SIMULATION & PHYSICS – PRACTICAL 6

Write a report (pdf or word) in which you **explain** your solution to the assignments below.
For each assignment:

1. repeat the assignment you are implementing;
2. explain your approach;
3. describe your code;
4. show (relevant) code snippets;
5. include a screenshot of your program.

Once your report is finished, make sure your name and student number is on the title page, and upload it to the corresponding Assignment in your **VLO group** before June 18th, 23:00.

Assignments are graded with a V (sufficient) or O (insufficient).
You can work in pairs, but you each have to write your own explanations!
(Code snippets and screenshots may be identical.)

Download the source solution for "Transformations" from the VLO. Make sure that the program runs, and you understand the code before you start implementing the assignments below.

Assignment 1: Animated solar system

Create an animated solar system with the Sun at its centre, with the Earth and four planets - *Mars, Jupiter, Saturn, and Uranus* - orbiting the Sun, and with the Moon orbiting the Earth:

Step 1: The Sun

- Study the way the *Sphere* class is used in the method *Initialize()*; explain how it works in your report.
- Scale the Sun by a factor 2 along all axes and make it yellow.

Step 2: Earth & Friends

- Create the Earth as a *Sphere* with scale 1, a center to center distance from the Sun of 16, and make it navy blue.
- Create Mars with scale of 0.6, a distance of 21, and make it red.
- Create Jupiter with a scale of 1.7, a distance of 27, and make it orange.
- Create Saturn with a scale of 1.6, a distance of 36, and make it khaki.
- Create Uranus with a scale of 1.5, a distance of 43, and make it cyan.
- Make the planets spin around the Sun by changing each Sphere's Transform in the Update method. Choose 5 different speeds between 0.15 and 0.5 (radians) per second.

Step 3: The Moon

- Create the Moon with a scale of 0.5, a distance from Earth of 2, and make it light grey.
- Make the Moon spin around the Earth with a speed of 1.5 radians per second.
- Change the orbit of the Moon so that it is rotated 45 degrees towards the Sun.

Step 4: Camera control

- Make the camera spin around the scene horizontally when pressing the left or right arrow keys. *Hint: rotate the cameraPostition by gameTime.ElapsedGameTime.TotalSeconds * 1.3f for the right arrow key.*

Assignment 2: Animated Michelin Man

In the same or a second scene as your solar system, create a Michelin Man so that he exists out of several spheres and make him wave his arm:

- Create the Michelin Man out of several *Sphere* objects:
  - 4x for the body
  - 3x for the arm, 1x for the hand *(assignment 3 requires both left and right arms)*
  - 3x for the leg, 1x for the foot (*assignment 3 requires both left and right legs)*
  - 1x neck, 2x head
- Animate the lower arm and hand *Sphere* objects using *Math.Sin()* such that the Michelin Man waves.

Bonus Assignment: Animated Michelin Man, part 2

This **bonus** assignment is **not required** to pass the practical part of the course.

Passing this assignment will however net you **a full extra point** on the final grade of your exam! (Maximum is still 10, no total grade of 11 will be possible) The Michelin Man should have all limbs and two eyes, wave while walking, and blink every few seconds. You also have to write a good *Bone* class for Sphere transformations and animations:

- Make sure the Michelin Man has his body, both arms, both legs, a head, and eyes.
- Animate the eyes to blink at random intervals between 2 and 5 seconds.
- Animate the legs to walk using different sine timings.
- The non-waving arm must sway such as when a person walks.
- All bone matrix transformations must be handled by a *Bone* class, that correctly (partly) propagates the transform from the parent *Bone,* and can also handle transform animation (e.g. via subclassing).