

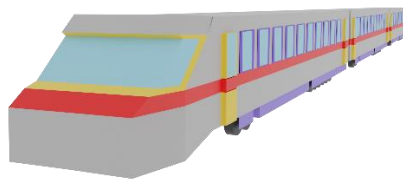
## **Assignment 2**

### **UCS636 3D Modelling & Animation**

**Software Used: Blender 2.8**

**Rendering Engine: Cycles**

**Output Format: Image format (PNG/JPG)**



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## Contents

Contents.....	2
Compatible Software(s) for enclosed file(s): .....	3
For PNG/JPEG/JPG file.....	3
For Blender (.blend) file .....	3
3D Model: Train .....	4
Output in PNG Format.....	4
Output in JPEG Format.....	4
Brief Procedure followed:.....	5
Question 1.....	6
Question 2.....	10
Question 3.....	11
Question 4.....	12
Question 5.....	13

**Compatible Software(s) for enclosed file(s):**

**For PNG/JPEG/JPG file**

Windows Photo Viewer

Photos App for Windows

Any other software compatible of opening image files

**For Blender (.blend) file**

Compatible: Blender version 2.8 or above

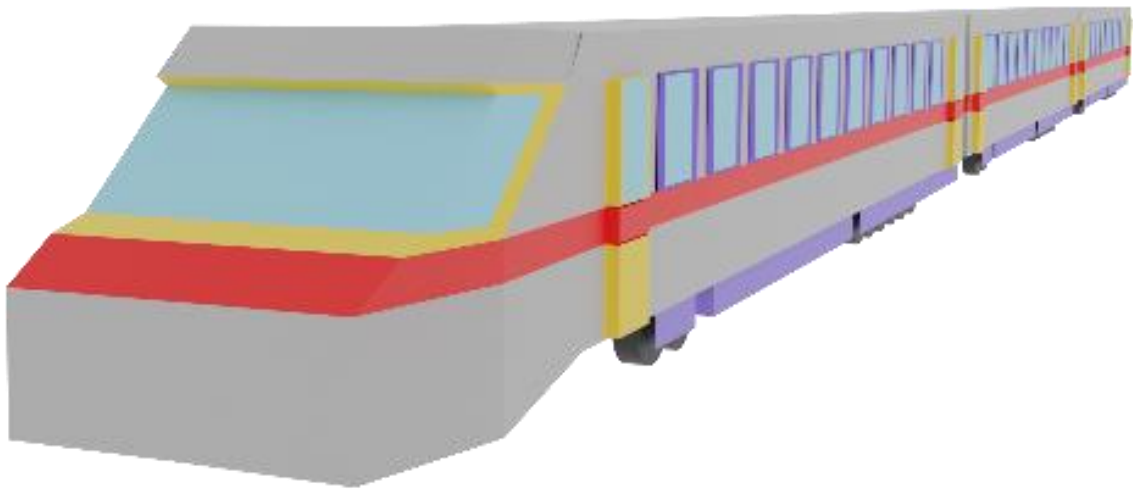
Ideal: Blender version 2.8

### **3D Model: Train**

The model was created in blender version 2.8 and was rendered in two image formats – PNG and JPEG formats.

