COMPUTER SCIENCE & ENGINEERING
UNIVERSITY OF MICHIGAN

Providing Computing Education for All

HOW SHOULD WE HELP ARTISTS LEARN ABOUT COMPUTING?

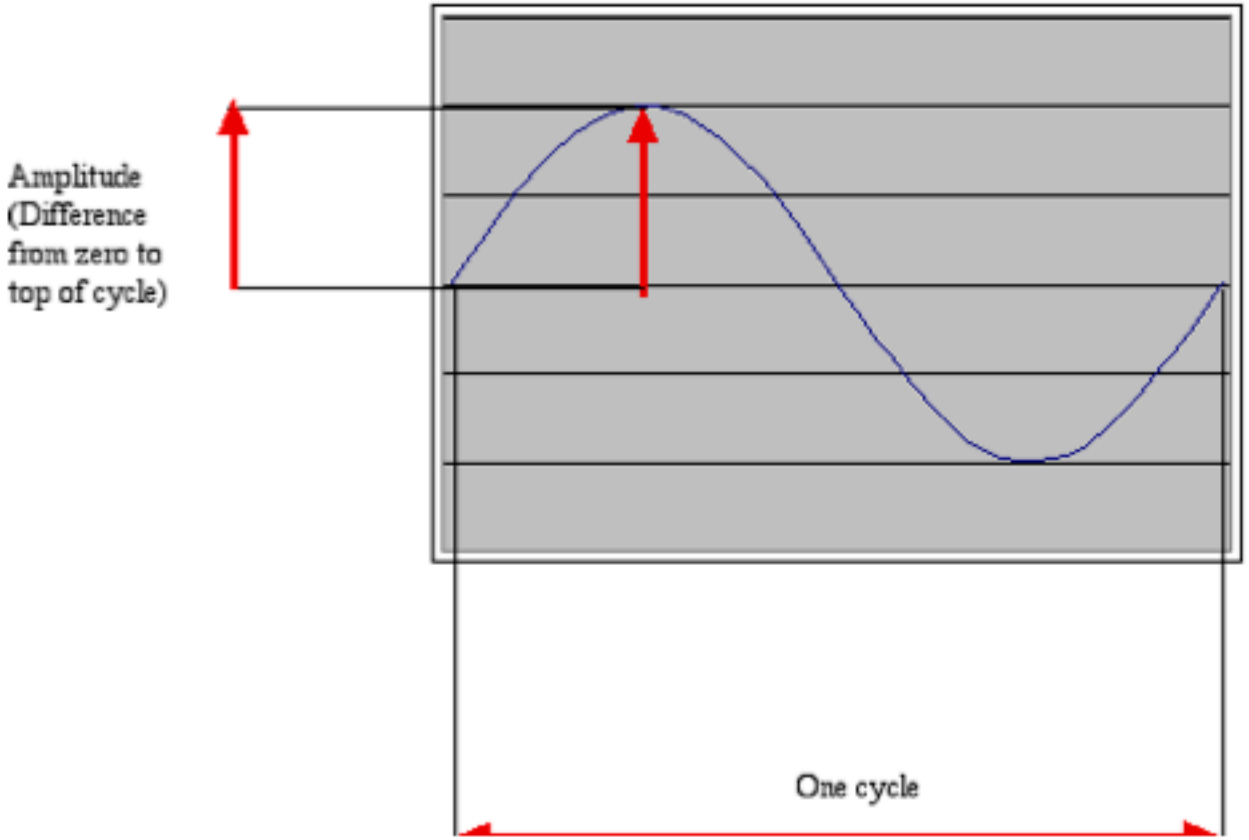
Three Part Story

- Example: Teaching about digital sound and being human.
- Example: Making computational art experiences accessible in K-12 classrooms
- New U. Michigan Program in Computation for the Arts and Science (PCAS)

