

The background features a network of red lines and circles, resembling a circuit board or a neural network diagram. The lines are of varying thickness and connect several circular nodes. Some lines are straight, while others are angled, creating a complex, interconnected pattern. The circles are also of varying sizes and are positioned at various points along the lines.

VIVIENNE SIZE

Energy-Efficient AI

Processing at the “Edge” Instead of in the “Cloud”



Communication



Privacy



Latency

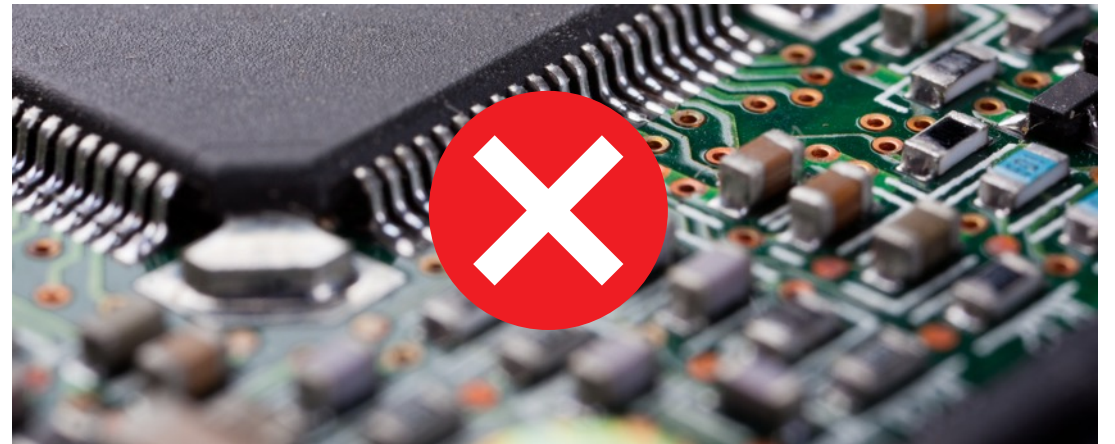
A thick red line starts from the top left, goes diagonally down to the left, then turns 90 degrees and goes straight down. Another thick red line starts from the bottom right and curves upwards and to the left, ending near the bottom center.

