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<u>STUDENT ID:</u>				
<u>TEACHER:</u>				

Question 1	Answer
<p>Convert the following numbers from decimal to binary in Two's Complement (2C) on 8 bits:</p> <p>$35_{10} = X_{2C}$</p> <p>$-112_{10} = Y_{2C}$</p>	<p>X = _____</p> <p>Y = _____</p>
<p>Report ALL steps</p>	

Question 2
<p>Determine if the following Boolean equality is true or false:</p> <p>$A \text{ AND } (B \text{ OR } C) \text{ OR NOT}(A \text{ OR NOT}(C)) = (A \text{ AND } B) \text{ OR } C$</p>

Question 3
<p>Briefly describe the role of the Program Counter in a program execution.</p>

Question 4 (PROGRAMMING)

An electronic control unit for automotive engine control is equipped with 10 sensors. Such sensors measure several engine parameters (e.g., speed, temperature, acceleration, etc.). Regardless of the type of sensor, each value is represented as a real number. The control unit acquires 10 values every 10 milliseconds and saves them in a new line of a file called **measurements.txt**. The 10 values are separated by a space.

Write a C program able to analyze the file **measurements.txt**. The purpose of the program is the detection of engine's anomalies according to the following criteria.

A file called **limits.txt** is composed of 10 lines and contains the minimum and maximum value in which the sensor measurement is valid. The first line is associated to the first sensor, the second line to the second sensor, and so on.

For each line of the file **measurements.txt**, the program shall analyze the average of the last 5 measurements of each sensor and count how many sensors have the average value out of limits (reported in the file **limits.txt**). If the result of this count is higher than an integer parameter **L**, provided to the program from the command line as first parameter, then an anomaly is detected. In this case, the program shall print on screen a message, which reports the line number in which the anomaly occurred (the lines are numbered starting from 1). In order to have enough measurements for the average computation, the check shall start from the line number 5.

At the end, the program shall print the total number of anomalies detected.

Assume that:

- The **format** of the files **measurements.txt** and **limits.txt** is always **correct**.
- The **number of lines** in the file **measurements.txt** is **not known**, but is **greater or equal to 5**

EXAMPLE

measurements.txt

5.26	0.04	9.68	2.23	9.70	7.62	0.94	1.10	4.70	5.70
0.86	4.50	6.45	5.48	0.28	3.90	1.22	6.63	0.24	8.99
8.58	2.36	5.50	4.08	2.73	3.88	7.05	8.12	8.27	2.43
1.00	2.78	6.36	8.18	8.65	7.37	5.78	5.53	6.36	0.49
4.06	6.53	7.32	2.62	7.24	0.04	5.70	8.36	9.00	4.81
7.71	6.27	4.72	3.63	9.87	0.77	8.01	6.09	2.75	7.53
9.07	2.33	5.32	0.93	0.34	7.62	4.17	7.88	7.82	3.10
4.64	2.15	6.96	9.34	2.24	4.00	3.34	9.76	3.20	2.68
3.78	6.80	3.33	7.70	6.74	3.98	2.23	9.60	6.42	1.23
7.46	0.85	6.73	6.09	5.87	6.73	1.90	6.96	1.34	2.60
2.15	1.74	9.87	3.25	7.14	7.50	6.44	8.75	3.95	5.72
5.33	4.81	0.64	0.17	4.82	9.72	2.79	7.85	2.80	8.42
5.87	1.70	8.14	2.13	5.12	9.97	8.06	6.62	1.78	4.47
5.21	2.18	8.80	9.89	0.03	4.20	8.09	7.25	9.05	5.28
6.16	2.48	9.99	2.86	4.46	0.57	6.08	9.59	1.38	8.14
7.34	9.70	0.48	9.23	5.79	4.80	6.99	1.60	1.21	5.63
0.39	4.05	9.56	9.75	9.85	5.94	0.40	3.56	2.47	6.29
2.04	3.85	9.62	9.21	6.71	9.10	6.50	8.07	4.98	9.44
4.01	9.02	9.61	0.06	9.05	8.54	3.38	4.91	9.15	7.27
4.58	3.11	4.55	0.47	0.01	2.81	1.48	2.73	6.71	1.52
2.46	1.00	3.91	0.50	4.72	2.94	0.20	1.04	5.30	4.89
2.31	0.76	1.34	5.77	0.25	7.87	7.70	8.09	9.14	0.77
7.69	4.54	5.74	9.39	1.10	8.68	6.47	4.42	2.99	7.71
7.32	1.14	2.35	0.22	1.13	2.84	9.16	6.79	8.97	9.91
1.93	0.12	4.04	4.61	0.05	5.67	1.35	7.51	1.37	2.86
9.96	0.83	9.94	7.21	2.57	0.76	2.79	0.18	1.70	9.38
6.15	9.50	8.72	4.78	1.56	5.03	9.42	5.76	2.74	4.81
2.58	3.51	8.07	6.60	7.24	0.59	9.95	4.80	8.61	2.84
8.86	4.95	8.91	7.15	6.92	6.20	3.31	0.19	1.66	5.25
5.29	8.25	9.31	1.19	4.42	2.73	6.51	1.96	7.05	1.21
2.90	9.53	0.97	2.83	8.38	6.82	7.62	1.26	5.30	1.58

