

实验课 1：虚拟世界三维建模实验

一、实验目的

1. 熟悉仿真实验环境
2. 掌握三维虚拟世界建模操作方法
3. 建造实验操作对象：三维虚拟机器人

二、实验内容

2.1 三维化身动作和摄像机控制操作方法

2.1.1 旋转视角

按下键盘上的左右方向键，视图转而人不转，这时候视野会被固定在一个方向，如正前方。

同时按 alt 键与方向键组合，旋转视图的同时，人跟随视图一起转动，即二者相对静止。

2.1.2 切换视角

点屏幕上的 view 键，选择 mouthlook，这时候第三人称视角会被第一人称视角替换。再按的话反之。第一人称视角配合 fly 几乎可以到达任何想去的地方。下面 fly 里会有讲解。

2.1.3 走动与跑动

(1) 一般的走动直接按键盘上的上下左右方向键即可。屏幕上的上下左右方向键也能用于走动。走动的时候，视角会跟随走动的方向一起旋转。

(2) 同时按一下 ctrl+R 键，可以在走与跑之间切换。

(3) 按 shift 加方向键，可以在不旋转视角情况下进行走动，尤其在墙角等视野容易被遮盖的地方，这样就避免了因旋转视角造成的视野被遮盖。

2.1.4 飞翔 fly

屏幕偏下方会有 fly 键，单击一下切换到 fly 模式，按 Pageup 键上升，PageDown 键下降。再单击 stop flying，即降落。一般降落在化身同一地方上最高的地块上。

飞翔和降落的特殊技巧：

(1) 前面的物块比自己稍高，身体尚能触及到它，但采用走动无法穿越或跨越该物块的时候，可以点击屏幕上的 fly 键，一般就能跨越过去。跨越过障碍以后，fly 的高度也会随之等高。

(2) 前面的地块明显比自己的高度高很多，连头部都无法触及它的时候，那么想单凭 fly

跨越上去是不可能的。这时候可以先点 **view**，选择 **mouthlook**，使自己的视角变为第一人称视角（你自己的化身会被隐藏）。然后把视角指针指向高处的物块如房屋，选择 **fly**，并长按键盘上的方向键前进。你会看到自己的视角渐渐逼近高处的房屋，当你觉得已经到达房屋的上方的时候，选择 **stop flying**，即降落在了房屋顶部。这种方法可以到达很高的地块。

（3）当自己在某个狭缝里且视线被遮挡，导致走不出去的时候，采用以上第一人称视角+fly，也能顺利出去。

2.1.5 地图和 Teleport

点击地图 **map** 按钮，会出现虚拟世界的地图。滑动鼠标中间滑鼠可以在放大或缩小地图，拖到地图，双击地图上自己想去的地点，即可通过 **Teleport** 的方式，直接抵达目的地。网速慢或所选的位置离自己现处位置较远的时候，需等待的载入时间会变长。需要耐心等待一下。

Teleport 是一种快速切换位置的方式，不需要走或者飞，直接抵达目的地。可以在地图上双击目的地抵达想去的地方，也可以通过搜索找到想去的地方，然后 **Teleport** 过去。也可以将有趣的好玩的位置记录在自己的库存的 **Landmark** 里，如果想去的话，直接在 **landmark** 里 **Teleport** 就可以了。

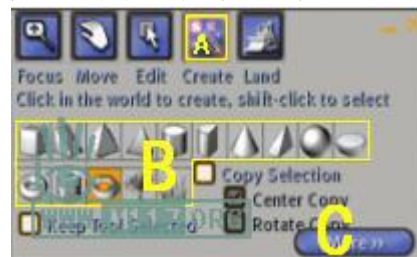
在任何时候，如果 **CTRL-SHIFT-H** 键可迅速回到自己设定的 **Home** 区。（提示：可以通过菜单 **World | Set Home** 命令创建自己的 **Home** 区。）

2.2 三维对象建模操作

2.2.1 基本体元 Prim

在 Secondlife 中所有的实体，都可以由玩家通过客户端创建出来。点击界面最下端的 **Build** 按钮，或者是在场景地上单击鼠标右键，弹出圆形菜单，选择 **Create** 来调出建造对话框。如图所示。

确认 **A** 栏处于选择状态，在 **B** 栏中任意选择一个物体，再用把鼠标放到场景中左击。ok 物体就这么建造出来了。**B** 栏的最后两项，树木和花草。

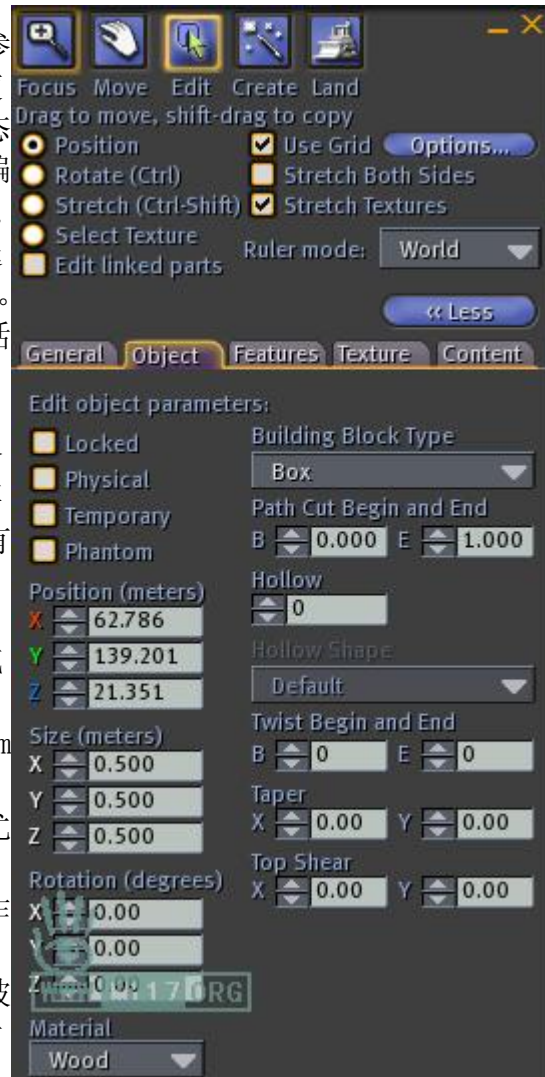


Prim 是一个非常重要的概念，是组成物体的最小单位。**B** 栏中所列的都是 **Prim**，多个 **prim** 就可以组成复杂的物体。一块土地只能容纳一定数量的 **prim**。

B 栏中的前四个 prim 是，立方体，三棱柱，金字塔和四面体。这四个 prim 具有相同的参数项，只要调节参数值，几个物体可以互相转换。



在编辑状态下，可以调节各参数项的值。Secondlife 物体的参数项比较多，通过这些参数项，可以使简单的 prim 作各种形变。进入编辑状态有两个方法，你可以点击 A 栏左边的编辑按钮，再选择场景中的物体。也可以在场景中右键点选想要编辑的物体，选择圆形菜单上的 Edit，弹出编辑对话框。选择 C 处的按钮 More》，展开整个对话框。如右图所示。



