**CSC528 Assignment #1.**

**Problem 1:** CCD to Camera Transformation

Consider a perfect perspective projection camera with focal length 24 mm and a CCD array of size 16 mm × 12 mm, containing 500 × 500 pixels.

Field of View (FOV) is defined as the angle between two points at opposite edges of the image (CCD array), either horizontally or vertically. Thus there are two FOVs, one horizontal and one vertical. The FOV is twice the angle between the optical axis and one edge of the image.

1. Give a general expression for computing horizontal FOV from focal length and image width.
2. Compute the horizontal FOV and vertical FOV of the given camera.

2.a horizontal FOV 🡪 FOV = 36.87°

2.b vertical FOV 🡪 FOV = 22.5°

1. Comment on how FOV affects resolution in an image.

3. FOV does not affect resolution because it is always 500x500 in this case

**Problem 2:** Exercise 2.2 from Szelinski book (2D transform editor)

Feel free to use any existing code/libraries you wish, in whatever language you like.

See ./Problem2

Run cmd at current folder

javac DrawRect.java

java DrawRect

Recorded Video is also available

**Problem 3:** Exercises from Forsyth book

1. 2.8.1 #1

1. Circle or ellipse

1. 2.8.1 #9

2. a (as described in class) When in daytime, sunlight rays go down, and air molecules reflect some light into the eyes. It is hard to see objects behind those light sources. When sunset, less sunlight rays hit the air molecules, so less light is reflected into the eyes, so the mountains is clearer to see.

2. b The more air molecules we have, the less acceptable to assume air as vacuum. Air molecules that reflect or block light are often vaper or air pollution, extreme examples are fog or “black smoke”. In a sunny and less moist weather, we can assume air as vacuum to a certain amount of distance.

1. 3.7 #1 (Then read <https://blog.xkcd.com/2010/05/03/color-survey-results/>)

3. Red wine absorbs all other colors and only reflect red, so a lot of “brightness” are lost. What’s more, human eyes are sensitive to green, and are not quite sensitive to red. So that, with a very “dark red” color, we may tend to think it as brown or even black.

1. Chapter 6 exercises, #5 (this has little to do with CV, but is very useful to understand)

4. Every time when a cone is flipped, it is independent with any previous result, so the possibility is always 50%, any conclusions about the possibility based on previous experience is muddled reasoning.

**Problem 4:** Computer Vision Concepts

Briefly explain the following concepts

1. Perspective projection

1. a linear projection with the effect that closer objects look larger and further objects look smaller, most natural way when we see the real world.

1. Vanishing point

2. In perspective projection, 2 parallel lines looks getting closer when going further, the vanishing point is where they get together.

1. Stereopsis

3. When 2 cameras taking image of the same object from different position, the differences of images can indicate the depth of the object.

1. Optical flow

4. When the position of an object is changed between two consecutive video frames, it is optical flow.

1. Parallax

5. In a dual camera system, camera parallax means the differences between the images/videos captured by each camera. The reason is that, the 2 cameras are apart from each other, which has different view position.