CS 194 Project Results

An Investigation of Xen and PTLsim for Exploring Latency Constraints of Co-Processing Units

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Outline

- The Problem
  - Theme
- The Solution
  - Vtune
  - PTLsim/Xen
- The Results
  - Research Platform
  - Vtune Data
  - PTLsim Data

The Problem

- Original Problem Statement
  - What impact do co-processing units have on system performance?
- Motivation
  - Extending the useful life of current systems.
  - Enhancing the performance of future systems.
- How well do PTLsim and Xen answer this question?
- Theme
  - Tradeoffs

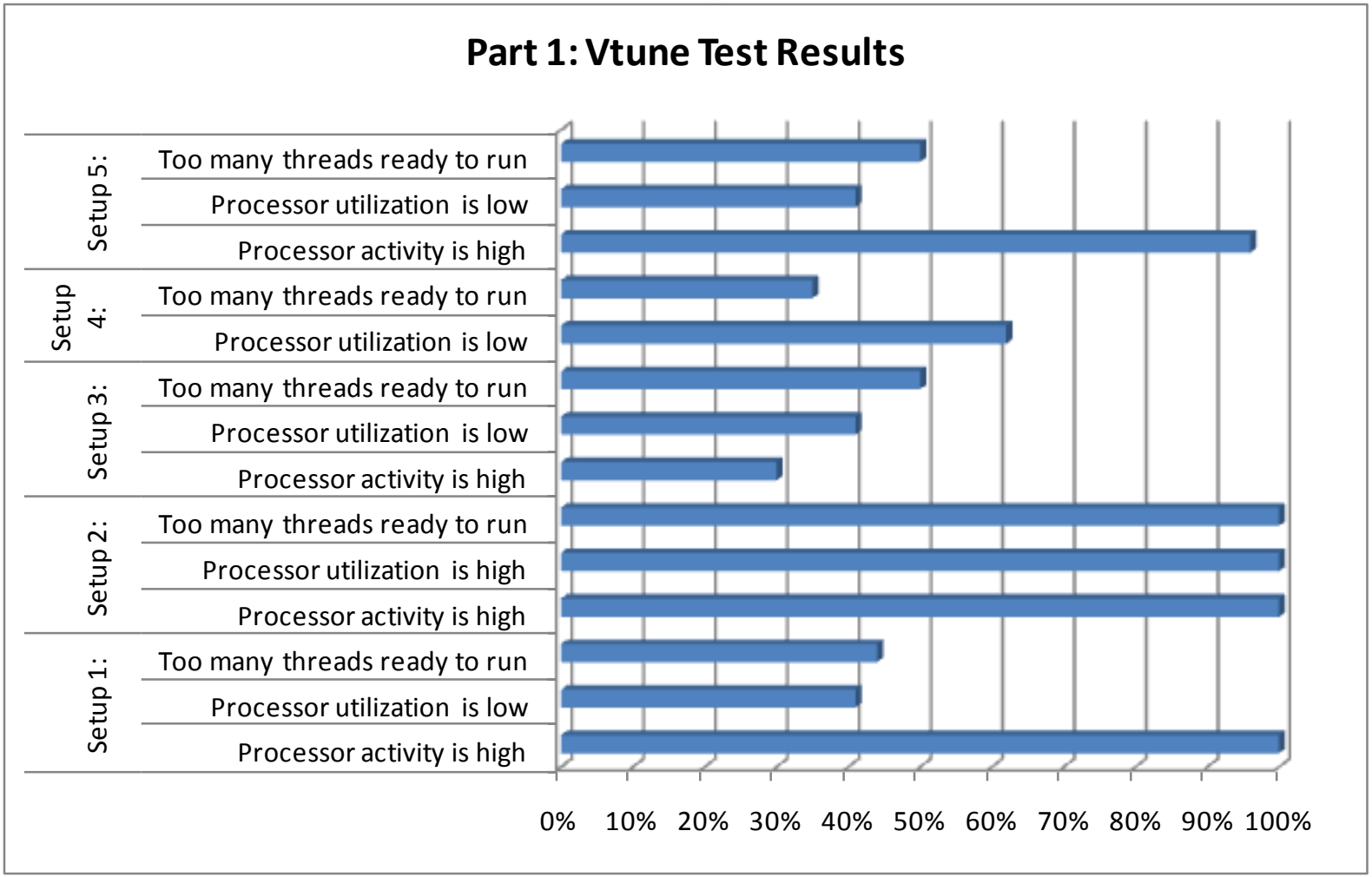
The Solution

- Step 1
  - Intel's Vtune Software
    - Application specific performance statistics on Microsoft Windows computer
- Step 2
  - PTLsim/Xen
    - Allows for custom machine models
    - Cycle accurate statistics
    - Most accurate model for actual physical hardware

The Solution: Step 1

- Evaluate need for more processing power.
- Use Intel's Vtune software to collect runtime profiles of a system under various loads.
- Varying Loads
  - Setup 1
    - Hyperthreading on, demanding game
  - Setup 2
    - Hyperthreading off, demanding game
  - Setup 3
    - movie playing, networked file transfer, anti-virus scan
  - Setup 4
    - movie playing, file compression
  - Setup 5
    - demanding game, music playing, anti-virus scan

The Results: Step 1



Vtune Notes

- Methodology
  - Reboot the computer
  - Start the programs to be evaluated
  - Start the Vtune monitor
