Major Information Session
ECE: Computer Engineering

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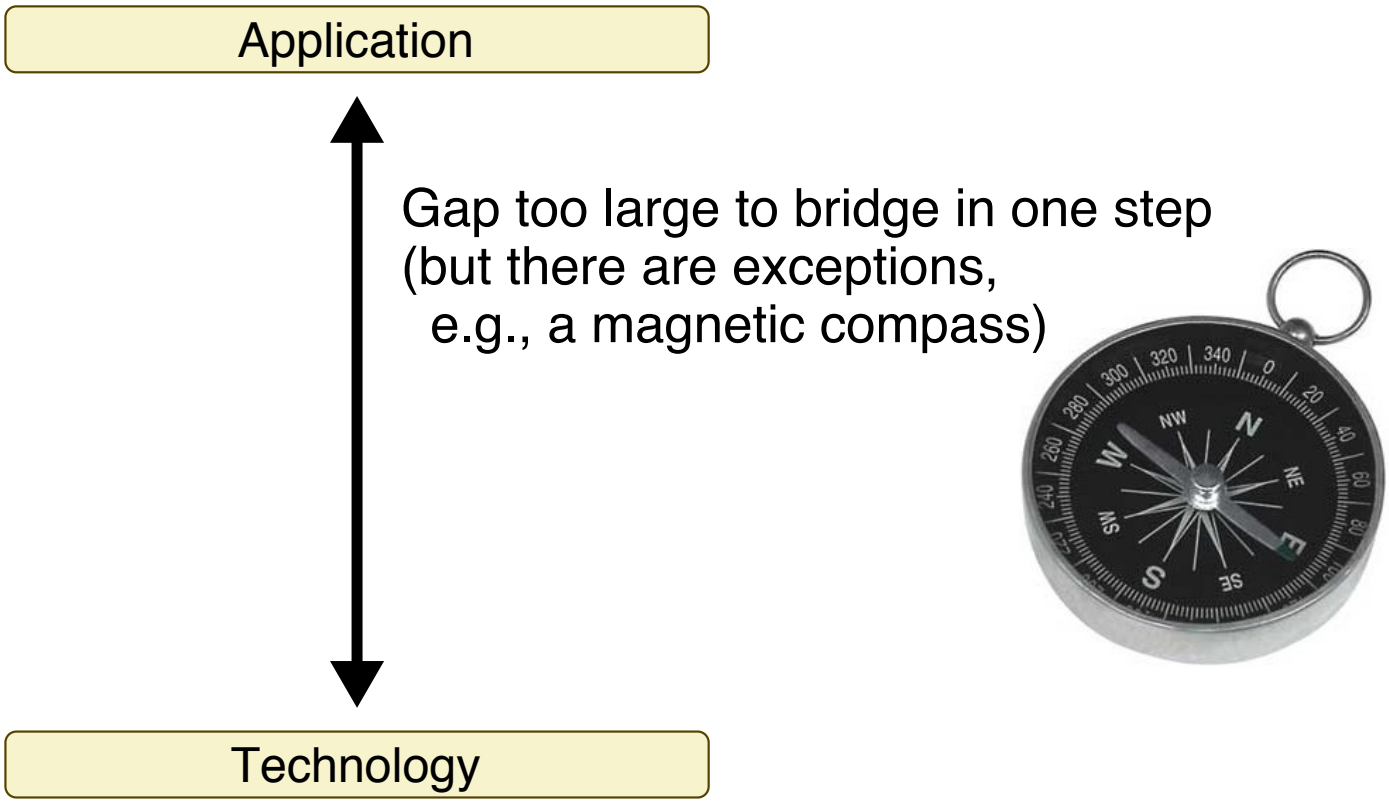
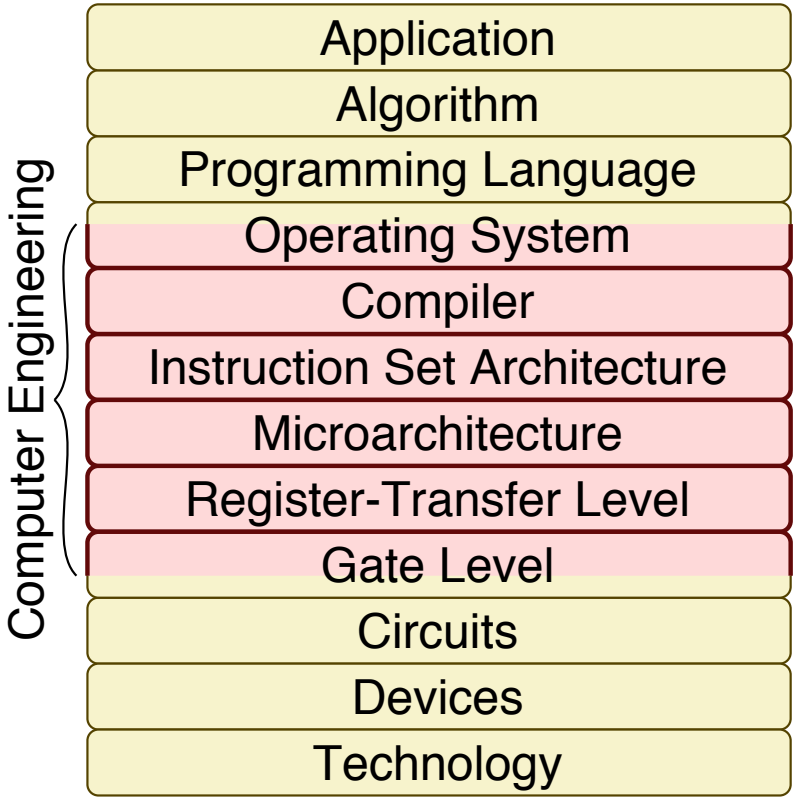
The Computer Systems Stack