在展开的对话框中，我们会看到 5 个分页标签，其中第 2 个就是我们所需要的 OBJECT tab。切换到该页，左上角有 4 个复选框。

- ◆ Lock 锁定，其功能和其他 2d 或者 3d 的类似，将已经编辑好的 prim 锁定，防止在编辑其他 prim 的时候影响到。在编辑由多个 prim 组成的复杂物体时，这点尤为重要。
- ◆ Physics 物理，设定该 prim 只作物理性的动作。
- ◆ Temporary on rez 临时物件，被设定本属性的物件，会在一段时间后自动消失。
- ◆ Phantom 幽灵，这样的 prim 仅仅是视觉存在，你的身体可以穿越它。在 Secondlife 中常被用作树木、花草。值得注意的是，如果你试图把一个幽灵 prim 和其他物体连接（Link）起来，整个物体都将变成幽灵属性。

接下来是 xyz 三个一组的 Coordinaters 坐标，设定 prim 在场景中的位置，即上下左右前后。具体是哪个轴，可以通过颜色来辨认。你可以直接在 xyz 的数字框里填写数字，也可以通过用鼠标点击数字框旁边的上下两个小箭头来微调。或者直接在场景中拖动 prim 上显示出的带箭头三条轴线。

下面一组是物体 Size 大小。用来设定 prim 在三个方向上的大小。最大值是 10 米，最小是 1 厘米。系统默认是 0.5 米。

Rotation 旋转。这组是让 prim 围绕某个轴线旋转。单位是角度。

左下角是 Material 材质。默认的是木头。还可以选择其他材质 stone 石头 metal 金属 glass 玻璃 flesh 肉 plastic 塑料 rubber 橡皮 light 光。

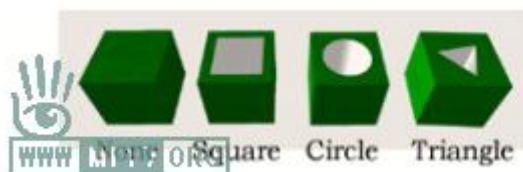
左栏是通用参数项，各 prim 都一样，简单也容易理解。右栏大部分是特色参数项，不同类的 prim 有不同的参数项，可以实现非常酷的效果，理解起来也有些难度。

右栏第一项是 prim 的类别，显示当前 prim 的所属于类别。可以在此把 prim 变成其他类别，比如把方块变成圆环、圆柱等。

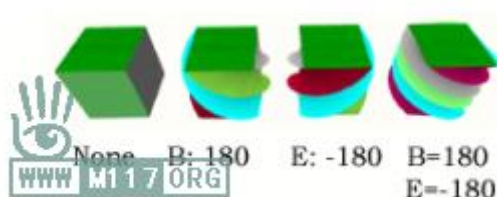
接下来是 Cut beginning and end 从头到尾的切割，效果就象切蛋糕。有两个参数，B 意思是 begin，从头切。E 意思是 End，从尾切。单位是百分比。数字框旁边的上下两个小箭头是微调，操作起来比较顺手。效果如下图。



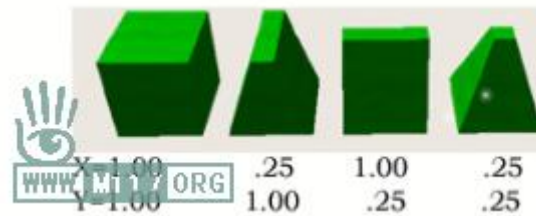
Hollow 孔，允许我们在 prim 上打孔。孔的大小由 hollow 下面的数字控制，默认是 0，最大值是 95，单位是百分比。当数字不为零的时候，可以通过下面的选择框设定孔的样式。有 Square 方 Circle 圆 Triangle 三角几个形状。值得注意的是，孔是从上到下贯通的，如果你从 prim 的侧面观察，会看不到效果。如下图所示。



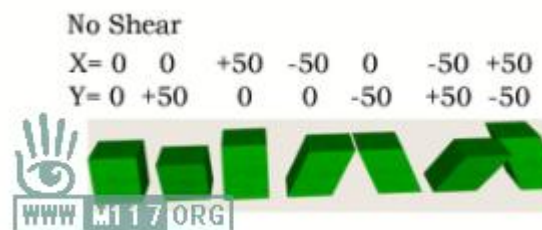
Twist Begin and End 从头尾两个方向螺旋化 物体，效果就象拧麻花。有两个值，B 代表头拧 的角度，E 是尾拧的角度。最小值-180，最大值 180，单位是角度。效果如图。



Taper 锥形化，两个值，可以从 x 轴方向，或者 y 轴方向锥化物体，单位是百分比。如果 xy 两个方向的 taper 值都为零，则立方体变成金字塔形状。效果如图。



Top Shear 顶部倾斜，两个值，分别从 x 或 y 轴方向倾斜，默认值为零，单位为百分比。效果 如下图。



另外三种 Prim 理解起来会非常简单。同是 Box 族，其参数项种类是一样的，区别仅仅是数值不同。

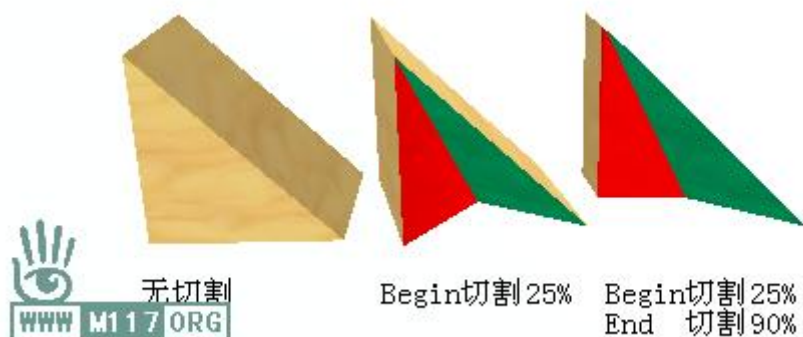
首先看看 Right-Sided Triangle 三棱柱。



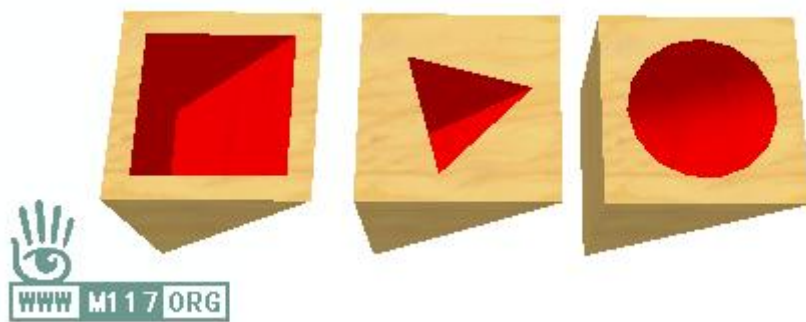
比较 Cube 正方体和 Right-Sided Triangle 三棱柱的编辑框，有两项参数值不一样。如果把三棱柱的 Taper 和 Top Shear 的 x 值都改为零，则三棱柱会变成正方体。



