

# Avantari Technologies Private Limited

## Embedded Engineer Test

### OBJECTIVE

The main objective of this test is to gauge if you have qualities we require in a embedded designer, which are listed below (in order):

- I. Good coding and logical reasoning skills
- II. Ability to work in multiple platforms
- III. Code documentation Skills
- IV. Creative and Inquisitive mindset

To assess these qualities, we require you to answer **any one of these two questions**. You have 72 hours to answer them from the time the test was given to you. The answers must be submitted to [bhairav@avantari.org](mailto:bhairav@avantari.org) with the subject: **Embedded Engineer Test**.

### TASK I

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#### AIM

When working with analog signals, one of the most pervasive noise elements is the power line noise. This **signal** ([link](#)), sampled at 200Hz, is an ECG signal, which is corrupted by power line frequency (50 Hz). The expected ECG signal should look like [this](#).

We need you to write a function, whose input is the **signal**. The function should clean the **signal** of the power line noise, detect the peaks, and output a clean ECG Signal as well as the heart rate detected from the signal.

#### Tasks

- 1) Remove power line noise from given ECG signal.
- 2) Calculate average heart rate of filtered ECG signal ([hint](#))

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## DELIVERABLE

C file called “**filter.c**”.

Complete the functions below, so that it returns the filtered signal as well as the average heart rate.

```
void RemovePowerlineNoise(float *inputSignal, float *outputSignal, unsigned int size)
{
    //write your code inside this function
    // outputSignal should be the filtered inputSingal
}

float ProcessEcgSignal( float *ecgSignal, unsigned int size)
{
    //write your code inside this function
    //Return average heart rate of ecgSignal.
}
```

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## RESTRICTIONS:

- If you have trouble understanding the question you can email [deljohn@avantari.org](mailto:deljohn@avantari.org) and ask your queries
- You can reach out to [deljohn@avantari.org](mailto:deljohn@avantari.org) regarding any C/C++ language related issues
- You can use the MATLAB for designing filter (FDATool can be used).
- If you are using MATLAB for design purpose, please provide following
  - Screenshot of FDATool configuration
  - All matlab files.
- The C Code you have to write the same filter without using the library
- Bonus points for making filter signal better than the typical output
- Bonus points for doing it as early as possible

## TASK II

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### AIM

When working with embedded systems, we are usually challenged by complex problems that requires a sound logical mind to solve. One such problem is as follows:

There is a partially constructed platform which is made of cubes. The platform can be represented by 2D array with each element representing number of cubes in respective position.

The way the platform is piled up, is given by an  $n \times m$  matrix, where each element says how many cubes are stacked upward in that position.

### Example I

A 3x3 matrix like the following

[2 . 2 . 2]

[2 . 2 . 2]

[2 . 2 . 2]

Indicates a cuboid of 3x3x2 area units, which cannot retain any amount of water (**0 units of water retained**).

### Example II

A 4x3 matrix like the following

[2 . 2 . 2 . 2]

[2 . 1 . 2 . 1]

[2 . 2 . 2 . 1]

The 1 area in the middle stores 1 unit of water. The 1 area on the sides will retain no water as the water will spill out. Hence this structure will hold **1 unit** of water

### Example III

A 4x3 matrix like the following

[5 . 5 . 5 . 3 . 3 . 3]

[3 . 1 . 5 . 1 . 1 . 3]

[3 . 1 . 1 . 1 . 1 . 3]

[3 . 3 . 3 . 1 . 3 . 3]

The matrix wouldn't contain any units of water, as the water would drain out from the 4th row, 5th column '1'. Hence the structure will hold **0 units** of water.

### Example IV

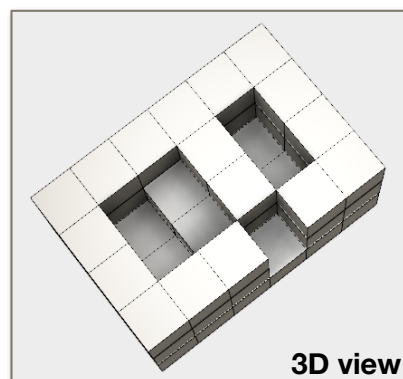
A 4x6 matrix like the following

[3 . 3 . 3 . 3 . 3 . 3]

[3 . 1 . 2 . 3 . 1 . 3]

[3 . 1 . 2 . 3 . 1 . 3]

[3 . 3 . 3 . 1 . 3 . 3]



This matrix will retain **10 units** of water.

You have to write a function for calculating the quantity of water which will be stored in that construction if we pour unlimited supply of water on top of it.

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## DELIVERABLE

Complete the function below, so that it returns the amount of water stored within it.

**unsigned int WaterStoredInPlatform(unsigned int \*\*platform, unsigned int rows, unsigned int columns)**

```
{  
    // rows = Number of rows in that platform ('n' of the matrix)  
    // columns = Number of columns in that platform ('m' of the matrix)  
    // unsigned int platform[n][m] is your 2d array passed into this function by reference  
  
    //write your code inside this function  
}
```

Save this function in a C file called (function.c)

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- You can reach out to [deljohn@avantari.org](mailto:deljohn@avantari.org) regarding any C/C++ language related issues
- **DON'T** take assistance from someone else in answering the logical part of the question