Homework # 1

Design of digital computer

I. Function.

For the given succession of integer positive numbers $\Omega \div a_0,\ a_1,...,a_i, ...$
a sum

$$S_N = \sum_{i=0}^{N} a_i$$

must be find for any integer N.

Algorithm for solving the problem:

$$S_0 = a_0;$$
$$S_1 = a_0 + a_1 = S_0 + a_1;$$
$$S_2 = a_0 + a_1 + a_2 = S_1 + a_2;$$
$$.........$$
$$S_i = S_{i-1} + a_i;$$

II.Architecture.

- **Set of instructions**:

1. **Copy** a_0 from the main memory in accumulator (one of ALU registers). Code 1;

2. **Add** to the content of accumulator (a_0) the second term (a_1). Code 5 ;

3. **Store** (copy) the content (result = S_N) from accumulator to the main memory. Code 2.

Language:

1). Format:

for integers (numbers)

Magnitude
0   15

for **instructions**

OC	Address
0 3	4 15

2).Alphabet:

input- binary;

output – hexadecimal.

Machine Language

0 1 . . . 3	4 5 . . . 15
OpCode	Address (of Operand)

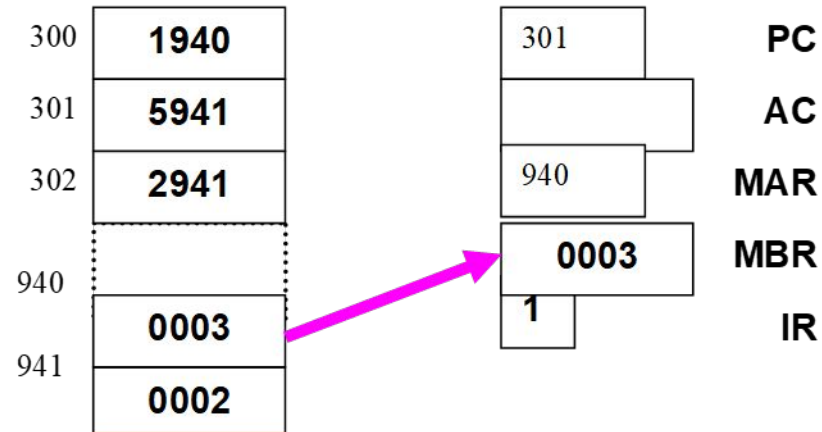*Format of machine Instruction*

0	1 2 . . . 15
S	Magnitude

Format of Integer

Example of Program Execution

III Program

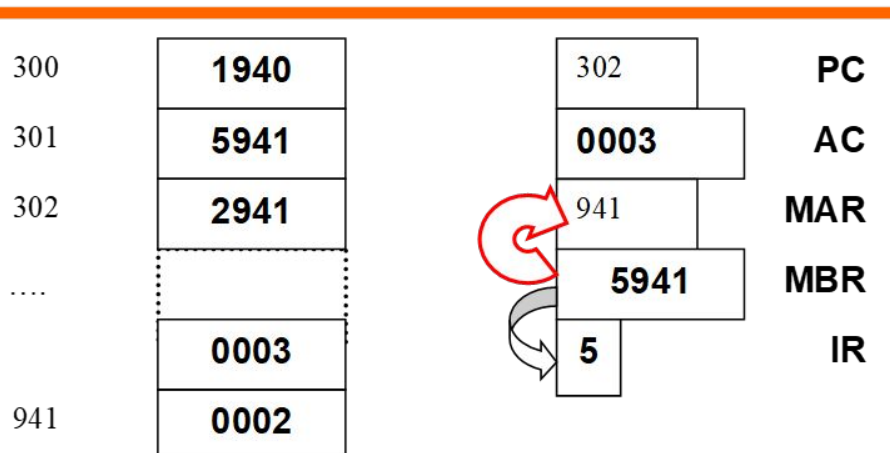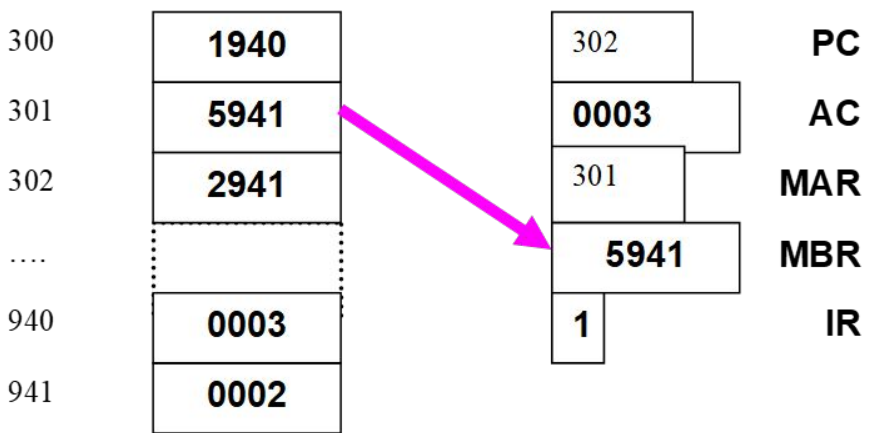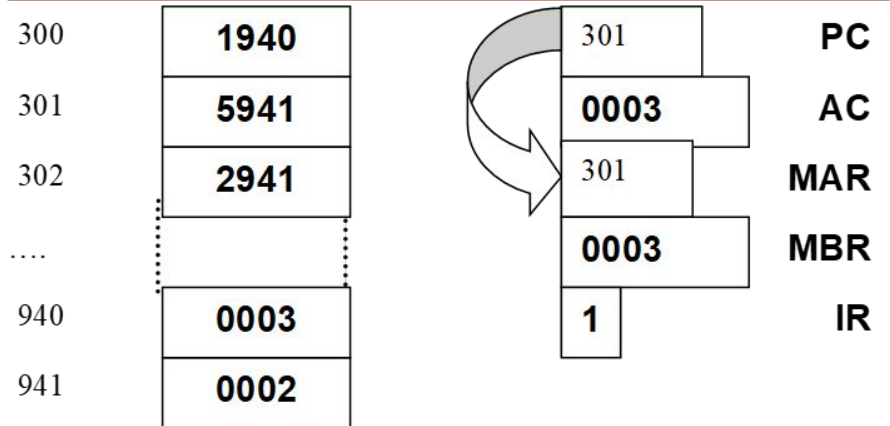|			
300	1940	301	PC
301	5941		AC
302	2941	940	MAR
940		0003	MBR
941	0003	1	IR
	0002		
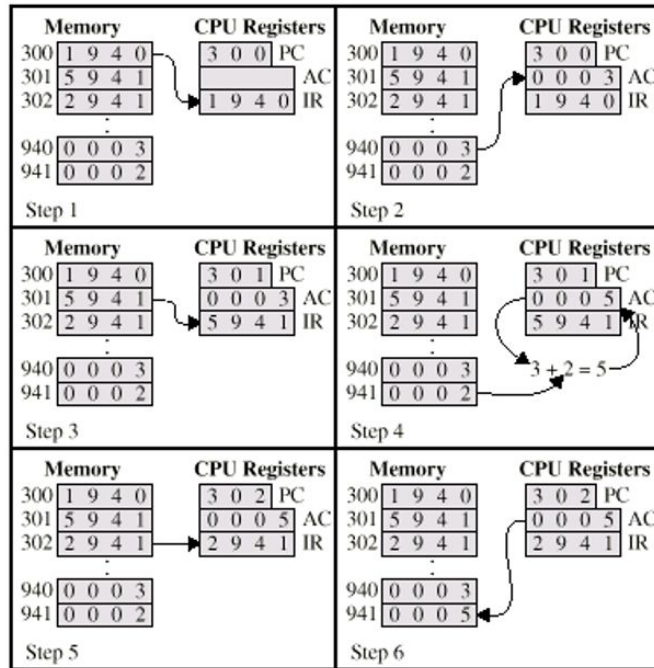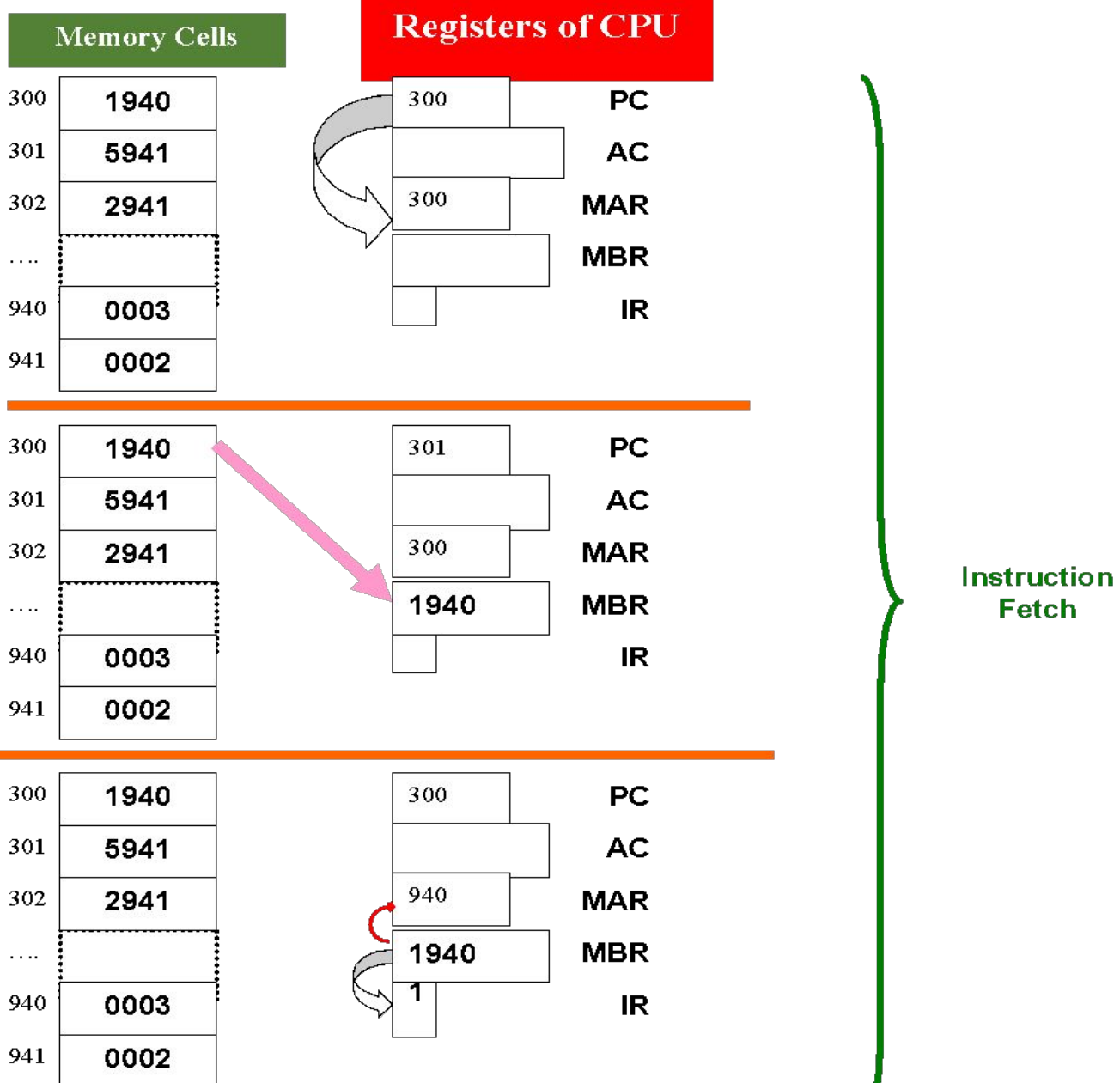
Loading of MBR from Memory

