

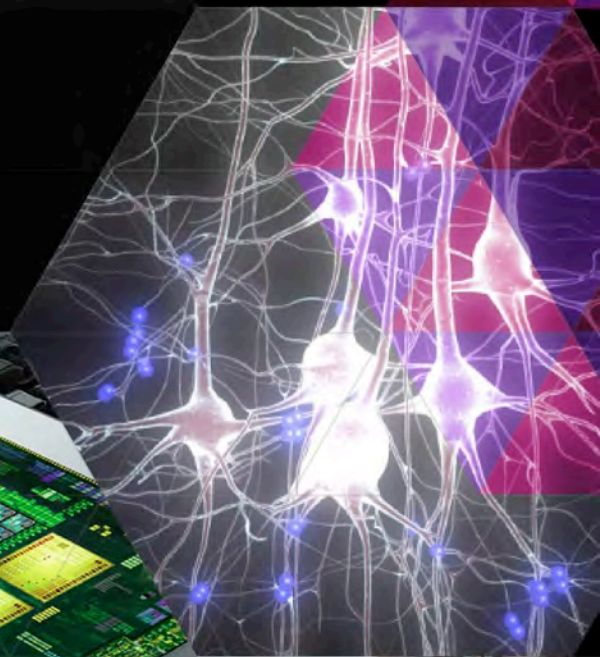
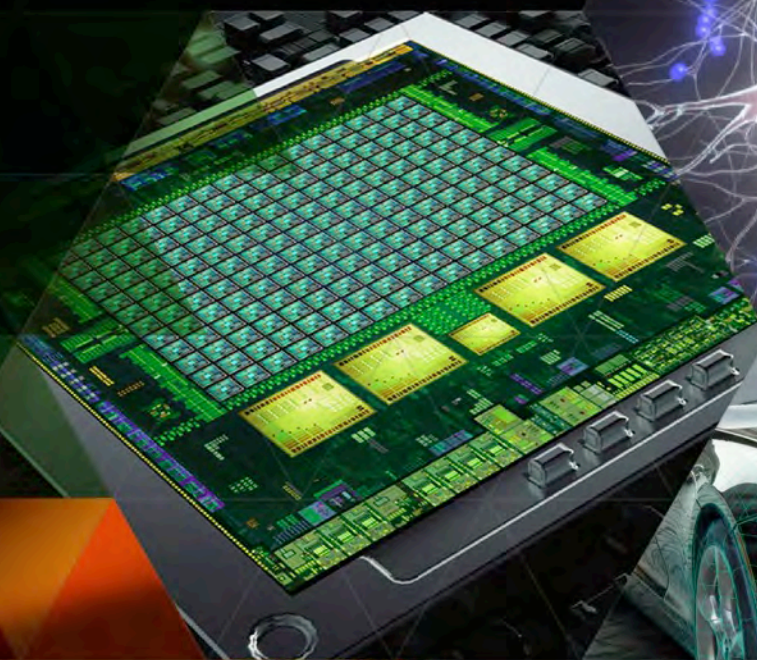


