

CPSC 314

Computer Graphics

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Quiz 2 review, Multipass

NOTICE:

Recordings of the lecture are provided to students enrolled in the course for self-study only.
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Preliminaries

- Reminders and Announcements
 - Assignment 4 will be out today, due March 28
 - Updated “Notepack” available on Canvas, main page
 - Wednesday guest lecture (on Zoom)
 - Friday March 18th Quiz 2, in-person in ANGU 098
 - Monday March 21st 2nd Industry Lecture (from Skybox Labs)
- Today
 - Multipass Rendering and Assignment 4 intro
 - Quiz 2 coverage
 - Quiz 2 review
 - **This will primarily be a Q&A session.**

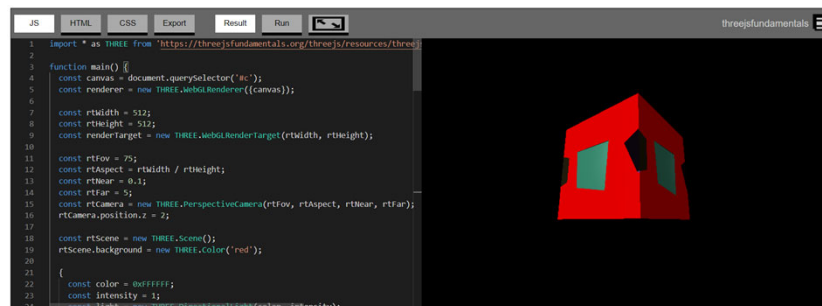
Multipass Rendering Assignment 4 intro

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Multipass Rendering

- Needed for Shadow Mapping (Read Textbook 15.5.2 for details)
- Feature of WebGL 2.0 (not available in 1.0)
- Good tutorial

<https://threejs.org/manual/?q=render#en/renderertargets>



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Multipass Rendering

1. Create a “render target” (and create a scene to render to it, as with frame buffer)

```
const renderTarget = new THREE.WebGLRenderTarget(rtWidth, rtHeight);
```

2. Utilize the image data in the render target as a texture, e.g., in the final scene

```
const material = new THREE.MeshPhongMaterial({  
  map: renderTarget.texture,  
});
```

3. In animation loop (“update”), first render to the render target

```
// draw render target scene to render target  
renderer.setRenderTarget(renderTarget);  
renderer.render(rtScene, rtCamera);  
renderer.setRenderTarget(null);
```

4. Finally render the scene to frame buffer that utilizes the render target texture

```
// render the scene to the canvas  
renderer.render(scene, camera);
```

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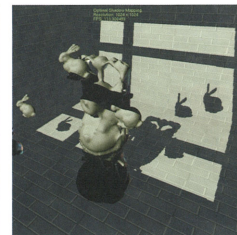
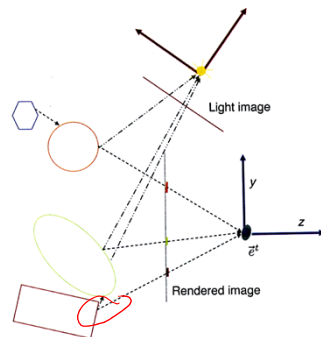
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- framebuffer blur effect demo



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Shadow mapping (from L21)

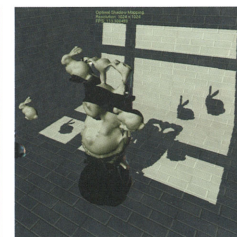
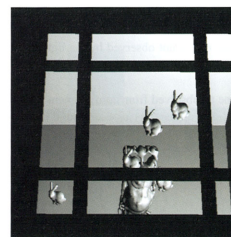
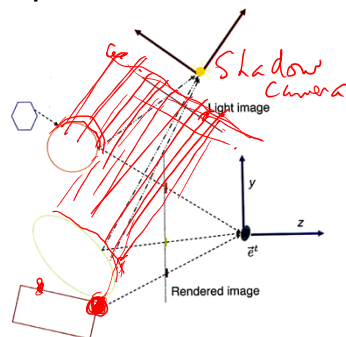
- First pass: create “shadow map”, a z-buffer image from the point of view of the light
- Second pass: check if fragment is visible to the light using shadow map.



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Shadow mapping

- If a point observed by the eye is not observed by the light, then there must be some occluding object in between, and we should draw that point as if it were in shadow.



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Shadow mapping

- In a first pass, we render into an FBO the scene as observed from some camera whose origin coincides with the position of the point light source. Let us model this camera transform as:

$$\begin{bmatrix} x_t w_t \\ y_t w_t \\ z_t w_t \\ w_t \end{bmatrix} = P_s M_s \begin{bmatrix} x_o \\ y_o \\ z_o \\ 1 \end{bmatrix}$$

for appropriate matrices, P_s and M_s .