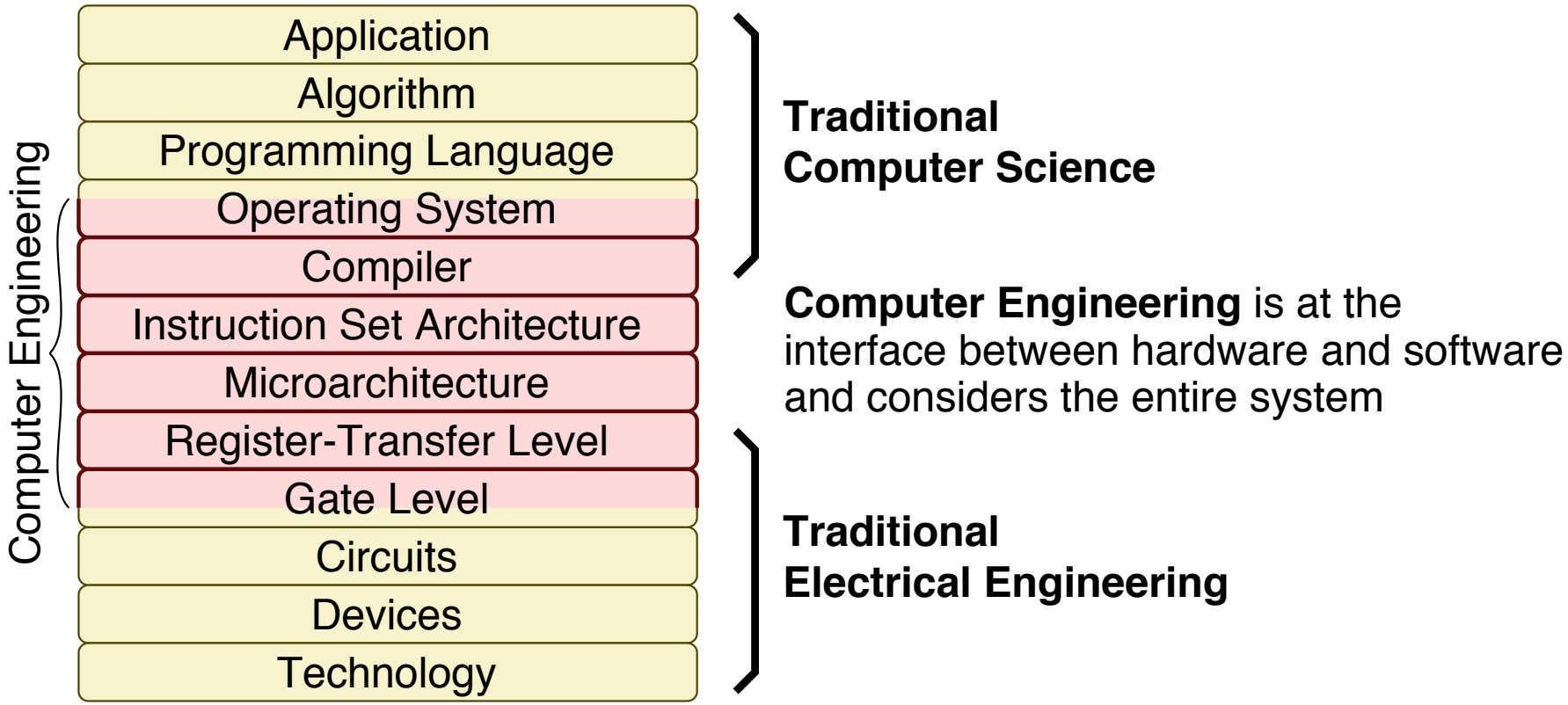
Gap too large to bridge in one step
(but there are exceptions,
e.g., a magnetic compass)

The Computer Systems Stack



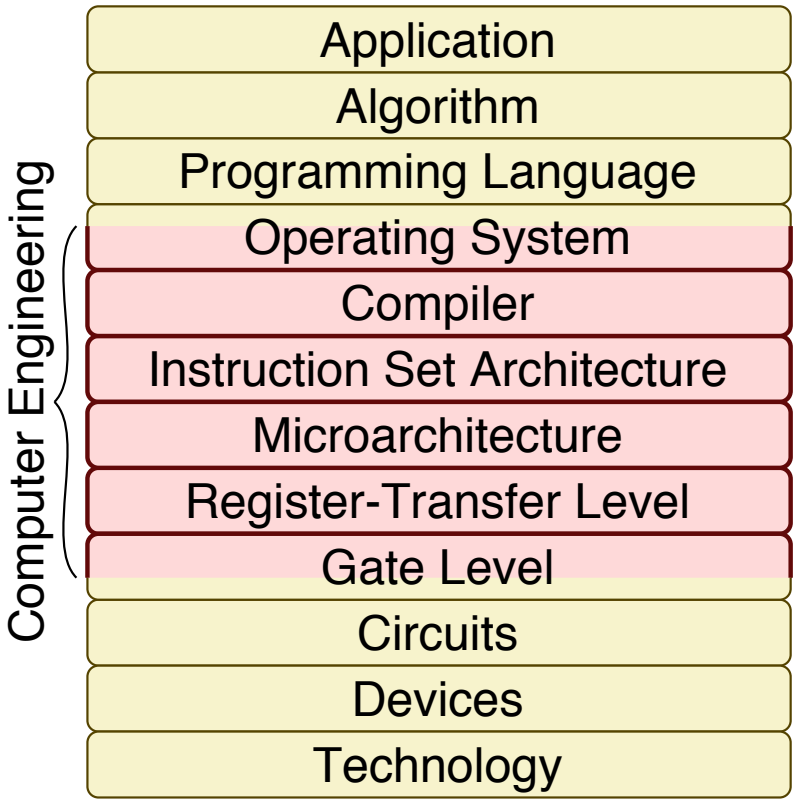
In its broadest definition, computer engineering is the development of the abstraction/implementation layers that allow us to execute information processing applications efficiently using available manufacturing technologies

CS vs. Computer Engineering vs. EE



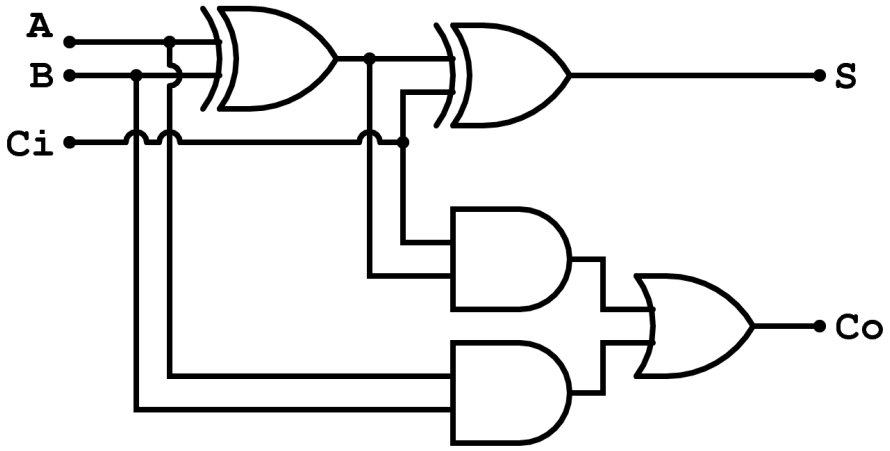
In its broadest definition, computer engineering is the development of the abstraction/implementation layers that allow us to execute information processing applications efficiently using available manufacturing technologies