# THE FUTURE CAR

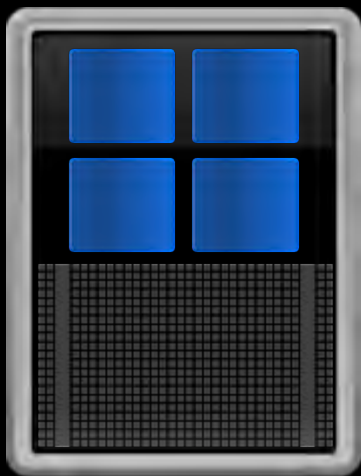
Danny Shapiro

Sr. Director, Automotive

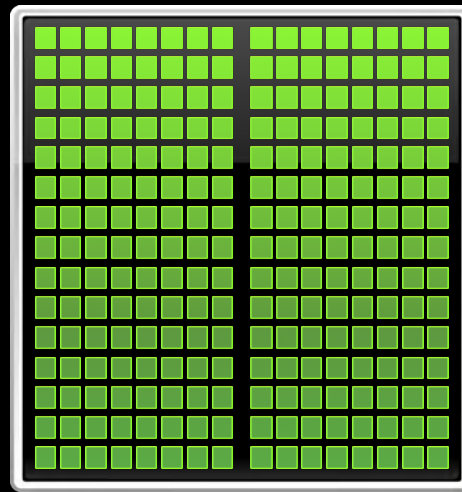
AUGUST 6, 2014



# THE PARALLEL PROCESSING ADVANTAGE



CPU



GPU

# THE WORLD OF VISUAL COMPUTING



DESIGN and  
VISUALIZATION



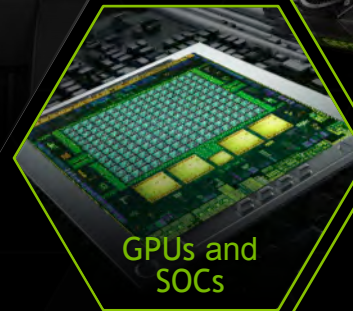
HIGH  
PERFORMANCE  
COMPUTING



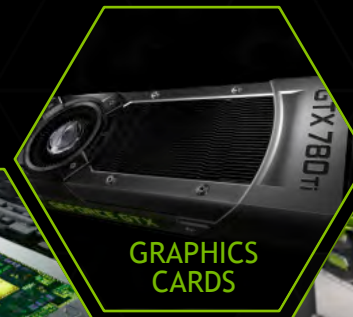
GAMING



AUTO



GPUs and  
SOC's



GRAPHICS  
CARDS



IP



SYSTEMS



# IN THE BEGINNING





# GAMING HAS EVOLVED





# STUNNING VISUAL EFFECTS





# REMARKABLE COMPUTER AIDED DESIGN





# PHOTOREALISTIC STYLING AND DESIGN





# SIMULATION STREAMLINES PRODUCT DESIGN





# SIMULATION MEANS BETTER PRODUCTS, FASTER





# INTERACTIVE POINT OF SALE...

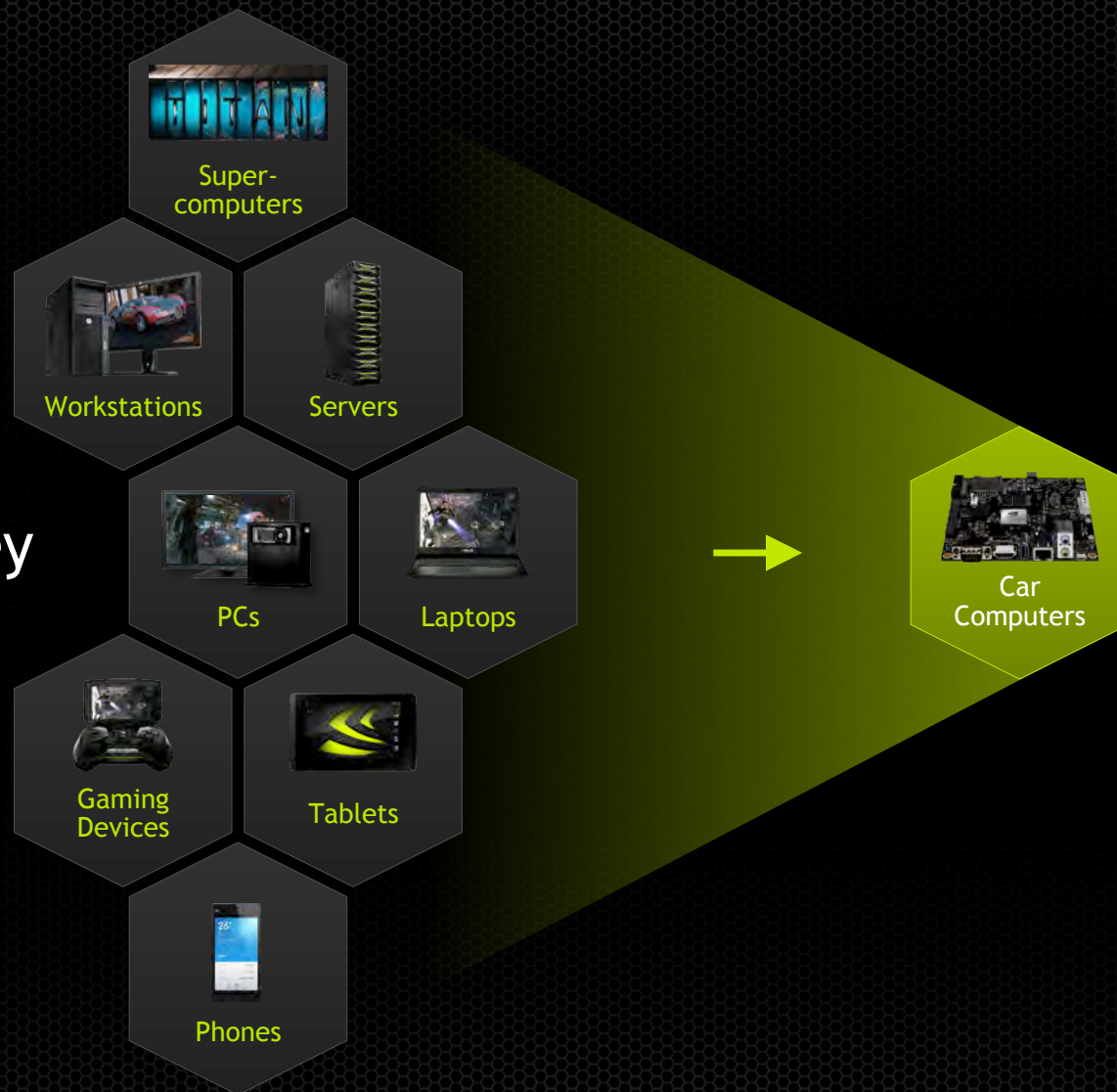


... AND FROM THE CLOUD





# Silicon Valley



# Tomorrow's Car Computer is a Visual Supercomputer



Car  
Computers





# *The Supercomputer in your Garage*

*“The next generation of Tegra will perform at 384 GFLOPS ... With four processors per car, a two-car garage would have as much computing power as the \$120 million Blue Mountain supercomputer installed at the Los Alamos National Laboratory in 1998.”*

*Gary S. Vasilash*

**CAR<sub>AND</sub>DRIVER**

# AUTOMOTIVE COMPUTING PLATFORM



**Tegra Visual Computing Module**





# NVIDIA AUTOMOTIVE

6.2M

Cars on the Road

New cars coming ...

