ASSIGNMENT NO: 1

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BATCH: RA1

AIM:

Create a world with objects such as two chairs, one stool and one ball that is supported by four pillars, without using Proto (Attached).

APPARATUS: Webots R2023b

THEORY:

Definitions

Compound Solids: These are complex 3D objects formed by combining multiple simpler shapes (such as boxes and spheres) into a single entity. They are used to create detailed and intricate structures or robots more efficiently.

Physics Attribute: This attribute specifies the physical properties of a 3D object, including its mass, friction, and density. These properties influence how the object interacts with forces and other objects in the simulation, ensuring realistic movement and collision behavior.

Concepts

Compound Solids: Compound solids can be hierarchically structured, allowing each shape or subpart to be independently positioned, rotated, and scaled. Transformations of individual parts are relative to the parent object, facilitating detailed and flexible designs.

Application: Compound solids are ideal for constructing robots or complex objects that require multiple components to work together as a single unit, such as a robot with multiple limbs or a vehicle with various parts.

Physics Attribute:

- Mass: Determines the weight of an object, affecting its response to forces, gravity, and collisions. Mass is crucial for the realistic simulation of dynamics and interactions.

- Friction: Governs how much an object resists sliding across surfaces. Higher friction values indicate more resistance, impacting how an object moves and stops, and influencing its interactions with other objects and surfaces in the simulation.

- Bounciness (Restitution): Defines how much an object bounces back after a collision. A higher restitution value results in more bouncing, while a lower value results in less bounce, affecting the realism of collisions.

What Is a World?

In Webots, a world is a 3D description of robots and their environment, detailing every object's position, orientation, geometry, appearance (such as color or brightness), physical properties, and type. Worlds are organized hierarchically, allowing objects to contain other objects. A world file does not contain the robot's controller code but specifies the name of the required controller for each robot. World files, saved as ".wbt" files, are stored in the "worlds" subdirectory of each Webots project.

What Is a Controller?

