Industry Standard BENCHMARKS

CoreMark®-Pro

CoreMark for High-Performance Processors

Quick Background:

Industry-Standard Benchmarks for the Embedded Industry

- EEMBC formed in 1997 as non-profit consortium
- Defining and developing application-specific benchmarks
- Targeting processors and systems
- Expansive Industry Support
  - >47 members
  - >90 commercial licensees
  - >120 university licensees

BUILDING BETTER BENCHMARKS SINCE 1997

Reminder: What is the Original CoreMark?

- Simple, yet sophisticated
  - Easily ported in hours, if not minutes
  - Comprehensive documentation and run rules
- Free, but not cheap
  - C code source downloaded from EEMBC website
  - Robust CPU core functionality coverage
- Dhrystone terminator
  - The benefits of Dhrystone without all the shortcomings
    - Free, small, easily portable
    - CoreMark does real work
- Almost 13,000 downloads and 500 scores posted

WHY COREMARK-PRO?

- The EEMBC CoreMark brand represents an EEMBC methodology to deliver reliable and repeatable benchmarks
- CoreMark (released in 2009) was designed to run on low-end 8-bit microcontrollers to 64-bit processor
- CoreMark-Pro delivers a huge jump in benchmarking capabilities
  - Multicore
  - Integer and Floating-Point
  - Greatly increased memory subsystem exercising
  - Targets 32-64 bit processors
  - Contains wider variety of workloads to expose more processor strengths and weaknesses
- Does not replace the need for the original CoreMark
- Performs double duty as the CPU workloads in EEMBC AndEBench-PRO

WHAT IS COREMARK-PRO

- PRO = Professional grade benchmark
- PRO = Processors for high-performance applications

Comparing CoreMark and CoreMark-Pro

CoreMark	CoreMark-Pro
Freely available	Commercial licensing available
Self-verification	Self-verification
Open score submission	Open score submission
Replaces Dhrystone	A more advanced, wider scope benchmark
One integer workload with 4 functions	5 integer and 4 floating-point workloads
Small (2k code, 16k data)	Robust 42k-3MB (per context))
Targets processor core	Targets processor and memory subsystems
Limited multicore support	Multicore support

