CZ2003: Computer Graphics and Visualization

Making Images with Mathematics

Final Assignment

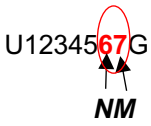
SESSION 2020/2021
SEMESTER 1
COMPUTER SCIENCE COURSE

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
NANYANG TECHNOLOGICAL UNIVERSITY

Final Assignment

This assignment follows the same format as the five lab assignments, but it is a timed 1-hour individual assignment covering multiple topics with a higher difficulty.

The final assessment is personalized, i.e. each student has different data to work with. The personalization is based on the two last digits of your matriculation number:



which can be integer numbers from 0 to 9 where 0 will stand for 10. Therefore, the two numbers from 1 to 10 will define your personal variant of the assignments. These numbers will be further referred to as ***N*** for the penultimate digit and ***M*** for the last digit.

This is an individual assignment. Any group work and/or discussions are not allowed. In case of plagiarism, all the involved parties will be failed without investigating who copied from whom.

Final assignment instructions
The final assignment will be evaluated and awarded up to **28 marks**. Partial marks for each question are indicated in the assignment instructions.

After completion of the assignment, you must fill in a table (Appendix 1) and submit it together with all your files. No other form of report is required. In the table, for each question you have to copy:

1. 1 screenshot of a static shape displayed with coordinate axes or
   3 screenshots of an animation displayed with coordinate axes.
2. Names of the respective FVRML or Shape Explorer files. The names must be Q1.wrl or Q1.func, Q2.wrl or Q2.func, ...

No other information, discussion, observations, etc. has to be added to the report.

BEFORE THE END OF THE 1-HOUR ASSIGNMENT you have to do the following:

1. Create a folder and name it **exactly as your name is written on your matriculation card and add as a suffix the two last matric digits NM**, e.g., JAMES BOND 67.
2. Copy to this folder the scan/photo of your matriculation card with clearly readable name and at least three last characters of the matriculation number.
3. Copy to this folder all the relevant files and the file of the report. Do not make any additional folders.
4. Zip your assignment folder. The zipped file **must have the same name as your folder**, i.e. your name and NM, e.g., JAMES BOND 67.zip. **Check that when the file is unzipped, the folder with the respective name (i.e. JAMES BOND 67.zip) will be created with all the files in it and without any subfolders.**
5. Submit the zipped file through the FINAL ASSIGNMENT digital drop box in the course site.

Technical problems with your computer, internet access, environment, public transport, etc. cannot serve as an excuse for not submitting the assignment results. Have a backup (e.g., use mobile internet if your internet supplier fails). Those who want to be certain that there will be no technical failures at their side are advised to work on the assignment in SW Lab 3 (reserved) or any other SW lab if there are seats available. Make sure you come there in advance so that you will have the seat.

If the digital drop box of the course site is not functioning, you must email your zipped assignment file to assourin@ntu.edu.sg before the deadline together with the screenshot proving the drop box unavailability. All submissions are time stamped. Late submissions will be penalised 10% for each minute of delay.

After submission, the subject coordinator will email you if something is wrong with your files.

Assignment instructions:

1. A curve is defined in polar coordinates by function

$$r = cos(0.25(\boldsymbol{N} + \boldsymbol{M})\alpha),\ \alpha = [0, 2\pi].$$

Display this curve in blue color in coordinate plane
XY if ***M*** is 1, 2 or 3;
YZ if ***M*** is 4, 5, or 6;
ZX if ***M*** is 7, 8, 9 or 10
of a 3D Cartesian coordinate system XYZ so that it is translated by $\boldsymbol{N}$ along the respective first axis (X, Y or Z). The curve must be displayed together with the clearly visible coordinate axes.

(3 marks)

2. Define by functions $(x,\ y,\ z) \geq 0$ a four-sided pyramid with the vertices of the base with coordinates (***N***, -***M***, 0), (0, -***M***, -***N***), (-***N***, -***M***, 0), (0, -***M***, ***N***) and the apex at (0, ***M***, 0). Translate it by (0, -***M***, 0). Display the translated pyramid together with the clearly visible coordinate axes. The pyramid has to be colored in yellow. Visualisation of the pyramid must be done within 1 sec with a minimum number of rendering artefacts.

(4 marks)

3. Define by functions $f(x,\ y,\ z) \geq 0$ a solid box with coordinates:

$$-N \leq x \leq N, \quad -N \leq y \leq N, \quad -1 \leq z \leq 0.$$

Color its front surface (i.e. z = 0) with a diffuse color as the pattern displayed in Table 1 according to the value of ***M***. Display the colored box together with the clearly visible coordinate axes. Visualisation of the box must be done within 1 sec with a minimum number of rendering artefacts.

(6 marks)

4. Using parametric functions, define an animation showing how a sphere with radius 1 is dropped down from a height of 5 and begins to bounce up and down (***N***+***M***) times on the horizontal plane y = 0. The bouncing has to be done within 10 seconds with reduction of an altitude of bouncing so that eventually at the end of the 10 sec period the sphere has to come to complete stop on the plane. Display the animated sphere together with the clearly visible coordinate axes. The sphere has to be displayed in red color with 50% shininess.

