CPSC 314
02 – RENDERING PIPELINE
UGRAD.CS.UBC.CA/~CS314

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Sep 2016

PROGRAMMING ASSIGNMENT 1

- Is out!
- Due 23:59:59, Sep 30th
- Grace days: 3 per term – use wisely
  - Weekend doesn't count

- It will take time to set up the environment
- You will not be able to complete all until Lecture 4 or so

- ENJOY

ENVIRONMENT

- Write code in any text editor
  - Notepad++ (win)
  - Sublime text (any platform)
  - vim (linux)
- Handin
- After it's handed in, TAs will set up face-to-face time
- Labs starting next week

PIAZZA

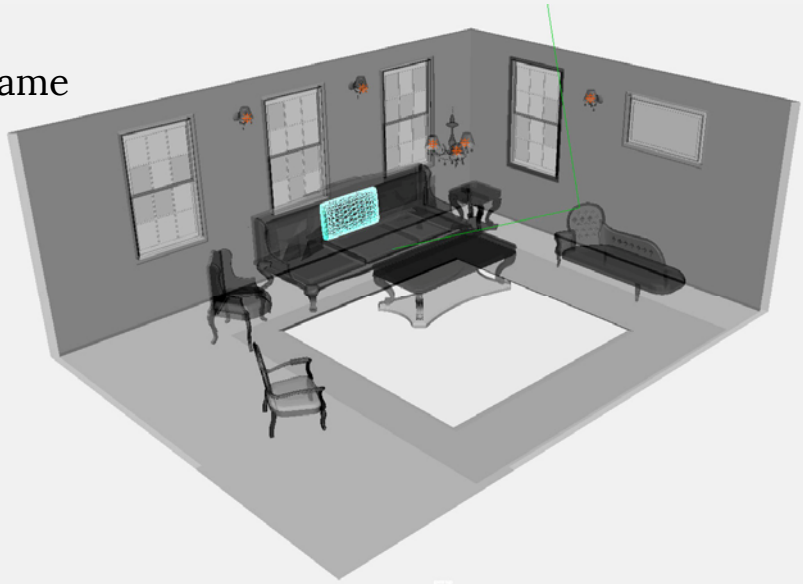
- Up and running
- Please sign up


WHAT IS RENDERING?
Generating image from a 3D scene

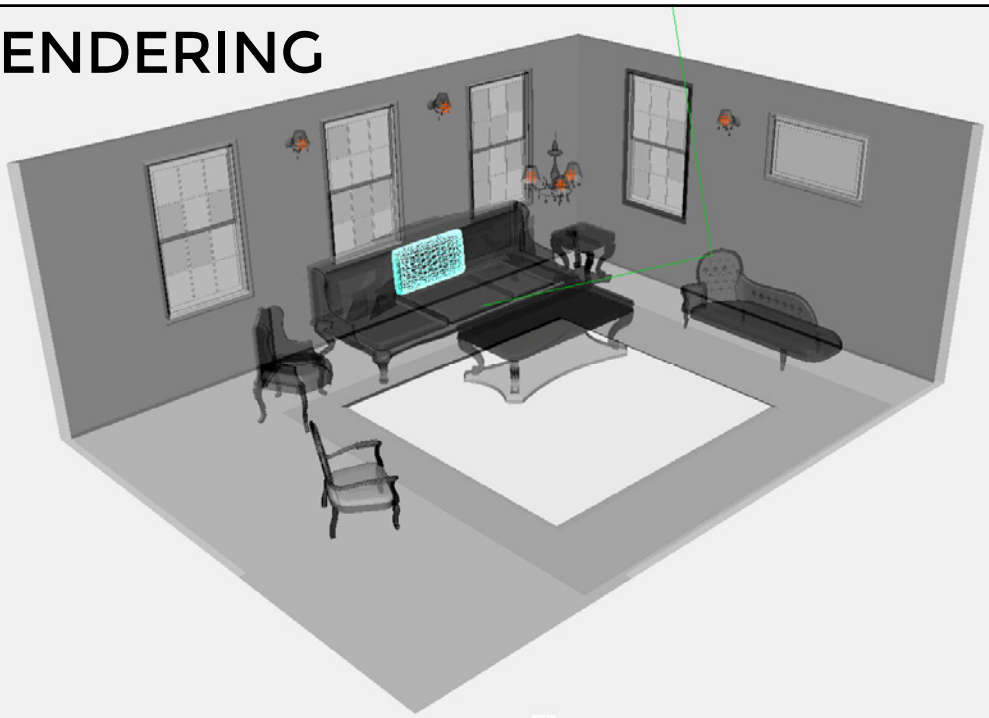

WHAT IS RENDERING?
Generating image from a 3D scene
Let's think HOW.

SCENE

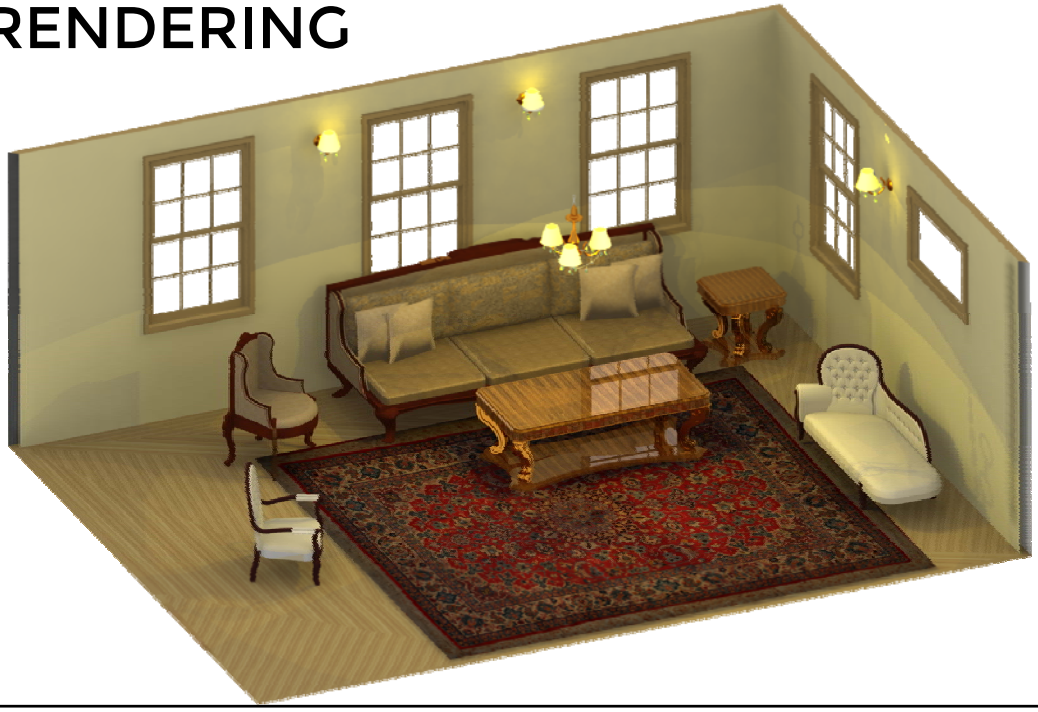
- A coordinate frame
- 3D objects
- Their materials
- Lights
- Cameras



