UNIVERSITY OF MINNESOTA
Driven to Discover®

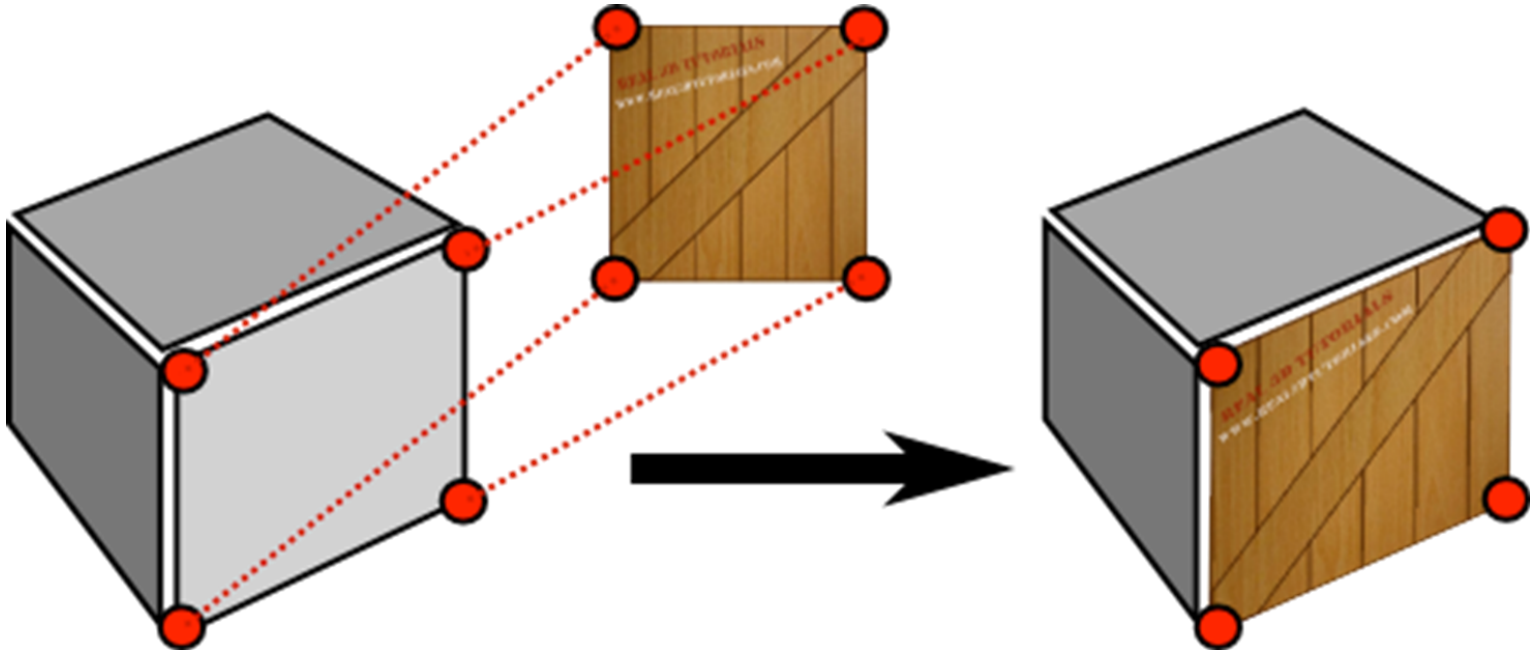
Texture Mapping

CSCI 4611: Programming Interactive Computer Graphics and Games

Evan Suma Rosenberg | CSCI 4611 | Fall 2022

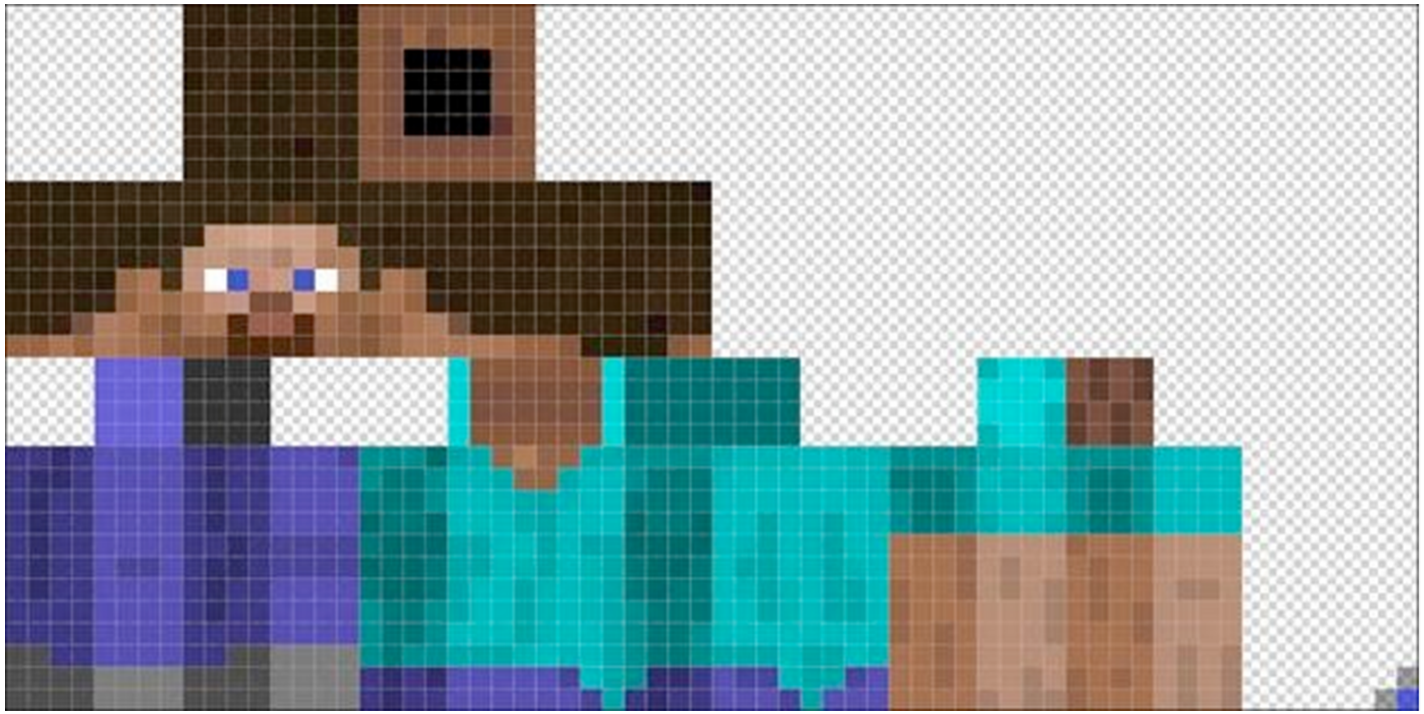
Textures

You have a polygon mesh and an image.



Imagine the image is printed on a stretchy rubber sheet and glued onto the polygons.

Example (Minecraft)

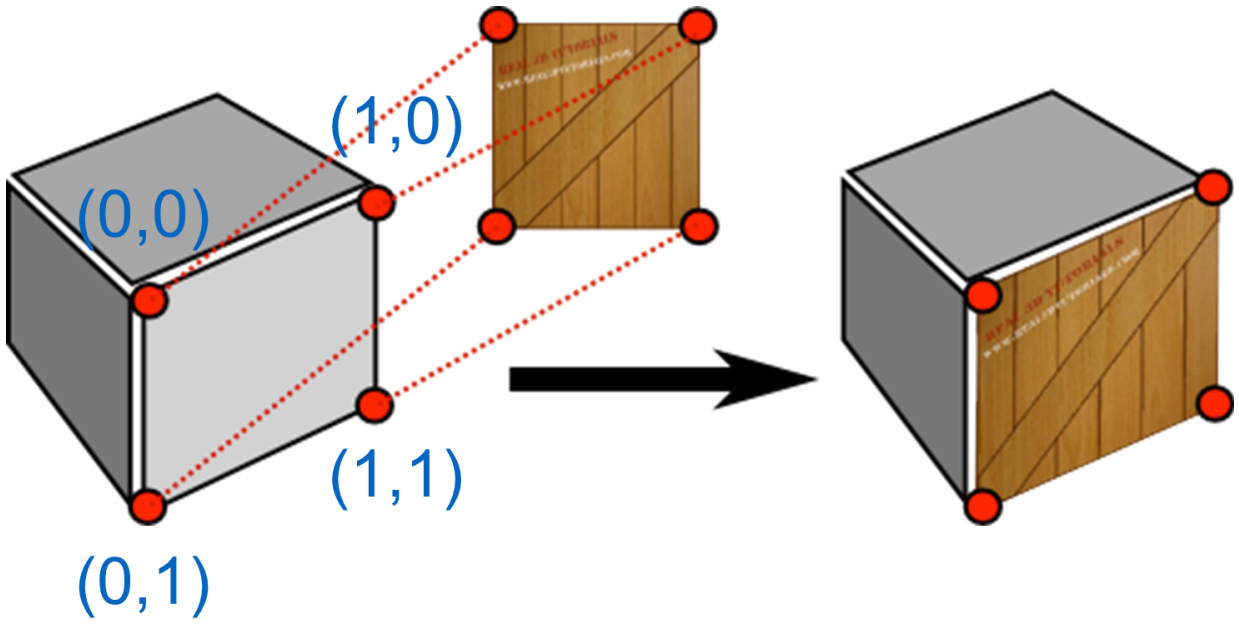


Texture Mapping

Each vertex has a 3D position: (**x**, **y**, **z**)

We'll also give it 2D texture coordinates: (u, v)

The texture coordinates specify where in the 2D image that vertex's texture should come from (between 0 and 1).



