

## 16.5 / KEY TERMS, REVIEW QUESTIONS, AND PROBLEMS 595

16.5 What basic tasks does a control unit perform?

16.6 Provide a typical list of the inputs and outputs of a control unit.

16.7 List three types of control signals.

16.8 Briefly explain what is meant by a hardwired implementation of a control unit.

## Problems

*Assume 1 address instructions*

16.1 Your ALU can add its two input registers, and it can logically complement the bits of either input register, but it cannot subtract. Numbers are to be stored in two's complement representation. List the micro-operations your control unit must perform to cause a subtraction.

16.2 Show the micro-operations for the processor in Figure 16.6 for the following instructions:

- Load Accumulator *(immediate add)*
- Store Accumulator *direct addressing*
- Add to Accumulator *indirect addressing*
- AND to Accumulator *direct*
- Jump to address *PC relative*

16.3 Assume that propagation delay along the bus and through the ALU of Figure 16.6 are 20 and 100 ns, respectively. The time required for a register to copy data from the bus is 10 ns. What is the time that must be allowed for

- a. transferring data from one register to another?
- b. incrementing the program counter?

16.4 Write the sequence of micro-operations required for the bus structure of Figure 16.6 to add a number to the AC when the number is

- a. an immediate operand
- b. a direct-address operand
- c. an indirect-address operand

16.5 A stack is implemented as shown in Figure 10.14. Show the sequence of microoperations for

- a. popping
- b. pushing the stack

*assume value to be pushed is in register R1*

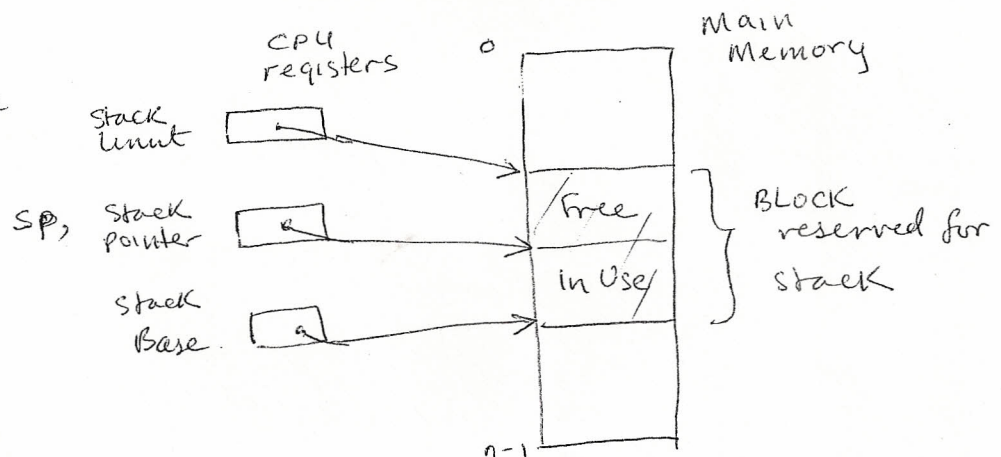


Fig 10-14: Ad of stack in memory