Model View Matrix of Shadow Cam

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General tips

- Check out
 - THREE.DepthTexture (saves depth when using a render target)
<https://threejs.org/docs/#api/en/textures/DepthTexture>
 Use renderTarget.depthTexture as the shadow map
- How (and why) to set
 - lightProjMatrix and lightViewMatrix
 - Remember that after Projection Matrix, and “perspective divide” (not needed for the directional light/orthographic camera), fragment position is in Normalized Device Coordinates!
 - To get uv coords, convert range (-1,1) -> (0,1)

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- Assignment 4 demo

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Quiz 2 logistics

- Same rules as Midterm, Same location. Only change: No Type D question
 - On Canvas. Closed book, closed Internet except to access Quiz 2 page
 - Location: ANGU 098
 - Exam is for 50 minutes, during class
 - Budget 45 minutes for doing the quiz (One minute per mark)
 - 3 Types of Question (Parts A,B,C) as in Quiz 1
 - T/F questions
 - "Recognition" Fill in the blanks (with multiple choice).
 - "Computing" Solve a small problem, and select the correct answer.

Quiz 2 Topics

- Everything covered in class through March 14th, and Assignment 3
- Textbook. Read **ALL** of these, except as noted
 - Ch 14.2-14.3 Rendering (parts covered after midterm, Assignment 3)
 - Ch 15 Texture Mapping (main focus of quiz)
 - Ch 16-18 Sampling, MipMapping (at the level we covered in class; no integrals required)
also review
 - Ch 11 Depth *Shadows Maps*
 - Ch 12 Vertex to Pixel (focus on what is covered in class)
- **NOTE:** several topics are only covered in lectures (e.g., file formats, physically based rendering). Please follow lectures
Topics from Quiz 1 and midterm will be assumed as pre-requisites (e.g., it is assumed you now know coordinate frames, transformations, reflection, etc.)

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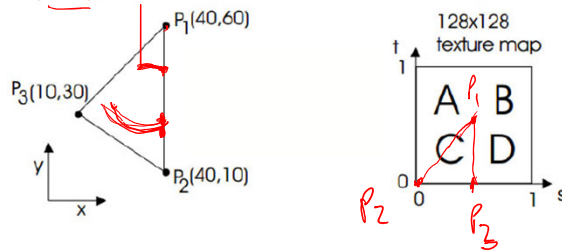


Call for Quiz question suggestions

- As you review the notes, think of questions that you wish you were tested on (within the constraints of an online test)
- Post these on Piazza to the folder “q2_questions”, for all to see (you can post anonymously)
- There are subfolders for Parts A-C: as in Quiz 1.
 - T/F questions
 - “Recognition” Fill in the blanks (with multiple choice).
 - “Computing” Solve a small problem, and select the correct answer.
- We may use some of the questions (if posted before midnight Wednesday)

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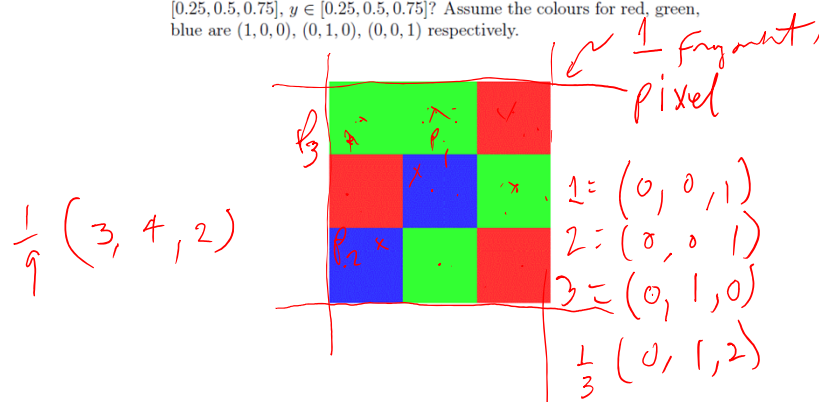
- (a, v)
- A texture with the letters "ABCD" is mapped onto the given triangle. The (s, t) texture coordinates of P_1 , P_2 , and P_3 are $(0.5, 0.5)$, $(0, 0)$, and $(0.5, 0)$, respectively. Draw the textured triangle.



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Sampling

Suppose we use over-sampling at points $P_1 = (0.4, 0.6)$, $P_2 = (0.3, 0.3)$, $P_3 = (0.2, 0.7)$, what is the output colour for the fragment in Figure? What if the sampling points are 9 points on a 3 by 3 grid at $x \in [0.25, 0.5, 0.75]$, $y \in [0.25, 0.5, 0.75]$? Assume the colours for red, green, blue are $(1, 0, 0)$, $(0, 1, 0)$, $(0, 0, 1)$ respectively.



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