Computer Graphics 2016

15. A ReVIEW

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Main content

- Rendering ?
- Frame Buffer
- Display algorithm
  - basic rasterization methods
  - Real-time: Z-buffer => Ray casting ...
  - illumination and shading
  - Photo realistic: Ray tracing, Radiosity

Main content

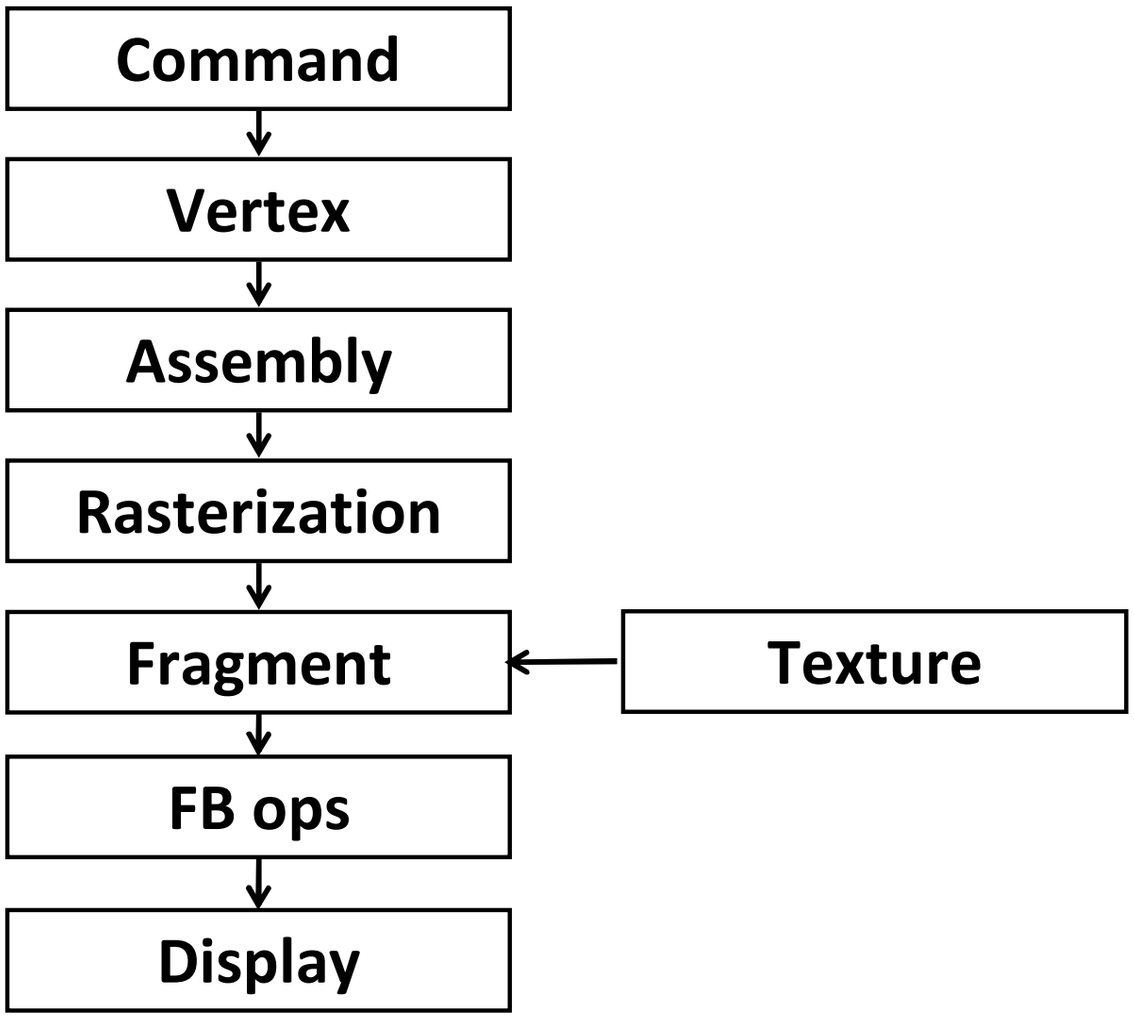
- Modeling
  - scene graph (transforms)
  - mesh representation
  - curves and surfaces
- Viewing

A walkthrough of computer graphics

Following pages are shame copied from
Pat Hanrahan's page

http://graphics.stanford.edu/courses/cs148-10-fall/lectures/programmable.pdf

a fixed graphics pipeline



Application

Simulation

Input event handlers

Modify data structures

Database traversal

Primitive generation

Graphics library utility functions (glu*)

Command

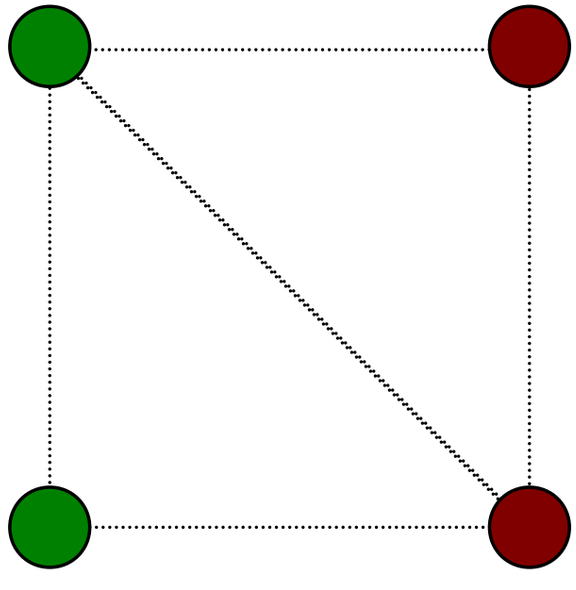
Command queue

Command interpretation

Unpack and perform format conversion

Maintain graphics state

```
glLoadIdentity( );
glMultMatrix( T );
glBegin( GL_TRIANGLE_STRIP );
glColor3f ( 0.0, 0.5, 0.0 );
glVertex3f( 0.0, 0.0, 0.0 );
glColor3f ( 0.5, 0.0, 0.0 );
glVertex3f( 1.0, 0.0, 0.0 );
glColor3f ( 0.0, 0.5, 0.0 );
glVertex3f( 0.0, 1.0, 0.0 );
glColor3f ( 0.5, 0.0, 0.0 );
glVertex3f( 1.0, 1.0, 0.0 );
…
glEnd( );
```



Vertex (per-vertex)

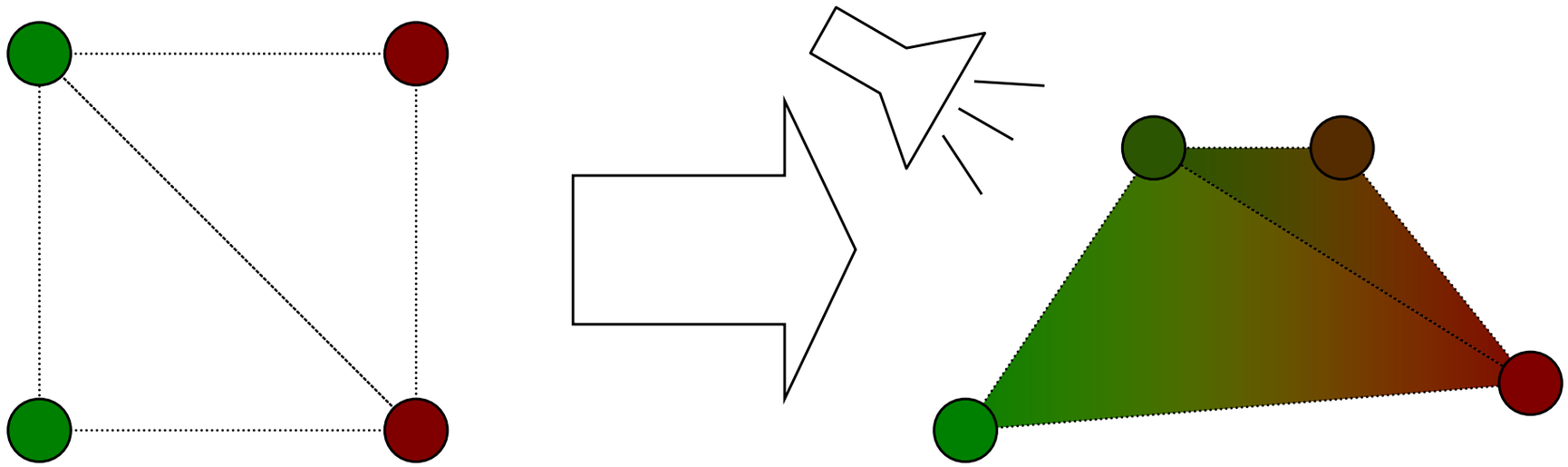
Vertex transformation

Normal transformation

Texture coordinate generation

Texture coordinate transformation

Lighting (light sources and surface reflection)



