

## Sheet 5, Small Instruction Computer

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### Question 1:

A computer uses a memory unit with 256K words of 32 bits each. A binary instruction code is stored in one word of memory. The instruction has four parts: an indirect bit, an operation code, a register code part to specify one of 64 registers, and an address part.

- How many bits are there in the operation code, the register code part, and the address part ?
- Draw the instruction word format and indicate the number bits in each part
- How many bits are there in the data and address inputs of the memory.

### Question 2:

What is the difference between a direct and an indirect address instruction ?

How many references to memory are needed for each type of instruction to bring an operand into a processor register?

### Question 3:

Consider the instruction formats of the small instruction computer SIC. For each of the following 16-bit instructions, give the equivalent four-digit hexadecimal code and explain in your own words what the instruction is going to perform.

- 0001\_0000\_0010\_0100
- 1011\_0001\_0010\_0100
- 0111\_0000\_0010\_0000

### Question 4:

The content of AC of the SIC is Hexadecimal A937 and the initial value of E is 1. Determine the contents of AC, E, PC, AR, and IR in hexadecimal after the execution of the CLA instruction. Repeat 11 more times, for each one of the RRI instructions. The initial value of PC is hexadecimal 021.

### Question 5:

An instruction at address 021 in the SIC had I = 0, an operation code of the AND instruction, and an address part equal to 083 (all numbers are in hexadecimal). The memory word at address 083 contains the operand B8F2 and the content of AC is A937. Go over the instruction cycle and determine the contents of the following registers at the end of the execute phase: PC, AR, DR, AC, and IR. Repeat the problem six more times starting with an operation code of another MRI.

### Question 6:

Show the contents in hexadecimal of registers PC, AR, DR, and IR of SIC when an ISZ indirect instruction is fetched from memory and executed. The initial content of PC is 7FF. The content of memory at address 7FF is EA9F. The content of memory at address A9F is 0C35. The content of memory at address C35 is FFFF.

**Question 7:**

The content of PC in the basic computer is 3AF. The content of AC is 7EC3. The content of memory at address 3AF is 932E. The content of memory at address 32E is 09AC. The content of memory at address 9AC is 8B9F.

- a. What is the instruction that will be fetched and executed next ?
- b. Show the binary operation that will be performed in the AC when the instruction is executed.
- c. Give the contents of registers PC, AR, DR, AC, and IR in hexadecimal and the values of E at the end of the instruction.