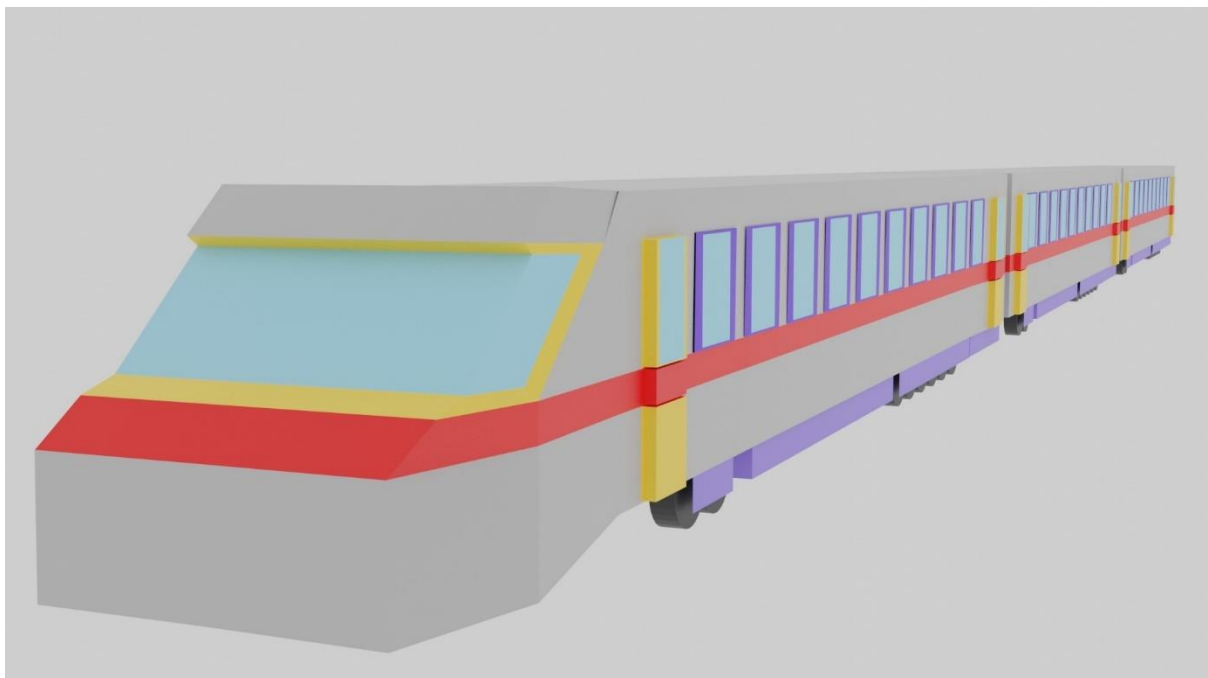
The output in PNG Format looks like:

**Output in PNG Format**



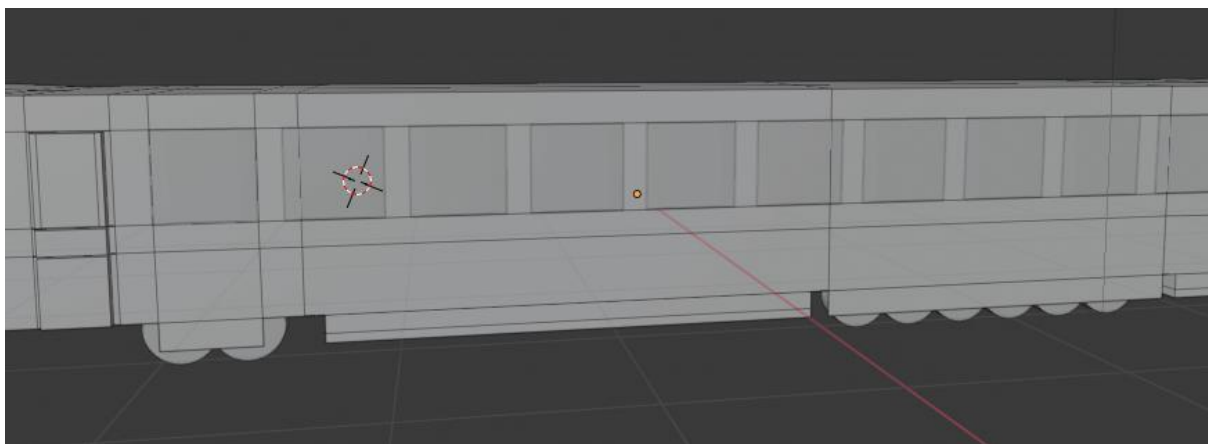
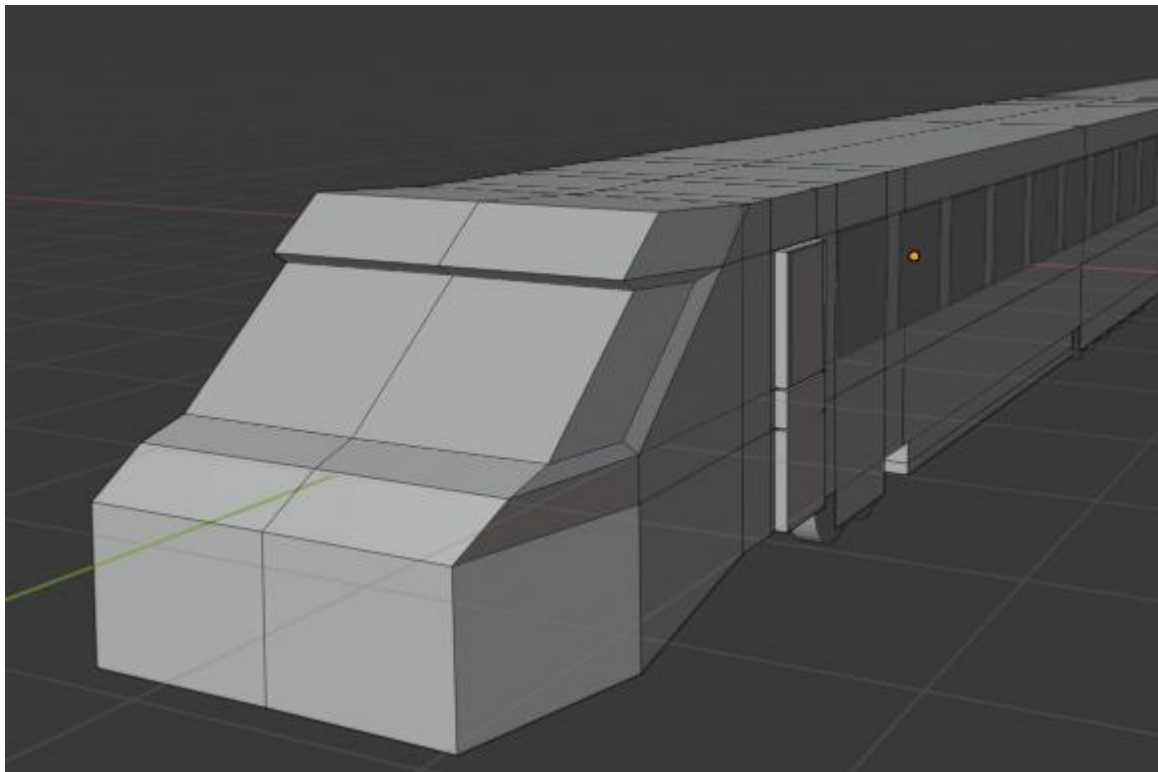
The output in JPEG Format looks like:

**Output in JPEG Format**



### **Brief Procedure followed:**

For modelling the front locomotive coach, I modified the Y-axis scale to make it a cuboid. Then I applied several loop cuts across the cuboid. Then, I selected faces in front part and moved it a just left to make it look a bit pointed. Then a face from the bottom was extruded. Similarly, doors were created using a combination of extrusion and inset. For the windows, inset tool was applied on the faces, then inset it to a little and subjected to array modifier. A few edges of the bottom were extruded to make space for wheels. For the wheels, a cylinder was modified and snapped it to the space created. Then the front locomotive (along with windows) was duplicated and its some faces were deleted and merged to create a coach. This coach was then snapped at the back of the train.



## **Question 1**

**1. Create your first 3D model using basic shapes (e.g., cube, sphere, cylinder, capsule, and plane) in blender by using the following tools and techniques learned in first unit of your course.**

**I. Write a short note on Duplicate and Merging techniques to create multiple objects from one object.**

**II. Discuss about normal and its importance. Apply them in your model.**

**III. Write a brief note on importance of Extrusion and Inset tools also apply Extrude/Inset tools during the planning of your model.**

