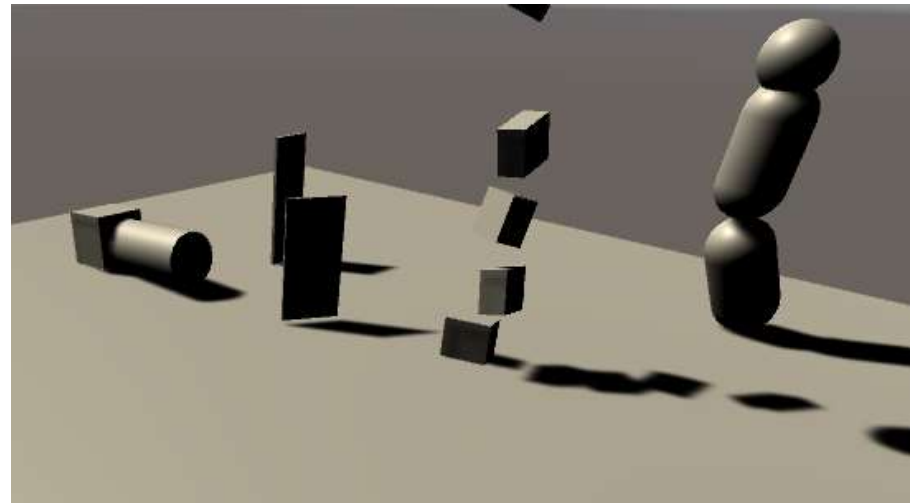


# Joints in Unity

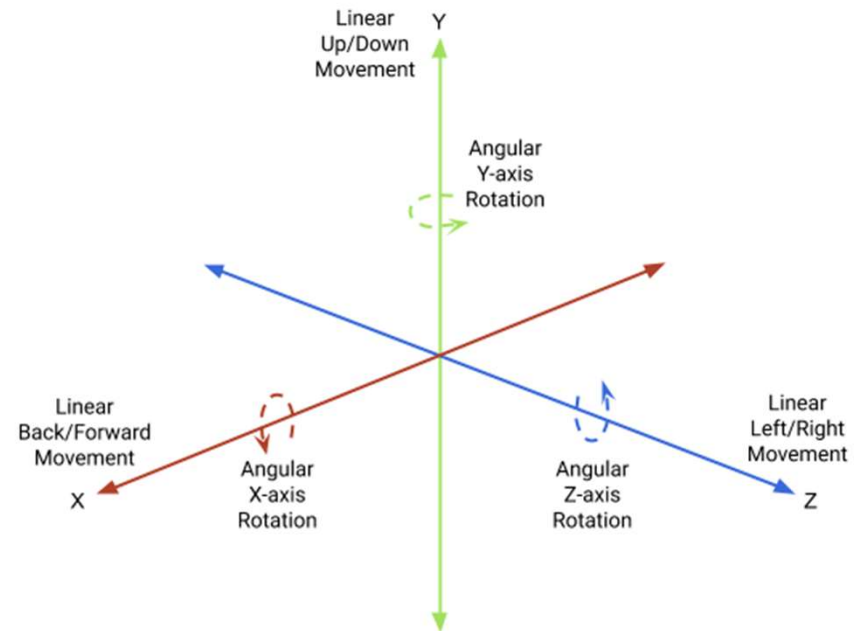
# Joints

- To connect rigid body together, we use joints
- In Unity, they provide five different joints
  - Fixed
  - Spring
  - Hinge
  - Character
  - Configurable



# Joints

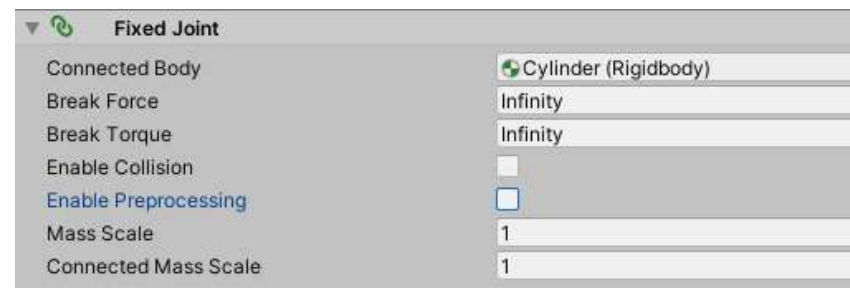
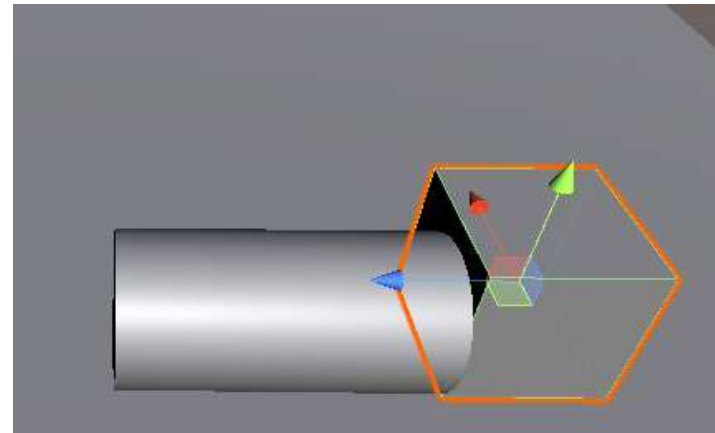
- In this tutorial, we will try different joints in Unity
- Coordinate system in Unity is as right
- Create a new project in Unity
- Add a plane to it