....300	1940	301	PC
301	5941		AC
302	2941	940	MAR
....		0003	MBR
940	0003	1	IR
941	0002		
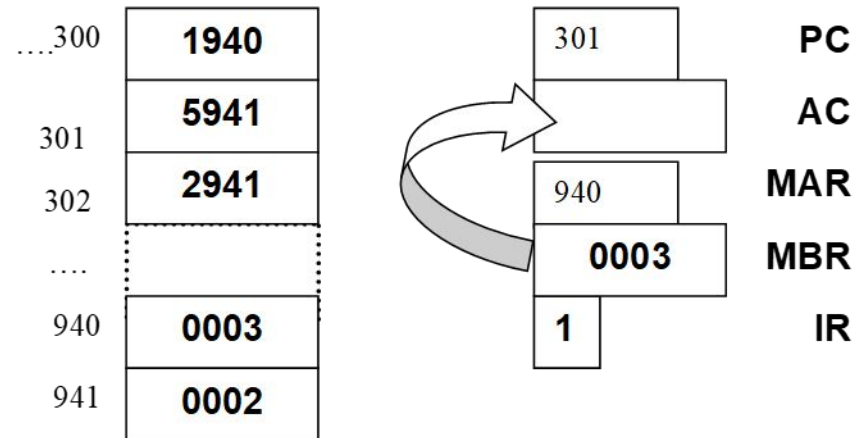
Loading of AC from MBR

