Lab Project #4 — Cachelab

- **Due Thursday, December 14, 6:00 PM**
  - No extensions possible!
    - Due to grading deadlines
- **Download cachelab-handout.tar.gz from *Canvas***
  - https://canvas.wpi.edu/files/885348/download?download_frd=1
- **Optional two-person teams**
  - Must "register" by sending e-mail to
    cs2011-staff@cs.wpi.edu
  - … in order to register team in *Canvas*
  - Either team member may submit on behalf of self or on behalf of team
    - Canvas gives you the option at the time of submission

Cachelab

- **Two parts:–**

A. Cache simulator

- Interprets memory access traces from **`valgrind`**
- 200-300 lines of *C* code

B. Array transpose function

- Minimize number of cache misses & evictions
- Performance counts!
- **`valgrind`** traces performance on cache simulator

Part A:– Cache simulator

- **Four arguments:**
  - s:– 2^s is number of sets
  - E:– associativity; E = 2^e, the number of lines per set
    - E = 1 ⇒ Direct-mapped cache
  - b:– 2^b is number of data bytes per cache line
  - t:– tracefile (output from **`valgrind`**) of memory references
    - Each line represents one memory access
      - L = load; S = store; M = modify (equivalent to L + S)

Cache simulator (continued)

- **Read sequence of memory traces from trace file**
- **Ignore instruction fetches!**
- **Pass all data accesses (load, store, modify) thru your simulated cache**
  - Record hits, misses, evictions

Follow Programming Rules in project description

- **Print summary of all cache activity …**
  - … using provided **`PrintSummary()`** function

Part B:– Matrix transpose

- **Write a *fast* matrix transpose function …**
- **… that is *cache aware***
- **Test against your simulator to determine how fast**
  - Measured in numbers of misses

Matrix transpose

- **`valgrind` used to trace *your* transpose function**
  - Invoked via `./test-trans` function from handout

- **Traces passed to *your* simulator**
  - Performance measured in terms of numbers of
    - Cache hits
    - Cache misses
    - Cache evictions

Project Handout

- **`cachelab-handout.tar.gz`**
  - On course web-site on Canvas
  - Select Projects and click on the link in projects table

Also, project description (`docx`, `pdf`)

- **Includes**
  - **`csim-ref`** — a reference simulator (binary only)
    - For helping to validate your simulator
  - **`csim.c`** — a skeleton for building your simulator
  - **`traces`** — a directory full of traces for testing
  - **`trans.c`** — contains transpose functions; you modify this
  - **`test-trans`** — program to evaluate your transpose function

Matrix transpose

- **Write a *fast* matrix transpose function …**
- **… that is *cache aware***
- **Test cases:–**
  - 32 × 32
  - 64 × 64
  - 61 × 67
  - $s = 5$, $E = 1$, $b = 5$

Use autograder in handout to check your score!

Graders may substitute different numbers

- **Score based on number of *misses!***
  - Fewer misses is better
  - Too many misses ⇒ zero performance points for that case!

Two-person Teams

- **You may *optionally* work in teams of two**
- **Register your team with cs2011-staff@cs.wpi.edu so that we may enter it into Canvas**
- **Remember to register early!**
  - We may not be watching e-mail when project is nearly due!

Note about teams

- **Do *NOT* divide up the project by**
  - One member works on csim.c
  - Other member works on trans.c

- **Reason:– `csim.c` is 3 times more difficult than `trans.c`**

- **Cannot always detect, but …**
  - If we do detect this behavior, it is a 25% penalty.

Submission

- **Tarball named `username-handin.tar` or `teamname-handin.tar`**
  - **`username`** replaced by your WPI user ID or by team name as registered in *Canvas*
  - Automatically created every time you issue **`make`** command in **`cachelab-handout`** directory
  - **`"make USER=username"`** and **`"make USER=teamname"`** automatically create tarballs with user (or team) name specified after '=' sign

- **Submit to Canvas**
  - Project *Cachelab*

Extra Credit

- **Submit a working version of `csim.c` by Friday, December 8, 6:00 PM**
  - Extra-credit submission file name must be **`extra-username-handin.tar`** or **`extra-teamname-handin.tar`**
  - Must execute graders' traces correctly

Reminder: Academic Honesty

- **Course rules:–**
  - You *may* consult with your classmates and others about algorithms and approaches to project
  - You *may* resource online and other materials for inspiration
- **However,**
  - You may *not* copy or look at code
- **Lots of temptations exist on web**
  - Don't succumb to them

Reminder: Academic Honesty (continued)

- **Detected violations:–**
  - Grade of **Incomplete** for the course
  - Resolution in C-term according to WPI procedures for Academic Dishonesty
- **Very disagreeable for all involved**

Questions?