RENDERING



RENDERING



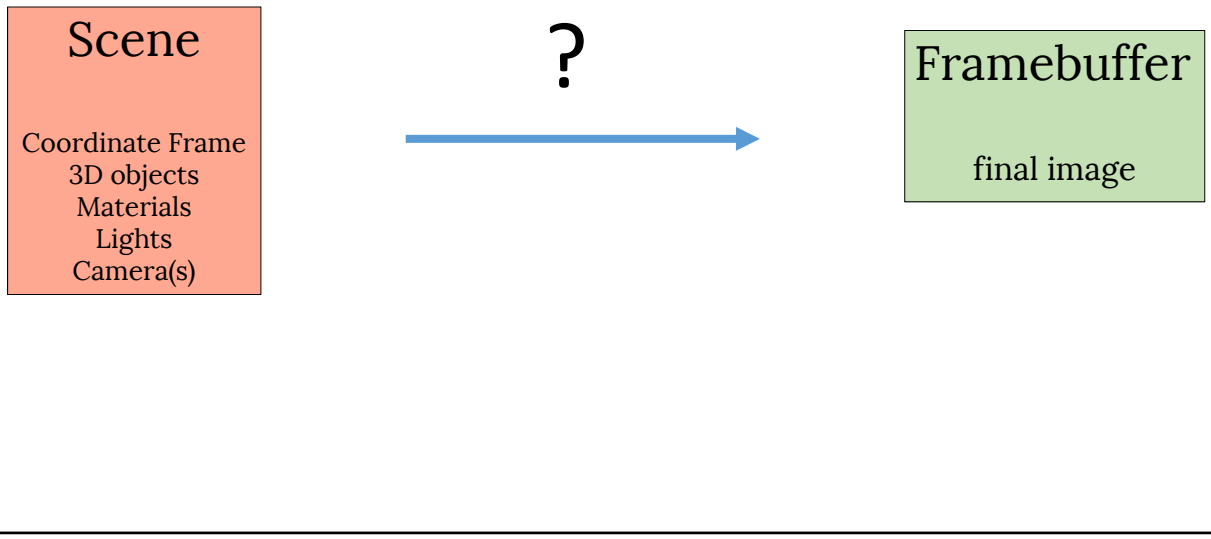
FRAME BUFFER

- Portion of RAM on videocard (GPU)
- What we see on the screen
- Rendering destination

SCREEN

- Displays what's in frame buffer
- Terminology:

Pixel: basic element on device
Resolution: number of rows & columns in device
Measured in
- Absolute values (1K x 1K)
- Density values (300 dots per inch)

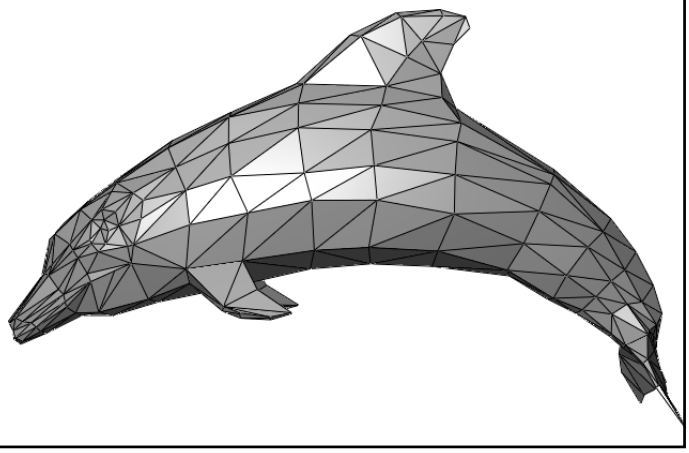


SINGLE OBJECT

- How to describe a single piece of geometry?