Instruction Fetch

300	1940	302	PC
301	5941	0005	AC
302	2941	941	MAR
....		0002	MBR
940	0003	5	IR
941	0002		

3 + 2 = 5

To the contents of AC the number, which has been read from the memory is adding

Instruction Fetch

300	**1940**	302	PC
301	**5941**	**0005**	AC
302	**2941**	941	MAR
....		**0005**	MBR
940	**0003**	2	IR
941	**0005**		

300	**1940**	302	PC
301	**5941**	**0005**	AC
302	**2941**	302	MAR
....		**0005**	MBR
940	**0003**	2	IR
941	**0005**		
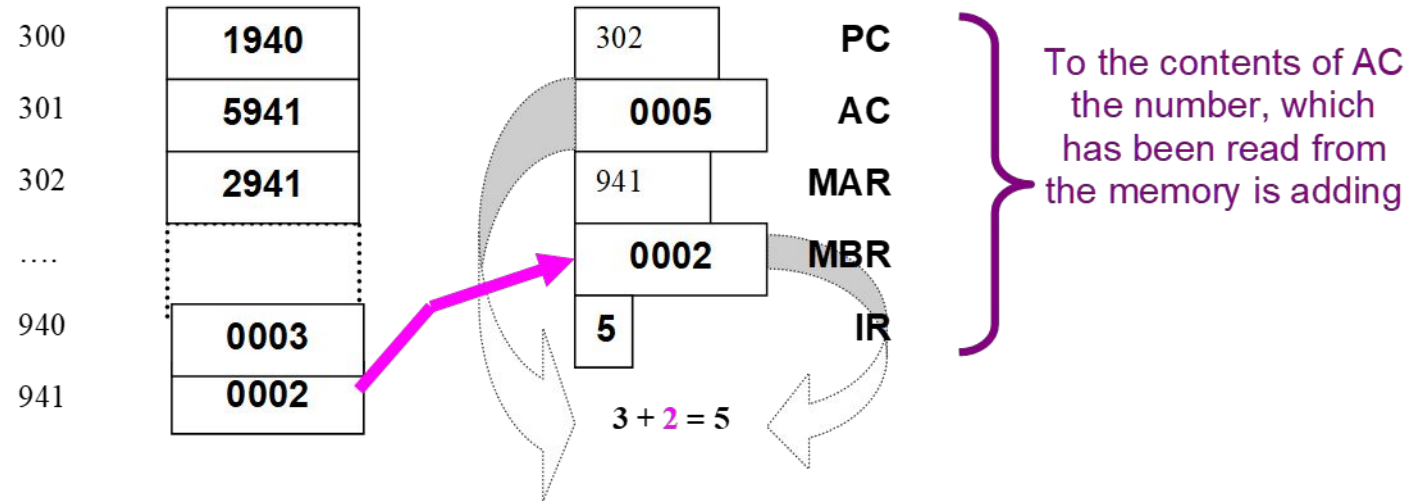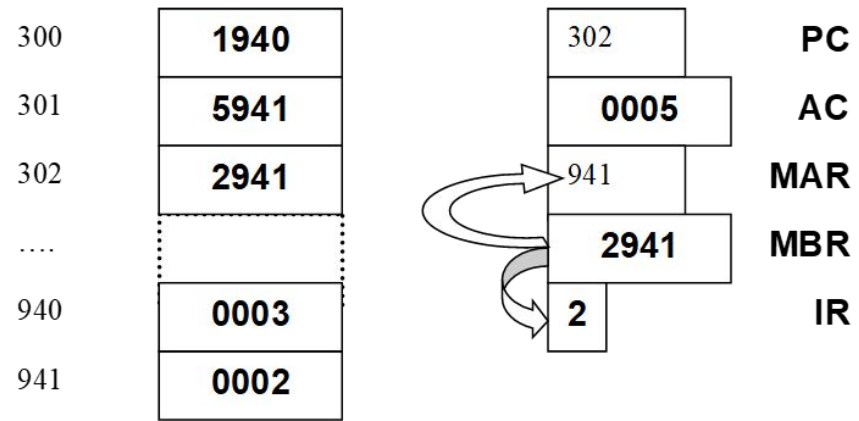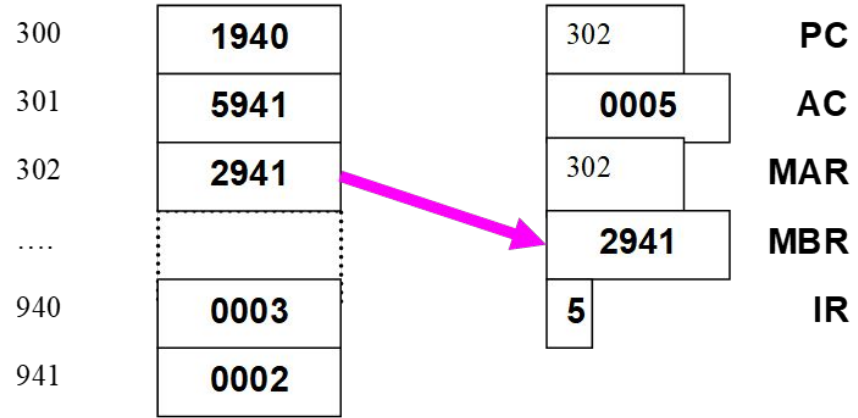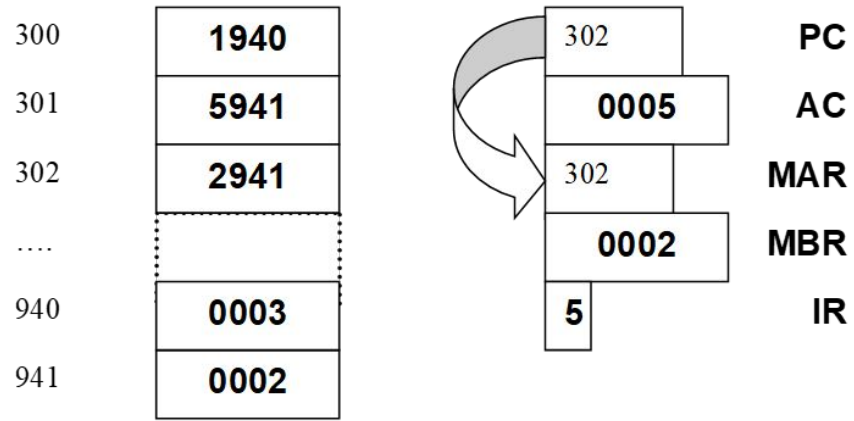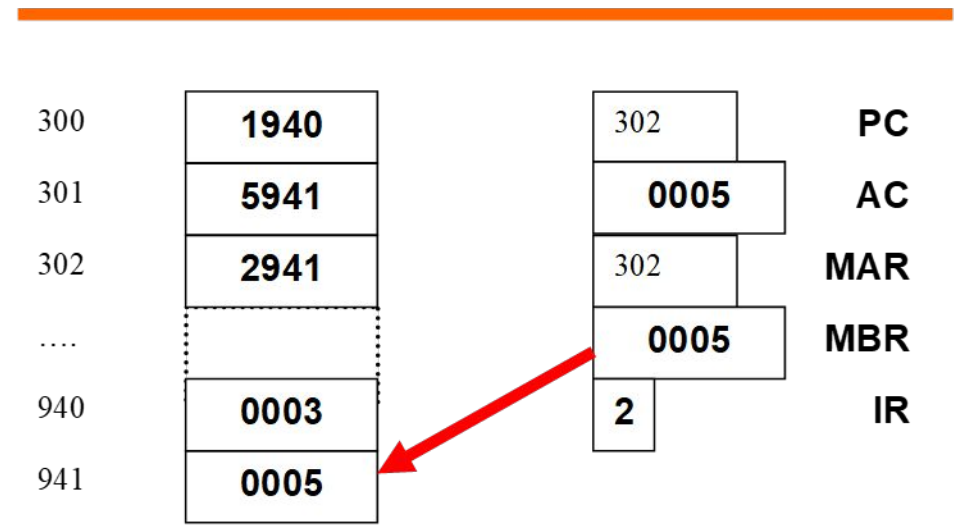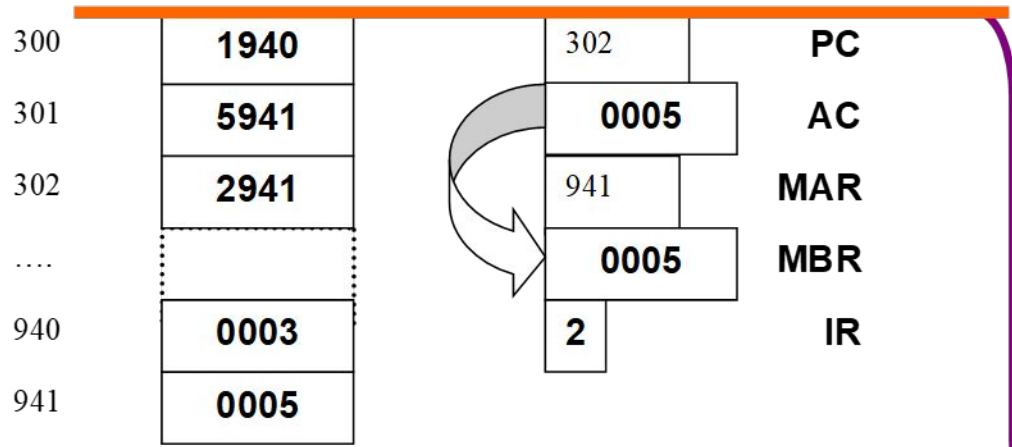
Loading of
Memory from
MBR

