OpenBR – Open Source Biometric Recognition

and Beyond

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www.openbiometrics.org

February 17, 2013

Why Open Source?

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Reproducible Research

Support a common set of file formats and tools for algorithm design, development, and evaluation.

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Improve Collaboration

Help foster a community where collaboration takes place at the source code level.

What's in it?

Off-the-shelf algorithms

- Face Recognition
- Gender Classification
- Age Estimation
- Commercial Wrappers

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Software framework for algorithm development

- C++ plugin API for implementing new algorithms
- Grammar for image processing
- Automatic testing, packaging and deployment

Software Architecture

Qt

Cross-platform application and UI framework

OpenCV

Image processing library

Eigen

Linear algebra library

CMake

Cross-platform build system

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br

Command line application for running algorithms and evaluating results.

C API

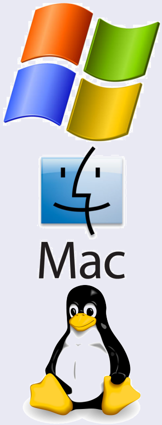
High-level interface for other programming languages.

C++ Plugin API

Core interface for using and developing algorithms.

Supported Platforms

Now



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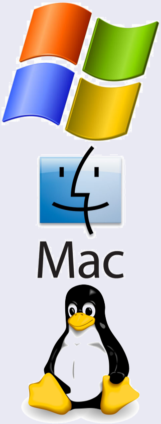
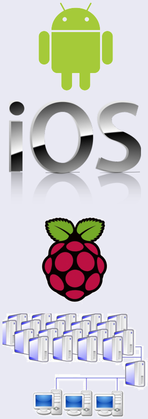


Soon



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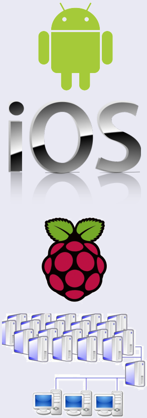


Future

intel inside
Xeon Phi
NVIDIA
ACCELERATED
A·SERIES
PROCESSOR
AMD

Algorithm Evaluation

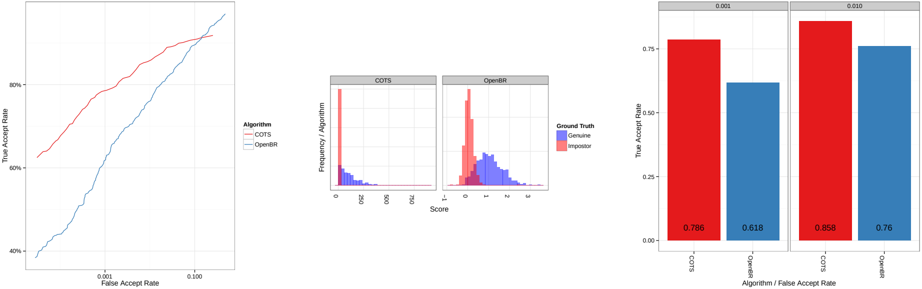


Figure: OpenBR vs COTS face recognition on *MEDS* mugshot database.

