

embedded **VISION** SUMMIT 2018

The Pilot AI Vision Framework: From Doorbells to Defense



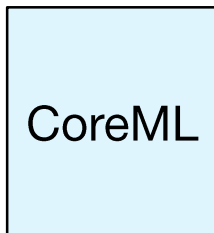
Jonathan Su - CEO
May 23, 2018

What is the Pilot AI Vision Framework



- **Deep learning based computer vision platform to solve real problems with limited compute.**
 - Better neural network algorithms that run efficiently on modern memory architectures
 - Optimized compute kernels across target platforms (from DSP to Cortex M to GPUs)
 - Vision Toolkit that exposes functionality like detection, classification, and tracking
 - Plug and play API/binaries that drop into existing customer products
 - Customer deployable data storage and labeling infrastructure

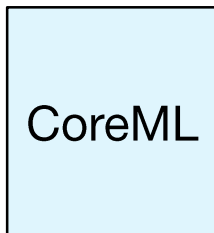
At the center of the Pilot AI Vision Framework is the CoreML module: a core set of machine learning building blocks optimized for speed.



Goal: Run deep learning faster

Alternatives:

- Low-precision: limited acceleration, need retraining
- Connection pruning: sparsity tends to be unstructured
- Weight quantization: limited win



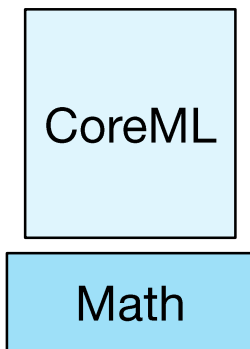
Our approach:

- Structured sparsity that works
- Dynamic evaluation
- Built in a way that is extensible to a variety of vector widths
- Layer on other techniques like lower precision, quantization, custom silicon, etc.
- Abstracted away from the user API

2-10x performance increase, depending on the problem

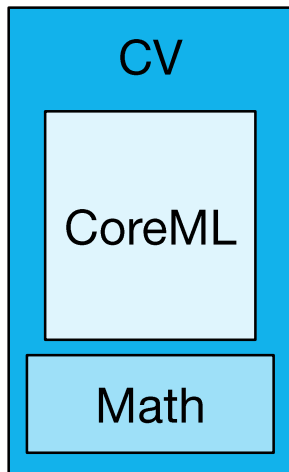
Custom Math Kernels

Goal: Exploit hardware features to further accelerate numerics



- s/dgemm, s/dgemv type operations
- Implemented in assembly/intrinsics on DSPs, Cortex M, Cortex A, x86, GPU
- Abstracted away from user API
- 1.5-3x performance boost

Computer Vision Library

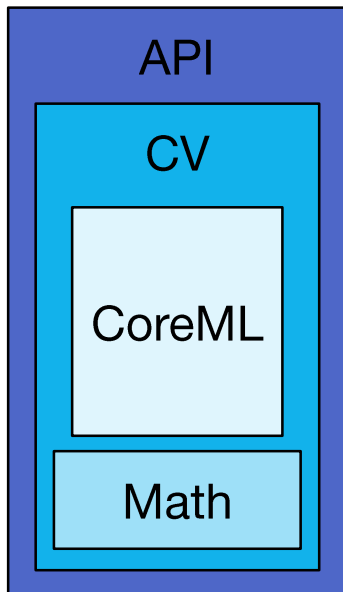


Goal: Implement common CV tasks on top of the Pilot AI CoreML library

- Detection
- Classification
- Tracking

Proprietary algorithms based on the literature, but built in the context of our CoreML building blocks for acceleration.

The Pilot AI Vision Framework

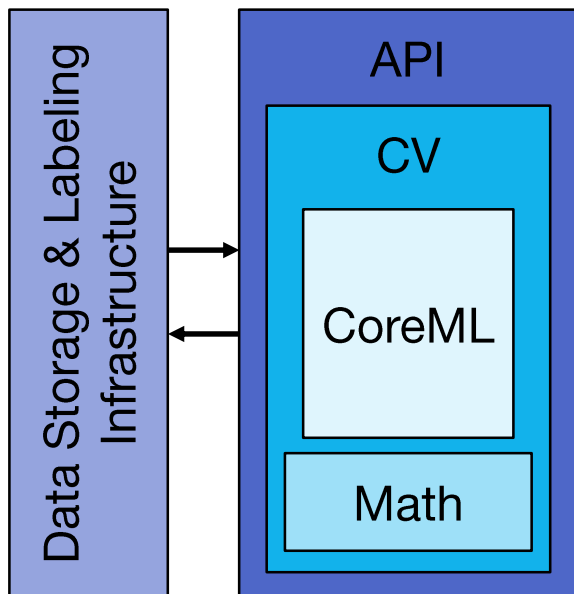


Computer Vision API

Goal: Plug and play interface for customers to access the features of the Pilot AI Vision Framework

