Image Databases
(Chapter 8)

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Image Databases: Retrieval Challenge

Problem: Suppose that we have a set of human faces stored in an image database. Suppose also that we have a camera that captures the faces of people who walk by. How can we recognize that a face seen by the camera is already stored in the image database?

Why is image retrieval a challenge?: We cannot expect that the image captured by the camera will exactly match an image stored in the database even if the two images come from the same person. There are many reasons for the images be different, but one very important reason is that the camera angle that captured the stored image and the camera angle that captured the passerby's face may be different. (In general, security cameras are often put high up and tend to look downward to people, while normal photographs are shot straight from the front with the same height as the head of the person.)

Affine Invariance

If we capture two images A and B of a flat object using two different camera angles, then A and B are affine invariant images.

Example: Two images of a bird that are affine invariant of each other.
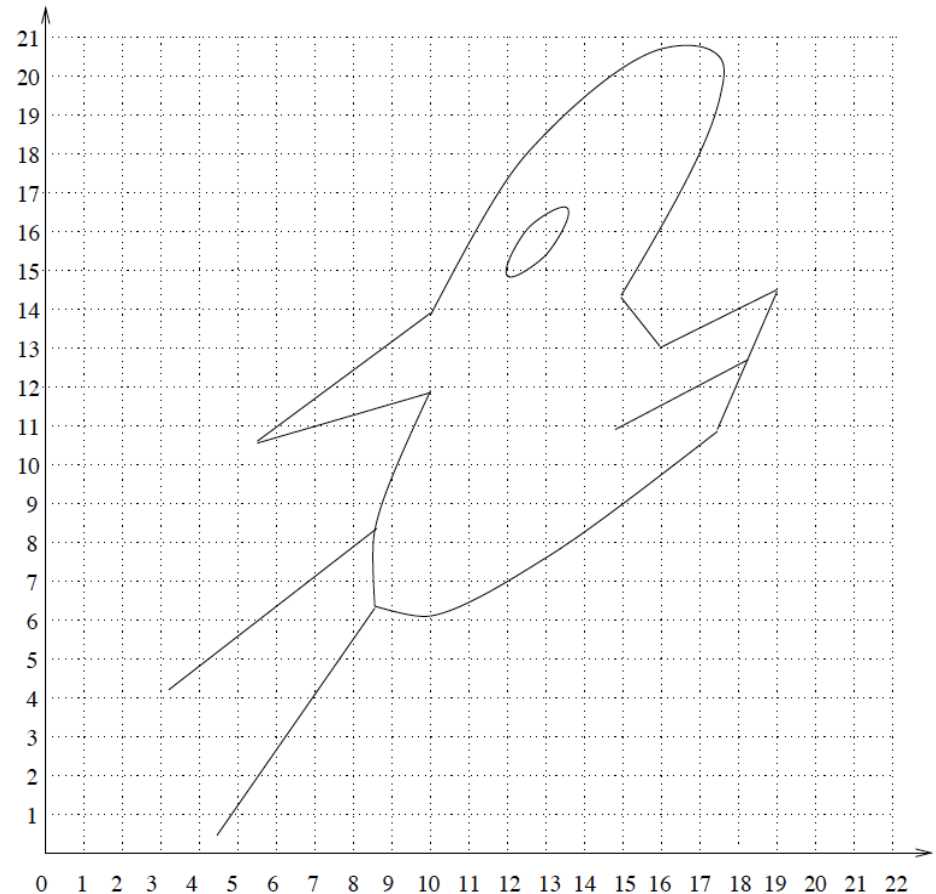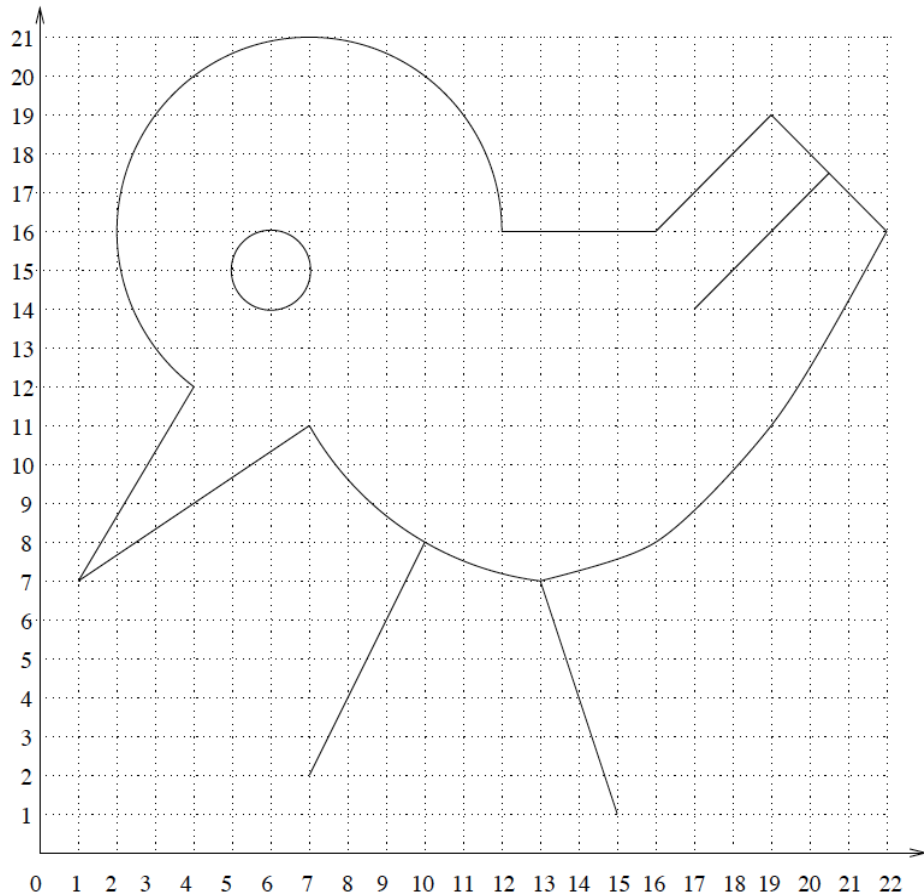
Affine Invariance

Definition: Two images A(x,y) and B(x,y) are affine invariant if the following holds:

$$\exists a,b,c,d,e,f \quad ad \neq bc \quad \forall x,y \quad A(x,y) \leftrightarrow B(ax+by+e, cx+dy+f)$$

Example 8.1.1 The two images of a bird shown in Figures 8.1 are affine transformations of each other because we can choose the following values in the formula:

$$a = \frac{1}{4}, \; b = \frac{3}{4}, \; c = \frac{6}{7}, \; d = \frac{-5}{14}, \; e = 0, \; f = 5$$

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Affine invariance has the following property:

Lemma 8.1.1 Let A and B be areas that are affine transformations of each other. Then the following holds:

$$Area(B) = |ad - bc|\ Area(A)$$

Exercise: Represent the bird as a constraint database Bird(x, y) and apply the affine invariant transformation to find another representation Bird2(x,y).

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