  - Activate the programs
  - Run the Vtune monitor for one minute
- Limitations
  - Runs in same space as measured programs
    - Inevitably affects the environment
  - Repeated runs are not identical
    - 5 trials were run for each setup

The Solution: Step 2

- PTLsim/Xen Capabilities
  - Simulate any processor model with cycle accurate measurements
- PTLsim/Xen layers
  - Special machine hardware
  - Patched Xen virtualization layer
  - Modified host operating system kernel
  - Modified guest operating system

PTLsim/Xen: Machine Hardware

- Requirements
  - 64-bit
  - Virtualization technology support
- Complications
  - Processor too new
  - Raid controller
  - Two Ethernet ports

PTLsim/Xen: Modified Xen

- Xen is a virtualization platform for guest operating sytems
- Requirements
  - Special C libraries
  - Operating system with Xen 3.0
  - gcc 4.0 to build modifications
- Complications
  - Hard to debug
    - Kernel panic error
  - May silently fail
  - Version patched by PTLsim is not the current release version

PTLsim/Xen: Dom0

- 6 operating systems tried
  - OpenSuse 10.2/10.1, Fedora Core 6, Ubuntu 6, CentOS 5, Xen 3
- Finally used OpenSuse 10.2 once raid issues were overcome
- Built a custom kernel for the system
  - 2.6.18 vs. 2.6.20
  - PTLsim patches

PTLsim/Xen: DomU

- Initially tried importing DomU from other sources
- Final method imported DomU from a bootable system
- Complications
  - Kernel panic error
    - Use kernel from PTLsim site with no ram disk
  - No networking
  - No graphics

