

<b>NAME</b>		<b>SURNAME</b>	
<b>ID. Number</b>	<b>S</b>		<b>A/1</b>
<input type="checkbox"/> Poli @ Home <input type="checkbox"/> 5 Crediti <input type="checkbox"/> AAA- LI B/ English <input type="checkbox"/> LI C- ZZZ/ English <input type="checkbox"/> ot her: .....			

<b>QUESTION 1</b>	<i>Resultant</i>
Given the following integers N1, N2, N3, N4, expressed in two's complement 8-bit, indicate which is larger and justify the steps  N1= 11110001    N3= 11100011 N2= 11111101    N4= 11100111	Greater:  <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px 15px;">N1</div> <div style="border: 1px solid black; padding: 5px 15px;">N2</div> <div style="border: 1px solid black; padding: 5px 15px;">N3</div> <div style="border: 1px solid black; padding: 5px 15px;">N4</div> </div>
Steps	

<b>QUESTION 2</b>
For which combinations of values of the binary constants K1 and K2, the following Boolean functions are equivalent: $f1(A, B) = (A \cdot \bar{A}) \cdot K2 + (B \cdot \bar{B}) \cdot K1$ , $f2(A, B) = (A \cdot \bar{A}) \cdot K1 + (B \cdot \bar{B}) \cdot K2$
Response

<b>QUESTION 3</b>
Explain the function of the linker inside a programming environment
Response

### QUESTION 4 (PROGRAMMING)

Write a program in C that performs the decoding of a series of codewords stored in a text file in ASCII format. The encoding in question is called COD32 and uses the symbols: **digits** 0 through 9, and the **letters** of the alphabet from A to Z (except I and O):

Then, the string of symbols is: 0123456789ABCDEFGHIJKLMNPQRSTUVWXYZ.

The decoding is done by transforming every one of the symbols taken in COD32 to a decimal value DEC. In particular, each symbol is decoded into a decimal number associated with its position in the string of symbols, previously reported by COD32 encoding (the first symbol position is equal to 0). For example a COD32 2 symbol is decoded into the number 2, A is decoded into the number 10, and Z in the number 33. An example of a complete decoding is:

(9AJ4D)<sub>COD32</sub> -> (91018413)<sub>DEC</sub>

The file with the encoded words in COD32 called "COD32.txt" is of **unknown length** and consists of one word for each line:

<codeword1>

<codeword2>

...

Where <codeword> is a **string of maximum 30 characters**. The program must perform the decoding from COD32 to DEC, producing a file named "**decimal.txt**". In the new file, each row contains a word decoded in DEC corresponding to the decode process, and separated by a space, a string that represents the decryption key. This description key is a sequence of characters "L" and "N", where N means that the decimal number is derived from a COD32 digit, while L indicates that the decimal number is derived from a COD32 letter. In this way, the lines of the file decoding result to be:

<decimalword> <key1>

<decimalword> <key2>

...

where <decimalword> is a **string of 60 characters maximum**, and <key> is a string composed of the two possible characters L and N. **The program must produce in the console output the shortest length codeword and the average length (with two digits decimal places) of the codewords.** Assume that the files are always in the correct format.

Example of files COD32 and decimal.txt:

COD32.txt	decimal.txt
9AJ4D	91018413 NLLNL
456F	45615 NNNL
FFD34	15151334 LLLNN

In the example, the produced key NLLNL in the first line of decimal.txt indicates that the first symbol represents a number (9) in the first line of the COD32.txt file, and therefore should be considered as a single digit, while the second is a letter (A) and therefore should be considered as two consecutive digits corresponding (10) and so on.

Example of a sequence coding for (COD32.txt is the input file and the output file is decimal.txt)

C:\> **codec32**

**Encoded shorter string: 456F**

**Average length codewords: 4.66**

<b>NAME</b>					<b>SURNAME</b>				
<b>MATRICULATION</b>	<b>S</b>							<b>A/2</b>	
<input type="checkbox"/> Poli @ Home <input type="checkbox"/> 5 Credit i <input type="checkbox"/> AAA- LI B/ English <input type="checkbox"/> LIC- ZZZ/ English <input type="checkbox"/> other: .....									