Object-space triangles

Screen-space lit triangles

Primitive Assembly

Combine transformed/lit vertices into primitives

- **1 vert -> point**
- **2 verts -> line**
- **3 verts -> triangle**

Clipping

Perspective projection

Transform to window coordinates (viewport)

Determine orientation (CW/CCW)

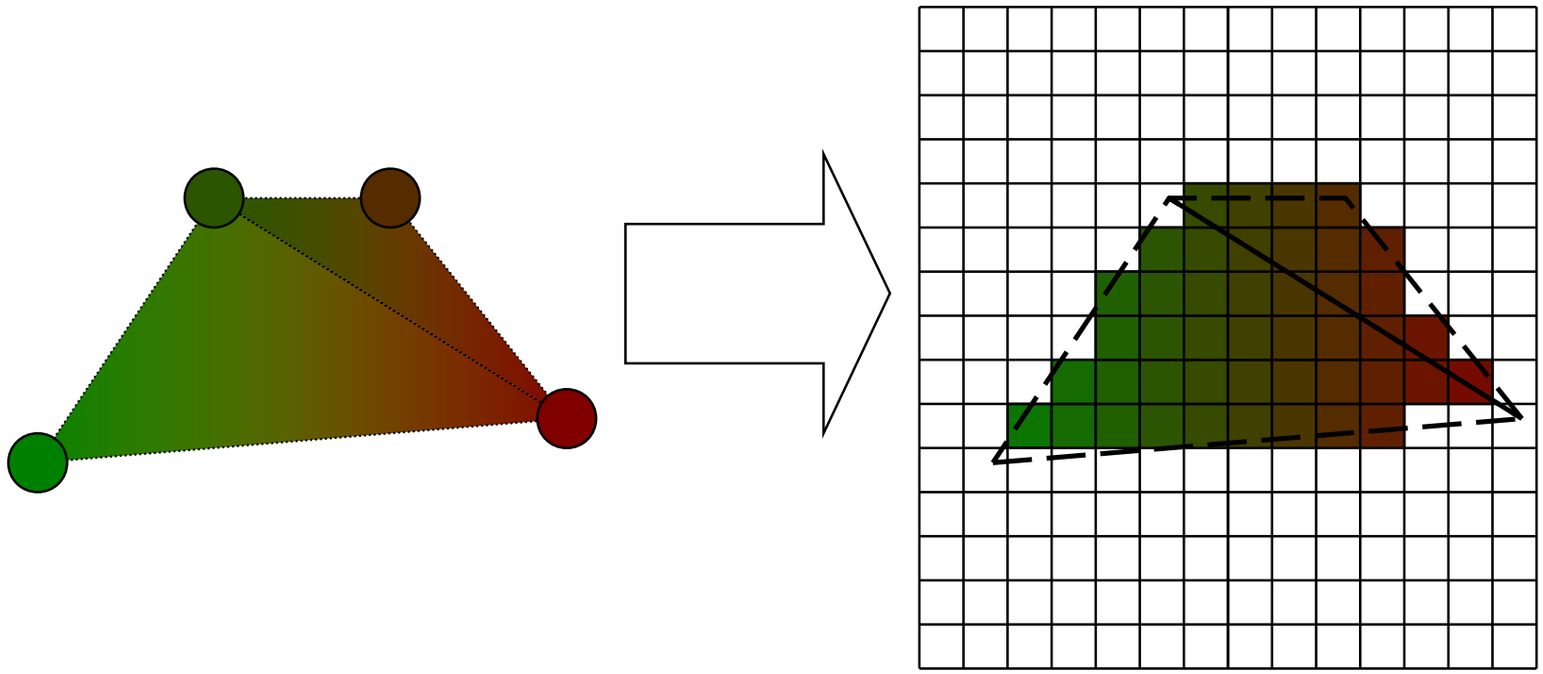
Back-face cull

Rasterization

Setup (per-triangle)

Sampling (triangle = {fragments})

Interpolation (interpolate colors and coordinates)



Screen-space triangles

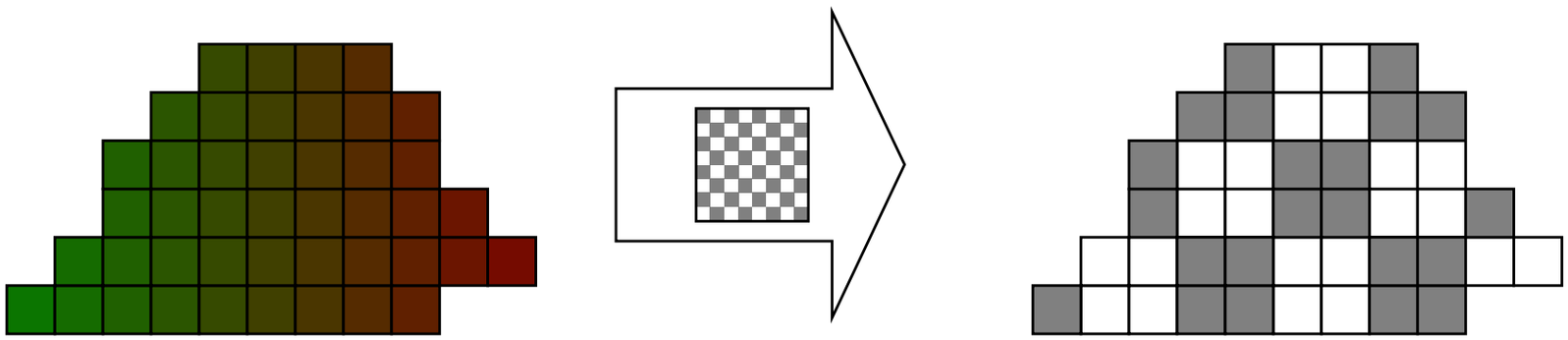
Fragments

Texture

Textures are arrays indexed by floats (Sampler)