Teaching programming As A Tool for Learning Powerful Ideas

IMAGINE YOU'RE A FIRST YEAR COLLEGE STUDENT…

Example 1: How sound works: Acoustics, the physics of sound



Reflection

- Prediction - PRIMM
- 7 Lines
- 1 Bit
- Learning without writing a Program

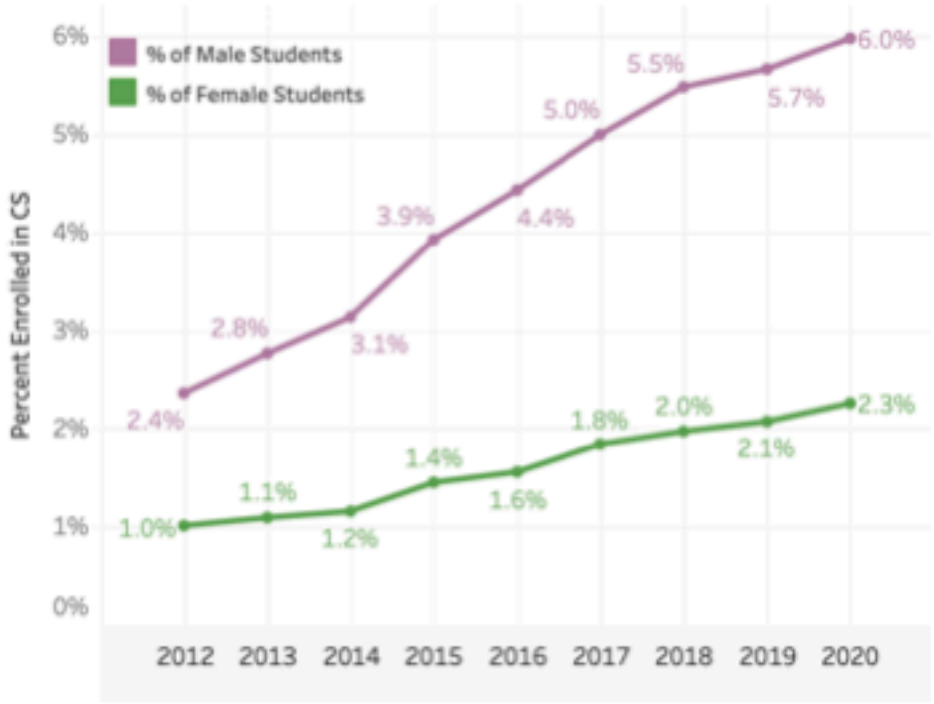
```
def maximize(sound):
  for sample in getSamples(sound):
    value = getSampleValue(sample)
    if value >= 0:
      setSampleValue(sample, 32767)
    if value < 0:
      setSampleValue(sample, -32767)
```

Teaching computing for insight into our world, not software development.

4.7%

4.7%

By Gender


% of Male Students
% of Female Students
Percent Enrolled in CS
6%
5%
4%
3%
2%
1%
0%
2.4%
2.8%
3.1%
3.9%
4.4%
5.0%
5.5%
5.7%
6.0%
1.0%
1.1%
1.2%
1.4%
1.6%
1.8%
2.0%
2.1%
2.3%
2012
2013
2014
2015
2016
2017
2018
2019
2020

Why?

1. As Youngmoo's students told us,

"Coding is hard."

2. And CS is *over there.*
That's not **where** the students ***are***.

2. My Research Focus: Task-Specific Programming

Goal: Use programming* to enhance learning in high school and university non-CS classes – where the students *are*.

* **N.B.** "programming" not "current programming languages."