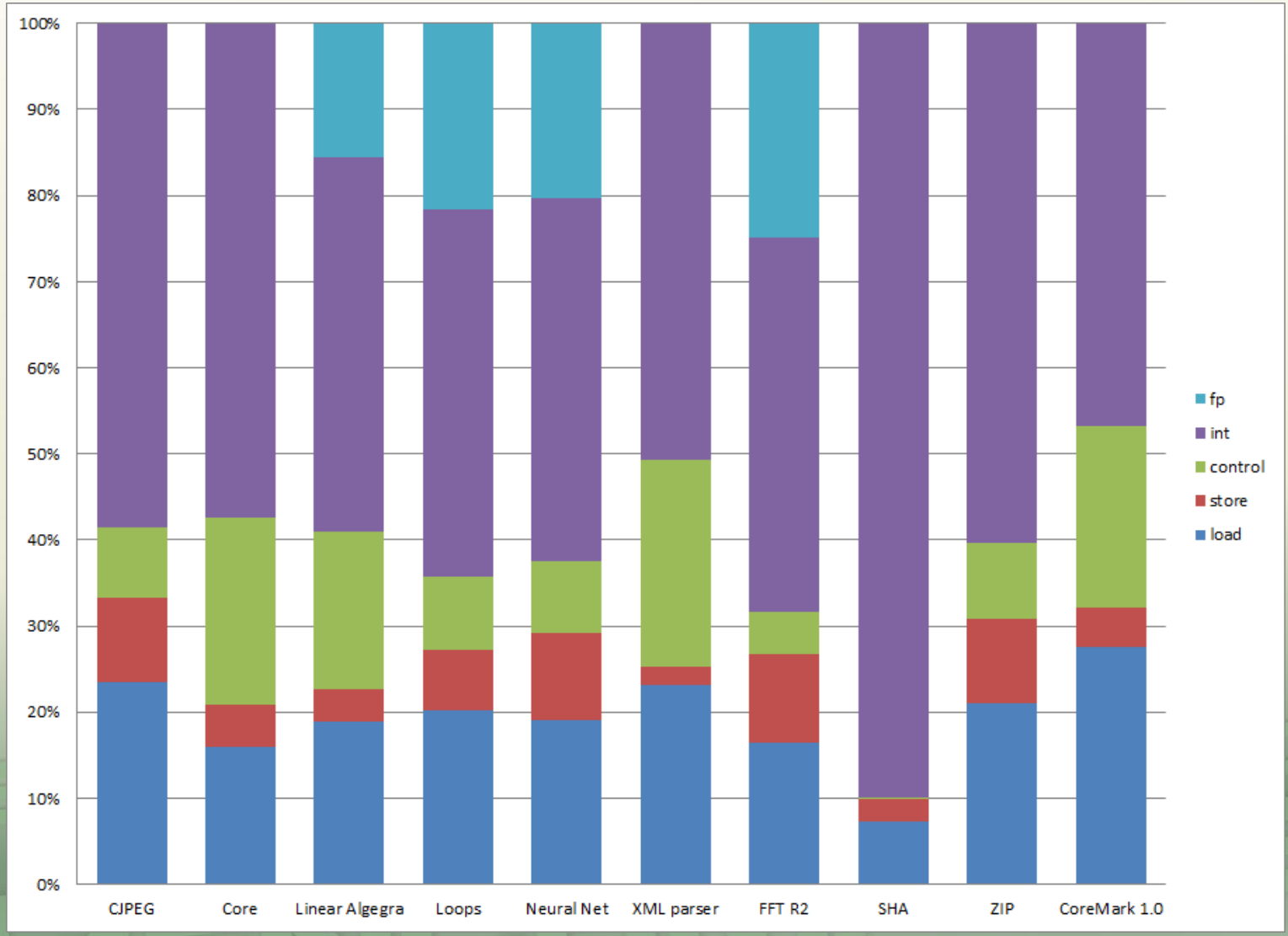
CoreMark-Pro integer workloads

- Core
  - A CoreMark derivation with modified datasets and CRC algorithm to target app processors and other high-end processors
- JPEG Compression
  - The two main benchmark phases are color space conversion and compression, contributing about equally to processing load
- XML parser
  - Parses an XML string and creates an ezxml structure, then performs simple validation on the output
- Secure Hash Algorithm (SHA256)
  - Subset of cryptographic hash functions consisting of hash functions with digests of 256 bits
- Zip compression
  - Uses zlib library and a variant called deflation that emits compressed data as a sequence of blocks. More information about zlib: http://www.zlib.net

COREMARK-PRO FLOATING-POINT WORKLOADS

- FFT R2
  - Performs FFT with Radix2 on the input
- Linear algebra
  - Solves linear equations
  - Solution obtained by Gaussian elimination with partial pivoting, and the implementation is derived from Linpack
- Loops benchmark
  - Variety of kernels based on greatly improved Livermore loops
  - Each kernel was put into a different function and made to work with parameterizable input size
  - Kernels modified to avoid the compiler being able to compute the results at compile time.
- Neural Net
  - Uses a neural net to evaluate patterns