Texture address calculation

Texture interpolation and filtering



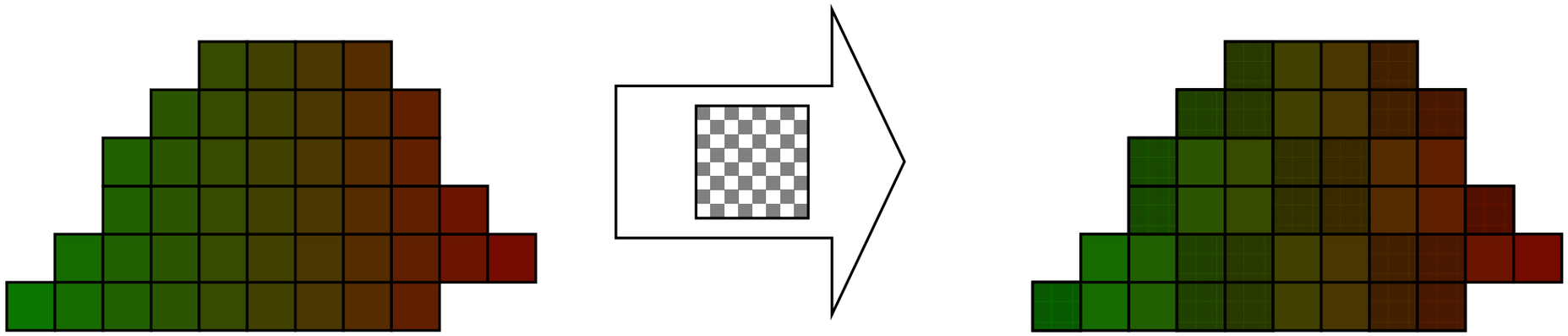
Fragments

Texture Fragments

Fragment

Combine texture sampler outputs

Per-fragment shading



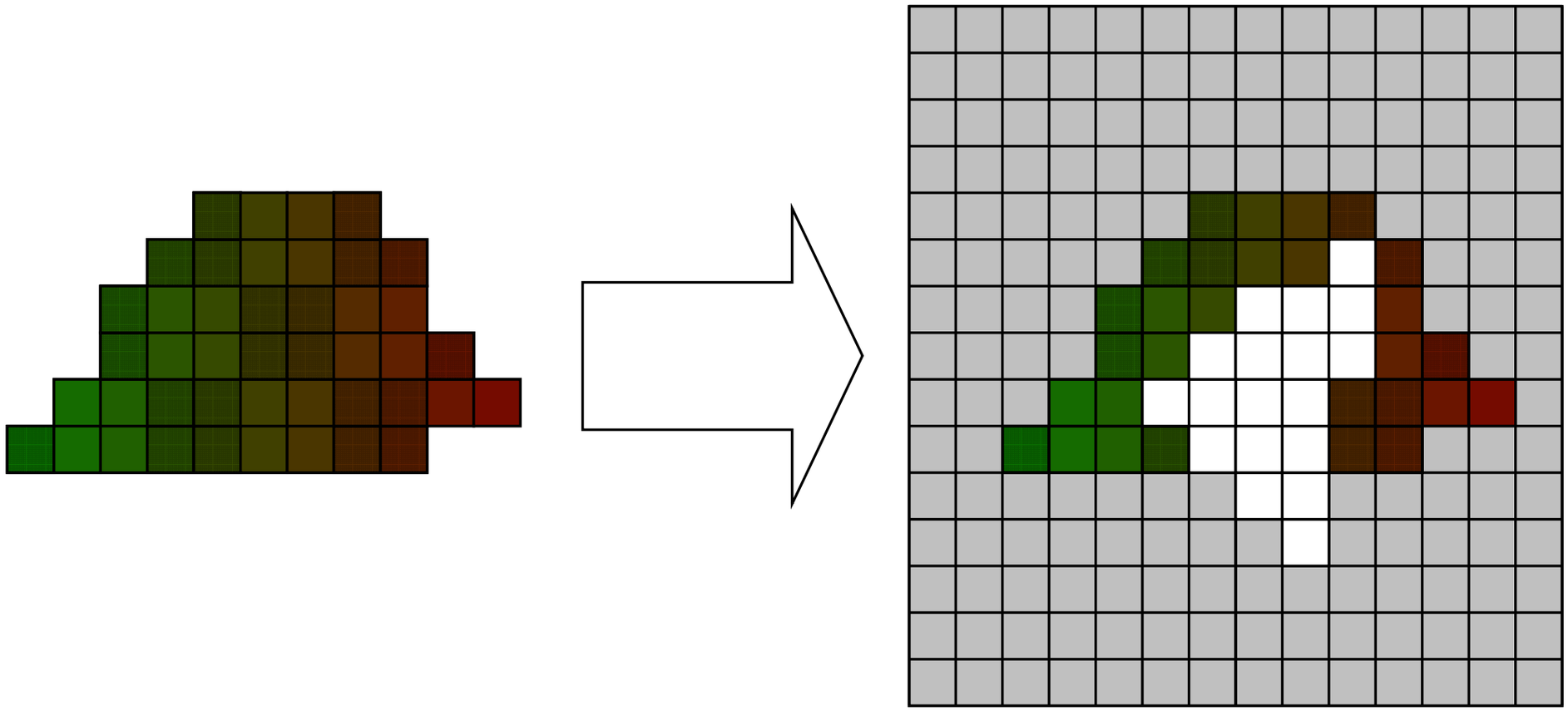
Fragments

Textured Fragments

Framebuffer Operations