**IV. Write the blender shortcuts about Edge Loops, Loop Cut and slide and apply them in your model.**

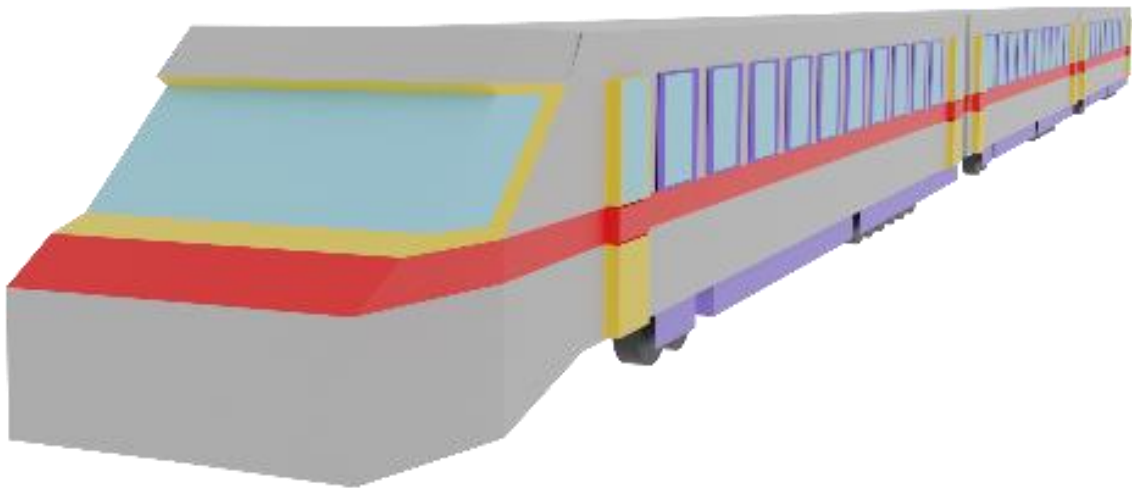
**V. Briefly discuss the importance of constrain movements using snapping tool. Also apply them in your model how to snap objects into place.**

**VI. Write a short note on Array modifier and apply them in your 3D model also discuss the methods of how to separate your geometry.**

**VII. Apply subdivision in your model and discuss about the side effect of subdivision.**

**Solution:**

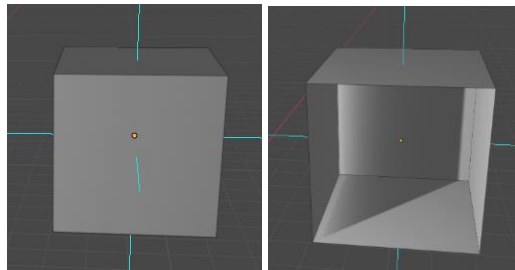
The 3D Model created is of a train.



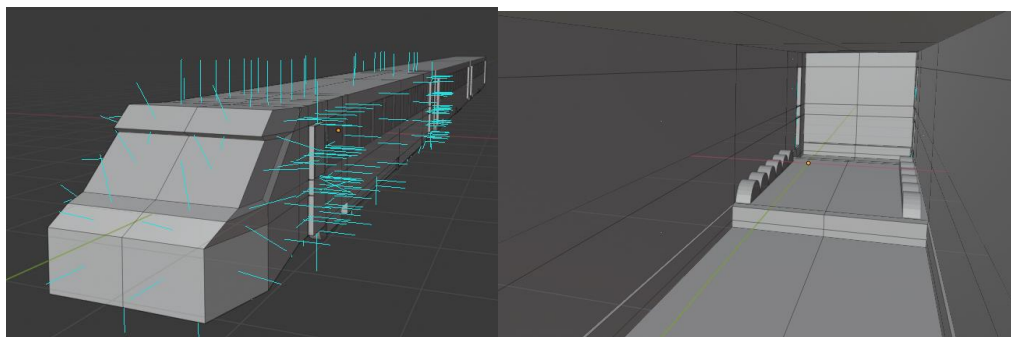
- I. **Duplication** refers to creation of another object whose properties are equal to the properties of the original object. Blender duplicates the selected objects when a shortcut key combination of **Shift+D** is used. By default, the duplicate object is located at the position of the original object and can be subjected to different transform and location properties. However, all the duplicate objects are linked to each other, that is the material and data of the object are same and any change in one object is reflected in all the duplicate objects. It can be sorted out by clicking on object>Relations>Make Single User.

**Merging** refers to joining of multiple objects into one object. To join objects in blender, one has to select the preferred objects and press **Ctrl+J**. This merges those different objects into one and can be modified as if it were one object.