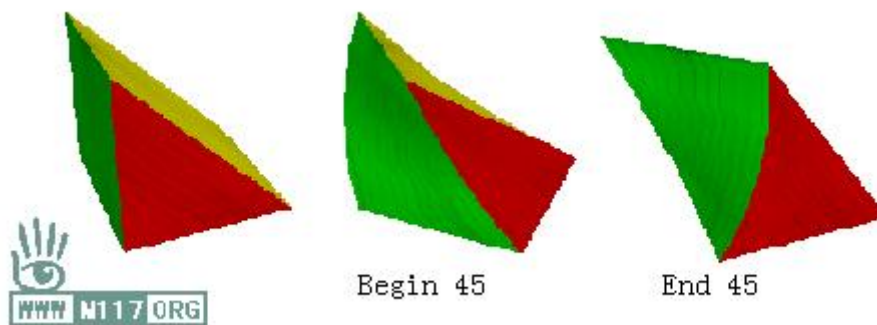
编辑框左栏各种 Prim 都是一样的，主要是位置、大小和旋转，这里就不再重复。右栏的 Path Cut Begin and End，从头到尾切割，和 Cube 正方体作用类似，不过是切下来，效果看起来怪怪的。如下图，第一无切割，第二个 Begin 切割 25%，第三个 Begin 25%、End 90%。



Hallow 打孔和三种形状的孔，方、三角和圆。



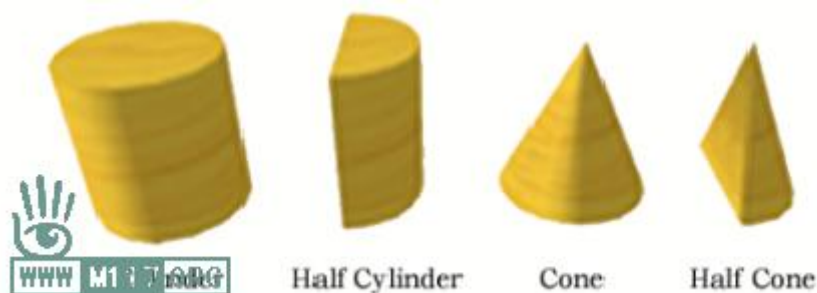
Twist Begin and End 从头尾两个方向螺旋化。



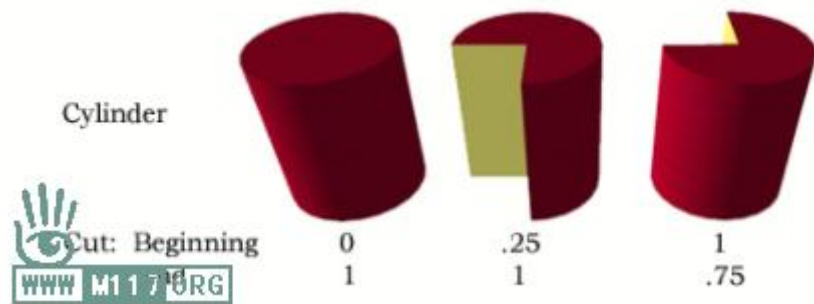
Taper 锥形化和 Top Shear 顶部倾斜这里不再演示。三棱柱本身就是通过 Cube 的锥形化和顶部倾斜变化过来的。

Pyramid 金字塔和 Prism 四面体的变化与三棱柱类似，各位可以自己实践一下。

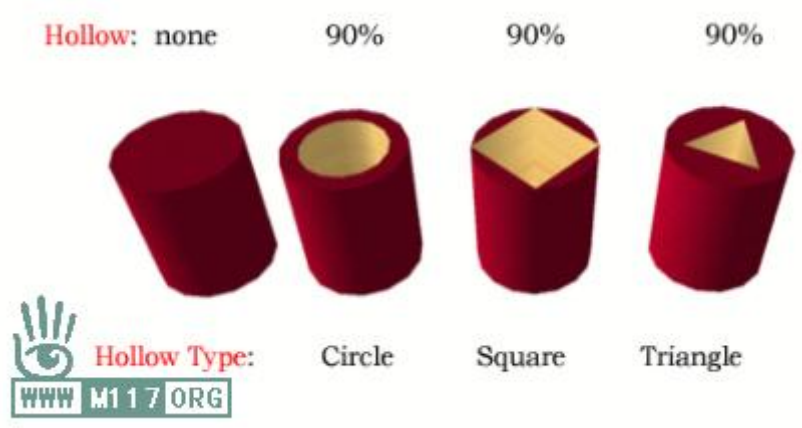
Cylinder 圆柱体一族，包括圆柱体和其衍生的三种 prim。Half Cylinder 半圆柱、Cone 圆锥和 Half Cone 半圆锥。衍生物体均可通过圆柱体调节参数得到。



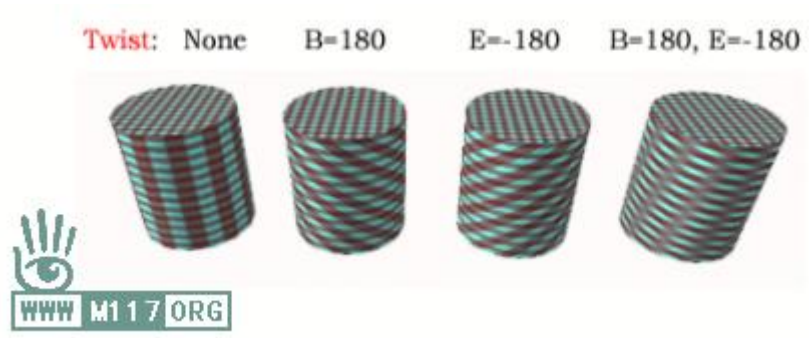
和前面讲的正方体类似，编辑框右栏依次为 Cut 切割、Hollow 孔径、Hollow type 孔样式、Twist 螺旋化、Top size 顶面大小（锥形化）和 Shear 顶部倾斜。下图演示 Cut 效果。