**Self-driving car prototypes use
approximately 2,500 Watts of
computing power.**

Existing Processors Consume Too Much Power

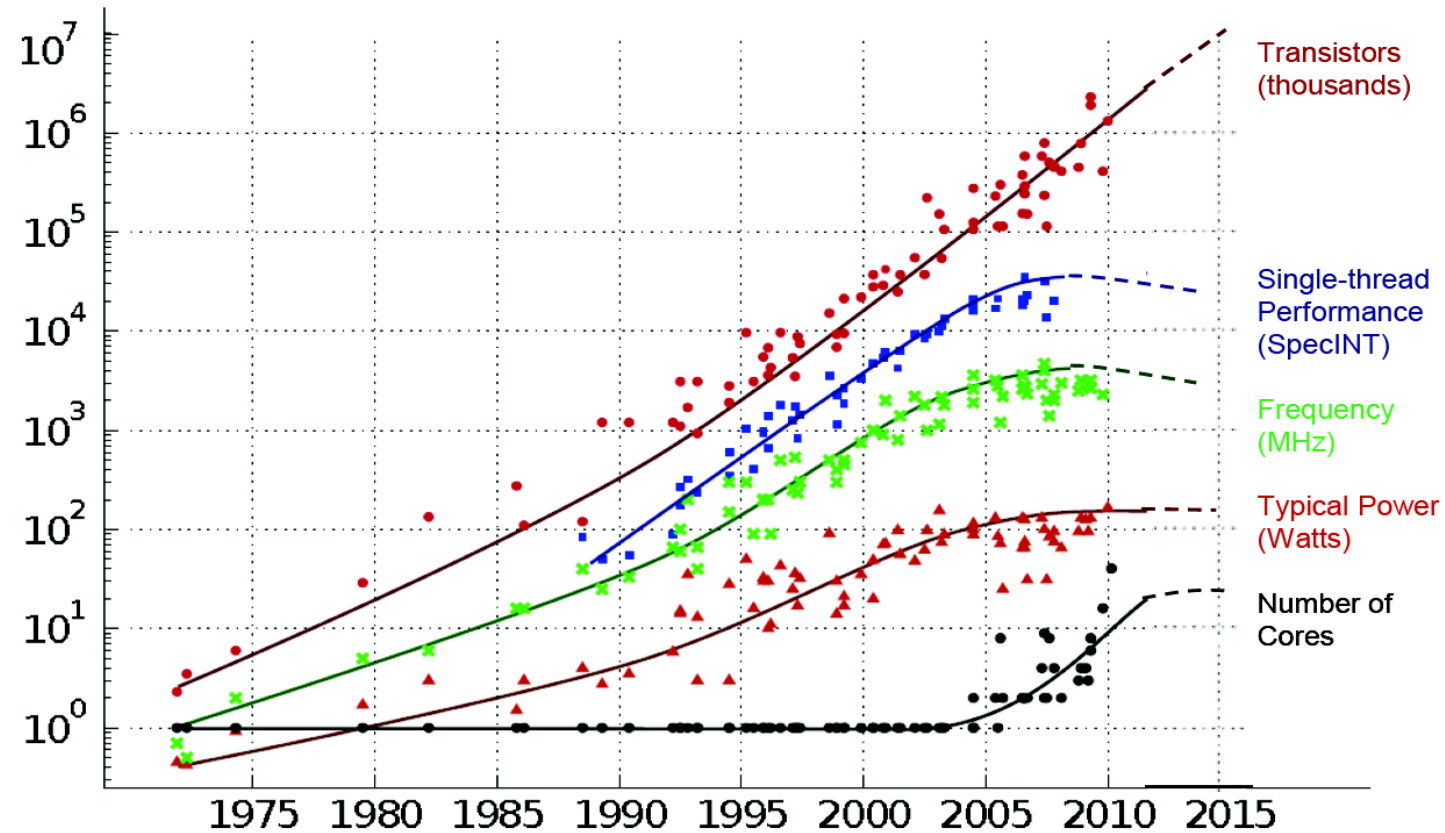


< 1 Watt



> 10 Watts

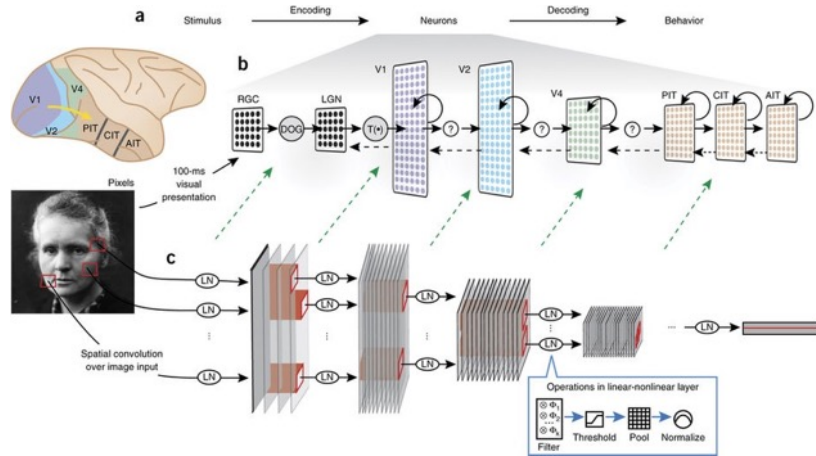
35 YEARS OF MICROPROCESSOR TREND DATA



Original data collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond and C. Batten
Dotted line extrapolations by C. Moore

