

## CENG 412 – Computer Graphics

Assignment #1: Using Basic OpenGL Commands

Due : October 25<sup>th</sup>, 2013

The aspect ratio of a rectangle is an important attribute. Over the centuries, one aspect ratio has been particularly celebrated for its pleasing qualities in works of art: that of the golden rectangle. Considered the most pleasing of all rectangles, the golden rectangle is neither too narrow nor too squat. It figures in the Leonardo da Vinci's *Mona Lisa*, Salvador Dali's *Sacrament of the Last Supper* etc.

The golden rectangle is based on a fascinating quantity: the golden ratio  $\phi=1.618033\dots$ . The value  $\phi$  appears in a surprising number of places in computer graphics.

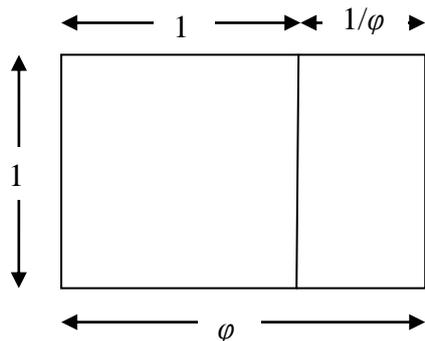
The following figure shows a golden rectangle with sides of length  $\phi$  and 1. This shape has the unique property that if a square is removed from the rectangle, the piece that remains will again be a golden rectangle. Note in the figure that a smaller rectangle has height 1, so to be golden; it must have width  $1/\phi$ . Thus,

$$\phi = 1 + \frac{1}{\phi},$$

which is easily solved to yield

$$\phi = \frac{1 + \sqrt{5}}{2} = 1.618033\dots$$

This is approximately the aspect ratio of a standard 3-by-5 index card. We see also that  $\phi - 1 = 1/\phi$ . This is the aspect ratio of a golden rectangle lying on its short end.



The idea that the golden rectangle contains a smaller version of itself suggests a form of “infinite regression” of figures within figures within figures, *ad infinitum*. The above figure demonstrates this regression. We simply keep removing squares from each remaining golden rectangle.

Write an application that draws the regression of golden rectangles centered in a screen window 600 pixels wide by 400 pixels high. (First determine where and how big the largest golden rectangle is that will fit in this window. Your picture should regress down until the smallest rectangle is about one pixel in size.)