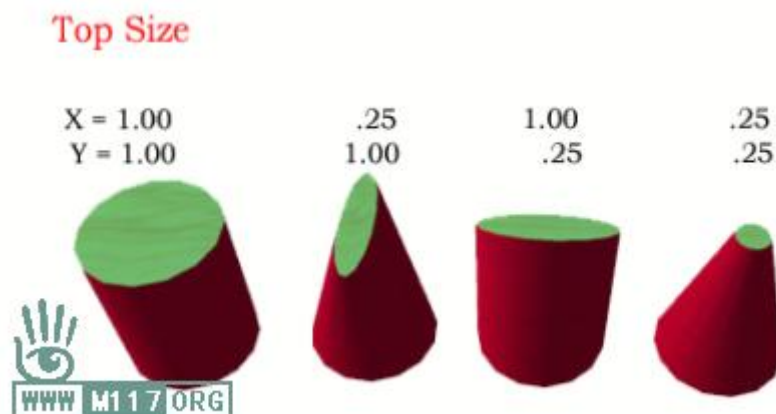
Hollow 孔径大小和样式。



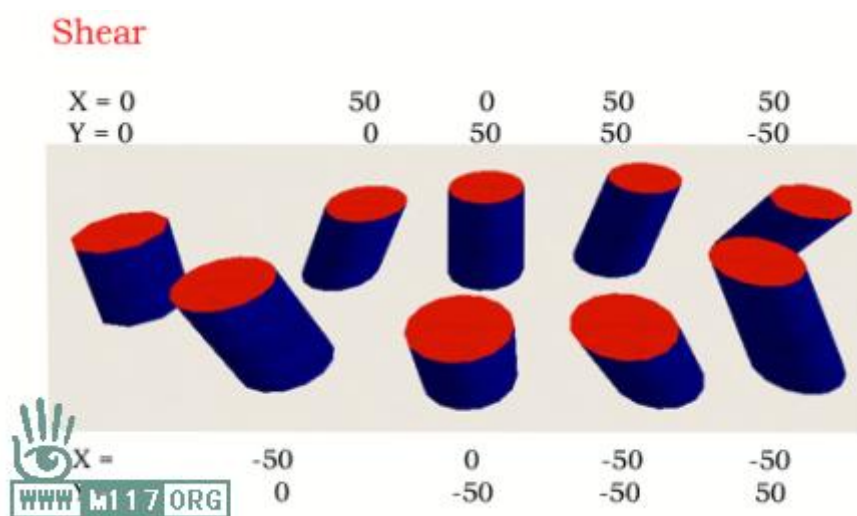
Twist 螺旋化，为方便观看，在圆柱体表面贴上方格材质。



Top size 顶面大小，有 XY 两个方向，如果两方向都调成最小，则圆柱体变为圆锥。



Shear 顶部倾斜，同样有 XY 两个方向。




圆柱体的三个衍生 Prim 编辑与其类似，大家可以自己实践一下，这里不再累述。

2.2.2 纹理

second life 中纹理的意思有两个，第一是指纹理文档里那些 TGA、JPG 格式的图片，同时，纹理还指所建造物体的外观，即混合了纹理图片、颜色、透明度、发光等一系列效果的总和，所有这些都可以在编辑窗口中的 texture 栏中设置

如果我们能很好得应用纹理，那么就可以建造真正的物品，而不是一个个立方体了。

纹理即是 texture，最基本的用法是在 build 物体时候，有一栏 texture 的选框，在里面可对纹理进行最初步的设定

首先点击  Select Texture 选择要添加材质的面 再点击下标为 texture 的图片 就会出现一个对话框 在这里可以选在想要添加的各种纹理，同样 color 是填充颜色。



- 右边的 transparency 是改变材质的透明度
- glow 是改变明亮程度 full bright 是最大光亮 这个效果并不是把物体变成光源 只是让物体看起来更亮而已
- bumpiness 能改变物体表面的凹凸性
- Repeats Per Face 是调整材质的密度
- Rotation 是旋转
- offset 是在这个面上水平移动

如何做自己的纹理

在上传图像之前，必须先对图像进行处理。

1. 剪裁纹理图片，所上传的图片必须是方正的，规格一半都是 128*128，256*256，512*512，1024*1024，如果你上传大于 1024*1024 的图片，系统会自动裁剪到 1024*1024，而且就效果而言，512*512 已是非常好的了，大于 256*256 的纹理图片都会对运行速度造成影响。例如，从近处看一个 10m*10m 的墙，用 512*512 的贴图就非常好了。

2. 你上传的图片可以是 .jpg .tga 或是 24 bit.bmp 的格式，但是所有的会自动被压缩成 JPG2000 的格式，所以推荐用 tga 格式上传，因为两次压缩会造成画质下降。

3. 有关透明度的设置

在 secondlife 里面就可以调节透明度，不过 sl 里会有诸多不便，如果你调整了透明度，即使只是 1%，也会使 shininess 和 bumpiness 效果缺失，而且透明度也只能对整个图片更改，所以，如果想要透明的材质的话，最好是先把图片

处理成透明的，而不是在 sl 里面调整，这就会用到带 alpha 通道的 32 位 tga 格式。

不过由于 sl 里面着色引擎的原因，透明的材质会有点小 bug，比如你设置了一层透明的玻璃，而在玻璃后面有一扇窗子，在一定的角度，玻璃可能会变成实体，就看不到后面的窗子，在一定的角度玻璃会不见，只看得到窗子，所以，除非是必要，不要把材质设置成 32bit 的 tga 格式。

三、实验作业：三维虚拟机器人建模

Introduction to building in Second Life

In this tutorial you will be creating a robot using basic building skills (you may do something quite different if you would prefer to be more creative) *Please note that if you are using a Mac to use Command+Click for right click.*

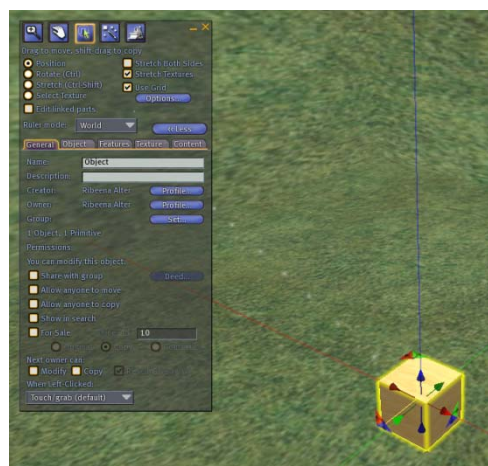
Creating the Robot

You should have now completed the introduction to Second Life practical, and understand the very basics of building. Some key points to remember;

- Hold down *Alt* while using your left mouse button to shift, zoom and rotate your camera focus.
- Hold down *Alt+Ctrl* to rotate your camera vertically.
- Use the mouse's *scroll* to zoom.
- Ensure you are working in a sandbox, or the DIM designated area – otherwise you will not be able to build.
- To start either *right click* the ground and select “*Create*” from the pie menu or press “*b*” on the keyboard
- The *Red, Blue* and *Green* arrows are ‘*handles*’ to move object, *left click* and hold to move an object.
- Holding *Ctrl* will allow you to rotate an object.
- Holding *Ctrl+Shift* will allow you to resize objects.
- Holding *shift* while selecting objects will allow you to select multiple objects. You can also deselect an object by *left clicking* it again while holding *shift*.
- Holding *shift* while using a moving handle will create a duplicate of that object. Also you can use *Ctrl+D*.