Coordinate system in Unity

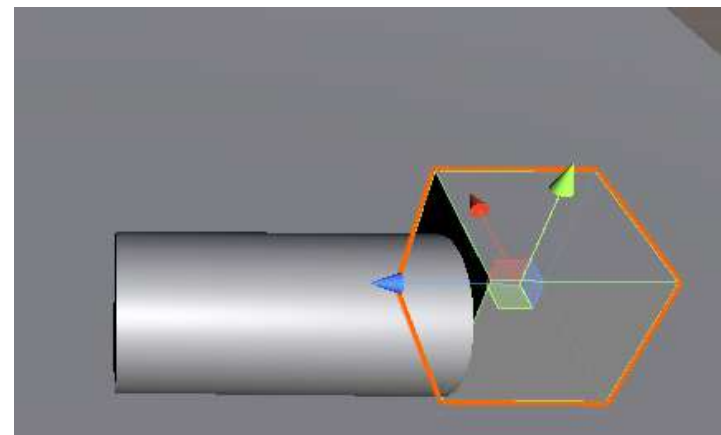
# Fixed Joint

- As its name imply, it wouldn't allow movement
- Add a cube to the scene with rigid body
- Add a cylinder with rigid body
- Place them together and in inspector of the cube, add component "Physics/Fixed joint"
- Drag the cylinder into "Connected body" under Fixed Joint of cube



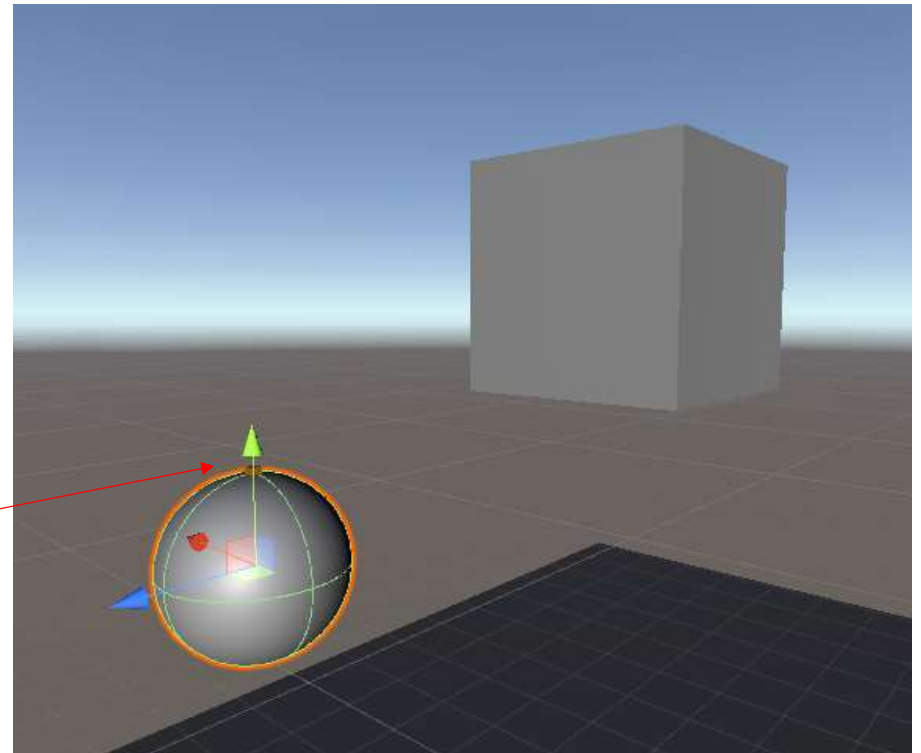
# Fixed Joint

- Now try to move the cube in the scene, they should move together
- Under the fixed joint, change the “Break Force” to 50
- Now try to move it again in scene
- Suitable for use in scene for breakable things