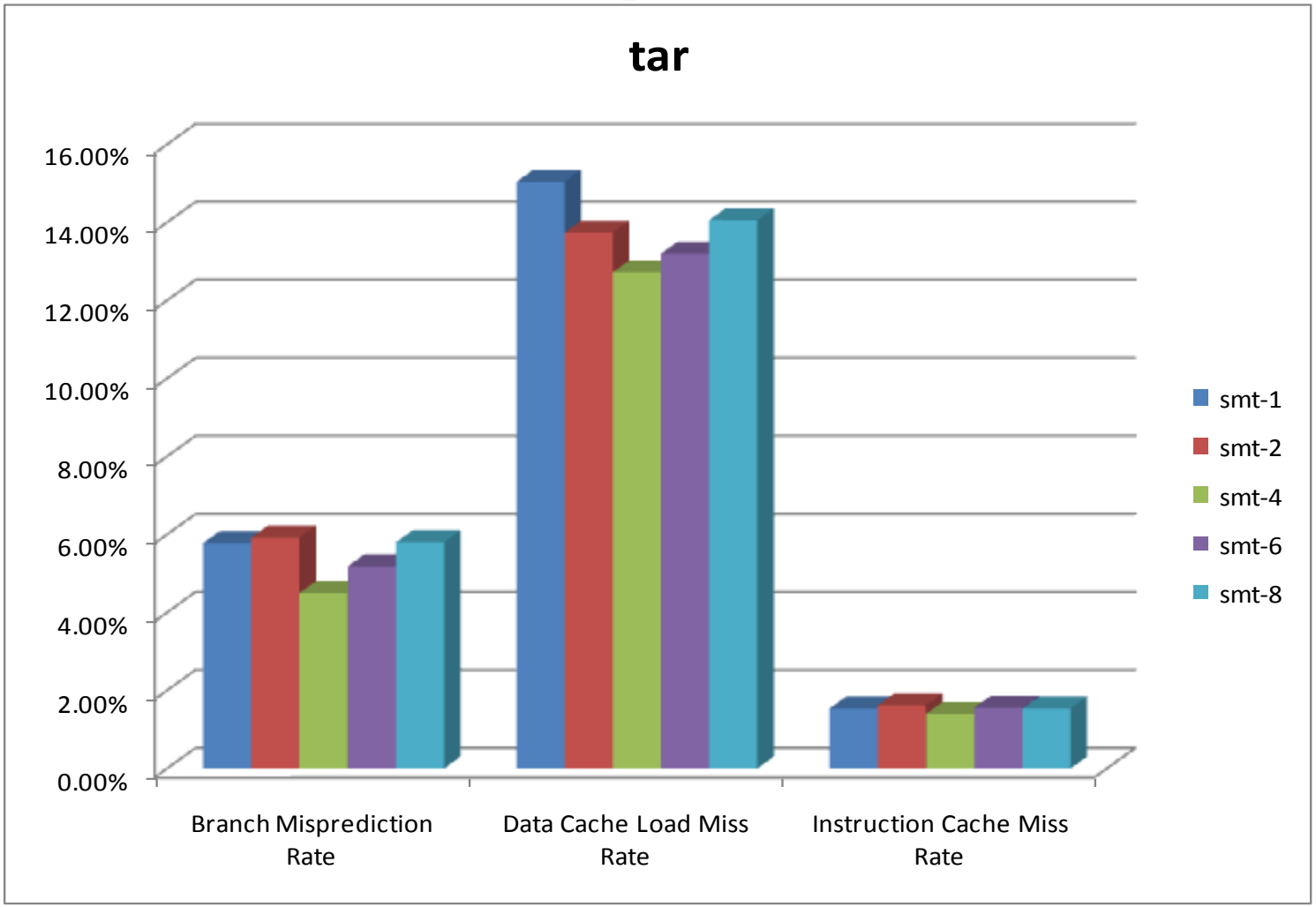
PTLsim/Xen: PTLsim

- PTLsim in Dom0
  - C files for simulated machine models
  - Can monitor multiple DomU's simultaneously
  - Very fast
  - No CMP support, only SMT
- PTLsim in DomU
  - Completely oblivious
  - No impact as opposed to Vtune