(7 marks)

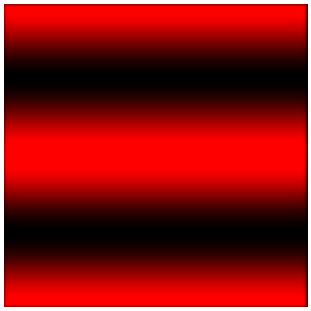
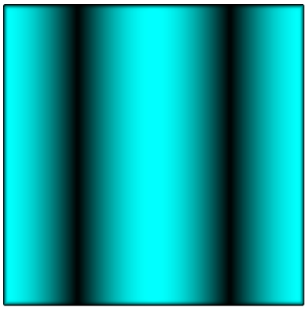
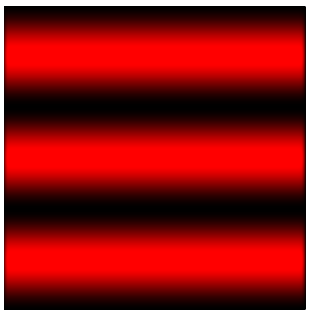
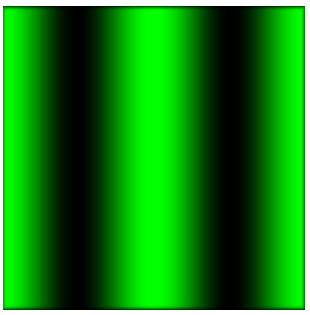
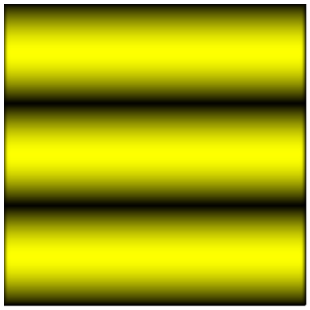
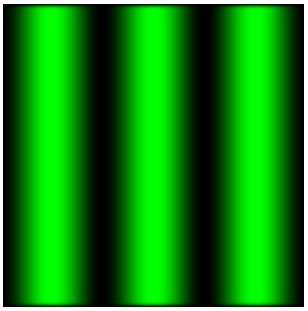
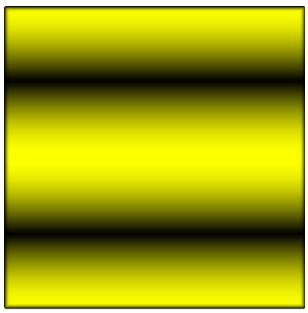
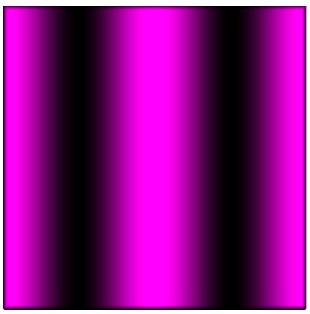
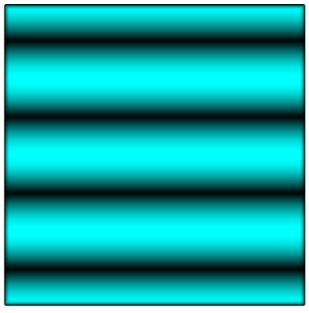
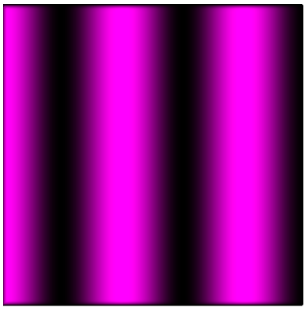
5. A profile curve is defined by

$$\begin{cases} x = 2 + 2\boldsymbol{N}u \\ y = \sin(\boldsymbol{N}\pi u) \\ z = \sin(\boldsymbol{N}\pi u) \end{cases},\ u \in [0,1].$$

Define the surface created by rotational sweeping of the curve by angle π about an axis from the origin to point:
(3, 4, 0) if ***M*** is 1, 2 or 3;
(0, 3, 4) if ***M*** is 4, 5, or 6;
(4, 0, 3) if ***M*** is 7, 8, 9 or 10.
Display the surface together with the clearly visible coordinate axes. The surface has to be colored in purple.

(8 marks)

Table 1. Color pattern

M	Color pattern		M	Color pattern
1			6	
2			7	
3			8	
4			9	
5			10	

Appendix 1.

CZ2003: Final Assignment

Name: < as in your matric card>	**Last two digits of the matric card:**
Q1	*1 Screenshot of the shape displayed with coordinate axes*
	Name of the file: Q1.func or Q1.wrl
Q2	*1 Screenshot of the shape displayed with coordinate axes*
	Name of the file: Q2.func or Q2.wrl
Q3	*1 Screenshot of the shape displayed with coordinate axes*
	Name of the file: Q3.wrl
Q4	*3 Screenshots of the animation displayed with coordinate axes*
	Name of the file: Q4.func or Q4.wrl
Q5	*1 Screenshot of the shape displayed with coordinate axes*
	Name of the file: Q5.func or Q5.wrl