Computer Engineering: From C/C++ to Logic Gates



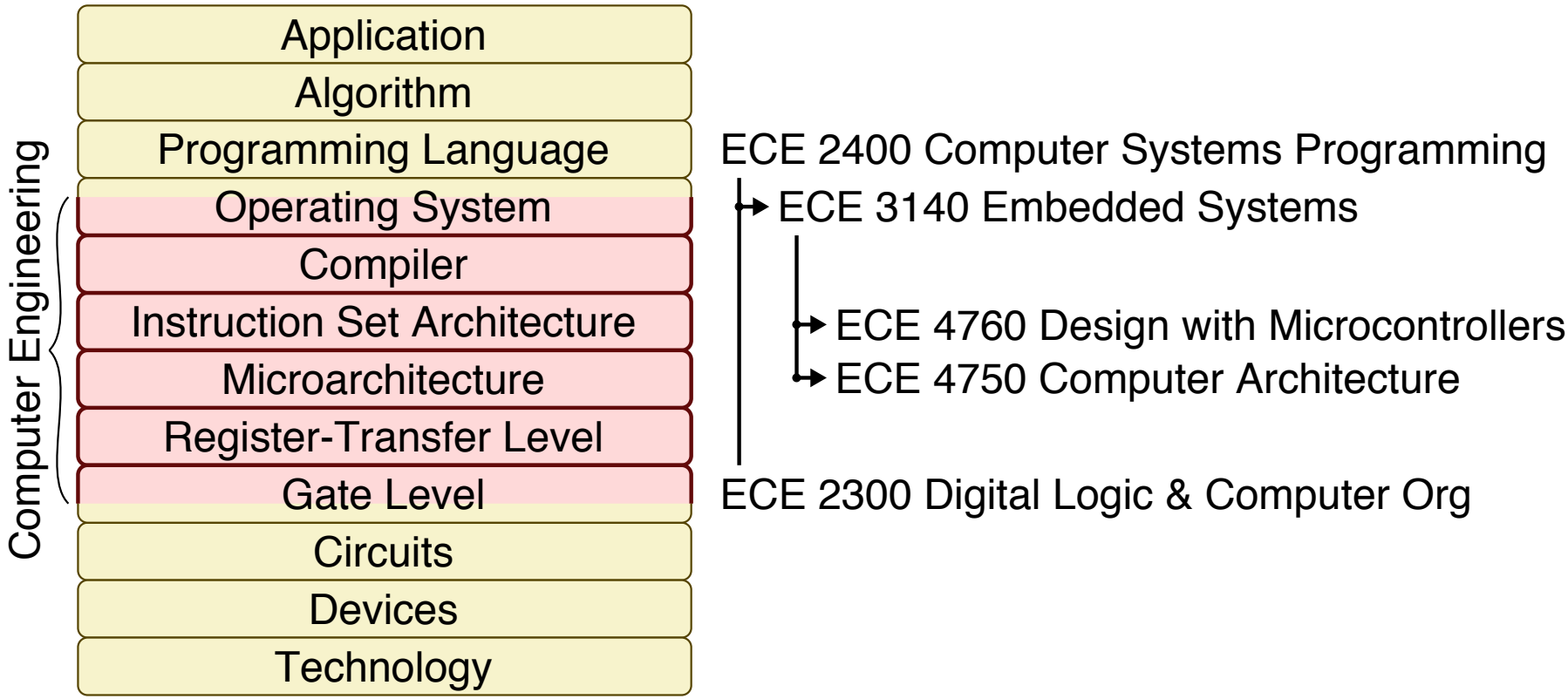
C/C++ Programming Language

```
template < typename T >
T* find_max( T* array, size_t n )
{
  if ( n == 0 ) return NULL;
  T* result = &array[0];
  for ( size_t i = 1; i < n; i++ ) {
    if ( array[i] > *result )
      result = &array[i];
  }
  return result;
}
```