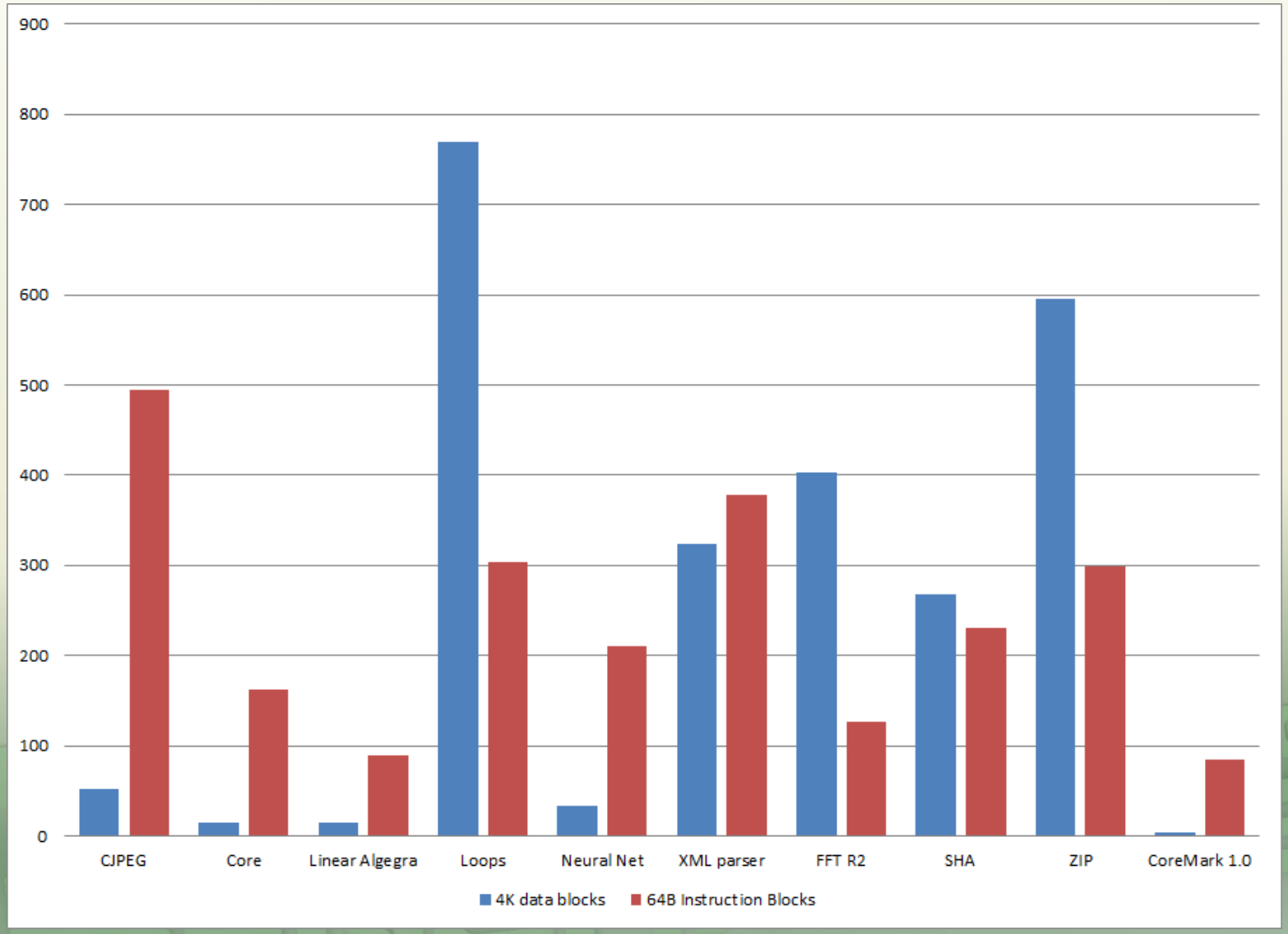
INSTRUCTION TYPE DISTRIBUTION SHOWS COMPUTE BALANCE



Representing a Wide Diversity of Performance Characteristics

EEMBC CERTIFIED

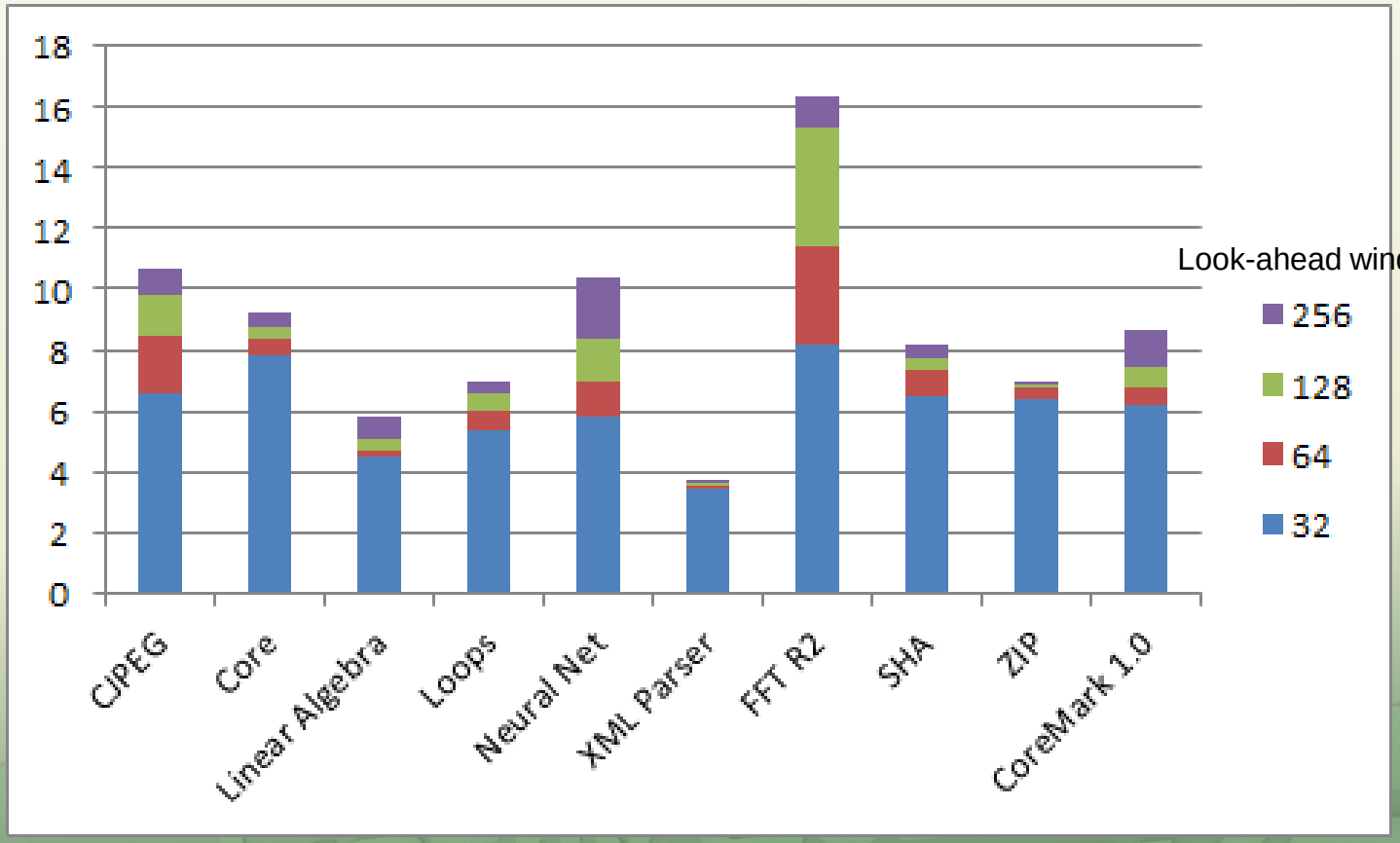
MEMORY FOOTPRINT



More Diverse Characteristics to Stress Memory Subsystems

A Wide Variety of Instruction Level Parallelism

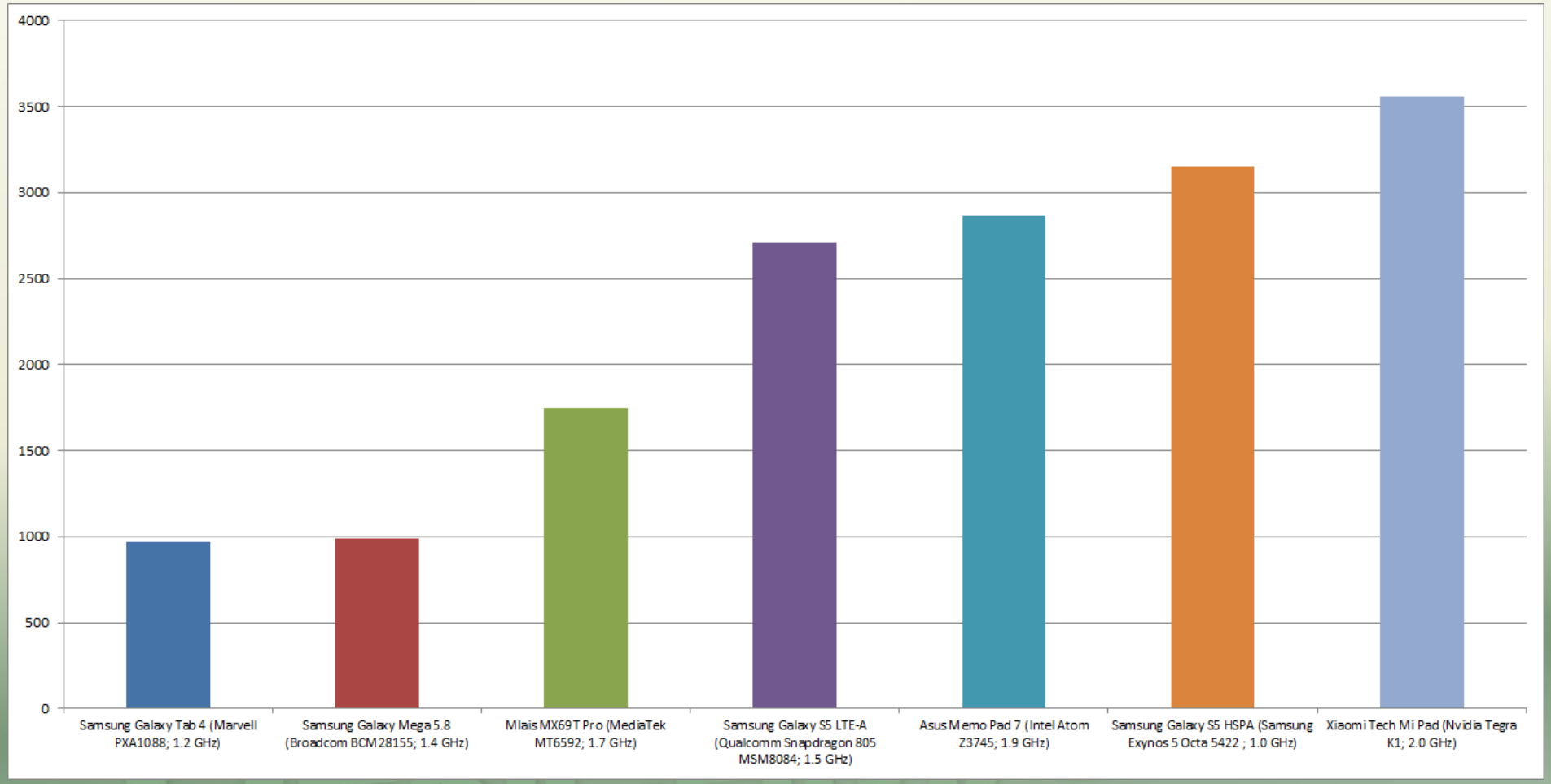
Instructions that can be executed in parallel



Differing levels of data dependencies helps rationalize the need for a processor with a bigger window of look-ahead capability.

Example: FFT Radix2 has maximum ILP; XML parser with minimal ILP

COREMARK-PRO RUNNING ON ANDROID DEVICES



Source: AndEBench-Pro results (www.eembc.org/andebench/index_pro.php)

CoreMark-Pro: Evolving the Value of CoreMark

- The industry standard tool to allow users to perform embedded processor analysis
- Commercial license available ($2500)
  - Required to disclose, reference, or publish test results generated by CoreMark-Pro in marketing of any of commercially-available, product-related materials.
  - Academic licensing is $250
- Use other EEMBC benchmarks for more comprehensive analysis and special focus
  - FPMark for full suite of floating-point tests
  - MultiBench for comprehensive multicore analysis
  - ULPBench for ultra low power
  - And more