- C++ style interface
- Lightweight binaries (no external dependencies)
- Currently deployed into Linaro, RTOS, Linux, and Windows environments

The Pilot AI Vision Framework



Data Storage/Labeling Infrastructure

Goal: Quality labeled data is critical; make it easily accessible to our customers

- Provide large off-the-shelf datasets
- 70K+ objects labeled every day
- Make it easy for our customers to ingest data and iterate models
- Data infrastructure is easily deployable for on-premise applications

Pilot AI in the Real World



Deployed on 1M+ cameras over the last 2.5 years

Consumer → Commercial → Government

IoT

- Security cameras
 - Drones
- Retail analytics
 - AR/VR



Automotive

- Inward facing car cameras
- Driver assistance cameras
- Multiple cameras per car
- Mobileye \$250M Rev 2015



Industrial Robotics

- Autonomous robot navigation
 - Picking/Packing
- Labor cost increasing, robotics will to solve more complex tasks
 - \$26B in 2013

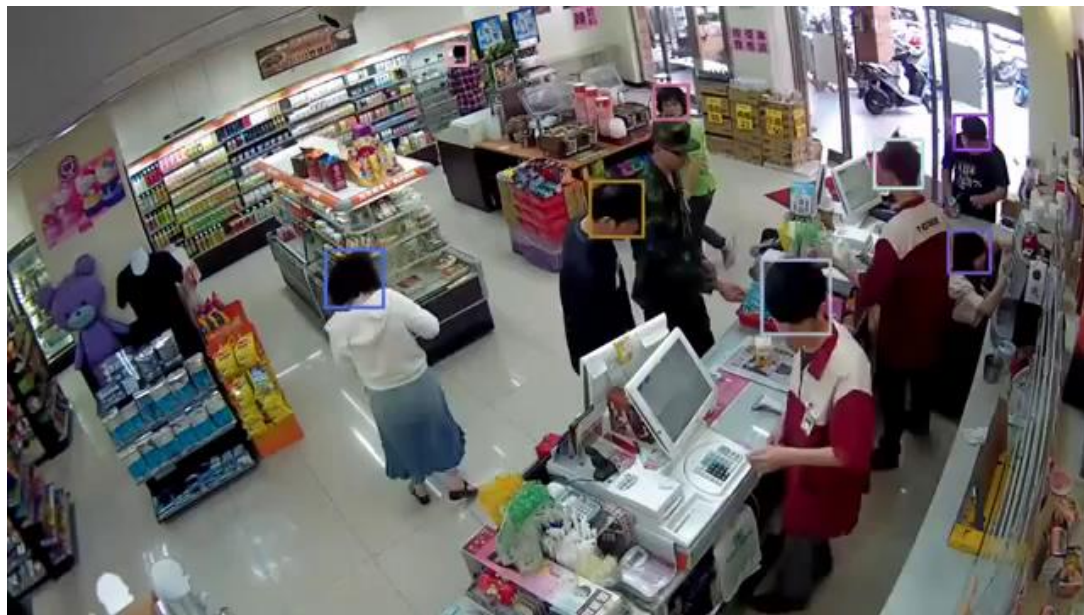


Home/Appliances

- Smart Refrigerators/Washers
- IP Cameras
- Home robotics
- 2015 global appl. sales \$180B



Example Application #1 – Retail Analytics



For retail analytics, we built an detection and classification system that runs directly on existing security cameras installed in stores.

This allows retailers to collect analytics like people counting, zone counting, heat maps, gender, and race.

This will be deployed in 10,000 stores, with an average of 15 cameras per store.

<https://www.youtube.com/watch?v=8iUtEqoB4Ks>

Example Application #2 – Security/Doorbell

For home security and automation our embedded robust computer vision algorithms can support a variety of applications, from smart IP cameras, intelligent door bells, to smart appliances.

Running directly on the edge device allows service providers to reduce bandwidth and cloud computing costs by performing that function on the consumer premises.



Example Application #3 – Drone Follow-Me



For drones, we built a robust deep learning based object detection and tracking system that runs directly on a small action camera. When this is connected to a drone, this solves various problems encountered by drones, such as allowing a drone to follow an object, or allowing the drone to determine a safe place to land.

https://www.youtube.com/watch?v=LWjwkl_cu-E

Example Application #4 – Government



Pilot AI's government work spans both the intelligence community as well as the DoD.

These applications range in distance from a few feet to satellites. As such, the applications span ARM cores, x86, and GPUs.

Though the hardware platforms are diverse, all the use cases are compute constrained.

Looking Ahead



Extending the Pilot AI Framework

- Deployment of temporal detectors
 - Fighting, shoplifting, etc.
- Visual Search
 - Both real-time and forensic
- Other sensor inputs
 - Depth, Radar, etc.
- Extend beyond vision to speech and other applications

Thank You



Pilot AI

We would love to hear from you!

CONTACT US



contact@pilot.ai



425-761-9140



www.pilot.ai