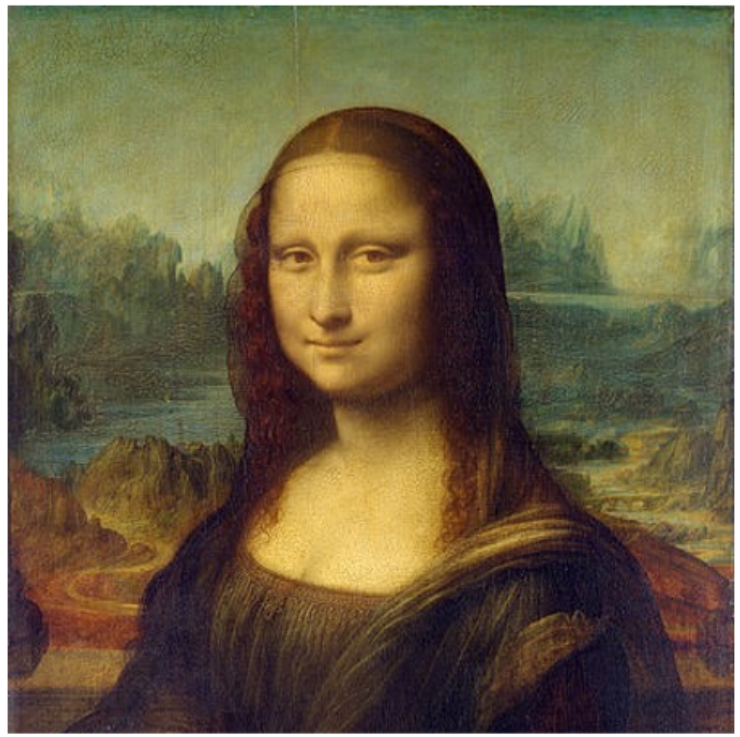
Texture Coordinates in the Mesh Data Structure

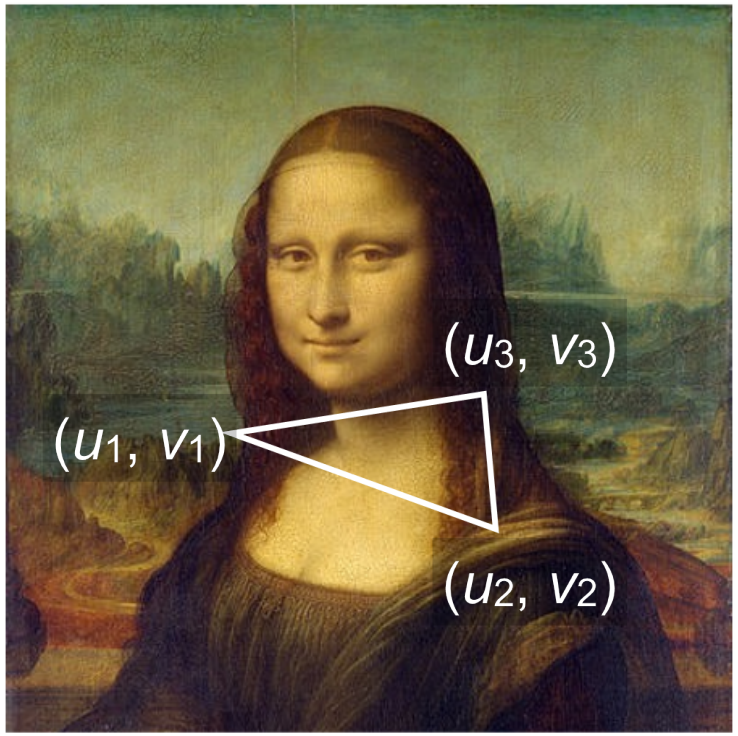
Remember, each vertex has a 3D position (**x**, **y**, **z**) and usually also a 3D normal <**x**,**y**,**z**>.

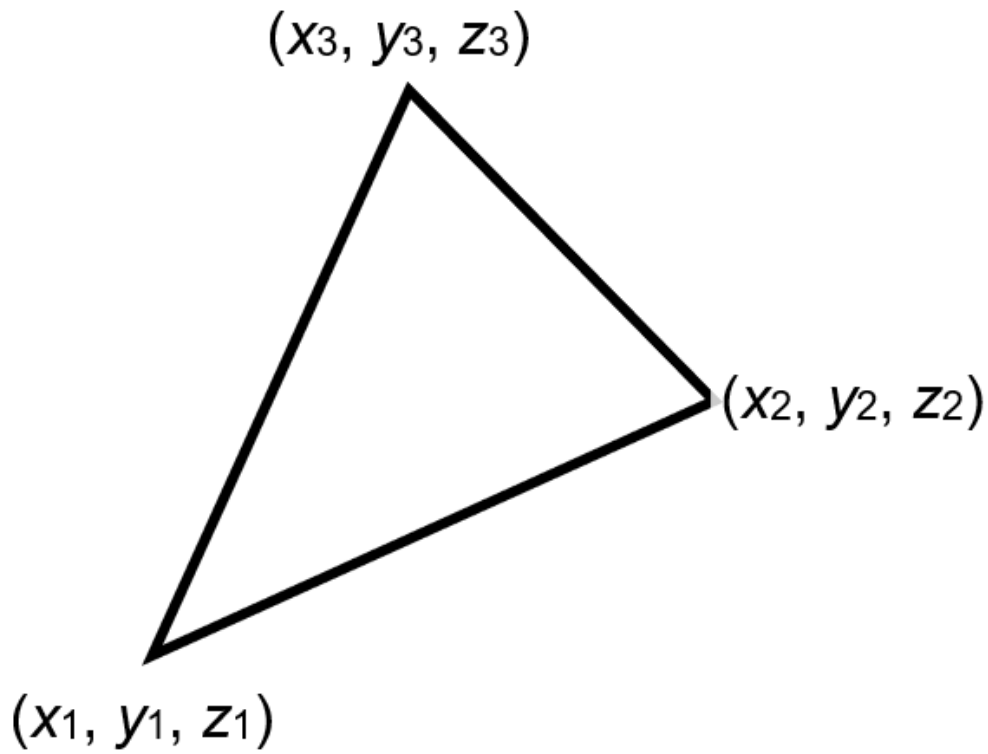
Now, we'll add one more bit of data for each vertex: (**u**, **v**).

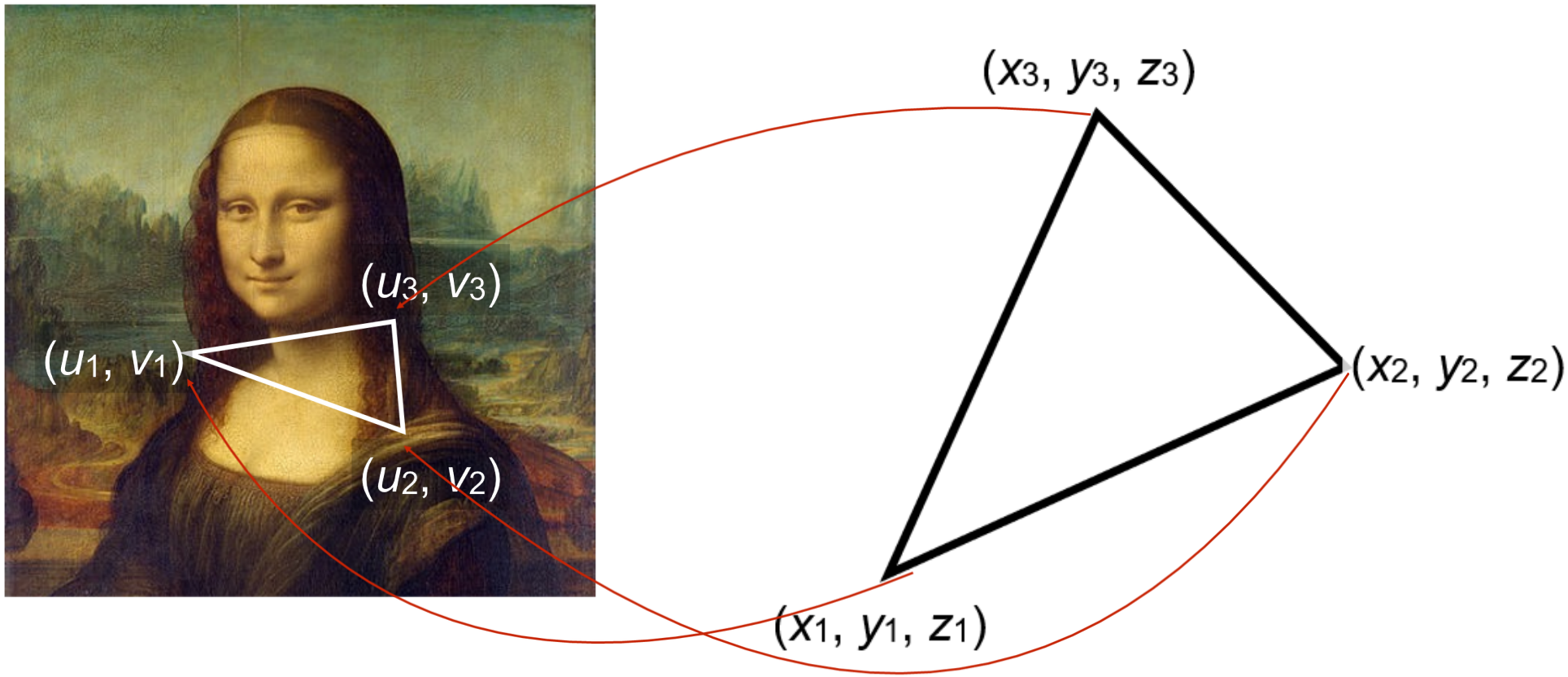
We will store it the same way, just adding one more array, with one entry per vertex.

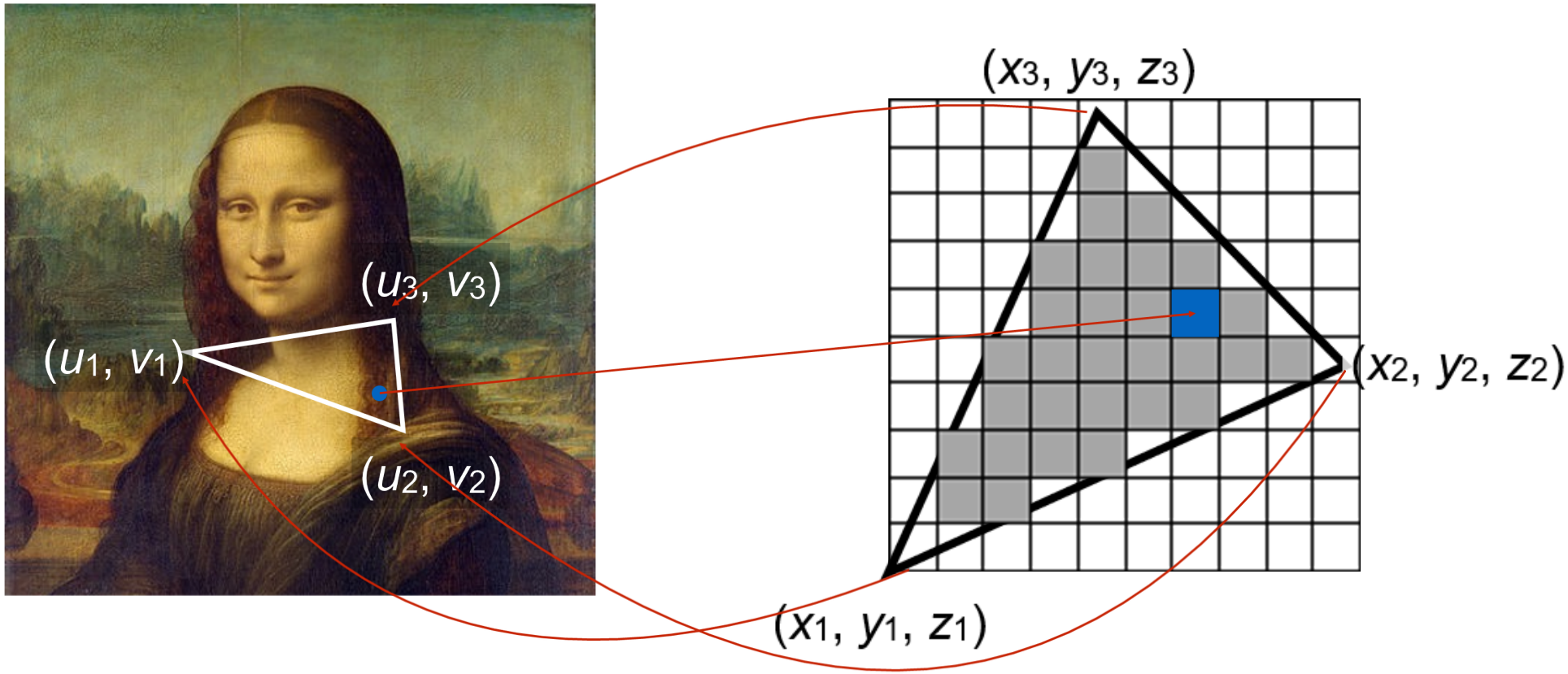
The (**u**,**v**) coordinates define the shape of the 2D "cookie cutter" used on the image!