Let's get started

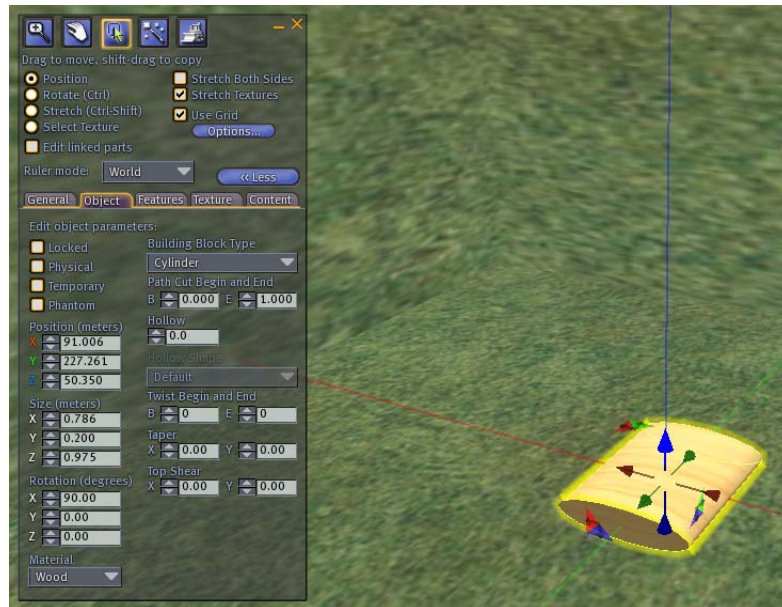
Once you've navigated yourself to an appropriate area to start building, bring up the build menu (*b*), and click the ground to create a cube;



You will need to get yourself well acquainted with this window. The top four buttons are “*zoom, move, edit, create, landscape*”. Because we can use the *Alt* and *Ctrl* key shortcuts for moving our camera, the first tool we won't use. The ‘*move*’ is designed for interacting with objects that have physics associated with them, not for development. ‘*Edit*’ is the key area we will be using. ‘*Create*’ will allow you to create new objects if you choose not to use duplication or the pie menu. And finally ‘*Landscaping*’ is not overly useful unless you own land, allowing you to deform the land.

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Since we have our lovely default cube we will start by making it a cylinder;



Selecting the object tab will bring up various options for changing our object. In this case from the '*Building Block Type*', select the drop down and change it to *cylinder*. Now you can use the handles, *Ctrl* and *Shift* to rotate and resize the cylinder to look like above, or alternatively enter the following value into the X, Y, and Z text fields;

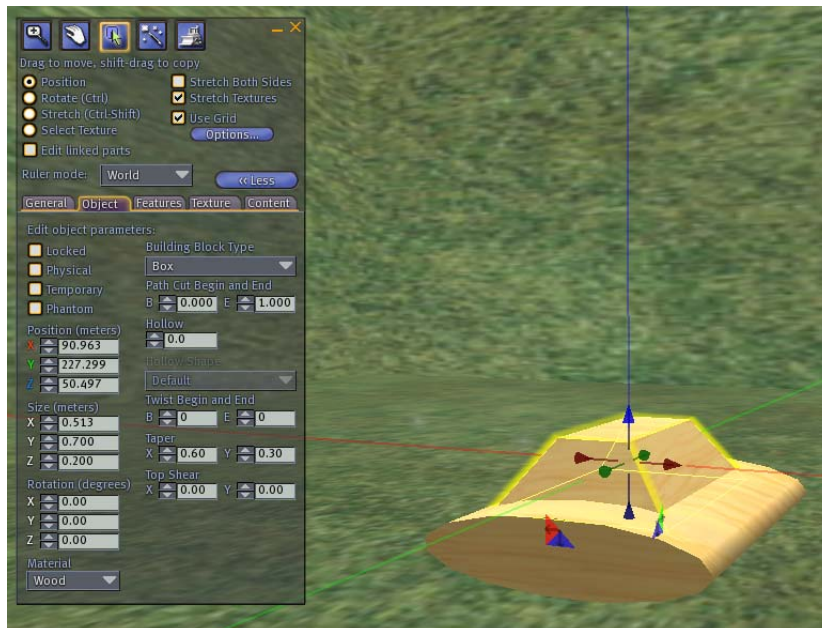
Size: **X:** 0.8 **Y:** 0.2 **Z:** 0.975

Rotation: **X:** 90.0 **Y:** 0.0 **Z:** 0.0

If your cylinder doesn't look the same it may just be the camera angle. Make sure that the values under size and rotation are similar. Position will be different as you won't make your robot exactly where this one was made.

The next step is to create another cube above the cylinder. Do this which ever way you feel comfortable. We will then adjust the value in the build window;

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In this case you want to set up the size first. Keep all the rotation at zero.

Size: **X:** 0.5 **Y:** 0.7 **Z:** 0.2

Now you will also need to change the taper on the box;

Taper: **X:** 0.6 **Y:** 0.3

And using your handles ensure it is centred to the cylinder, and just inside of it.

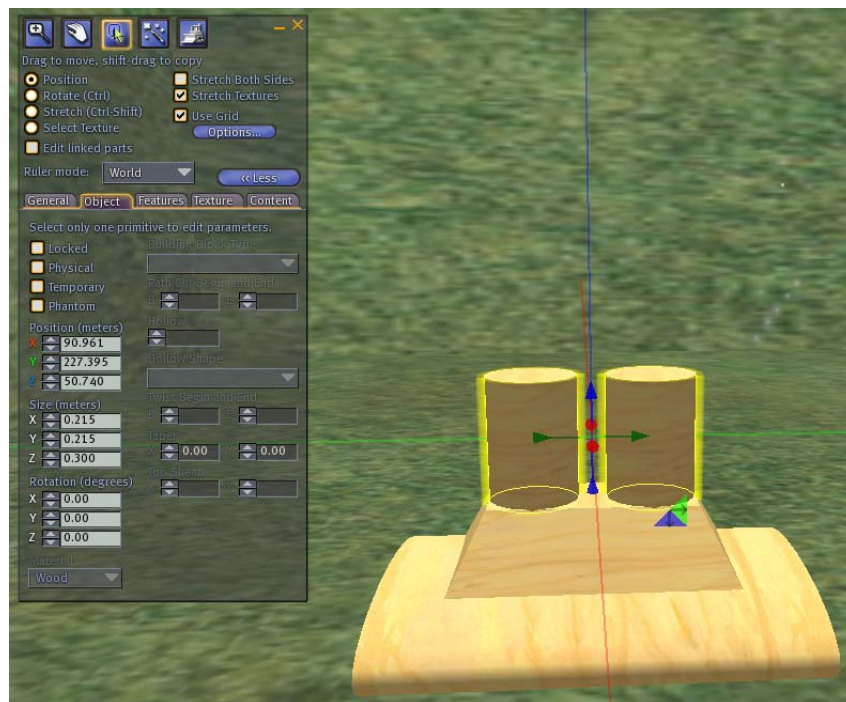
Now that we have the roller foot of the robot we will make some legs out of cylinders. To start create a new cylinder. This time set up the size and rotation values like such;

