ENABLING HIGH-PERFORMANCE APPLICATION OF MACHINE-LEARNING ON MIPS AND POWERVR

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GOAL
- Research ways to efficiently implement machine-learning algorithms on MIPS/PowerVR
- Research possible extensions to MIPS

MOTIVATION
Consumer products applications:
- Product personalisation (e.g. musical preference analysis)
- Product tuning (e.g. voice recognition)

Case Study: Face-Detection with Features
Based on pixel-intensity-sum over rectangular regions of the subject image
Sum the pixel intensity values in the positive regions, subtract sum of the pixel intensity values in negative regions

Dark regions are ‘negative’ (subtractive), light region is ‘positive’ (additive)
Features can be evaluated very efficiently using the ‘integral image’
Feature ‘shapes’: Edge, Line, Chequer

MACHINE LEARNING APPROACH

Offline machine learning:
Training phase distinct from actual use

Online machine learning:
Learns ‘in the field’
- Viola/Jones algorithm is offline
- Uses AdaBoost boosting meta-algorithm

BOOSTING
- Machine-learning strategy based on composing ‘weak learners’
- Each weak learner has less-than-50% error-rate
- Face-detection uses features as weak-learners
- Very broadly applicable

THE MIPS ISA
- RISC
- Widely used in embedded applications
- Multi-core & SIMD

POWERVR
- Leading mobile embedded-graphics product-line
- OpenCL conformant
- Potential for customisation

REFERENCES
A Short Introduction to Boosting, Freund & Schapire
Robust Real-Time Face Detection, Viola & Jones
A Novel SoC Architecture on FPGA for Ultra Fast Face Detection, He, Papakonstantinou & Chen