A controller is a computer program that governs the actions of a robot specified in a world file. Controllers can be written in various programming languages supported by Webots, including C, C++, Java, Python, or MATLAB. Upon starting a simulation, Webots launches the specified controllers as separate processes, associating each controller process with its corresponding simulated robot. Some programming languages, such as C and C++, need to be compiled, while others, like Python and MATLAB, need to be interpreted. Java requires both compilation and interpretation. The source and binary files for each controller are stored together in a controller directory, which is placed in the "controllers" subdirectory of each Webots project.
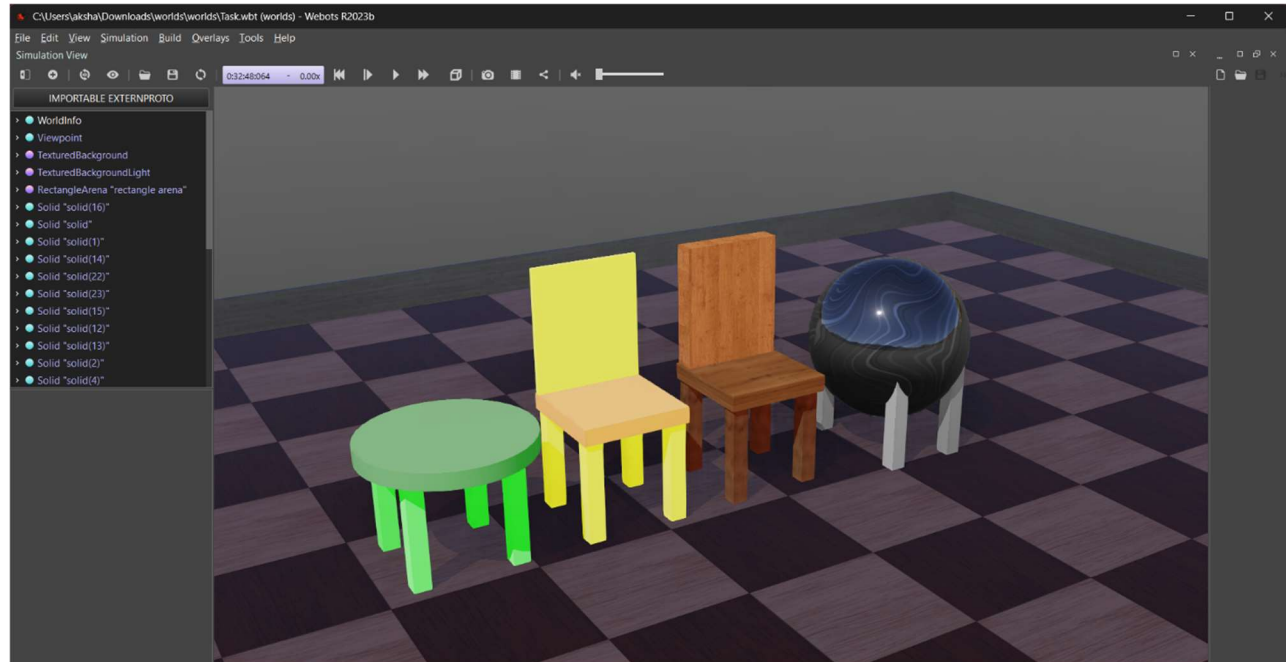
Block Diagram:
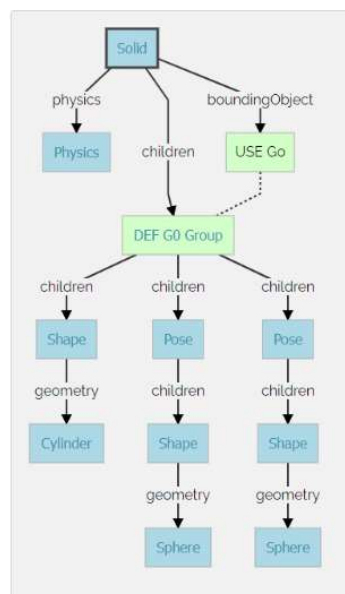
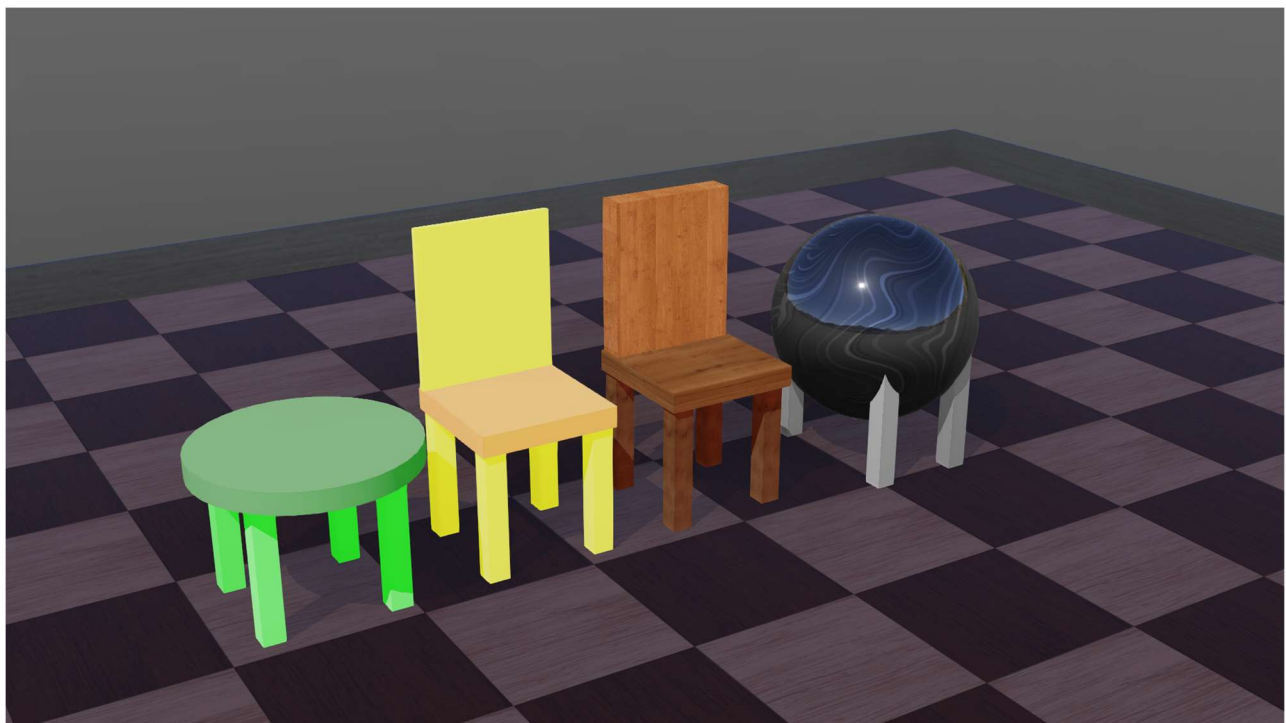*Representation of the subnodes of a compound solid made of several transformed geometries.*

