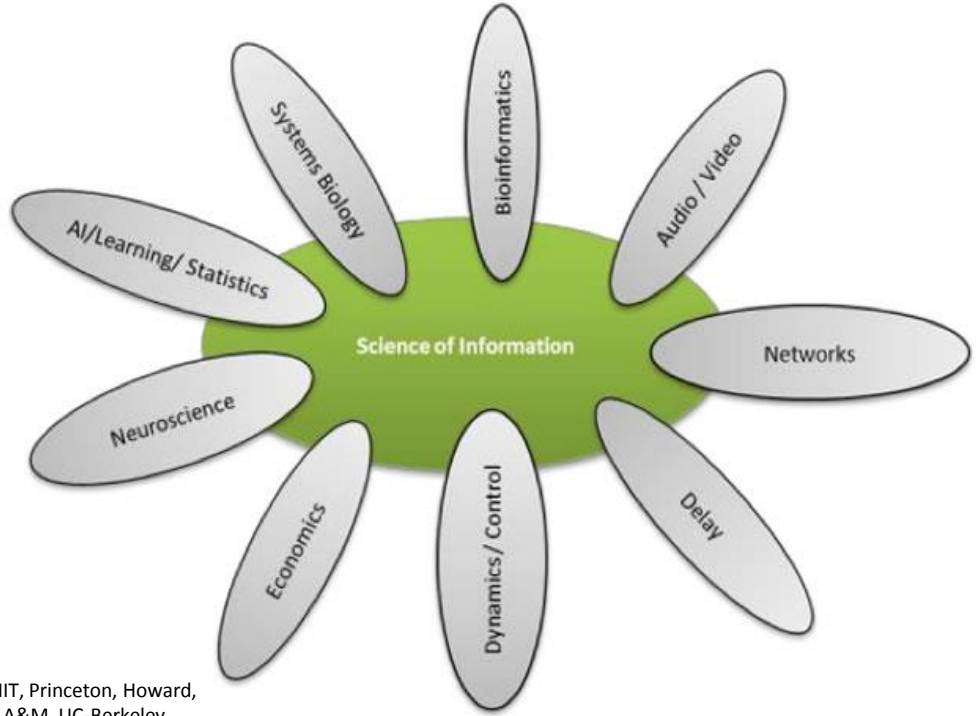
Center for Science of Information

An NSF Science & Technology Center

Bryn Mawr College, MIT, Princeton, Howard, Purdue, Illinois, Texas A&M, UC-Berkeley, Stanford, UC-San Diego, Hawai'i

Science of Information

Bringing Many Disciplines Together

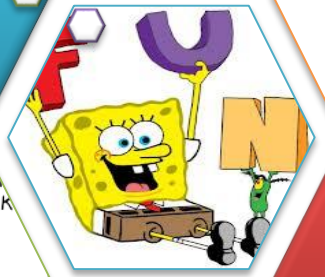


Bryn Mawr College, MIT, Princeton, Howard, Purdue, Illinois, Texas A&M, UC-Berkeley, Stanford, UC-San Diego, Hawai'i

10,000 Hours!

Make it fun

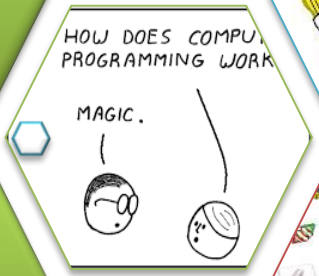
Read Programs



Learn half dozen programming languages!

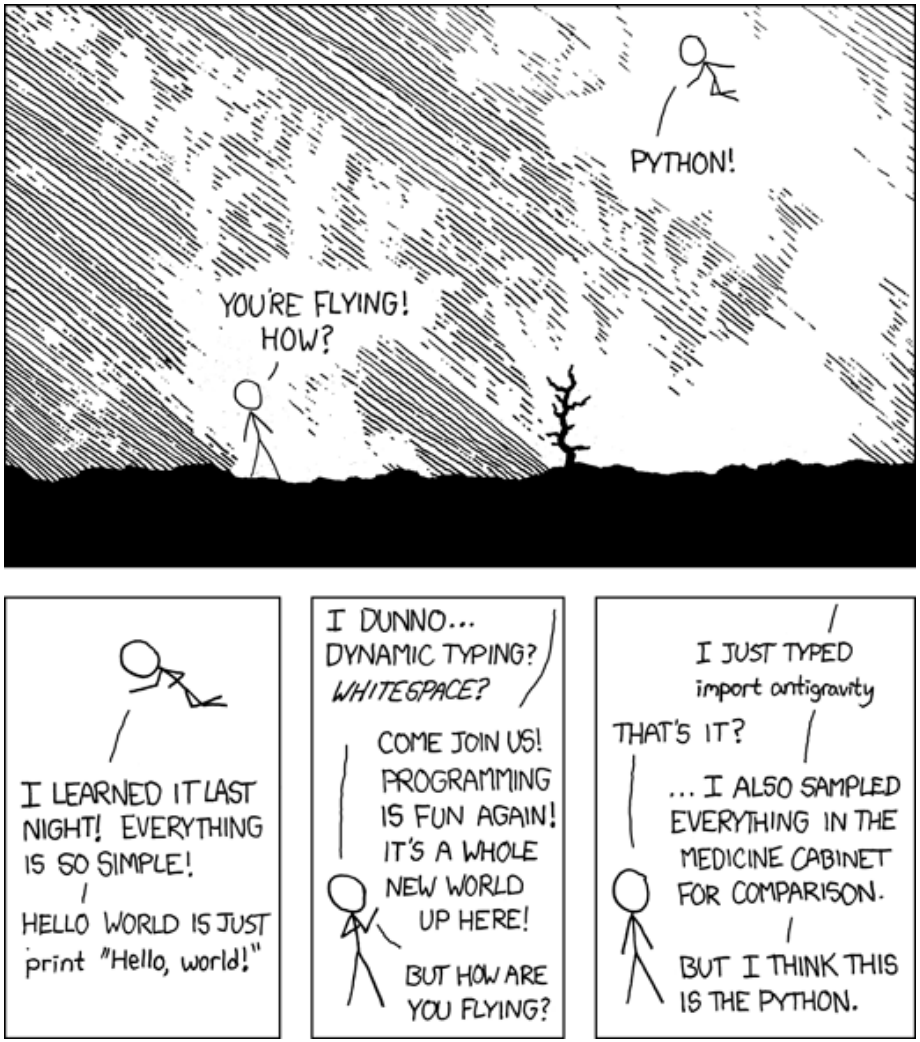
Encourage Playfulness

Program



Deliberate Practice

Work in Teams


PYTHON!
YOU'RE FLYING! HOW?
I LEARNED IT LAST NIGHT! EVERYTHING IS SO SIMPLE!
HELLO WORLD IS JUST print "Hello, world!"
I DUNNO... DYNAMIC TYPING? WHITESPACE?
COME JOIN US! PROGRAMMING IS FUN AGAIN! IT'S A WHOLE NEW WORLD UP HERE!
BUT HOW ARE YOU FLYING?
I JUST TYPED import antigravity
THAT'S IT?
... I ALSO SAMPLED EVERYTHING IN THE MEDICINE CABINET FOR COMPARISON.
BUT I THINK THIS IS THE PYTHON.

Thank you!