# Approaching a Parallelized XML Parser Optimized for Multi-Core Processors*

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## Outline

## Explosion of Data

- Enormous increase in data from sensors, satellites, experiments, and simulations*
- Use of XML to store these data is also on the rise
- XML is in use in ways it was never really intended (GB and large size files)

## Limitations of XML

- Poor CPU and space efficiency when processing scientific data with mostly numeric data [Chiu et al 2002]
- Features such as nested namespace shortcuts don’t scale well with deep hierachies
    - May be found in documents aggregating and nesting data from disparate sources
- Character stream oriented (not record oriented): initial parse inherently serial
- Still ultimately useful for sharing data divorced of its application

## Prevalence of Parallel Machines

- All new high end and mid range CPUs for desktop- and laptop-class computers have at least two cores
- The future of AMD and Intel performance lies in increases in the number of cores
- Despite extant SMP machines, many classes of software applications remain single threaded
  - Multi-threaded programming considered “hard”
  - Reinforced in the current curricula and by existing languages and tools

## XML and Multi-Core

- Most string parsing techniques rely on a serial scanning process
- **Challenge:** Existing (singly-threaded) XML parsers are already very efficient [Zhang et al 2006]

## Research directions

- Pre-scan and schedule parser [Lu et al 2006]
- Parallelized scanner

Requires some communication/buffering between threads

## But first...

- Try some easy, generic techniques
- Offload disk input to another thread/core

- Introduce two parsers which extend the existing, high performance **Piccolo** parser [Head et al 2006]
  - **Runahead:** opens two file descriptors for the input file
    - Start a thread that repeatedly calls `read()` on one of the file descriptors
    - Pass the other file descriptor to the existing Piccolo parser in the main thread
  - **Readahead:** opens one file descriptor for the input file, and one pipe
    - Start a thread that reads from the file descriptor and writes to the pipe
    - Pass the pipe to the existing Piccolo parser in the main thread*

## Test run

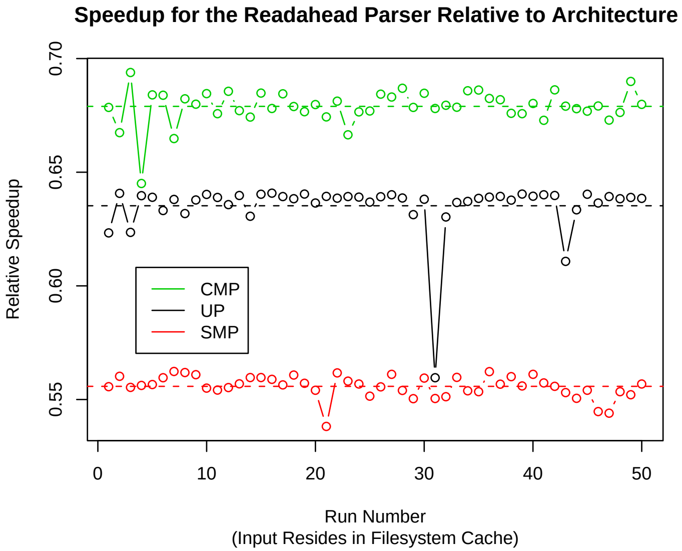
- Run each parser (**Piccolo**, **Runahead**, and **Readahead**) on a large (GB-scale) XML file
    - Specifically, a protein sequence database file, `pdf7003.xml`
- No user code is run for any SAX event – just the parser itself is tested
- File cache is cleared between each run running a separate process that reads multiple gigabyte files
- Each test is run 50 times for each parser
- Hotspot is warmed by running the parser on another input file with identical content before timing begins

## Two Environmental Conditions Tested

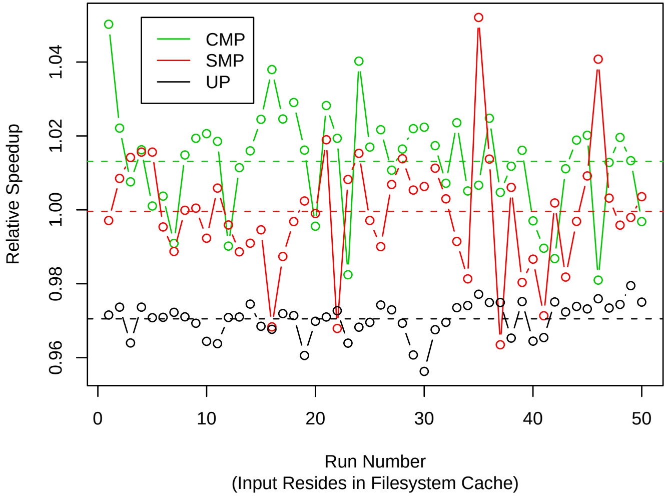
- Architectures
  - **UP:** Classic Uniprocessor P4-based machine (Dell workstation)
  - **SMP:** Classic Symmetrical MultiProcessing P4-based machine (has server-class I/O system) (IBM e-server)
  - **CMP:** Modern Chip MultiProcessing Core 2 Duo-based machine (Dell workstation)
- System conditions
  - **Cached:** The input file is read (hence loaded into the system file cache) before timing begins
  - **Uncached:** The input file is not read before timing begins (and flushed between each run)