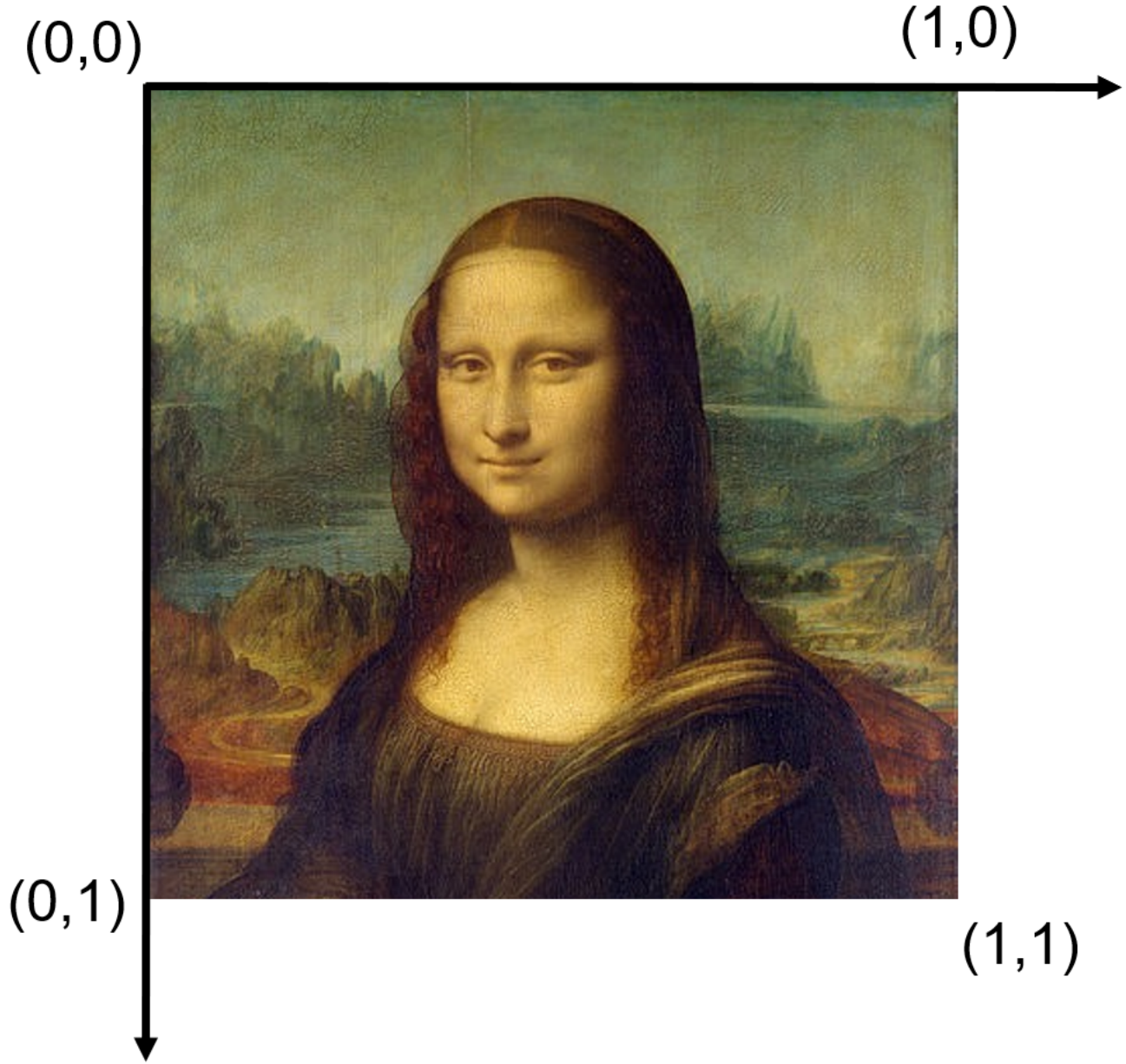



(u_3, v_3)
(u_1, v_1)
(u_2, v_2)

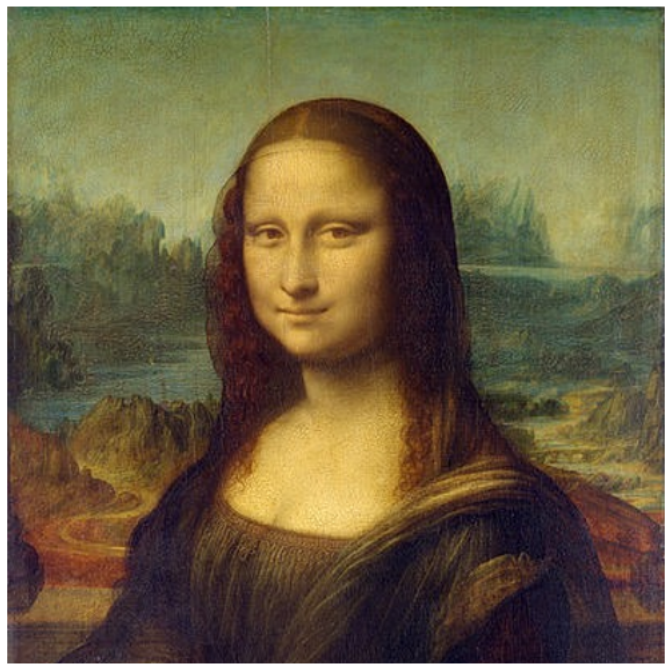

(x_3, y_3, z_3)
(x_2, y_2, z_2)
(x_1, y_1, z_1)


(u_3, v_3)
(u_1, v_1)
(u_2, v_2)
(x_3, y_3, z_3)
(x_2, y_2, z_2)
(x_1, y_1, z_1)


(u_3, v_3)
(u_1, v_1)
(u_2, v_2)
(x_3, y_3, z_3)
(x_2, y_2, z_2)
(x_1, y_1, z_1)

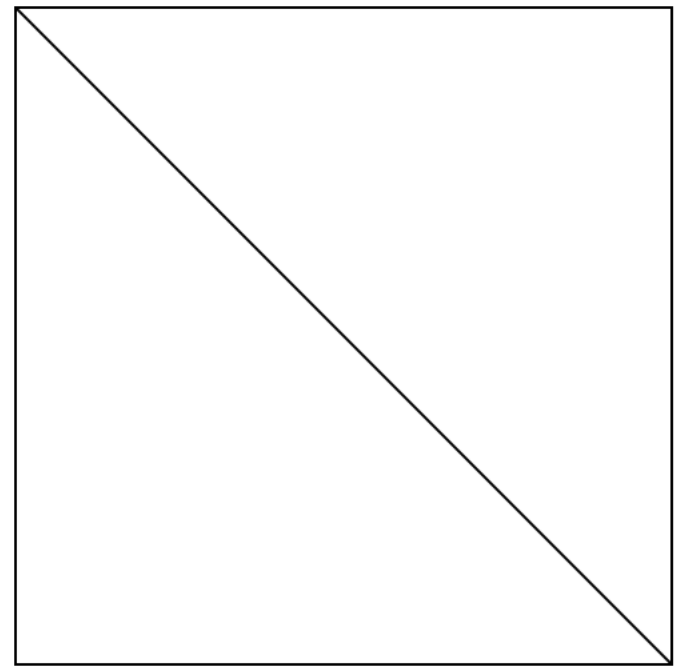

(0,0)
(1,0)
(0,1)
(1,1)

(0,0) (1,0)

