Office Hours

• Now only 1 OH per week
  – Hank, Weds 230-330

• Abhishek still doing a lot...
If you make mistakes uploading textures, OpenGL often just defaults to the first texture.

Wanted: colored by texture1 and tiger striped by texture 2
Got: colored by texture1 and tiger striped by texture 1
3B (collisions) and 3C (level-of-detail) will be released today

Other projects are in progress
Plan – Parentheticals Are Likely to Change

- This went well before, let’s do it again

<table>
<thead>
<tr>
<th>Week</th>
<th>Sun</th>
<th>Mon</th>
<th>Tues</th>
<th>Weds</th>
<th>Thurs</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td></td>
<td>2B due</td>
<td>Lec13 (mouse+camera) (textures) 3A avail Proposals due</td>
<td></td>
<td>Lec14 (ray-tracing) Quiz 4 (GL)</td>
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<tr>
<td>9</td>
<td></td>
<td></td>
<td>Lec15 (textures) Live code 3B, 3C, ... avail</td>
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<td>Quiz 5 (project 1D)</td>
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<tr>
<td>10</td>
<td></td>
<td></td>
<td>More lecture</td>
<td></td>
<td></td>
<td>Quiz makeup</td>
<td></td>
</tr>
<tr>
<td>Finals Week</td>
<td></td>
<td></td>
<td>Final Projects due All other work due: 1A-1F, 2A-2B not accepted after this point</td>
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</tbody>
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Plan for Thursday

- Start at 9am
- 9am-9:15am: Q&A on miscellaneous topics
- 9:15am-9:45am: Quiz 4
- Arrive no later than 9:10am
Quiz 4

• This quiz will test what you learned in Project 1D.
• Sorry to be reaching back to a project from a month ago, but there is a concept there I want to do the quiz on
3.X

• 3B: collisions
• 3C: level of detail
Collision Detection
Collision Detection

- Collision detection: as objects in the scene move, figure out when they collide and perform appropriate action (typically bouncing)

- Game setting: 30 FPS, meaning 0.033s to figure out what to render and render it.
  → Need to do this quickly!
Collision Detection

• Two flavors:
  – A priori
    • before the collision occurs
    • calculate the trajectory of each object and put in collision events right before they occur
  – A posteriori
    • after the collision occurs
    • with each advance, see if anything has hit or gotten close
How to Do Collision Detection: Brute Force

• For each object X
  – For each other object Y
    • Check if X and Y collide

• $\mathcal{O}(n^2)$
How to Do Collision Detection: Spatial Search Structures

• Divide volume into many cubes
• Place each object into its cube
• For each cube
  – Check to see if objects in cube have collided
  → O(n)
  – ... Sort of / kind of / not really
  • How many cubes?
  • What is they all end up in the same cube
  • So maybe expected run time is O(n).
• Brute force on collision detection
  – Few enough objects that spatial search structures are not needed
• But nice effects for colliding balls
Level of detail (LOD) techniques

- **Level of detail**: decreasing the complexity of some 3D object representations, because they
  - are far away
  - are moving fast
  - are not important

- Increases the efficiency of rendering by decreasing the workload on graphics pipeline stages
  - Reduced visual quality of the model is often unnoticed because of the small effect on object appearance when distant or moving fast
Types of LOD

- Two types:
  - Discrete LoD (DLoD)
  - Continuous LoD (CLoD)
Discrete LoD (DLOD)

- Make a fixed amount of models, ranging from highest quality to coarse approximation & render appropriate one based on importance factor
- Fastest in practice, but leads to “popping”
<table>
<thead>
<tr>
<th>Rendered images</th>
<th>Brute</th>
<th>DLOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Render time</td>
<td>27.27 ms</td>
<td>1.29 ms</td>
</tr>
<tr>
<td>Scene vertices</td>
<td>2328.48</td>
<td>109.44</td>
</tr>
</tbody>
</table>

**Discrete LoD example**
OK, how do we create coarse versions?

- How do we take and make these?

  - Answer: surface decimation (can lecture on this later)
- Have 3 levels of details for spheres
- Render closer spheres at high LOD, further away at low LOD