3.95	3.24	7.06	4.52	5.72	4.56	4.14	5.95	5.72	4.48
4.44	4.49	6.07	4.80	5.76	3.19	5.56	6.95	5.33	4.85

limits.txt

4.00	5.00
2.00	3.00
5.01	7.02
3.10	7.03
2.00	6.00
5.00	5.50
3.00	4.00
6.00	6.20
4.00	6.00
3.50	6.90

C:\> search_anomalies.exe 5

Anomaly found in line 5
 Anomaly found in line 7
 Anomaly found in line 16
 Anomaly found in line 18
 Anomaly found in line 19
 Anomaly found in line 21
 Anomaly found in line 25
 Anomaly found in line 26
 Anomaly found in line 27
 Anomaly found in line 29
 Anomaly found in line 30
 Anomaly found in line 31
 Total anomalies found: 12

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Question 1	Answer
<p>Convert the following numbers from decimal to binary in Sign and Magnitude (SM) of 8 bits:</p> <p>$98 = X_{SM}$</p> <p>$-63_{10} = Y_{SM}$</p>	<p>X = _____</p> <p>Y = _____</p>
<p>Report ALL steps</p>	

Question 2
<p>Determine if the following Boolean equality is true or false:</p> <p>$(A \text{ AND } B) \text{ OR } (A \text{ AND } C) \text{ OR } (A \text{ AND NOT}(B)) \text{ OR } (\text{NOT}(B) \text{ AND } C) = A \text{ OR } (\text{NOT}(B) \text{ AND } C)$</p>

Question 3
<p>Briefly describe what is the ALU of a microprocessor.</p>

Question 4 (PROGRAMMING)

An electronic control unit for automotive engine control is equipped with 8 sensors. Such sensors measure several engine parameters (e.g., speed, temperature, acceleration, etc.). Regardless of the type of sensor, each value is represented by a real number. The control unit acquires 8 values every 10 milliseconds and saves them in a new line of a file called `measurements.txt`. The 8 values are separated by a space.

Write a C program able to analyze the file `measurements.txt`. The purpose of the program is the detection of engine's anomalies according to the following criteria.

A file called `limits.txt` is composed of 8 lines and contains the minimum and maximum value in which the sensor measurement is valid. The first line is associated to the first sensor, the second line to the second sensor, and so on.