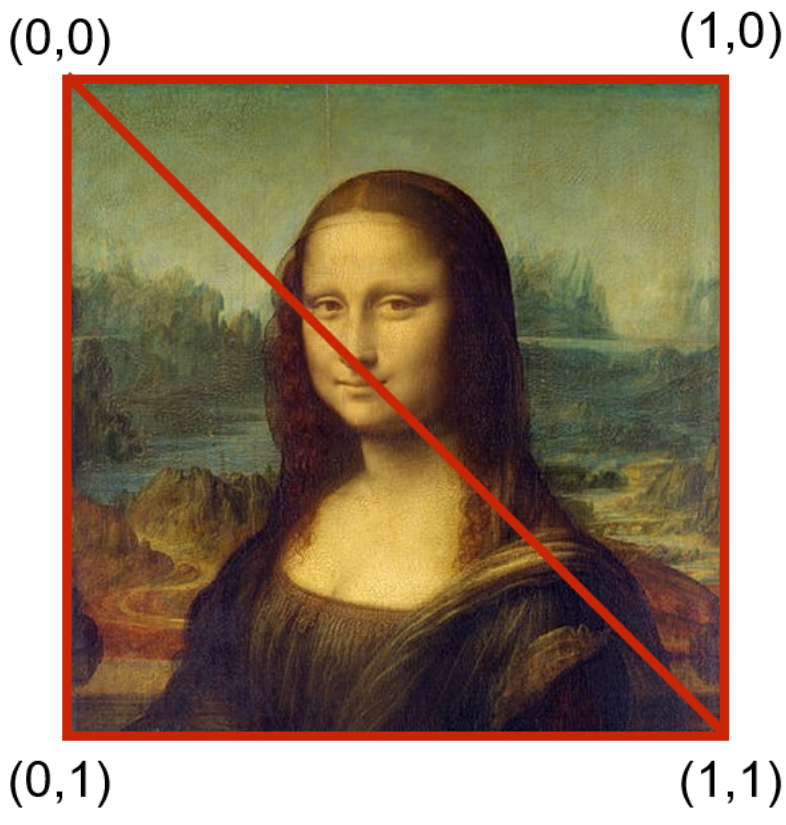


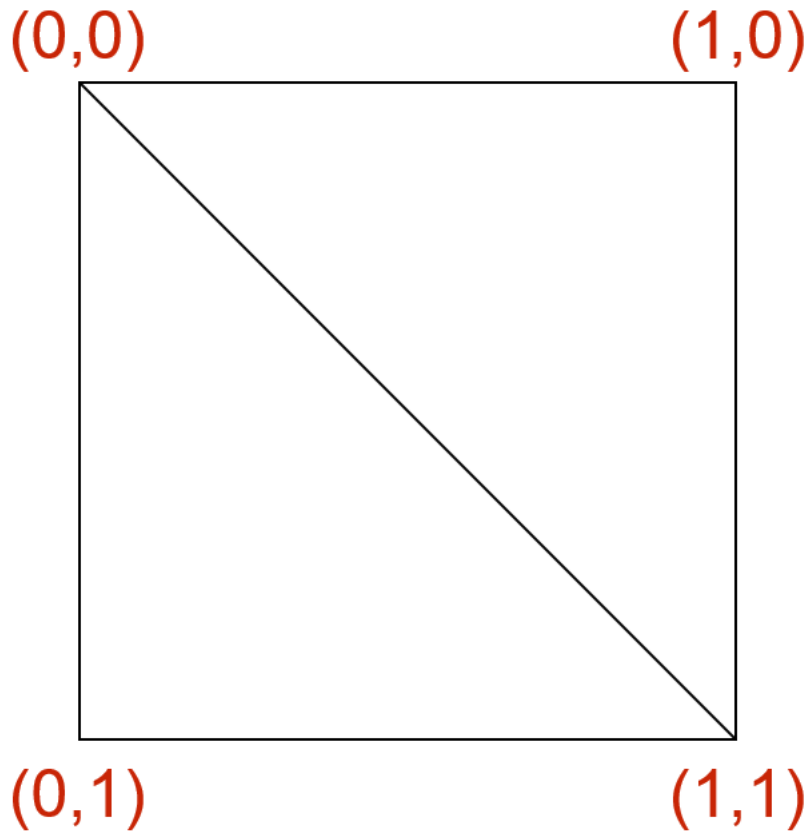
(0,1) (1,1)

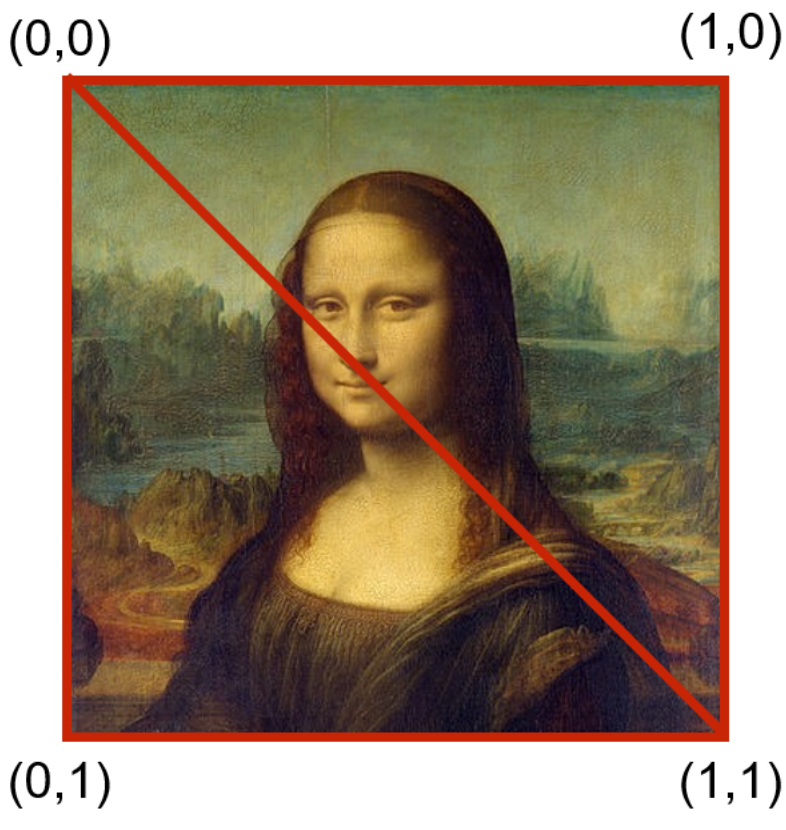
(0,0) (1,0)

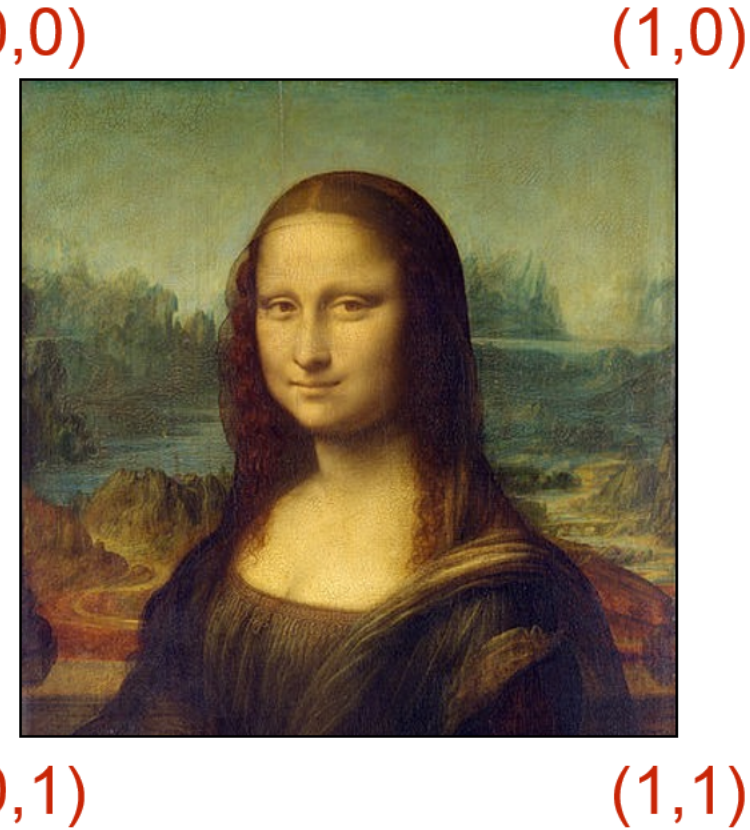


(0,1) (1,1)

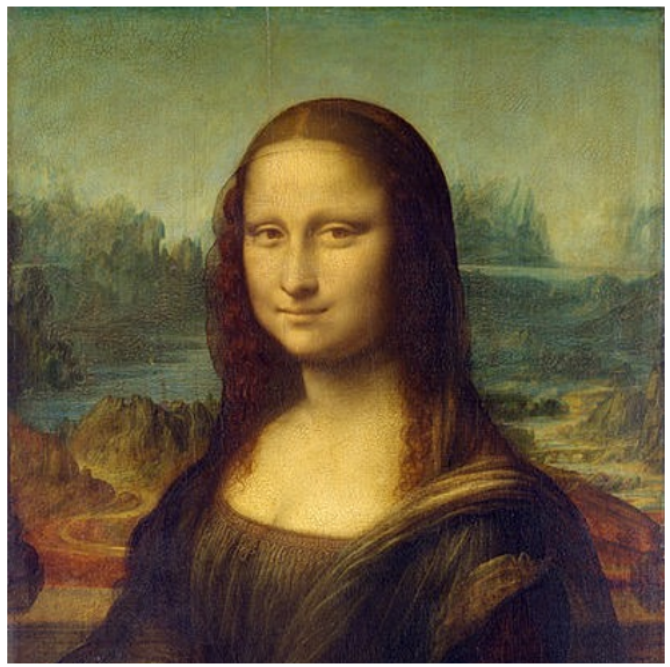

(0,0)
(1,0)
(0,1)
(1,1)


(0,0)
(1,0)
(0,1)
(1,1)


(0,0)
(1,0)
(0,1)
(1,1)

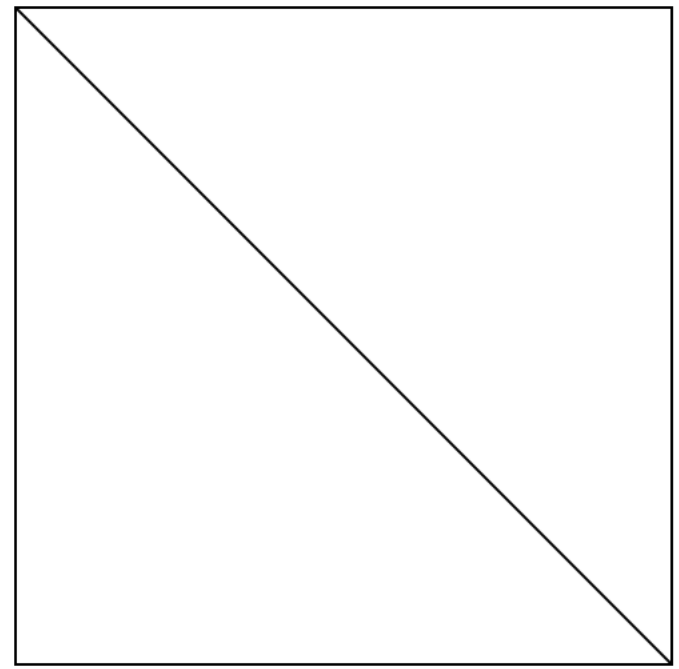

(0,0)
(1,0)
(0,1)
(1,1)

(0,0) (1,0)