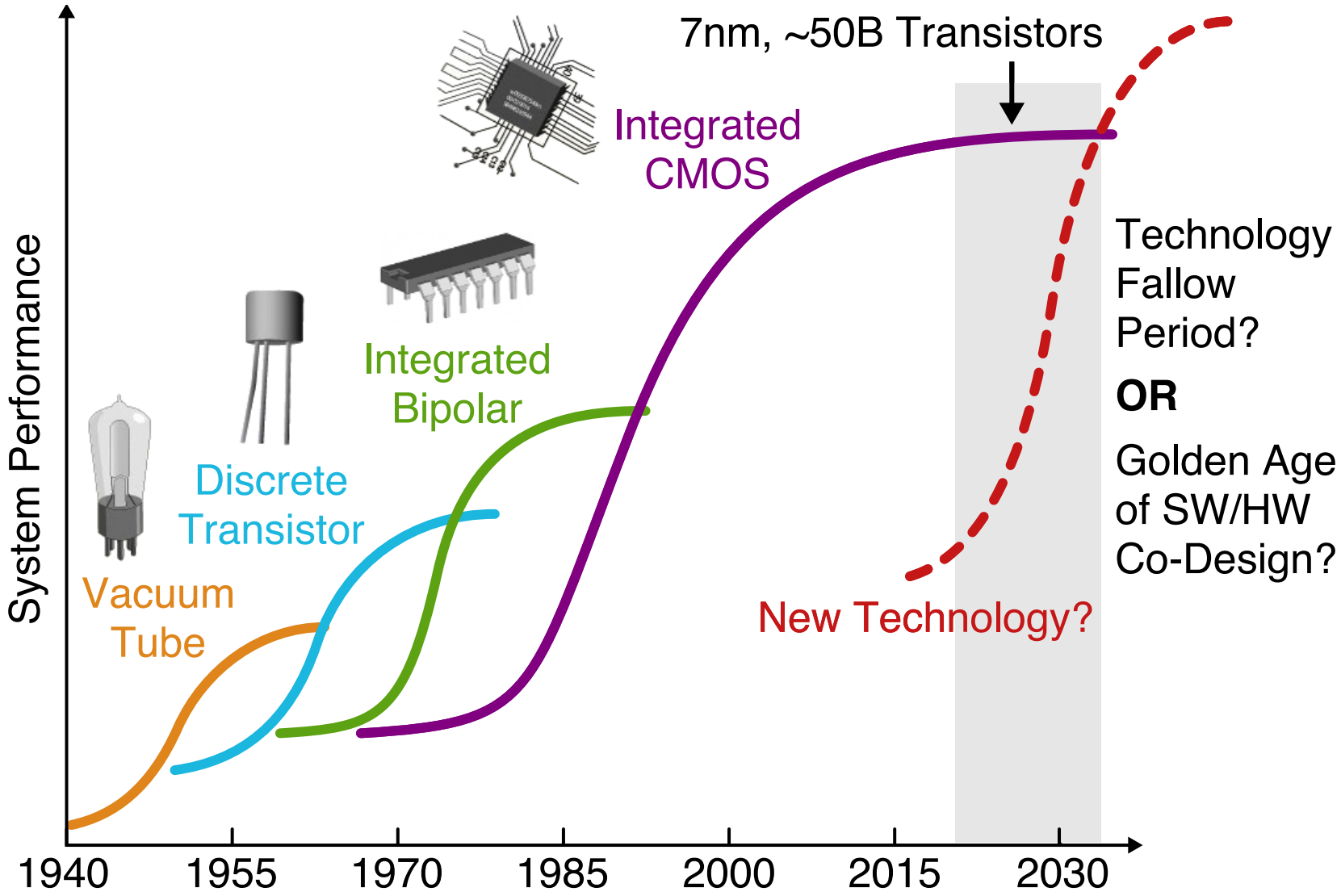


Boolean Logic Gates for Adder

Core Computer Engineering Curriculum

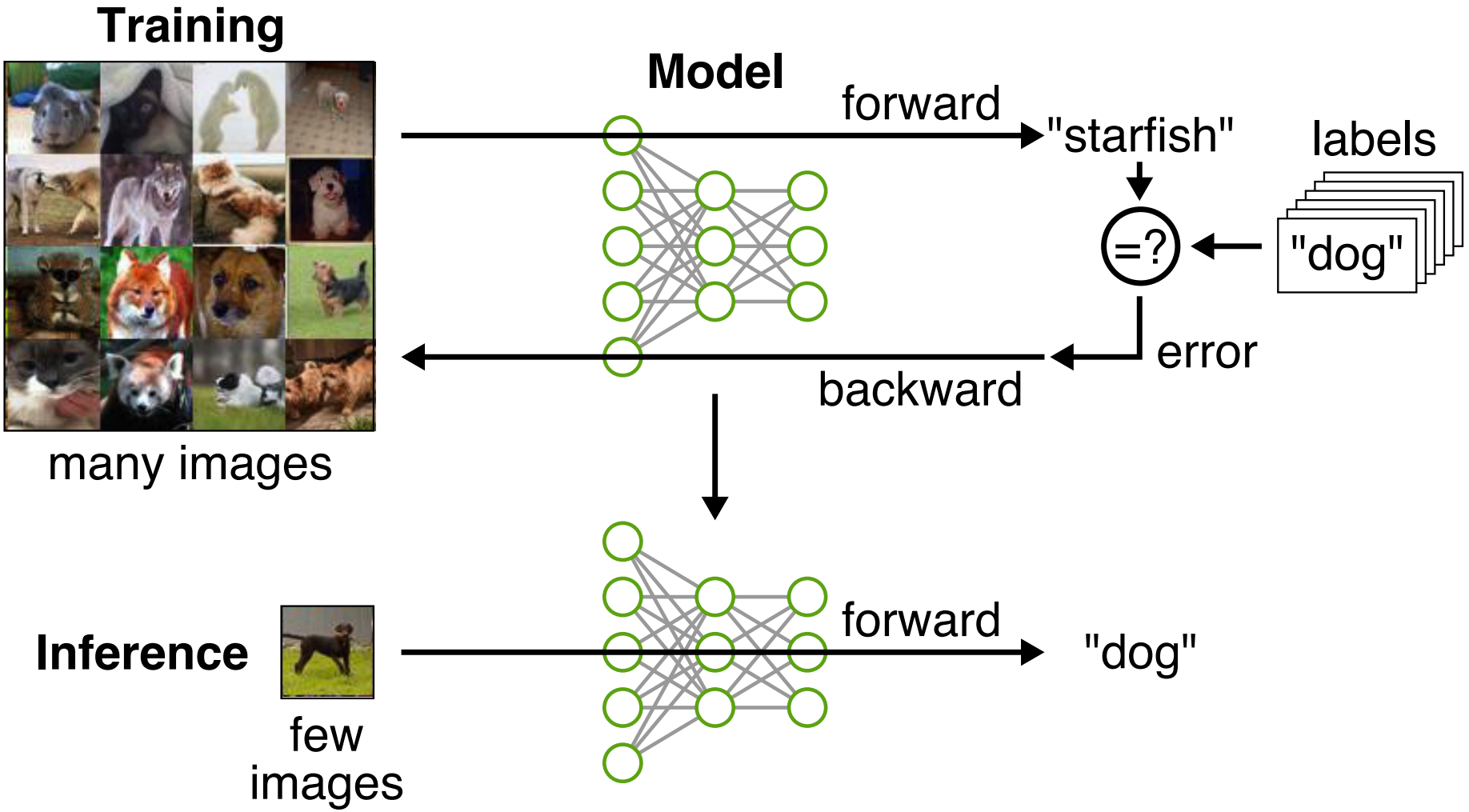


Technology Scaling is Slowing

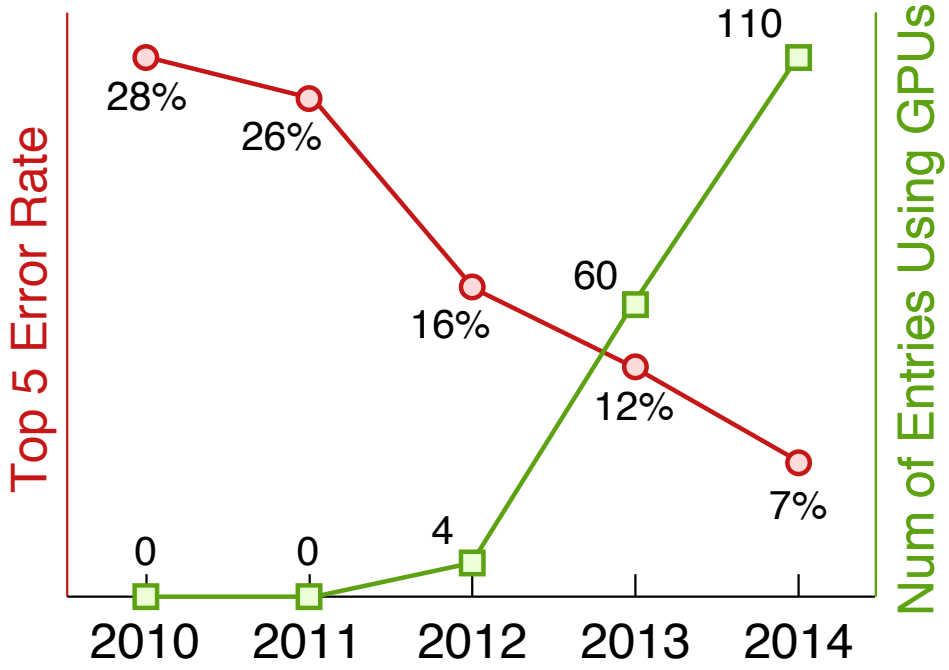


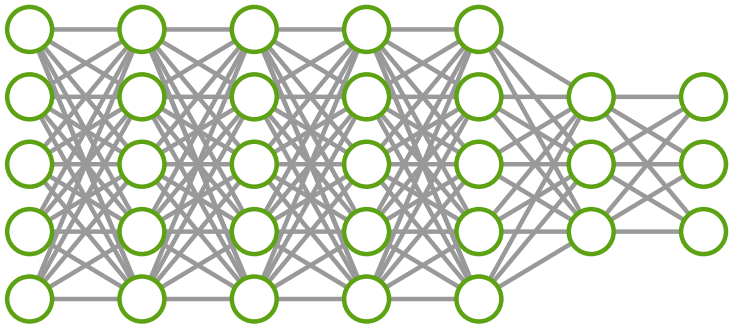
Example Application Domain: Image Recognition

Machine Learning: Training vs. Inference



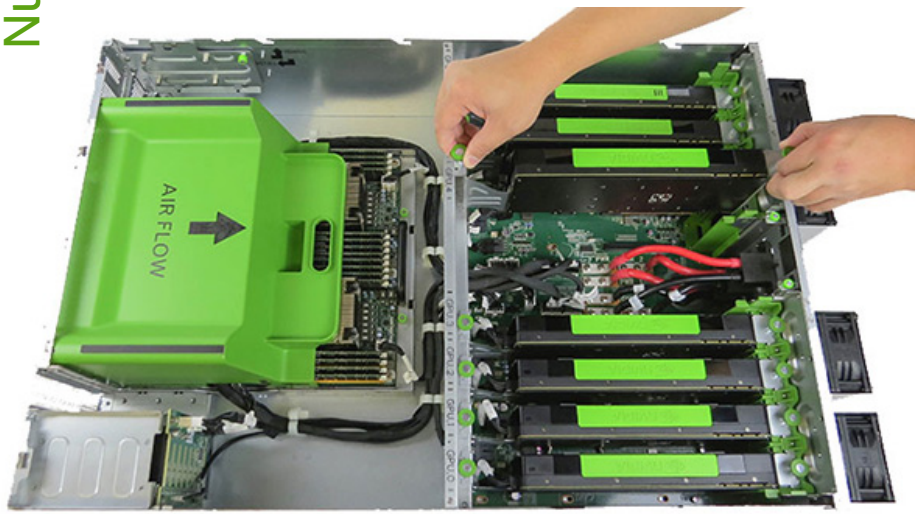
ImageNet Large-Scale Visual Recognition Challenge