Owner, scissor, depth, alpha and stencil tests

Blending or compositing



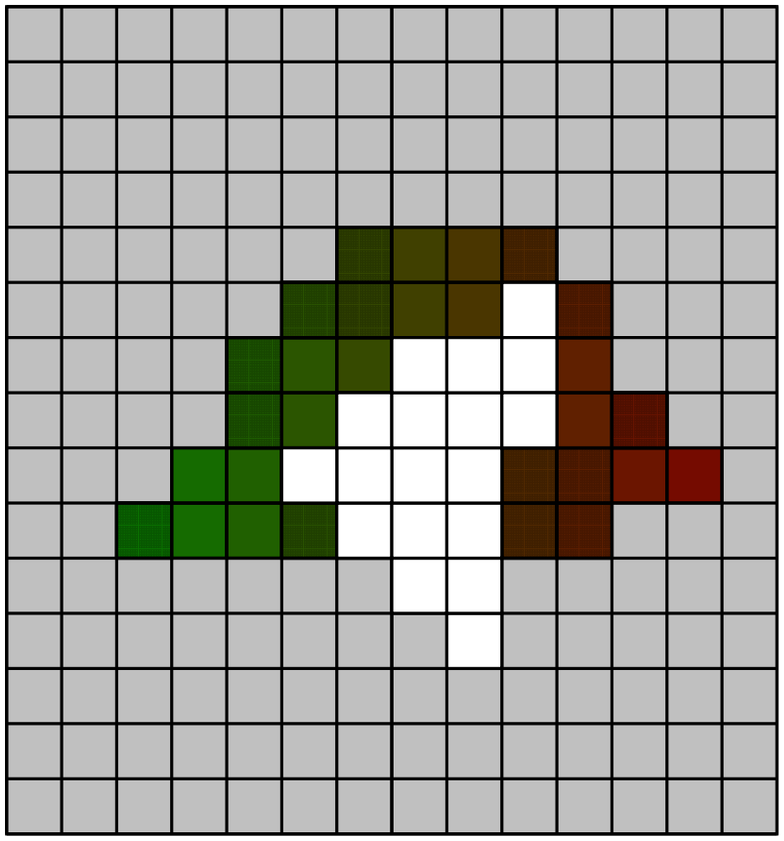
Textured Fragments

Framebuffer Pixels

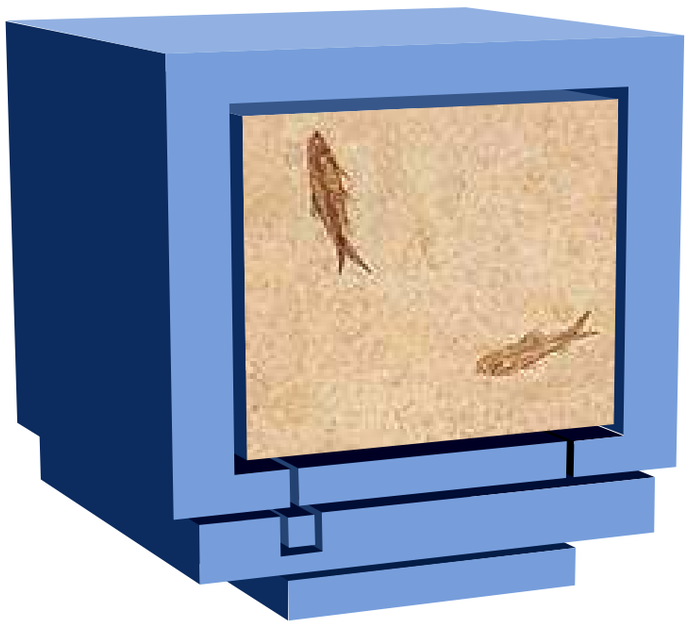
Display

Gamma correction

Analog to digital conversion

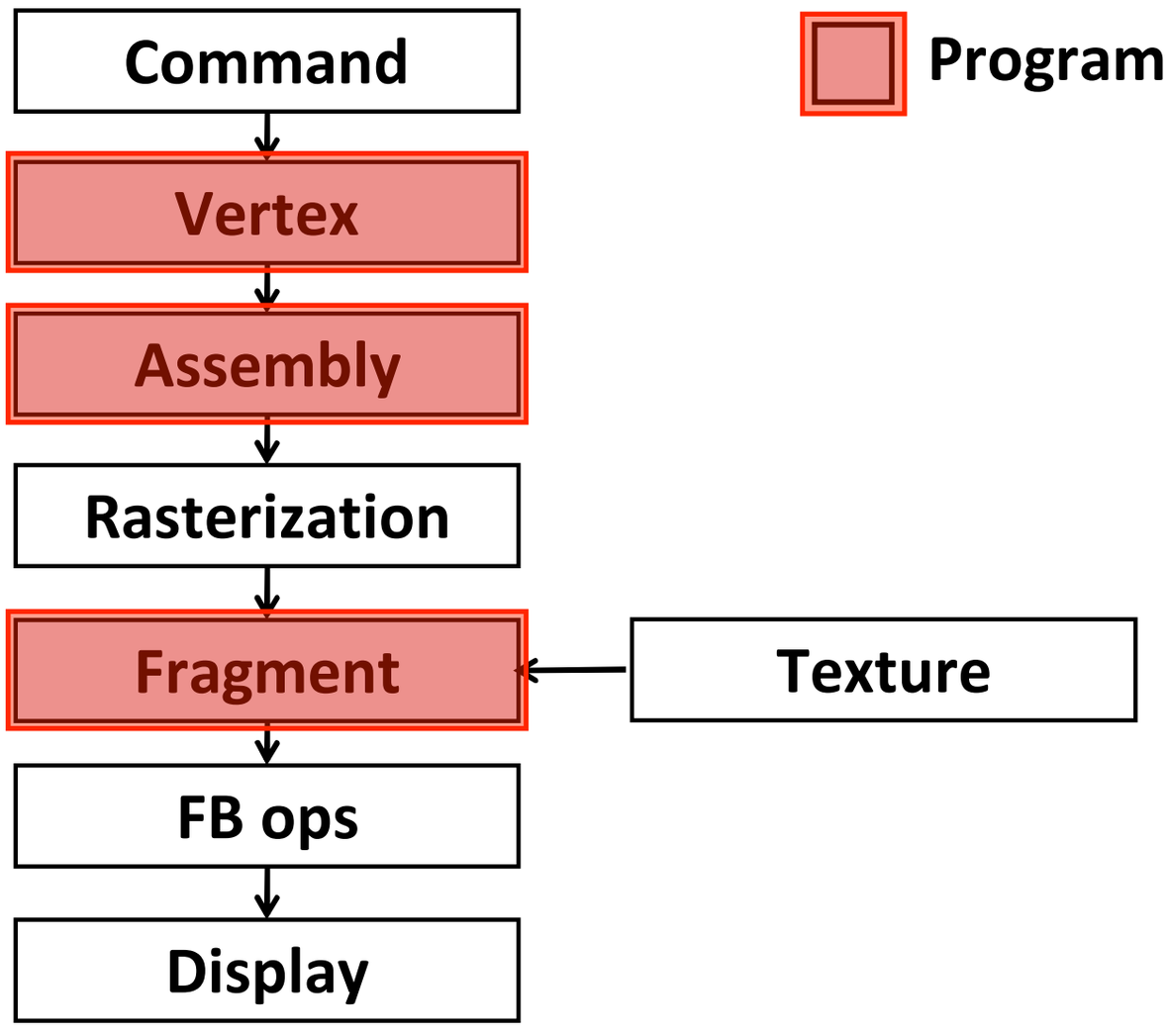


