A.

24.4 Edges in an image can correspond to a variety of events in a scene. Consider Figure 24.4 (page 933), and assume that it is a picture of a real three-dimensional scene. Identify ten different brightness edges in the image, and for each, state whether it corresponds to a discontinuity in (a) depth, (b) surface orientation, (c) reflectance, or (d) illumination.

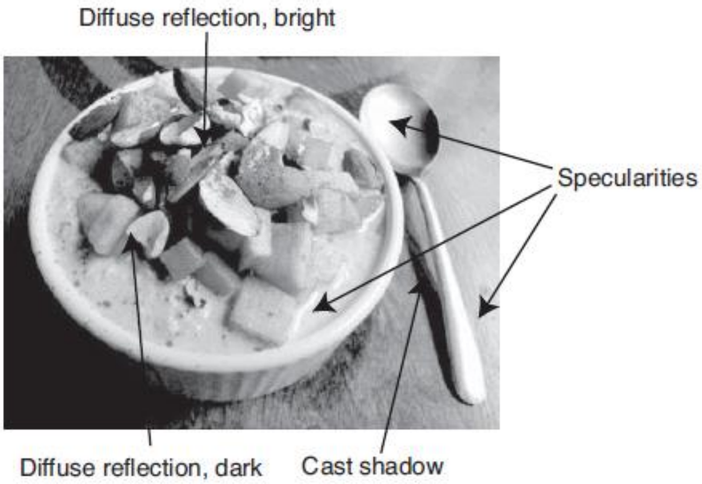


Figure 24.4 A variety of illumination effects. There are specularities on the metal spoon and on the milk. The bright diffuse surface is bright because it faces the light direction. The dark diffuse surface is dark because it is tangential to the illumination direction. The shadows appear at surface points that cannot see the light source. Photo by Mike Linksvayer (mlinksva on flickr).

a. Depth: Depth of the bowl

Width of the bowl

Height of the food

Surface Orientation

Orientation of the spoon

Orientation of the shadow

Reflectance

Spoon

Milk

Bowl

Illumination

Shadow of the food

Shadow of the spoon

Shadow of the bowl

B .

24.7 (Courtesy of Pietro Perona.) Figure 24.27 shows two cameras at X and Y observing a scene. Draw the image seen at each camera, assuming that all named points are in the same horizontal plane. What can be concluded from these two images about the relative distances of points A, B, C, D, and E from the camera baseline, and on what basis?

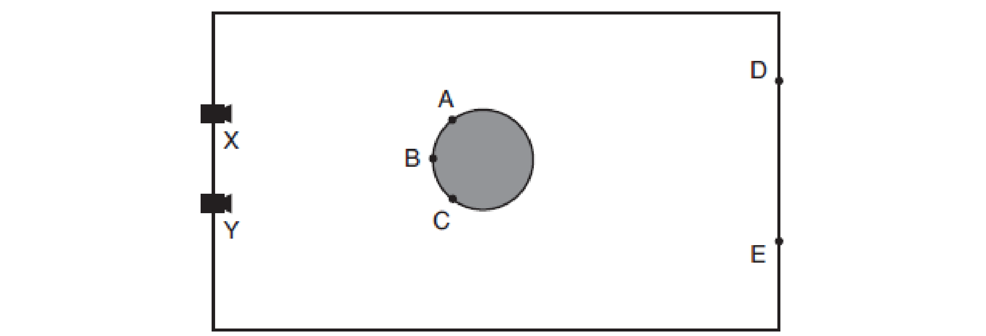


Figure 24.27 Top view of a two-camera vision system observing a bottle with a wall behind it.

A. B and C can be measured, and the observer can determine that B is the nearest, while a and C are equidistant. However, D and e cannot be observed. They may be very close to the camera, but they are outside the shooting range, so the distance cannot be determined.

C.