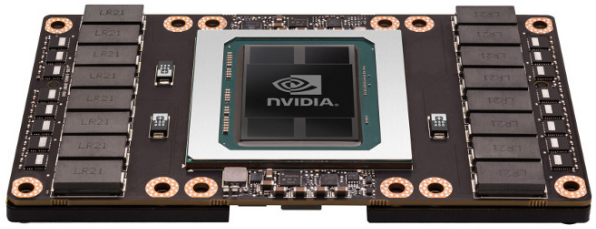


Software: Deep Neural Network

Hardware: Graphics Processing Units

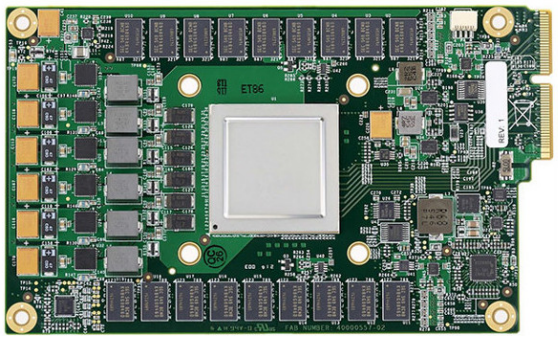


SW/HW Co-Design for Deep Learning



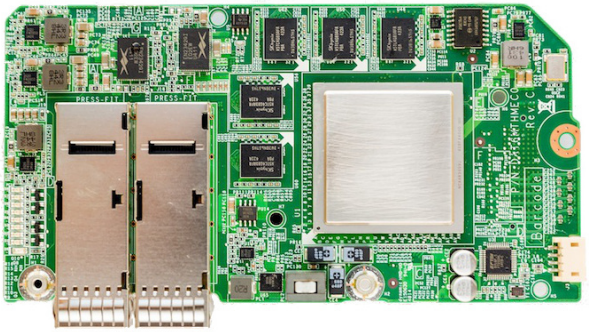
NVIDIA DGX-1

- Graphics processor specialized just for machine learning
- Available as part of a complete system with both the software and hardware designed by NVIDIA



Google TPU

- Custom chip specifically designed to accelerate Google's TensorFlow C++ library
- Tightly integrated into Google's data centers
- 15–30× faster than contemporary CPU and GPUs

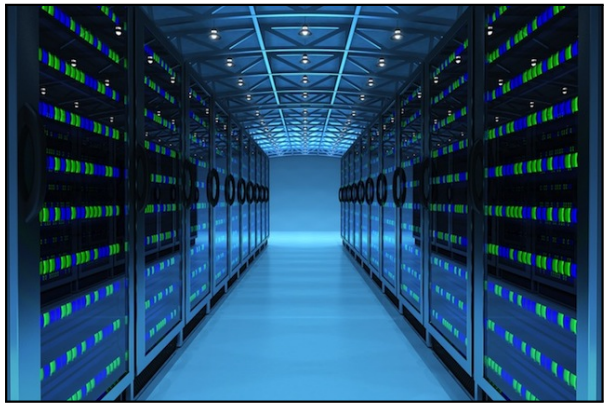


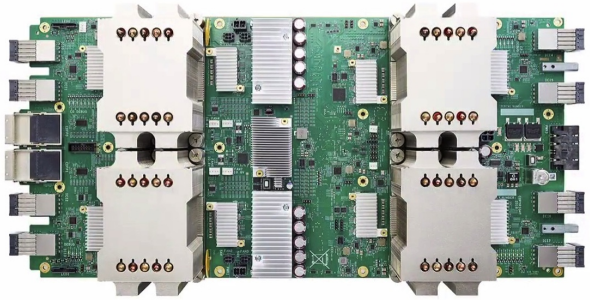
Microsoft Catapult

- Custom FPGA board for accelerating Bing search and machine learning
- Accelerators developed with/by app developers
- Tightly integrated into Microsoft data center's and cloud computing platforms

SW/HW Co-Design Across Computing Spectrum

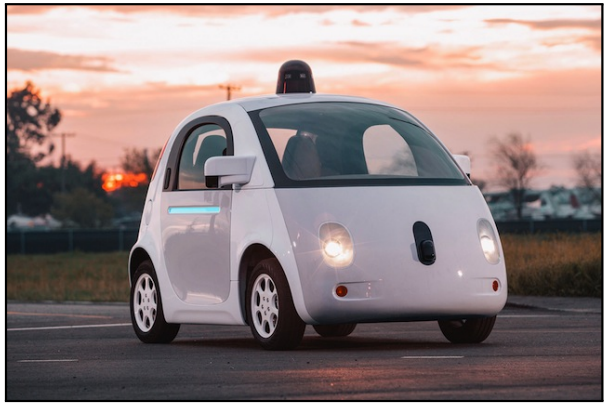
Cloud Computing

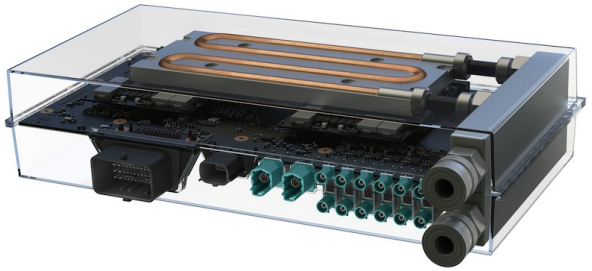




Google Cloud TPU

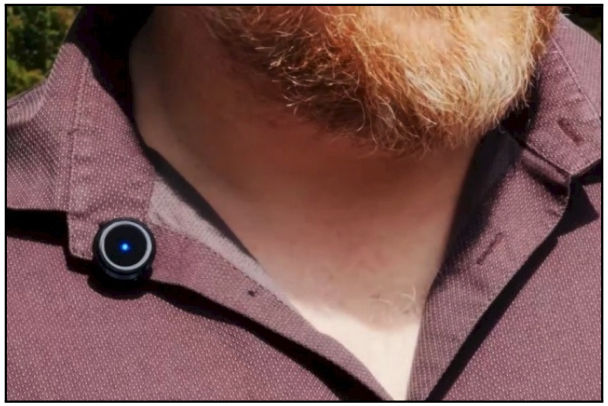
Autonomous Driving

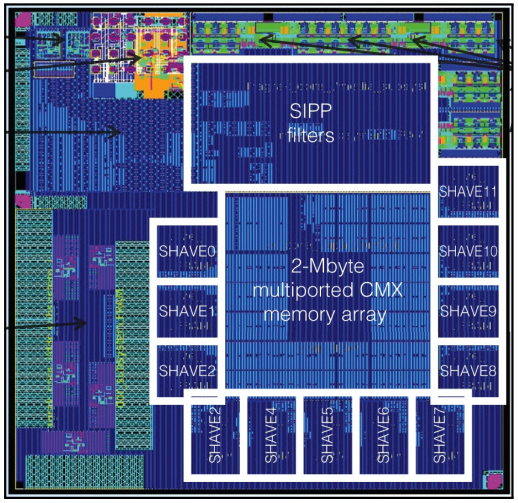




NVIDIA Drive PX2

Wearable Computing





Movidius Myriad 2

The field of computer engineering is experiencing a disruptive sea change and has a critical choice:

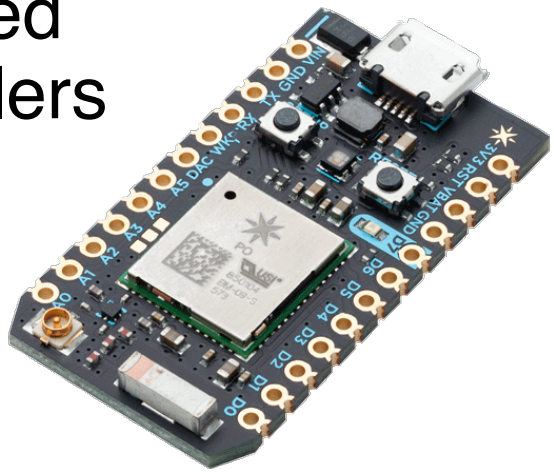
1. A technological fallow period
2. A golden age of SW/HW co-design

Majoring in electrical and computer engineering means you will have the opportunity to shape this golden age!