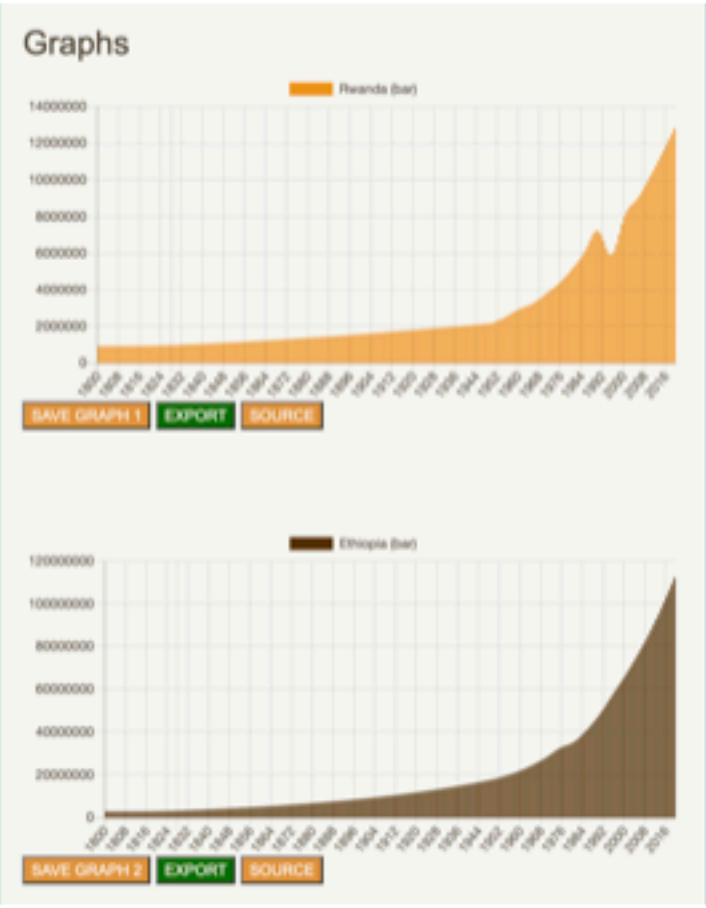
- Using participatory design with teachers to result in *adoptable* programming environments.

- Building task-specific programming environments to be *highly-usable*: Less than 10 minutes to become productive.

- *TSP* Languages => Teaspoon Languages
  Putting a Teaspoon of Computing in other subjects

DV4L

History In Data
Visualizations
Data
HELP
ENTER DRIVING QUESTION
DEFAULT
Driving Question:
How do rates of population growth among countries in the same region/continent compare? What explains observed differences?
Graph 1:
Database (y-axis): Populations
Location: Rwanda
Year Range (x-axis): 1800 2019
Graph type: bar
Color:
SUBMIT
Graph 2:
Database (y-axis): Populations
Location: Ethiopia
Year Range (x-axis): 1800 2019
Graph type: bar
Color:
SUBMIT
Light
Dark


Graphs
Rwanda (bar)
SAVE GRAPH 1
EXPORT
SOURCE
Ethiopia (bar)
SAVE GRAPH 2
EXPORT
SOURCE

Saved Graphs
Add Notes
Customize
Customize
Customize
Customize

1968
1982
1996
2010
{
"DB": "Populations",
"Yaxis": "Rwanda",
"lowDate": 1800,
"highDate": 2019,
"gtype": "bar"
}
x
Customize
Modify the json code in the scripting version of DV4L

History In Data

Visualizations

Data

UPLOAD SCRIPT | DEFAULT | CLEAR | HELP

Graph 1:

Database (DB): Populations

Y axis: Rwanda

Year Range: 1800 — 2019

Graph type: bar Color:

SUBMIT

```
{
  "DB": "Populations",
  "Yaxis": "Rwanda",
  "lowDate": 1800,
  "highDate": 2019,
  "gtype": "bar",
  "color": "orange"
}
```

Graph 2:

Database (DB): Populations

Y axis: Congo

Year Range: 1800 — 2019

Graph type: bar Color:

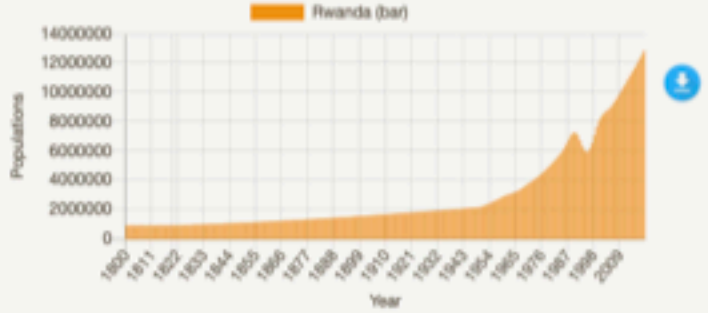
SUBMIT

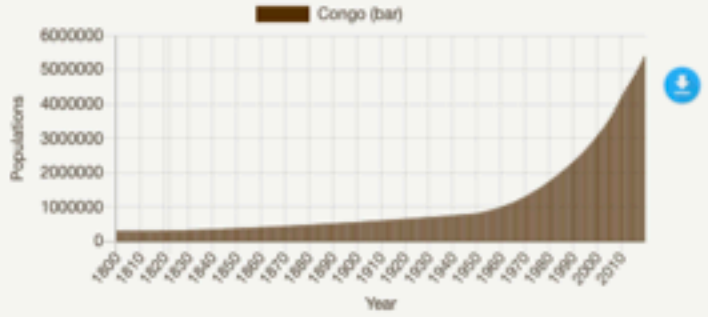
```
{
  "DB": "Populations",
  "Yaxis": "Congo",
  "lowDate": 1800,
  "highDate": 2019,
  "gtype": "bar",
  "color": "darkBrown"
}
```

Light Dark

Graphs

Are there any noticeable differences in the trend of population growth in the following countries? Why?





Pixel Equations

Pixel Equations

Select your preferred language/Seleccione su idioma preferido

- (•) English
- ( ) Español

Idioma/Language

Step 1: Pick your input picture

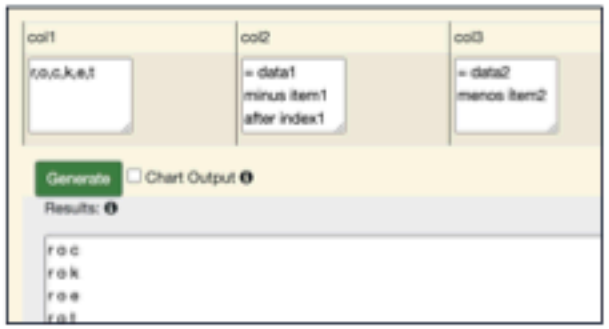
Which picture would you like to use?

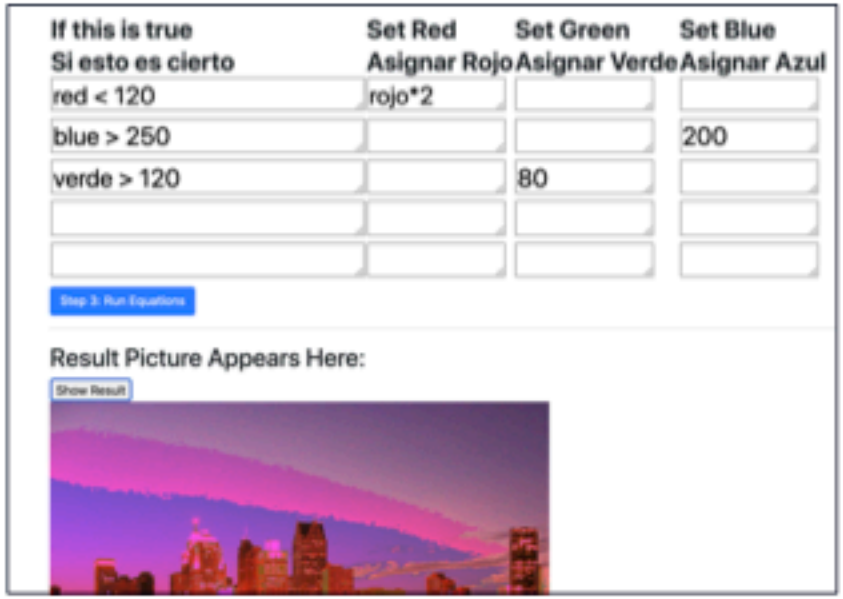
- (•) File named: arch.jpg
- ( ) File named: Bayamon.jpeg
- ( ) File named: beach.jpg
- ( ) File named: san-juan.jpeg
- ( ) File named: TSM-Map.png
- ( ) File named: detroit.jpg

This too is Programming

A place to learn about intermediate representations and debugging.