<b>QUESTION 1</b>	<i>Resultant</i>
Given the following integers N1, N2, N3, N4, expressed in two's complement 8-bit, indicate which is larger and justify the steps N1= 10110001    N3= 11000011 N2= 11101101    N4= 10100111	Greater: <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px 15px;">N1</div> <div style="border: 1px solid black; padding: 5px 15px;">N2</div> <div style="border: 1px solid black; padding: 5px 15px;">N3</div> <div style="border: 1px solid black; padding: 5px 15px;">N4</div> </div>
Steps	

<b>QUESTION 2</b>
For which combinations of values of the binary constants K1 and K2, the following Boolean functions are equivalent: $f1(A,B) = (B \cdot \bar{B}) \cdot K2 + (A \cdot \bar{A}) \cdot K1$ , $f2(A,B) = (B \cdot \bar{B}) \cdot K1 + (A \cdot \bar{A}) \cdot K2$
Response

<b>QUESTION 3</b>
Explain what are libraries and how are they used in a programming environment
Response

## QUESTION 4 (PROGRAMMING)

Write a program in C that performs the decoding of a series of code words stored in a text file in ASCII format. The encoding in question is called COD32 and uses symbols such as the digits 0 through 9 and the letters of the alphabet from A to Z (except I and O): 0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ. The decoding is done by transforming each of the symbols taken individually by a COD32 decimal. In particular, each symbol is translated into a decimal number associated with its position in the string of symbols, previously reported by COD32 encoding (the first symbol position is equal to 0). For example 2 is translated into the number 2, A is translated into the number 10, and Z in the number 33. An example of a complete decoding is: (9AJ4D)<sub>COD32</sub> -> (91018413)<sub>DEC</sub>

The file with the encoded words is passed as the first argument on the command line and is of unknown length and consists of one word for each line:

<codeword1>

<codeword2>

...

Where <codeword> is a **string of maximum 30 characters**. The decoder must **produce a file whose name is specified as the second argument on the command line** in which each line contains a word decoded and separated by a space, a string that represents the decryption key. This key is a sequence of characters "L" and "N" where N is the decimal number is derived from a figure COD32 while L indicates that the decimal number is derived from a COD32 letter. In this way, the lines of the file decoding result to be:

<decimalword1> <key1>

<decimalword2> <key2>

...

where <decimalword> is a **string of 60 characters maximum** and <key> is a string composed of the two possible characters "L" and "N". **The program must produce as output on the console (in coded format that is decoded) the codeword of the maximum value (in alphabetic sense) and the number of words decoded.** In case there are more words than the maximum value will be enough to print one. Assume that the files are always in the correct format.

Example of file encoding(input) and decoding(output):

COD32.txt (input)	decimal.txt (output)
9AJ4D	91018413 NLLNL
456F	45615 NNNL
FFD34	15151334 LLLNN

NOTE: In the example the sequence NLLNL in the first line indicates that the first symbol represents a number (9), while the second is a letter (A).

Execution example:

C:\> **codec32 COD32.txt decimal.txt**

**Decoding 3 words.**

**String of maximum value: FFD34 - 15151334.**

<b>NAME</b>						<b>SURNAME</b>			
<b>Student ID</b>	<b>S</b>							<b>C/1</b>	
<input type="checkbox"/> AAA- LI B/ Engl i sh <input type="checkbox"/> LI C- ZZZ/ Engl i sh <input type="checkbox"/> O t h e r s : .....									

<b>QUESTION 1</b>	<i>Result</i>
Calculate the range of a 16-bit number when it's interpreted as Two's complement and when it's interpreted as Sign and Magnitude. Point out the differences.	Range as Two's Complement: $< (X)_{CA2} <$  Range as Sign and Magnitude: $< (X)_{SM} <$
Main differences:	

<b>QUESTION 2</b>
Explain the reason why the two expressions $\bar{A} \cdot A$ and $A + \bar{A}$ always produce different values no matter the value of A.
Answer:

<b>DOMANDA 3</b>
List the main memory technologies you know in order according to memory size generally used in computer systems.
Answer:

#### QUESTION 4 (Programming)

Write a program in C that applies encoding to binary strings called **bus-invert**. The encoding acts on the sequence of binary words (strings) of length N. Every word is compared with previous word and a distance between the two words is calculated. The distance is the number of different bits between the two words. For example (with the words of length 8):

```
11110000 00001111 distance: 8
11110000 11110000 distance: 0
11110000 11111111 distance: 4
```

The encoding consists of inverting all the bits in the word when the distance from the previous word is strictly greater than  $N/2$ , otherwise the word is left the same. Note that the distance must be calculated with respect to the encoding of the previous word (that is, if the previous word is encoded as inverted, the distance should be calculated with the inverted word).