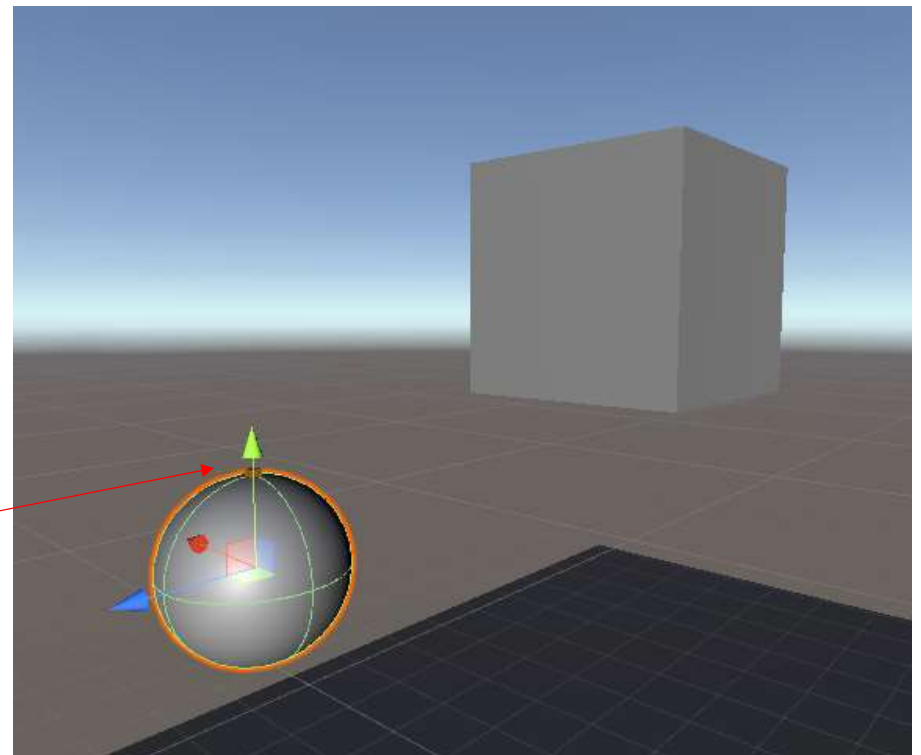
# Spring Joint

- Create a cube and hang it at some distance from ground
- Add rigid body and uncheck gravity and check “IsKinematic”
- This will make the object not falling down(gravity) and not affected by physics
- Now add a sphere and move it under the cube
- The position should be something like this



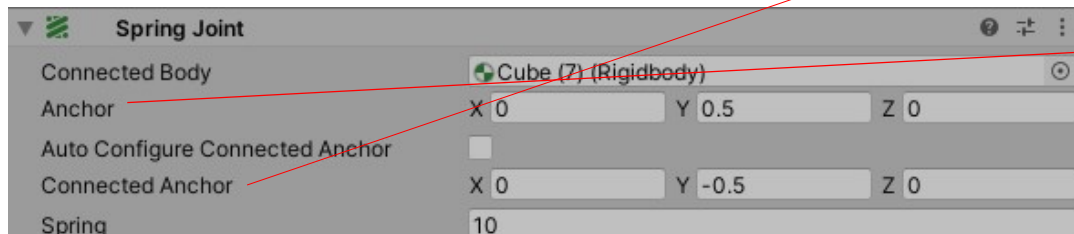
# Spring Joint

- Now add a spring joint to the sphere (rigid body automatically added)
- Drag the cube into “Connected Body” of joint in sphere
- Play to see
- The hanging position seems awkward
- Because it is automatically calculated

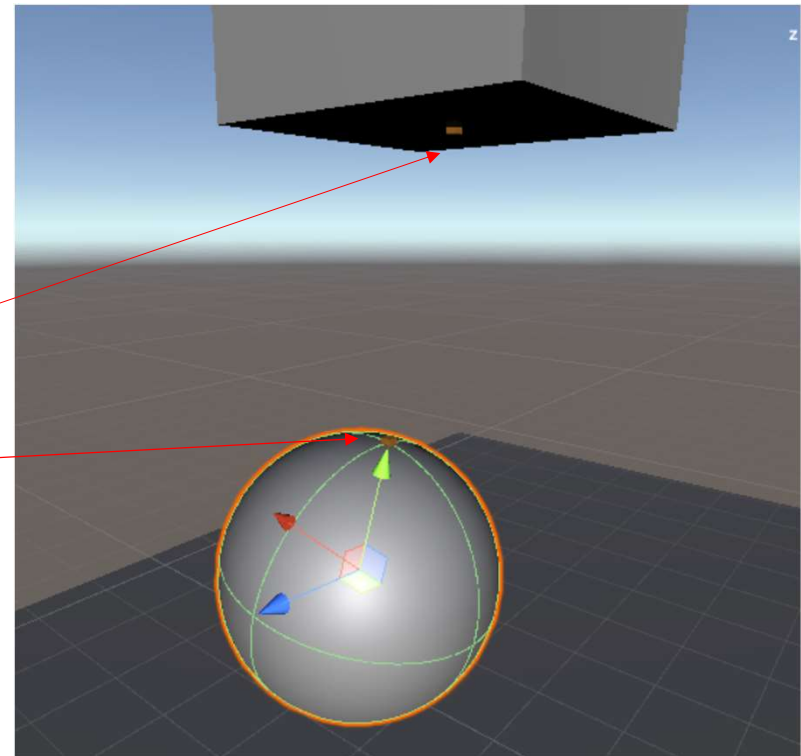


# Spring Joint

- Uncheck “Auto Configure Connected Actors”
- Change the “Connected Anchor” to as below and play



