Vrije Universiteit, Department of Computer Science

Examination paper for **Pervasive Computing**

19th of December 2013, 8:45

This is a closed book written exam.

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

The answers may be given in English or Dutch.

Both practical work and exam are compulsory and graded on an 1 to 10 scale.

The exam grade is calculated as (Q1+Q2+...+Q6+10)/10.

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

A pass is given only if both practical work and exam components are >= 5.5.

	Q1	Q2	Q3	Q4	Q5	Q6	ΣQi	Maximum credits= (ΣQi+10)/10
a)	4	3	3	4	8	3		
b)	2	4	5	4	8	3		
c)	4	5		3	6	4		
d)				3	8			
e)				6				
Total	10	12	8	20	30	10	90	10

Good luck!

Q1. Systems [10p]

Take as an example a computerized system that reminds hypertensive patients to take the medication at the prescribed time and dose.

a) Enumerate the three properties of pervasive computing systems and show how these properties are manifested in this system. [4p]

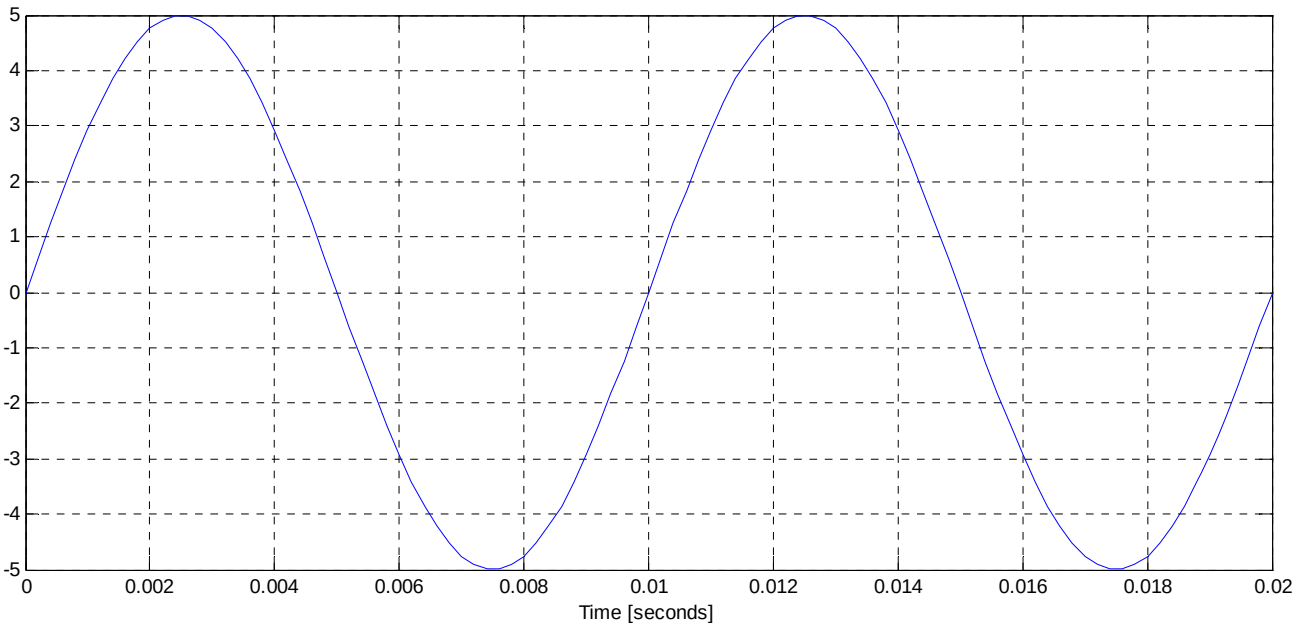
b) Formulate an ethical question related to this system. [2p]

c) Identify one hazard and show how to estimate its risk. [4p]

Q2. Signals [12p]

a) What is a typical value for the color resolution of an RGB color image? a grayscale image? a black and white image? [3p]

Given the sinusoidal signal plotted below in time domain:



b) What is its amplitude? Its phase? Its period? Its frequency? [4p]

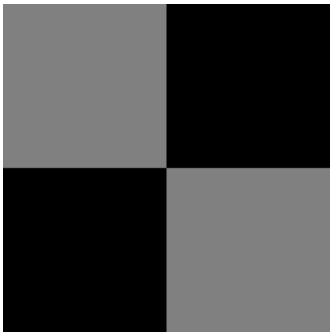
c) What would be a reasonable sampling frequency? Justify your answer. How many samples will you then obtain? [5p]

