VILNIAUS GEDIMINO
TECHNIKOS UNIVERSITETAS

Virtual Machine

4 laboratory work

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SAPERE AUDE

The main aim of laboratory work

- Create a virtual machine (VM), which will be able to read a given binary file instructions and save/run given tasks.
- To learn how to read/work with binary files (*.BIN).
- Improving programming skills.

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4 laboratory work (1)

(until *2019.11.29*)

- Create a virtual machine, which will have:
  - 16 general registers R0-R15 (8 bits);
  - 8 bits program addressing;
  - 256 bytes program memory;
  - Flag register.
- Two files are given:
  - input data (*q1_encr.txt*);
  - instructions binary file (*decryptor.bin*).

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4 laboratory work (2)

(until *2019.11.29*)

- The task is considered completed when VM by executing the given program (**decryptor.bin**) and using the input data (**q1_encr.txt**) will decode the text into a separate file.

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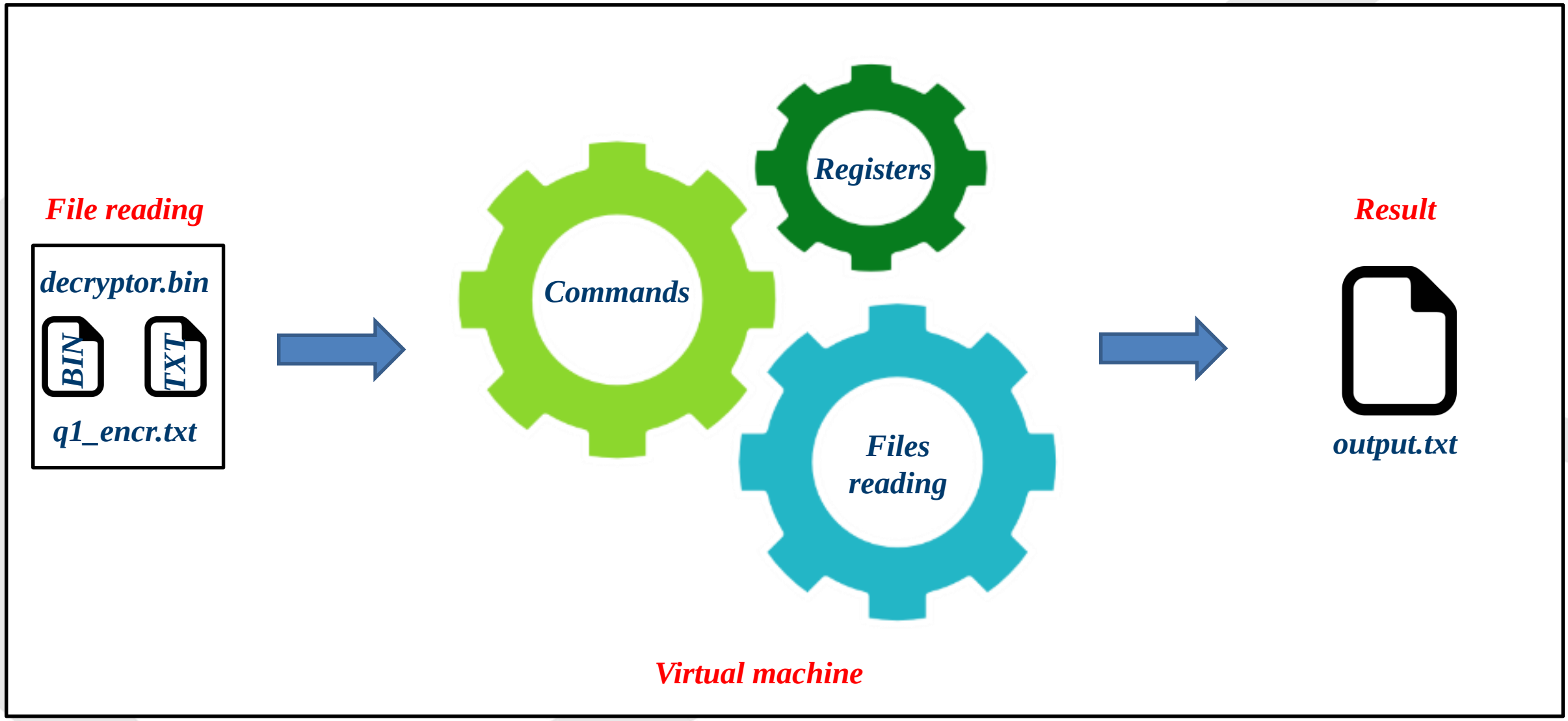
Scheme of the program



