

Solutions to Optional Homework (Lecture 14)

Problem 11.4

(a) The first difference only counts the number of directions that separate adjacent elements of the code. Because the counting process is independent of direction, the first difference is independent of boundary rotation. (It is worthwhile to point out to students that the assumption here is that rotation does not change the code itself).

(b) Code: 0101030303323232212111. Difference: 3131331313031313031300. The code was treated as a circular sequence, so the first element of the difference is the transition between the last and first element of the code, as explained in the text.

Problem 11.10

(a) The rubber-band approach forces the polygon to have vertices at every inflection of the inner and outer walls that surround the gray cell wall illustrated in Fig. 11.7. Because the vertices are joined by straight lines, and the resulting curve is convex, this produces the minimum-perimeter polygon for any given wall configuration, as defined in the discussion in the Section 11.2

Problem 11.13

(a) From Fig. P11.13(a), we see that the distance from the origin to the triangle is given by

$$\begin{aligned}
 r(\theta) &= \frac{D_0}{\cos \theta} & 0^\circ \leq \theta < 60^\circ \\
 &= \frac{D_0}{\cos(120^\circ - \theta)} & 60^\circ \leq \theta < 120^\circ \\
 &= \frac{D_0}{\cos(180^\circ - \theta)} & 120^\circ \leq \theta < 180^\circ \\
 &= \frac{D_0}{\cos(240^\circ - \theta)} & 180^\circ \leq \theta < 240^\circ \\
 &= \frac{D_0}{\cos(300^\circ - \theta)} & 240^\circ \leq \theta < 300^\circ \\
 &= \frac{D_0}{\cos(360^\circ - \theta)} & 300^\circ \leq \theta < 360^\circ
 \end{aligned}$$

where D_0 is the perpendicular distance from the origin to one of the sides of the triangle, and $D = D_0 / \cos(60^\circ) = 2D_0$. Once the coordinates of the vertices of the triangle are given, determining the equation of each straight line is a simple problem, and D_0 (which is the same for the three straight lines) follows from elementary geometry. The signature is shown next to the plot.

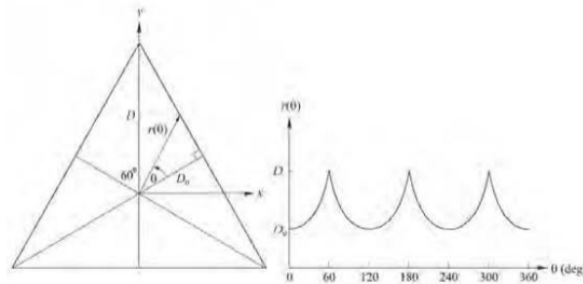


Figure P11.13(a)

Problem 11.15

(a) The answer is a single point:

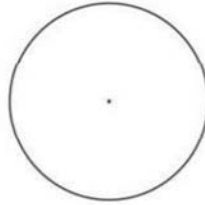


Figure P11.15(a)

(b) See Fig. P11.15(b)

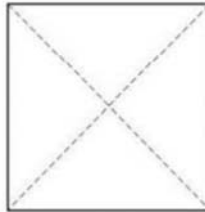


Figure P11.15(b)

Problem 11.16

(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.

Problem 11.19

The mean is sufficient.