

The background features a dark blue field on the left with white text. On the right, there are geometric shapes: a grey triangle at the top with white wavy lines, a blue triangle below it, and a 3D wireframe plot with a color gradient from yellow to blue. In the bottom right, there are faint blue circuit-like diagrams.

MATLAB EXPO 2017

Academic Faculty Focus Track

Academic Faculty Focus Track

Time	Session	Speaker
11:45am – 12:15pm	Academic Keynote	Jim Tung, MathWorks Fellow
12:15 – 1:30pm	Effective Teaching Techniques using MATLAB and Simulink – Part 1	Prof. Arun Tangirala, IIT Madras
2:45 – 3:30pm	Effective Teaching Techniques using MATLAB and Simulink – Part 2	Prof. Arun Tangirala, IIT Madras
3:45 – 4:30pm	Leveraging MathWorks Resources for Academia	Dr. Viju Ravichandran, MathWorks
4:45 – 5:30pm	Building a Course Implementation Plan	Anuja Apte and Dr. Viju Ravichandran, MathWorks

MATLAB EXPO 2017

Computational Thinking: Making an Impact on Engineering Education

Jim Tung
MathWorks Fellow
jim@mathworks.com

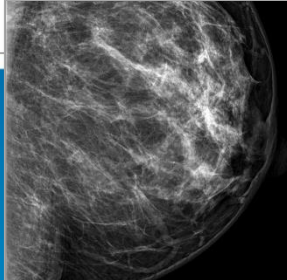
Industry Case Studies



**Spectral Imaging:
Breast Density Measurement
Using Matlab Coder**

Abha Ramesh Chandra
Sr. Technical Specialist
Philips India Limited, Bangalore
January 15, 2017

innovation + you



Introduction

www.ifbappliances.com

- The IFB group celebrates over four decades of technical excellence, leading technology solutions that have touched people's lives
- IFB Launched first connected washing machine that can connect with Smartphone via Bluetooth.

1989 - India's First Front loader washing machine	2002 - India's First Digital washing machine	2013 - India's First Connected washing machine
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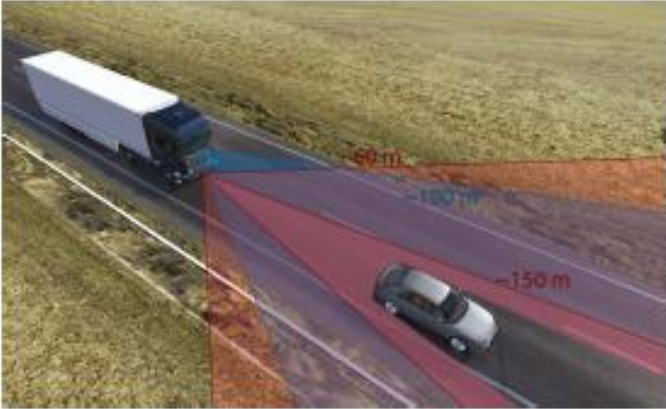
Smart phone?
Take Control!

IFB Senoria Smart Front Loader

Scania Automatic Emergency Braking System

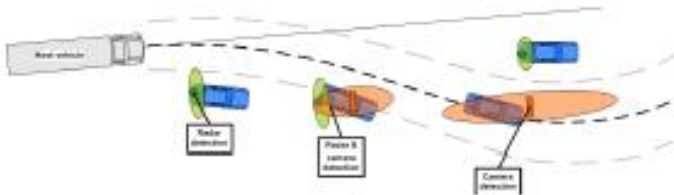
Sensor fusion

Two sensors -> One "truth"




Sensors have different advantages

- Radar
 - + Range (longitudinal)
 - + Relative velocity
 - + Solid object reflection
 - No shapes
 - Lateral position
- Camera
 - + Object type
 - + Object width
 - + Lateral position
 - Range
 - Optical illusions



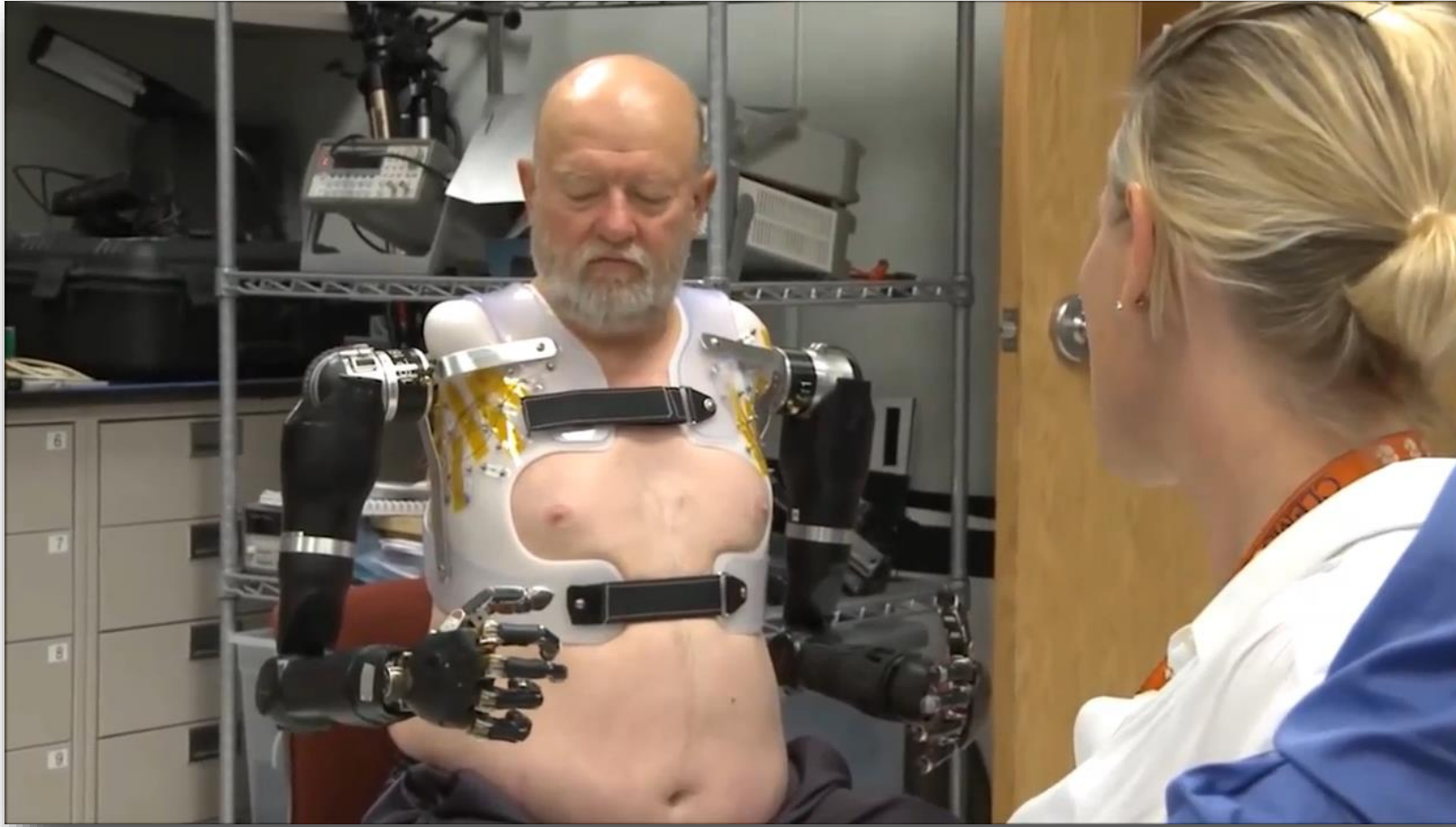
2015-09-24 Jerry Andersson



Scania Automatic Emergency Braking System



Johns Hopkins Thought-controlled Prosthetic Arms



Combines

- Pattern recognition algorithms classify neural signals to movement
- Controls
- Virtual simulator for training

Computational Thinking

2006



“Computational Thinking is the thought processes involved in formulating problems and their solutions ... in a form that can be effectively carried out by an information-processing agent.”

- Cuny, Snyder, Wing

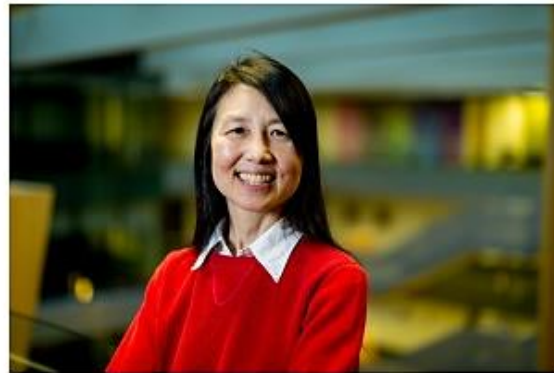
Computational Thinking

Computational thinking, 10 years later

Rate this article ★★★★★

March 23, 2016 By Microsoft Research Blog

f 0 t 0 in 99



By Jeannette M. Wing, corporate vice president, Microsoft Research

“Computational thinking will be a fundamental skill used by everyone by the middle of the 21st century...as fundamental as reading, writing and arithmetic.”

