Computer Engineering Laboratory

Overview

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http://www.ee.usyd.edu.au/cel/index.html

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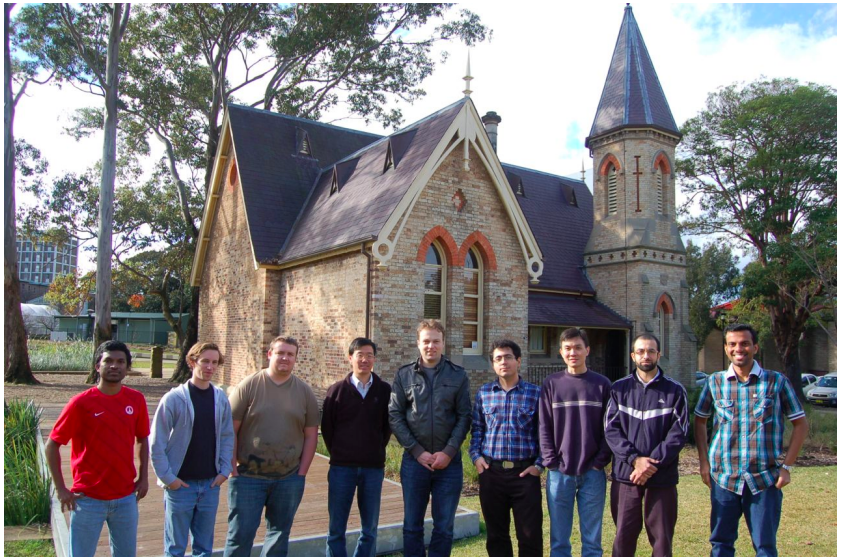
Computer Engineering Laboratory

- Research lies in addressing otherwise computationally intractable problems using custom hardware and parallel computing
- Expertise in
  - FPGA design, parallel computing, machine learning
- Applications
  - Computational Finance
  - Signal Processing
  - Biomedical Engineering
  - Machine prognostics



Major Projects

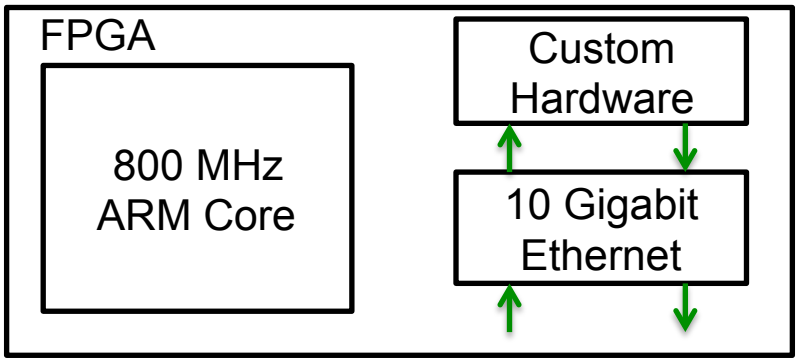
Hedging of Foreign Exchange Risk

- Three year ARC Linkage project started 2012 sponsored by Westpac
- Problem
  - Alice buys $0.969M AUD using $1M USD -> Bank buys $1M USD
  - AUDUSD exchange rate falls and bank loses money (if position large)
  - Need to understand and hedge risk
- Apply parallel computing and machine learning techniques to better understand and manage exposure to FX risk
  - Software environment for the testing of risk management strategies
  - Interface to scalable cloud computing resources
  - Predict customer flow and exchange rates
  - Develop hedging strategies and market models
- Enable Australian banks to better quantify and manage risk, making them more competitive in global FX markets

Online FPGA-based classification and Anomaly Detection

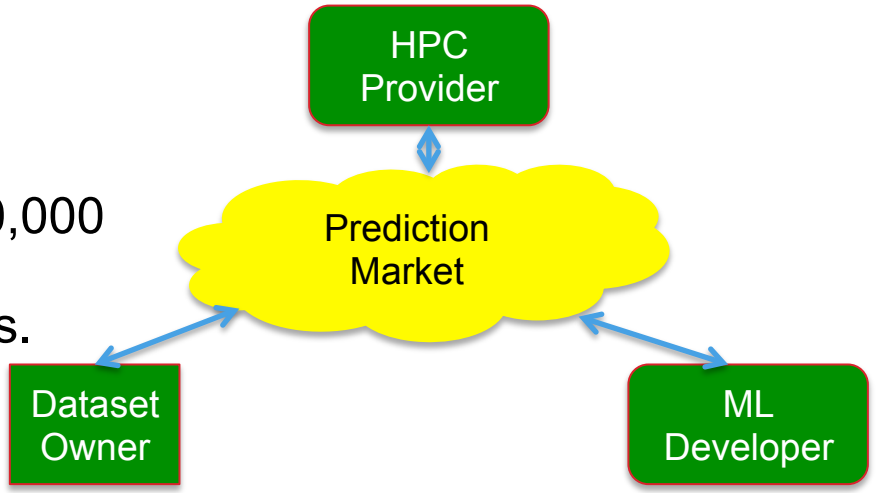
- Three year ARC Linkage project announced 2013 sponsored by Zomojo
- Online hardware-assisted machine learning systems which reduce latency and energy consumption by 10-1000x
  - FPGAs which integrate network and decision logic
- Improved classifiers, regression and outlier detection algorithms with emphasis on latency with applications in network monitoring, high speed signal processing, and machine prognosis