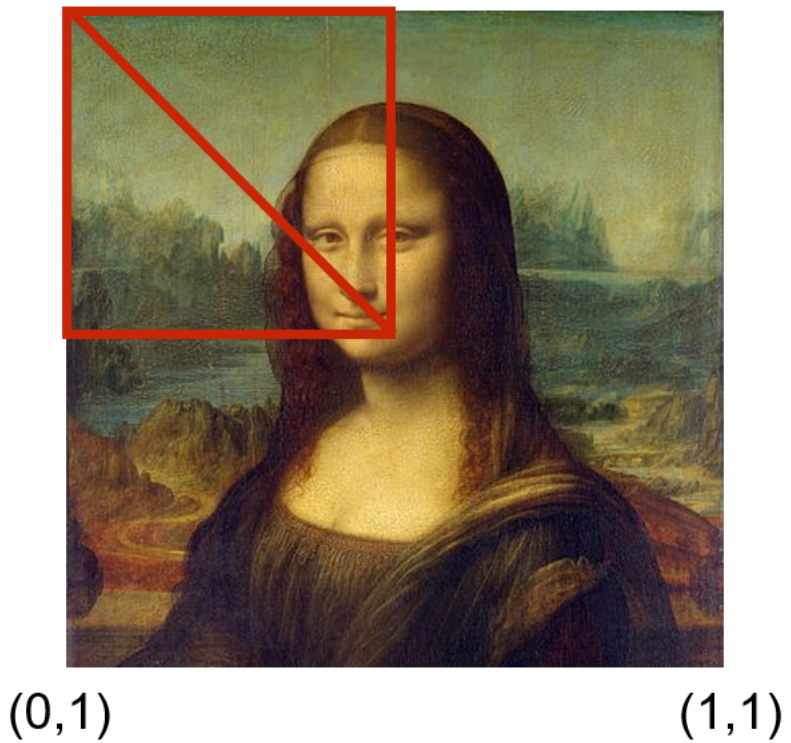


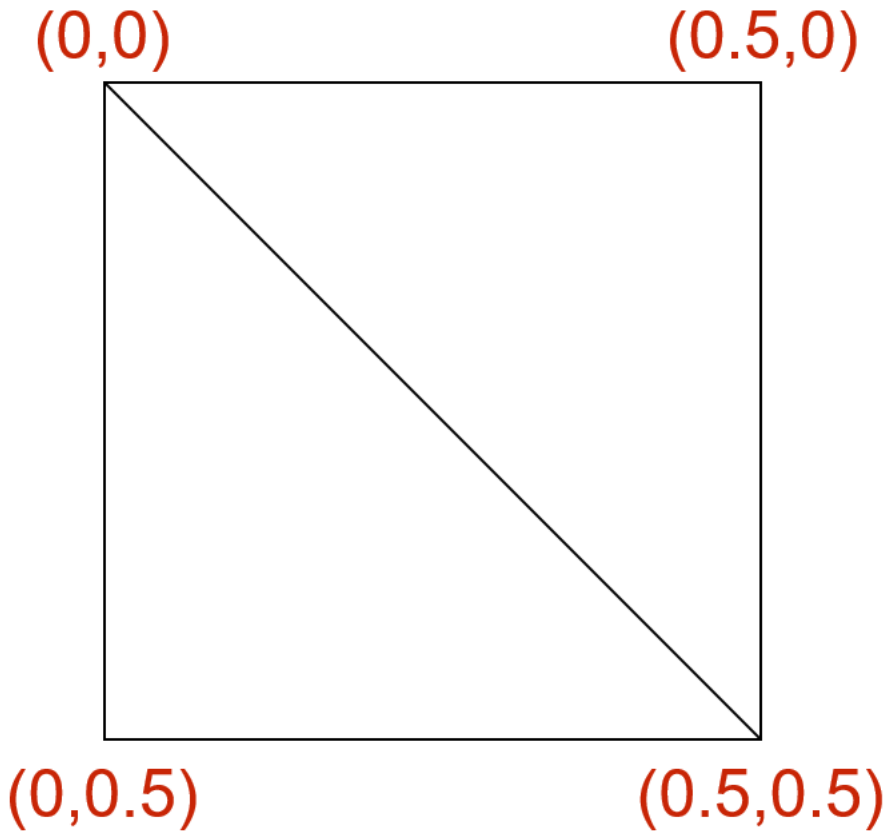
(0,1) (1,1)

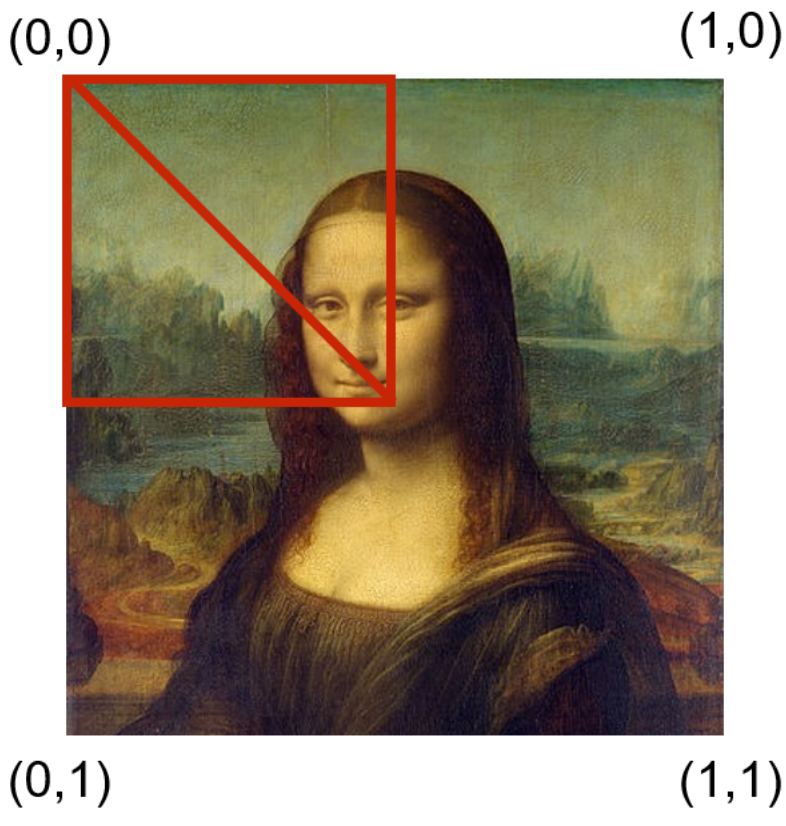
(0,0) (0.5,0)



(0,0.5) (0.5,0.5)

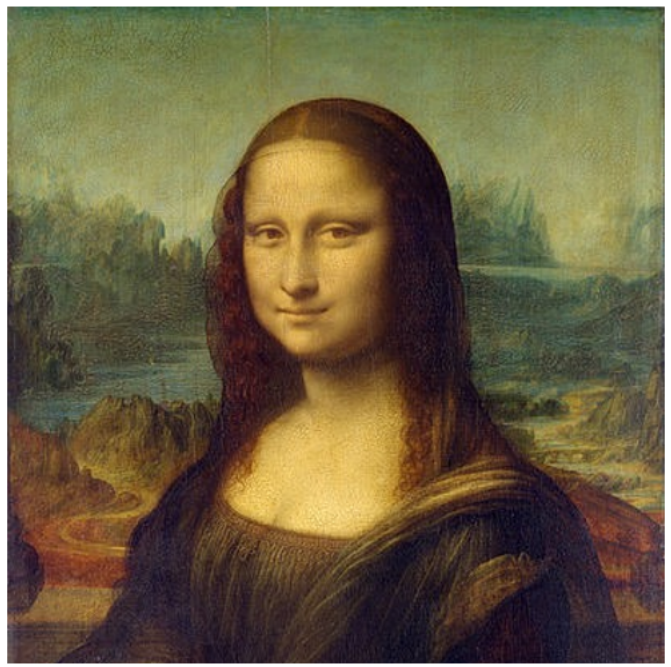

(0,0)
(1,0)
(0,1)
(1,1)


(0,0)
(0.5,0)
(0,0.5)
(0.5,0.5)


(0,0)
(1,0)
(0,1)
(1,1)

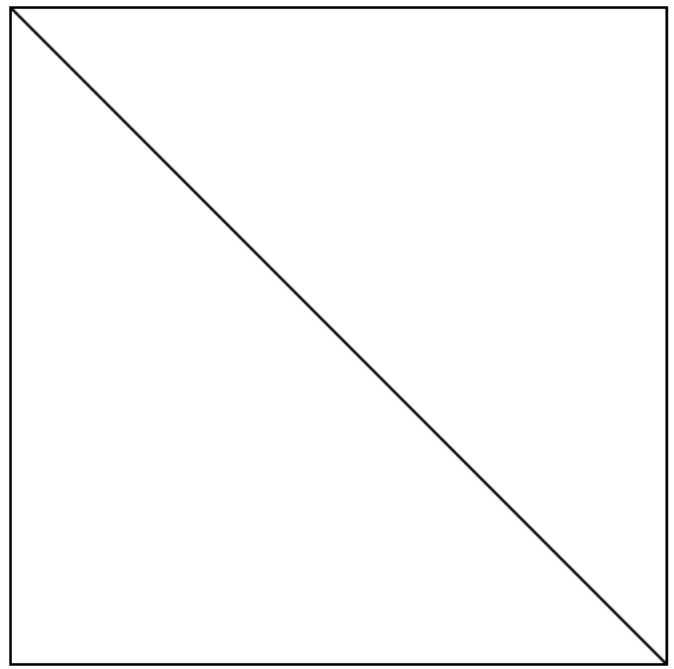

(0,0)
(0.5,0)
(0,0.5)
(0.5,0.5)

(0,0) (1,0)

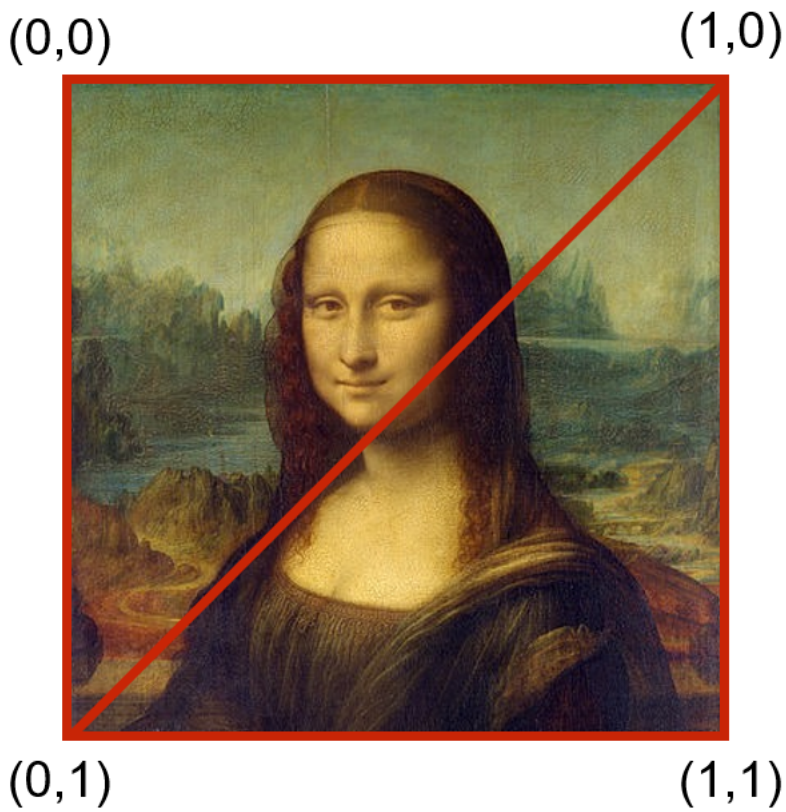


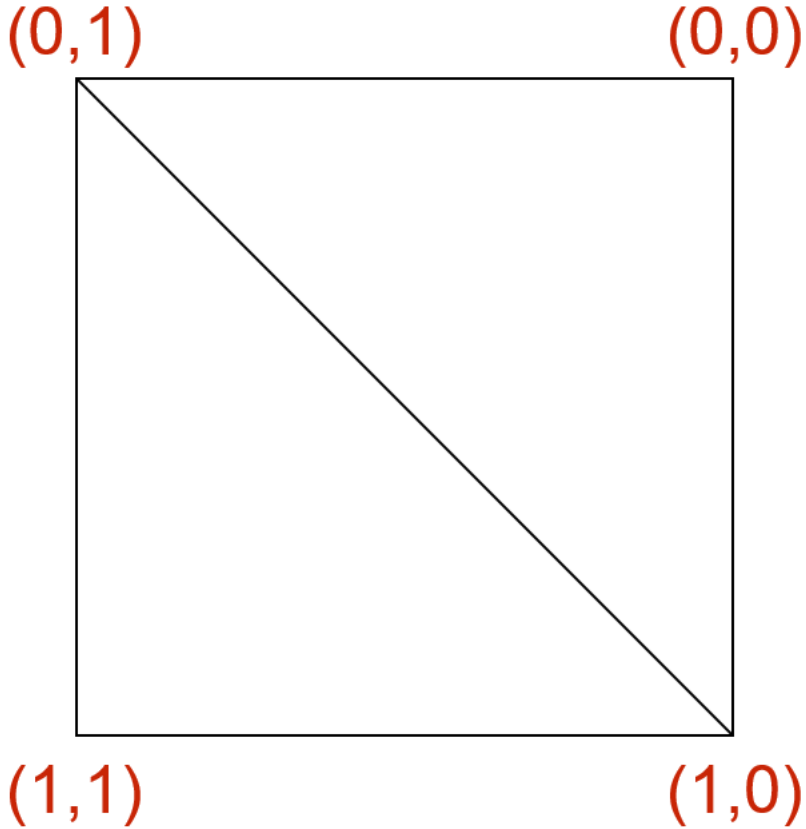
(0,1) (1,1)