Transistors Are Not Becoming More Efficient

Energy-Efficient AI with Cross-Layer Design

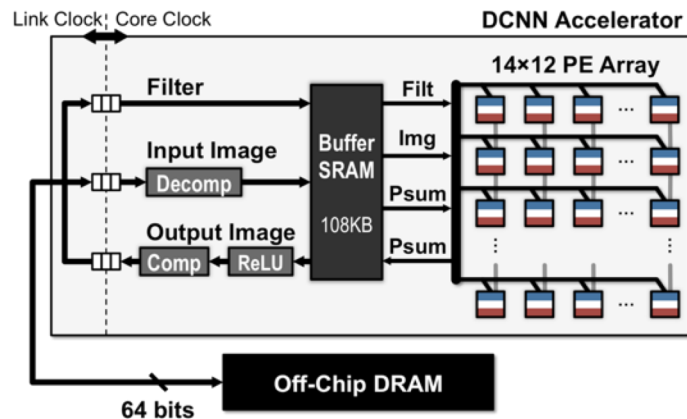


Algorithms

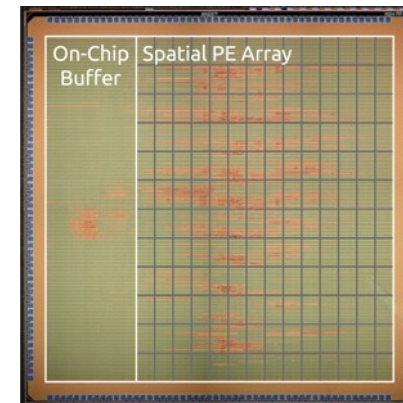


Systems

Specialized Compute Hardware



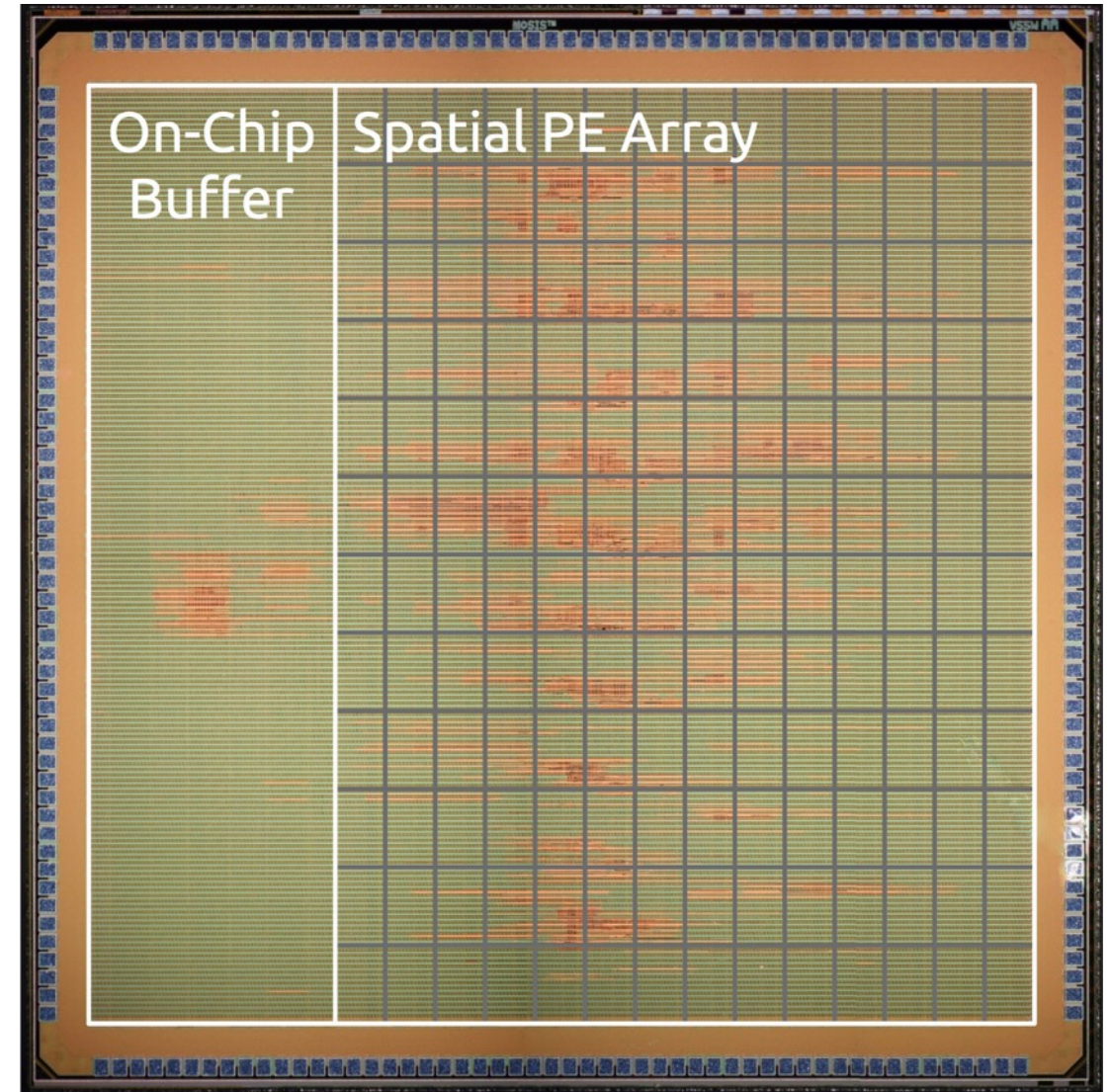
Compute Architectures



Circuits

Deep Neural Networks

- Cornerstone of AI applications
- Specialized hardware focuses on reducing data movement and memory accesses
- Image classification under a third of a Watt
- > 10x energy reduction comparable to mobile GPU