Size: **X:** 0.215 **Y:** 0.215 **Z:** 0.3

Rotation: **X:** 0.0 **Y:** 0.0 **Z:** 0.0

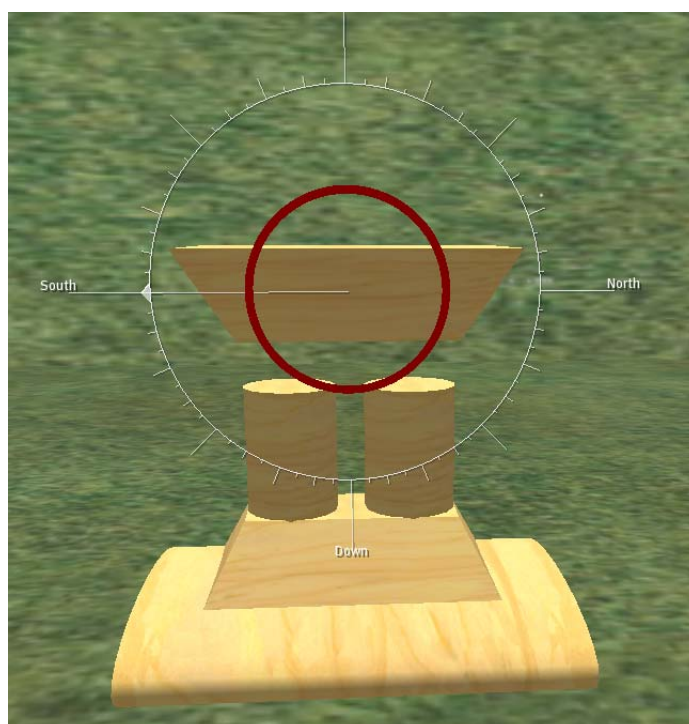
Now position the 'leg' to one side of our tapered box, and hold down *shift* while moving the object to get a duplicate for the other side of the box.

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- *If your cylinders aren't slightly inside the box; select one cylinder, then hold down shift and select the second one. Now use the moving handles as usual.*

Now to create the base of the torso for our robot we will create a duplicate of the tapered box. Select it, and then holding onto the *Blue (Z axis) handle*, hold *shift* and move the object above the two cylinders we just made. Holding down *control* we can now rotate;



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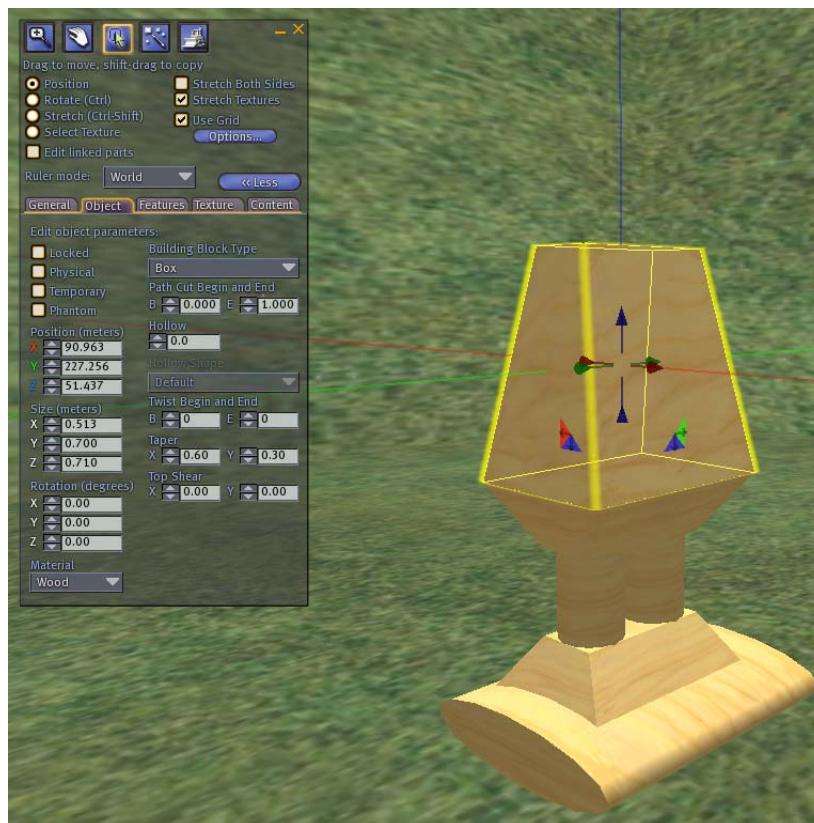
If the default options have grid set up you will see a circle while holding *Alt* and the mouse button. Going outside of the circle with your mouse will allow you to snap to the particular direction. In this case to the south will upturn our box.

- *If you do not see the circle and have grid disabled, enable it using “Tools → Snap to Grid” from the tool menu, or quickly access it using the ‘G’ key.*
- *This also works for moving and resizing, snapping to metres.*

Move the base of the torso so it is slightly intersecting the cylinder legs. Now to create an upper torso, copying the ‘feet box’ and moving it along the Blue axis to above the bottom torso box. Resize it;

Size: **X:** 0.5 **Y:** 0.7 **Z:** 0.71

It should look like;



- *Now do remember if you don't like the look of this robot, feel free to very loosely follow this tutorial, but ensure that you are comfortable using all the different functions of the building window.*

Create a small neck, using whatever you would like. The robot seen in this tutorial uses a small thin box with a negative Y taper. Now on top of the neck create a cylinder, using your grid rotate it so it is sideways and resize it to look like;

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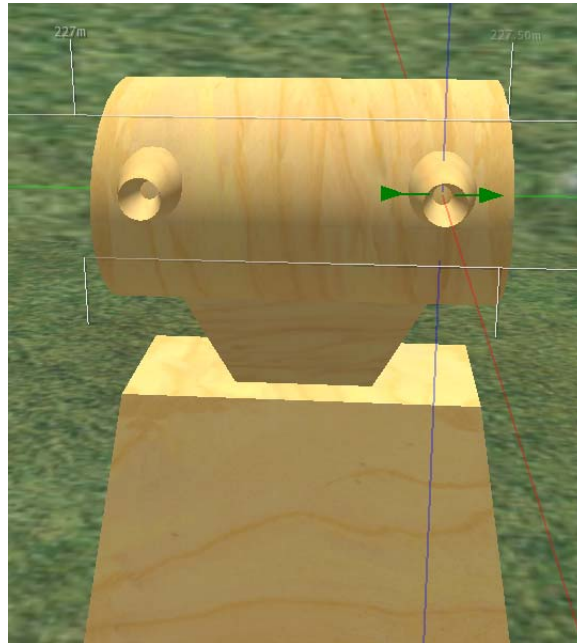


