Test Model-Exam-Percom-2020

Test instruction

This is a digital exam.

No printed material or electronic devices are admitted for use during the exam.

The answers must be given in English.

Both practical (PRAC) and exam (EXAM) are graded on an 1 to 10 scale.

The exam grade is calculated as (Q1+Q2+...+Q5+10)/10.

The final grade is calculated as 0.5*PRAC + 0.5*EXAM.

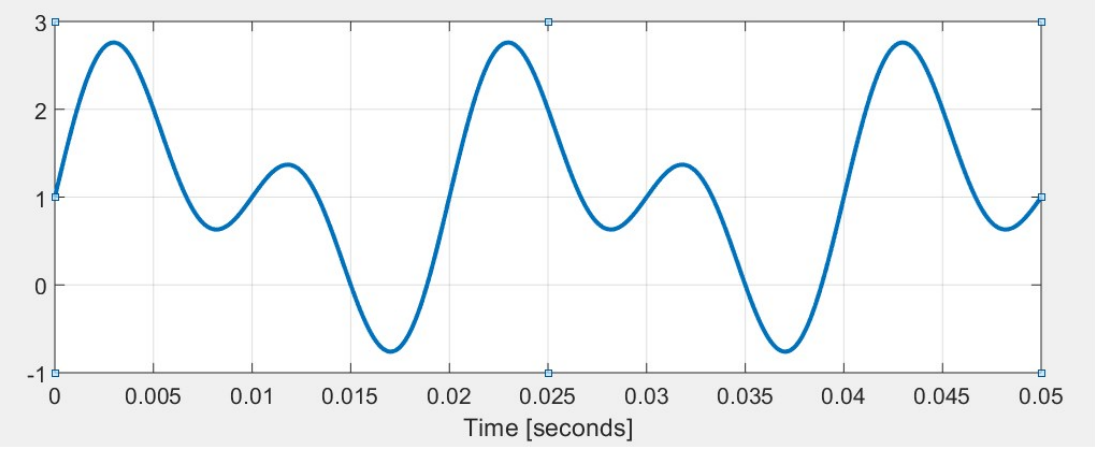
A pass will be granted only when both practical and exam components are >= 5.5.

Q1. Signals

Question order: Fixed

Question 1 – Signals–2–a – 207216.4.0

For the following signal plotted in time, which statement is true? [5p]



A This is a plot of 2.5 periods from a signal with the frequency 0.05 Hz and DC component =0.

B This is a plot of 1 period from a signal with the frequency 0.15 Hz and DC component =1.

C This is a plot of 2.5 periods from a signal with the frequency of 50 Hz and DC component =0.

D This is a plot of 2.5 periods of a signal with the period of 50 Hz and DC component =1.

Question 2 – Signals–2–b – 207217.3.0

Suggest a reasonable sampling frequency for a sinusoidal signal with the frequency f. [5p]

A Shannon theorem says to use as many samples as possible, so we choose 100 f.

B Shannon theorem says a maximum of 2 f, so a reasonable frequency can be 1,5 f.

C Shannon theorem says that a minimum sampling frequency should be 2 f, but for a good reconstruction we suggest 10 f.

D Shannon theorem does not specify any constraints for sampling, so we can choose 10 f.

Question 3 – Signals–2–c – 207224.4.1

We record 5 periods of a signal that has a frequency of 10 Hz. The sampling frequency is 1000 Hz. How many samples do we eventually obtain? [5p]

A 1000 x 5 = 5000 samples

B 1000 x 0.1 = 100 samples

C 5 x 0.1 x 1000 = 500 samples

D 5 x 10 x 1000 = 50 000 samples

Question 4 – Signals–2–d – 207226.4.1

Which of the following statements is correct ? [5p]

A A too high sampling frequency will improve the quality of the reconstructed signal, but it will generate a large number of samples.

B A too high sampling frequency will create aliasing, which improves the quality of the reconstructed signal.

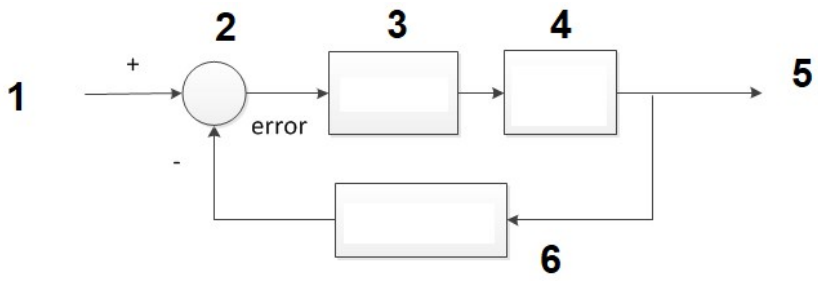
C A too high sampling frequency is always good.