Algorithm Evaluation

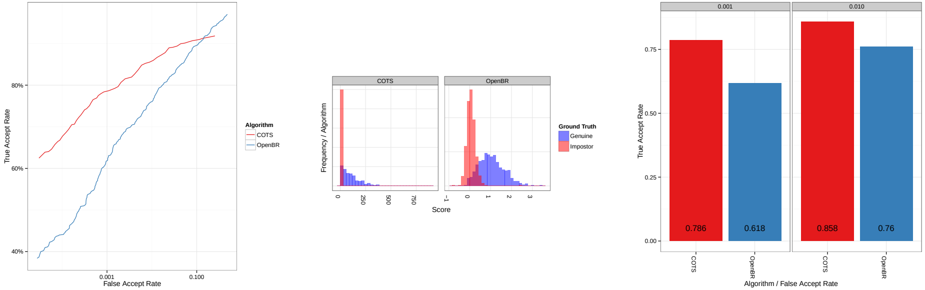
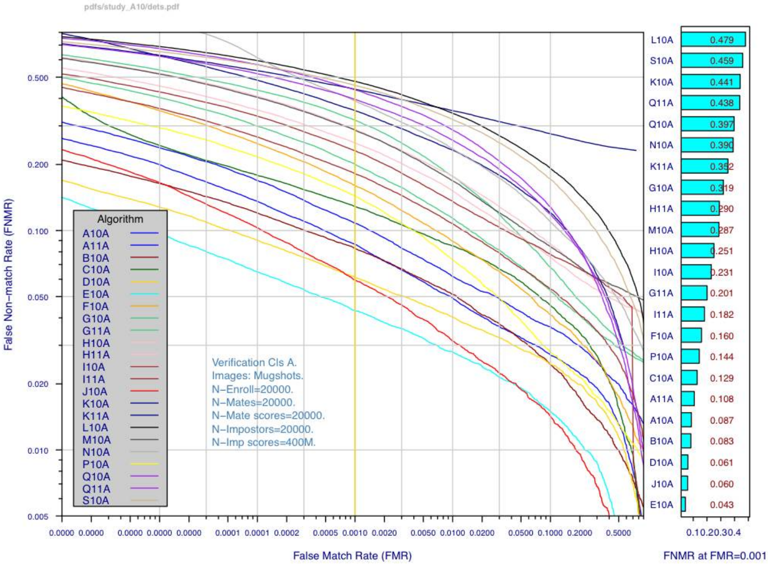


Figure: OpenBR vs COTS face recognition on *MEDS* mugshot database.

	OpenBR	COTS-A	COTS-B	COTS-C	COTS-D
TAR @ FAR = 0.01	0.77	0.93	0.96	0.86	0.80
Template Size (kB)	0.75	2.8	5.0	36	74
Enrollment Speed	10	N/A	N/A	1.3	1.2
Comparison Speed	3,800,000	N/A	110,000	19,000	2,000

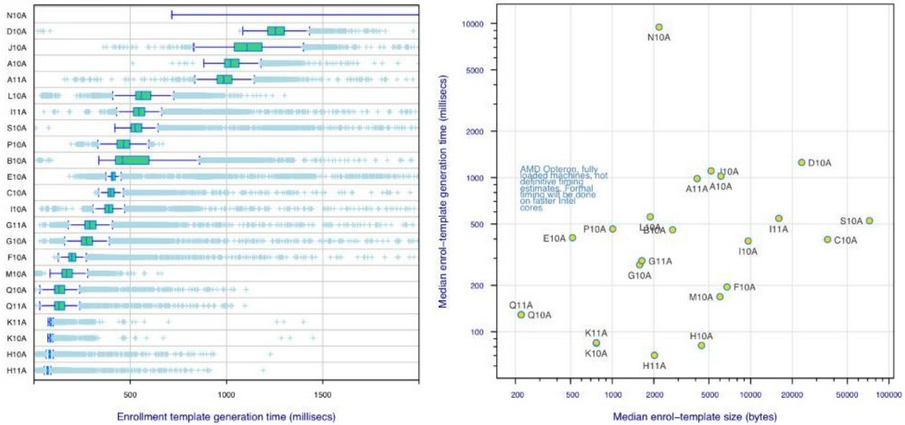
FRVT 2012 (OpenBR = 'K')



Verification Cls A.
Images: Mugshots.
N−Enroll=20000.
N−Mates=20000.
N−Mate scores=20000.
N−Impostors=20000.
N−Imp scores=400M.

FRVT 2012 (OpenBR = 'K')

pdfs/study_A10/ttime_and_tsize.pdf



AMD Opteron, fully loaded machines, not definitive timing estimates. Formal timing will be done on faster Intel cores.

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$ br -algorithm FaceRecognition -compare me.jpg you.jpg
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...