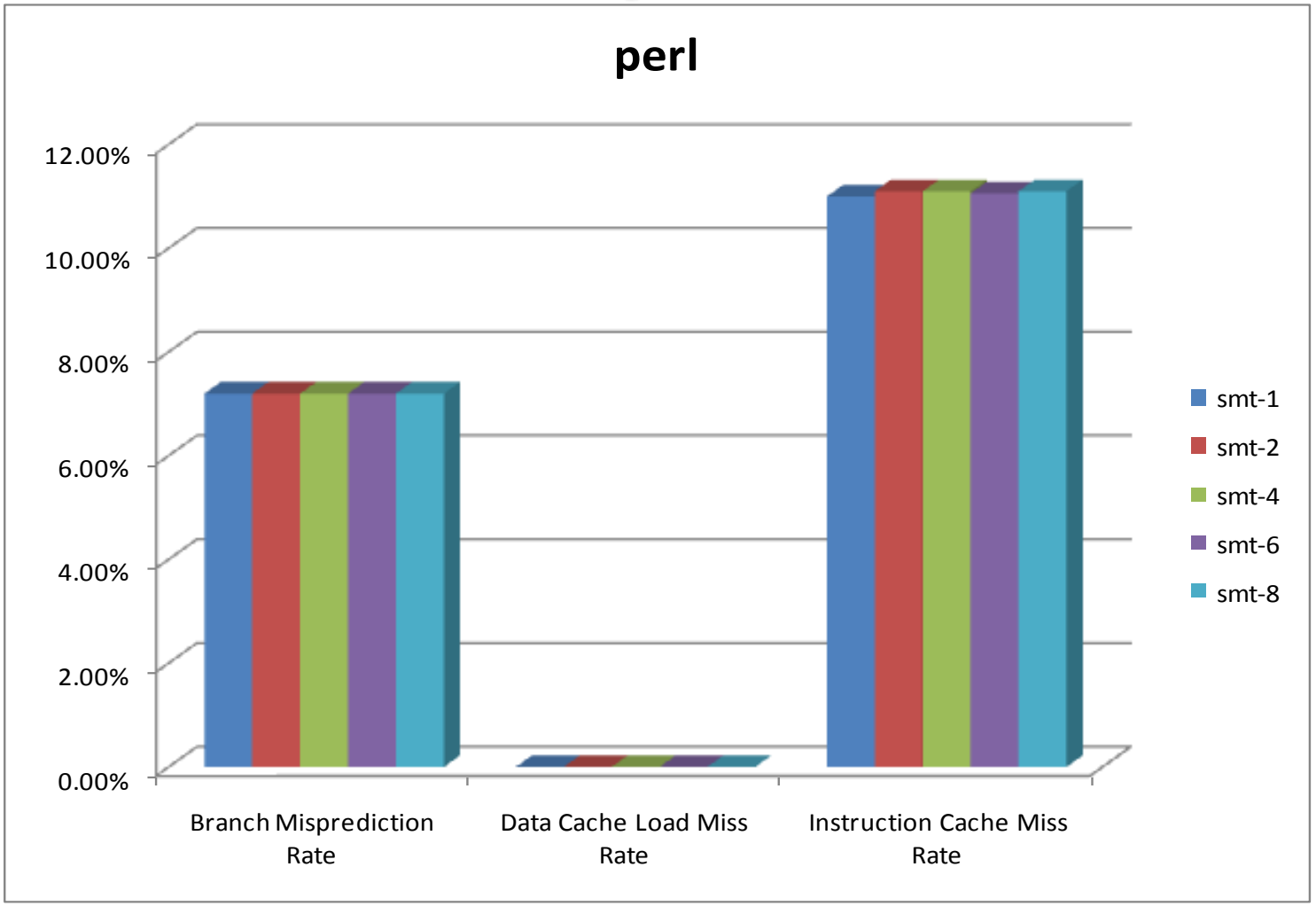
PTLsim/Xen: Trials

- Methodology
  - Start guest domain in paused state and connect console
  - Use PTLsim to boot guest domain
  - Start benchmark in DomU
  - Start logging in Dom0
- Three benchmarks used
  - File compression
  - Random number generation
  - Combination