-Wing

Computational Thinking

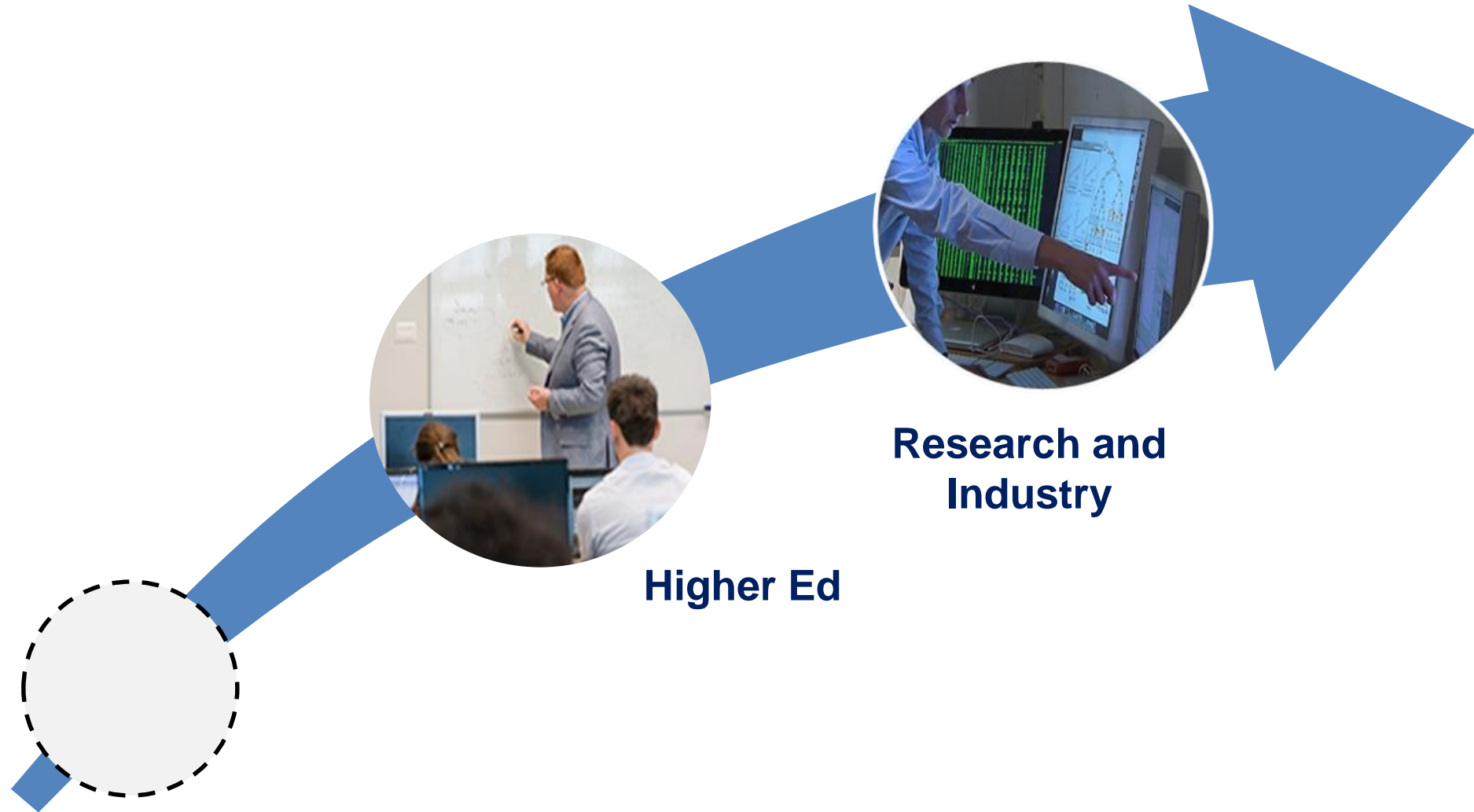
A Thought Process to Formulate
Problems and Solutions



Computational Thinking: Making an Impact on Engineering Education

1. How can we teach **Computational Thinking** effectively in Higher Ed?
2. Can **Computational Thinking** be introduced earlier?
3. How can we prepare students so they can use **Computational Thinking** after they graduate?

The Computational Thinking Continuum



How Can We Teach Computational Thinking?

**Computational
Thinking**

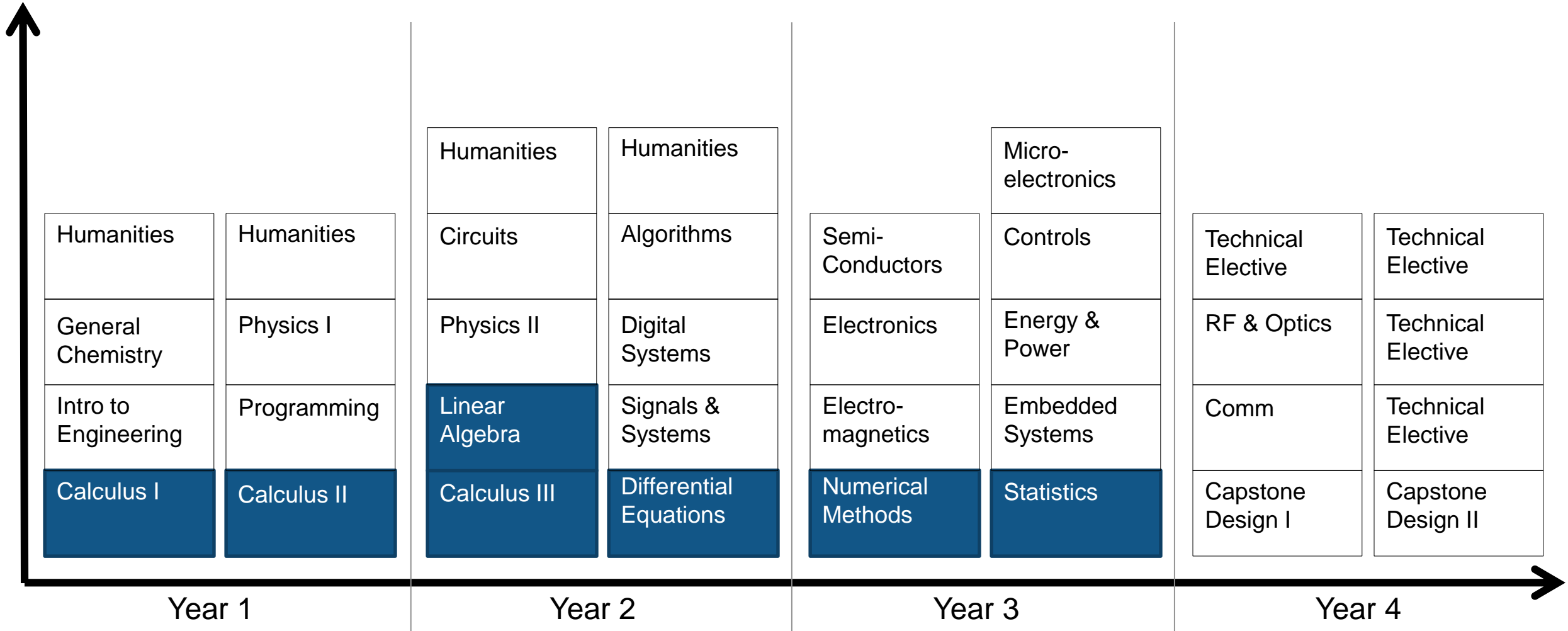
**Do students just “pick up”
computational thinking?**

VS

Math Skills

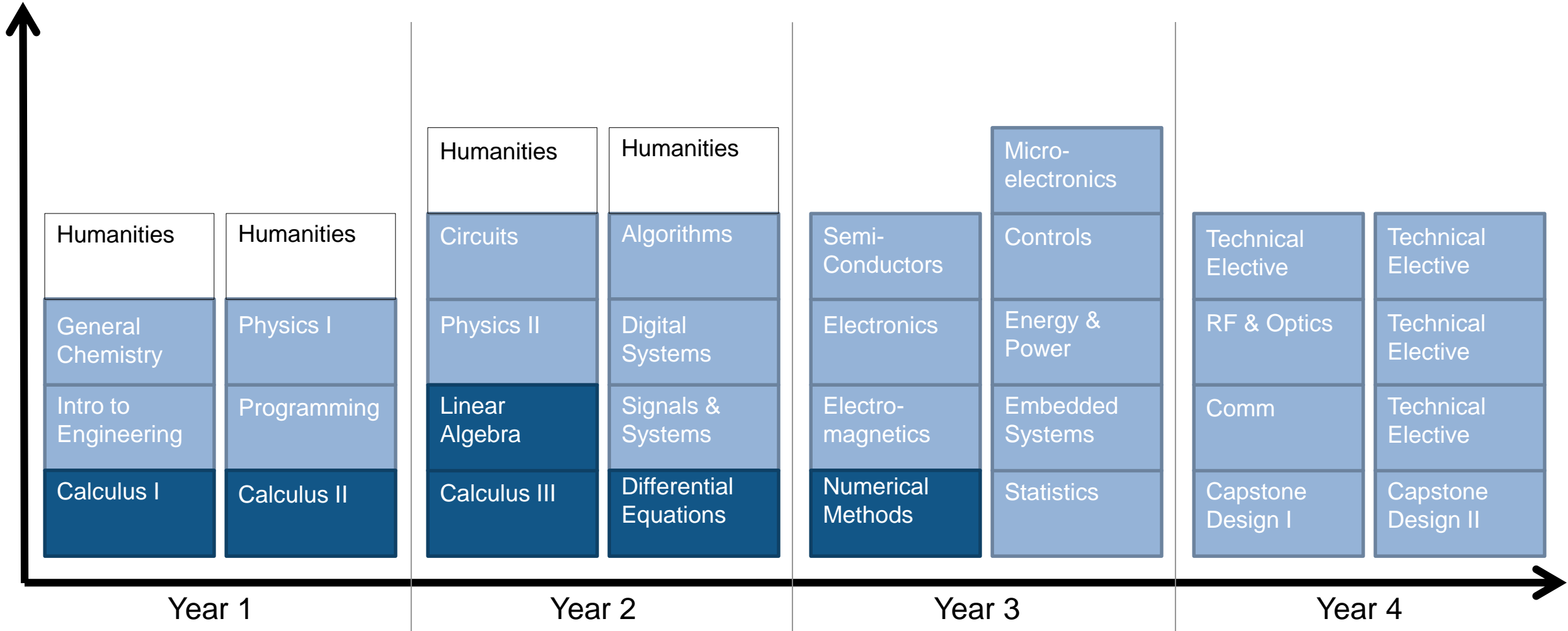
**Isn't math taught
systematically and reinforced
throughout the curriculum?**

How Math is Introduced in a 4-Year EE Curriculum?