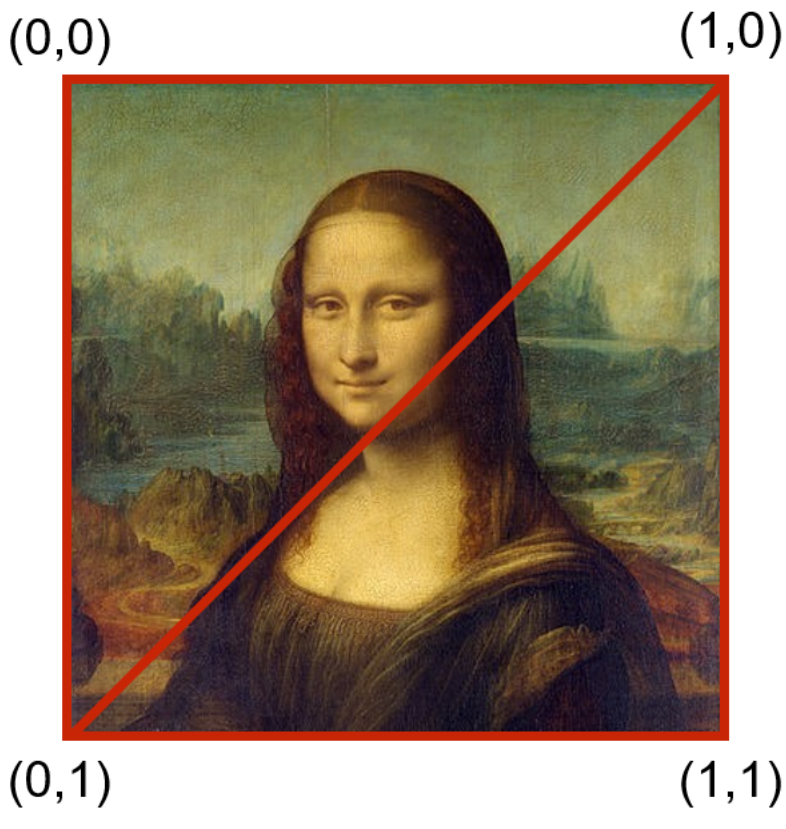
(0,1) (0,0)



(1,1) (1,0)


(0,0)
(1,0)
(0,1)
(1,1)

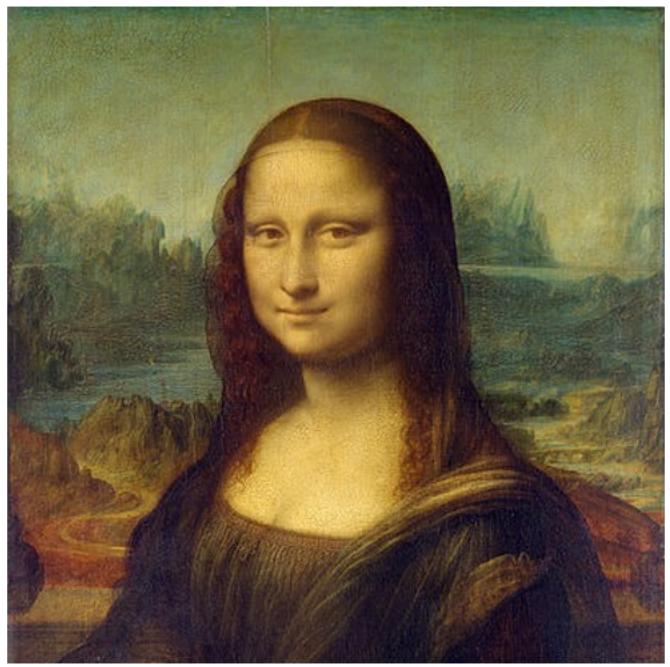

(0,1)
(0,0)
(1,1)
(1,0)


(0,0)
(1,0)
(0,1)
(1,1)


(0,1)
(0,0)
(1,1)
(1,0)

(0,0)

(1,0)

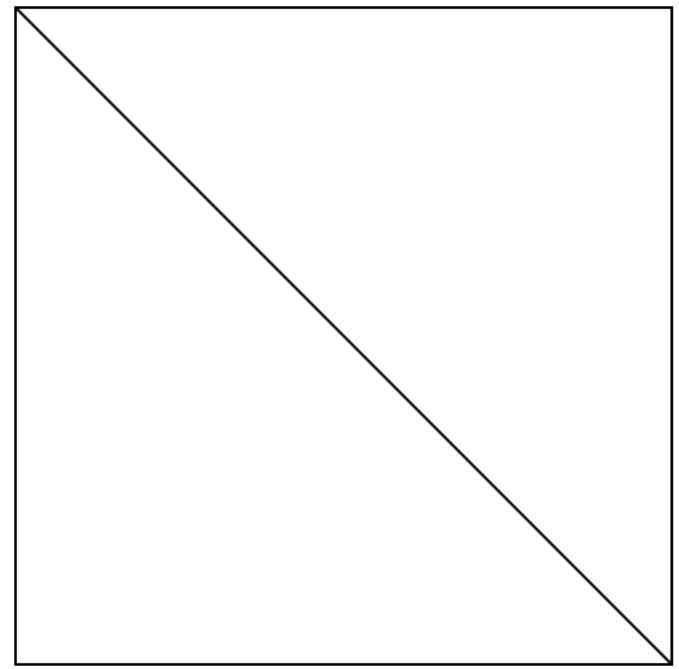


(0,1)

(1,1)

(0,0.5)

(1,0.5)

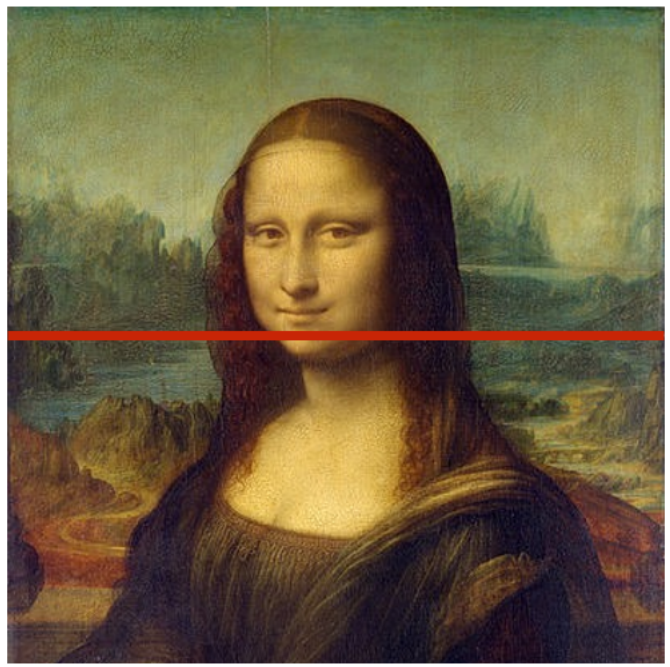


(0,0.5)

(1,0.5)

(0,0)

(1,0)

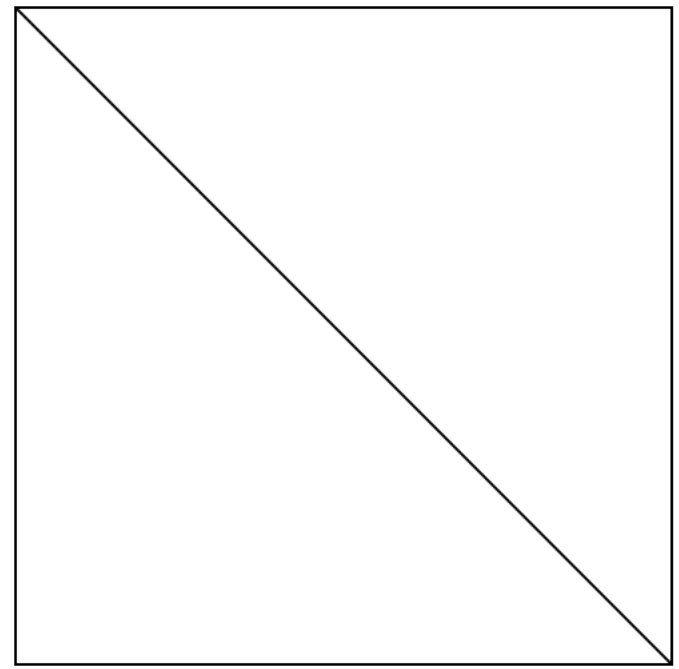


(0,1)

(1,1)

(0,0.5)

(1,0.5)

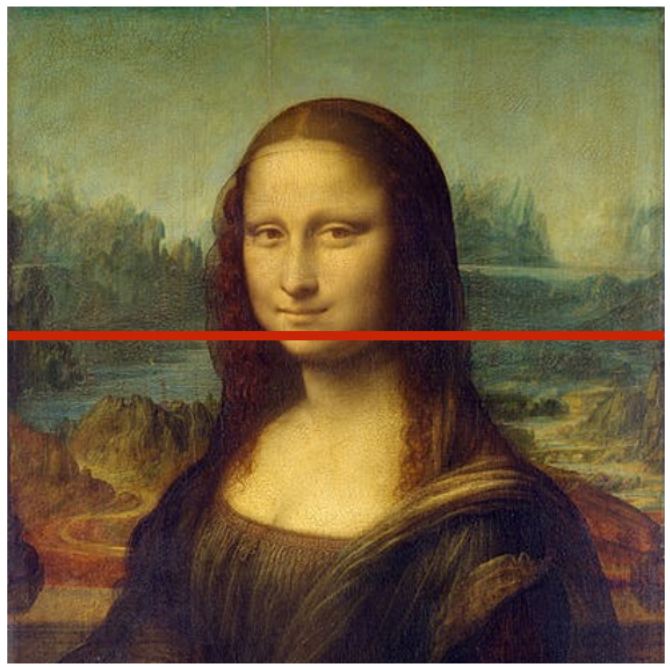


(0,0.5)

