2005 Paper 8 Question 11

Computer Vision

(*a*) Consider the *eigenface* algorithm for face recognition in computer vision.

   (*i*) What is the rôle of the database population of example faces upon which this algorithm depends? [3 marks]

   (*ii*) What are the features that the algorithm extracts, and how does it compute them? How is any given face represented in terms of the existing population of faces? [4 marks]

   (*iii*) What are the strengths and the weaknesses of this type of representation for human faces? What invariances, if any, does this algorithm capture over the factors of perspective angle (or pose), illumination geometry, and facial expression? [4 marks]

   (*iv*) Describe the relative computational complexity of this algorithm, its ability to learn over time, and its typical performance in face recognition trials. [3 marks]

(*b*) In a visual inference problem, we have some data set of observed features x, and we have a set of object classes $\{C_k\}$ about which we have some prior knowledge. Bayesian pattern classification asserts that:

$$P(C_k|x) = \frac{P(x|C_k)P(C_k)}{P(x)}$$

Explain the meaning of, and give the name for, each of these three terms:

$P(C_k|x)$
$P(x|C_k)$
$P(C_k)$ [3 marks]

(*c*) Define the concept of *reflectance map* $\phi(i, e, g)$ and define the three variables i, e, and g on which it depends. [3 marks]