Framebuffer Pixels

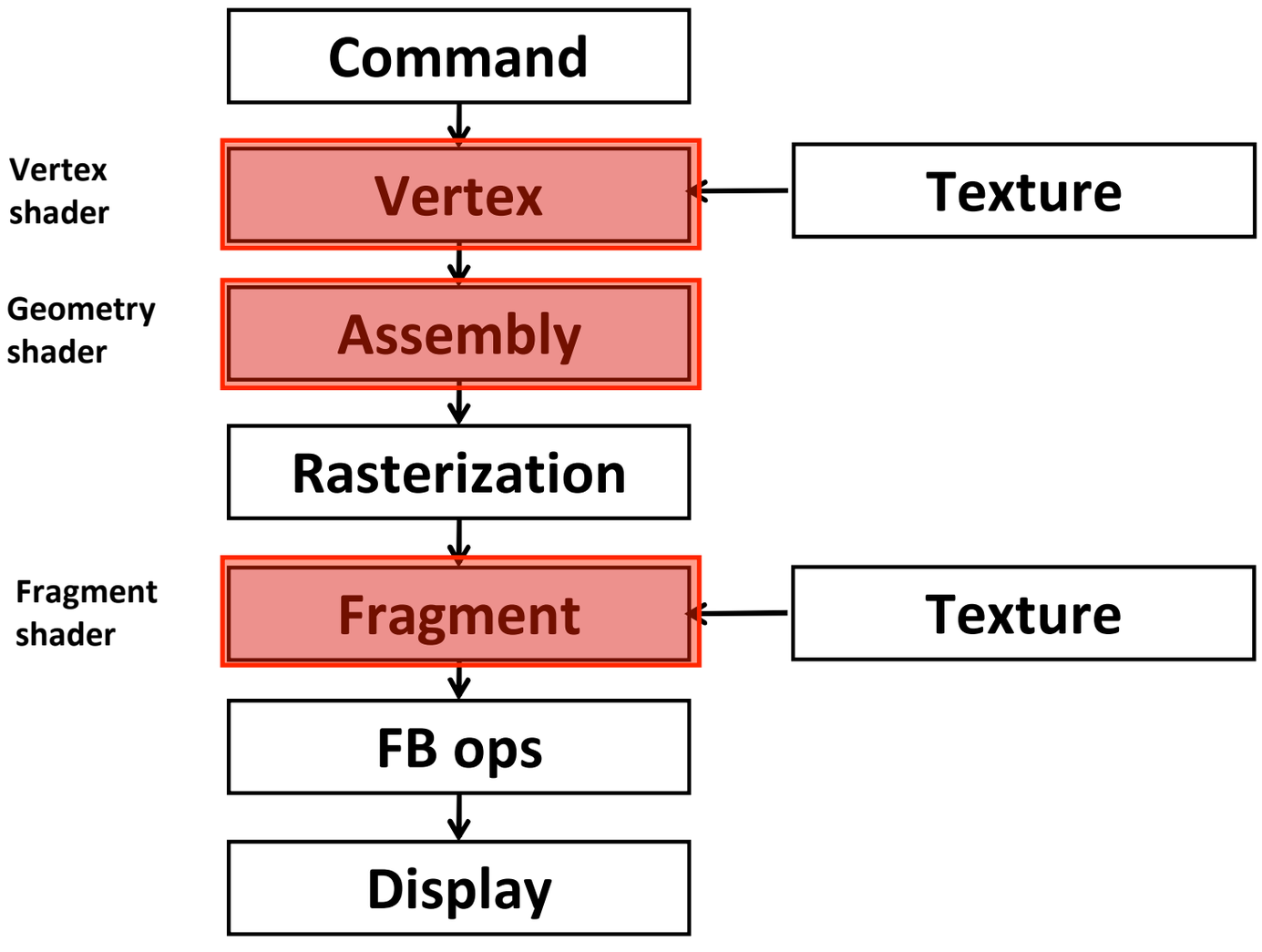


Light

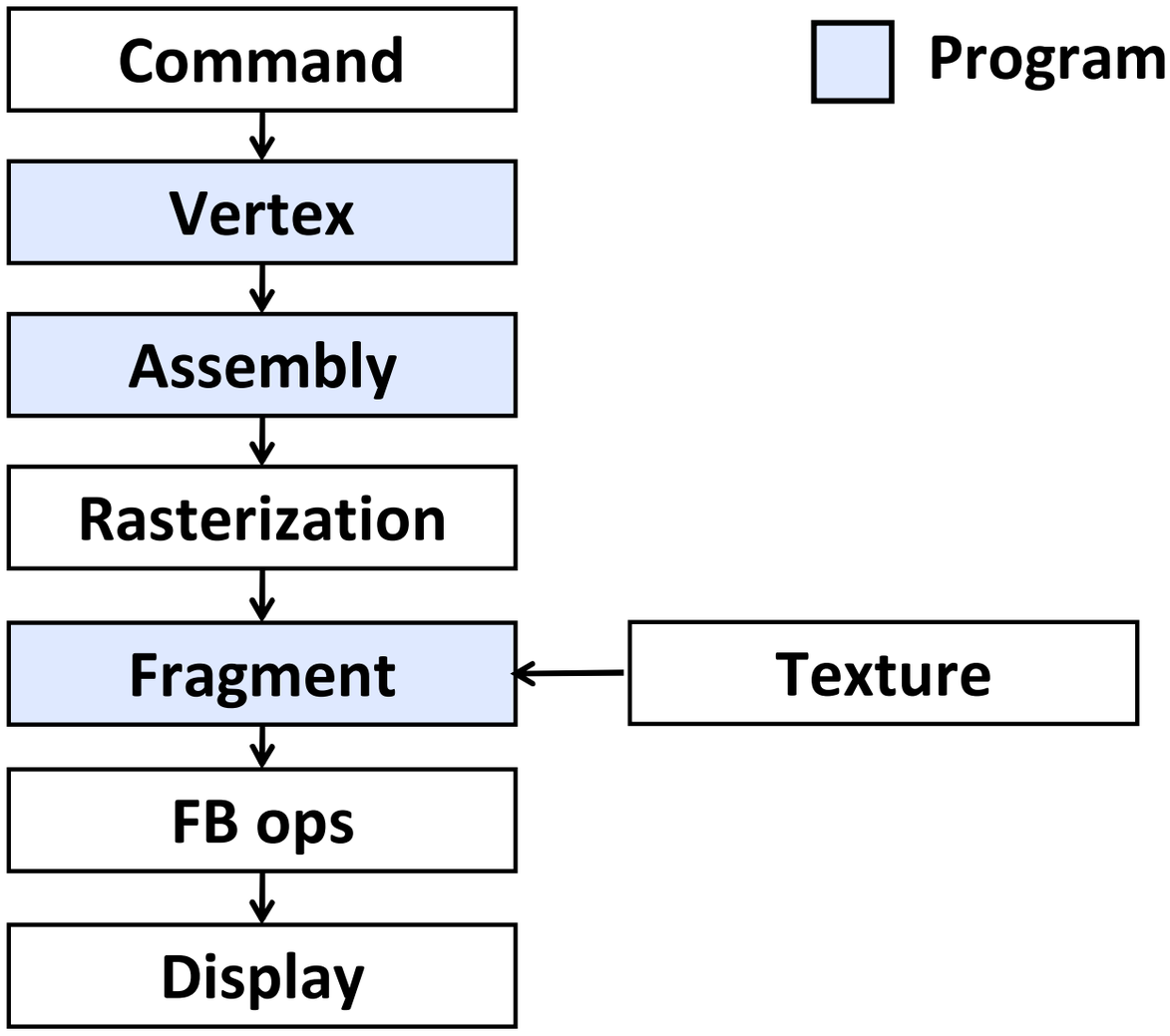
Programmable graphics pipeline



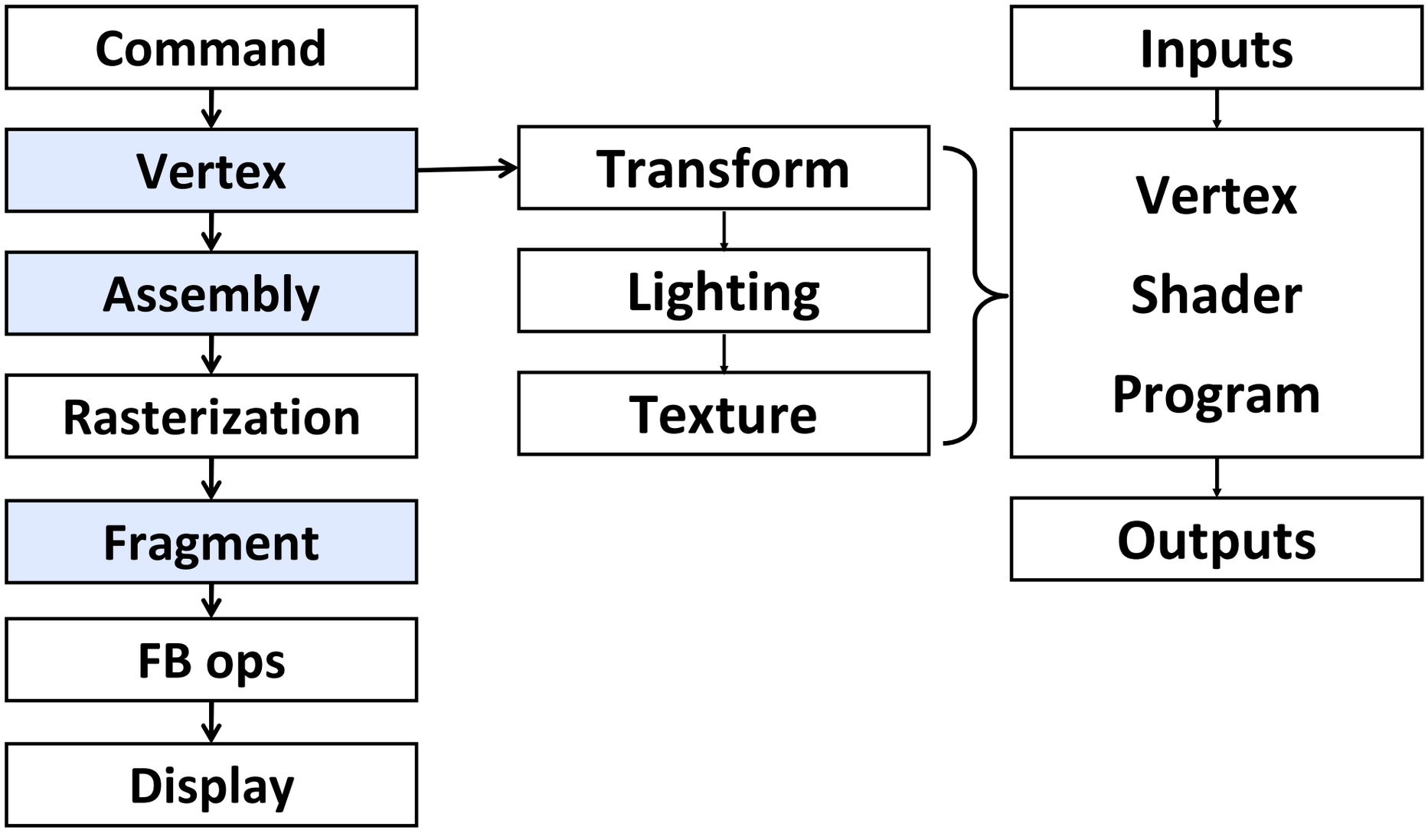
Programmable graphics pipeline



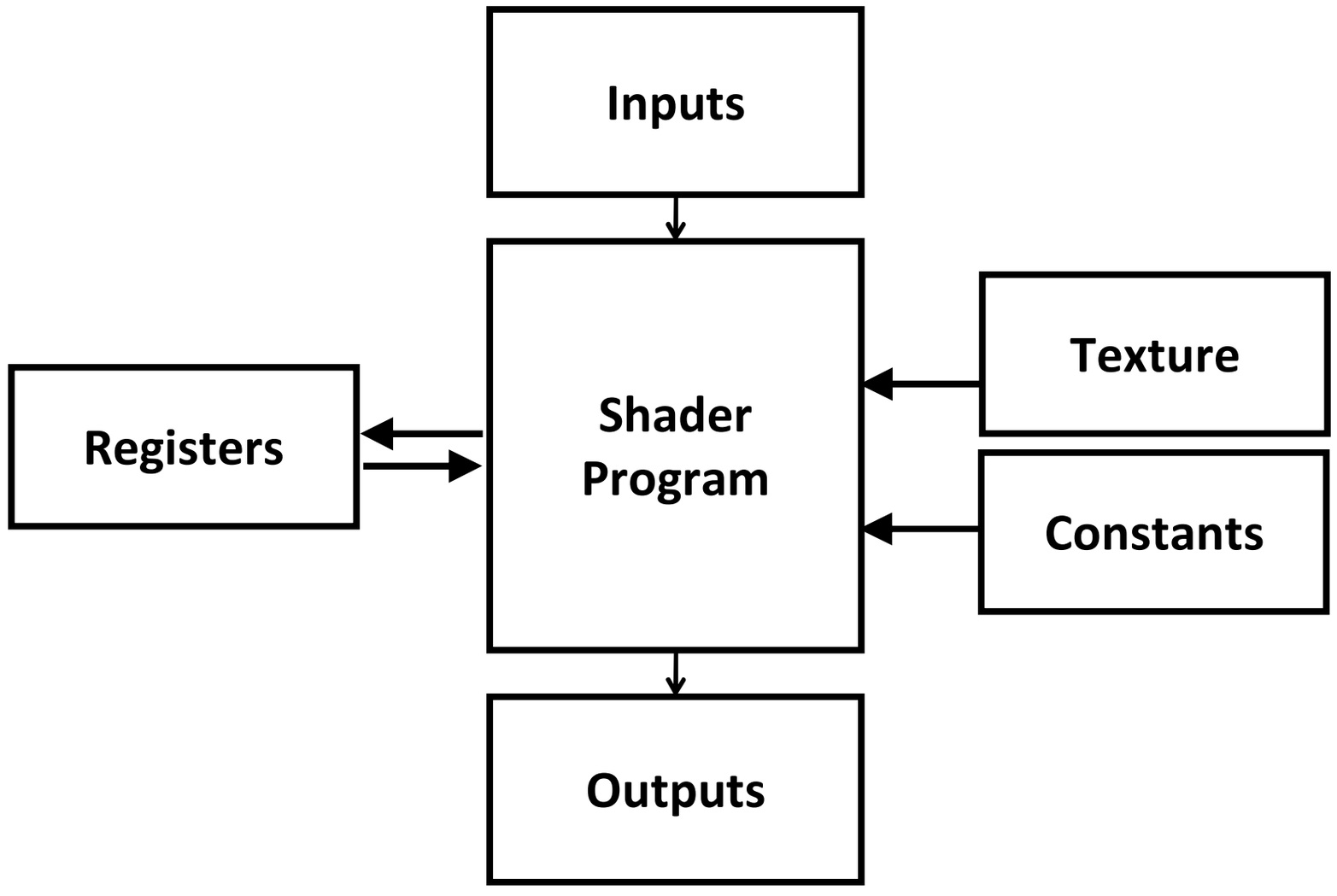
Programmable graphics pipeline