Q2. Control

Question order: Fixed

Question 5 – Control–2–a – 207246.3.1

The goal of a cruise-control system is to maintain the vehicle's speed at a certain preset value without the driver intervention. Below you can see the feedback control diagram for this system. Fill in the correct names of its components. [5p]



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Question 6 – Control–2–b – 207249.3.0

What is a LIDAR? What does it measure, how does it work and where is it used?

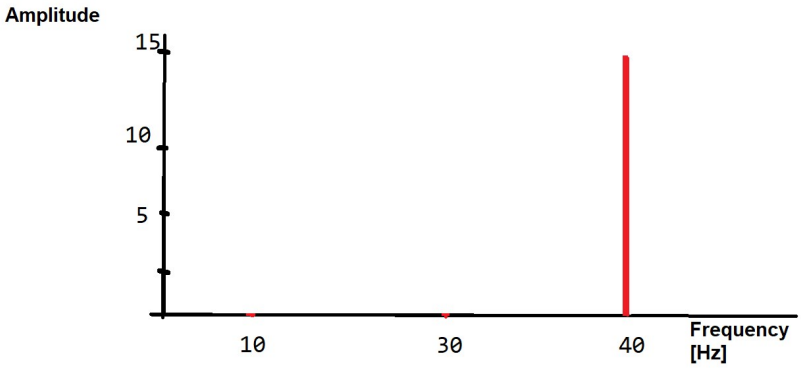
Q3. Processing

Question order: Random

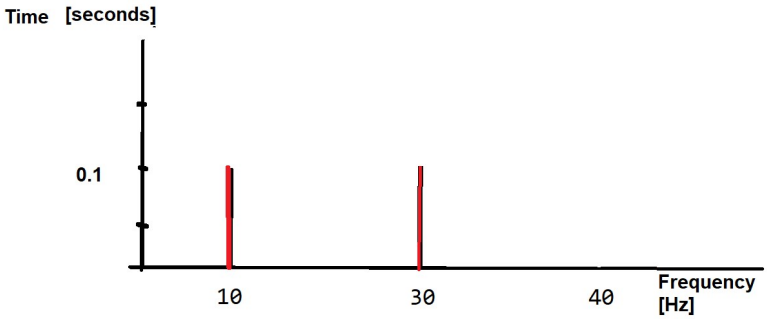
Question 7 – Processing–2–a – 207566.2.2

We performed FFT on a signal consisting of the sum of two sinusoidal signals, of frequency 10Hz and 30Hz, and amplitudes of 5V and 10V respectively, all of a duration of 0.1 second. Which figure below represents correctly the signal's frequency spectrum? [5p]

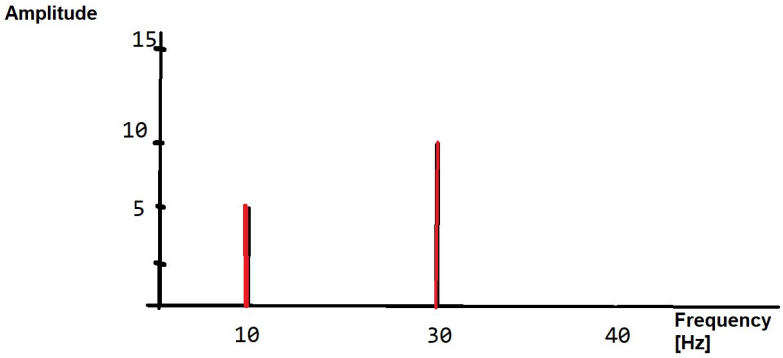
A



B



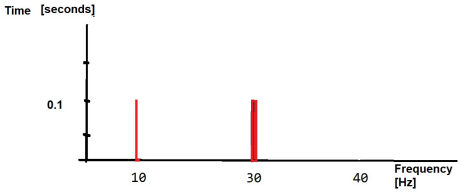
C



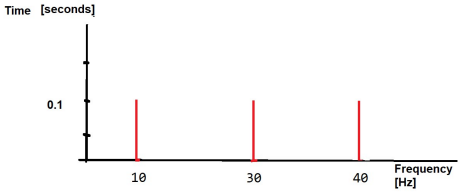
Question 8 – Processing–2–b – 207689.3.1

We built a spectrogram for the sum of two sinusoidal signals of frequency 10Hz and 30Hz, and amplitudes of 5V and 10V respectively, all of a duration of 0.1 second. Which figure correctly represents this spectrogram? [5p]

