Concordia University

COMP 477 - 6311

Animation for computer games

Prof. Tiberiu Popa

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Purpose

This homework will give you the opportunity to acquire practical experience with Hierarchical Modelling and Linear Blend Skinning. This is a programming assignment which requires you to write a program that deform a character using skeleton deformations and linear blend skinning.

Submission

The assignments must be done individually. On-line submission is required - a hard copy will not be read or evaluated. The code must compile and run on the Windows machine in the lab. Evaluation is based on functionality ONLY (i.e. we will not look at partial code). The only time we look at the code in detail is to detect plagiarism. Submission deadline is Wed Oct 5th, 1pm EST. No late submissions or extensions allowed.

What's given to you already

You are given a simple application that opens a geometric model and a skeleton model and renders it in an OpenGL window. You will also be given in a different file blending weights that binds the mesh to the skeleton.The code was compiled and run in your lab. You can download a copy of this code-base from moodle.

The given code renders the geometric model in OBJ format and the skeleton joints but not the bones. A picking mechanism is provided to detect when the mouse hovers over a joint. This is useful for the required user interface. Pressing the key **m** toggles several visualisation modes.

Expected behaviour

The final goal is to deform the character using the skeleton provided and a mouse interface (clicking and dragging). A binary solution that works in Windows is provided for convenience.

Clicking and dragging a joint node should apply a local rotation. All joints need to be transformed in a hierarchical manner as shown in class and during

the labs. Once the skeleton has been deformed according to the user input, the geometric vertices have to be transformed using linear blend skinning.

Detailed Steps

This homework can be broken down into three steps. First is to generate a rotation based on a user mouse input. Consider J the selected joint with the initial position P and final position P' (in screen coordinates). Consider J_p the parent joint with the screen position P_p. In brief, the rotation is along an axis perpendicular to the projection plane that goes through the parent joint J_p by an angle determined by two lines: $P - P_p$ and $P' - P_p$.

The second step is to compute the correct position of each joint based on the skeleton hierarchy. As presented in class, the global transformation for each joint is the accumulation of transformation fom the root down. These transformations have to be managed by you in a special data structure that you have to design for the skeleton.

Finally once the skeleton is deformed properly, you need to read in the weights for each vertex and transform it using linear blend skinning.

The code has to be reasonably optimised such that the application run in real-time.

Skeleton and weights files

The format for the skeleton file is: each line describes a joint as a space separated list of $[x\ y\ z\ p]$ where x, y, z are 3D positions and p is the index of the parent joint. $p = -1$ for the root joint. The program provided can already parse and render skeleton files.

The format of the weights file is as follows: every line i contains as a space separated string the sequence of weights of vertex i (i.e. the number of entries on each line corresponds to the number of bones in the skeleton).

Transformation Algebra

During this (and subsequent) homeworks and projects you will need support to manipulate matrices and vector operations. We provide in the code-base a simple library to do that. However, you are welcome to used third party libraries if you wish under the following conditions: you must documented and acknowledge it properly and the code must still run in the lab with no additional installation required.

Submission Deliverables:

You musy submit all the code as a zip file to the submission system.