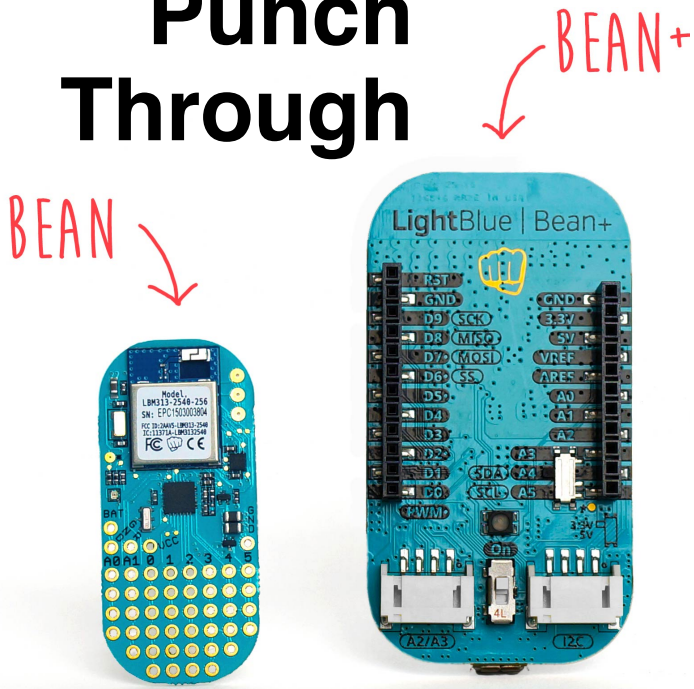
Build Software/Hardware for IoT Startups