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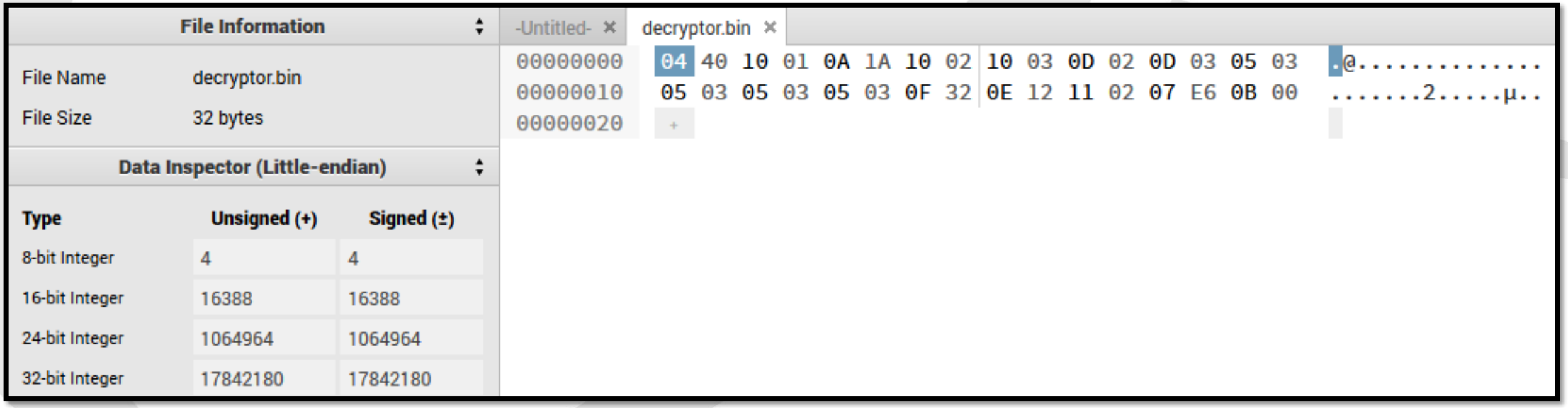
Binary file

- To see the content of binary file (***decryptor.bin***) you can use the hex dump programs or simply visit the website **https://hexed.it/**



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Input data

- Text file (***q1_encr.txt***) is used as input data, inside of him is totally 717 letters and symbols.

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Structure of VM commands (1)

I type (command with two parameters):

- These commands are used to work with registers:

8 bits command code							
R_y				R_x			
b_7	b_6	b_5	b_4	b_3	b_2	b_1	b_0

- Some of commands (*LSL*, *INC*) doesn't have the R_y register, so in this case the 7-4 bits are ignored.

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Structure of VM commands (2)

2 type (command with one parameter):

- 1 byte command code and 1 byte constant (MOVC) or jump (JZ, JNZ, JFE) size.

