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

Max Barraclough (mhb2e08@ecs.soton.ac.uk) - Supervisors: Dr Denis Nicole, Professor Steve Gunn - Sponsored by Imagination Technologies™

GOAL

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

MOTIVATION

Consumer products applications:

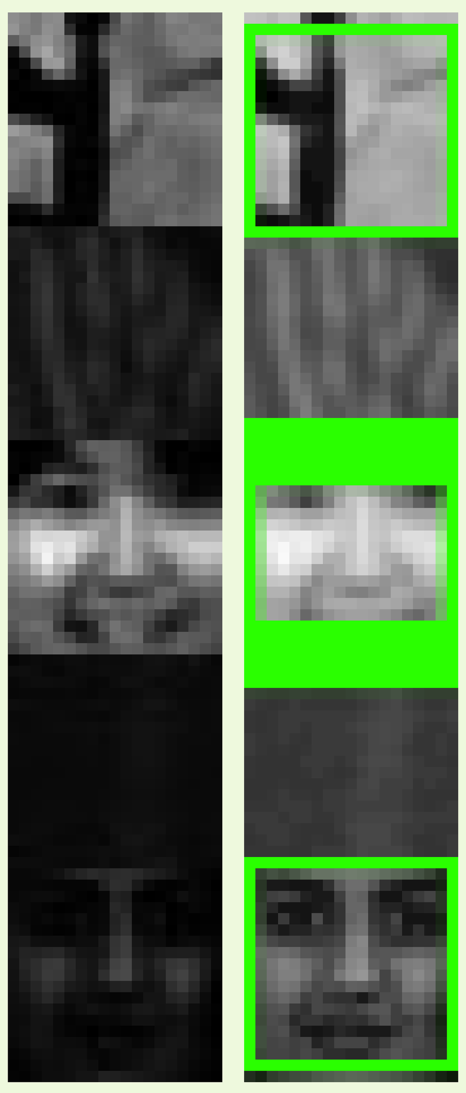
- Product personalisation (e.g. musical preference analysis)
- Product tuning (e.g. voice recognition)

Case Study: Face-Detection with Features

Based on pixel-intensity-sum over rectangular regions of the subject image

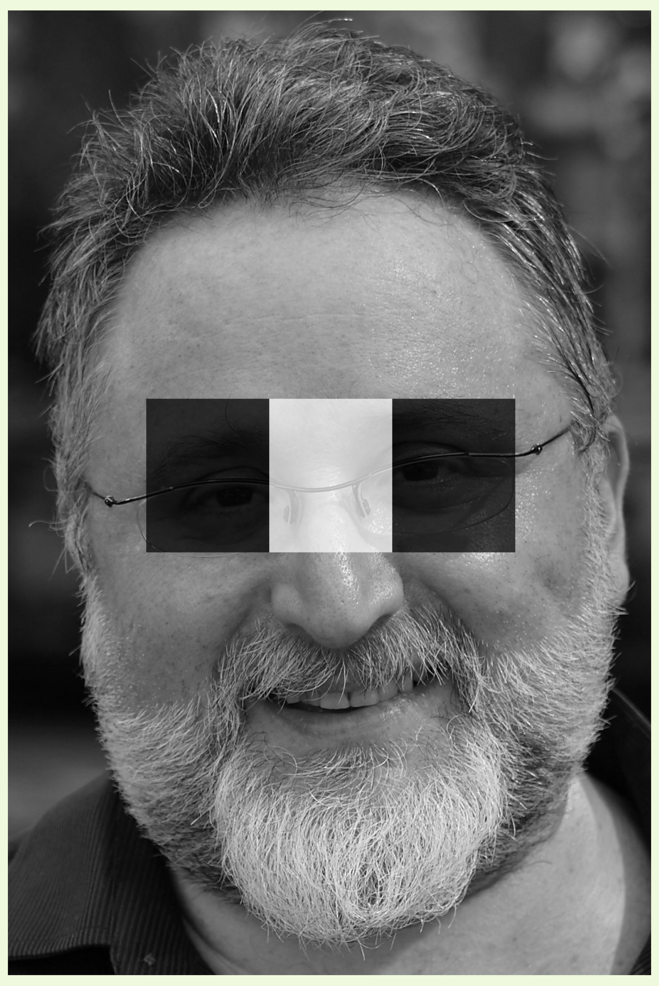
Low-resolution images rom the CMU image database

Sum the pixel intensity values in the positive regions, subtract sum of the pixel intensity values in negative regions



