Announcements

- Quiz 1 preparation tips
- Assignments
  - Please do not miss your face-to-face grading time! If you need to reschedule, do it at least a day in advance. No-show Policy: unless you have a documented excuse, 15% deduction from the max grade for that assignment.
  - Lateness policy: up to three days in the entire term Submit well before your grading time slot
- Today:
  - Essential math for graphics
    (read Textbook Chapter 3)
Quiz 1 Preparation

- CAREFULLY review lecture notes, and assignment 1
- Textbook. Read all of these, except as noted. But use class notation (see L4 and today for differences).
  - Ch 1
  - Ch 2: skip Eq. 2.5
  - Ch 3: skip Section 3.6

Quiz Format

- The Quiz is closed book, closed electronic device (laptops, phones, etc. should be out of sight).
- 45 marks (in 45 minutes. Please be on time, will start at 10!)
- Three types of questions
  - small questions (fill in the blank, many choices given) “Can you recognize the concepts?”
  - direct questions (write down short answer) “Do you understand the concepts?”
  - problem solving questions “Can you use your knowledge in a new situation?”
Quiz Format

- The first two question types are meant to be easy. Try to go through them quickly, so that you have time to think about the problem solving questions at the end.
- Some questions may have multiple parts that build on one another. Answer for part (a) is used in part (b), etc. Even if the answer for (a) is incorrect, you can get credit for later parts if you show your steps (i.e., later parts will be graded on the subsequent logic).

Quizzes will be scanned and returned electronically

**Important notes about this examination**
1. This exam has 2 separate parts. Part A is 25 minutes and Part B is 90 minutes.
2. This exam will be graded largely on how well you follow the design recipes. You have been given a copy of the Recipe Exam Sheet. Use it!
3. Put away books, papers, laptops, cell phones... everything but pens, pencils, erasers and this exam.
4. Good luck!

**Student Conduct during Examinations**

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**Please do not write in this space**

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2017-09-18
### Important Notation

<table>
<thead>
<tr>
<th>Us</th>
<th>Book</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \vec{p} )</td>
<td>Point</td>
</tr>
<tr>
<td>( \vec{r} )</td>
<td>Vector</td>
</tr>
<tr>
<td>( \vec{a} )</td>
<td>Column matrix ( \begin{pmatrix} a_1 \ a_2 \ a_3 \end{pmatrix} )</td>
</tr>
<tr>
<td>( \vec{a}^+ )</td>
<td>Row matrix: ((a_1, a_2, a_3))</td>
</tr>
<tr>
<td>( \vec{b} )</td>
<td>Row of vectors ( (\vec{b}_1, \vec{b}_2, \vec{b}_3) )</td>
</tr>
<tr>
<td>( \vec{b}^+ )</td>
<td>Coordinate matrix ( \begin{pmatrix} \vec{b}_1 &amp; \vec{b}_2 &amp; \vec{b}_3 \end{pmatrix} )</td>
</tr>
</tbody>
</table>

\[
\begin{pmatrix} \vec{b}_1 \\ \vec{b}_2 \\ \vec{b}_3 \end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{pmatrix}
\]

This is also how GLSL represents matrices

- `mat3 b;
- `b[0]` → First column of `b`
- `vec3 a;
- `b + a` → Vector addition
- `a * b;` → Matrix multiplication

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Examples

§ Scaling

\[ \vec{v} = \frac{1}{2} \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix} \]

Uniform

\[ \alpha \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \]

or

\[ \begin{bmatrix} 2 \\ 2 \end{bmatrix} \]

Notation: [Blank means '0'

≠ means non-zero]

Non-uniform

\[ \begin{bmatrix} 3 \\ 2 \\ -3 \end{bmatrix} \]

§ Reflection

E.g. in the \((\vec{b}_2, \vec{b}_3)\) plane

Reflected

\[ \vec{v}_{\text{new}} \]

\[ \vec{b}_1 \]

\[ R = \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} \]

\[ \vec{v}_{\text{new}} = R \cdot \vec{v} = \begin{pmatrix} -v_1 \\ v_2 \\ v_3 \end{pmatrix} \]

§ Rotation

(Next Class?)
Affine Space

(Read Ch. 3)

Translation

Recall

\[ \vec{p} = \vec{b}_0 + \vec{v} \]

Using a basis for the vector space

\[ \vec{p} = b_1 \vec{v}_1 + b_2 \vec{v}_2 + b_3 \vec{v}_3 + b_0 \vec{1} \]

“Frame”

“Affine frame”

\[ \vec{p} = \begin{pmatrix} \vec{b} \\ \vec{v} \end{pmatrix} \]

“Homogeneous” coordinates of a point

\[ \frac{\vec{a}}{\vec{b}} = \frac{\vec{v}}{\vec{w}} \text{ such that } \vec{b} + \vec{v} = \vec{a} \]

\[ \frac{1}{\vec{a}} = \vec{a} \]

\[ \vec{a} = \vec{b} + \vec{v} \]