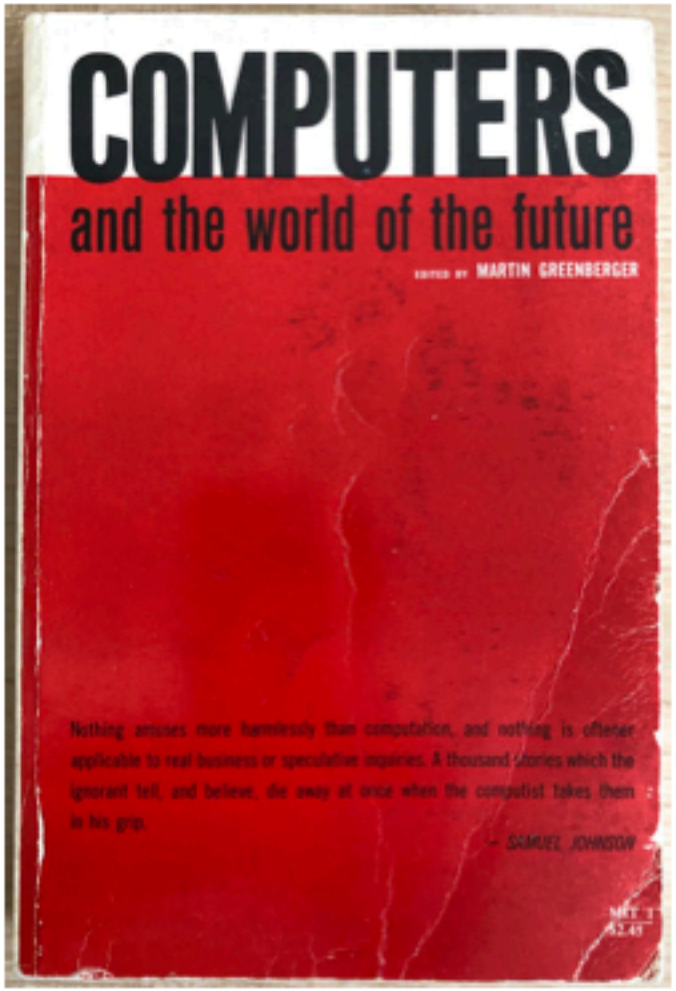
Useful tools in social studies, mathematics, engineering, and art.



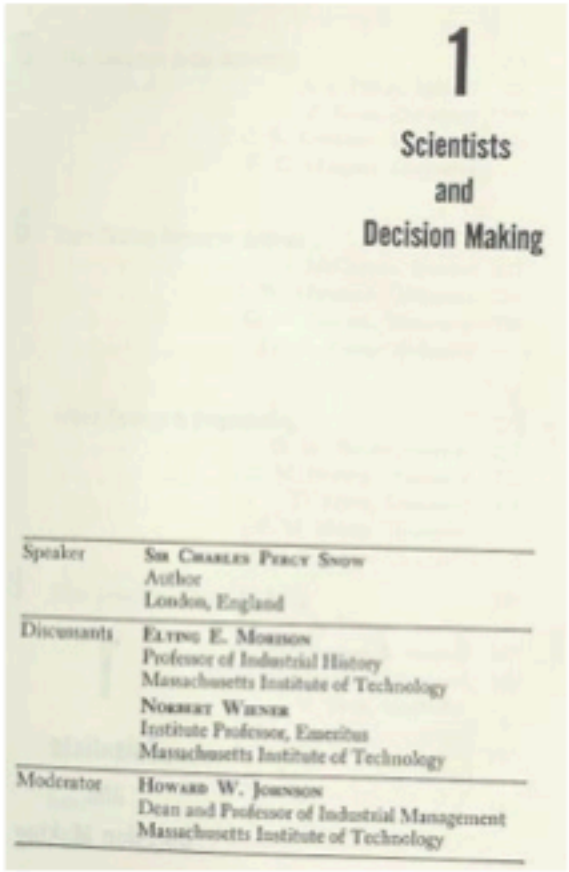


Please note the use of Spanish.
2/3 of the world does not speak English.