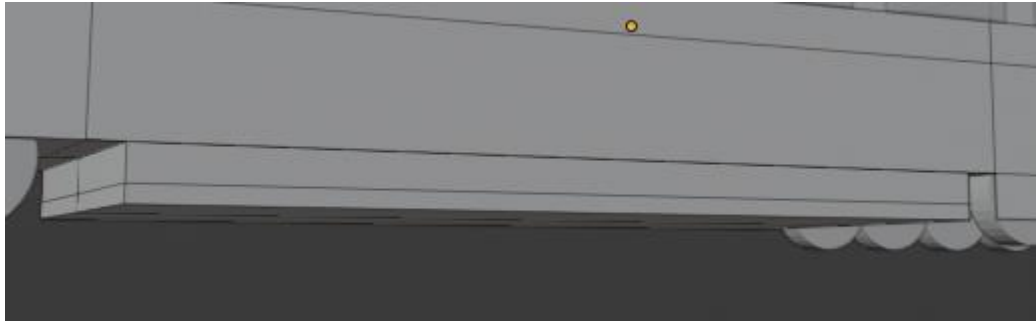
- II. **Normals** are perpendicular to the surfaces of the mesh. The default normal can be displayed by enabling display normals in Edit Mode>Overlays>Display Normals. The orientation of the normal can be changed by flipping them. Normals are mainly helpful in backface-culling where non-visible faces need not be rendered.



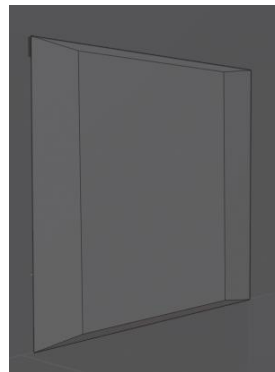
In our model, we have applied normals and backface culling, so that the faces that are not visible need not be rendered.



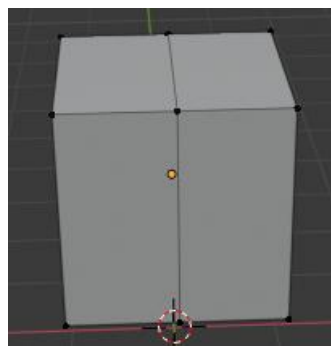
- III. **Extrusion** and Inset tools are used for altering the geometry of the object. These tools are available only in edit mode. Extrusion helps create a new geometry from the object. For example, a face of a cube can be subjected to extrusion on one of the faces to get adjacent cubes/cuboids. The shortcut key for Extrusion is E. In our model, we have applied extrusion to create the base of the train as shown in the figure.



On the other hand, **inset** takes the currently selected faces and creates an inset of them, with adjustable thickness and depth. The shortcut key for inset tool is **I**. The base window in our model have been made by using inset tool.

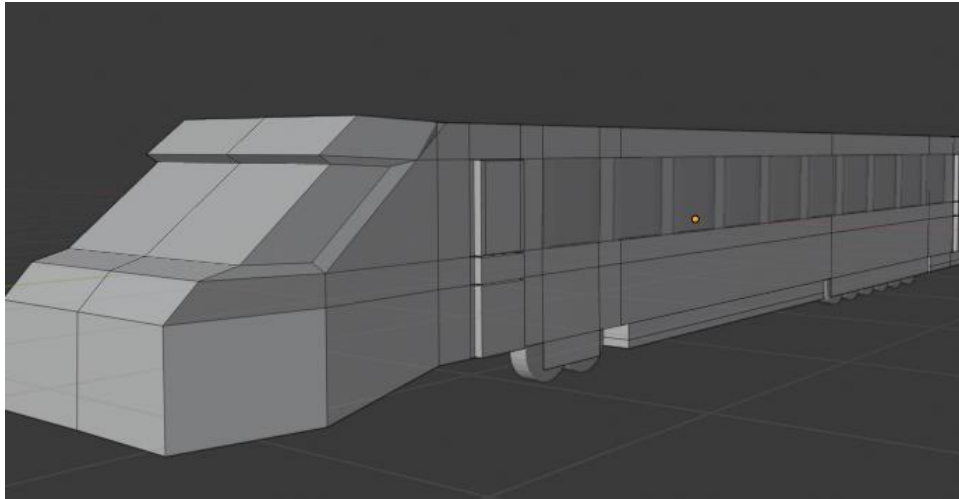



- IV. The shortcut for edge loop/loop cut is **Ctrl+R** and shortcut key for Edge Slide is **G** **twice**. The edge loops run across the surface such that the first and end points are connected, thus forming a loop