Q3. Control [8p]

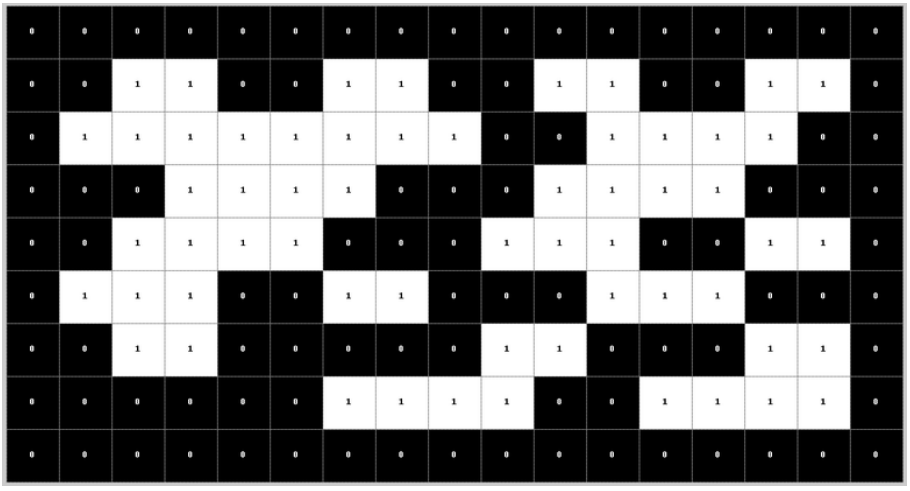
a) What is a sonar? What does it measure and how? [3p]
b) Write in pseudocode a feedback closed-loop controller for a robot equipped with a sonar that has to follow a wall. Make also a drawing where you show the robot with the sonar and the wall. [5p]

Q4. Image & sound processing [20p]

a) Define the image histogram concept and sketch the histogram for the 200x200 grayscale image shown below. [4p]



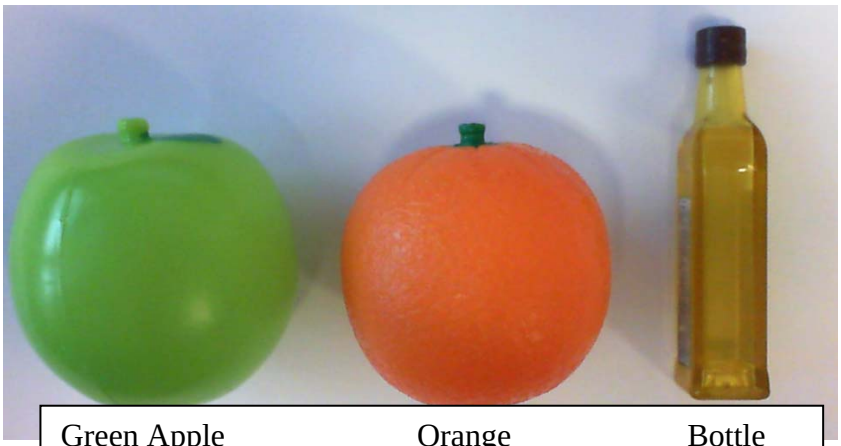
b) Define the concept of BLOB in image processing and count the number of BLOBs using 4-connectivity in the image below. [4p]



c) What is the frequency spectrum of an uni-dimensional signal? Describe the procedure to obtain it. [3p]
d) What is a spectrogram? How is it built? [3p]
e) We play a pure sound of 200Hz for 0.1 seconds, followed by a pure 400Hz sound, played with half of the previous volume, for another 0.1 seconds. We record this " song" with a sampling frequency of 8000Hz and we apply spectral analysis. Sketch the obtained frequency spectrum and spectrogram. [6p]

Q5. Classification [30p]

a) Explain the classification problem and solve it for the situation below using a rule-based classifier. [8p]



Green Apple Orange Bottle

b) What is a perceptron? Can a perceptron classify? If yes, then how? If not, then why? [8p]
c) What is a confusion matrix? Describe the ideal confusion matrix. [6p]
d) Explain how Naïve Bayes classifier works for two classes. [8p]

Q6. Guests [10p]

a) What features are frequently used to discriminate between spoken vowels? [3p]
b) What is motor imagery ? Give an example of a pervasive computing application that can use it. [3p]
c) What are HMM and how they can be used for activity recognition? [4p]