Lab Goals

- Write a `Matrix` class in Processing
- Solve some math challenges

Assignment Details

In the past week of lecture, we created a class-based bouncing ball simulator and then spent two lectures reviewing some topics from linear algebra that we will use throughout the semester. Time to put that knowledge to use!

A Matrix Class (20 points)

Matrix multiplication is used heavily in the field of computer graphics. In fact, your computer’s GPU is just a specially busy CPU that is tailored to do matrix multiplication very quickly, rather than to adapt to many different applications. We use matrices to apply transformations to one or more points, so that we can manipulate objects in 2D and 3D space.

In this section, you will write a `Matrix` class in Processing, that we can use later in the semester for other projects. The `Matrix` class should support two basic functions, `add` and `multiply`. In both, the inputs to the functions will be a pair of matrices of unknown dimensions, and the output will be the matrix that results from the given operation.

Thus, your function definitions should be something similar to:

```
Matrix addMatrices(Matrix m1, Matrix m2)
```

and

```
Matrix multiplyMatrices(Matrix m1, Matrix m2)
```

Your `Matrix` class should be `float`-based, storing floating-point numbers. The constructor should hence initialize a two-dimensional array of `floats` to a provided number of rows and columns:

```
Matrix(int rows, int columns)
```

Please test your code, and provide test cases to prove that it works as intended!
Some math problems (30 points)

For three points each, please answer the following:

1. \[
\begin{bmatrix}
12 \\
17 \\
-3
\end{bmatrix} + \begin{bmatrix}
-6 \\
1.2 \\
-1
\end{bmatrix}
\]

2. \[
5 \left( \begin{bmatrix}
8 \\
-7 \\
-3
\end{bmatrix} - \begin{bmatrix}
0 \\
2 \\
-1
\end{bmatrix} \right)
\]

3. Express \[
\begin{bmatrix}
5 \\
2 \\
-4
\end{bmatrix}
\] in terms of basis vectors \[
\begin{bmatrix}
1 \\
0 \\
0
\end{bmatrix}, \begin{bmatrix}
0 \\
1 \\
0
\end{bmatrix}, \text{ and } \begin{bmatrix}
0 \\
0 \\
1
\end{bmatrix}
\]

4. Find the length of vector \[
\begin{bmatrix}
5 \\
3 \\
1
\end{bmatrix}
\]

5. Find the angle between vectors \[
\begin{bmatrix}
12 \\
17 \\
-3
\end{bmatrix} \text{ and } \begin{bmatrix}
-6 \\
1.2 \\
-1
\end{bmatrix}
\]

6. \[
\begin{bmatrix}
12 \\
17 \\
-3
\end{bmatrix} \times \begin{bmatrix}
-6 \\
1.2 \\
-1
\end{bmatrix}
\]
7. Find the surface normal for the face that includes points $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$, and $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$.

8. $\begin{bmatrix} 5 & 7 \\ 1 & -8 \end{bmatrix} \begin{bmatrix} 3 \\ 2 \end{bmatrix}$

9. $\begin{bmatrix} 3 & 5 & 2 \\ 2 & 1 & -4 \end{bmatrix} \begin{bmatrix} 4 \\ 2 \\ 3 \end{bmatrix}$

10. $\begin{bmatrix} 1 & 3 \\ 5 & 7 \\ 9 & 11 \end{bmatrix} \begin{bmatrix} 12 & 10 & 8 \\ 6 & 4 & 2 \end{bmatrix}$

**Submission Details**

For this assignment, please submit the following items which you have followed while completing this lab in paper form. Also, please upload these same items to your cs382f2015-<your user name> repository. Your submission should include the following:

1. The commented source code for your Matrix class
2. The answers to the math problems from the second section
3. An Assignment Information Sheet

**Additional Group Requirements**

You are welcome to submit this assignment on your own, or in a group with one other person. In cases of groups, I would prefer one experienced programmer and one inexperienced programmer in the group, but this is not an absolute requirement. Additionally, each group need only submit one paper copy of their work, but each member of the group should push all items to their own repositories.

Finally, each group must create a short document (0.5-1 pages) detailing the work breakdown of the group members: who worked on which components, which lines of code belong to each group member, etc. Comments in the code will help here too.