Size: **X:** 0.378 **Y:** 0.3 **Z:** 0.5

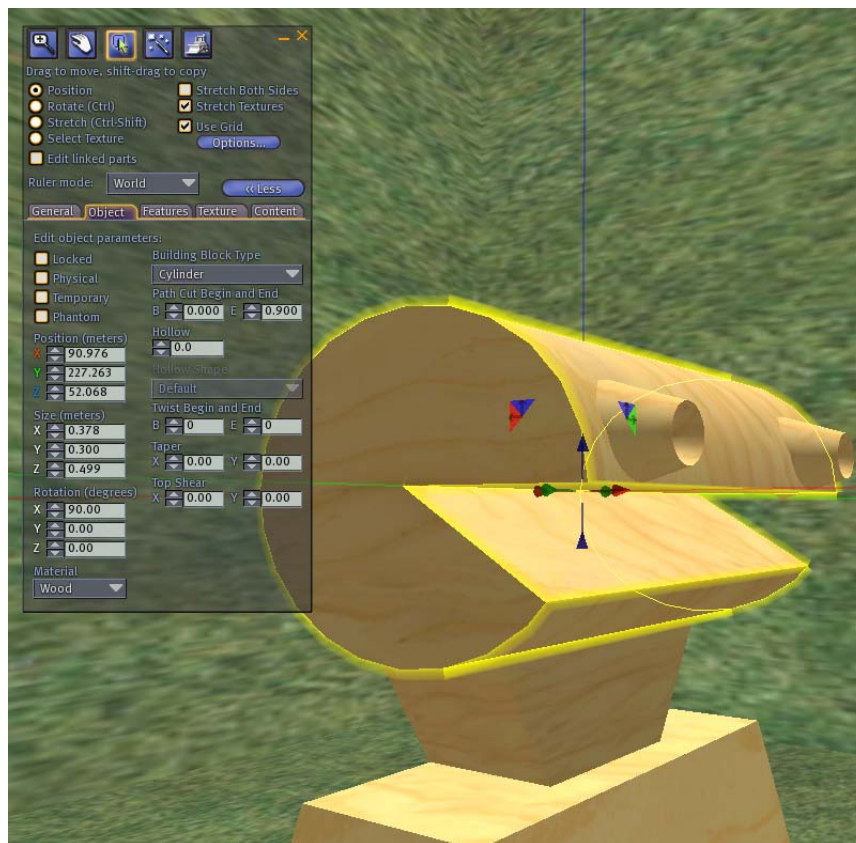
Rotation: **X:** 90.0 **Y:** 0.0 **Z:** 0.0

Now to create some small eyes. Create a very small 'ring' primitives and ensure that it is intersecting the head. If you lock to the grid while moving the ring, you may find it easier to duplicate it to the opposite site as the other eye. You should have a result resembling;

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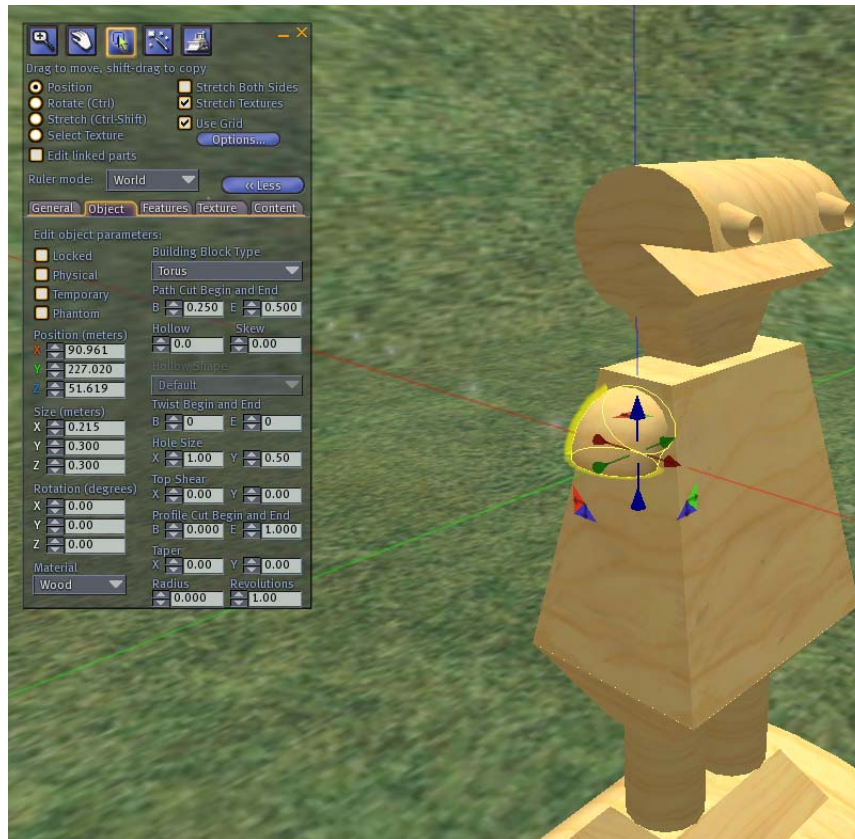
Let's give our robot an open mouth. Select the head cylinder by itself - we are going to use the path cut to cut in a mouth.



In this case the '*Path Cut Begin and End*' '*E*' (End) value was changed from 1.0 to 0.9. Experiment with the values to open the mouth whichever way you want.

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Onto the arms! Now we are going to use a torus. Create a torus primitive to the side of your robot and use these values;



Size: **X:** 0.215 **Y:** 0.3 **Z:** 0.3

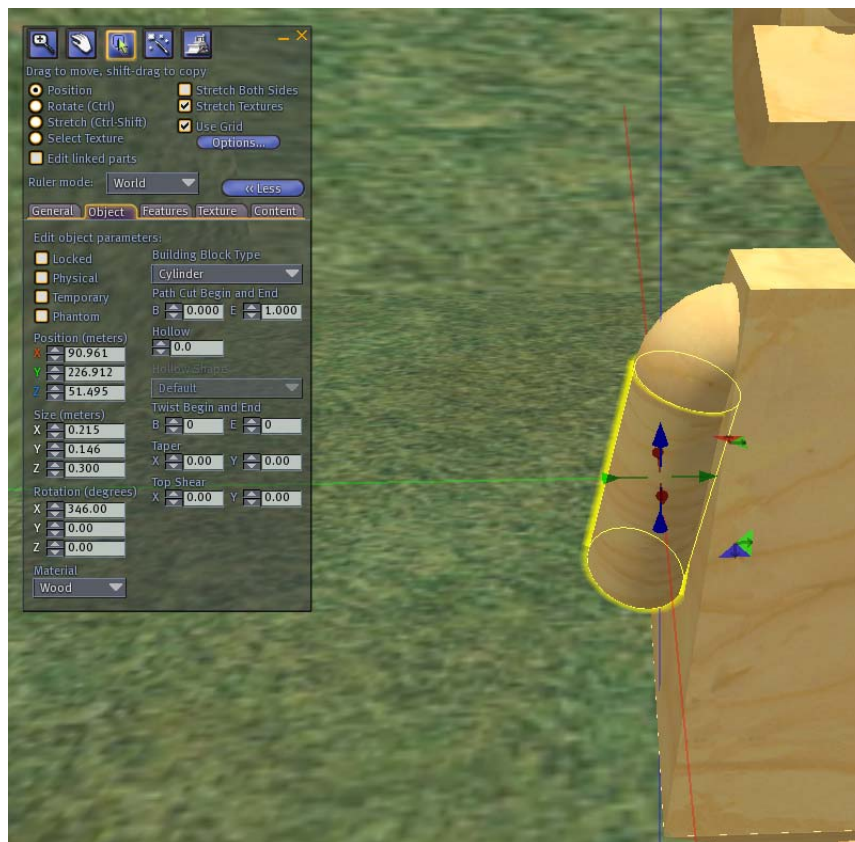
Rotation: **X:** 0.0 **Y:** 0.0 **Z:** 0.0

