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#####
# CS:APP Architecture Lab
# Directions to Instructors
#
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This directory contains the files that you will need to run the CS:APP architecture lab, which develops a student's understanding of processor design and the close relationship between software and hardware.

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1. Overview
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In this lab, students learn about the design and implementation of a pipelined Y86-64 processor, optimizing its performance on a benchmark Y86-64 array copy program called `ncopy.ys`. Students are allowed to make any semantics preserving transformations to the benchmark program, or to make enhancements to the pipelined processor, or both. The goal is to minimize the number of clock cycles per array element (CPE).

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2. Files
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Makefile	Makefile that builds the Lab
README	This file
archlab-handout/	The files handed out to the students
grade/	Autograding scripts
simguide/	CS:APP Guide to Simulators document
src/	Master distribution of the Y86-64 tools
sim/	Student distribution of the Y86-64 tools (subset of src)
writeup/	The architecture lab writeup

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3. Building the Lab
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Step 1: Build the "master distribution" of the Y86-64 tools in directory `./src` on your system. The master distribution is the instructor's version of the tools that contains the solution files for the lab. See `./src/README` for instructions on how to build the master distribution. The process involves setting three variables in `./src/Makefile` and then typing "make". The default values are for Linux.

Step 2. Modify `./src/Makefile-sim` with the same three variable assignments that you used in `./src/Makefile`. The `Makefile-sim` file is the Makefile that the students will use in their personal student distributions of the Y86-64 tools. The student distribution is a subset of the master distribution, minus the solution files and a master set of HCL files.

Step 3. Modify `./src/Makefile-handout` with the default team name (TEAM), default handin version number (VERSION), and the directories where the three parts should be copied to when they are handed in (HANDINDIR-PART{A,B,C}). The `Makefile-handout` file is the the Makefile that the students receive in the `archlab-handout/`. They use it to hand in their solutions.

Step 4: Modify the Latex writeup in `./writeup/archlab.tex` to reflect the handout and handin directions for your site. If you don't use Latex, use your favorite document preparation system to prepare Postscript and PDF versions of the writeup in `archlab.pdf`.

Step 5: Modify `./Makefile` with the name of the lab (`LABNAME`) and the name of the directory where the handout tarfile will be copied to and where the students can pick it from (`DEST`). `LABNAME` is typically `archlab`.

Step 6: In the same directory as this README file, type

```
make clean; make
```

to the shell. This will do the following things:

- (a) Compile the master distribution of the Y86-64 tools in `./src`
- (b) Build the student distribution in `./sim`
- (c) Build a tarfile of the student distribution in `sim.tar`
- (d) Build a handout directory `./$(LABNAME)-handout`
- (e) Build the `$(LABNAME)-handout.tar` file that you will be handing out to students.

Step 7: Type "make dist" to copy the `$(LABNAME)-handout.tar` file and the writeup to the distribution directory where the students will retrieve the lab.

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4. Grading the Lab
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There are Perl autograding scripts for each part of this lab. See `./grade/README` for details.

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5. Notes
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- * If you are running in GUI mode, you'll need to install Tcl/Tk along with the Tcl and Tk developer's packages. On an Ubuntu machine:

```
linux> sudo apt-get tcl tcl-dev tk tk-dev
```

- * If you are running in GUI mode on a system with X windows, make sure that your `DISPLAY` environment variable is set:

```
linux> setenv DISPLAY mymachine.myschool.edu:0
```

If you're using ssh, you can set the `DISPLAY` variable automatically by using the "ssh -X hostname" command.

- * The lab compiles with no warnings and passes all regression tests on the following systems:

```
Linux/2.2.20, Pentium III, gcc 2.95.3, Gnu make, Perl 5
Solaris/5.8, Sparc Ultra 80, gcc 2.95.3, Sun make, Perl 5
Linux/2.6.18, Intel x86_64, gcc 4.3.5, Perl 5.8.8
```

- * The autograders for parts B and C run the regression tests in `pctest/` as part of the evaluation of the student solutions. On older systems, these tests can take a long time, 5 minutes or so, with most of the time being spent by the `hctest.pl` script. If this is too long, you can sacrifice completeness for speed by commenting out the call to `hctest.pl` in `pctest/Makefile`.