

## HCI/ComS 575X: Computational Perception

### Homework 2

Out: Mon. Jan 30, 2006

Due: Mon. Feb 13, 2006

Submission format: post code and images on your section of the class wiki page. Templates will be provided.

#### 1. Basic Mathematical Morphology

(A) In this problem you are asked to replicate one of the results given in the “Mathematical Morphology” paper by Haralick and Shapiro (i.e., Chapter 5 in “Computer and Robot Vision”, Addison-Wesley, 1993). Using the morphological operators provided by matlab write a short program that reads the image of the pendulum and separates it into its two basic components: disk and handle. Post your matlab code, your original image and your two resulting images on the wiki page. The original grayscale image will be provided along with the submission templates.

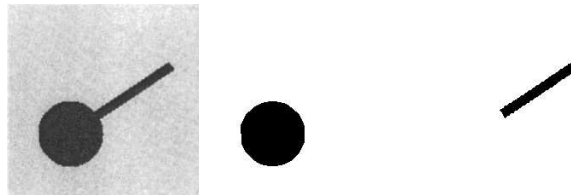


Figure 1: **Left:** original Image; **Center:** segmented disk; **Right:** segmented handle.

(B) Now do the same but this time use openCV to perform the segmentation. Post your C code, your original image and your two resulting images on the wiki page.

## 2. More Morphology

In this problem you are asked to replicate another result given in the “Mathematical Morphology” paper by Haralick and Shapiro (i.e., Chapter 5 in “Computer and Robot Vision”, Addison-Wesley, 1993). The goal is to start with the original image of the chip and to identify the positions of its 14 pins. The figure below shows some of the partial results which we were able to obtain using openCV (i.e., we know for sure that this problem is doable even though we started with the scanned image of the chip and not with the original image used by Haralick and Shapiro which we don’t have).

For this problem you can choose your platform: matlab or openCV. If you want to use the open source package octave feel free to do so, but most likely you will be on your own if you run into problems.

Once again, post your code and all intermediary images on the wiki page.

