Important: Please do all assignments on hoare

Basic Image Operations

1. Problem 2.5 from text. A CCD camera chip of dimensions $7 \times 7$ mm, and having $1024 \times 1024$ elements, is focused on a square, flat area, located 0.5 m away. How many line pairs per mm will this camera be able to resolve? The camera is equipped with a 35 mm lens. (Hint: Model the imaging process as in Fig. 2.3, with the focal length of the camera lens substituting for the focal length of the eye.)

2. Problem 2.9 from text. A common measure of transmission for digital data is the baud rate, defined as the number of bits transmitted per second. Generally, transmission is accomplished in packets consisting of a start bit, a byte (8 bits) of information, and a stop bit. Using these facts, answer the following:

   (a) How many minutes would it take to transmit a $1024 \times 1024$ image with 256 intensity levels using a 56K baud modem?

   (b) What would the time be at 3000 K baud, a representative medium speed of a phone DSL connection?

3. Use OpenCV to create an 8-bit single-channel image of size $640 \times 480$ pixels. In this image, at random locations, place a square of size $100 \times 100$ pixels, a rectangle of size $200 \times 160$ pixels, and a circle of diameter 70 pixels. Your background should be black. For each object, the center pixel of the object will be white. Other pixels will be given a grayscale value as $0xFF - d$ where $d$ is the distance of the pixel from the center. Make sure that you crop the objects at the borders. If two objects overlap, the object being drawn later takes precedence. Call your executable objects. Make sure you display the image on screen.

What to hand in

Hand in an electronic copy of all the sources, README, Makefile(s), and results. Create your programs in a directory called username.1 where username is your login name on hoare. Once you are done with everything, remove the executables and object files, and issue the following commands:

```bash
% cd
% ~sanjiv/bin/handin cs5420 1
```