Getting Started in Programming Languages Implementation Research

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Overview

- About Cristina
- Projects
- Lessons Learned
- Overall Advice

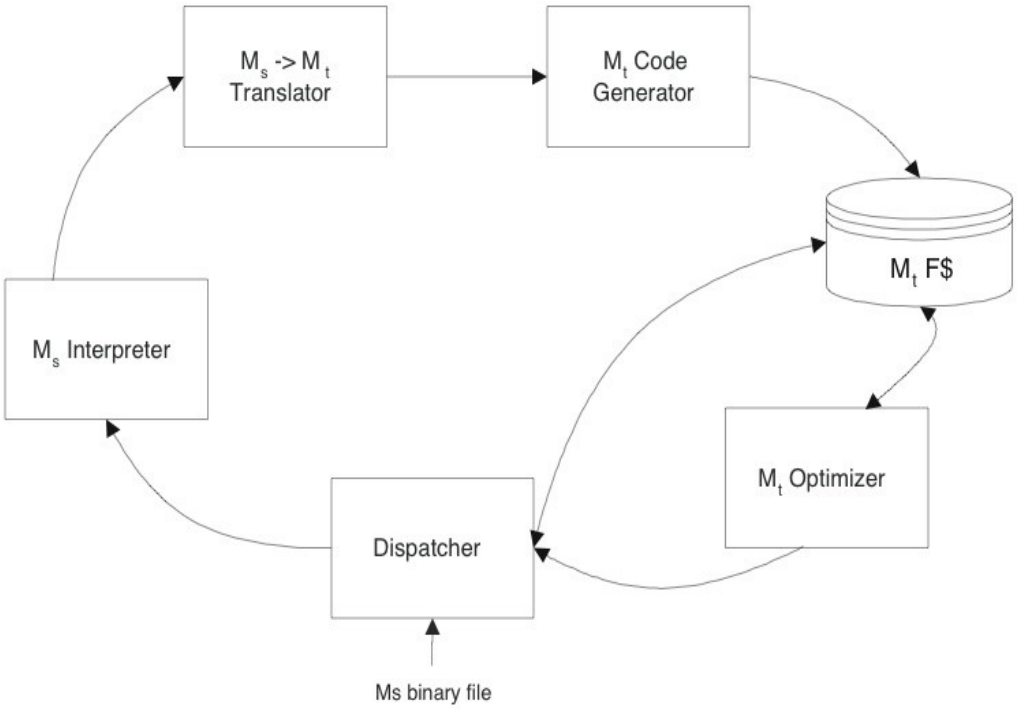
About Cristina – Birth to PhD

About Cristina – Career

Projects

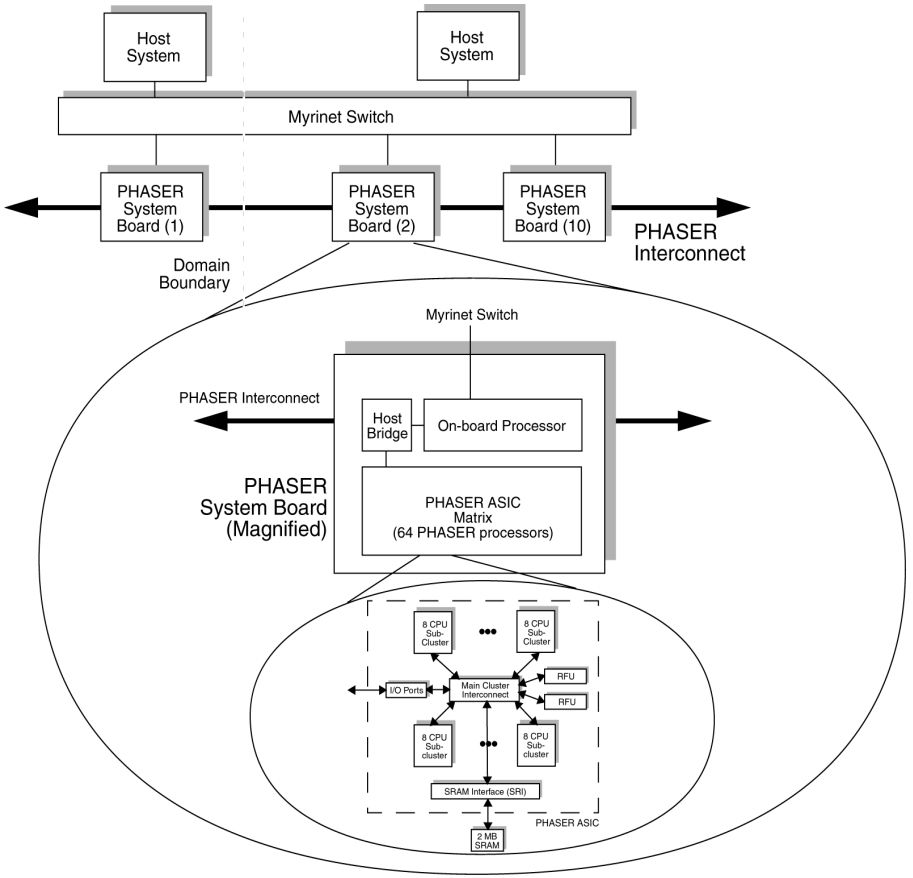
Year	Project
1991-94	Decompilation
1995-99	Retargetable static binary translation
2000-01	Dynamic binary translation
2002-03	Verilog compiler for massively parallel machine
