I fired my hardware architect!

Who’s going to write the program NOW?

Efficient Code Generation for Custom Processors

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Embedded Systems Design Group
Dept. of Computer Science
The Project: HiPEC

High Performance Embedded Computing

Hi.u LINKÖPING UNIVERSITY

Hw

EIT

Lund University Faculty of Engineering

ESD@CS

Halmstad University

Sw
HP + Low P/E

Classic RISC pipeline
HP + Low P/E

Custom architecture pipeline

Multi-bank memory

IF → ID → MR → EX → MW/WB

Pre (shuffle/mask)

Vector FU

Post (sort/reduce)

DIV

SQRT

CORDIC

Classic RISC pipeline

IF → ID → EX → MEM → WB
HP + Low P/E
HP + Low P/E

Custom architecture pipeline

IF → ID → MR → EX → MW/WB

Pre (shuffle/mask)
Vector FU
Post (sort/reduce)

DIV
SQRT
CORDIC

Multi-bank memory

long pipeline (feedforward)
HP + Low P/E

Custom architecture pipeline

Multi-bank memory

IF → ID → MR → Pre (shuffle/mask) → EX → Vector FU → Post (sort/reduce) → MW/WB

Long pipeline (feedforward)

Wide data path (reconfig.)

DIV

SQRT

CORDIC
HP + Low P/E

Custom architecture pipeline

Multi-bank memory

scatter/gather access

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wide data path (reconfig.)

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vector operations + mask, reorder, reduce

Pre (shuffle/mask)

Post (sort/reduce)

Vector FU

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SQRT

DIV

CORDIC

MW/WB

EX

EX

EX

EX
HP + Low P/E

Custom architecture pipeline

Multi-bank memory

scatter/gather access

specific hardware accelerators

vector operations + mask, reorder, reduce

long pipeline (feedforward)

wide data path (reconfig.)
High throughput, low power consumption… ideally
The Challenge...
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...is to fully utilize such architectures!

- group/schedule operations
- place data (vectors) in memory
- keep the pipeline busy
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Typically no compiler and one programmer: the architect!

- tiny kernels only
- hand-written assembly/machine code (Excel sheets)
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…is **to fully utilize** such architectures!

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**Our goal:** **compile C-like source to efficient machine code**
Our Solution

• briefly: use Constraint Programming
  architecture + application = one model
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Invitation — Doctoral Dissertation:
“Code Generation for Custom Architectures
using Constraint Programming”

Mehmet Ali Arslan

November 3 (Thursday), 13:15 in E:1406 (E-house)