For each line of the file `measurements.txt`, the program shall analyze the average of the last 4 measurements of each sensor and count how many sensors have the average value out of limits (reported in the file `limits.txt`). If the result of this count is higher than an integer parameter `L` from the command line, then an anomaly is detected. In case there is no anomaly in the line, the program shall print on screen a message, which reports the line number (the lines are numbered starting from 1). In order to have enough measurements for the average computation, the check shall start from the line number 4.

At the end, the program shall print the total number of correct measurements (i.e. lines) without anomaly.

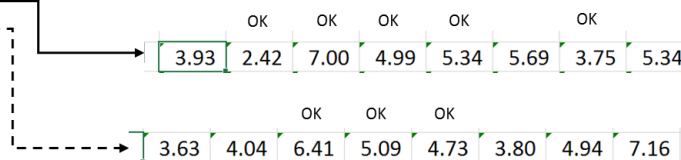
Assume that:

- The **number of lines** in the file `measurements.txt` is **not known**, but is **greater or equal to 4**
- The **format** of the file `measurements.txt` is **correct**.

EXAMPLE

measurements.txt

5.26	0.04	9.68	2.23	9.70	7.62	0.94	1.10
0.86	4.50	6.45	5.48	0.28	3.90	1.22	6.63
8.58	2.36	5.50	4.08	2.73	3.88	7.05	8.12
1.00	2.78	6.36	8.18	8.65	7.37	5.78	5.53
4.06	6.53	7.32	2.62	7.24	0.04	5.70	8.36
7.71	6.27	4.72	3.63	9.87	0.77	8.01	6.09
9.07	2.33	5.32	0.93	0.34	7.62	4.17	7.88
4.64	2.15	6.96	9.34	2.24	4.00	3.34	9.76
3.78	6.80	3.33	7.70	6.74	3.98	2.23	9.60
7.46	0.85	6.73	6.09	5.87	6.73	1.90	6.96
2.15	1.74	9.87	3.25	7.14	7.50	6.44	8.75
5.33	4.81	0.64	0.17	4.82	9.72	2.79	7.85
5.87	1.70	8.14	2.13	5.12	9.97	8.06	6.62
5.21	2.18	8.80	9.89	0.03	4.20	8.09	7.25
6.16	2.48	9.99	2.86	4.46	0.57	6.08	9.59
7.34	9.70	0.48	9.23	5.79	4.80	6.99	1.60
0.39	4.05	9.56	9.75	9.85	5.94	0.40	3.56
2.04	3.85	9.62	9.21	6.71	9.10	6.50	8.07
4.01	9.02	9.61	0.06	9.05	8.54	3.38	4.91
4.58	3.11	4.55	0.47	0.01	2.81	1.48	2.73
2.46	1.00	3.91	0.50	4.72	2.94	0.20	1.04
2.31	0.76	1.34	5.77	0.25	7.87	7.70	8.09
7.69	4.54	5.74	9.39	1.10	8.68	6.47	4.42
7.32	1.14	2.35	0.22	1.13	2.84	9.16	6.79
1.93	0.12	4.04	4.61	0.05	5.67	1.35	7.51
9.96	0.83	9.94	7.21	2.57	0.76	2.79	0.18
6.15	9.50	8.72	4.78	1.56	5.03	9.42	5.76
2.58	3.51	8.07	6.60	7.24	0.59	9.95	4.80
8.86	4.95	8.91	7.15	6.92	6.20	3.31	0.19
5.29	8.25	9.31	1.19	4.42	2.73	6.51	1.96
2.90	9.53	0.97	2.83	8.38	6.82	7.62	1.26



```
C:\> check_measure.exe 3
Measurement correct in line: 4
Measurement correct in line: 11
Measurement correct in line: 12
Measurement correct in line: 14
Measurement correct in line: 15
Measurement correct in line: 23
Total correct measurements: 6
```

limits.txt

4.00	5.00
2.00	3.00
5.01	7.02
3.10	7.03
2.00	6.00
5.00	5.50
3.00	4.00
6.00	6.20