SHAPES: TRIANGLE MESHES

- Triangle = 3 vertices
- Mesh = {vertices, triangles}
- Example

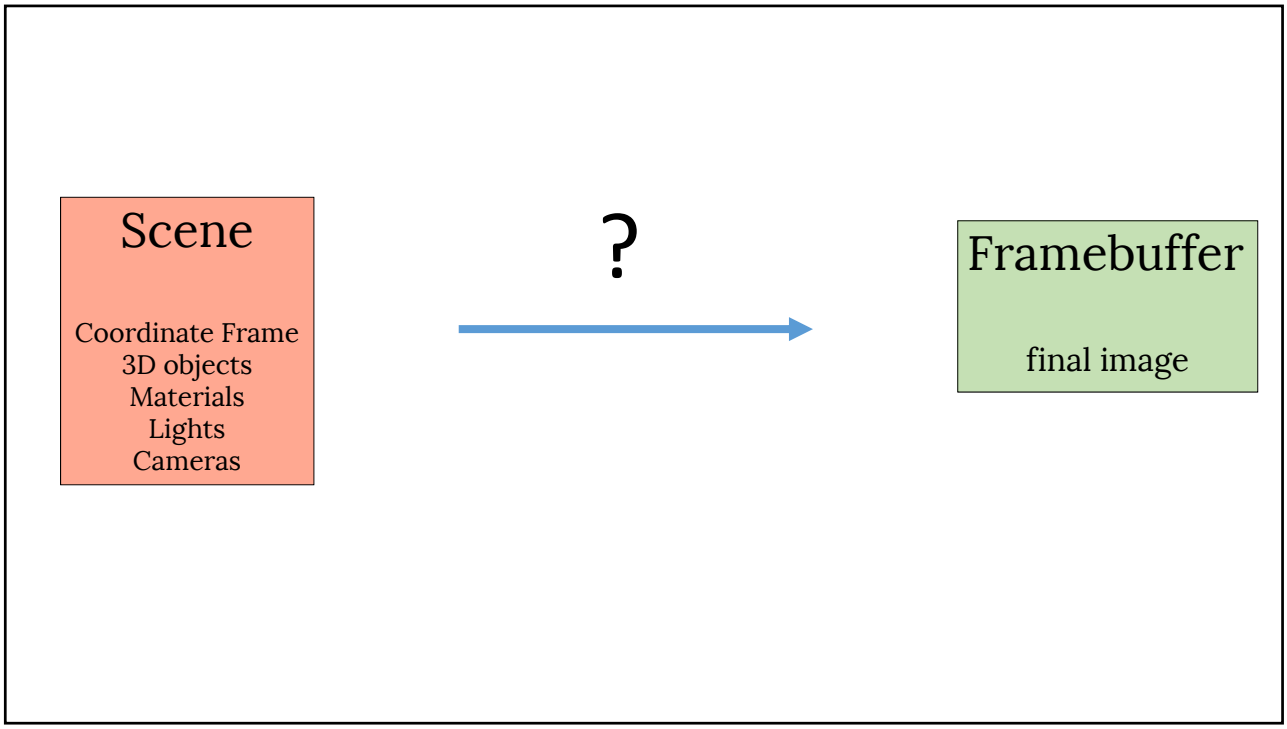


SCENE

- How to describe a scene?

SCENE

- How to describe a scene?
- Local Transformations



SKETCH OF A RENDERING PIPELINE

- Scene
  - Coordinate frame
  - 3D models
    - Coordinates
    - Local transforms
    - properties (color, material)
  - Lights
  - Camera

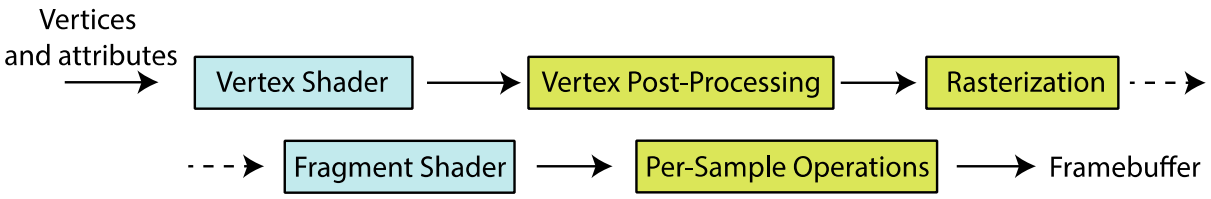
SKETCH OF A RENDERING PIPELINE

- **Scene**
  - Coordinate frame
  - 3D models
    - Coordinates
    - properties (color, material)
  - Lights
  - Camera
- **Camera View**
  - 2D positions of shapes
  - Depth of shapes
  - Normals
- **Image**
  - Shape pixels
  - Their color
  - Which pixel is visible