Reaching **everyone** requires new languages and tools



1961

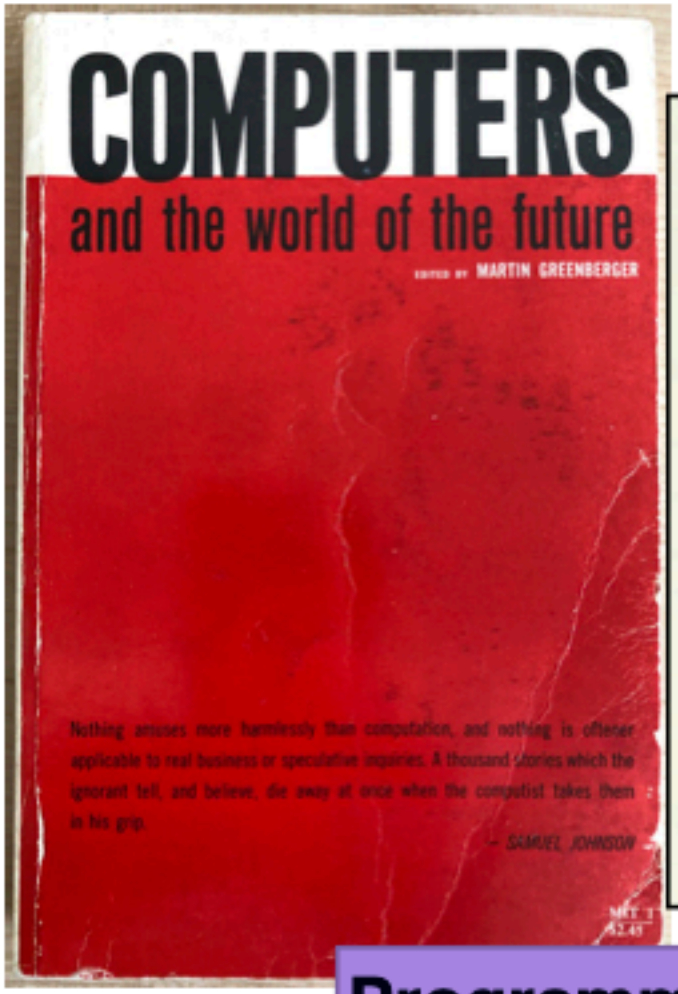


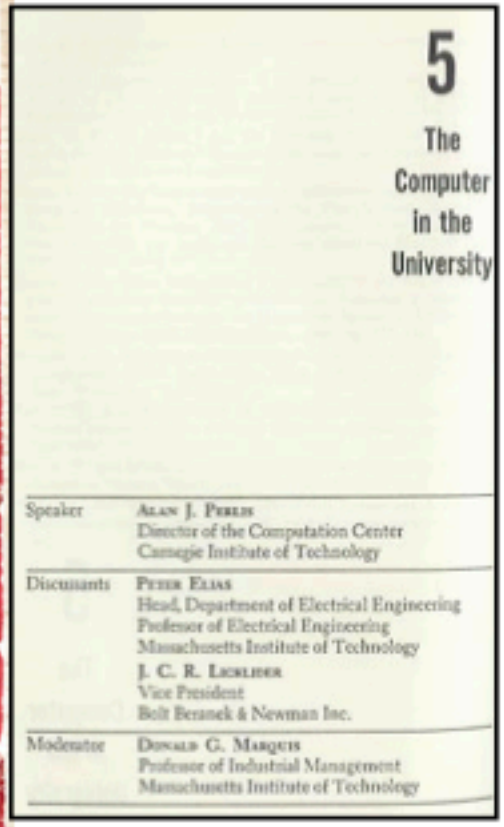
1

Scientists and Decision Making

Speaker	Sir Charles Percy Snow Author London, England
Discussants	Elting E. Morison Professor of Industrial History Massachusetts Institute of Technology Norbert Wiener Institute Professor, Emeritus Massachusetts Institute of Technology
Moderator	Howard W. Johnson Dean and Professor of Industrial Management Massachusetts Institute of Technology

"A handful of people, having no relation to the will of society, having no communication with the rest of society, will be taking decisions in secret which are going to affect our lives in the deepest sense."





5

The Computer in the University

Speaker	Alan J. Perlis Director of the Computation Center Carnegie Institute of Technology
Discussants	Peter Elias Head, Department of Electrical Engineering Professor of Electrical Engineering Massachusetts Institute of Technology J. C. R. Licklider Vice President Bolt Beranek & Newman Inc.
Moderator	Donald G. Marquis Professor of Industrial Management Massachusetts Institute of Technology

Alan Perlis

1961

Programming changes how we understand

Photo: CMU

Seymour Papert

```
TO NOUN
OUTPUT PICK [BIRDS DOGS WORMS DONKEYS GEESE CATS [GUINEA PIGS]]
END

TO VERB
OUTPUT PICK [HATE TRIP BITE LOVE]
END

TO ADJECTIVE
OUTPUT PICK [RED PECULIAR JUMPING FAT FUZZY [FUZZY WUZZY]]
END

TO SENGEN
PRINT (SENTENCE ADJECTIVE NOUN VERB ADJECTIVE NOUN)
SENGEN
END
```

When SENGEN is invoked,[1] this code produces sentences such as

```
RED GUINEA PIGS TRIP FUZZY WUZZY DONKEYS
PECULIAR BIRDS HATE JUMPING DOGS
FAT WORMS HATE PECULIAR WORMS