8 bits command code
8 bits constant or jump size

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Command list of VM (1)

COMMAND	CODE	TYPE	COMMENT
INC	01	1	Register R_x increased by one.
DEC	02	1	Register R_x decreased by one.
MOV	03	1	Copy the register R_y content to the register R_x.
MOVC	04	2	Copy the byte constant to the register R_0.
LSL	05	1	Register R_x shifting by one bit to the left.
LSR	06	1	Register R_x shifting by one bit to the right.
JMP	07	2	Jump command, which are obtained after address constant are added to the command counter with the sign.
JZ	08	2	Jump command, which are obtained after address constant are added to the command counter with the sign, if flag is on.
JNZ	09	2	Jump command, which are obtained after address constant are added to the command counter with the sign, if flag is off.

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VM komandų sąrašas (2)

COMMAND	CODE	TYPE	COMMENT
JFE	0A	2	Jump command, which are obtained after address constant are added to the command counter with the sign, if input file ends (IN).
RET	0B	–	Virtual machine stop working.
ADD	0C	1	ADDITION: $R_x = R_x + R_y$
SUB	0D	1	SUBSTRACTION: $R_x = R_x - R_y$
XOR	0E	1	XOR operation: $R_x = R_x \oplus R_y$
OR	0F	1	OR operation: $R_x = R_x \vee R_y$
IN	10	2	Reads one byte from the input data file, assigns value to the register R_x and set up the file end trigger.
OUT	11	1	Prints the content of register R_x to the file.

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ADVICES

- Realize VM registers as **CHAR** array: *unsigned char regs[16]*.
- Realize VM program memory as a **CHAR** array: *char prog_mem[256]*.
- Flag register can be a simple **INT** variable.
- Inside the binary file ***decryptor.bin*** there are **ASCII** control codes, so you will need to open/read this file in binary mode **(“rb”)**.
- For commands realization use **IF**, **ELSEIF** or **SWITCH**.

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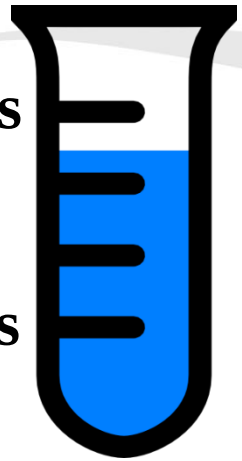
Evaluation

MAX: 1.2 points

MIN: 0.6 points



REALIZATION

COLLECTED SCORE

PRESENTATION

General requirements (1.2 points)

1. Program works correctly (0.8);
2. Result are presented in output file (0.1);
3. All commands are realized (0.3).

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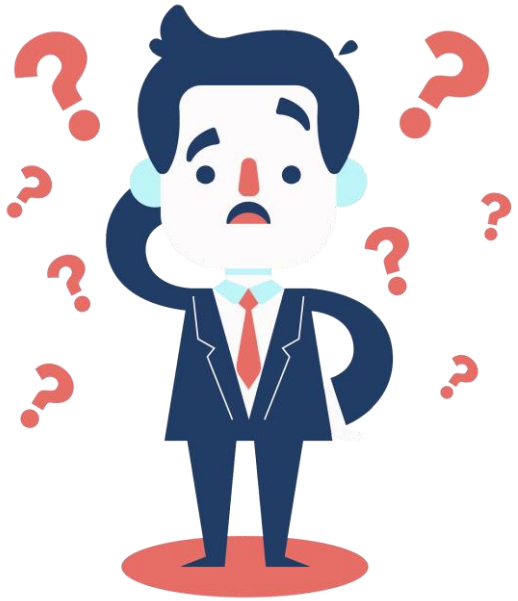
ADDITIONAL OPTIONAL TASK

- Modify your program in such way, that yours VM could read the few sentence paragraph and according to yours binary file encode it.



```
01010100 01101000 01101001 01110011
00100000 01101001 01110011 00100000
01110100 01101000 01100101 00100000
01110100 01110101 01110100 01101111
01110010 01101001 01100001 01101100
00100000 01110100 01101111 00100000
01101100 01100101 01100001 01110010
01101110 00100000 01100010 01101001
```

+ 0.5 POINTS TO FINAL GRADE.