(1,0.5)

(0,0)

(1,0)

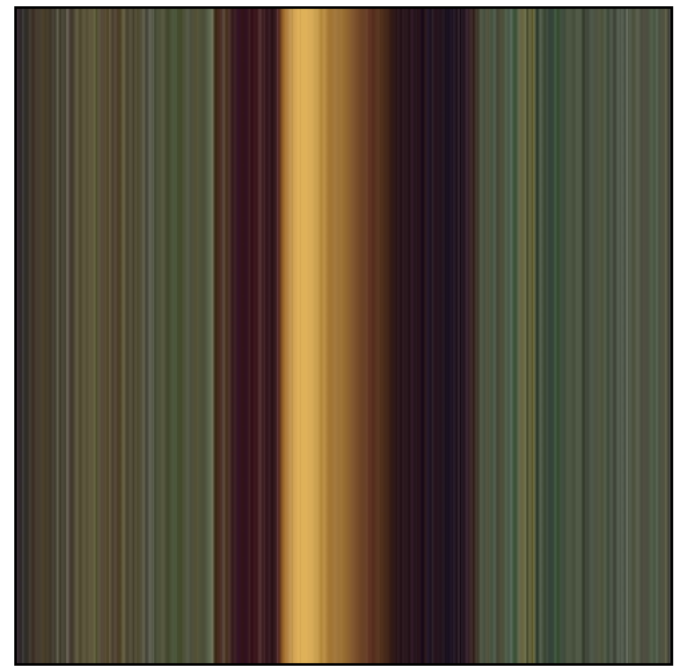


(0,1)

(1,1)

(0,0.5)

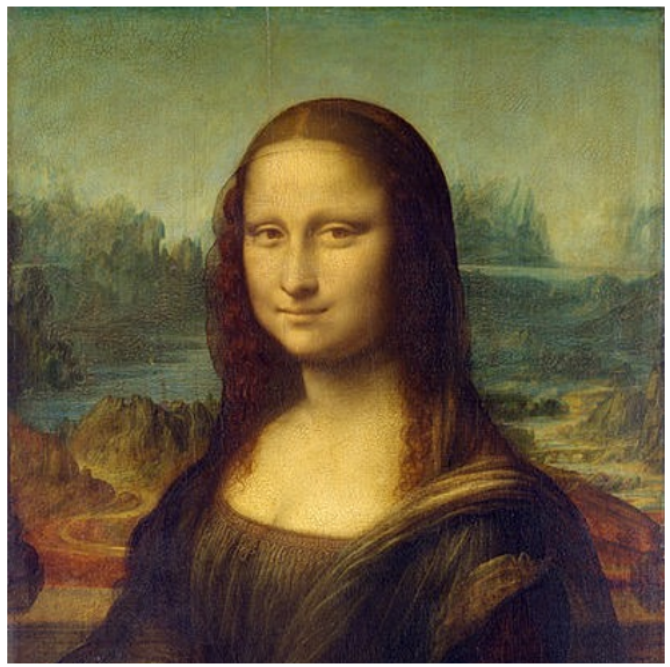
(1,0.5)



(0,0.5)

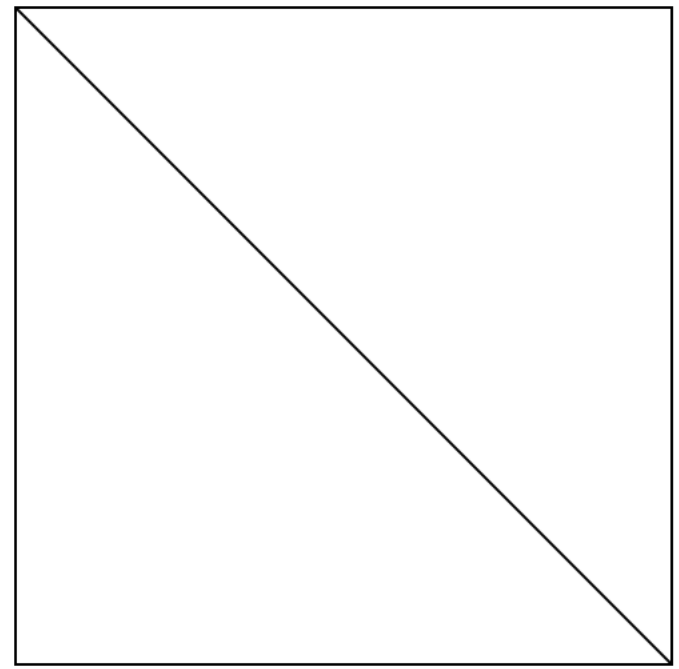
(1,0.5)

(0,0) (1,0)

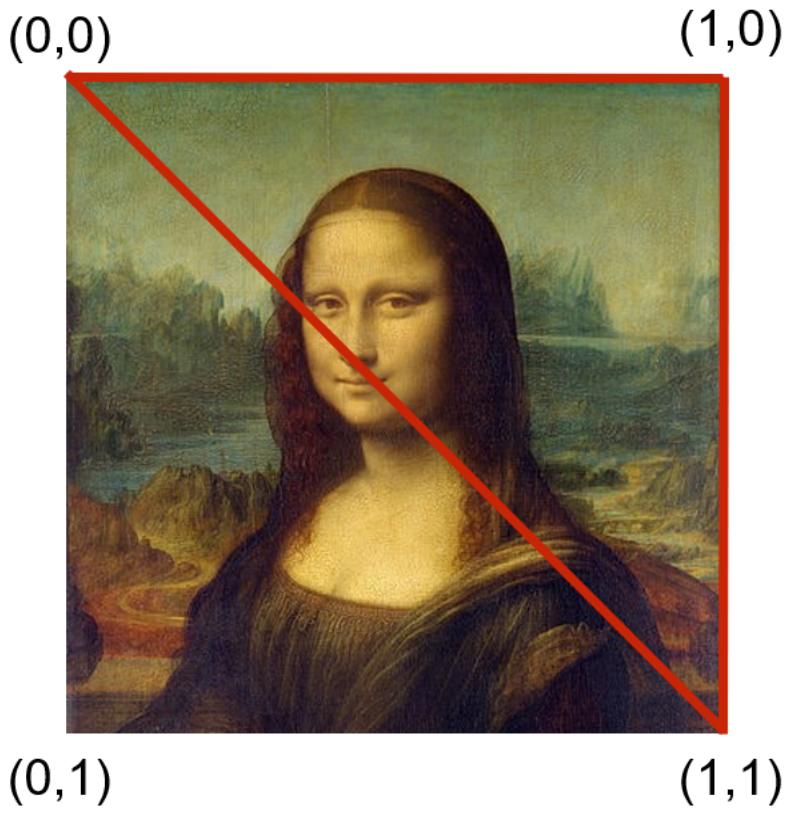


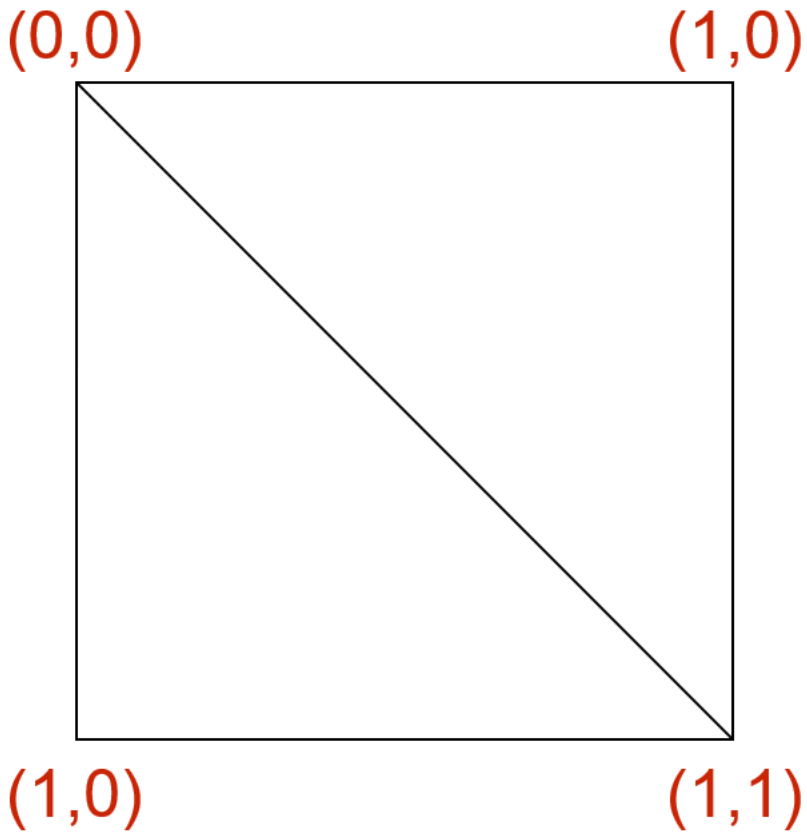
(0,1) (1,1)

(0,0) (1,0)

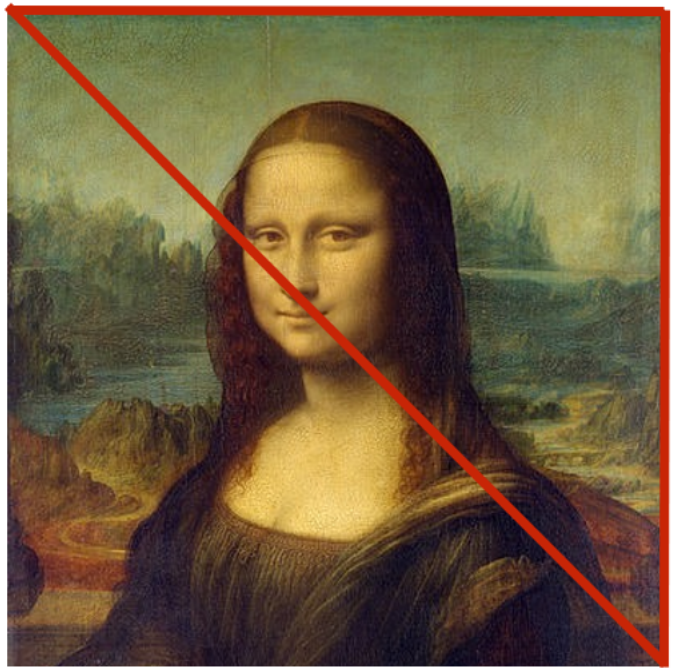


(1,0) (1,1)


(0,0)
(1,0)
(0,1)
(1,1)

