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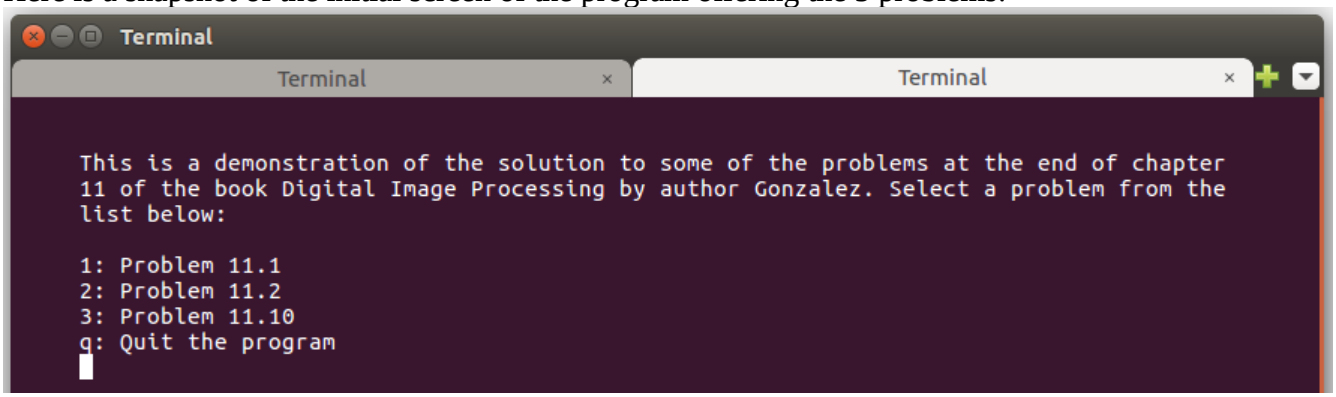
Solutions to 5 of the problems at the end of chapter 11 of the book Digital Image Processing, Second Edition, by Rafael C. Gonzalez and Richard E. Woods. The accompanying source code uses libncurses to display a text mode menu through which the user can select the solution to which problem to view. The complete source code for the program can be downloaded from the repository at https://github.com/misoboute/dip-repr-desc.
Here is a snapshot of the initial screen of the program offering the 5 problems:



Excerpts of the the original book showing each individual problem along with an explanatory solution to each will follow:

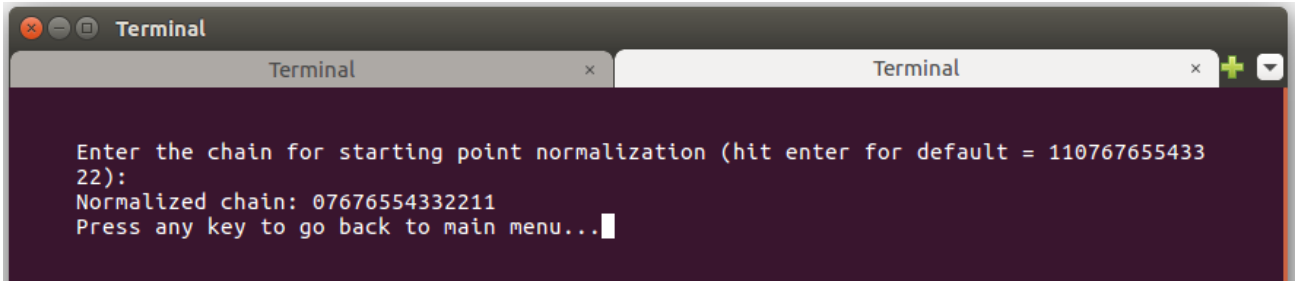
11.1 ★ (a) Show that redefining the starting point of a chain code so that the resulting sequence of numbers forms an integer of minimum magnitude makes the code independent of the initial starting point on the boundary.

(b) Find the normalized starting point of the code 11076765543322.

Solution:

a) The key to this problem is to recognize that the value of every element in a chain code is relative to the value of its predecessor. The code for a boundary that is traced in a consistent manner (e.g., clockwise) is a unique circular set of numbers. Starting at different locations in this set does not change the structure of the circular sequence. Selecting the smallest integer as the starting point simply identifies the same point in the sequence. Even if the starting point is not unique, this method would still give a unique sequence. For example, the sequence 101010 has three possible starting points, but they all yield the same smallest integer 010101.

b) The normalized chain point was computed by the accompanying computed program. Here is a snapshot of the program giving the solution 07676554332211