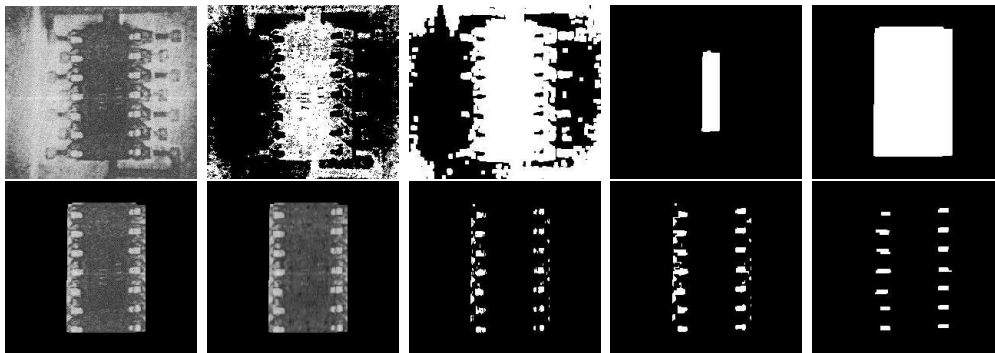


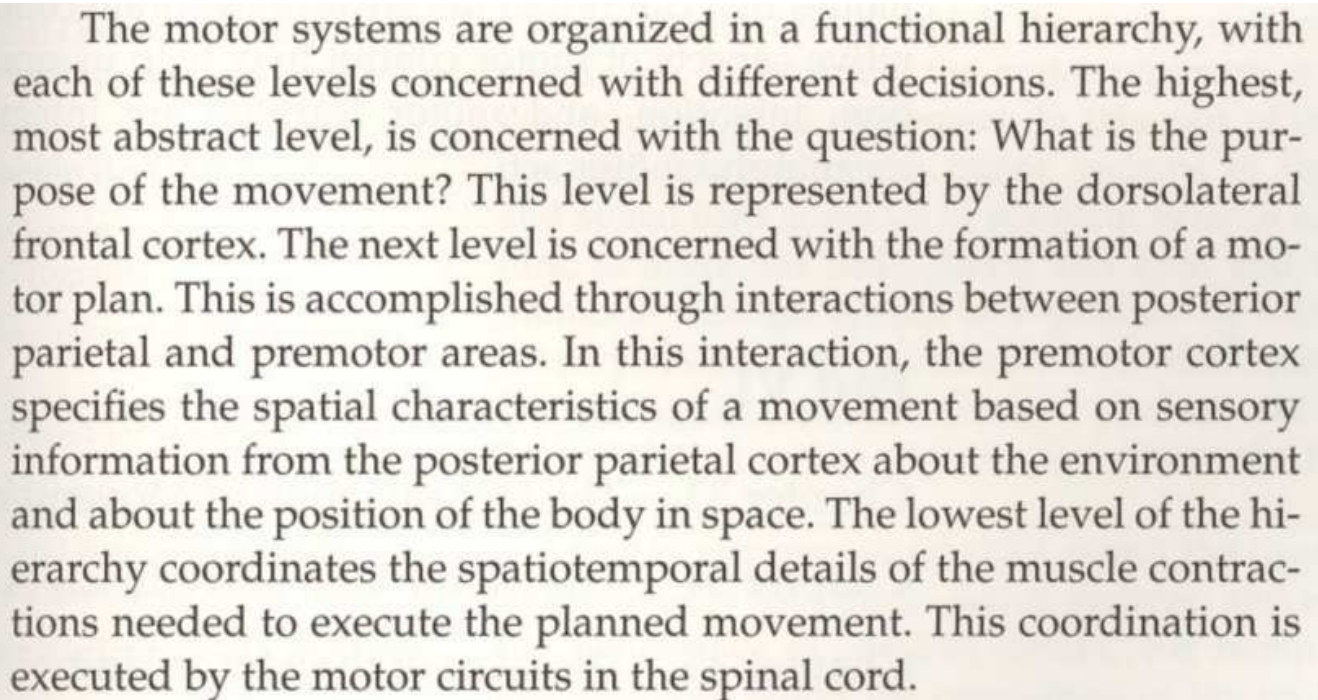
Figure 2: Segmenting the 14 pins of the chip. For more details see Chapter 5 in Haralick and Shapiro’s book.

### 3. Optical Character Recognition (OCR)

For this problem you are asked write a program that can find all occurrences of the letter 'e' in the scanned text shown below. Figure 4 shows a sample result which we were able to obtain using matlab.

You can use this text as a training sample (the scanned image will be provided on the wiki page) but try not to overfit your program to that image only. Your code will be evaluated with an image of another paragraph from the same book which will have the same font and font size but the text will be totally different.

Once gain, you can choose your favorite platform: matlab or openCV. Submit your code and any intermediary images on your wiki page.



The motor systems are organized in a functional hierarchy, with each of these levels concerned with different decisions. The highest, most abstract level, is concerned with the question: What is the purpose of the movement? This level is represented by the dorsolateral frontal cortex. The next level is concerned with the formation of a motor plan. This is accomplished through interactions between posterior parietal and premotor areas. In this interaction, the premotor cortex specifies the spatial characteristics of a movement based on sensory information from the posterior parietal cortex about the environment and about the position of the body in space. The lowest level of the hierarchy coordinates the spatiotemporal details of the muscle contractions needed to execute the planned movement. This coordination is executed by the motor circuits in the spinal cord.

Figure 3: Original text that will be your training set. This paragraph is from the following book: “Principles of Neural Science”, by Kandel, Schwartz and Jessel; Published by McGraw Hill, NY; p. 651, 2000.

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Figure 4: Sample result with all occurrences of the letter 'e' highlighted in red.

#### 4. Optical Character Recognition (Part II)

Modify the code that you wrote for the previous problem to handle all vowels of the English alphabet. In other words, find all occurrences of the letters 'a', 'e', 'i', 'o', 'u'. In the resulting image color each vowel with a different color.