20<sup>+</sup> Brands | 100<sup>+</sup> Models







# VISUAL COMPUTING IN THE CAR



High-Res  
Infotainment



Digital Instrument  
Clusters



Advanced Driver  
Assistance Systems



Smart Automotive  
Tablets



# VIRTUAL COCKPIT





# VIRTUAL COCKPIT



# THE SOFTWARE DEFINED CAR





# NEXT GENERATION USER EXPERIENCES



Augmented Reality HUD



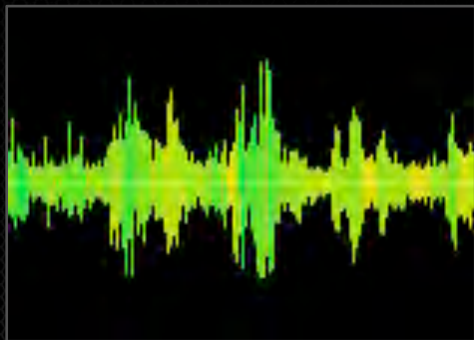
Photorealistic Materials



High Fidelity Navigation



4K Experience



Natural Language  
Processing



Intelligent Driver Assist

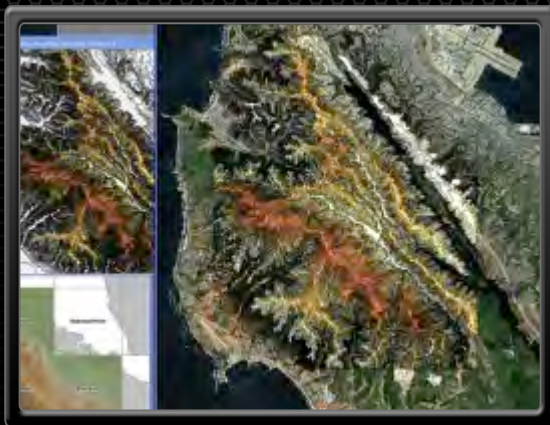


Human Interactions



High Speed Connectivity

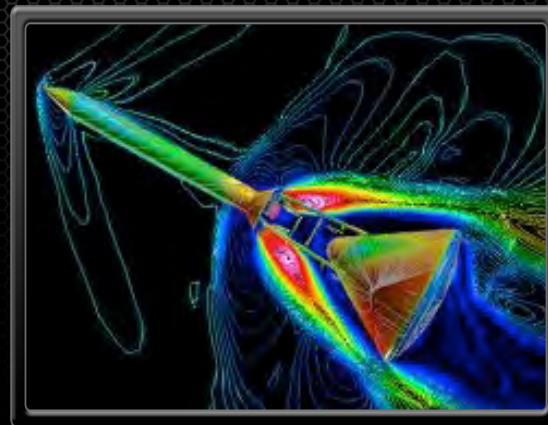




Satellite Imaging

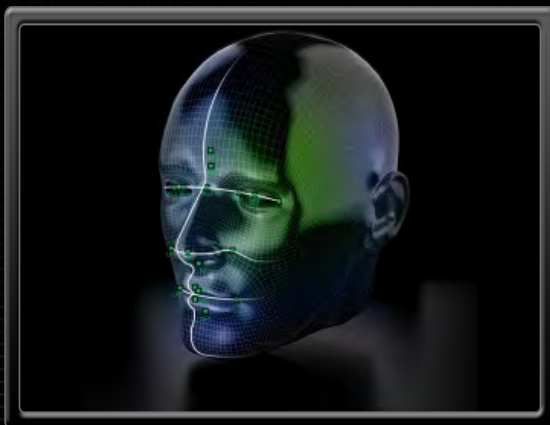


Video Enhancement

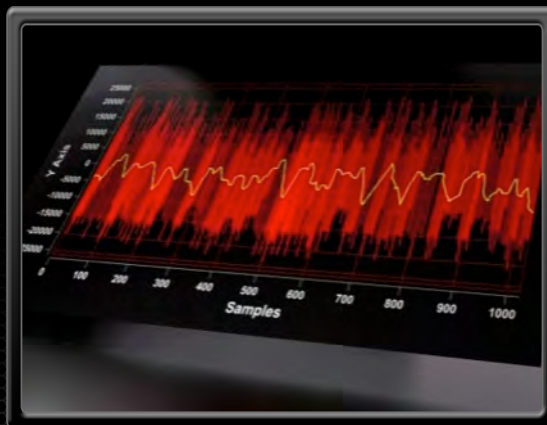


Aerodynamics/CFD

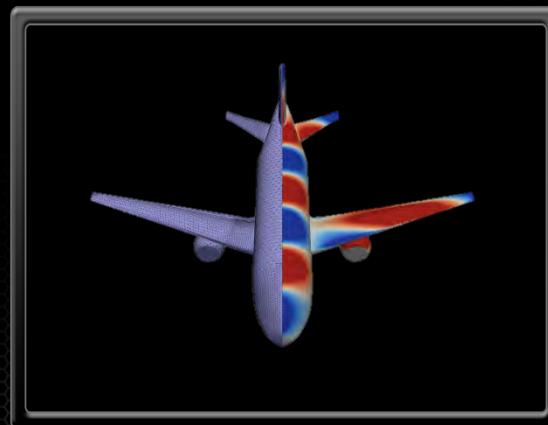
# GENERAL PURPOSE GPU COMPUTING



Computer Vision