2004-06	Compilation techniques for small Java virtual machine
	Project management wireless sensor project
2007	Static program analysis for security vulnerability

Walkabout – Dynamic Binary Translation



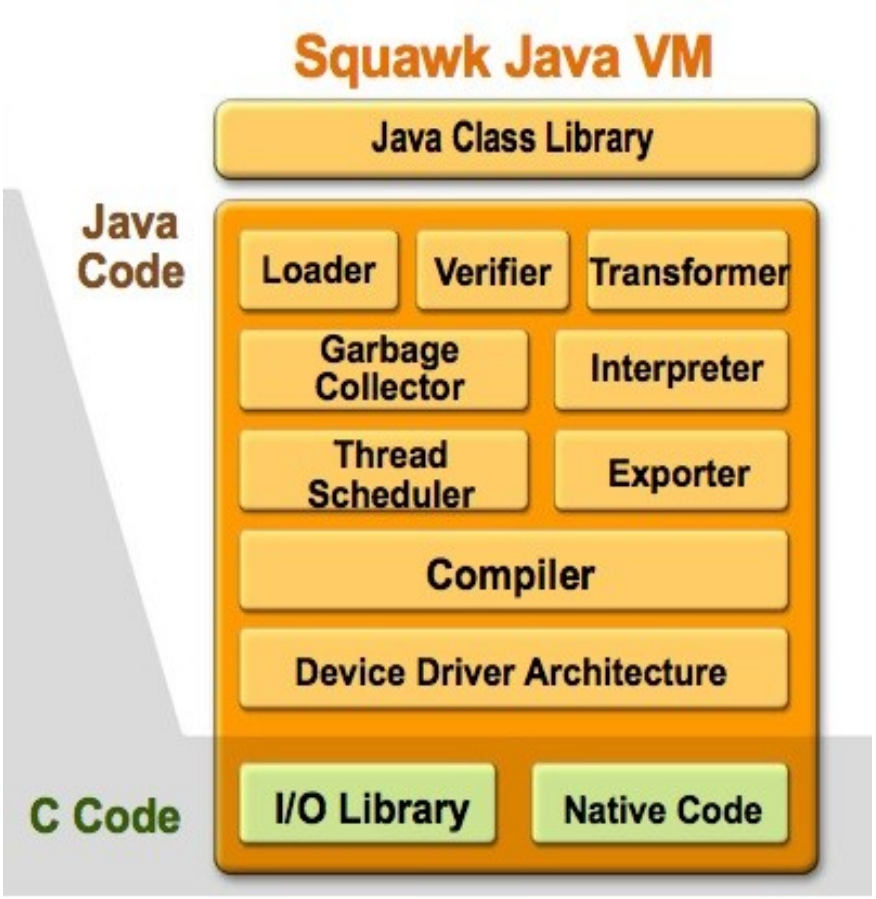
- 10 KLOC
- Reused SPARC, x86 instruction specs
- Instrumentation spec
  247 LOC
- Several tools:
  disassemblers, emulators, instrumented interpreters, binary rewriters, binary translators
- 1.2 staff-years
  over 9 months, 5 diff people
- SPEC95 benchmarks (1MB)
  [WBT'02]

