*TDT4195: Visual Computing Fundamentals*

*Computer Graphics – Assignment 3*

October 10, 2018

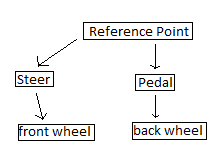
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**Task 1a:** Give a Scene Graph structure and motivate your answer.

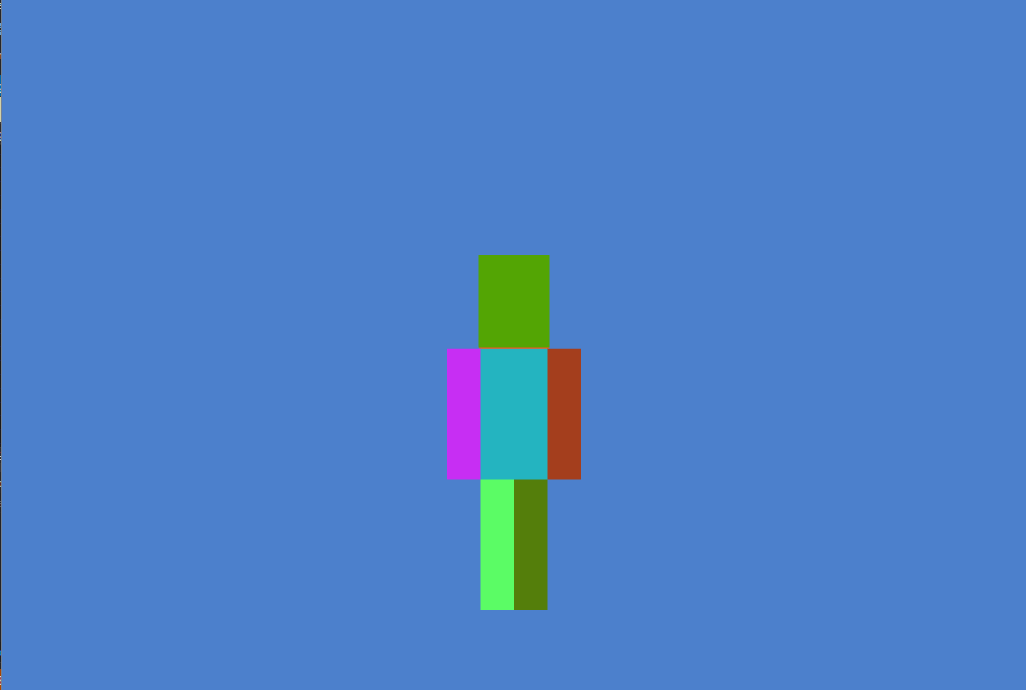


Starting from our reference point (bicycle frame) we have two components (steer and pedal) that have a direct influence on the wheels. If I move the steering wheel, the front wheel changes. Similarly, the rear wheel changes when the pedals start to move.

**Task 1b:** Give a sequence of affine transformations.

Translate(-73,-26)\*Translate(7, -4) \*Rotate(30, z-axis)\*Translate(73, 26)\*Translate(-7, 4) \* Backwheel

**Task 2a:** Render the created VAO’s, and put a screenshot in your report.



**Task 2b:** Explain in your own words:

i) How does the w-component in homogeneous coordinates allow us to perform  
translation transformations?

With homogeneous coordinates we have an additional dimension which allow us to use the (x,y,w) – plane compared to the (x,y)-plane. Furthermore, the translation can be described as a linear transformation:

x‘ = 1x + 0y + dx\*w = x +dx

y‘ = 0x + 1y +dy\*w = x + dy

w‘ = 0x + 0y + 1w = 1

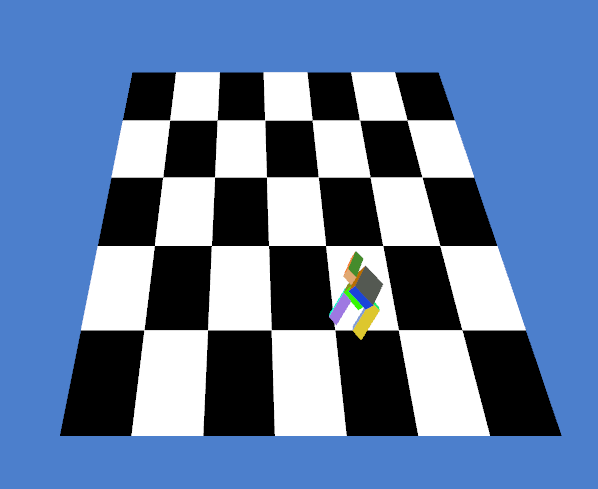
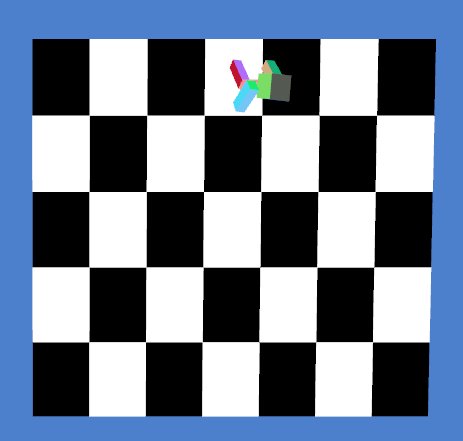
So, the translation by a vector d is just an addition (as long as w=1) regarding the x and y values.

ii) How does the w-component in homogeneous coordinates allow us to perform the  
perspective projection?

If the w-component is equal to 1, then we have a projection without any noticeable changes. Changing the w-value affects the scaling of the x,y and z-values by dividing the w-value. So if w is greater than 1, then the image becomes smaller. So the distance between the viewer and image is getting greater. Changing w < 1 the image becomes bigger decreasing the distance between viewer and image.

iii) What is the viewport transform, and why do we need it?

The viewport transformation is needed because graphics objects have their own coordinate system. So these coordinates will be translated and scaled for the coordinate system of the device to display rendered objects on the defined screen.

**Task 5b:** Put two screenshots in your report showing the scene you created from two different angles at different points in time. ****