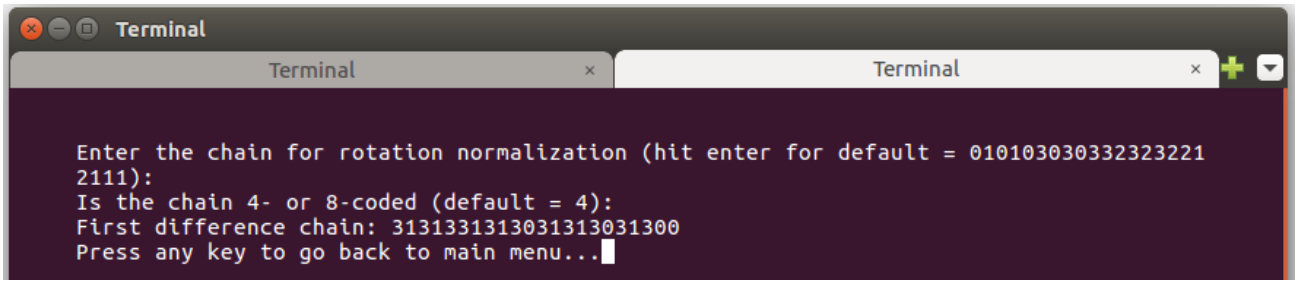
11.2 **(a)** Show that the first difference of a chain code normalizes it to rotation, as explained in Section 11.1.1.

(b) Compute the first difference of the code 0101030303323232212111.

Solution:

a) The first difference only counts the number of directions that separate adjacent elements of the code. Since the counting process is independent of direction, the first is independent of boundary rotation.

b) The first difference code for the 4-coded chain 0101030303323232212111 was computed by the accompanying computed program as 3131331313031313031300. Here is a snapshot of the program showing the answer.



11.4 ★ **(a)** Discuss the effect on the resulting polygon if the error threshold is set to zero in the merging method discussed in Section 11.1.2.

(b) What would be the effect on the splitting method?

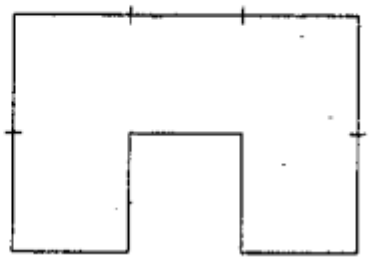
Solution:

a) The resulting polygon would contain all the boundary pixels.

b) Actually, in both cases the resulting polygon would contain all the boundary pixels.

11.10 ★ **(a)** What is the order of the shape number for the figure shown?

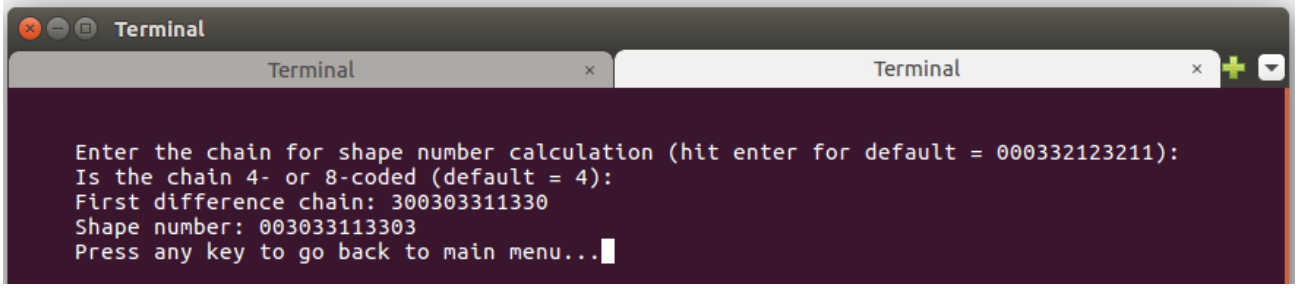
(b) Obtain the shape number.



Solution:

a) The number of symbols in the first difference is equal to the number of segment primitives in the boundary, so the shape order is 12.

b) Starting at the top left corner, the chain turns out to be 000332123211. Feeding this to the accompanying program, the first difference and the shape number are calculated as 300303311330 and 003033113303. Here is a snapshot of the program showing the answer.



11.11 The procedure discussed in Section 11.2.3 for using Fourier descriptors consists of expressing the coordinates of a contour as complex numbers, taking the DFT of these numbers, and keeping only a few components of the DFT as descriptors of the boundary shape. The inverse DFT is then an approximation to the original contour. What class of contour shapes would have a DFT consisting of real numbers and how would the axis system in Fig. 11.13 have to be set up to obtain these real numbers?

Solution:

With reference to the discussion in Section 4.6.1, the DFT can be real only if the data sequence is conjugate symmetric. Only contours that are symmetric with respect to the origin have this property. The axis system of Fig. 11.13 would have to be set up so that this condition is satisfied for symmetric figures. This can be accomplished by placing the origin at the center of gravity of the contour.

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