READING AND RESEARCH ASSIGNMENT

A) [15] [Max 1 page] Read the paper labeled R4a and comment on it, providing a short summary of the focus of the paper and their key arguments, and answer the following questions.

   a. Which applications would benefit most from the VLIW architectures?

   b. Is it suitable for desktop computers, or mobile devices?

B) [15] Read paper labeled with R4b and comment on it. Make sure to specifically address these points:

   a. What assumptions were made about computer organization before adding SMT?

   b. How does it compare to Wall's claims of ILP limits?

   c. What changes were made to add SMT?

   d. What performance advantages are claimed? For what workloads?

C) [15] The Top 500 list categorizes the fastest scientific machines in the world accounting to their performance on the Linpack benchmarks. Visit the web site www.top500.org (also the page under the statistics tab).

   a. Name the most dominant architecture and operating system.

   b. List the imperative characteristics of two machines (ranking among top ten) in a table format.

EXERCISES

1) [45] If you ever get confused about what a register rename has to do, go back to the assembly code you're executing, and ask yourself what has to happen for the right result to be obtained. For example, consider a three-way superscalar machine renaming these three instructions concurrently:

```
ADDI R1, R1, R1
ADDI R1, R1, R1
ADDI R1, R1, R1
```

   If the value of R1 starts out as 5, what should its value be when this sequence has executed?

2) [10] Consider following loop:

```
Loop:  LW      r2, 0(r2)
       BEQ     r2, r0, LOOP
       OR      r2, r2, r3
       SW      r2, 0(r5)
```

   Assume that there is no delay slot and the nextPC in located in ID stage. Also assume that the loop is iterated for 100 times.

   a) Draw the pipeline diagram for the first 2 iterations

b) How many cycles does is take to complete the instruction sequence?

c) If a one bit branch predictor is used, which is initialized to N(i.e. branch not taken), how many correct and wrong predictions that it will produce?

EXERCISES

3) [10] Why might speculation and prediction be of less value in the embedded computer marketplace than in the server or desktop arena? What are the market niches where they will be least valued?

4) [10] Determine the loop‐carried (inter‐iteration) dependencies in the following loop and rewrite it so that it is parallel.

```
for (i = 1; i<=99; i++)
{
  a[i] = b[i] + c[i];    /S1/
  b[i] = a[i] + d[i];    /S2/
  a[i+1] = a[i] + e[i];  /S3/
}
```

LAB

5) [15] In this lab, you are expected to compare the source code and assembly code for the following C code. (You can get the assembly code with usually the –s flag). Can you see any optimizations that can be done on the assembly code?

```
int a=1, b=2, c=3;

int proc1 (int a, int b, int c)
{
  if (a > 0) return b - c;
  else return b + c;
}
int main()
{
     int w, x, y;
     w = proc1 (a, b, c);
     switch (w)
     {
          case 0: x = 3;
          break;
          case 1: x = 4;
          break;
          case 2: x = 7;
          break;
          default: x = 9;
          break;
     }
     y = w + x; return 0;
}
```

Report:

Please include your (well‐commented) assembly code and your explanation of what this program does and how the assembly code can be optimized. Include your test results with several screenshots.