Core Math Courses

How Math is Used in the Curriculum?

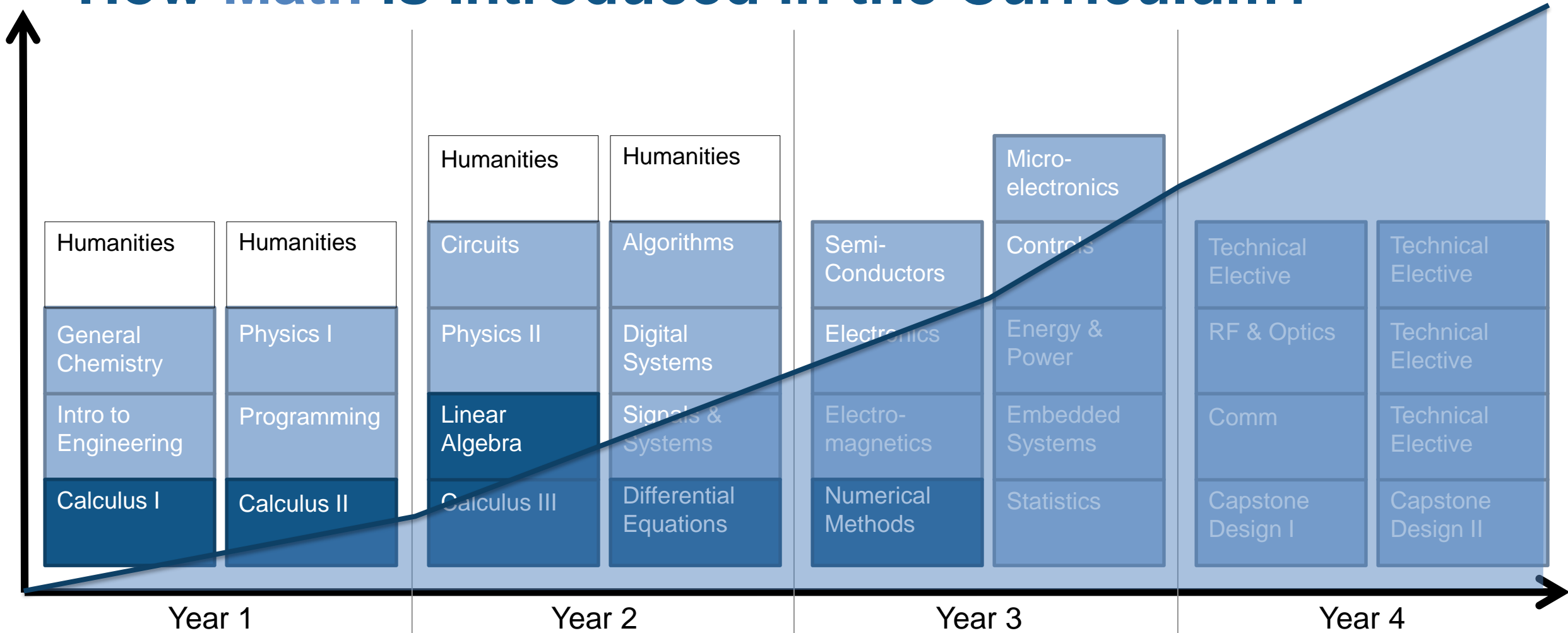


Core Math Courses



Courses applying Math

How Math is Introduced in the Curriculum?

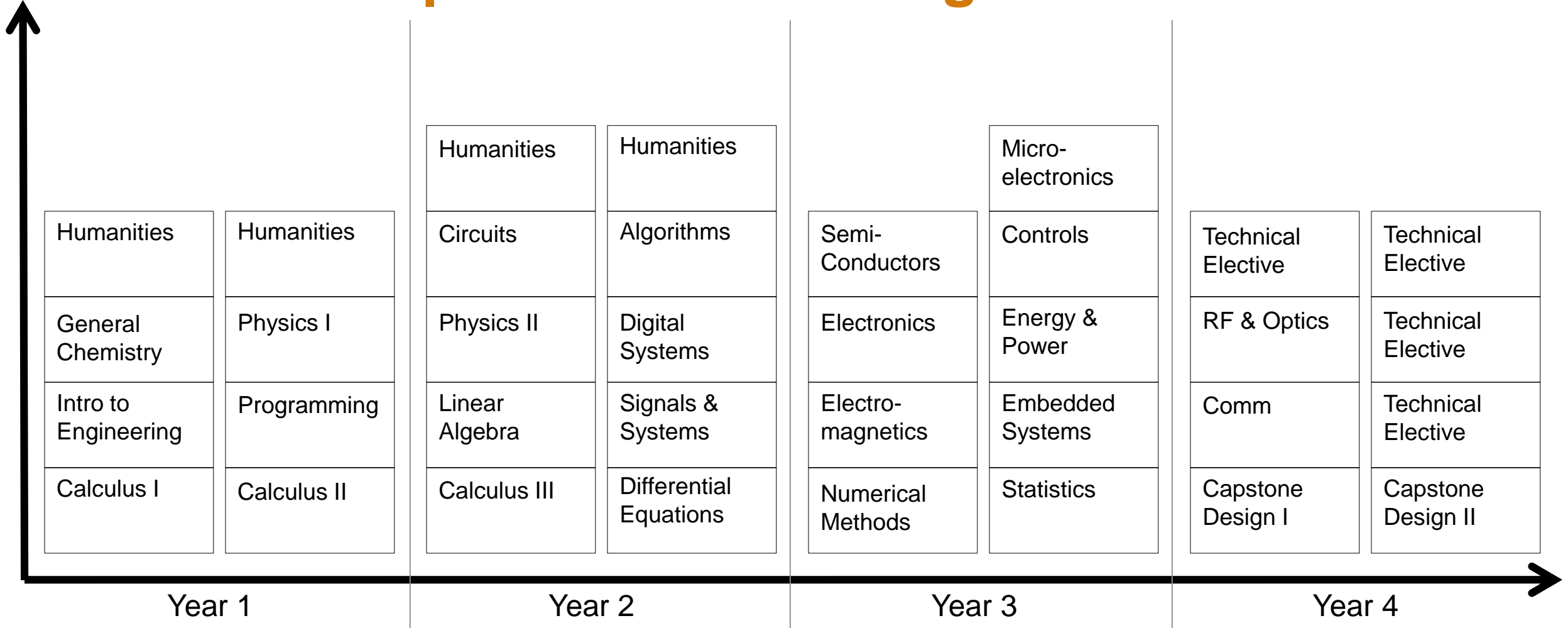


Core Math Courses

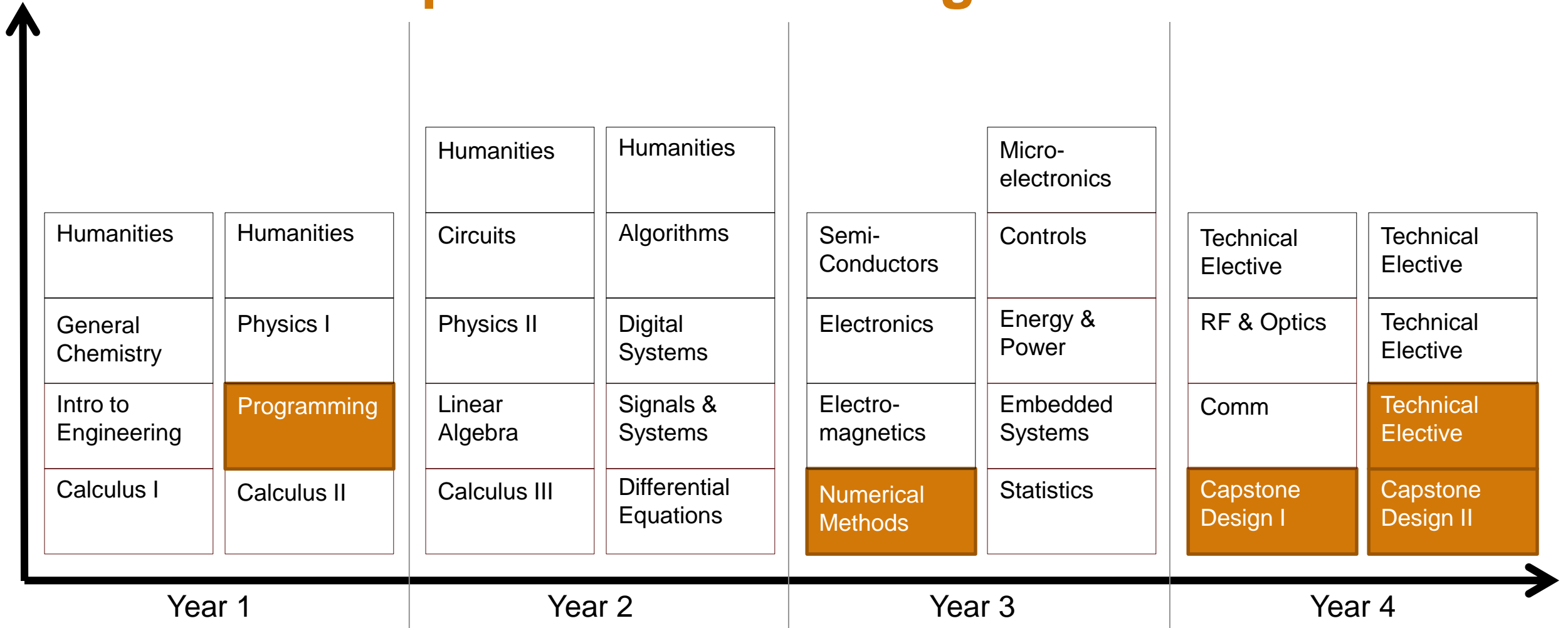
Courses applying Math

Students' cumulative Math proficiency

How is Computational Thinking Introduced?