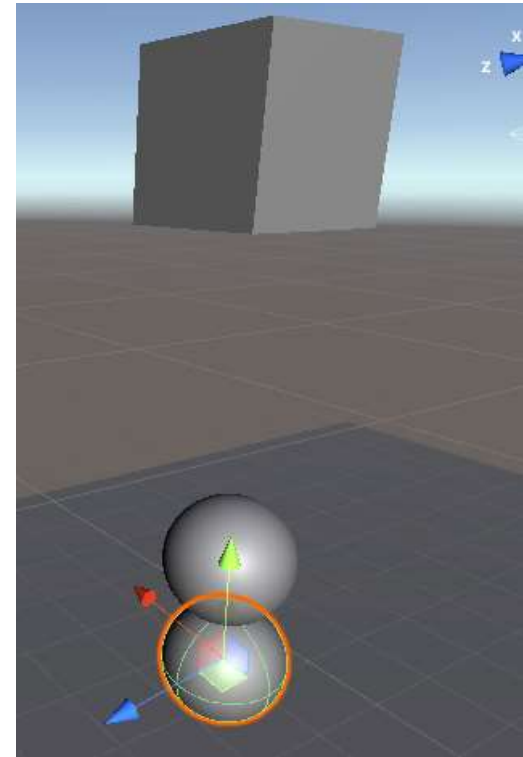
- Note: in local coordinates





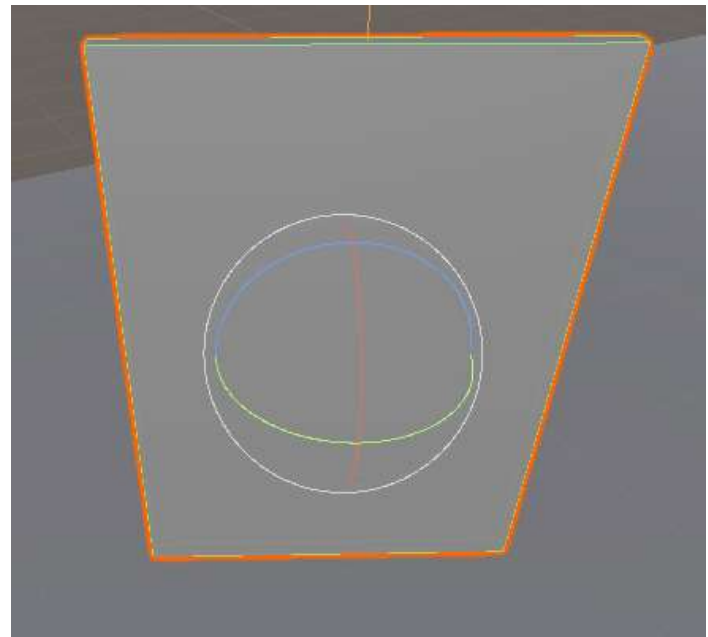
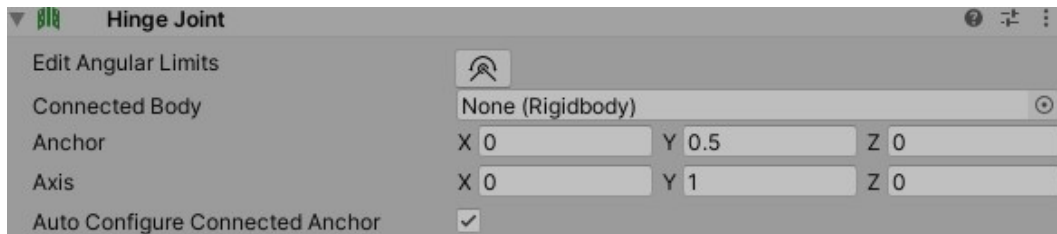
# Spring Joint

- Duplicate(Ctl-D) the sphere and move the new one down a little bit
- Change the “Connected Body” to the old sphere
- change “Spring” to 1000, Damper to 50
- Try again
- “Spring determine the stiffness
- “Damper” control the “viscosity” of movement