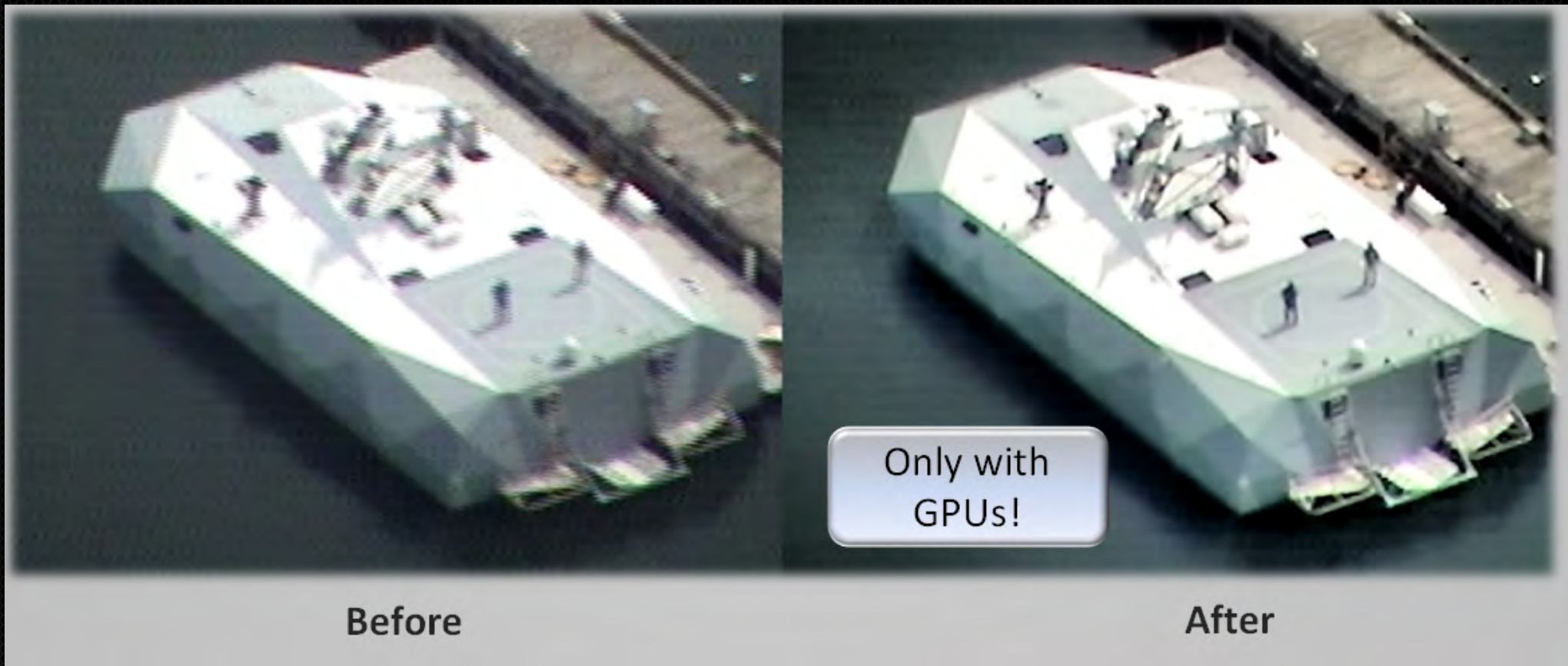
Signal Processing



Stealth & Antenna



# VIDEO ENHANCEMENT AND ANALYTICS

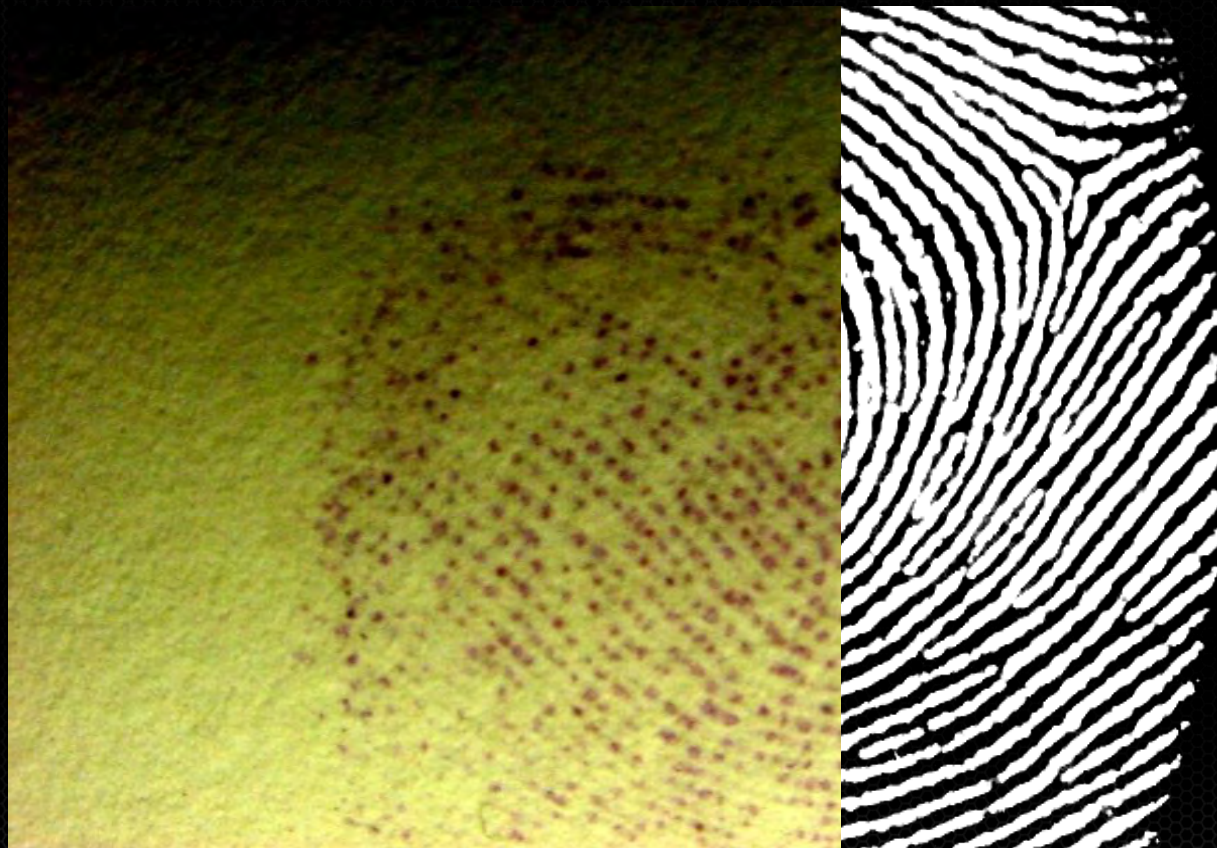


# OPERATING ON A BEATING HEART





# GPU-ACCELERATED FINGERPRINT MATCHING





# VIDEO AND IMAGERY SEARCH AND ANALYSIS



Find objects of interest in an hour of video in a matter of seconds

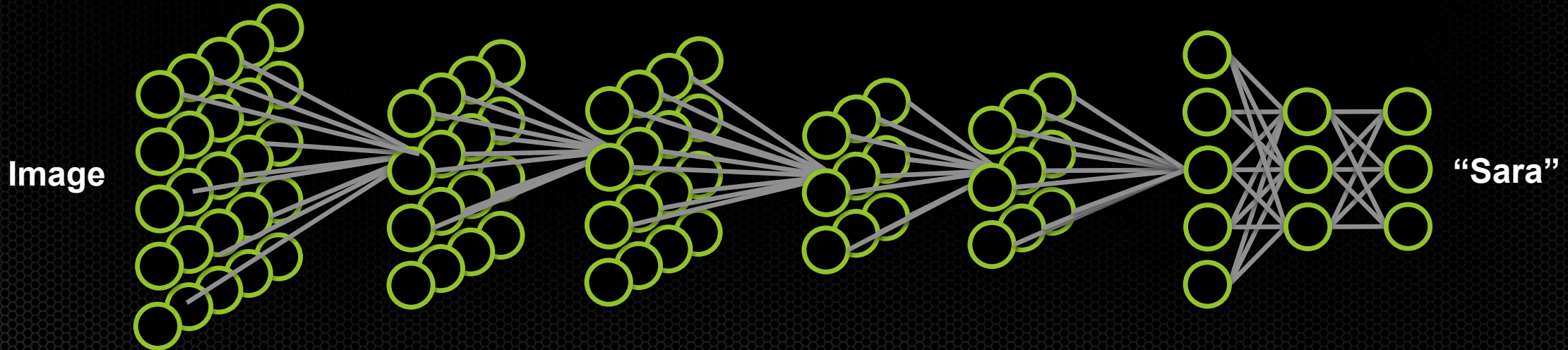
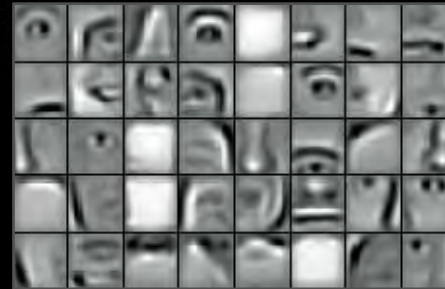
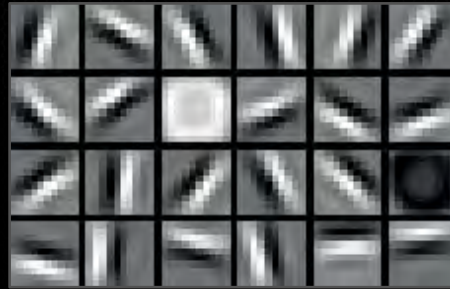