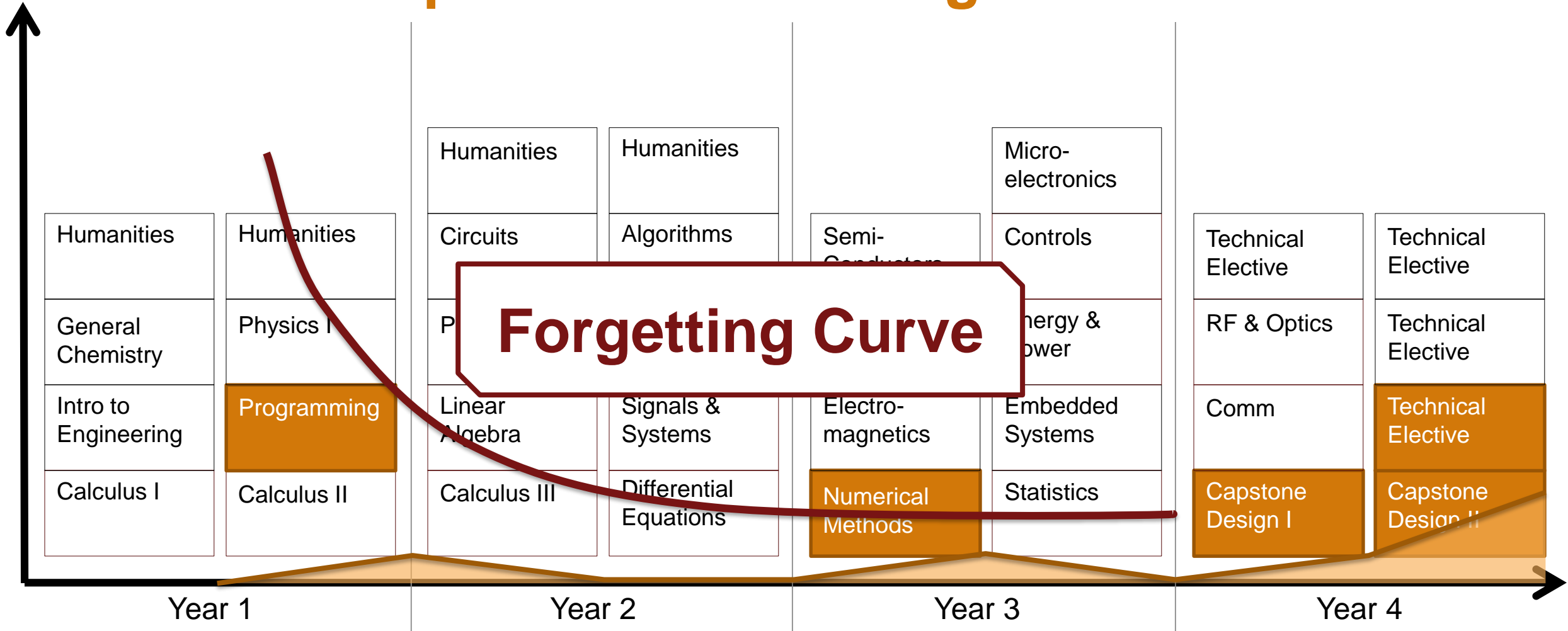


How is Computational Thinking Introduced?



Computational Courses

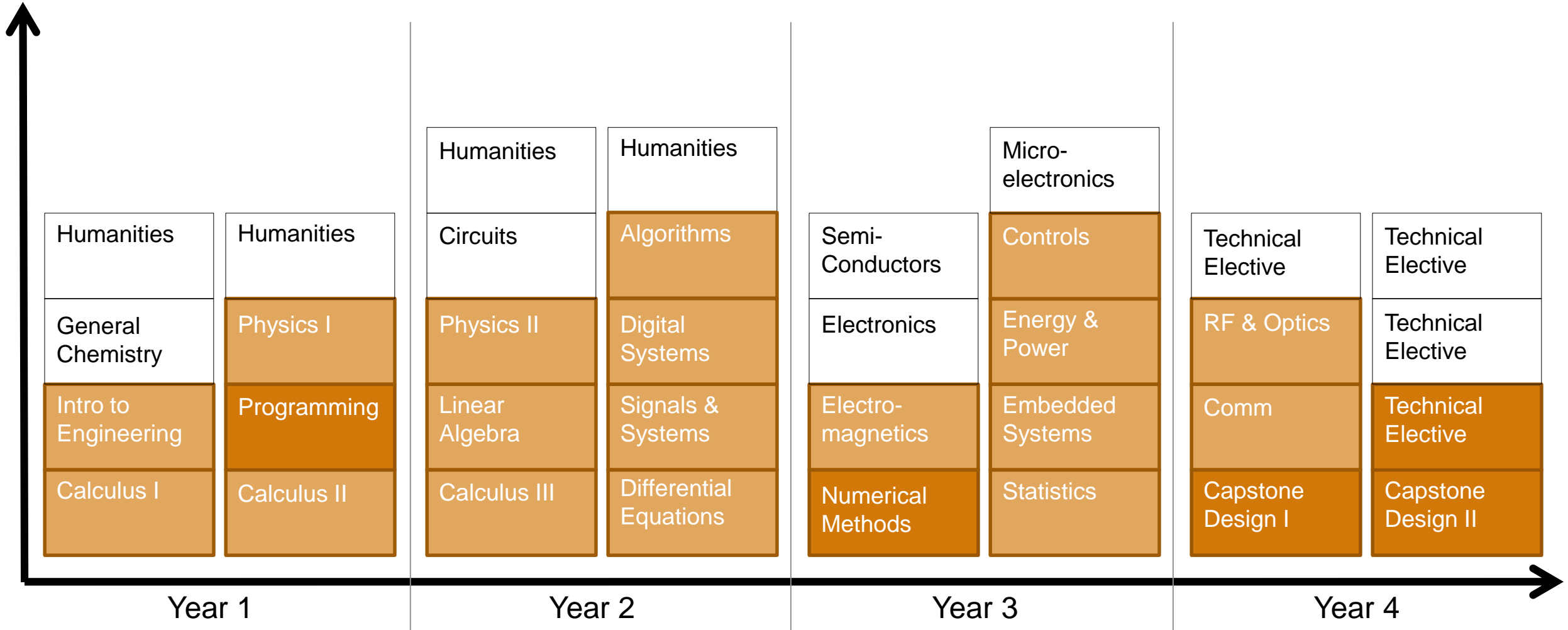
How is Computational Thinking Introduced?



Computational Courses

Students' cumulative Computational proficiency

Should Computational Thinking be built up like we introduce Math?