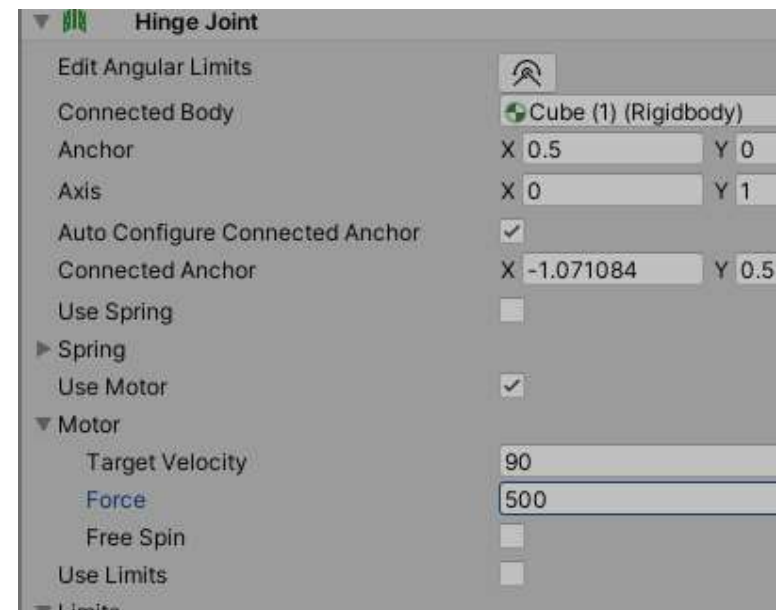
# Hinge Joint

- Create a door like game object
- Add “Physics/Hinge Joint”
- Change the “Axis” to as below (rotation axis is Y-axis) and play to rotate the door



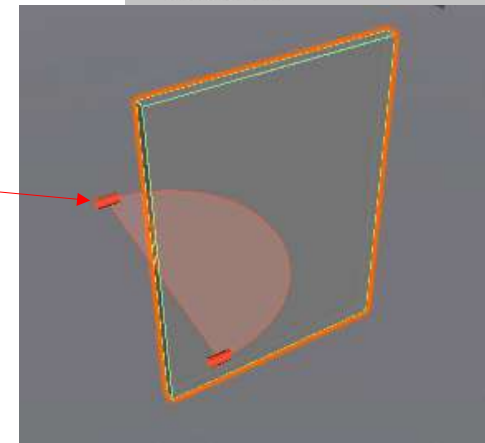
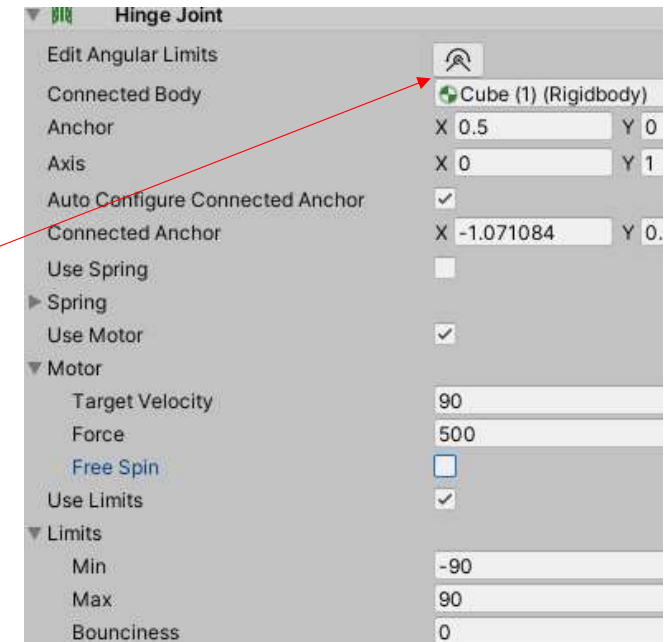
# Hinge Joint

- Modify the anchor to “(+/-0.5,0,0)” or (0,0,+/-0.5) depends on which axis & side you want to be the hinge
- Play to see
- Change the motor section of hinge joint as right and play
- automatic rotation of door
- Target velocity is measured in degree/sec



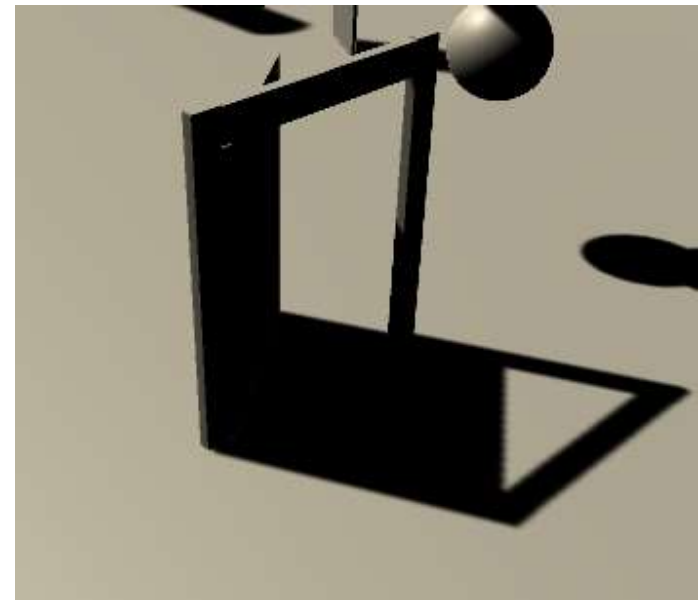
# Hinge Joint

- Modify the Limits section as right
- Note the limits are from -180 to 180
- Play to see
- You can also edit the range by click on “Edit Angular limit” and drag the handles with “Use Limits” checked