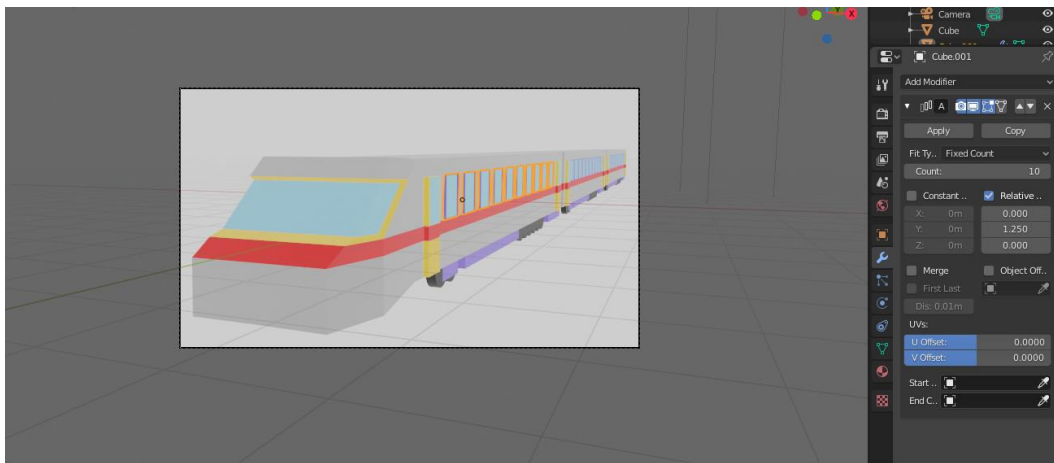


Various loop cuts have been applied in our model as shown in the following figure.





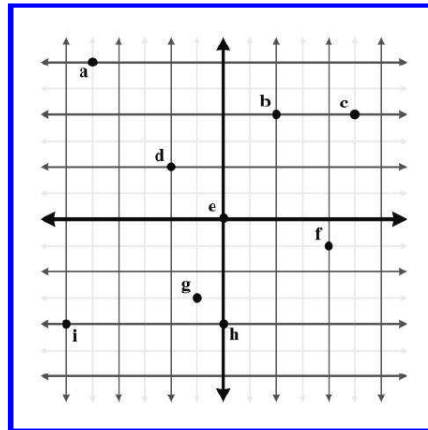
- V. Constrain movements using snapping tool (magnet shaped tool i. e. snap during transform ) snaps the movement of the selected objects to grid. These constrain movements are useful when objects need to be translated in some fixed amounts.
- VI. The Array modifier creates a series (an array) of copies of the base object, wherein each copy is at a certain offset from the previous one in different possible ways. In our model, it has been used for windows. Before applying array modifier, in edit mode we need to press P to separate the selected faces into a separate object.



- VII. **Subdivision** is used to split the faces of a mesh into smaller faces. However, higher levels of subdivisions result in more vertices, which leads to higher memory consumption and can cause Blender to hang or crash in case of insufficient memory.

## Question 2

2. Give the coordinates of the following points. Assume the standard 2D conventions. The darker grid lines represent one unit.