*One hour of video searched in 5 seconds*





# MACHINE LEARNING USING DEEP NEURAL NETWORKS



*“Now You Can Build  
Google’s Artificial  
Brain on the Cheap”*

**WIRED**

## GOOGLE DATACENTER



1,000 CPU Servers  
2,000 CPUs • 16,000 cores

**600 kWatts**  
**\$5,000,000**

## STANFORD AI LAB

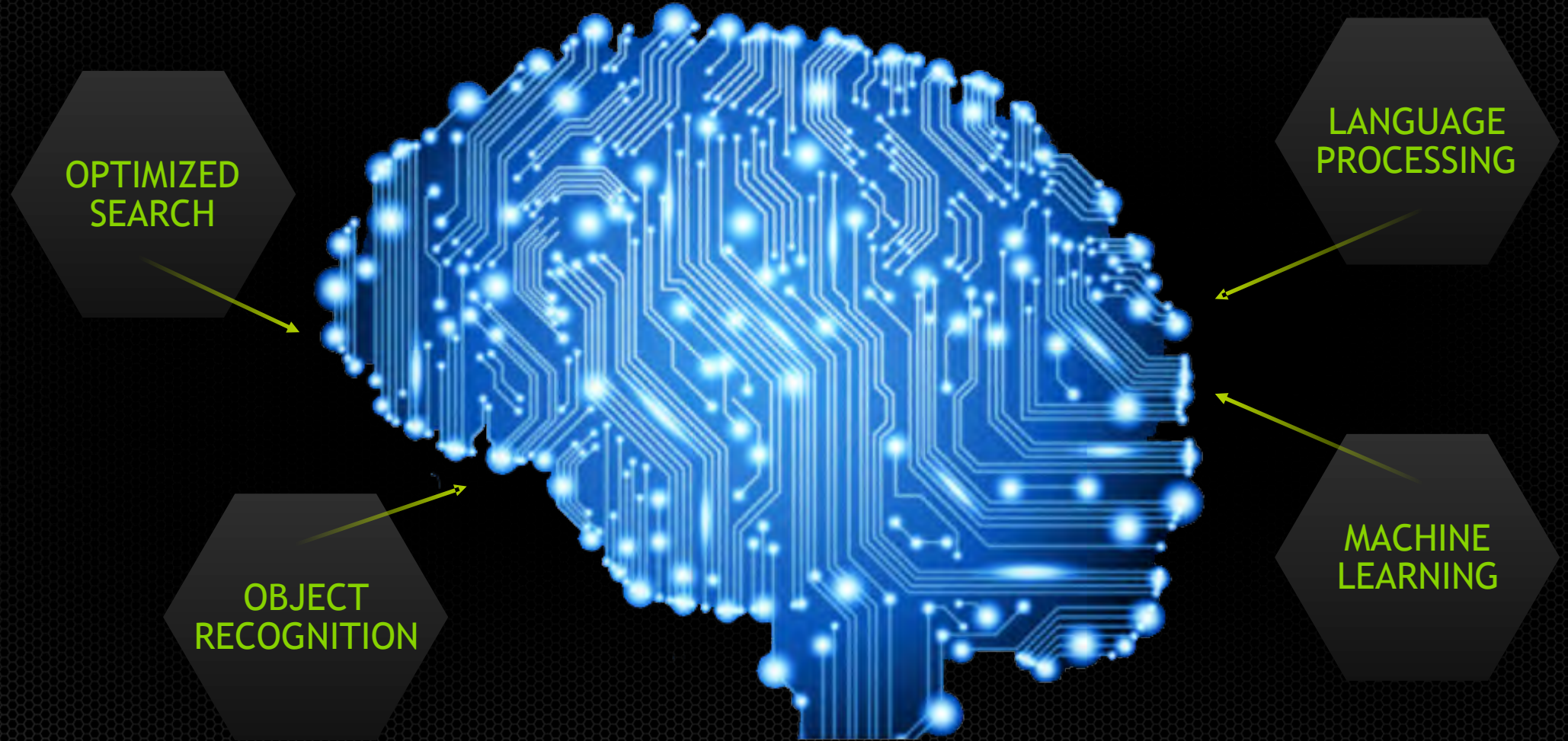


3 GPU-Accelerated Servers  
12 GPUs • 18,432 cores

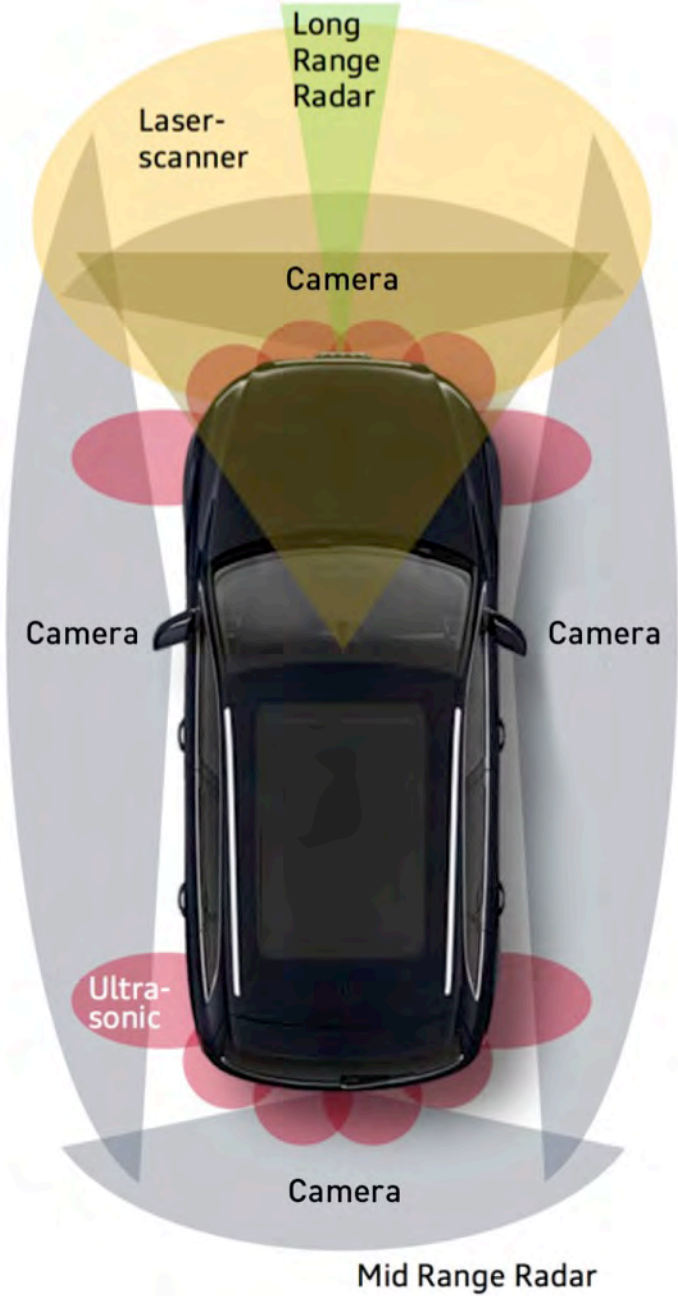
**4 kWatts**  
**\$33,000**



# ARTIFICIAL INTELLIGENCE ON THE GPU







# SUPERCOMPUTING FOR DRIVER ASSISTANCE

Pedestrian Detection  
Blind Spot Monitoring  