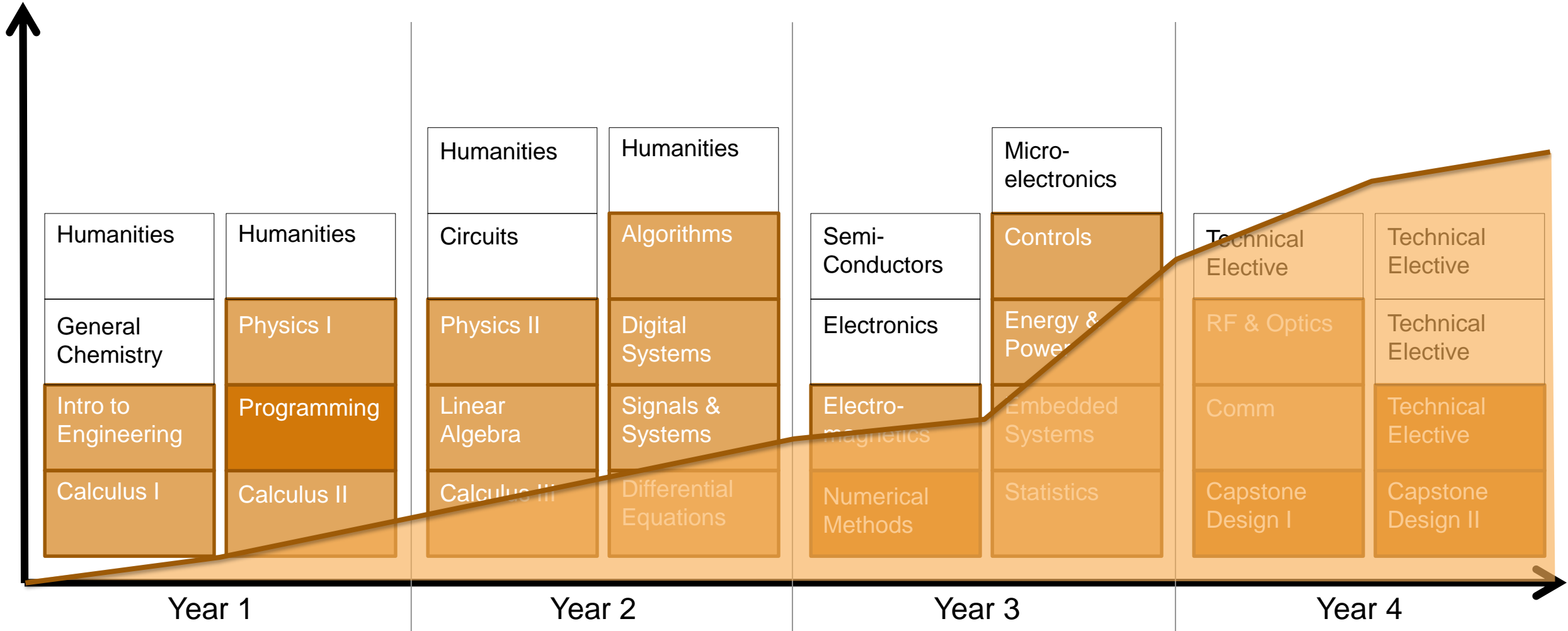


Computational Courses

Courses using Computation

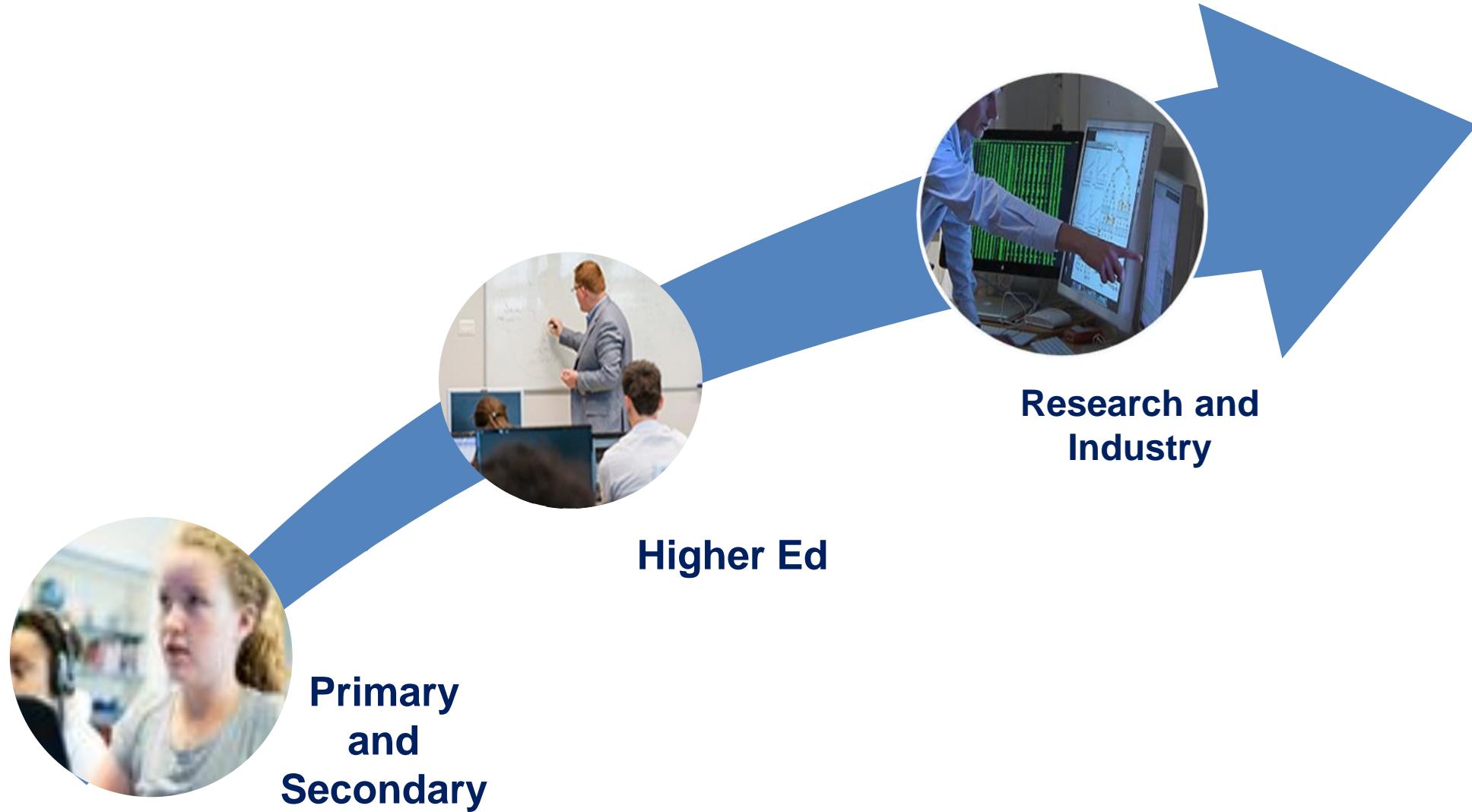
Students' cumulative Computational proficiency

Integrated Curriculum for Computational Thinking



Computational Courses
 Courses using Computation
 Students' cumulative Computational proficiency

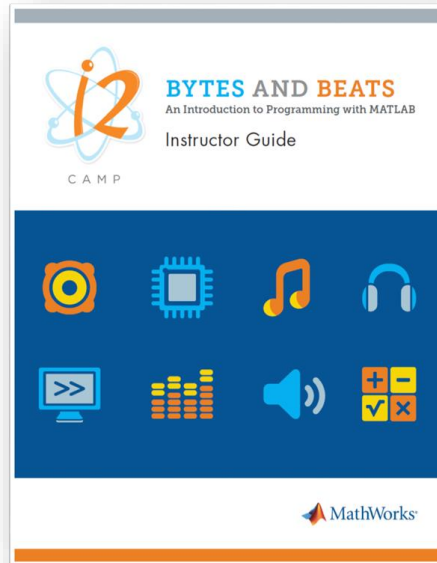
Can we introduce Computational Thinking earlier?



i2- iNVENT and iNSPIRE



- **i2- iNVENT and iNSPIRE**
 - Worldwide camp at 50 locations
 - Expanding to middle schools
- **Partners with leading STEM organizations, e.g.**
 - MIT Media Lab, Stanford, Woods Hole Oceanography, Bose, MathWorks



MATLAB Programming with Music

```

function song (pitch, speed)
load('musicNotes');

% Notes being used: G4 A4 G5 E5 F5 394.2 440 493.9 392 C4 D5]

% intro
notes = [G4 A4 G4 A4 G5 G4 G4 A4 A4 G5 G4 E5 G4 E5 G5 G4 G4 E5 E5 G5 C
% first verse
notes2 = [G5 E5 F5 E5 D5 F5 G5 E5 F5 E5 D5 G4 G5];
% short scale, goes down at end
notes3 = [394.2 440 493.9 392];
% secondnd verse same speed & pause as the intro
notes4 = [G5 E5 G5 E5 D5 C4 G5 E5 D5 G5 E5 G5 E5 D5];
% slow
notes5 = [E5 G5];
% loops back to intro
% final note, double past long notes in section 5
notes6 = G5;

% intro
for k = 1:30

    %sineSound(notes(k)/pitch, 0.2/speed);
    board.playTone('D3', notes(k)/pitch, 0.2/speed);
    pause(0.2/speed)
    plot(notes)

end

```



Computational Thinking in Primary and Secondary

“Programming in MATLAB teaches you how to think in a logical way”