#### 5. EXTRA CREDIT: Optical Character Recognition (Part III)

Modify your code from the previous two problems to locate all vowels in a text that can have arbitrary orientation. Here is a sample image that you can use (the original will be posted on the wiki page):

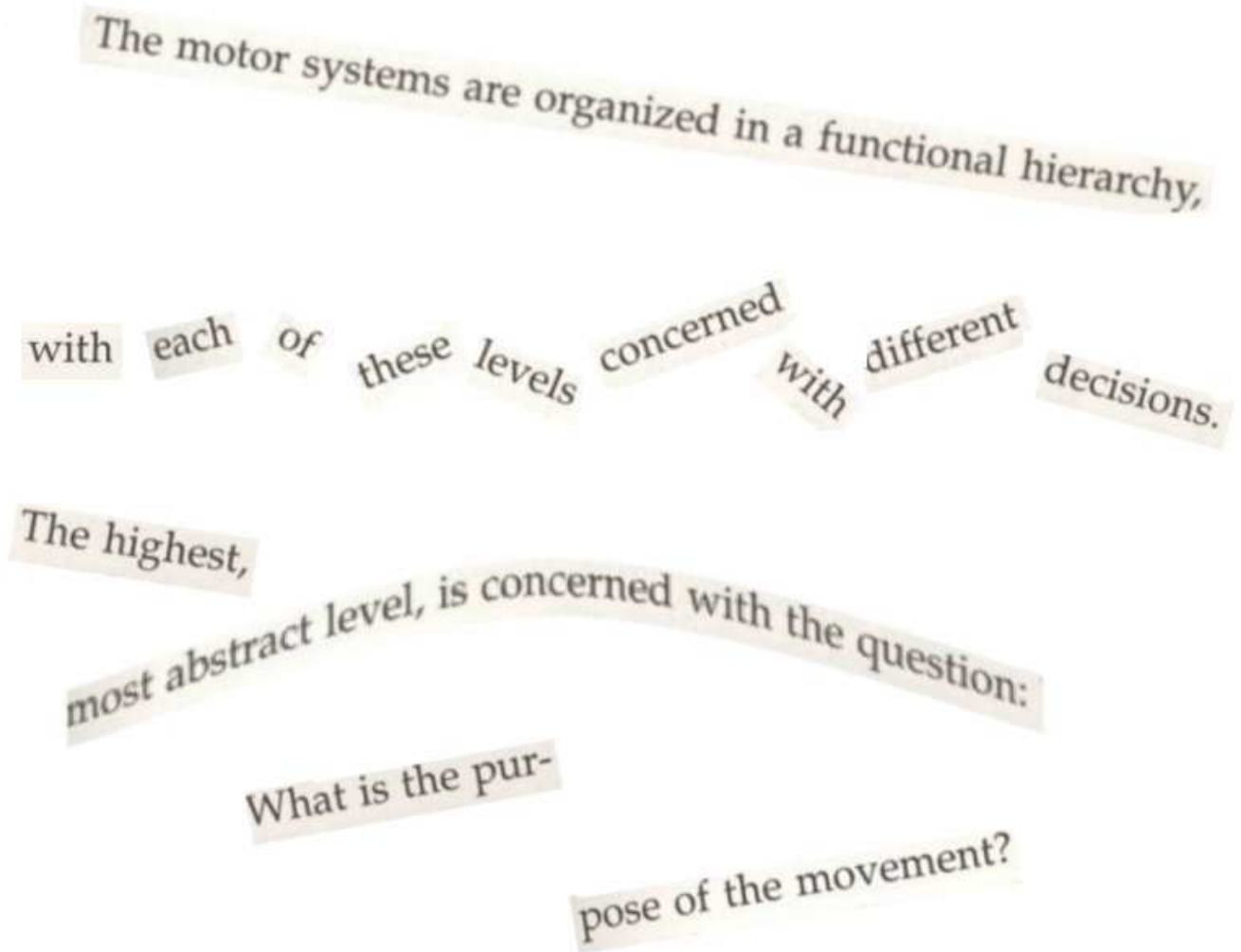


Figure 5: Skewed text. Can your program find all vowels in this image?