CS 251: Simple Science: [Tools] Octave

- Handed out: 7/25 Due: 7/27 11pm
- Please write (only if true) the honor code. If you used any source (person or thing) explicitly state it. You can find the honor code on the web page.

Overview

The goal of this assignment is to make you familiar with a scientific computing environment like Matlab/Octave. Octave is well documented at `http://www.gnu.org/software/octave/octave.pdf`. You will need mainly for, while, if, fopen, scanf – all similar to standard C. In addition, you will need some math/science related functions.

The goal is not to do any significant science, but you may be inspired by the tasks mentioned below. For example, see this (completely optional) `http://math.stackexchange.com/questions/150242/teenager-solves-newton-dynamics-problem-where-is-the-paper`

Tasks:

1. Dart Game: In this problem, you are asked as input where you are (x_0, y_0), and with what velocity v you can throw a dart so that a target position (x_f, y_f) can be reached. Write a script `ProjectileMotion.m` which outputs legal launch orientation, if any, to achieve this goal. Assume that diameter of the bullseye of dartboard is 0.06 units . Consider three subcases. (Notation: t, time, g, acceleration due to gravity, θ, orientation, and k: drag coefficient set to 0.05 here).

   - **Case I:** Assume there is no air resistance. The equations that you will need: (you don't but lets go with it).

   $$x(t) = vt\cos\theta + x_0 \quad (1)$$
   $$y(t) = vt\sin\theta - \frac{1}{2}gt^2 + y_0 \quad (2)$$

   - **Case II:** Assume 'Stokes Law' i.e. air resistance with force F $\propto$ v. The equations that you will need: (make sure you know how to derive this)

   $$x(t) = \frac{v\cos\theta}{k}(1 - \exp(-kt)) + x_0 \quad (3)$$
   $$y(t) = \frac{v\sin\theta}{k}(1 - \exp(-kt)) + \frac{g}{k^2}(1 - kt - \exp(-kt)) + y_0 \quad (4)$$

   - **Case III:** Assume air resistance such that Force F $\propto$ v^2 . The equations that you will need: (again make sure you know how to derive this)

   $$x(t) = \frac{1}{k}\ln(ktv\cos\theta + 1) + x_0 \quad (5)$$
   $$y(t) = \frac{1}{k}\ln\frac{\cos(\sqrt{gk}\ t - \arctan(\sqrt{\frac{k}{g}}v\sin\theta))}{\cos\arctan(\sqrt{\frac{k}{g}}v\sin\theta)} + y_0 \quad (6)$$

   Input: position, velocity, target
   Assumed: g, k, bullesye diameter
   Output: Report all angles rounded to a hundredth of a radian.

2. Pagerank. An Internet digraph is a digraph in which every node has no self edges, and every node at least one outgoing edge. Let k_j be the outdegree of j^{th} node of the graph. The connectivity matrix C is then given by,

$$C_{ij} = \begin{cases} \frac{1}{k_j}, & \text{if } j \text{ points to to } i \\ 0 & \text{otherwise} \end{cases}$$

The Simple Pagerank of a set n of pages is a normalized eigenvector associated with the eigenvalue $1 + c$ where $c = 0.15$ is a constant.

Wikipedia consists of around five million webpages. A smaller version of Wikipedia has been provided to you in the form of an adjacency graph: `./data/small.txt`.

The format of the file is,

```
dst1 dst2 dst3 ...
dst4 src1 ...
...
```

This excerpt says that the first page (assumed to be with id 1) points to `dst1`, `dst2` and so on.

Write an octave program `pagerank.m` that compute the page rank as discussed in the class. Output the page number of top 20 pages along with their page ranks.

Input: File "small.txt", standard input value of c
Output: Page Id, Page Rank.

Aside: You may be able to see the original Wikipedia page by looking at `titles-sorted.zip` in the data directory. There are many missing pages in the provided adjacency graph because the data has been reduced from approx 5×10^6 to 10^3 by taking the (last) least three significant digits (for the purpose of this assignment).

Additional Info: There are several, see for example, `http://blog.xebia.com/2011/09/27/wiki-pagerank-with-hadoop/`

Submission Guidelines:

1. When you submit, please document individual percentages such as Student 1: 80%, Student 2:100%, Student 3:10%. In this example, the second student will get full marks, i.e., 10/10 and the first student will receive 8/10.

2. Do include a `readme.txt` (telling me whatever you want to tell me including individual percentages). Do include group members (name, roll number), group number, honour code, citations etc. Make sure that numbers are in sorted ascending order.

3. Place `ProjectileMotion.m` and `readme.txt` in one folder and compress it. The compressed version should be identifiable. For example folder should be named `lab01_group07_final` and the related `tar.gz` should be named `lab01_group07_final.tar.gz`

How We will Grade You

Numbers below are positive marks. When necessary, negative marks are mentioned. These are approximate numbers and guidelines.

1. Honor code, and package complete in all respects +10 (This is an early assignment submission, and we want to make sure that you are careful in submitting your material). Incorrect, or incomplete -10

2. Relevant comments in code: 5 points. Don't put comments just for the sake of it (e.g. "This line has a comment")

3. Projectile

    - Script works for Case I: 30 point
    - Script works for Case II: 30 points
    - Script works for Case III: 30 points

4. Pagerank: 50 points