

2002 Paper 9 Question 13

Computer Vision

- (a) Consider the “eigenfaces” approach to face recognition in computer vision.
- (i) What is the rôle of the database population of example faces upon which this algorithm depends? [4 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. [4 marks]
- (b) What is the following block of code doing over the image array `image[i][j]` as it computes the resulting new image array `result[i][j]` ? Give the appropriate mathematical name for this operation, and describe what it accomplishes. What are some computer vision tasks that might use this block of four nested `for` loops?

```
for (i = 0; i < iend; i++) {
    for (j = 0; j < jend; j++) {
        sum = 0;
        for (m = 0; m < mend; m++) {
            for (n = 0; n < nend; n++) {
                sum += kernel[m][n] * image[i-m][j-n];
            }
        }
        result[i][j] = sum/(mend*nend);
    }
}
```

[4 marks]