Autotuning HLS for FPGAs using OpenTuner and LegUp

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ReConFig, December 5, 2017

Institute of Mathematics and Statistics
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Slides

The slides and all source code are hosted at GitHub:

- Code & Data: `github.com/phrb/legup-tuner`
- Slides: `github.com/phrb/slides-reconfig-2017-autotuning`

FPGAs

FPGAs:

- Logic Blocks and Interconnections
- Reconfigurable

Tradeoff:

- Energy Efficiency and Performance
- Programmability

Using FPGAs in Bing:

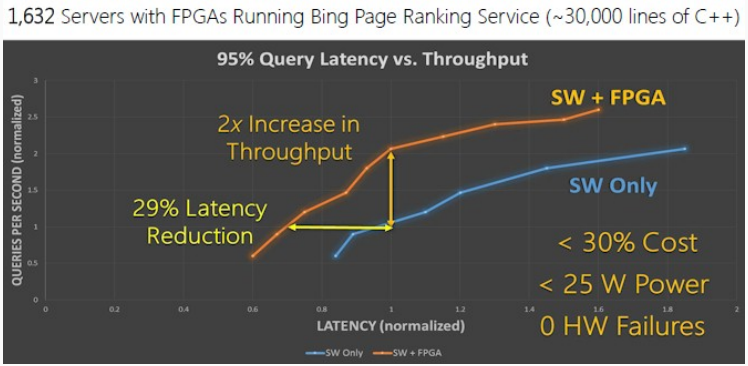


Image: enterprisetech.com/2014/09/03/microsoft-using-fpgas-speed-bing-search/ [Accessed in 27/11/17]

LegUp HLS flow:

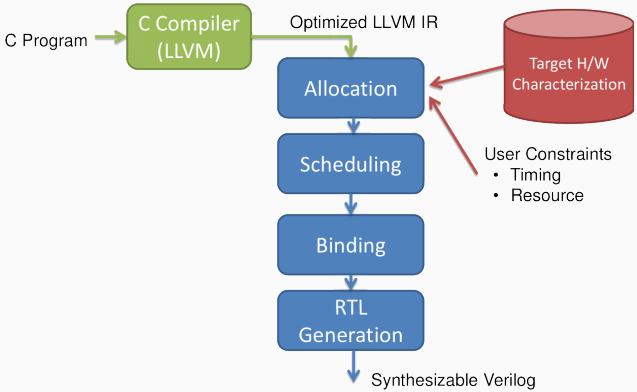
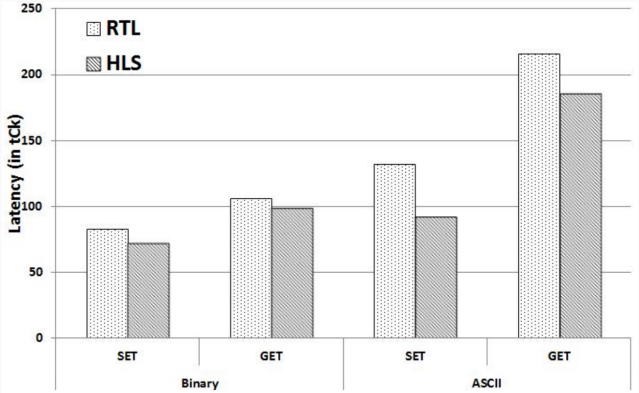


Image: Canis, Andrew Christopher. LegUp: Open-Source High-Level Synthesis Research Framework. Diss. University of Toronto, 2015.

HLS can generate lower-latency applications:



Memcached pipeline latency

Image: Karras, Kimon, Michaela Blott, and Kees Vissers. ”High-Level Synthesis Case Study: Implementation of a Memcached Server.” arXiv preprint arXiv:1408.5387 (2014).

Qualitatively, with less effort:

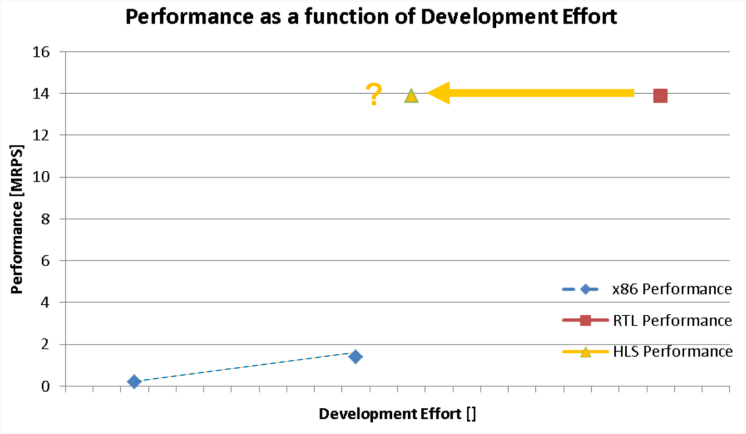


Image: Blott, Michaela, et al. "Achieving 10Gbps line-rate key-value stores with FPGAs." Presented as part of the 5th USENIX Workshop on Hot Topics in Cloud Computing. 2013.

This is an old issue:

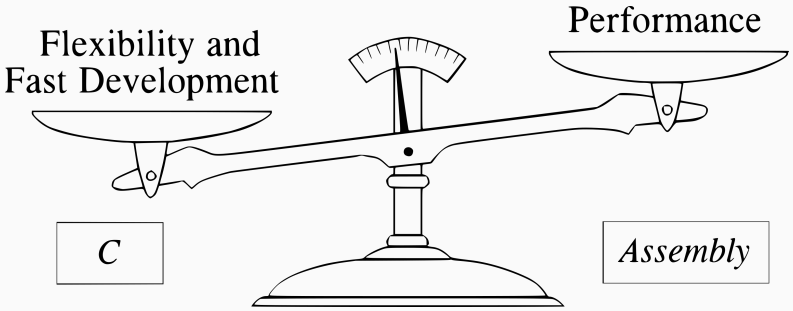


Image: Smith, Steven W. ”The scientist and engineer’s guide to digital signal processing.” 1997

Why use autotuning for HLS?

Compare with Huang's work

Describe Xu's work with OpenTuner

Describe CHStone and Metric Composition Strategy

Weighted Optimization Scenarios

An Optimization Scenario consists of:

- An optimization objective: performance, area, . . .
- Weights for hardware metrics

Our scenarios:

- 3 specific scenarios & 1 balanced scenario
- Weights: powers of two from 1: irrelevant to 8: high

Table 1: Weights for Optimization Scenarios (High $= 8$, Medium $= 4$, Low $= 2$)

Metric	*Area*	*Perf. & Lat*	*Performance*	*Balanced*
LUT	High	Low	Low	Medium
Registers	High	High	Medium	Medium
BRAMs	High	Low	Low	Medium
DSPs	High	Low	Low	Medium
FMax	Low	High	High	Medium
Cycles	Low	High	Low	Medium

Present the heatmaps for each optimization scenario

Limitations of this Work

Discuss the issues with the weighted cost function

Future Work

Discuss all future work topics

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