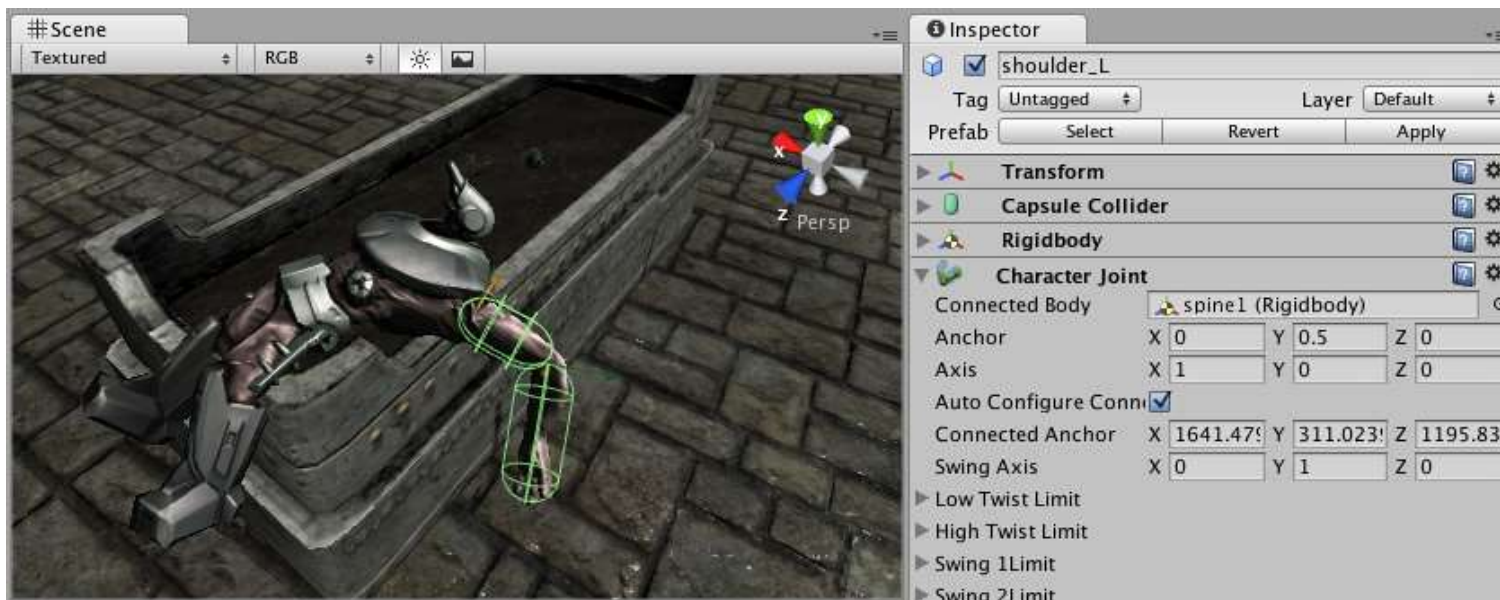
# Hinge Joint

- Add a door frame over our door
- Drag the frame into the “Connected Body” field of our door
- You can also hook up any movable joints object to achieve miscellaneous motions



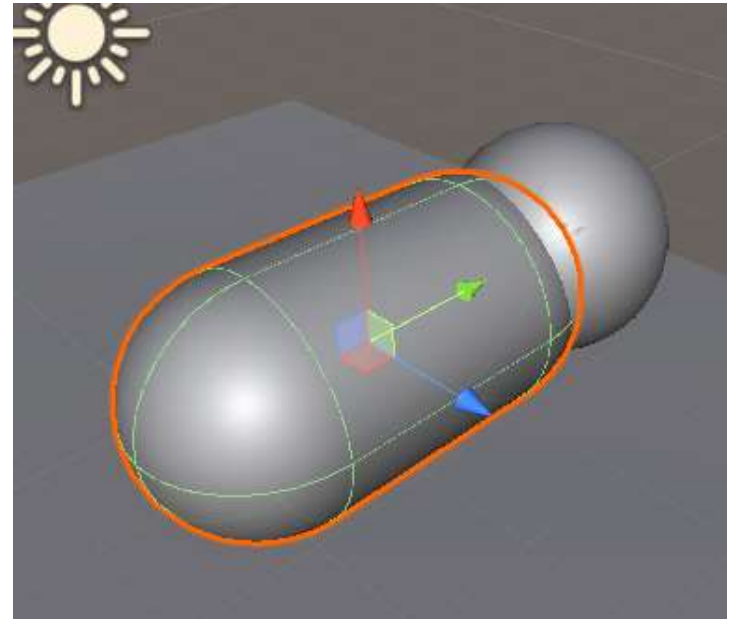
# Character Joint

- mainly used for Ragdoll effects
- extended ball-socket **joint** which allows you to limit the **joint** on each axis