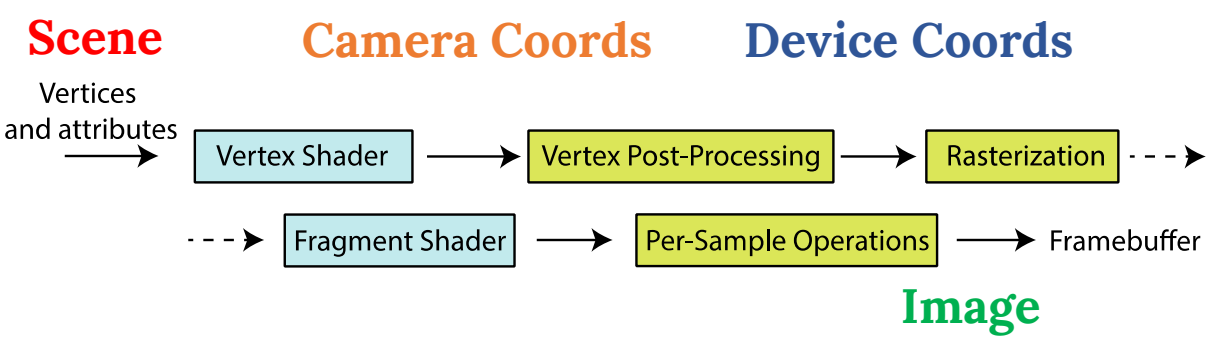
OPENGL/WEBGL

- Open Graphics Library
- One of the most popular libraries for 2D/3D rendering
- A software interface to communicate with graphics hardware
- Cross-language API

