Ankara University
Computer Engineering Department
COM376/BLM376 Computer Architecture Final Exam

Name-Surname:
Number:
Signature:

Note: 1. The questions will be answered by only using the techniques discussed in the classes.
2. Write your answers right under the questions or in the given tables.
Good luck!

QUESTIONS

1. (20 points) Answer the following questions considering modern computers.
   a. (10 points) List the four main **structural components of a computer**.

1.	Main memory
2.	CPU (central Processing unit)
3.	I/O
4.	System inter connection

   b. (10 points) List the four major **structural components of a processor**.

1.	ALU (Arithmatic-logic unit)
2.	Register
3.	control unit
4.	CPU inter connection.

2. (20 points) You have a disk with an average seek time of 3ms. Its rotation speed is 20,000rpm. The disk is organized as 512-byte sectors with 500 sectors per track. Assume that the disk uses sequential organization.
   a. (10 points) How long would it take to read a file consisting of 3000 sectors?

for the first track: Aur seek time= 3 ms
Aur rotation time=1,5 ms
Read   500 sector = 3 ms +

$$\frac{3000 \text{ sector}}{500 \text{ s/track}} = 6 \text{ tracks needed}$$

first track   time = 7,5 ms

$$\frac{60.000}{x} = \frac{20000 \text{ rpm}}{1} \Rightarrow x = 3$$

3+1,5 = 4,5 seek time

   **b. (10 points)** What is the total size of the file read in **MB**?

$$\frac{512 \times 500 \times 6}{10^6} = 1,536 \text{ MB}$$

Total time = first track time
+ (n track × seek time)

= 7,5 + (5 × 4,5)

= 30 ms = 0,035

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3. (10 points) Draw the complete instruction cycle diagram with **10 states** (including indirect and interrupt states). Note that you need to draw the diagram with all labels correctly depicted to get a full mark or you shall receive none.
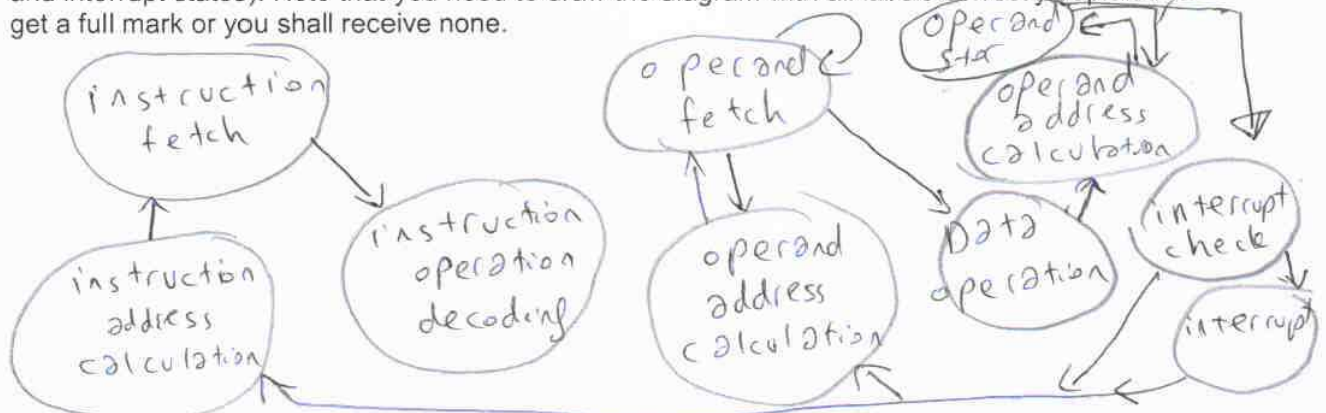
4. (30 points) Answer the following questions considering pipelining: You have a system with a single memory port, but a separate port is available dedicated to the stack. **So you need to be careful when accessing the memory.** Consider the following pipelining scenario to identify the types of the hazards and indicate the numbers of related instructions (which pair of instructions) along with the reason why they occurred. **Note that out instruction uses an I/O port isolated from the memory.**

#	Instruction/Time	1	2	3	4	5	6	7	8	9	10
1	add ax, [si]	FI	DI	FO	EI	WO					
2	push bx		FI	DI	FO	EI	WO				
3	out bx			FI	DI	FO	EI	WO			
4	add cx, dx				FI	DI	FO	EI	WO		
5	and bx, 0					FI	DI	FO	EI	WO	
6	add bx, cx						FI	DI	FO	EI	WO

Hazard #	Hazard Type	Instruction Numbers (instA, instB)	Reason
1.	Resource Hazard	4, 6	both ~~trying~~ to instructions need cx as resource in the same time
2.	Data Hazard	4, 6	trying to fetch cx in inst 6 before inst 4 finishing writing on it

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5. (20 points) Assume that you have the instruction format described below:

OPCODE	MODE	I	OPE1	OPE2
4 bit	2 bit	2 bit	8 bit	8 bit

The OPCODE field specifies the instruction as below. Assume the instructions take 2 parameters. Example:

```
SAL RX, 5; performs left arithmetic shift 5 times on RX register.
```
0001 is the code for SAL (Shift Arithmetic Left) instruction.
0010 is the code for SAR (Shift Arithmetic Right) instruction.
0100 is the code for the ROL (Rotate Left) instruction.

Note that the second operand can be stored in a register or memory location.

The MODE field indicates whether either of the OPE1 and OPE2 are register or memory addresses:
00: OPE1 and OPE2 are memory addresses.
01: OPE1 is register, OPE2 is memory address.
10: OPE1 is memory address, OPE2 is register.
11: OPE1 and OPE2 are registers.

Registers		
Code	Register	Value
00	R0	EB
01	R1	B3
10	R2	00
11	R3	51

Memory	
Address	Valu
...	...
A1	03
A2	A3
A3	04
A4	A1
A5	03
...	...

I field indicates whether indirection is used:
00: No indirection is used for both OPE1 and OPE2.
01: Indirection is used only for OPE1.
10: Indirection is used only for OPE2.
11: Indirection is used for both OPE1 and OPE2.

Show the **output result and used operands** for the following instructions for the given memory and register values by giving full explanation of your solution to get a mark. Use (X) notation to indicate indirection where X can be a register (denote as e.g. R1) or a memory location (denote as e.g. [A1]).

  i. (10 points)

OPCODE	MODE	I	OPE1	OPE2	Operands Used	Result (in hexadecimal notation)
0100	01	00	00000011	10100101	R3(51),A5 (3)	8 A

P ← ROL   OPE1 is register   no indirection   R3   memory lol

R0 1:010 10001, 3
→ 10001010

  ii. (10 points)

OPCODE	MODE	I	OPE1	OPE2	Operands Used	Result (in hexadecimal notation)
0001	01	10	00000001	10100100	R1(B3), A4 A1 (03)	9 8

SAL   OPE1 I's register   R1   memory 100
opE2 is memory address

SAL 10110011, 3
→ 10011000 ...