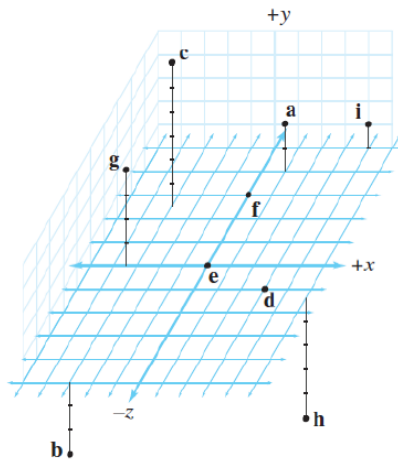
### **Solution:**

Assuming the horizontal line as X-axis and vertical line as Y-Axis, the coordinates of the given points are

- a.  $(-2.5, 3)$
- b.  $(1, 2)$
- c.  $(2.5, 2)$
- d.  $(-1, -1)$
- e.  $(0, 0)$
- f.  $(2, -0.5)$
- g.  $(-0.5, -1.5)$
- h.  $(0, -2)$
- i.  $(-3, -2)$

### **Question 3**

**3. Give the coordinates of the following points.**



#### **Solution:**

The coordinates of the points are

- a. (1 ,2 , 4)
- b. (-3, -3, -5)
- c. (-3, 6, 2.5)
- d. (3, 0, -1)
- e. (0, 0, 0)
- f. (0, 0, 3)
- g. (-3.5, 4, 0)
- h. (5, -5, -1.5)
- i. (4, 1, 5)

#### **Question 4**

**4. List the 48 different possible ways that the 3D axes may be assigned to the directions “north,” “east,” and “up.” Identify which of these combinations are left-handed, and which are right-handed.**

**Solution:**

The possible combinations in which the 3D axes may be assigned to the directions “north”, “east” and up are.

<b>Left-Handed</b>			
S. no	East	Up	North
1	-y	-z	+x
2	-z	-x	+y
3	+z	+y	-x
4	-x	+z	+y
5	+y	-z	-x
6	-z	+x	-y
7	+x	+y	+z
8	-z	-y	-x
9	+x	+z	-y
10	+z	-x	-y
11	+y	+x	-z
12	-x	+y	-z
13	+x	-y	-z
14	-x	-z	-y
15	+x	-z	+y
16	-y	-x	-z
17	-y	+z	-x
18	+y	-x	+z
19	-z	+y	+x
20	+z	+x	+y
21	+z	-y	+x
22	+y	+z	+x
23	-x	-y	+z
24	-y	+x	+z

<b>Right Handed</b>			
S. no	East	Up	North
1	-x	-z	+y
2	-y	+x	-z
3	-z	-x	-y
4	-y	-x	+z
5	+y	+x	+z
6	-x	+y	+z
7	+z	-x	+y
8	+z	+y	+x
9	+x	-y	+z
10	-z	-y	+x
11	+x	+z	+y
12	-x	+z	-y
13	+x	+y	-z
14	+z	-y	-x
15	+y	-x	-z
16	-y	-z	-x
17	-z	+x	+y
18	+y	+z	-x
19	+y	-z	+x
20	-y	+z	+x
21	-z	+y	-x
22	+z	+x	-y
23	+x	-z	-y
24	-x	-y	-z

### **Question 5**

**5. In the popular modelling program such as 3DS Max and Blender, the default orientation of the axes is for +x to point right/east, +y to point forward/north, and +z to point up.**

**(a) Is this a left-or right-handed coordinate space?**

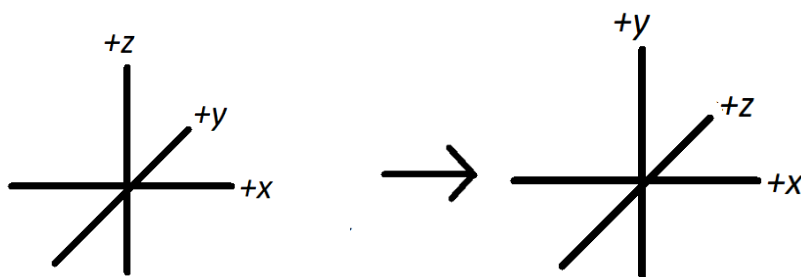
**(b) How would we convert 3D coordinates from the coordinate system used by 3DS Max into points we could use with our coordinate conventions discussed in?**

**(c) What about converting from our conventions to the 3DS Max conventions?**

**Solution:**

(a) It is a right-handed coordinate space

(b) We can convert 3D coordinates from the coordinate system used by Blender and 3DS Max into the conventional coordinate space by swapping y and z axes.



(c) We can do so by swapping y and z axes.