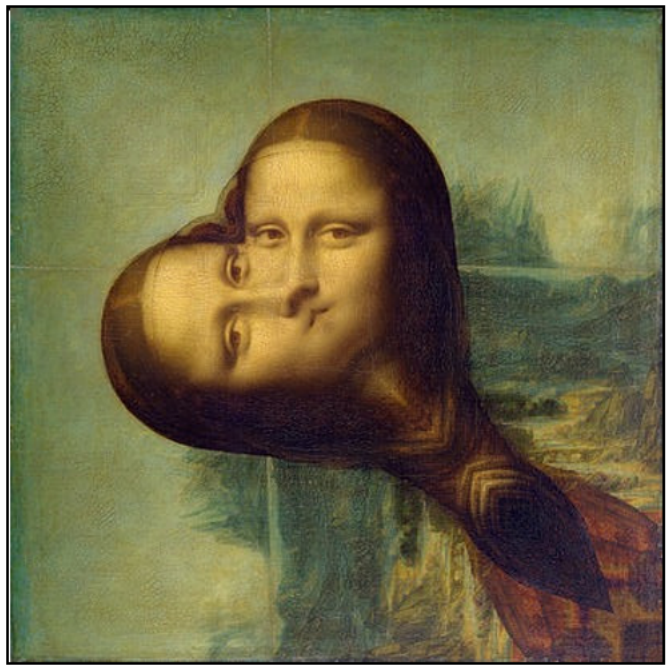

(0,0)
(1,0)
(1,0)
(1,1)

(0,0) (1,0)



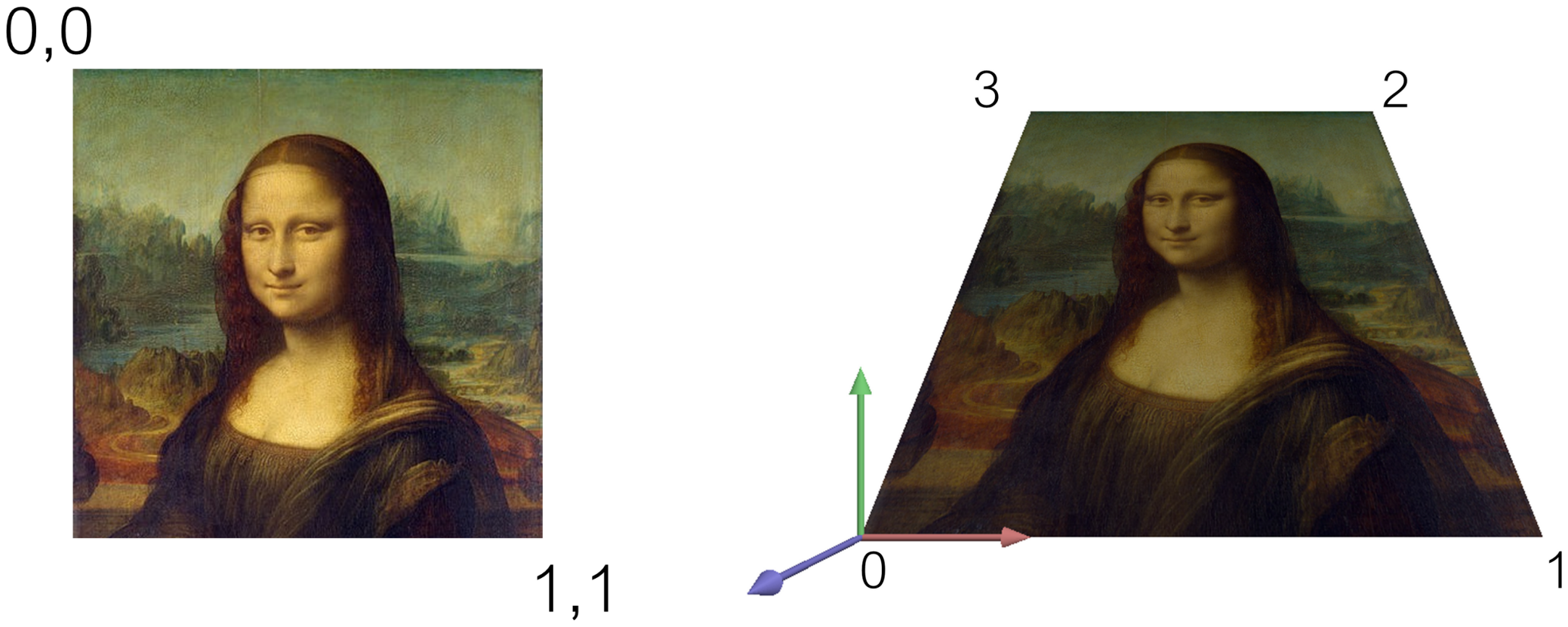
(0,1) (1,1)

(0,0) (1,0)

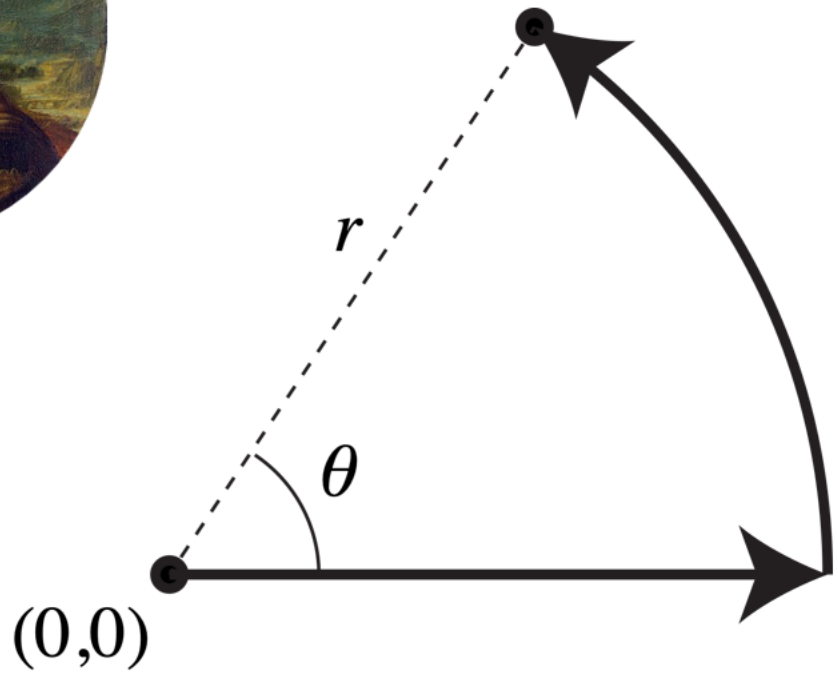


(1,0) (1,1)

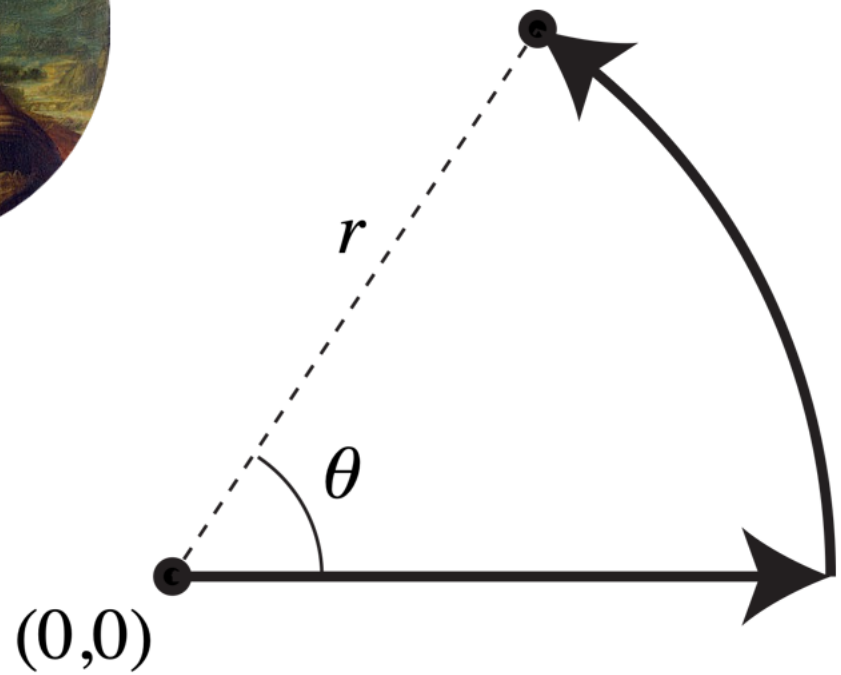
Example in 3D



Challenge: Draw a Textured Circle



Challenge: Draw a Textured Circle



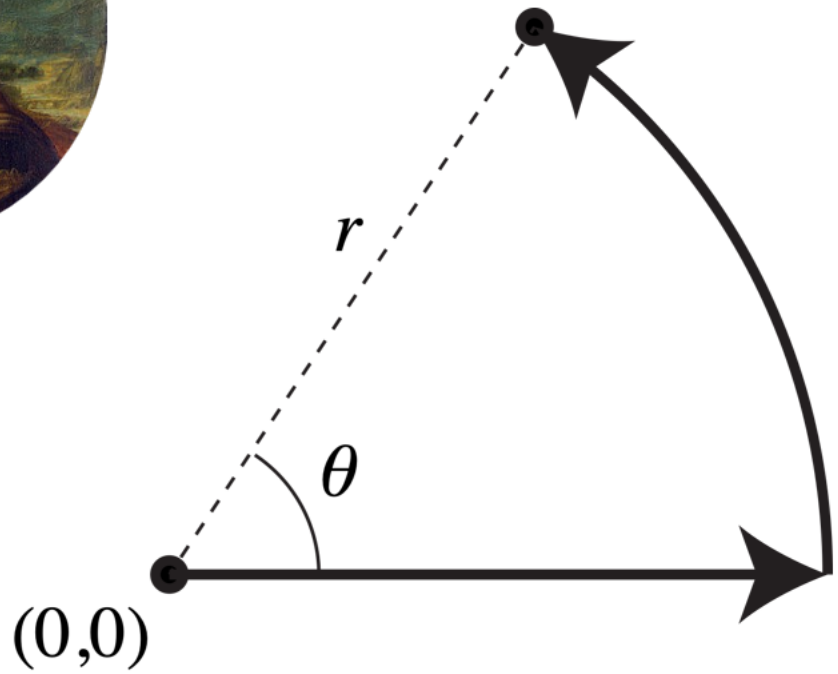
$$x = r\cos(\theta)$$

$$y = r\sin(\theta)$$

$$u = ???$$

$$v = ???$$

Challenge: Draw a Textured Circle



Needed to define vertices:

$r = 5$

$x = r\cos(\theta)$

$y = r\sin(\theta)$

How to define texture cords?

$u = ???$

$v = ???$

A New Challenge

Campbell's Soup Cans
Andy Warhol, 1968

Virtual Soup Cans
CSCI 4611