## Data Analysis

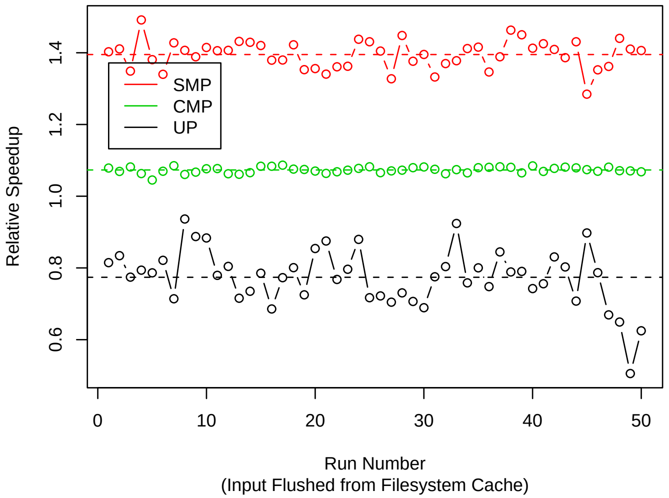
- Speedup for both of the proposed parsers is computed to compare across architectures
- Baseline value is computing by averaging the times for each run of the unmodified **Piccolo** parser
- Speedup for each run is computed by dividing the baseline by the time at each test point
- Data presented is from the most recent tests (same systems as in the paper, but with an equitable amount of RAM in the **CMP** machine)

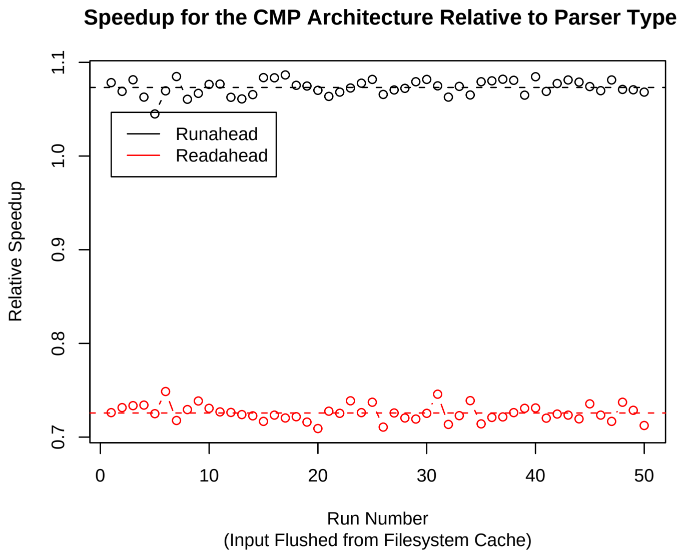

Speedup for the Readahead Parser Relative to Architecture
Relative Speedup
0.70
0.65
0.60
0.55
0
10
20
30
40
50
CMP
UP
SMP
Run Number
(Input Resides in Filesystem Cache)

## Speedup for the Runahead Parser Relative to Architecture



## Speedup for the Runahead Parser Relative to Architecture




Speedup for the CMP Architecture Relative to Parser Type
Relative Speedup
1.1
1.0
0.9
0.8
0.7
0
10
20
30
40
50
Runahead
Readahead
Run Number
(Input Flushed from Filesystem Cache)

## Limitations

- Haven’t yet tested against a suite of differently sized and structured XML files
- Haven’t yet examined effect on system (CPU utilization, I/O load)
- Very simple optimization (for just 2 cores), may cause an overall slowdown in an application which may be able to use the core more effectively

## Summary

- Still, in some cases, the benefit is surprisingly substantial for such a simple change
    - Compare performance against more complicated approaches