Phaser – Verilog Compiler for Massively Parallel Machine



- Phaser machine:
  10 boards x 64 ASICs x 64 processors => > 40,000 procs
- Input: RTL designs
- 500 KLOC, C++
- Tools:
  compiler for Sparc and Phaser, emulators, visualizer
- Effort: 10-12 people, 4 years
- My contribution: partitioning of code
  [PACT'04]

Squawk – Small Java™ Virtual Machine Written in Itself



- 300 KLOC
- Designed for small devices
- GC and Interpreter automatically translated to C
- Effort:
  2-3 people over 3 years
- My contribution: fast and compact compiler in Java
- Deployed on the Sun™ SPOT platform
  [VEE'06]

Sun™ SPOT – Java on Wireless Sensor Devices

- Squawk on the bare metal
- Distributed team
  California, Boston, UK, Australia
- Project manager/QA:
  build process, testing infrastructure, project schedules, task allocation, porting, ...
- Support role:
  hands-on lab (JavaOne'06), presentations (JavaOne'06, various universities and Java industry forums), community-based research

SPAsec – Static Program Analysis for Security Vulnerability

Too new for a project diagram!

- Analyze C source code for bugs
  - > focus on security bugs
- Check systems code
  - > scalability
- Techniques of interest: type analysis, abstract interpretation, model checking
- Effort: 2 people + interns
- Reuse existing infrastructure
  - > build prototype on top

Lessons Learned

Project	Implementation	# pp	LOC	input type	input
Walkabout	Reused UQBT and NJMC specs	2	40K	SPEC	< KLOC
Phaser	Written from scratch in C++	15	1000K	Next gen SPARC	< MLOC
Squawk	Written from scratch in Java	2.5	300K	Java ME	< KLOC
Sun SPOT	Developed from scratch	10	500K	Java ME	< KLOC
SPA	Reuse compiler front-end, build abstraction on top of IR	2		Solaris	< MLOC

Lessons Learned

"Technology transfer is a contact sport."

Bert Sutherland
Former Sun Labs Director

Lessons Learned

- Industry Research Focus
  - more applied research
    - have impact on the company
  - justify relevance to the company
  - interaction with product group essential
  - at Sun Labs, small teams
    - work with colleagues and interns
    - team size grows when/if needed for tech transfer

Lessons Learned

- Role in the project
  - Individual contributor
    - contribute to a subcomponent of the system
  - Principal investigator / chief investigator / project lead
    - determine project and direction
    - form group
    - create links with product division
    - extra admin overhead (reports, justifications, web pages, anything non-technical)

Lessons Learned

- Your group
  - > the most important part for success of the project
  - > like-minded people
  - > need to know how to work in a group
  - > agreement on choice of language and tools to use
    - – be pragmatic
  - > need to clearly define parts of the project
  - > remove vs co-located

Lessons Learned

- Project life cycle
  - spend time on feasibility analysis and design
  - spend a large percentage of the project implementing ideas and techniques, as well as infrastructure
  - have a testing framework early in the process
  - once prototype built, rewrite parts that need rewriting or throw away prototype and rewrite
  - write the papers, file patents, update your web page
  - continue research or engineering (academia vs industry)
  - determine when project should stop

Lessons Learned

- Publications
  - Forums
    - workshops, conferences, journals
  - Impact
    - where you publish and whether you get cited
  - “Marketing”
    - web presence
    - facilitate access to publications, software artifacts

Overall Advice

- Follow your interests
- Be aware of trends
- Be recognized for something new/different
- Know when to stop
  - Keep on working while you're interested in the research
- Work in different areas
  - have depth and breadth

Overall Advice

"Be yourself and have fun"

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