1. Bzip2 prefetch behavior on the x86 Haswell Machine

a. Measure (in one command) bzip using the following events: L2_RQSTS:ALL_DEMAND_REFERENCES (r53e724:u) which is total L2 cache accesses, L2_RQSTS:DEMAND_DATA_RD_MISS (r532124:u) which is total L2 cache misses, and L2_RQSTS:ALL_PF (r53f824:u) which is total prefetches from the L2 cache.

Performance counter stats for '/opt/ece571/401.bzip2/bzip2 -k -f ./input.source':

   285,465,711   r53e724:u

    89,708,536   r532124:u

   103,968,466   r53f824:u

   3.497639326 seconds time elapsed

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

Miss rate: 89708536/285465711=31.4%

Total time 3.5s

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.

Performance counter stats for '/opt/ece571/401.bzip2/bzip2.swprefetch -k -f ./input.source':

   249,302,035   r53e724:u

    83,226,431   r532124:u

   165,070,103   r53f824:u

   3.412034034 seconds time elapsed

Miss rate: 83226431/249302035=33.38%

Time: 3.4s

3. equake_l prefetch behavior on the x86 Haswell Machine

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

Performance counter stats for '/opt/ece571/equake_l.specomp/equake_l':

13,541,781,336   r53e724:u

2,051,705,195   r532124:u

37,254,617,844   r53f824:u

134.519077680 seconds time elapsed

Cache miss= 2051705195/13541781336=15.15%

Total time : 134s

4. equake_l software prefetch behavior on the x86 Haswell Machine

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

Performance counter stats for '/opt/ece571/equake_l.specomp/equake_l.swprefetch':

14,842,463,217   r53e724:u

2,449,174,747   r532124:u

37,714,660,121   r53f824:u

145.028718323 seconds time elapsed

Miss rate=2449174747/14842463217=16.5%

Total time 145s

5. Hardware Prefetch Disabled

benchmark	L2-total	L2-miss	L2-prefetches	time
bzip2	291,991,138	128,965,209	155,118	3.47
bzip2.swprefetch	291,643,272	129,178,945	151,348	3.39
equake_l	28,041,463,608	19,000,119,990	3,370,942	159.9
equake_l.swprefetch	28,341,994,698	18,978,027,534	3,373,831	159.8

6. Short Answer Questions

a. Did enabling software prefetch help on bzip2? (i.e. the results in question 1 and question 2?)

No the miss rate has increased when the software prefetch is on.

b. Did enabling software prefetch help on equake_l? (i.e. the results in question 3 and question 4?)

No, the miss rate has increased when the software prefetch is on.

c. How did turning off the prefetcher affect the bzip2 results (i.e. question 1 vs question 5?)

Hardware prefetch diabled bzip2 L2 miss rate=44.16% time:3.47s

Prefetch 31.4% time 3.5s.

Turning off the hardware prefetch will increase the miss rate a lot.

d. How did turning off the prefetcher affect the equake_l results (i.e. question 3 vs question 5?)

Hardware prefetch diabled equake_l L2 miss rate=67.76% time 159.9s

Prefetch equake_l miss rate=15.15% time 134s

Disabling the hardware prefetcher has greatly increase the miss rate and time.

e. With the hardware prefetcher disabled, did enabling software prefetch help at all? (question 5)

Bzipswprefetch miss rate=129178945/291643272=44.29%

Equake_lswprefetch miss rate=66.96%

The bzip and equake_l do not change lot for the miss rate.

f. Why do you think the software prefetch performance is so underwhelming?

I think the bzip2 and equake_l does not have a lot improvement that can be done by the software prefetch. It's just how the software is written to be not so much room improvement for the software prefetches.