25.3 Consider a robot with two simple manipulators, as shown in figure 25.31. Manipulator A is a square block of side 2 which can slide back and on a rod that runs along the x-axis from x=$-$10 to x=10. Manipulator B is a square block of side 2 which can slide back and on a rod that runs along the y-axis from y=$-$10 to y=10. The rods lie outside the plane of

manipulation, so the rods do not interfere with the movement of the blocks. A configuration is then a pair $\langle x, y\rangle$ where x is the x-coordinate of the center of manipulator A and where y is the y-coordinate of the center of manipulator B. Draw the configuration space for this robot, indicating the permitted and excluded zones.

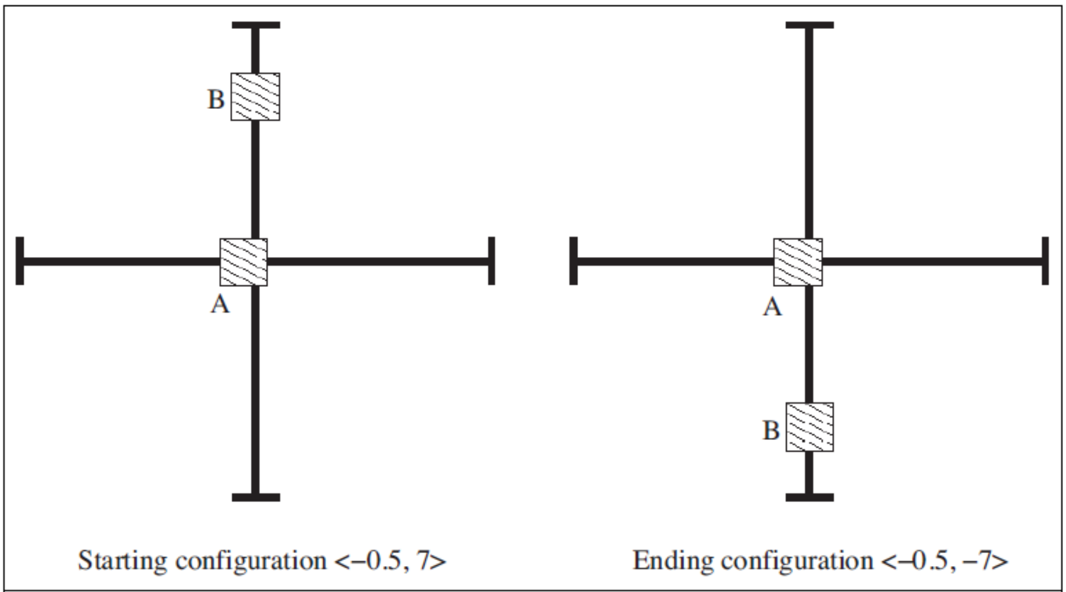
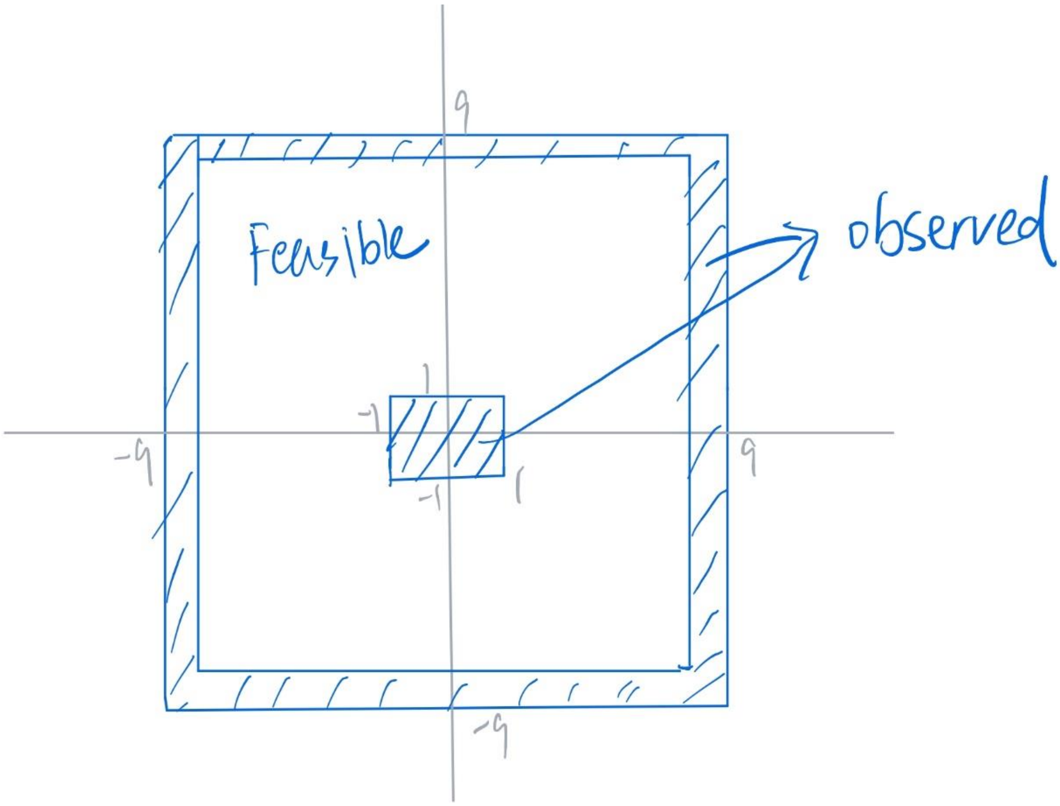