Platform	Power (mW)	Latency (uS)	Energy (10^-5 J)
Our processor	26880	**28**	**75**
NIOS II	15120	58428	88344
DSP	**2025**	54926	111123
CPU (Intel)	36818	238	876



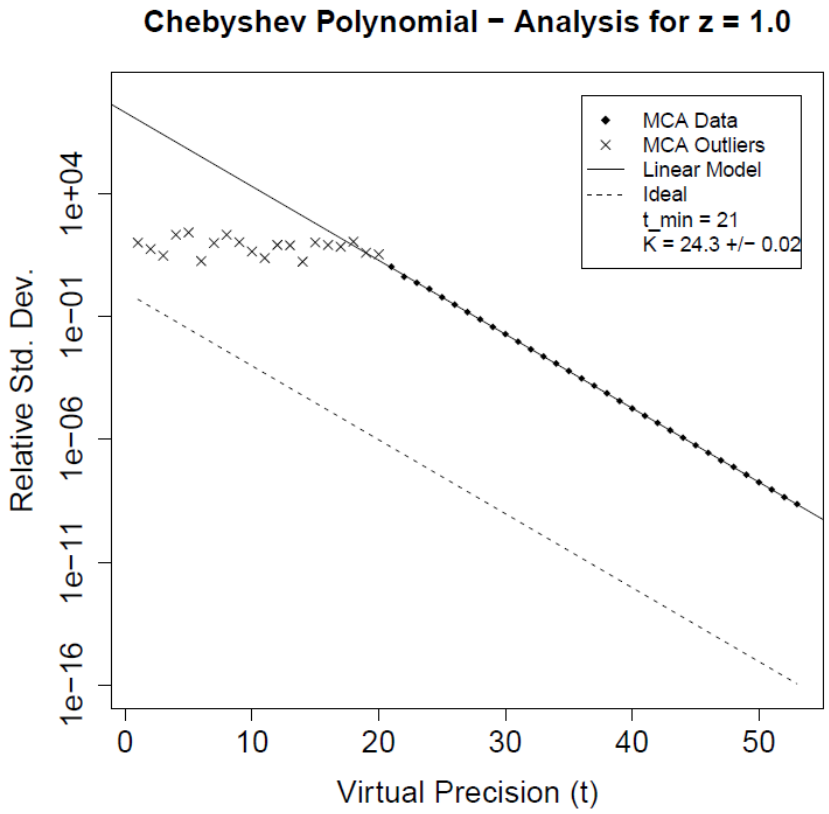
Prediction Market

- A $54M Industry Innovation Precinct with SIRCA announced by Minister for Industry http://sydney.edu.au/news/84.html?newsstoryid=12244
- Financial services contribute >10% of the Australian gross domestic product account for < 0.5% of exports (c.f. 50% Britain, 25% Singapore, 8% Canada and US)
- Goals is to double the current exports, create 30,000 new jobs over the next 5 years, improve the international competitiveness of existing services.
- Project
  - Create market which allows trading in predictions
  - Improving on the current limits of throughput and latency.



Rounding Error Analysis

- Floating point arithmetic can have arbitrarily large errors
- Example shows program requires 21 bits of precision meaning single precision is insufficient for an accurate results
- Developed technique and tool for automatic quantification of a program's sensitivity to rounding errors



Translation of Functional Programs to FPGAs

- Developing a tool which allows problem to be specified in Scala, and the problem automatically translated to execute on a heterogeneous cluster of FPGA and compute nodes
  - Problem described as map-reduce
  - Platform is compatible with Hadoop and its distributed filesystem
  - Arbitrarily large clusters supported
- Applications in business intelligence, big data and machine learning

Wildlife Tracking

- Collaboration with Vet Sci
- We developed first device capable of recording 20 hours of continuous video and used it to record masked boobies (alas, no GPS)
- Develop improved low-power video+GPS using microcontroller
- Understand nutrition of animals in wild

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GPS Tracking