Lane Departure Warning

Collision Avoidance  
Traffic Sign Recognition  
Adaptive Cruise Control



Optical Flow



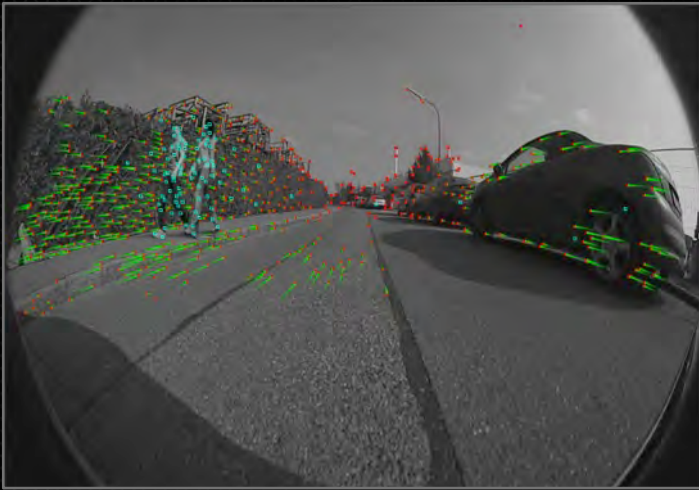
Histogram



Feature Detection



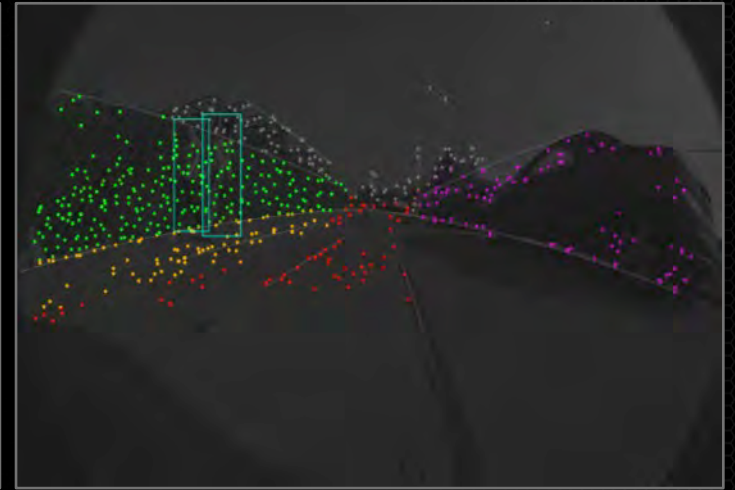
# Computer Vision on CUDA



Feature Detection / Tracking  
~30 GFLOPS @ 30 Hz

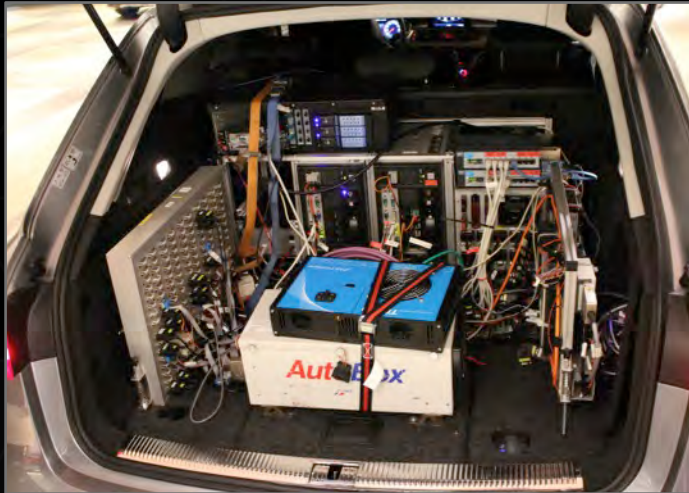


Object Recognition / Tracking  
~180 GFLOPS @ 30 Hz



3D Scene Interpretation  
~280 GFLOPS @ 30 Hz

# THE ROAD TO THE SELF DRIVING CAR DEPENDS ON VISUAL SUPERCOMPUTING





# AUDI TRAFFIC JAM PILOT



LET'S SHOW THE WORLD WHAT'S NEXT