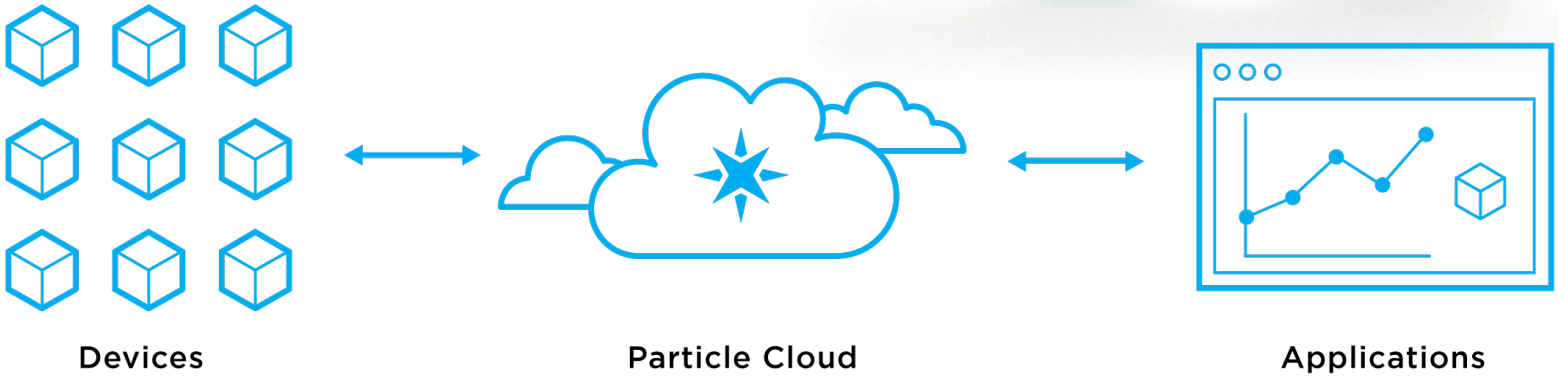
Particle: Photon

WiFi connected µcontrollers w/ Particle Cloud

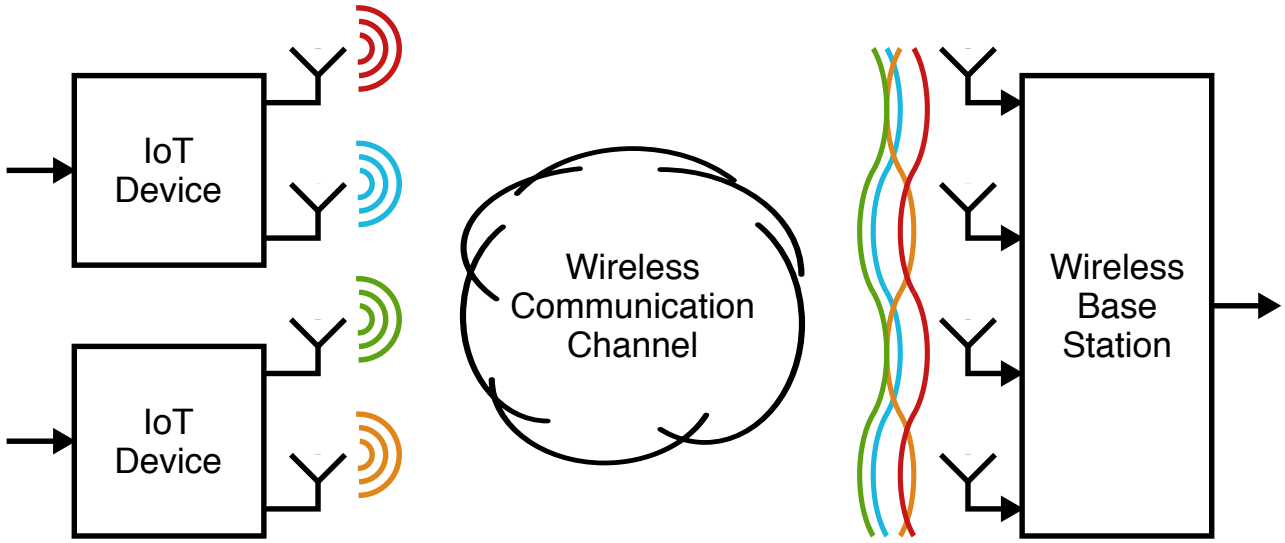


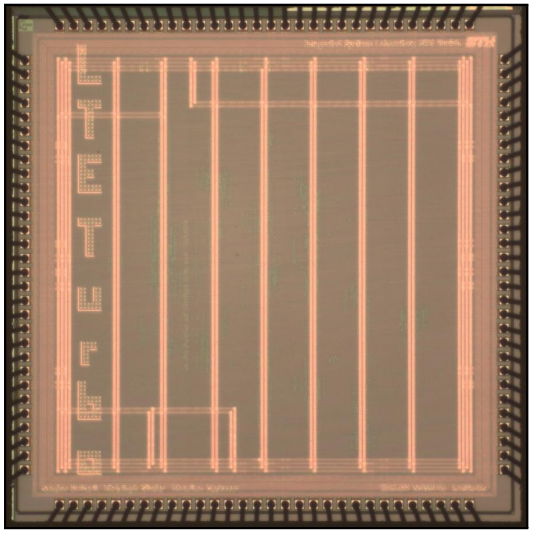
Punch Through

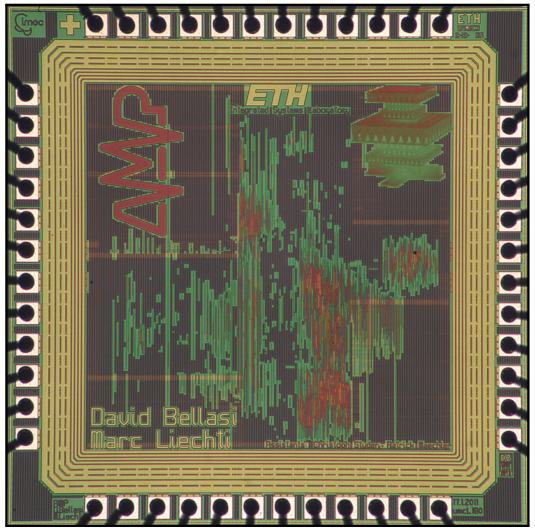




Develop Algorithms and Chips for IoT







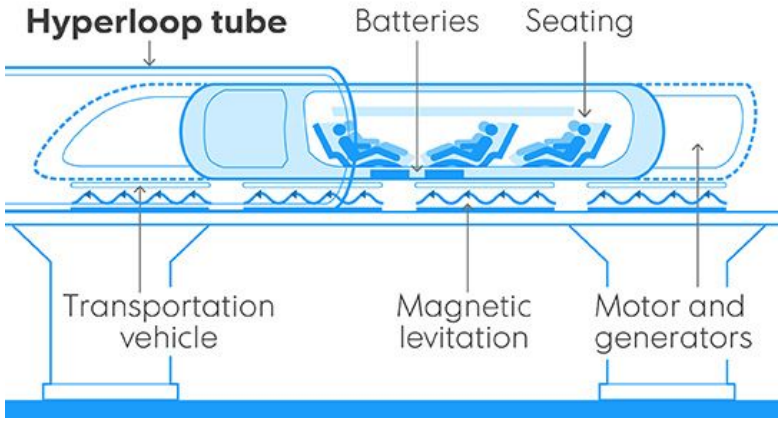
Research from Prof. Christoph Studer, ECE @ Cornell University