SNAPSHOTS:

FULL WINDOW WITH DIRECTORY:

OUTPUT:

File in notepad:
VRML_SIM R2023b utf8

```
EXTERNPROTO
"https://raw.githubusercontent.com/cyberbotics/webots/R2023b/projects/objects/backgrounds/protos/TexturedBackground.proto"

EXTERNPROTO
"https://raw.githubusercontent.com/cyberbotics/webots/R2023b/projects/objects/backgrounds/protos/TexturedBackgroundLight.proto"

EXTERNPROTO
"https://raw.githubusercontent.com/cyberbotics/webots/R2023b/projects/objects/floors/protos/RectangleArena.proto"


WorldInfo {

}

Viewpoint {

  orientation      -0.11317845863279295      -0.7800388664924905      0.6154104348015361
5.820108266933198

  position -1.8150753234439783 0.4655162028347365 0.9196331915484598

}

TexturedBackground {

  skyColor [

    1 1 1

  ]

}

TexturedBackgroundLight {

  luminosity 0.15

}

RectangleArena {
```

```
  translation 0 0 -0.08

  rotation 0 0 1 -1.3089953071795861

  floorSize 4 3

}

Solid {

  translation 0.01 0.37 0.13

  children [

    Shape {

      appearance Appearance {

        material Material {

          emissiveColor 0 0.6 0

        }

      }

      geometry Cylinder {

        height 0.03

        radius 0.15

      }

    }

  ]

  name "solid(16)"

}

Solid {

  translation 0.159538 0.177332 0.02

  rotation 0 0 1 1.8326

  children [

    Shape {

      appearance Appearance {

        material Material {
```

```
        emissiveColor 1 1 0

      }

    }

    geometry Box {

      size 0.03 0.03 0.2

    }

  }

 ]

}

Solid {

  translation 0.00499137 0.135924 0.02

  rotation 0 0 1 1.8326

  children [

    Shape {

      appearance Appearance {

        material Material {

          emissiveColor 1 1 0

        }

      }

      geometry Box {

        size 0.03 0.03 0.2

      }

    }

  ]

  name "solid(1)"

}

Solid {

  translation -0.0752434 0.435357 0.02
```

```
rotation 0 0 1 1.8326

children [

  Shape {

    appearance Appearance {

     material Material {

      emissiveColor 0 1 0

     }

    }

    geometry Box {

     size 0.03 0.03 0.2

    }

   }

 ]

 name "solid(14)"

}

Solid {

 translation 0.120714 0.322221 0.02

 rotation 0 0 1 1.8326

 children [

  Shape {

    appearance Appearance {

     material Material {

      emissiveColor 0 1 0

     }

    }

    geometry Box {

     size 0.03 0.03 0.2

    }
```

```
    }
  ]
  name "solid(22)"
}
Solid {
  translation 0.0793044 0.476765 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
        material Material {
          emissiveColor 0 1 0
        }
      }
      geometry Box {
        size 0.03 0.03 0.2
      }
    }
  ]
  name "solid(23)"
}
Solid {
  translation -0.0752434 0.435357 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
        material Material {
```

```
          emissiveColor 0 1 0
        }
      }
      geometry Box {
        size 0.03 0.03 0.2
      }
    }
  ]
  name "solid(15)"
}
Solid {
  translation -0.0312439 0.271154 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
        material Material {
          emissiveColor 0 1 0
        }
      }
      geometry Box {
        size 0.03 0.03 0.2
      }
    }
  ]
  name "solid(12)"
}
Solid {
```

```
translation -0.0312439 0.271154 0.02

rotation 0 0 1 1.8326

children [

  Shape {

    appearance Appearance {

      material Material {

        emissiveColor 0 1 0

      }

    }

    geometry Box {

      size 0.03 0.03 0.2

    }

  }

]

name "solid(13)"

}

Solid {

  translation 0.200946 0.0227865 0.02