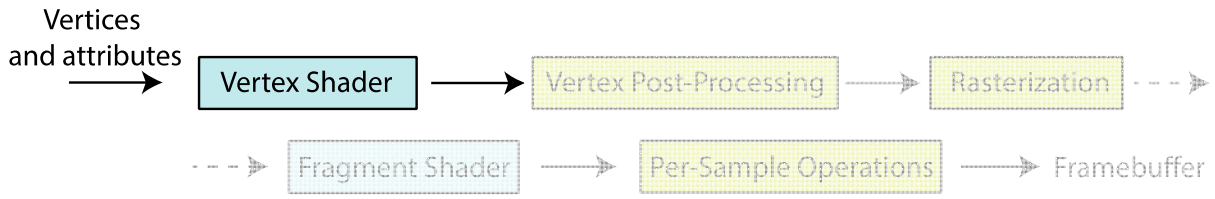
OPENGL RENDERING PIPELINE



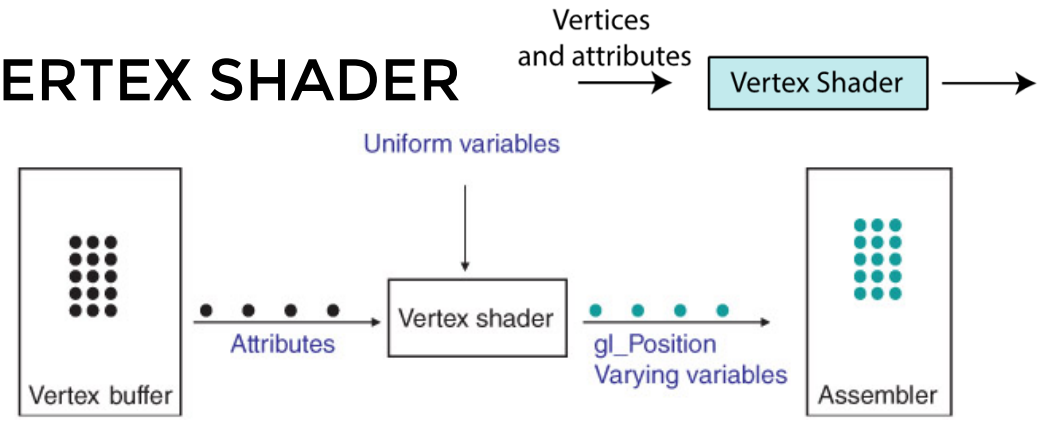
OPENGL RENDERING PIPELINE



VERTEX SHADER

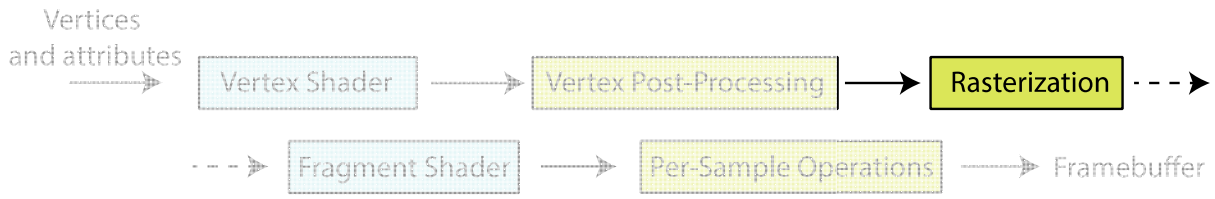


VERTEX SHADER

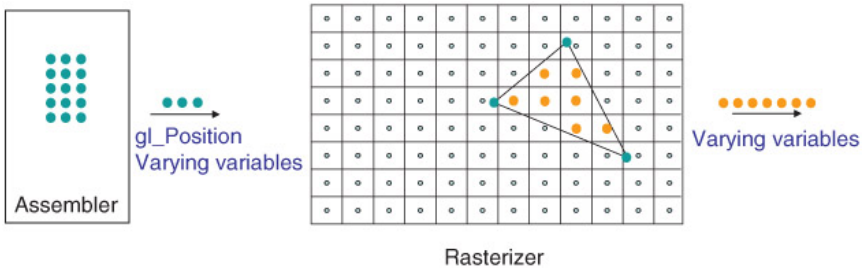


- Vertices are stored in vertex buffer
- Each one is processed by vertex shader
- Converts vertex into camera coordinates (View Coordinates)
- May compute per-vertex variables (normal, etc.)

RASTERIZATION

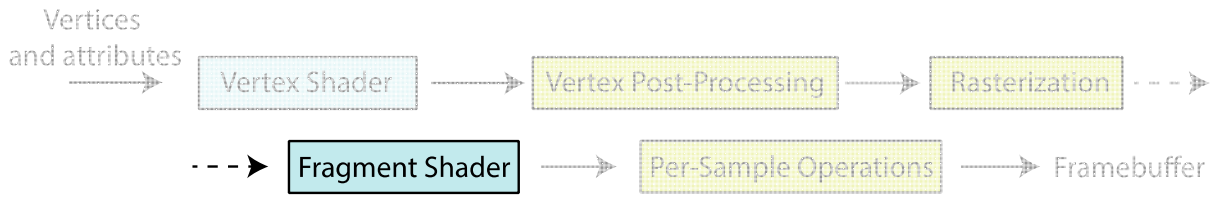


RASTERIZATION

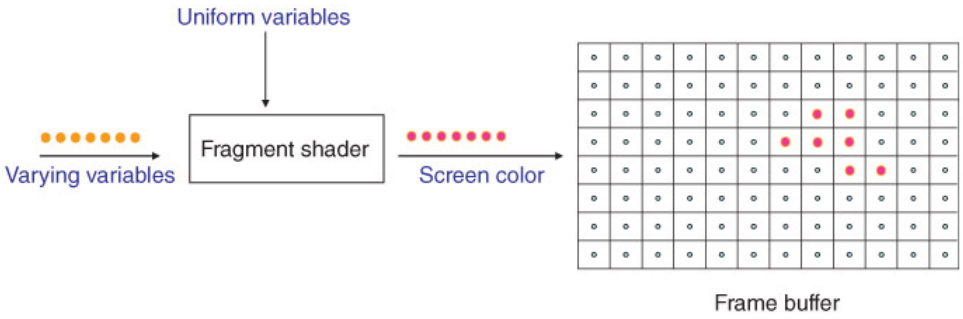


Places three 2D vertices on a virtual screen
Fills up the space between them
Interpolates per-vertex variables to get per-fragment vars

FRAGMENT SHADER



FRAGMENT SHADER



- Each fragment is passed through Fragment Shader
- Here it computes fragment color

FRAGMENT SHADER

- Can simulate different materials and lights