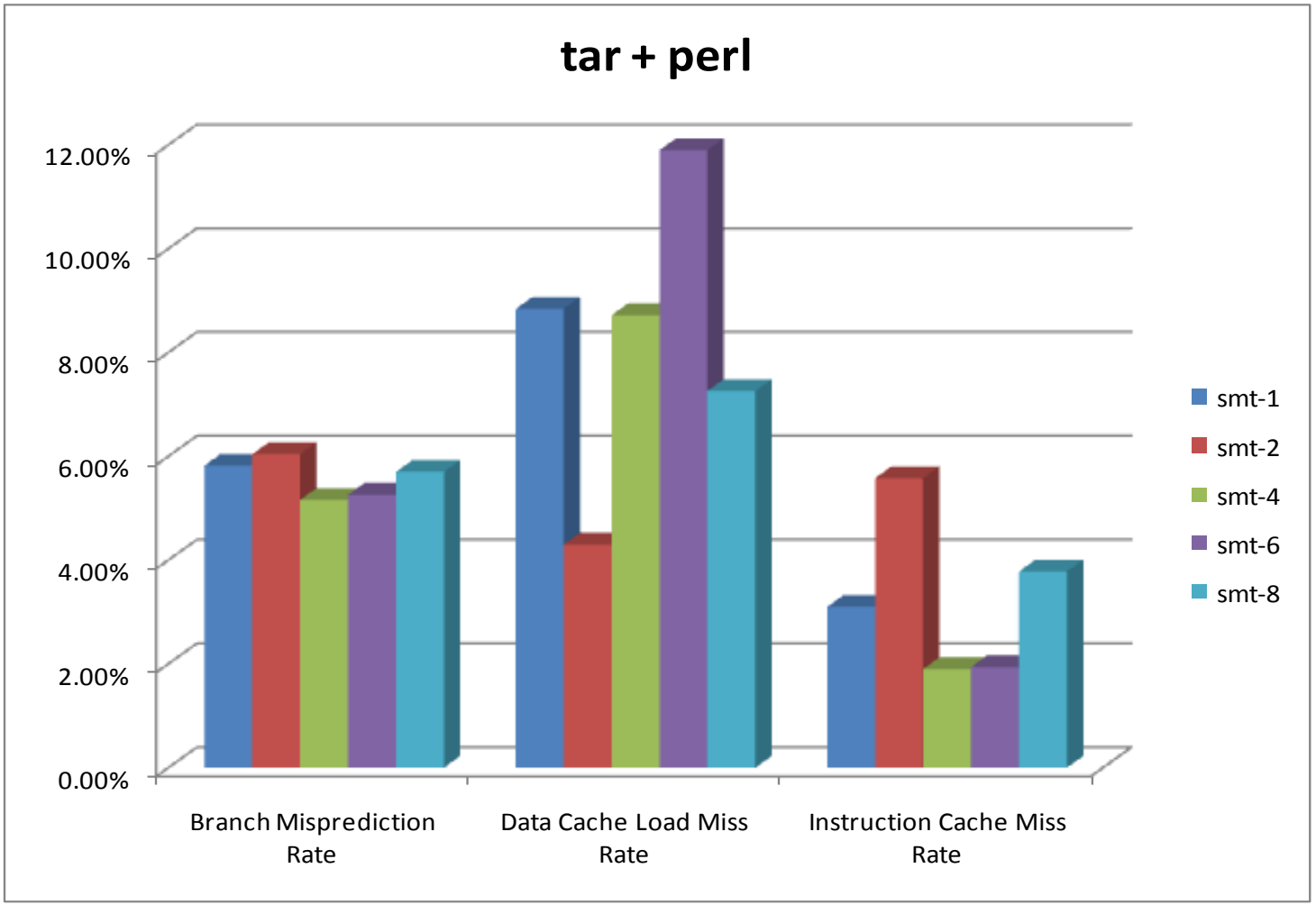
The Results: Step 2



The Results: Step 2



The Results: Step 2



PTLsim/Xen Notes

- Non-determinism drastically affects results
- Lack of application specific data
- Setup is challenging
- Machine modeling is robust but complicated
- Without network, disk, and graphics monitoring the simulation environment is incomplete
  - PTLsim/Xen with Vtune?

PTLsim Notes

- Future development will eliminate Xen
  - New system uses kernel virtualization which removes an entire layer
- Support for CMP systems is new and not documented

Conclusion

- Vtune Data
  - More parallel processing improves system performance
- PTLsim/Xen Research Platform
  - Platform is robust and fully featured
  - Setup is challenging with virtualization
- PTLsim Data
  - Too much parallel processing may hinder system performance
  - More application specific data needed

Future Work

- Consider combining PTLsim/Xen with Vtune to get best of both monitors
- Wait for PTLsim to develop more parallel processing support
- Questions?