IV Structure.

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Figure 3.2   Computer Components: Top-Level View

PC   =   Program counter
IR   =   Instruction register
MAR   =   Memory address register
MBR   =   Memory buffer register

Accum = Accumulator

V. State Diagram for one Instruction.
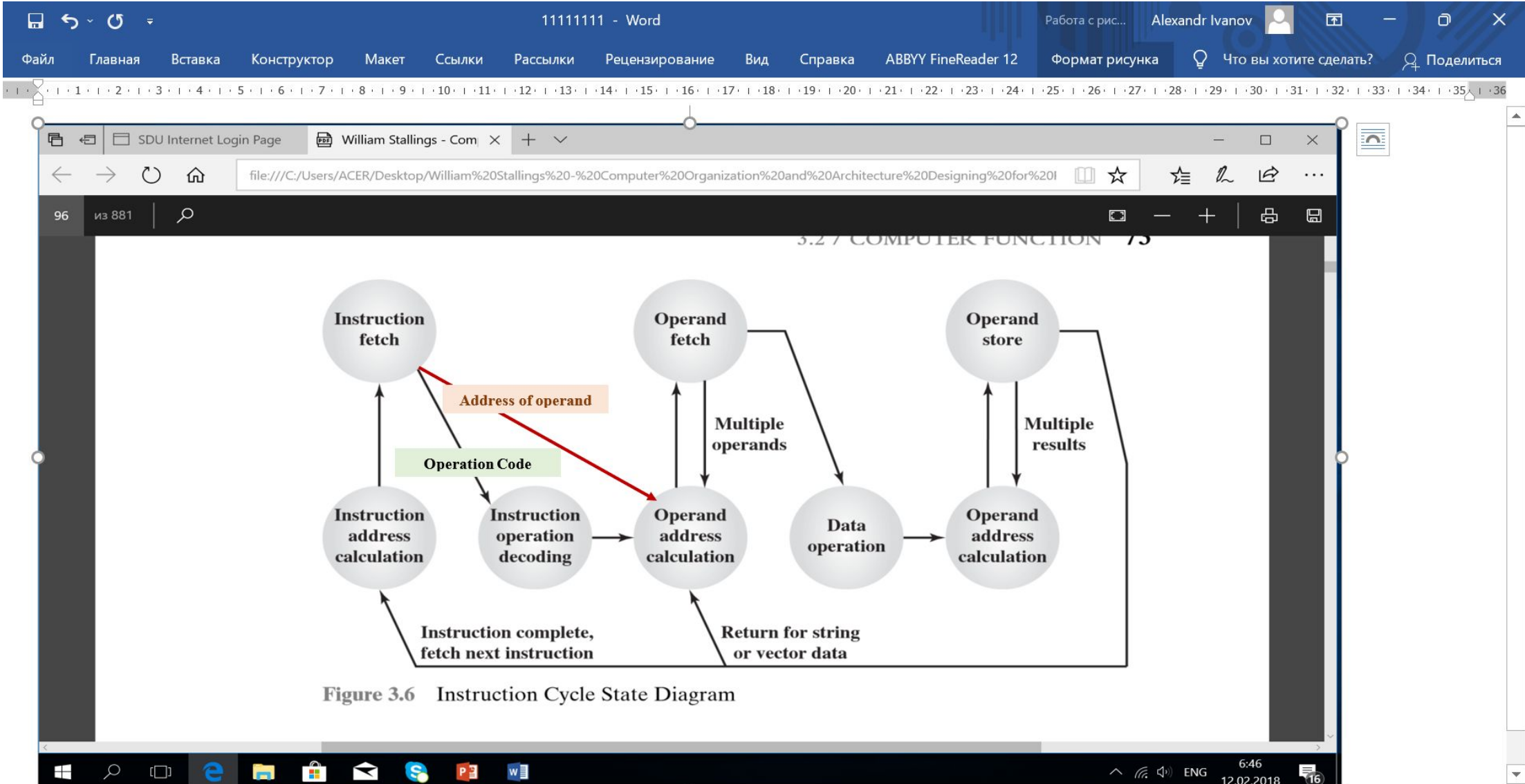
Figure 3.6 Instruction Cycle State Diagram

VI. Computer Organization

CPU

PC

MAR

IR

MBR

Accum

???

???

System bus

Main memory

	0
⋮	1
	2
Instruction	⋮
Instruction	
Instruction	
⋮	
Data	
Data	
Data	
Data	
⋮	$n-2$
	$n-1$

PC   =   **Program counter**
IR   =   **Instruction register**
MAR   =   **Memory address register**
MBR   =   **Memory buffer register**

Accum = Accumulator