Trinity High School, Indiana



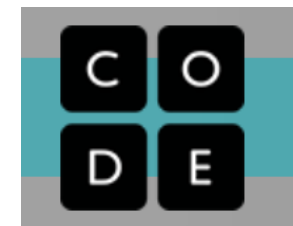
French Engineering Olympiad



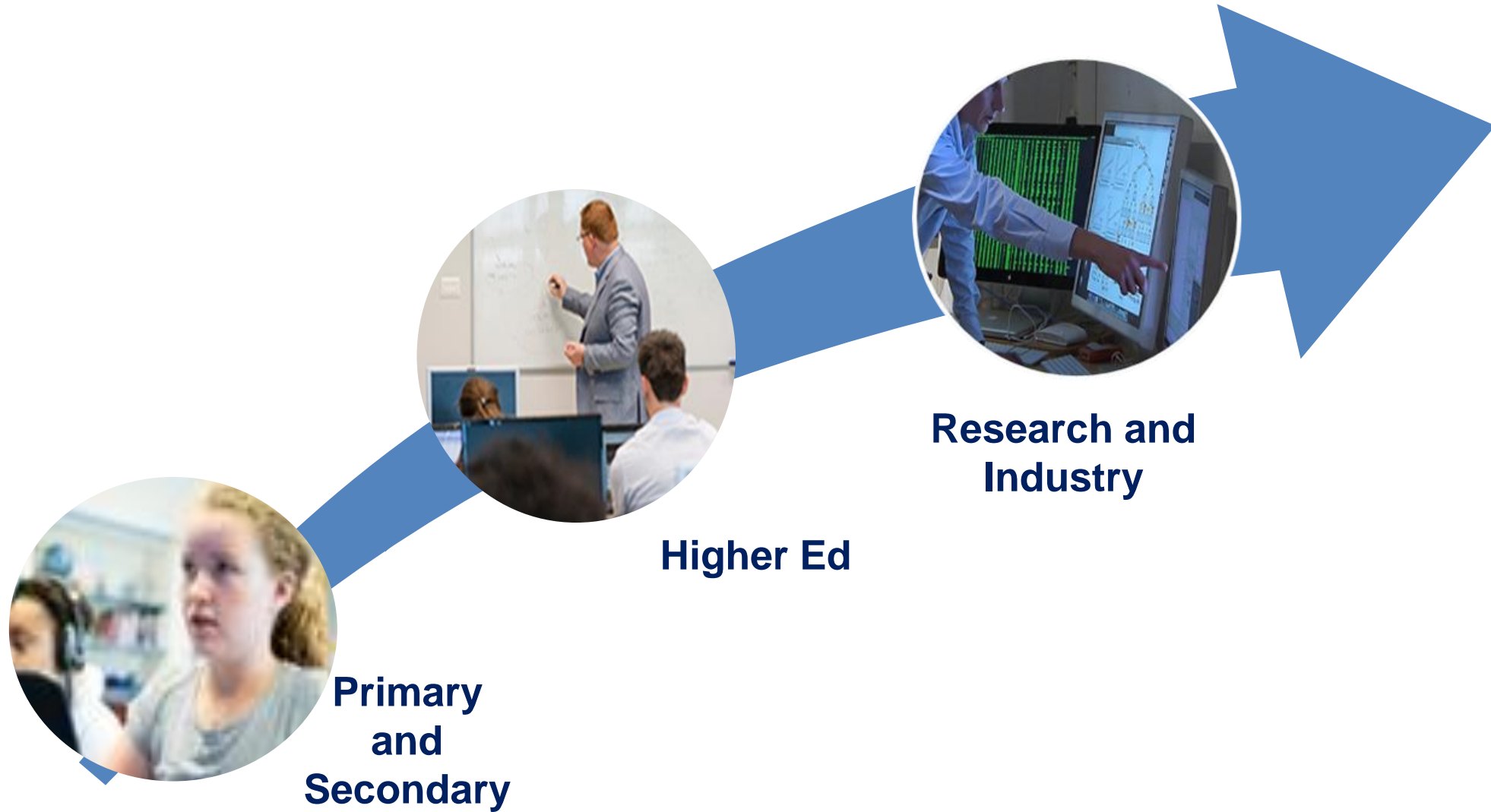
LEARN TO CODE
with MATLAB

Learn to Code is an online, interactive tutorial that teaches the basics of programming using MATLAB.