Low-resolution images from the CMU image database
25 rounds of boosting used

Based on public domain image of Eben Moglen by Andrew McMillan

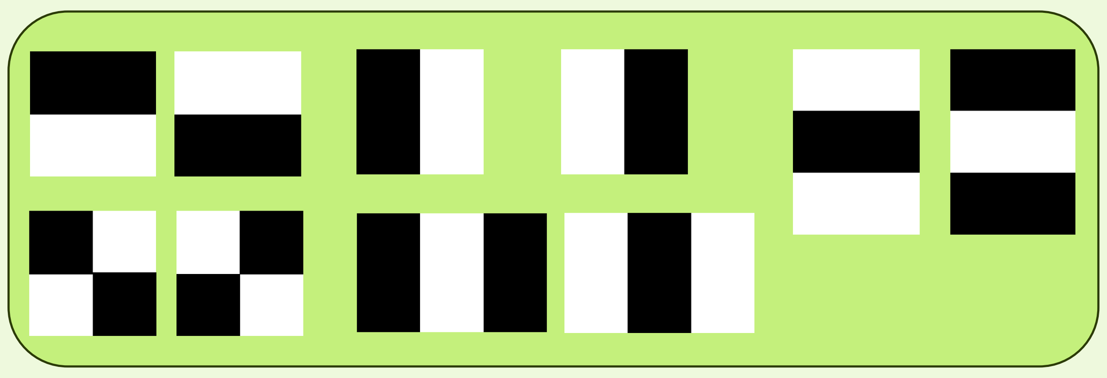


Eyes-detecting feature

