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ECE 242

Exercise #2

1. Answer the following questions **(10 points)**

   a) In detail, describe the RISC architecture explained in class.
      - In RISC, it is more oriented towards hardware and has the load and store architecture which uses a fixed instruction size with a small number of instructions sets. In this architecture there is only a single-cycle execution and compiler optimization is necessary for multiple instructions.

   b) In detail, describe the CISC architecture explained in class
      - In CISC, it is more oriented towards software and is focused to minimize the use of memory (uses variable instruction size and execution times). There is a limited register set and performs some instructions and arithmetic operations, stores data temporarily by accessing the memory. Since simple assembly language is used, no special compiler is required.

   c) Why does RISC architecture have large number of registers?
      - Large number of registers are needed to load and store operands to or from memory to do calculations.

   d) Why does CISC architecture have various instruction sizes and execution times?
      - There are various instruction sizes and execution times to minimize the use of memory for instructions.

2. Answer the following questions regarding Data Registers **(10 points)**

   a) How many Data Registers exist in MC68000? and explain their purposes.
      - In MC68000 there are 8 data registers (D_0 to D_7) and the general purpose is to transfer data from the chip to the memory and back. Data registers can be used as an index register. Few of the registers have dedicated: D_0 is Accumulator, D_1 is Buffer register, D_2 is Index register, and the rest are used as temporary storage.

   b) Explain the three lengths possible with data registers and its notation in assembly language

> There are three possible lengths with data registers:
>   i.   Byte (Dn) [7:0]
>   ii. Word (Dn) [15:0]
>   iii. Longword (Dn) [31:0]

c) How many transfers does MC68000 use for longword data?

> It takes two transfers of 16-bits each for a longword data (32-bit value).

3. Answer the following questions regarding Address Registers **(10 points)**
   a) How many Address Registers exist in MC68000? and explain their purposes.
   > There are 8 address registers numbered from A_0 to A_7. Address registers store pointers of locations in main memory. Registers A_0- A_6 are general purpose registers that can be used for word and long-word operations. A7 is used to maintain a stack of returning addresses of subroutine calls and exception handling.

   b) Size of an address register is <u>32</u> bits, but MC68000 utilizes only <u>24</u> bits via address/control lines.
   > MC68000 has a space restriction only with 24 lines in address bus from the chip to memory.

   c) Explain the purpose of a stack and explain when it is used. (Use the example explained in class)
   > Stacks are used for processing nested structures or for functions which call other functions. Stacks are used for implementing functions, parsers, expression evaluation, and backtracking algorithms. In stacks its last-in-first-out, example is a pile of books.

   d) Explain a subroutine call procedure.
   > Collection of instructions that are repeatedly required in a program are called subroutines. It can be called using a specific call instruction. The content of register must be saved by subroutine call instruction to make a correct return to the calling program.

   e) Why an exception handling routine procedure would be executed on a computer?

➢ Exception handling routine would be executed on a computer to signal that the program or routine is not executed normally.

4. Answer the following questions regarding Status Register **(10 points)**
   a) Explain the purpose of status register
      ➢ A status register (flags) is used to get the information about the state of the program. In MC68000 there are 16-bit status registers each of which has a unique purpose from modes, interrupt status, and arithmetic/logical conditions.

   b) Explain the purpose of condition code register
      ➢ Condition code register is a set of 5 status flag bits in the ALU which is used for storing the values of the condition codes, it includes Carry (C), Overflow (V), Zero (Z), Negative (N), and Extend (E).

   c) Explain each bit fields of the status register
      ➢ The 8 types of bit in the status register:
         i. Extend (X) is used in arithmetic operations set like the Carry bit.
         ii. Carry (C) is set to 1 for either borrowing in subtraction or generating a carry in addition.
         iii. Overflow (V) is set if an out-of-range condition occurs in two's complement.
         iv. Zero (Z) is set if all bits of an operand are 0.
         v. Negative (N) is set if most significant bit of an operand is 1.
         vi. Interrupt Mask (I_0, I_1, I_2) are set to indicate level of interruptions.
         vii. Supervisor (S) is set if the processor program is in supervisor mode.
         viii. Trace (T) is set if trace mode is being used in single instruction stepping.