FAT GEESE BITE JUMPING CATS
```

1968

Seymour Papert claimed "that children can learn to program and learning to program can affect the way that they learn everything else."

What do LSA students need to know about computing?

LSA COLLEGE OF LITERATURE, SCIENCE, AND THE ARTS UNIVERSITY OF MICHIGAN

HOME MEET THE TASK FORCE TASK FORCE CHARGE RESOURCES CONTACT LSA

- Three themes for U-Michigan LSA Computing Education:
- ***Computing for Discovery***
  - More than data science. Computational scientists create models and simulate them.
- ***Computing for Expression***
  - From social media to Pixar, computing is changing forms of human expression.
- ***Computing for Justice***
  - Computing systems can encode and exacerbate inequities.

Computing Education Task Force (CETF)

The Computing Education Task Force (CETF) was launched in the Fall of 2020. This faculty task force is

Activities

New! Computing Education Task Force Progress

A Program in Computation for Arts and Sciences (*Just Announced*)

Programming can be a Tool for Learning Anything, including Discovery, Expression, and Justice

WE NEED TO *MAKE* COMPUTING FOR EVERYONE

Collaborators on This Work

- Barbara Ericson, Miranda Parker, Kathryn Cunningham, Amber Solomon, Bahare Naimipour, Tamara Nelson-Fromm, Emma Dodoo, Tammy Shreiner, Elise Lockwood, Adaline de Chenne, Gus Evrard.
- Undergraduate researchers: Aryan Bannerjee, Alexandra Rostkowycz, Erin Shi, Brandon Geng, Jessica Zhang, Ben Steinig, Kashmira Reddy, Kristen Taurence, Angela Li, Derrick White, Jessie Houghton.
- Work in social studies funded by NSF CSforAll #2030919

- http://computinged.wordpress.com
- http://guzdial.engin.umich.edu

Thank you!