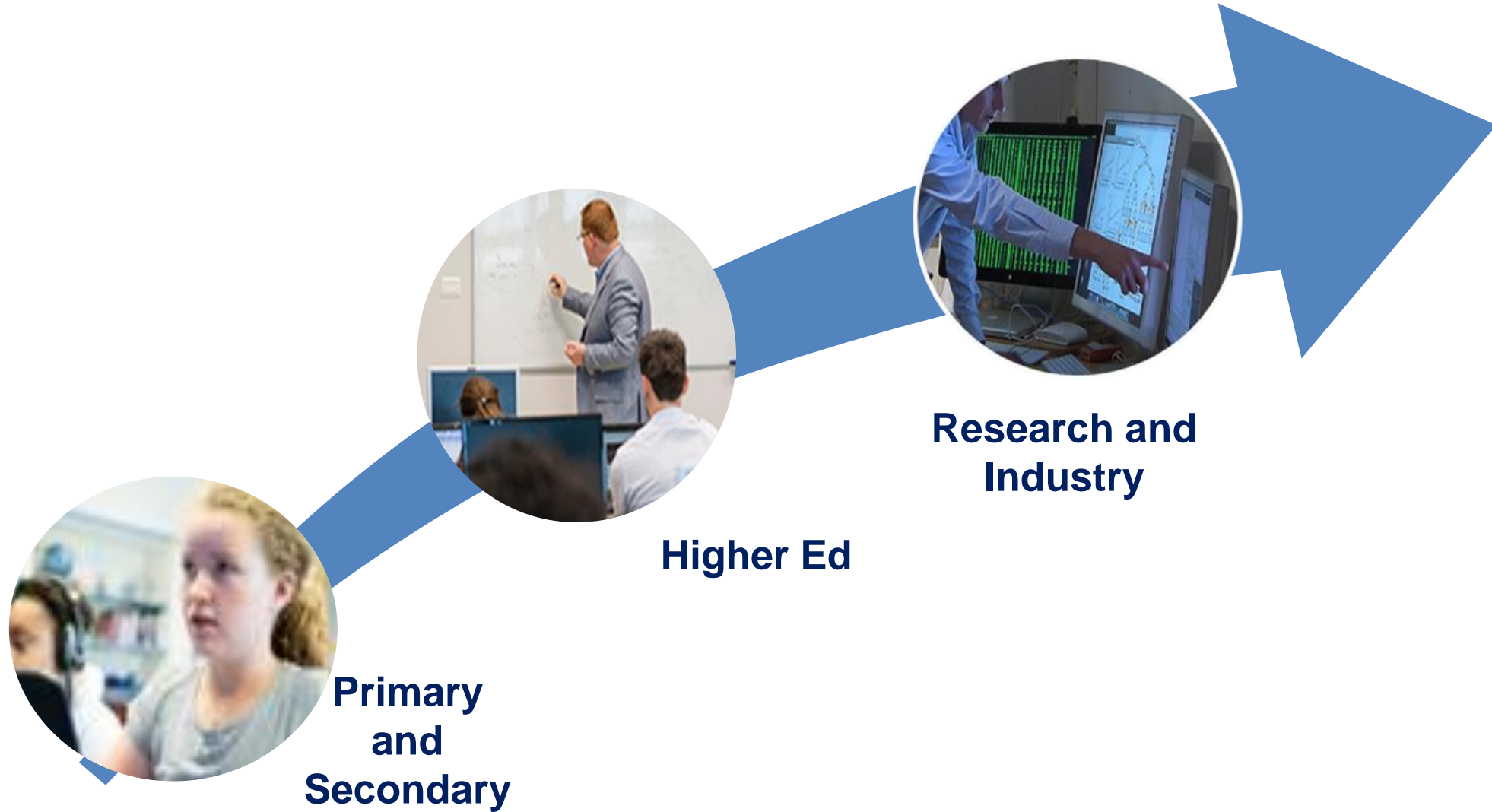
Let's get started



The Computational Thinking Continuum

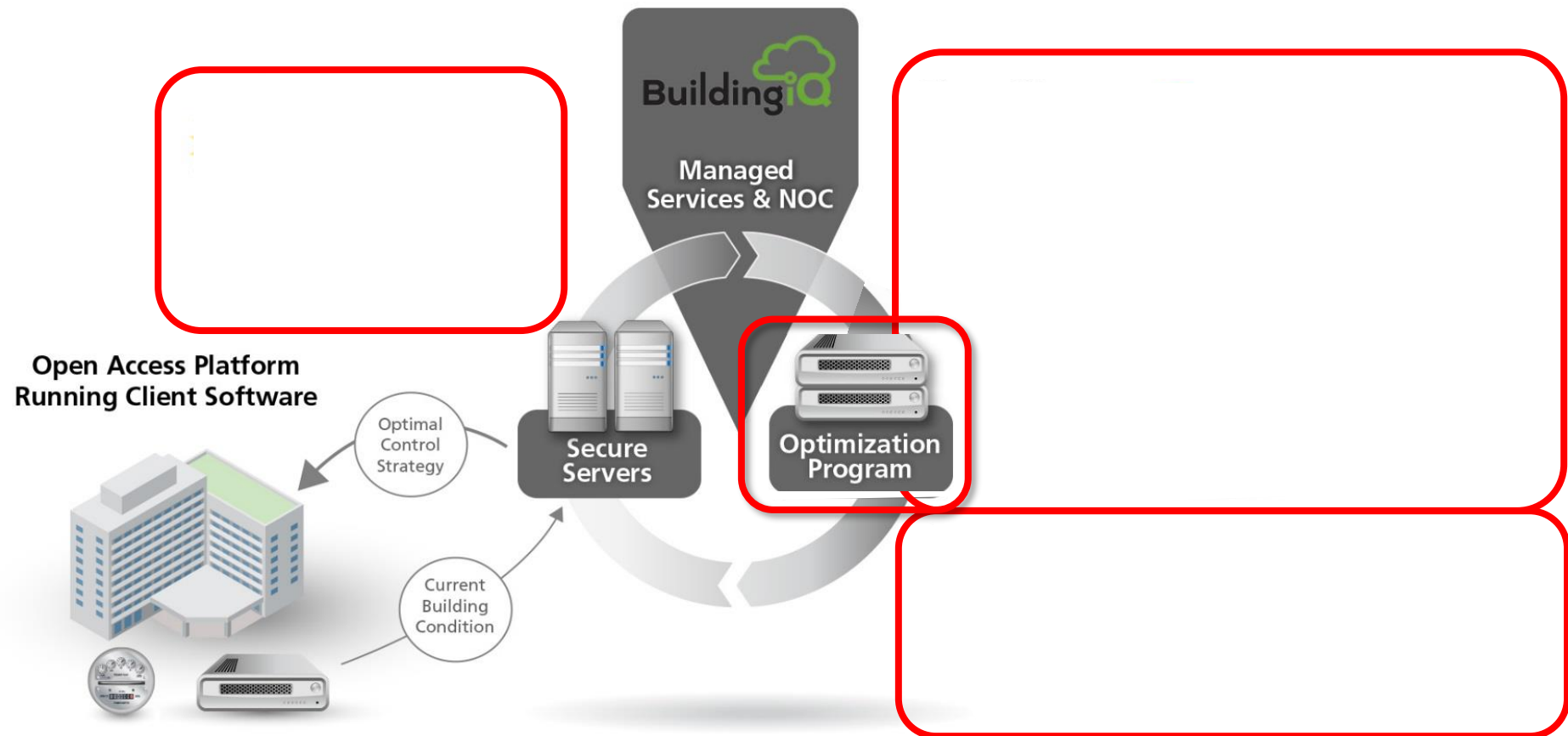


The Computational Thinking Continuum



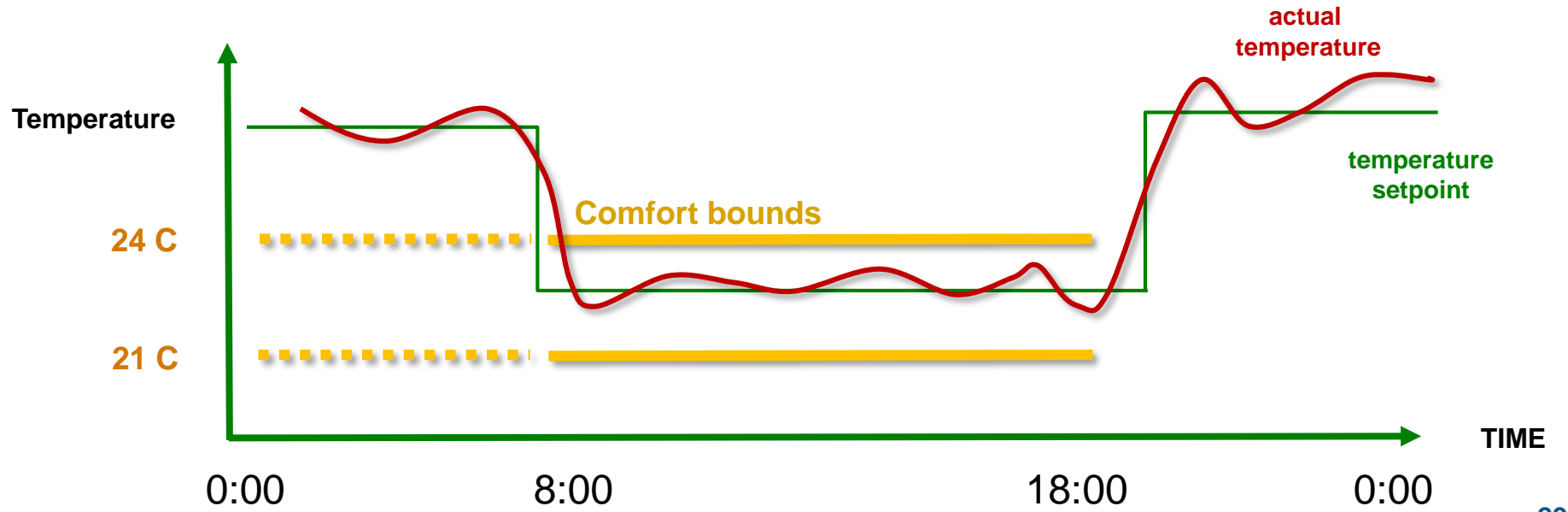
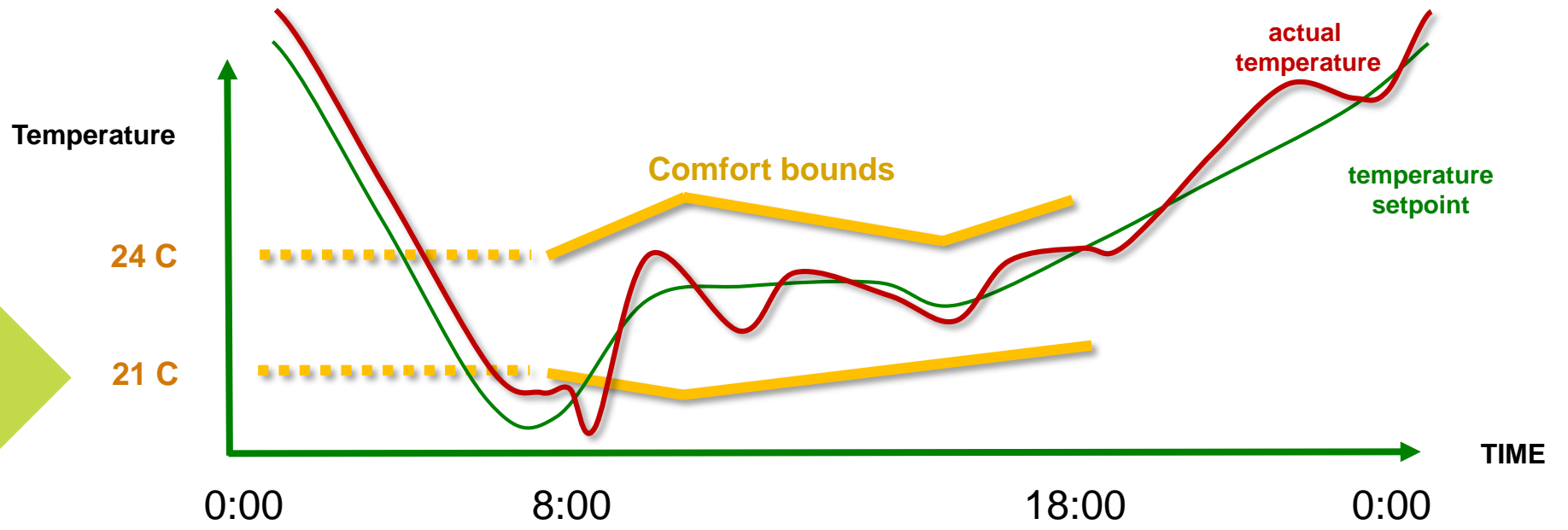
BuildingIQ