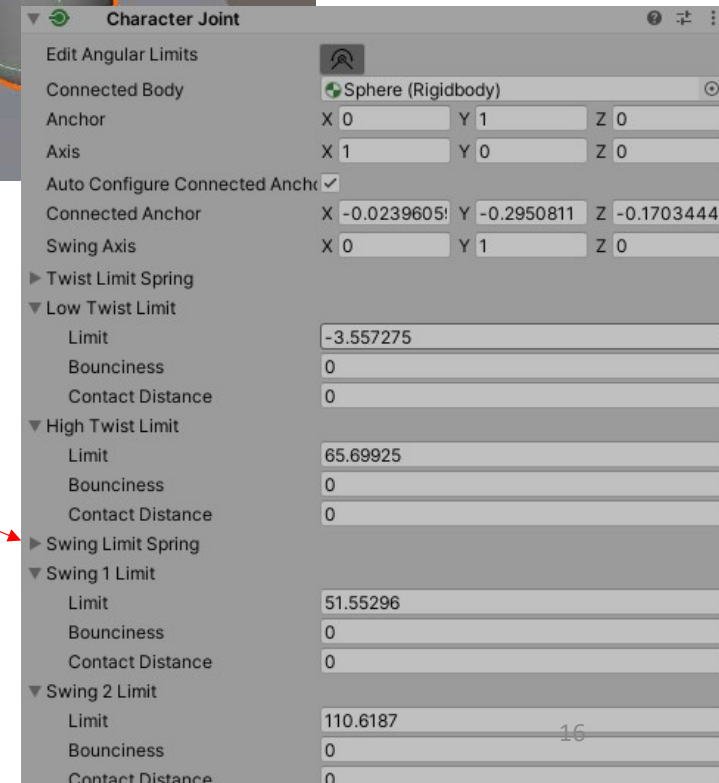
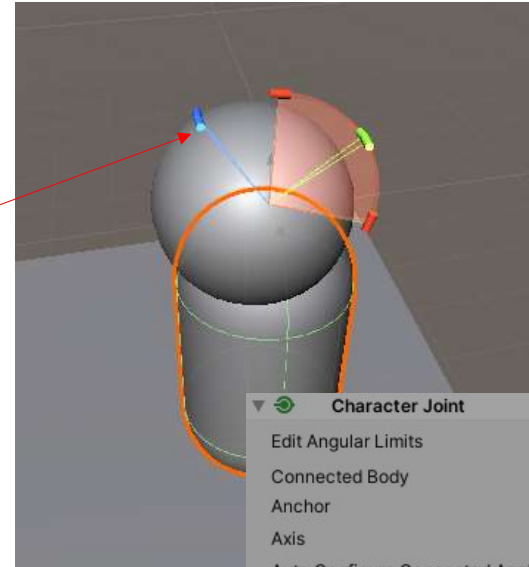
# Character Joint

- Create a sphere with rigid body
- Uncheck gravity and check “isKinematic”
- Then add a capsule and adjust its position to overlap with sphere a bit as that on right
- Add a character joint to the capsule
- Drag the sphere to “Connected Body” field of the character joint
- Play to see



# Character Joint

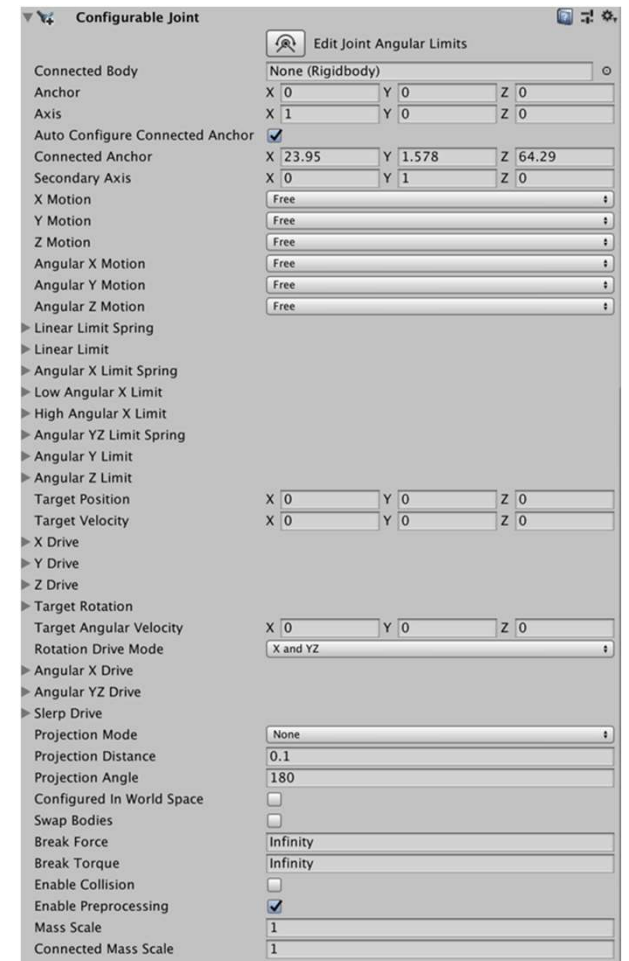
- Can apply restriction by clicking on the “Edit Angular limits” and drag the handlers
- You can model twist, swing like that of human arm motion