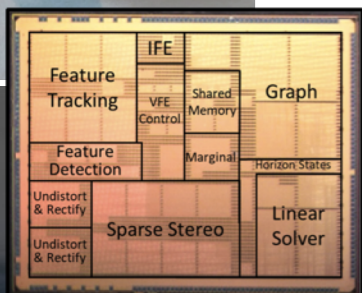


Eyeriss

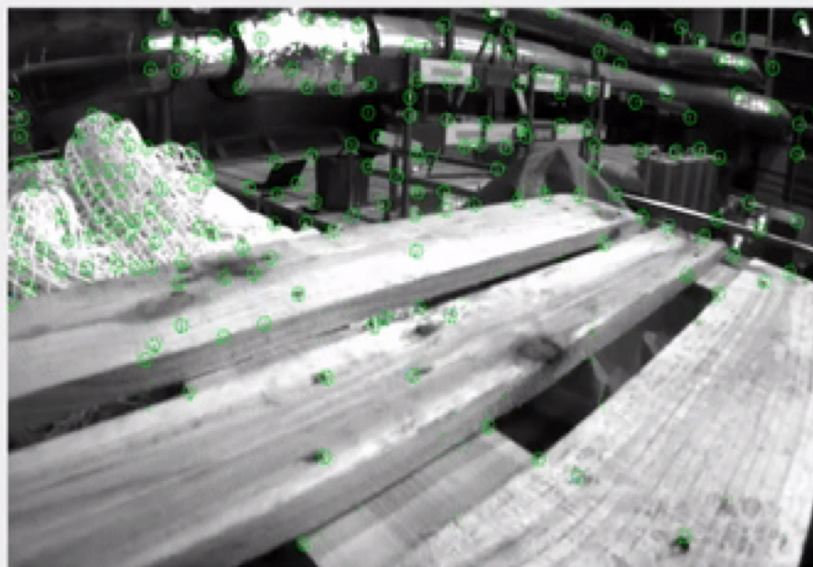
Robot Localization Under a Tenth of a Watt



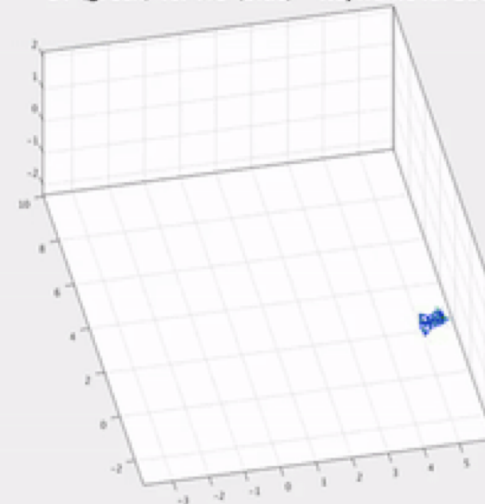
Sertac Karaman



Navion



GT (green) vs. VIO (blue) - Keyframe id: 217



[EuRoC Dataset]

Low Energy Robotics



Lighter than Air Vehicles



Miniature Satellites



Origami Robots

Neuropsychological Testing


- Important component in treatment of:
 - traumatic brain injury
 - dementia
 - psychiatric disorders
- Assessments are:
 - pencil and paper test
 - time consuming
 - require a trained specialist
- Repeat assessments are:
 - sparse
 - mostly qualitative
 - high retest variability



Thomas Heldt



We are investigating how to perform eye movement tests on a smart phone in order to enable low-cost, in-home measurements.

A thick red line starts from the top left corner, goes diagonally down to the left, then turns 90 degrees and goes vertically down to the bottom left corner.

**“Whatever it is that
[chip vendors and researchers]
build will influence the progress
of AI over the next decade.”**

Yann LeCun, Facebook's chief AI scientist

A thick red curved line starts from the bottom right corner and curves upwards and to the left, ending near the center of the bottom edge.