The program should read from an ASCII formatted file, in which each line is a binary word of length N, where N is a constant number defined with the **#define** directive. **The input file's name is passed as the first argument through the command line, and the input file's length is not known a priori.** The program should write the **encoded word**, a **space** to separate with a **character (I or N)** for indicating whether the word is Inverted or Non-inverted to **a file whose name is passed as the second argument through the command line**. Assume the first word is never to be encoded and should remain the same in the output file.

In addition, the program should print out the **M adjacent words which have the minimum total distance** which **M** is a constant number defined with the **#define** directive. Assume the format of input file is always correct.

Example of input and output file (with N=8):

words.txt (input)	encoded.txt (output)
11110000	11110000 N
<b>00111111</b>	11000000 I
11 <b>111</b> 000	11111000 N
11111 <b>110</b>	11111110 N

In the example, the bits in bold are the ones different with previous encoded word. Note that the encoding is always done with respect to the encoded previous word. So the distances are 6, 3 and 2.

Example of program execution (with M=3):

```
C:\> businvert words.txt encoded.txt
```

```
Sequence of 3 adjacent words which have the minimum total distance are: 00111111
11111000 11111110
```

<b>NAME</b>					<b>SURNAME</b>				
<b>Student ID</b>	<b>S</b>							<b>C/2</b>	
<input type="checkbox"/> AAA- L I B/ Engl i sh <input type="checkbox"/> L I C- ZZZ/ Engl i sh <input type="checkbox"/> O t h e r s : .....									

<b>DOMANDA 1</b>	<i>Result</i>
Calculate the range of a 32-bit number when it's interpreted as Two's complement and when it's interpreted as Sign and Magnitude. Point out the differences.	Range as Two's Complement: $< (X)_{CA2} <$  Range as Sign and Magnitude: $< (X)_{SM} <$
Main differences:	

<b>QUESTION 2</b>
Explain why the two expressions $A \cdot \bar{A}$ and $\overline{(A + \bar{A})}$ are always the same
Answer:

<b>QUESTION 3</b>
List the main memory technologies you know in order according to access speed
Answer:

#### QUESTION 4 (Programming)

Write a program in C that applies the encoding to binary strings called **bus-invert**. The encoding acts on the sequence of binary words (strings) of length N. Every word is compared with previous word and a distance between the two words is calculated. The distance is the number of different bits between the two words. For example (with the words of length 8):

```
11110000 00001111 distance: 8
11110000 11110000 distance: 0
11110000 11111111 distance: 4
```

The encoding consists of inverting all the bits in the word when the distance from the previous word is strictly greater than  $N/2$ , otherwise the word is left the same. Note that the distance must be calculated with respect to the encoding of the previous word (that is, if the previous word is encoded as inverted, the distance should be calculated with the inverted word).

The program should read from an ASCII formatted file, in which each line is a binary word of length N, where N is a constant number defined with the **#define** directive. **The input file's name is passed as the first argument through the command line, and its length is not known a priori.** The program should write the **encoded word**, a **space** to separate with a **character (I or N)** for indicating whether the word is Inverted or Non-inverted to **a file whose name is passed as the second argument through the command line**. Assume the first word is never to be encoded and should remain the same in the output file.

In addition, the program should print out the **M adjacent words which have the maximum total distance** which **M** is a constant number defined with the **#define** directive. Assume the format of input file is always correct.

Example of input and output file (with N=8):

words.txt (input)	encoded.txt (output)
11110000	11110000 N
<b>00111111</b>	11000000 I
11 <b>111</b> 000	11111000 N
11111 <b>110</b>	11111110 N

In the example, the bits in bold are the ones different with previous encoded word. Note that the encoding is always done with respect to the word encoded. So the distances are 6, 3 and 2.

Example of program execution (with M=3):

```
C:\> businvert words.txt encoded.txt
```

```
Sequence of 3 adjacent words which have the maximum total distance are: 11110000
00111111 11111000
```