  rotation 0 0 1 1.8326

  children [

    Shape {

      appearance Appearance {

        material Material {

          emissiveColor 1 1 0

        }

      }

      geometry Box {

        size 0.03 0.03 0.2
```

```
        }
      }
    ]
    name "solid(2)"
}
Solid {
  translation 0.10297 0.0793546 0.12
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
        material Material {
          emissiveColor 1 0.7 0
        }
      }
      geometry Box {
        size 0.2 0.2 0.03
      }
    }
  ]
  name "solid(4)"
}
Solid {
  translation 0.178022 -0.200761 0.12
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
```

```
      material Material {

        emissiveColor 0.7 0.4 0

      }

      texture ImageTexture {

       url [

         "https://cdn.architextures.org/textures/20/11/oak-5fc4cb29cb8cc-1200.jpg"

        ]

      }

      textureTransform TextureTransform {

       }

      }

     geometry Box {

       size 0.2 0.2 0.03

      }

     }

   ]

   name "solid(7)"

  }

Solid {

  translation 0.189901 0.102648 0.25

  rotation     0.47690389062282057     0.6215158574562867     -0.62151485745 6516    -
2.2515953071795867

  children [

   Shape {

    appearance Appearance {

     material Material {

       emissiveColor 1 1 0

       shininess 0.5
```

```
      }
    }
    geometry Box {
      size 0.2 0.23 0.01
    }
   }
  ]
  name "solid(5)"
 }
Solid {
 translation 0.255295 -0.180056 0.25
 rotation    0.47690389062282057    0.6215158574562867    -0.621514857456516    -2.2515953071795867
 children [
  Shape {
   appearance Appearance {
    material Material {
     emissiveColor 0.9 0.6 0.4
     shininess 0.5
    }
    texture ImageTexture {
     url [
      "https://i.pinimg.com/736x/ca/c7/bb/cac7bbc674f86d031293442b2dafcfa8.jpg"
     ]
     filtering 0
    }
   }
   geometry Box {
```

```
        size 0.19 0.23 0.04
      }
    }
  ]
  name "solid(6)"
}
Solid {
  translation 0.0464004 -0.0186252 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
        material Material {
          emissiveColor 1 1 0
        }
      }
      geometry Box {
        size 0.03 0.03 0.2
      }
    }
  ]
  name "solid(3)"
}
Solid {
  translation 0.129406 -0.482954 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
```

```
      appearance Appearance {

        material Material {

          emissiveColor 0.4 0.4 0.4

        }

      }

      geometry Box {

        size 0.03 0.03 0.2

      }

    }

  ]

  name "solid(19)"

}

Solid {

  translation 0.129406 -0.482954 0.02

  rotation 0 0 1 1.8326

  children [

    Shape {

      appearance Appearance {

        material Material {

          emissiveColor 0.4 0.4 0.4

        }

      }

      geometry Box {

        size 0.03 0.03 0.2

      }

    }

  ]

  name "solid(17)"
```

```
  }
Solid {
  translation 0.165639 -0.618181 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
        material Material {
          emissiveColor 0.4 0.4 0.4
        }
      }
      geometry Box {
        size 0.03 0.03 0.2
      }
    }
  ]
  name "solid(18)"
}
Solid {
  translation 0.387796 -0.558657 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
        material Material {
          emissiveColor 0.4 0.4 0.4
        }
      }
```

```
      geometry Box {
        size 0.03 0.03 0.2
      }
    }
  ]
  name "solid(20)"
}
Solid {
  translation 0.351564 -0.423431 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
        material Material {