FaceEmbedding

Dup(12)+RndSubspace(0.05,1)+LDA(0.98)+Cat+PCA(768)

Live Coding

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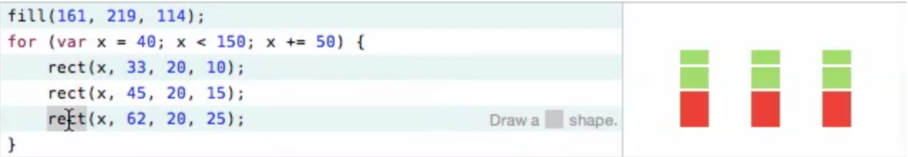
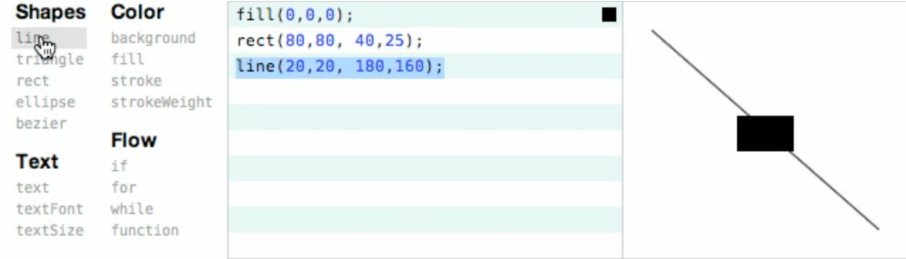


```
fill(161, 219, 114);
for (var x = 40; x < 150; x += 50) {
    rect(x, 33, 20, 10);
    rect(x, 45, 20, 15);
    rect(x, 62, 20, 25);
}
```



```
fill(0,0,0);
rect(80,80, 40,25);
line(20,20, 180,160);
```

Inventing on Principle

http://www.youtube.com/watch?v=PUv66718DII

CPU Scaling

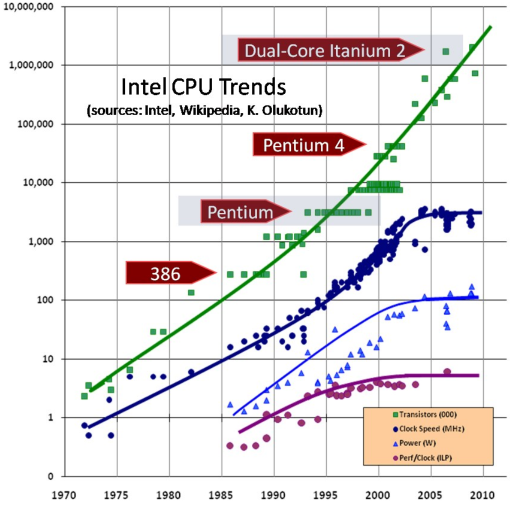
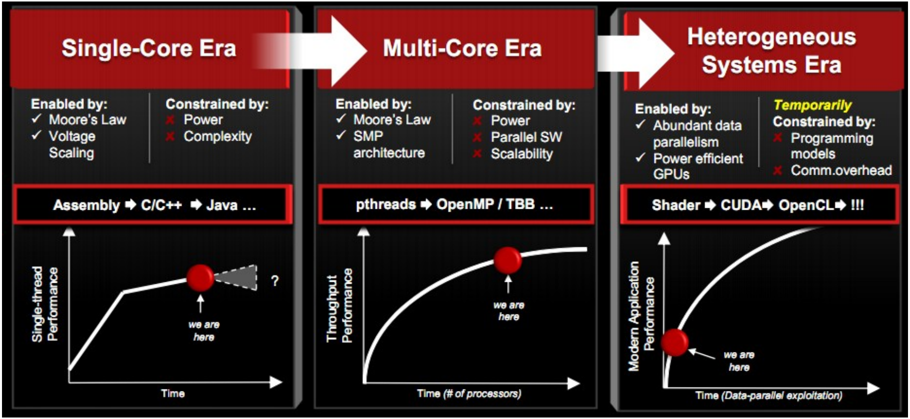


Figure: http://www.extremetech.com/computing/116561-the-death-of-cpu-scaling-from-one-core-to-many-and-why-were-still-stuck