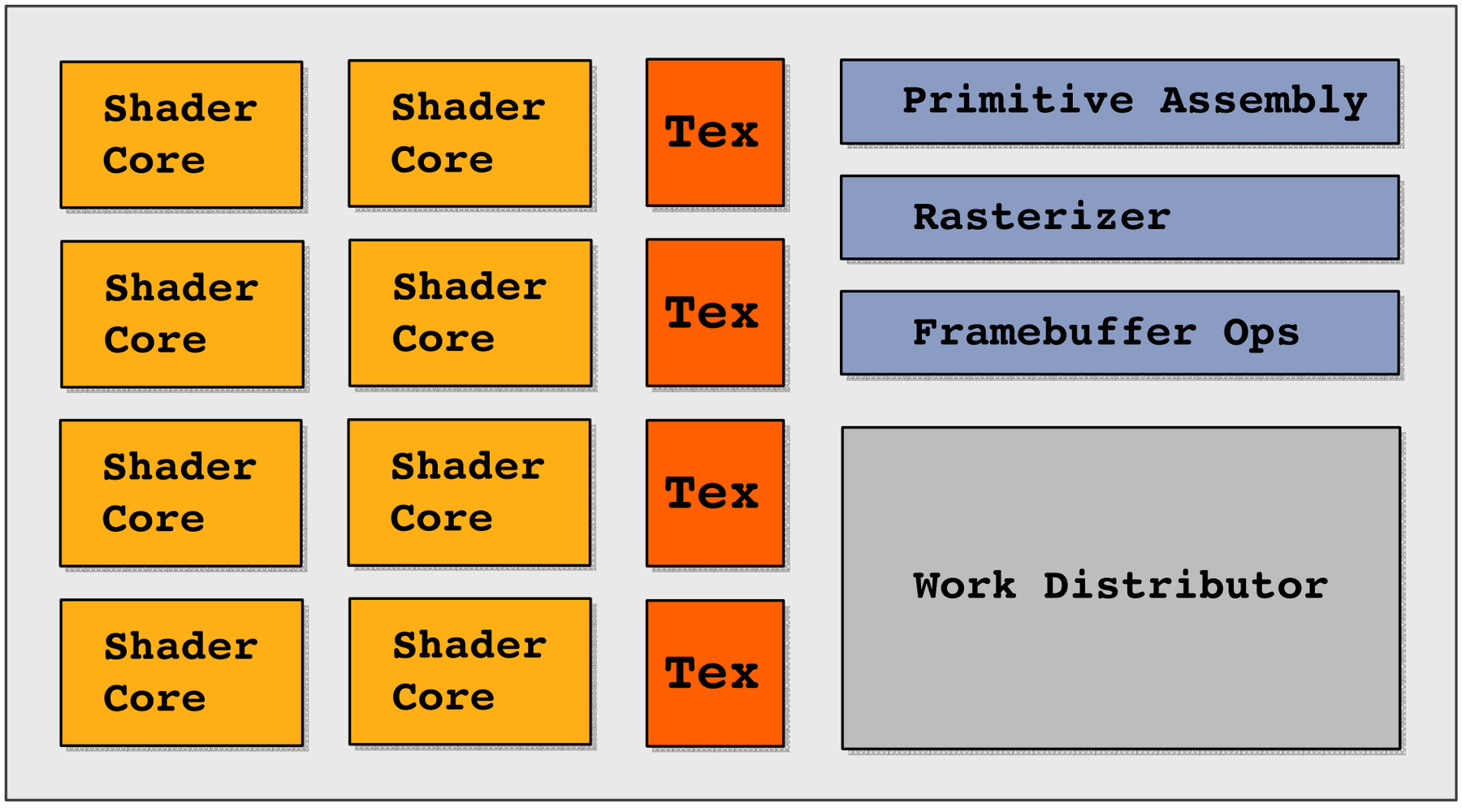
Programmable Graphics Pipeline



Shader Program Architecture



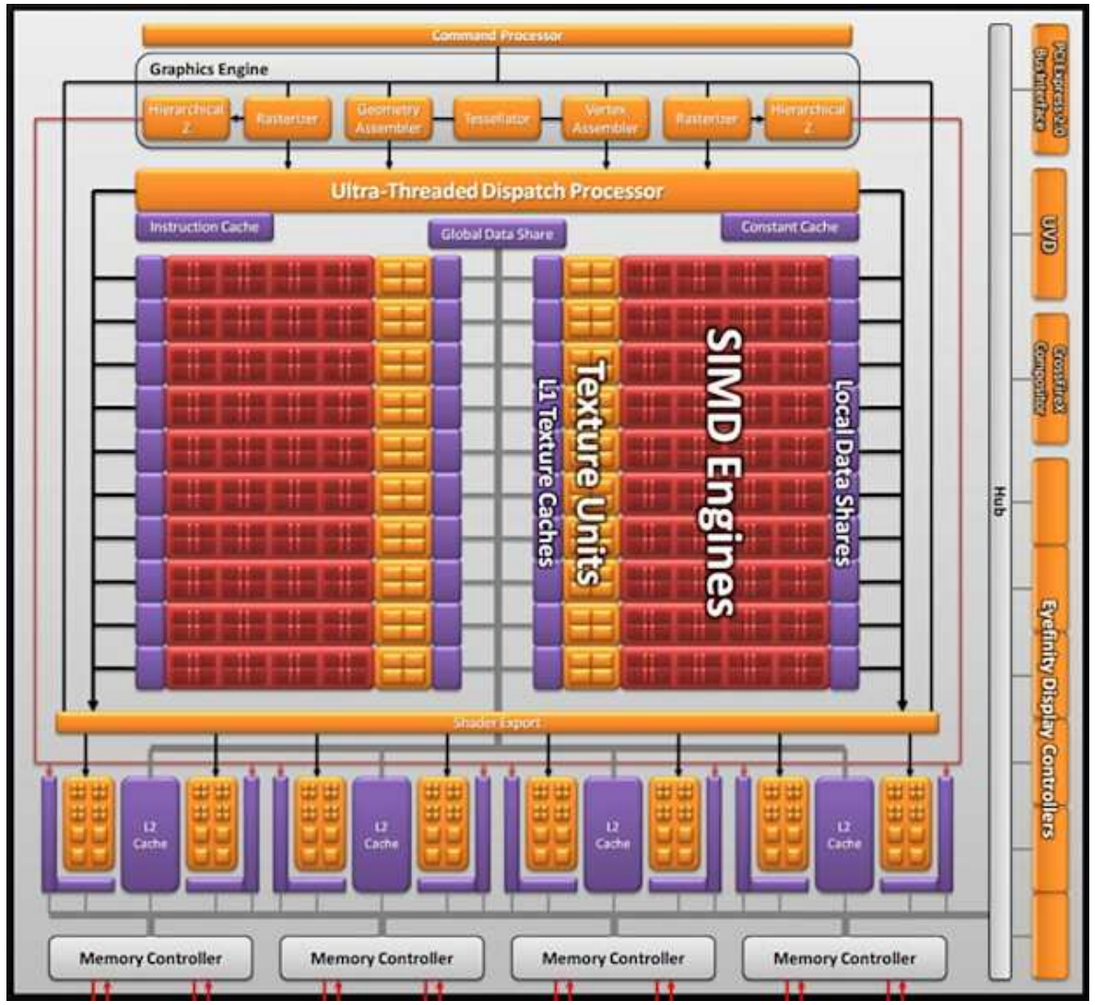
What's in a GPU?



What's in a GPU?

NVIDIA GF100

(GeForce GTX 480)



AMD Cypress

(Radeon HD 5870)

GLSL

Simple Vertex and Fragment Shaders

```
// simple.vert
void main()
{
    gl_Position =
      gl_ModelViewMatrix *
        gl_ProjectionMatrix * gl_Vertex;
    gl_Normal = gl_NormalMatrix * gl_Normal;
    gl_FrontColor = gl_Color;
    gl_BackColor = gl_Color;
}
// simple.frag
void main()
{
    gl_FragColor = gl_Color
}
```