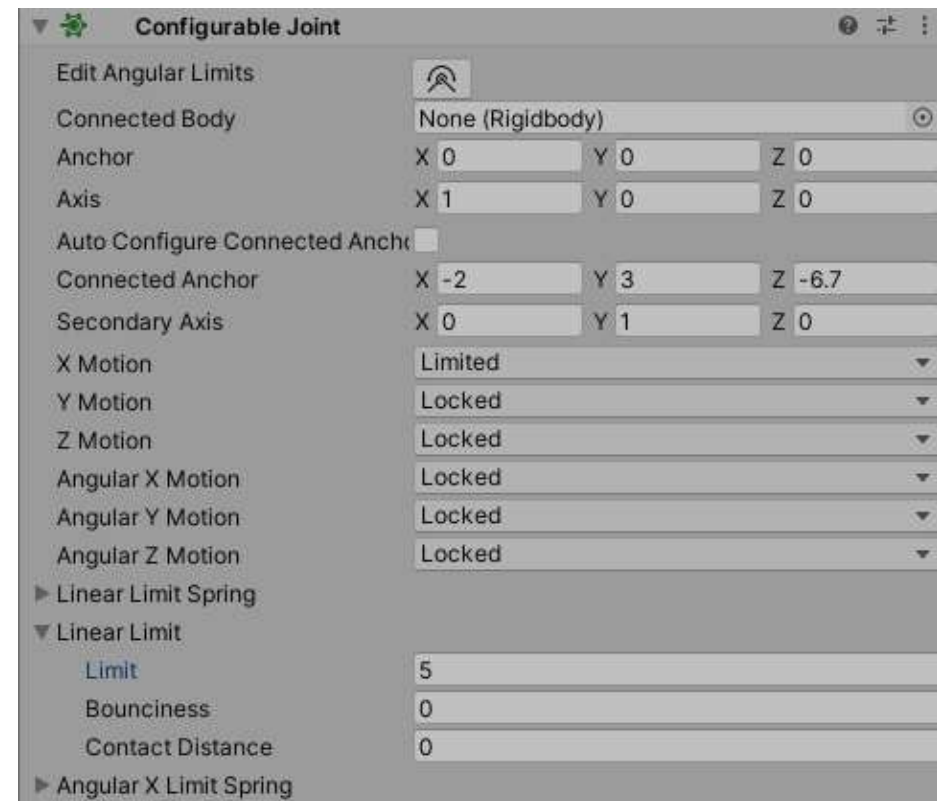
# Configurable Joint

- Sometimes we may want miscellaneous motion such as sliding or striking
- Previous joints cannot achieve as they are rotational
- Meet the configurable joint
- Superset of all joints and highly configurable



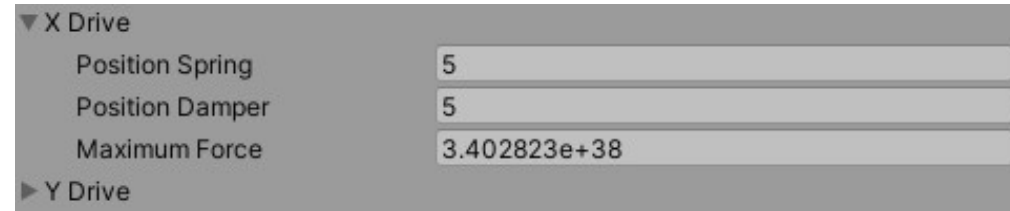
# Configurable Joint

- Let's build a sliding door using configurable joint
- create a door shape object
- Add "Physics/Configurable joint"
- We want to build it move along X-axis towards +ve
- Change "Anchor", "Axis", X/Y,Z motion,, Angular X/Y/Z Motion, and Linear Limit as that on right
- Uncheck "Auto-Configure Connected Actor" and modify "Connected Anchor" to position with X increment from original door position
- Note: read your object position and change accordingly



# Configurable Joint

- Set also the “X Drive” parameters to tune the desired sliding motion
- Finally set the rigid body rotation parameters to freeze all rotations
- Now the door should be able to slide along
- “Connected Anchor” is the default position
- Add the code on right to the door test the open door effect



```
Rigidbody rb;

// Start is called before the first frame update
void Start()
{
    rb = GetComponent<Rigidbody>();
}

// Update is called once per frame
void Update()
{
    if (Input.anyKey)
        rb.AddForce(Vector3.left * 80.0f);
}
```