Figure 25.31 A Robot manipulator in two of its possible configurations.



D.

25.7 This exercise explores the relationship between workspace and configuration space using the examples shown in Figure 25.32.

a. Consider the robot configurations shown in Figure 25.32(a) through (c), ignoring the obstacle shown in each of the diagrams. Draw the corresponding arm configurations in configuration space. (*Hint:* Each arm configuration maps to a single point in configuration space, as illustrated in Figure 25.14(b).)

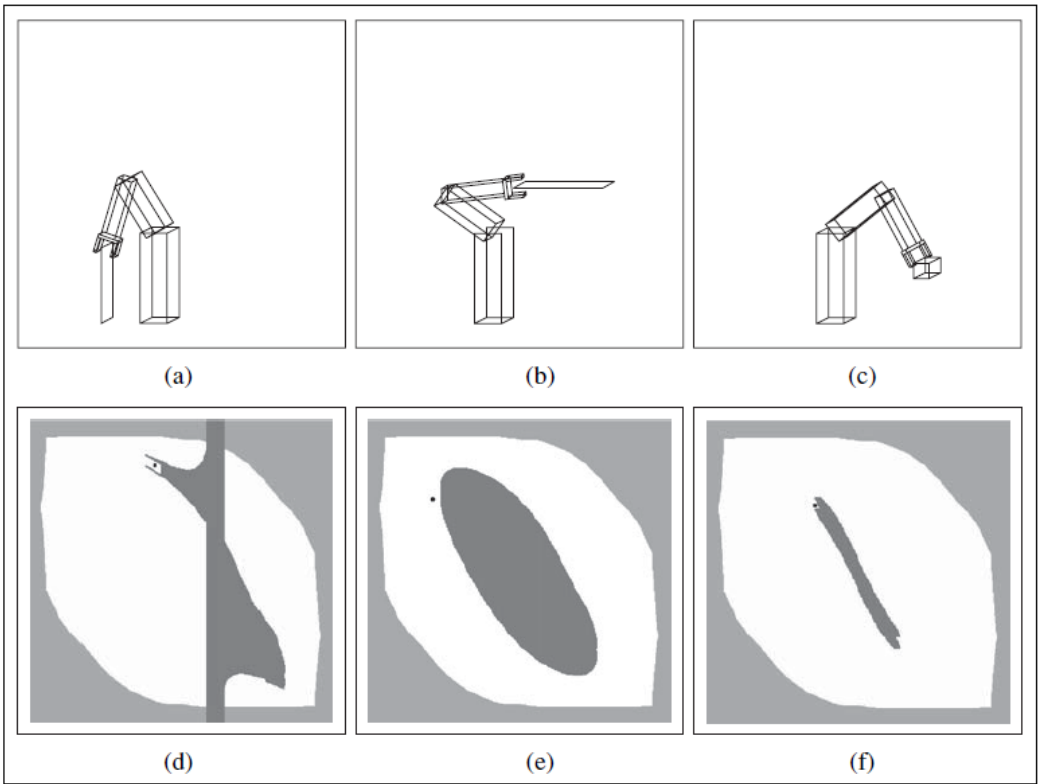
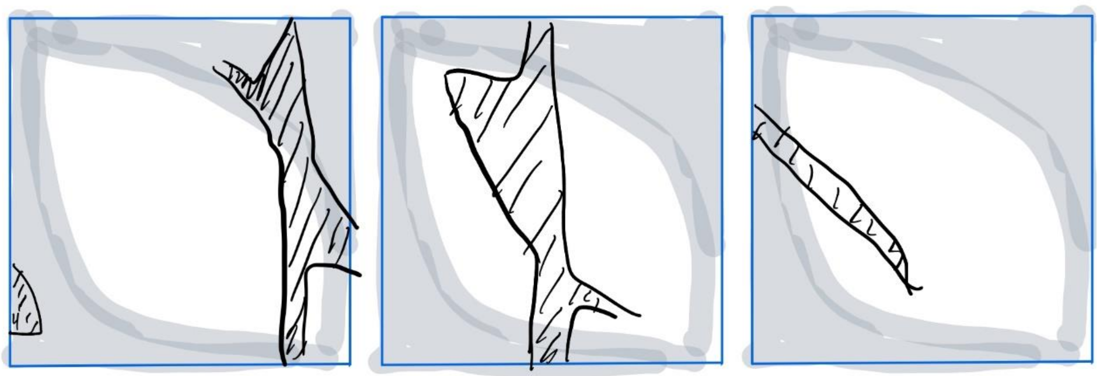


Figure 25.32 Diagrams for Exercise 25.7.



E.

25.9 Consider the simplified robot shown in Figure 25.33. Suppose the robot's Cartesian coordinates are known at all times, as are those of its goal