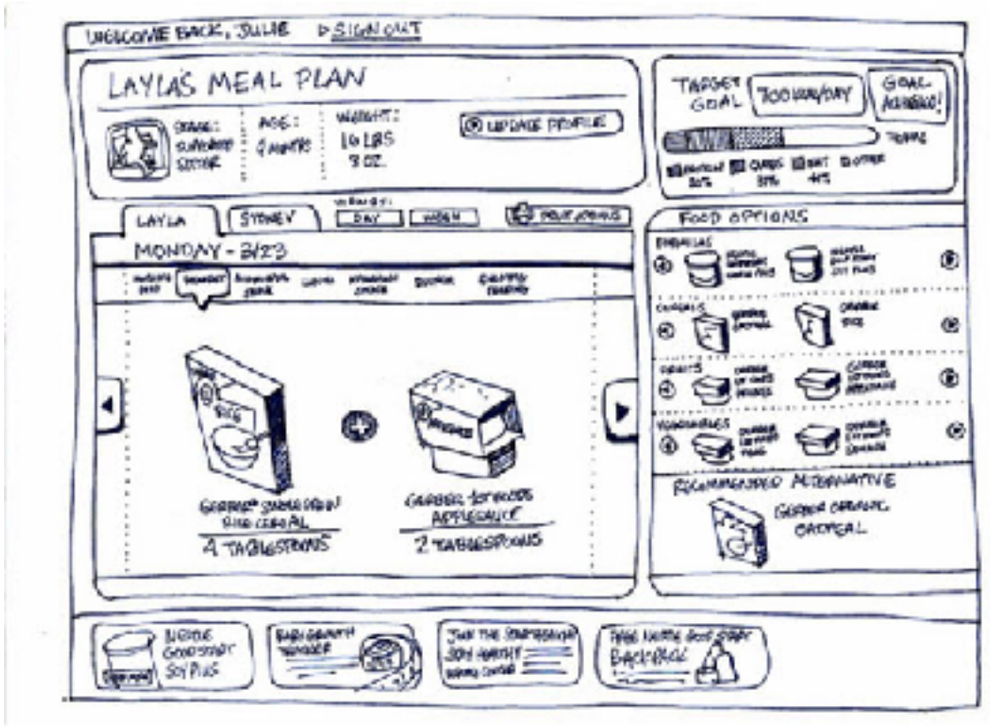
DEMO:WebGL

http://learningwebgl.com/blog/?page_id=1217

Things does not covered yet in the course

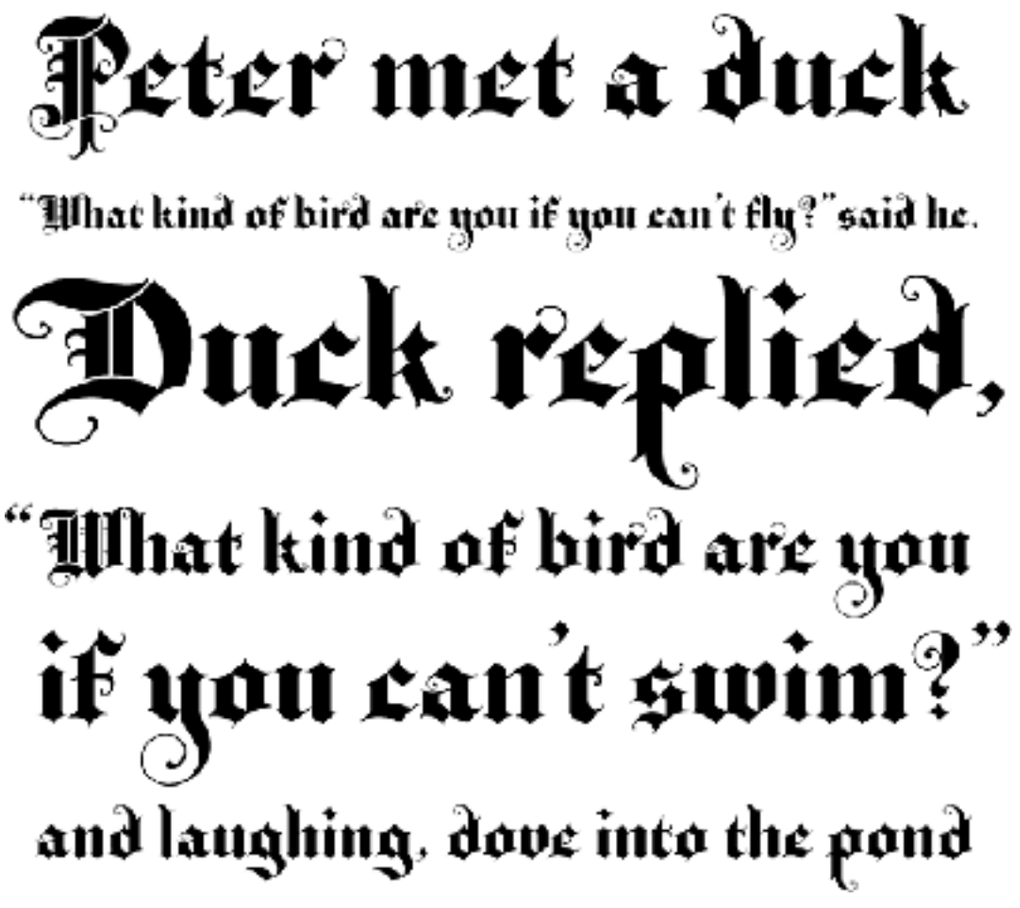
User Interface

- pick
- feedback
- special ui devices

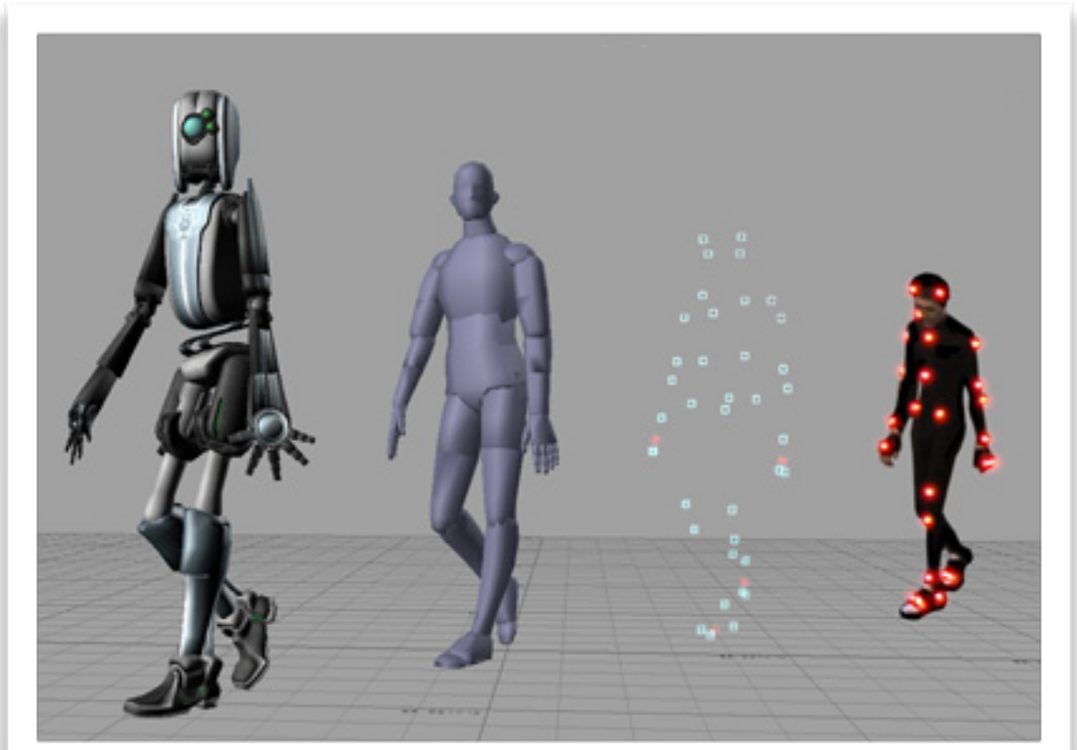


Text

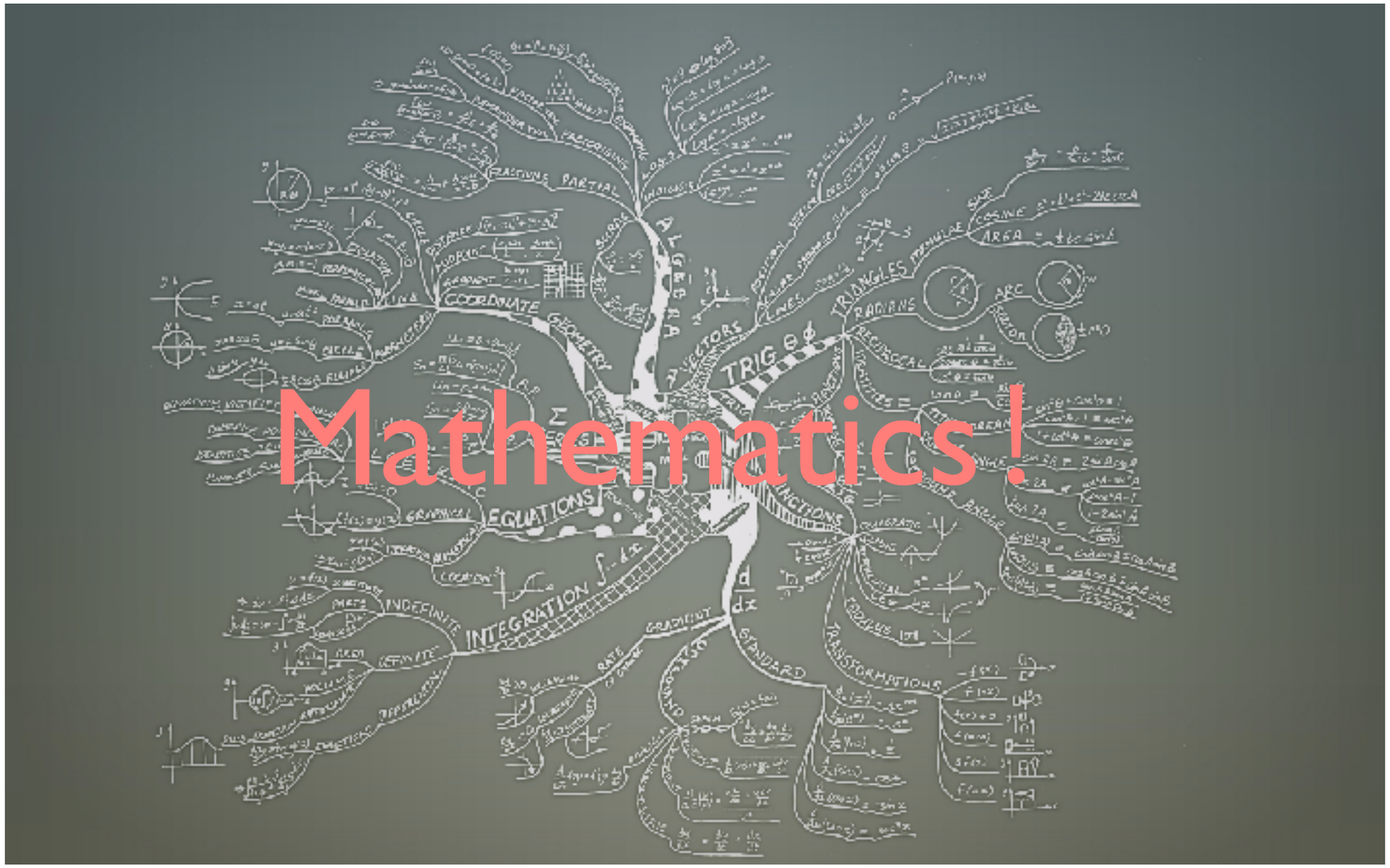
- The beautiful text once was a hot topic in computer graphics
  - font representation
  - antialias
  - encoding
  - ...



Computer Animation



One more thing ...



天真，热爱，实践，批判

This is not an end but a start

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