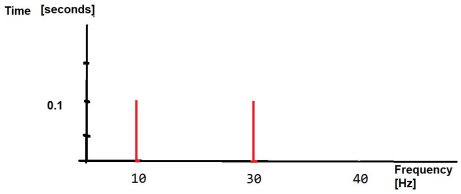
A



B

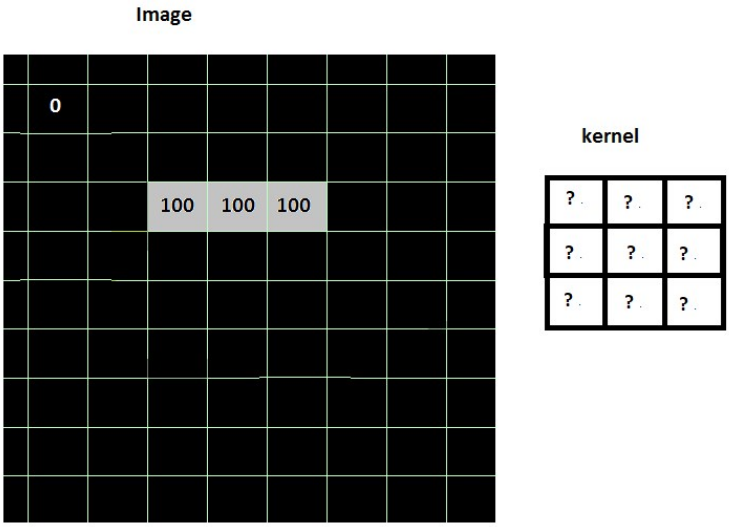


C



Question 9 – Processing–2–c – 207690.4.2

Given the image below, we want to shift it one pixel to the right, by applying a convolution (correlation) operation with a 3x3 kernel. Design a suitable kernel that will do the job. [5p]



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Question 10 – Processing–2–d – 207779.3.0

Regarding mean and median filters for images, which of the following statement is correct? [5p]

A They both do the same thing.

B Mean filter calculates the average of the colours of the neighbours including the pixel itself. Median filter is ordering all the pixels by colour and takes the middle value.

C Mean filter is ordering all the pixels by colour and takes the middle value. Median filter calculates the average of the colours of the neighbours including the pixel itself.

Q4. Classification

Question order: Random

Question 11 – Classification–2–a – 207781.2.0

Imagine we want to control a wheelchair using speech. Can you suggest a method to solve the recognition problem? Enumerate the steps you need to take, specify which kind of classifier are you going to use and which features. What are the advantages and disadvantages of your approach ? [10p]

Question 12 – Classification–2–b – 207795.2.1

What are Hidden Markov Models (HMM) and where can we use them in pervasive computing? [5p]

A HMM are a graphical language used to model the requirements of a pervasive computing system. They contain hidden information for the user that only programmers can see.

B These are graphical probabilistic reasoning algorithms that can be used for example for classification. They contain hidden states and observable states connected with edges. Each transition from on estate into another has a certain probability. The challenge is to infer the hidden states knowing the visible observable states.

Question 13 – Classification–2–c – 207786.2.0

Show a "good" confusion matrix for a (red-yellow-green) traffic light recognition system used in a smart car, tested on 10 000 traffic lights.[5p]

A

True class	RED	YELLOW	GREEN	SOMETHING ELSE	Total
Red	296	2	1	1	300
Yellow	1	296	2	1	300
Green	0	1	298	1	300
Something else	1	1	1	97	100

B

True class	RED	YELLOW	GREEN	SOMETHING ELSE	Total
Red	300	0	0	0	300
Yellow	300	0	0	0	300
Green	300	0	0	0	300
Something else	100	0	0	0	100

Q5. Systems

Question order: Random

Question 14 – Systems–2–a – 207801.3.1

Imagine you have to build an automatic insulin pump, a wearable device that keeps the blood glucose concentration BGC of a diabetes patient in a healthy range of 4-5.5 mmol/L. Insulin is injected any time the BCG is higher than this range. A BCG lower than this range can be fatal for the patient. The system stores in a log file all the insulin quantities that have been injected.

Identify 5 stakeholders for this system and formulate one functional and one non-functional requirement. [5p]

Question 15 – Systems–2–b – 207798.3.0

Imagine you have to build an automatic insulin pump, a wearable device that keeps the blood glucose concentration BGC of a diabetes patient in a healthy range of 4-5.5 mmol/L. Insulin is injected any time the BCG is higher than this range. A BCG lower than this range can be fatal for the patient. The system stores in a log file all the insulin quantities that have been injected.

Identify one accident and for that accident identify one hazard, its possible causal scenario and specify a measure to prevent the hazard from happening. Identify one ethical question related to this system. [10p]

Question 16 – Systems–2–c – 207856.2.0

Imagine you have to build an automatic insulin pump, a wearable device that keeps the blood glucose concentration BGC of a diabetes patient in a healthy range of 4-5.5 mmol/L. Insulin is injected any time the BCG is higher than this range. A BCG lower than this range can be fatal for the patient. The system stores in a log file all the insulin quantities that have been injected.

Generate a set of test cases using Boundary Value Analysis to test the functionality of the system. [5p]