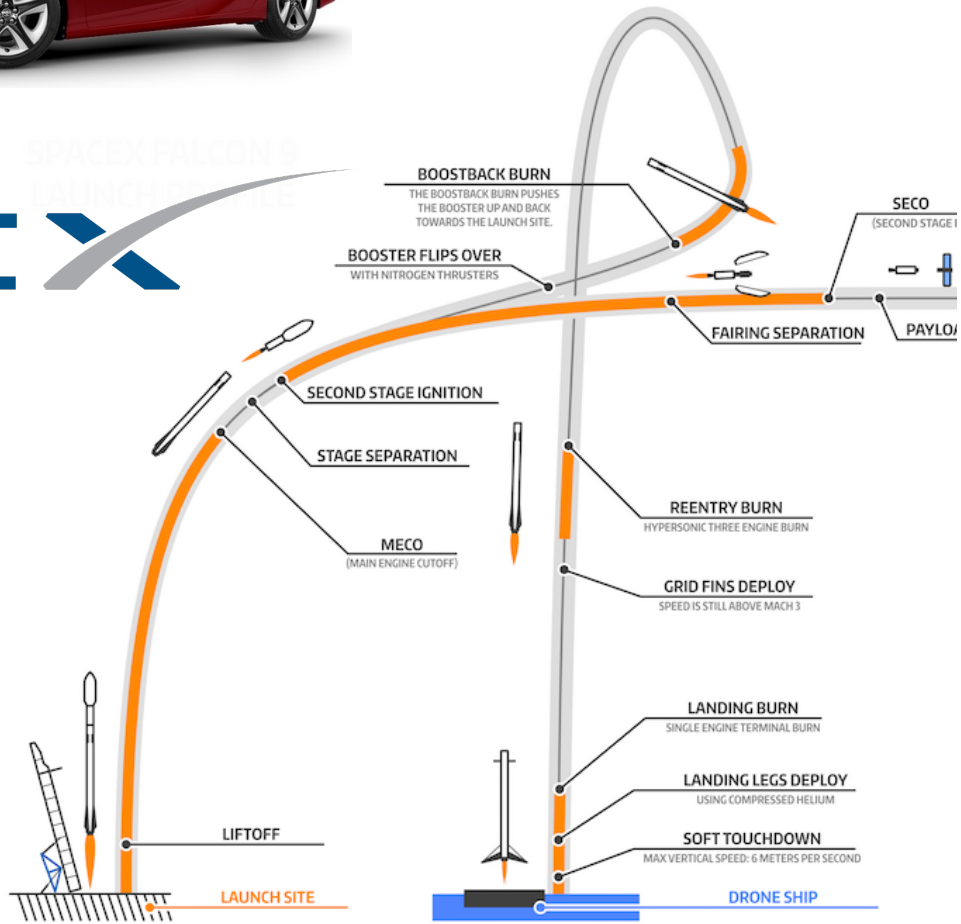
Develop Embedded Software and Gateware

Green Hills® SOFTWARE

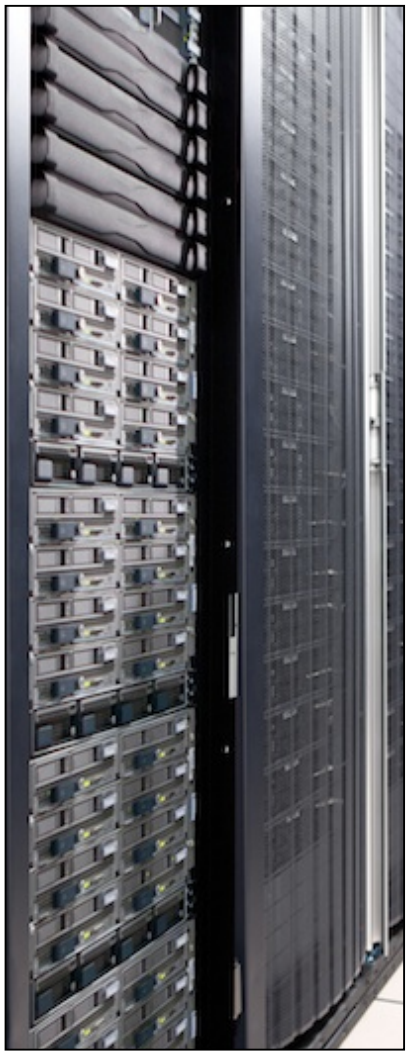
SPACEX

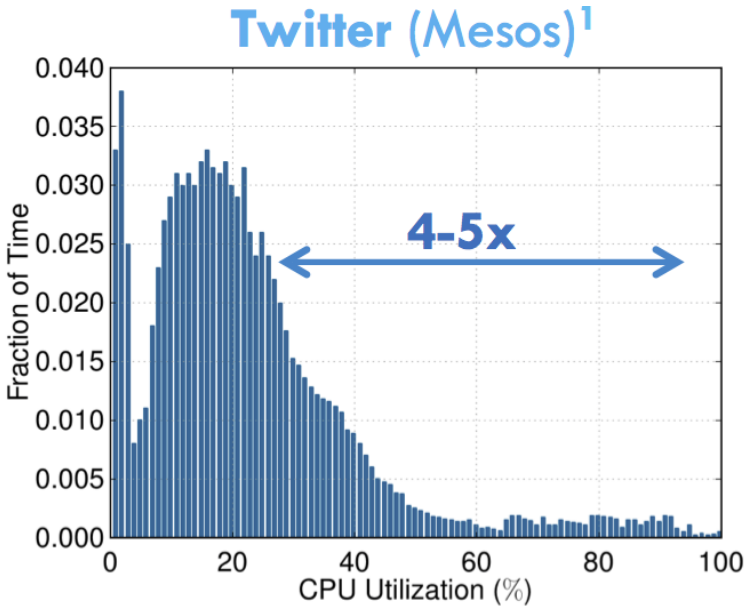
hyperloop

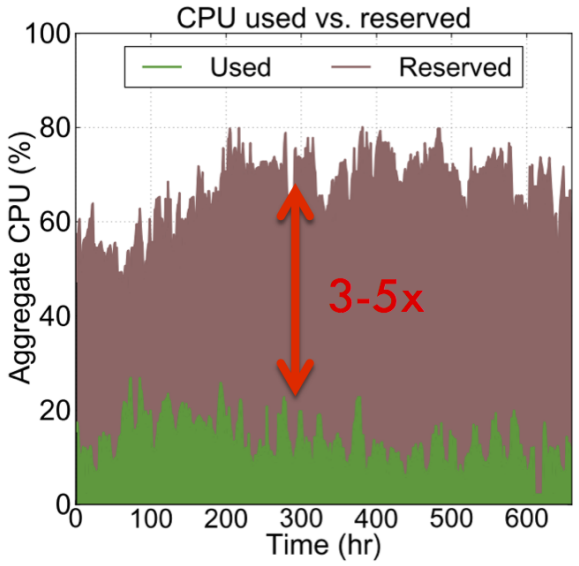


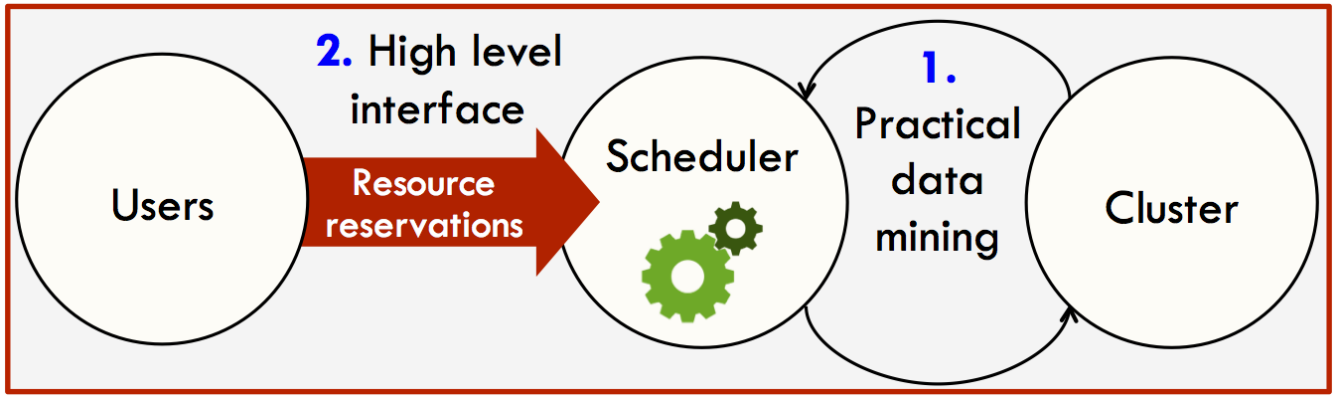


Build System-Level Software for Data Centers









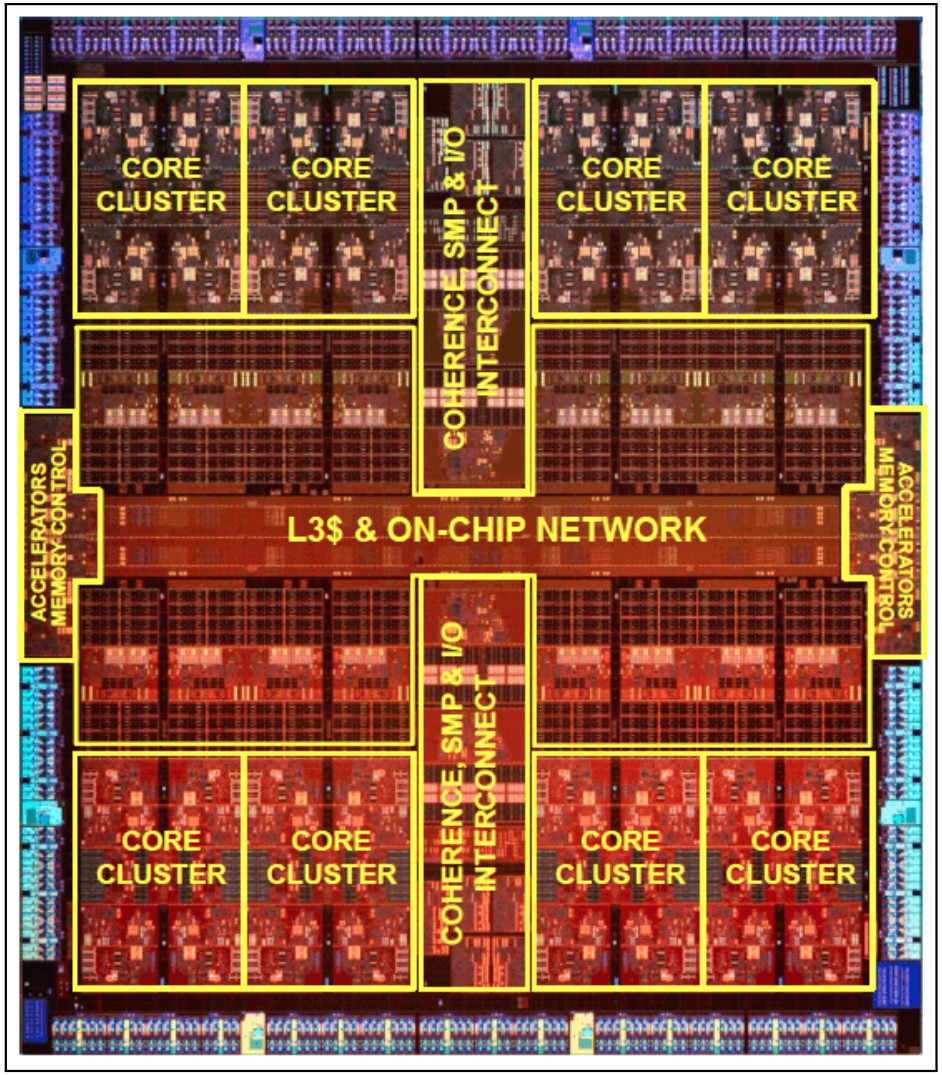
Paragon [ASPLOS'13,TopPicks'14] **Quasar** [ASPLOS'14]

Research by Prof. Christina Delimitrou, ECE @ Cornell University

Build High-Performance Chips for Data Centers

Oracle's Sparc M7 Processor

- 4+ GHz in TSMC 16 nm
- 10B transistors
- 32 cores 256 threads per chip
- On-chip 64MB L3 cache
- Specialized hardware accelerators
  - Solaris Operating System
  - Java middleware
  - Oracle's relational database



Build Software/Hardware for Robotics

Research from Prof. Kirstin Pretersen, ECE @ Cornell University