location. However, the locations of the obstacles are unknown. The robot can sense obstacles in its immediate proximity, as illustrated in this figure. For simplicity, let us assume the robot's motion is noise-free, and the state space is discrete. Figure 25.33 is only one example; in this exercise you are required to address all possible grid worlds with a valid path from the start to the goal location.

a. Design a deliberate controller that guarantees that the robot always reaches its goal location if at all possible. The deliberate controller can memorize measurements in the form of a map that is being acquired as the robot moves. Between individual moves, it may spend arbitrary time deliberating.

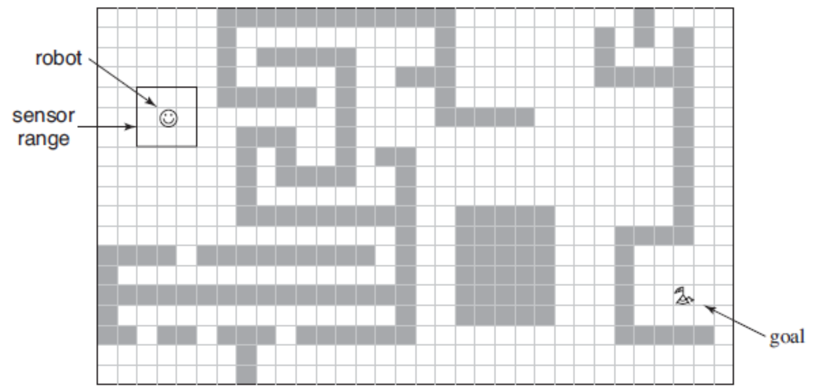


Figure 25.33 Simplified robot in a maze. See Exercise 25.9.