Interactive Graphics: Homework 2

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All points of the homework have been tested on Windows OS and macOS and have proven to work on Chrome, Firefox and Edge (chromium version).

1. Create a hierarchical model of a (simplified) sheep (`https://en.wikipedia.org/wiki/Sheep`), composed of the following parts; body; 4 legs, each one composed of 2 independent components (upper and lower leg), head, tail. All components are cubes, use the cube function present in the file. The sheep has a white/light grey color.

Starting from the initial code, the dimensions and shapes of the cubes generated have been modified in order to obtain the stylized shape of a sheep. In addition, a new item corresponding to the tail has been created. In order to generate it successfully, the following steps have been carried out: created a new index in the theta array of rotations; create the respective properties of height and width; created a new "tail" function to define the translation and scaling with respect to the modelViewMatrix before calling the "drawArrays" function and to set the uniform variables that are used for the texture; finally a new "case" has been added inside the initNode function to define the translation and rotation before calling the previously mentioned function. To generate the tail, it was inserted into the computation tree as the sibling of the right upper leg. Finally the basic color of the sheep is a light gray all over the sheep, except on the lower legs and on the lower arms, which are whiter. This last choice was made to make the animal slightly more realistic. However, a bump texture was required in point 3, so the sheep has a light gray aspect, but of course the color changes according to the tangent and the normal that is formed with lights.

2. Add a surface on which you position the sheep that corresponds to a grass field. Attach to it a texture (color, bump or both) to give the appearance of a grass field.

To create a surface to put the sheep on, a cube was created and its y component was greatly reduced. This element called "ground" was generated as a sibling of the sheep's torso. To generate this new element, the same procedure described in the previous point for the tail was carried out. Furthermore an image texture was applied to it to give the effect of a grass field. To manage this and all the other textures that have been used in the homework, a function has been defined that takes all the textures (color and bump) as input, sets the respective parameters and sets the uniforms to be passed to the html so that they do not overlap.

3. Load or generate at least two more textures. A color texture to be attached to the front face of the head and a bump texture to be applied to the sides of the body to give the "Load or generate at least two more textures. A color texture to be attached to the front face of the head and a bump texture to be applied to the sides of the body to give the "wool effect".

To give the wool effect of a sheep, a bump texture was generated and was applied to the torso, tail, head and 4 upper limbs. It was generated using random numbers because they lead to a more realistic effect of the wool. On the 4 lower limbs it was not applied because they usually correspond to the hoof which does

not have this effect. Obviously, to have a bump texture effect it was necessary to use Phong Shading, and consequently it was also used to compute the color of all the other elements in the scene.
In addition two point lights were added to the scene. By inserting two lights at the same y coordinate and opposite along the x and z axes it was possible to illuminate the scene comprehensively from all sides so as to have a full view of the sheep, its bump texture and the environment when the camera is rotated. The values of x and z are very large, or very small if negative, while the y is a smaller value than the latter. This combination of coordinates creates two very distant lights and also not very high.
Instead, as for the texture to be applied on the front face of the sheep's head, sheep face texture was applied using the procedure explained in the previous point. The face was taken from a google photo.
In the end, to better show the difference in color and texture between the various parts of the sheep and the environment, the color of the canvas has been changed to recreate the effect of the sky.

4. Create a (very simplified) model of a fence and position it on the surface and near the sheep.

The required fence was created as the intersection of two parallel vertical poles and two parallel horizontal poles. The insertion of new objects follows the same procedures as in point 1. The first pole was computed as the sibling of the ground, while the second has been set as the sibling of the previous and so on for the others. In addition, all wodden poles are generated from the same structural properties of height and width and what changes are the rotation and the position. Finally a texture was applied to each pole using the procedure explained in the point 2 in order to simulate the effect of wood.

5. Add a button that starts an animation of the sheep so that, starting from an initial position where it is in a walking mode, it walks on the surface towards the fence by moving (alternatively back and forth) the legs, then jumps over the fence and lands on the surface on the other side of the fence.

There are 3 buttons to manage the animation: the start of the animation slowly that allows to take a full vision of the various movements; the start of the animation in a normal speed to better see the effective walk; and finally a button that allows to reset the scene after the animation. The animation function that is called when one of the first two buttons is clicked controls the values of the position or inclination of the sheep and applies various types of movement: walking alternating legs, preparing to jump, jumping, descending and final walking alternating of the legs. Note that the sheep's hooves also move, but not too much. This choice is intended to make the animation more realistic. Finally, during the walk, it is possible to see that the various parts of the body change slightly color. This effect is due to the bump texture which is subjected to the lights in the environment. Given the position of the lights, the sheep is illuminated quite well constantly, expect for the highest ones which are darker. This is because the y component of the lights is not very big, so the lights are not on top. However, it is possible to see a variation in these parts during the jump and descent when these surfaces are in favor of light.

6. Allow the user to move the camera before and during the animation.

Three sliders have been added to allow the control of the following parameters of the "viewerPos" (or even called "eye"): the radius in a range of values between 0.05 and 30.0; theta in a range of values between -180° and 180°; phi in a range of values between -180° and 180°. The starting values are: $radius = 0.05$, $theta = 46.0°$, $phi = -37.0°$.
Furthermore, 3 additional sliders have been added to modify the projection matrix parameters: the "Depth" slider change the near and far values; the "Height" slider change the bottom and top values; and finally the "Width" slider change the values of left and right. All sliders can be set between 5 and 100. Left, Bottom and Near are set as negative values, while Right, Top and Far are set as positive. Finally, the value is updated as half of the value set on the slider. Initially the value is 20 (or -20 for the 3 negatives), so 40 in the slider ($40/2 = 20$) for all.