

ECE571: Advanced Microprocessor Design – Homework 6
Spring 2018

Due: Thursday 8 March 2018, 3:30pm

Create a document that contains the data and answers described in the sections below. A .pdf or .txt file is preferred but I can accept MS Office or Libreoffice format if necessary.

1. Bzip2 prefetch behavior on the x86 Haswell/Quadro Machine

For this section, log into the Haswell machine just like in previous homeworks.

Run the bzip2 benchmark on the Haswell machine.

- (a) Measure (in one command) bzip using the following events: `l2_rqsts.all_demand_references` which is total L2 cache accesses, `l2_rqsts.demand_data_rd_miss` which is total demand L2 cache misses, and `l2_rqsts.all_pf` which is total prefetches into the L2 cache.

```
perf stat -e l2_rqsts.all_demand_references:u,\
l2_rqsts.demand_data_rd_miss:u,\
l2_rqsts.all_pf:u \
/opt/ece571/401.bzip2/bzip2 -k -f ./input.source
```

Note, if the program finishes instantly with an error message, be sure you have `input.source` in your current directory. You can recopy it with

```
cp /opt/ece571/401.bzip2/input.source .
```

Calculate the L2 cache miss rate from the first two results, also note the total time.

2. Software Prefetching and bzip2 on Haswell

- (a) Re-run the previous prefetch results on Haswell, but instead of running `bzip2 run bzip2.swprefetch` which was compiled with `-fprefetch-loop-arrays` which enables sw prefetch instructions.

Record the miss rate and total time.

```
perf stat -e l2_rqsts.all_demand_references:u,\
l2_rqsts.demand_data_rd_miss:u,\
l2_rqsts.all_pf:u \
/opt/ece571/401.bzip2/bzip2.swprefetch -k -f ./input.source
```

3. equake_1 prefetch behavior on the x86 Haswell Machine

Run `equake_1`:

- (a)

```
perf stat -e l2_rqsts.all_demand_references:u,\
l2_rqsts.demand_data_rd_miss:u,\
l2_rqsts.all_pf:u \
/opt/ece571/equake_1.specomp/equake_1 < \
/opt/ece571/equake_1.specomp/inp.in
```

Calculate the L2 cache miss rate from the first two results, also note the total time.

4. earthquake_1 software prefetch behavior on the x86 Haswell Machine

Run earthquake_1 with software prefetch enabled:

```
(a) perf stat -e l2_rqsts.all_demand_references:u, \
    l2_rqsts.demand_data_rd_miss:u, \
    l2_rqsts.all_pf:u \
    /opt/ece571/earthquake_1.specomp/earthquake_1.swprefetch < \
    /opt/ece571/earthquake_1.specomp/inp.in
```

Calculate the L2 cache miss rate from the first two results, also note the total time.

5. Hardware Prefetch Disabled

It is possible to disable hardware prefetch on modern Intel processors.

See:

<https://software.intel.com/en-us/articles/disclosure-of-hw-prefetcher-control-on-some-intel-processors> for details.

It requires root permissions, so I have done the measurements for you, included below.

benchmark	L2-total	L2-miss	L2-prefetches	time
bzip2	294,105,194	127,429,015	174,122	3.28
bzip2.swprefetch	293,392,001	128,848,679	197,188	3.25
earthquake_1	27,182,307,882	18,938,356,292	8,988,780	137.5
earthquake_1.swprefetch	28,005,813,185	19,127,383,783	8,390,162	137.4

6. Short Answer Questions

- Did enabling software prefetch help on bzip2? (i.e. the results in question 1 and question 2?)
- Did enabling software prefetch help on earthquake_1? (i.e. the results in question 3 and question 4?)
- How did turning off the prefetcher affect the bzip2 results (i.e. question 1 vs question 5?)
- How did turning off the prefetcher affect the earthquake_1 results (i.e. question 3 vs question 5?)
- With the hardware prefetcher disabled, did enabling software prefetch help at all? (question 5)
- Why do you think the software prefetch performance is so underwhelming?
- perf warns that some of the events we use may be affected by errata HSD78 for Intel chips. Look up this errata (it can be found in a document with a really long name, Desktop 4th Generation ... Specification Update), briefly describe the bug, and say if you think our results might be affected by this.

7. Submitting your work.

- Create the document containing the data as well as answers to the questions asked.
- Please make sure your name appears in the document.
- e-mail the file to me by the homework deadline.