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

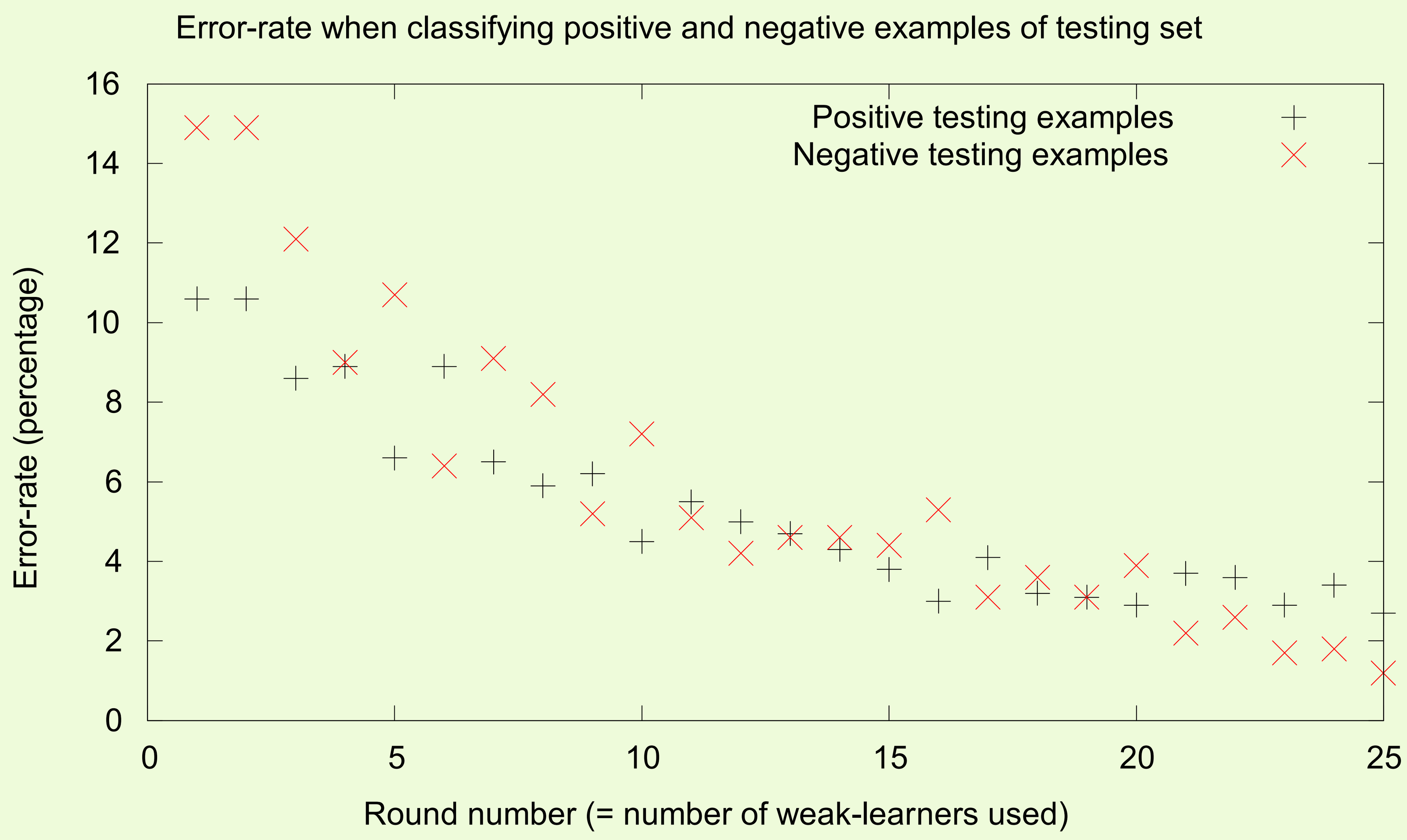
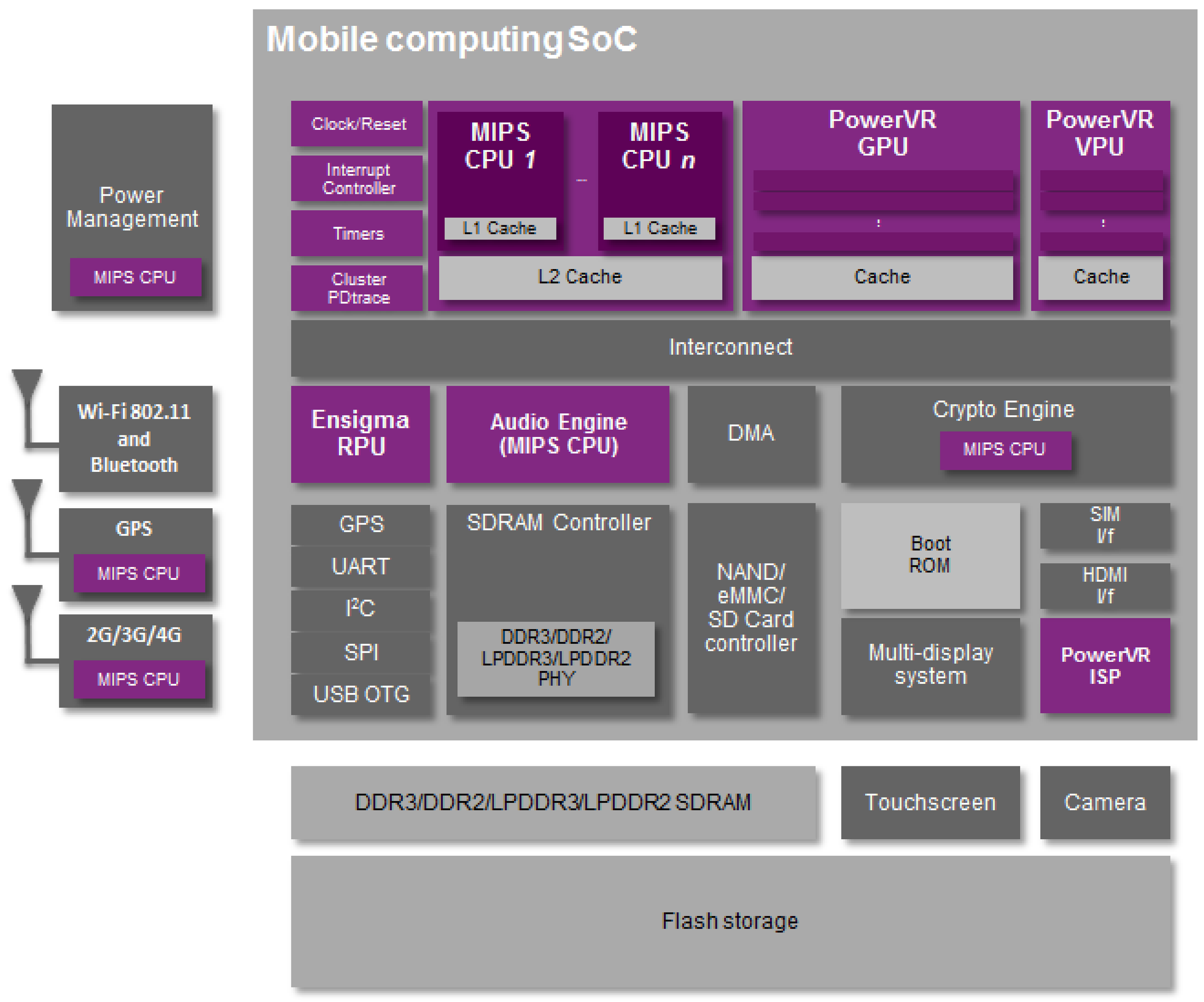


Image from Imagination Technologies™ web-site



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