Adaptive building energy management



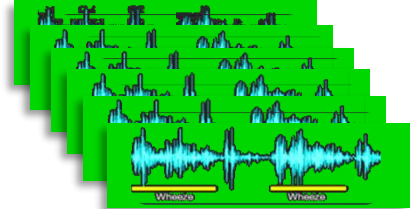
BuildingIQ

25% cost reduction



Respiri

Cloud + Embedded Analytics
for wheeze detection and asthma management



Windpipe sound capture
and processing to clean up
and reduce ambient noise

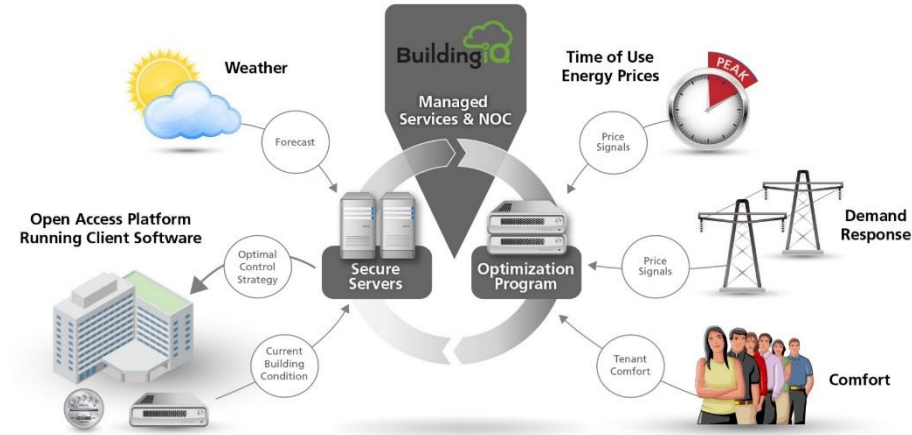


Find key characteristics
and classify the wheeze



Internet of Things

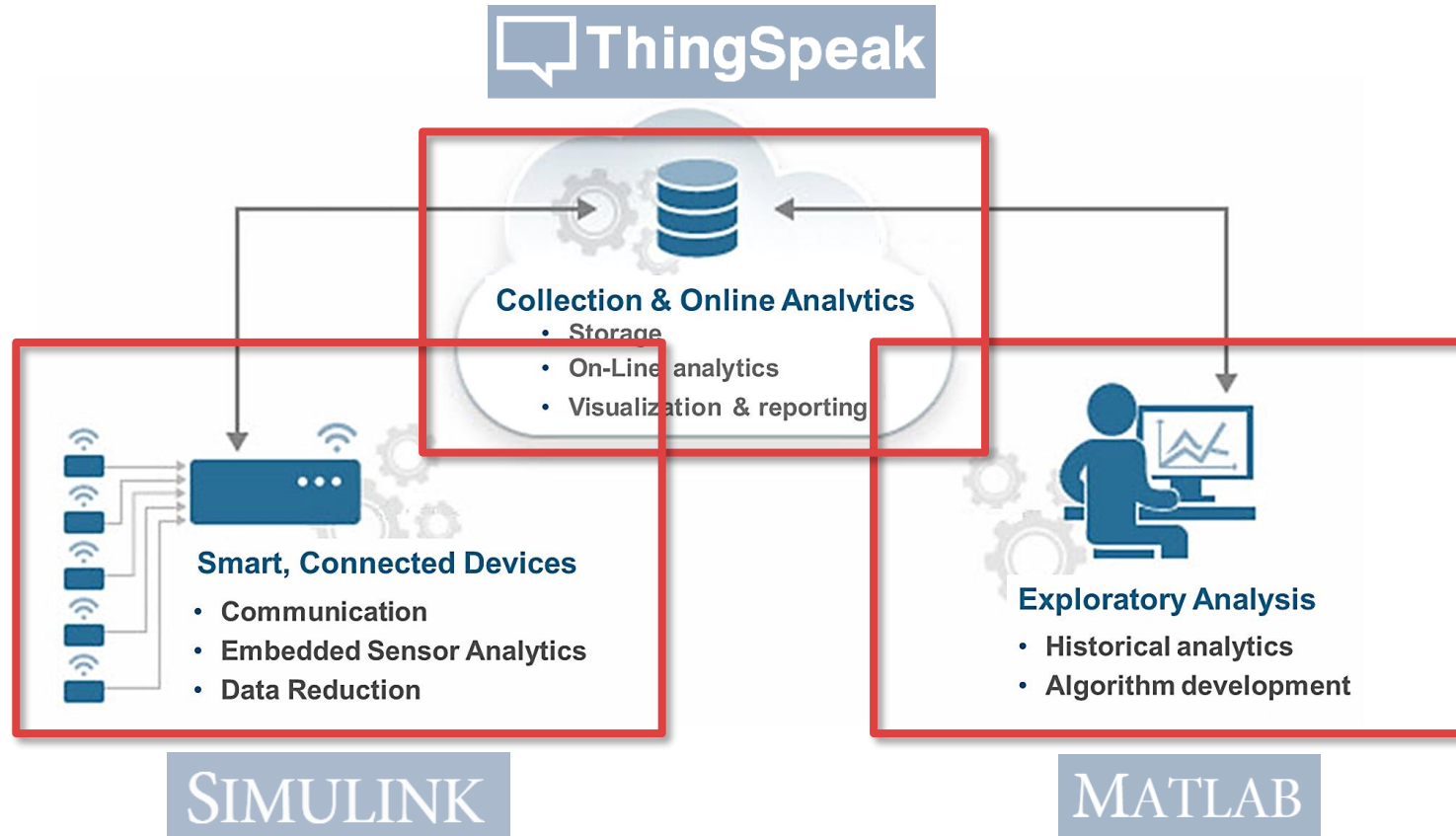
BuildingIQ



Respir



Internet of Things



ThingSpeak

IoT platform for students, makers, and industry

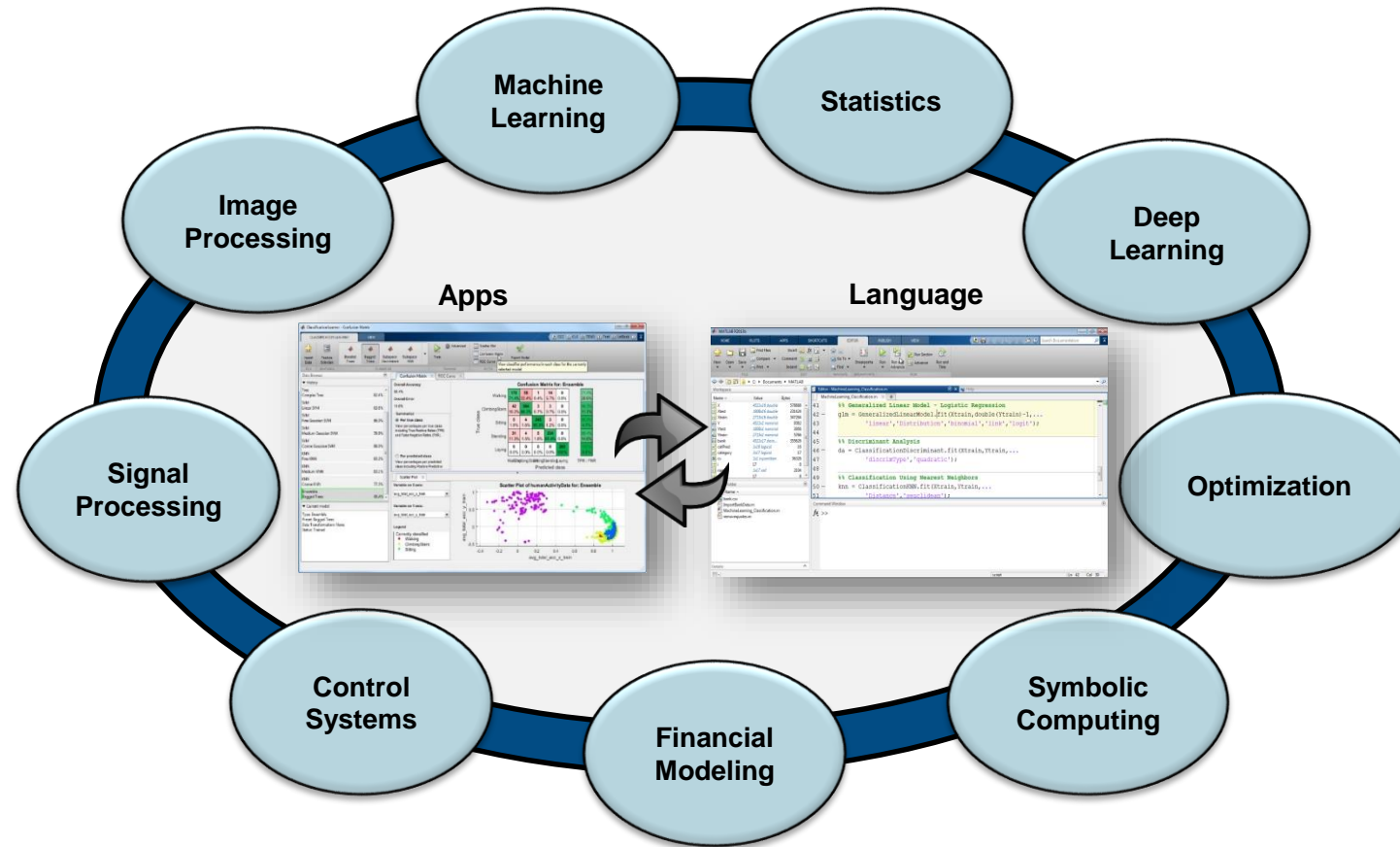
The collage illustrates the workflow from hardware simulation to data analysis. It includes:

- The ThingSpeak homepage with the tagline "The open data platform for the Internet of Things".
- A Simulink model titled "Live Car Counting with Raspberry Pi Hardware" showing a block diagram with components like "VCL2 Video Camera", "Image Acquisition", "Image Processing", and "Raspberry Pi".
- A "MATLAB Analysis Templates" page with options: "Custom (no starter code)", "Get data from a private channel", and "Get data from a public channel".
- A line graph showing "Vehicle Count per 15 second interval" over time from 07/25 to 08/01, with a y-axis ranging from 0 to 80.

Edge Node development using Simulink and Raspberry Pi

Built-in MATLAB analysis

Tools for Computational Thinking



Computational Thinking: Making an Impact on Engineering Education

1. How do we help students develop **Computational Thinking**?
▶ **Integrated Curriculum**
2. How can we introduce **Computational Thinking** earlier?
▶ **Primary and Secondary**
3. How can we prepare students so they can use **Computational Thinking** after they graduate?
▶ **Industry Tools and Technology**

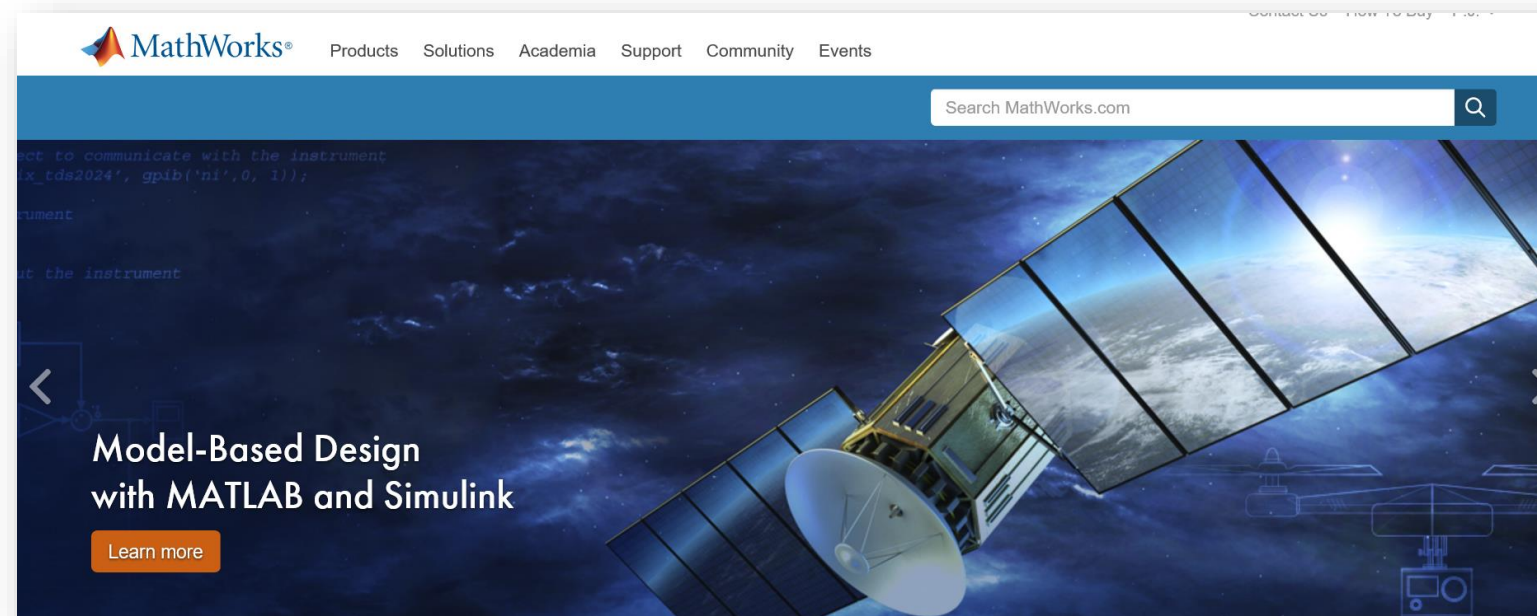
3 Questions to Consider

1. How should your courses and **curriculum** introduce and reinforce skills in computational thinking?
2. Are you and your colleagues engaging students in **secondary schools** in STEM?
3. Do you have the **tools to support computational thinking in your research and teaching?**

Partnering with MathWorks

Contact us

Visit us at www.mathworks.com



Questions