          emissiveColor 0.4 0.4 0.4
        }
      }
      geometry Box {
        size 0.03 0.03 0.2
      }
    }
  ]
  name "solid(24)"
}
Solid {
  translation 0.0800474 -0.144195 0.02
  rotation 0 0 1 1.8326
  children [
```

```
Shape {

  appearance Appearance {

    material Material {

      emissiveColor 0.6 0.2 0

    }

    texture ImageTexture {

     url [

       "https://cdn.architextures.org/textures/20/11/oak-5fc4cb29cb8cc-1200.jpg"

     ]

    }

   }

   geometry Box {

     size 0.03 0.03 0.2

    }

   }

  ]

  name "solid(11)"

}

Solid {

 translation 0.234593 -0.102786 0.02

 rotation 0 0 1 1.8326

 children [

   Shape {

    appearance Appearance {

     material Material {

       emissiveColor 0.6 0.2 0

     }

     texture ImageTexture {
```

```
      url [
        "https://cdn.architextures.org/textures/20/11/oak-5fc4cb29cb8cc-1200.jpg"
      ]
    }
  }
  geometry Box {
    size 0.03 0.03 0.2
  }
  }
  ]
  name "solid(8)"
}
Solid {
  translation 0.276004 -0.257333 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
      appearance Appearance {
        material Material {
          emissiveColor 0.6 0.2 0
        }
        texture ImageTexture {
          url [
            "https://cdn.architextures.org/textures/20/11/oak-5fc4cb29cb8cc-1200.jpg"
          ]
        }
      }
      geometry Box {
```

```
      size 0.03 0.03 0.2
    }
   }
  ]
  name "solid(9)"
 }
Solid {
  translation 0.131118 -0.296154 0.02
  rotation 0 0 1 1.8326
  children [
    Shape {
     appearance Appearance {
      material Material {
        emissiveColor 0.6 0.2 0
      }
      texture ImageTexture {
       url [
         "https://cdn.architextures.org/textures/20/11/oak-5fc4cb29cb8cc-1200.jpg"
       ]
      }
     }
     geometry Box {
      size 0.03 0.03 0.2
     }
    }
  ]
  name "solid(10)"
 }
```

```
Solid {

 translation 0.26 -0.52 0.14

 children [

  Shape {

   appearance PBRAppearance {

    baseColorMap ImageTexture {

     url [

        "https://static.vecteezy.com/system/resources/previews/043/178/946/non_2x/damascus-
steel-texture-cloud-pattern-color-illustration-damascus-abstract-flat-background-free-vector.jpg"

     ]

    }

    roughnessMap ImageTexture {

     url [


"https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.cyberbotics.com%2Fdoc%2Fg
uide%2Fappearances%3Fversion%3Domichel%3Amaster%23!&psig=AOvVaw3QeAz_cWNZk
FhnOeZ6cFI-
&ust=1722874441665000&source=images&cd=vfe&opi=89978449&ved=0CBEQjRxqFwoTCJ
jtm8nd24cDFQAAAAdAAAAABAD"

     ]

    }

    metalnessMap ImageTexture {

     url [

       ""

     ]

    }

    normalMap ImageTexture {

    }

    occlusionMap ImageTexture {

    }

    emissiveColorMap ImageTexture {
```

```
          }

      textureTransform TextureTransform {

        }

      }

    geometry Sphere {

      radius 0.16

      subdivision 5

      }

    }

  ]

  name "solid(21)"

  }
```

LEARNING OUTCOME:
- Learn how to create and manipulate complex 3D objects by combining simpler geometric shapes. This involves using compound solids to model the chairs, stool, and pillars by arranging basic shapes like boxes and spheres.
- Acquire skills in applying physical properties such as mass, friction, and restitution to objects to simulate realistic interactions and behaviors. This includes ensuring that the ball is properly supported by the pillars and that the chairs and stool interact realistically with their environment