1. (10%) What are the advantages of PC relative conditional branch?

2. (10%) For machines with little endian memory byte ordering, how to store 12345678h in the memory?

   (A)  
   
   (B)  
   
   (C)  
   
   (D)  
   
   (E)  
   
   (F)  

3. (10%) (Multiple Choices) Consider the following code sequence:

   ```
   Load R1, 100(R2)
   Load R3, 500(R2)
   AND R4, R1, R5
   ```

   Which detection rules would detect the situation that requires forwarding in the code sequence?
4. (10%) Give an example of RAW, WAR and WAW dependencies, respectively.

5. (10%) Briefly and clearly explain how a \((m,n)\) correlating branch predictor works? For a \((2,2)\) correlating branch predictor, how many branch-selected entries are there in the predictor with a total 64K bits in the prediction buffer? How many bits from the last bits of branch address are used to select the prediction entries?

6. (14%) Suppose a computer’s address size is \(d\) bits, the cache size is \(C\) bytes, the block size is \(B\) bytes, and the cache is \(A\)-way set associative. Assume that \(B\) is a power of two, so \(B=2^b\). Please figure out the following quantities in terms of \(A, B, C, b\) and \(d\).

   (1). The number of sets in the cache. (4 pts.)
   (2). The number of index bits in the address. (4 pts.)
   (3). The number of bits needed to implement the cache (including valid bits, tag bits and data bits.) (6 pts.)

7. (12%) Your company is developing an embedded system with a clock rate equal to 100MHz. It can perform jump (1 cycle), branches (3 cycles), arithmetic instructions (2 cycles), multiply instructions (5 cycles) and memory instructions (4 cycles). A testing program has 10% jumps, 10% branches, 50% arithmetic, 10% multiply, and 20% memory instructions. Please answer the following questions:

   (1). What is its MIPS (million instructions per second)? (4 pts.)
   (2). If the program executes 108 instructions, what is its execution time? (4 pts.)
   (3). A 5-cycle multiply-add instruction is implemented that combines an arithmetic and a multiply instruction. 50% of the multiplies can be turned into multiply-adds. What is the resulting CPI? (4 pts.)

8. (24%) Please answer the following questions:

   (1). What are “microprogramming” and “hardwired control”? Please compare them. (6 pts.)
   (2). Given TLB, main memory, page table, cache and the secondary storage, please describe the procedures of a memory access by using these components. (8 pts.)
   (3). Please compare VLIW and superscalar machines. (6 pts.)
   (4). What is “loop unrolling”? (4 pts.)