Evolution of Hardware and Software



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Hardware Realities

Figure: i7 3930k

Figure: GTX 680

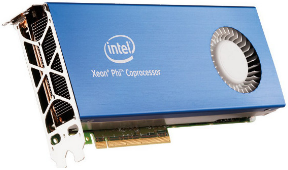

Figure: Xeon Phi 5110p

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Figure: GTX 680

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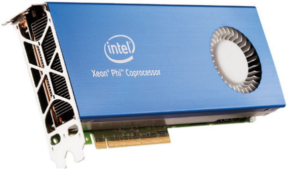

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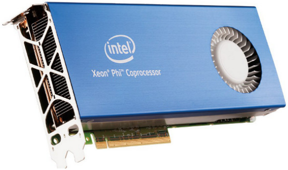

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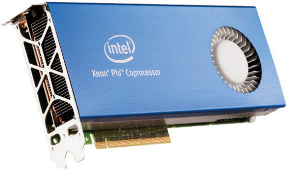

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Gotcha: Memory Bandwidth

12.8 GFLOPS **48.0 GFLOPS** **80 GFLOPS**

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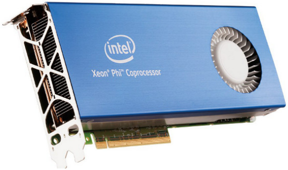

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Gotcha: Code Duplication

Need a separate code base for optimized performance on each device!

Requirements

What we want

- Write once and run everywhere
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- Virtual machine or just-in-time compiler
- Express computations using induction variables or “kernels”:

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void example_kernel(int *a, int *b, int i) { a[i] += b[i]; }
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What we’re proposing

- LLVM IR and JIT compiler
- Designing for OpenCL 2.0 standard

Goals

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A grammar for building algorithms from orthogonal primitive kernels with typeless semantics and optimized execution.

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Give me a pointer to a function that computes $LBP_{8,1}^{u2}$ on an image, minimizes main memory transactions by combining kernels, and is optimized for parallel execution on the hardware available.

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Take-Home Message

$Compilation = Source\ Code + Available\ Hardware + First\ Image$

The End

Slides

openbiometerics.org/slides.pdf

Source

github.com/biometrics/openbr

E-mail

openbr-dev@googlegroups.com

Thank You!

Welcome to the Parallel Jungle!

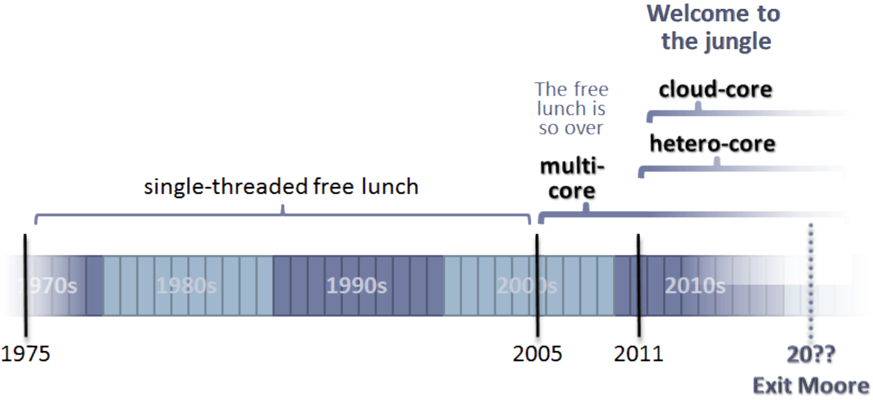

Figure: http://www.drdobbs.com/parallel/welcome-to-the-parallel-jungle/232400273

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    for (int r=radius; r<src.rows-radius; r++)
      for (int c=radius; c<src.cols-radius; c++) {
        float cval = p[r*src.cols+c];
        dst(r, c) =
          (p[(r-radius)*src.cols+c-radius] >= cval ? 128 : 0) |
          (p[(r-radius)*src.cols+c] >= cval ? 64 : 0) |
          ...;
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