Path Cut: **Begin:** 0.25 **End:** 0.5

Hole Size: **X:** 1.0 **Y:** 0.5

Now create a cylinder coming out of the torus segment to extend the arm;

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Use these values to make it the same size as the torus;

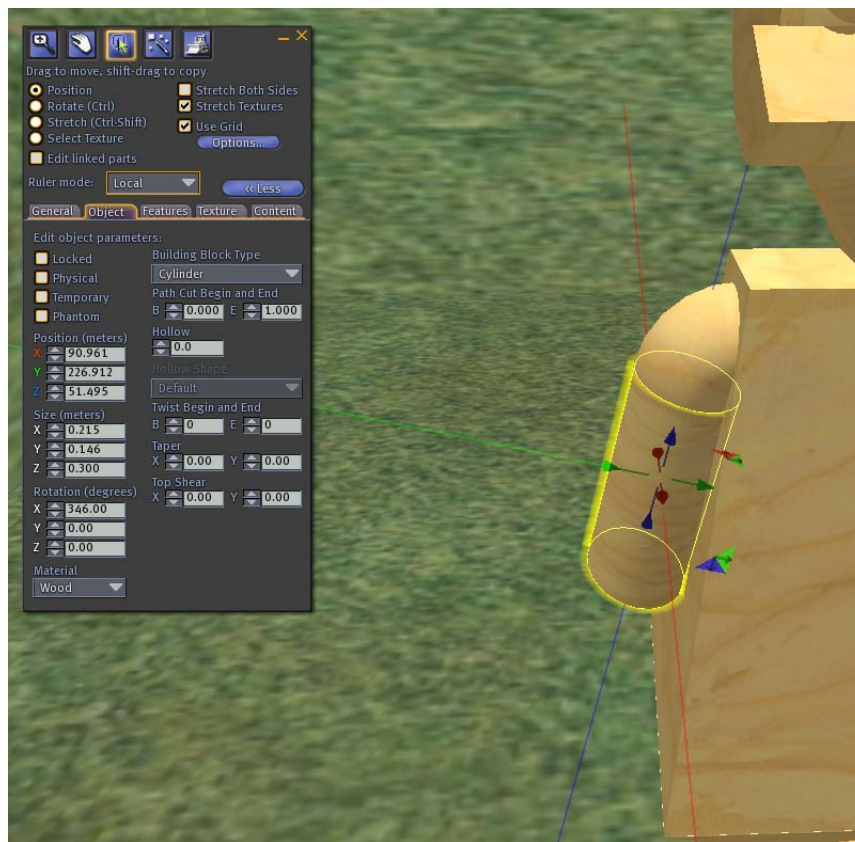
Size: **X:** 0.215 **Y:** 0.15 **Z:** 0.3

Rotation: **X:** 345.0 **Y:** 0.0 **Z:** 0.0

Again, ensure it is intersecting the shoulder torus segment. Now as opposed to Duplicating the cylinder to try to create the hand and require a lot of moving to get it beneath, we will change the '*Ruler mode*', found above the object tabs.

Using the drop down change it from '*World*' to '*Local*';

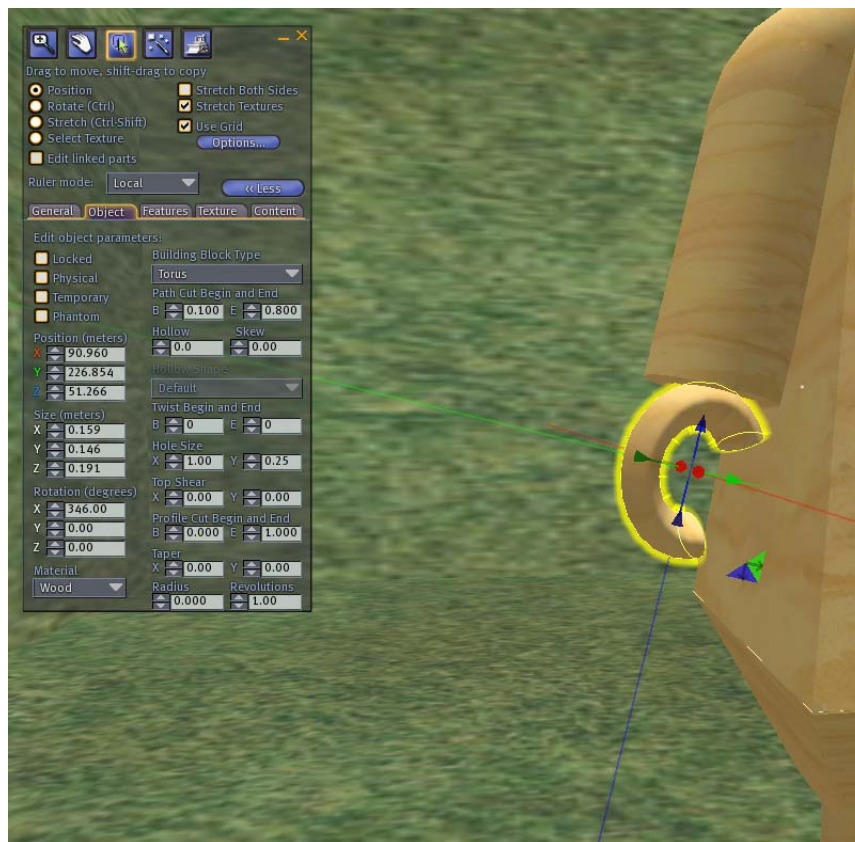
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Notice how the handles are now rotated to that of the cylinder. Now if we duplicate the cylinder along the Blue axis, we will be extending onto the end of the arm.

After creating another cylinder, change its primitive type to Torus. Resize it using the blue sizing-handle, and change the values to make it look like;

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Size: **X:** 0.15 **Y:** 0.15 **Z:** 0.2

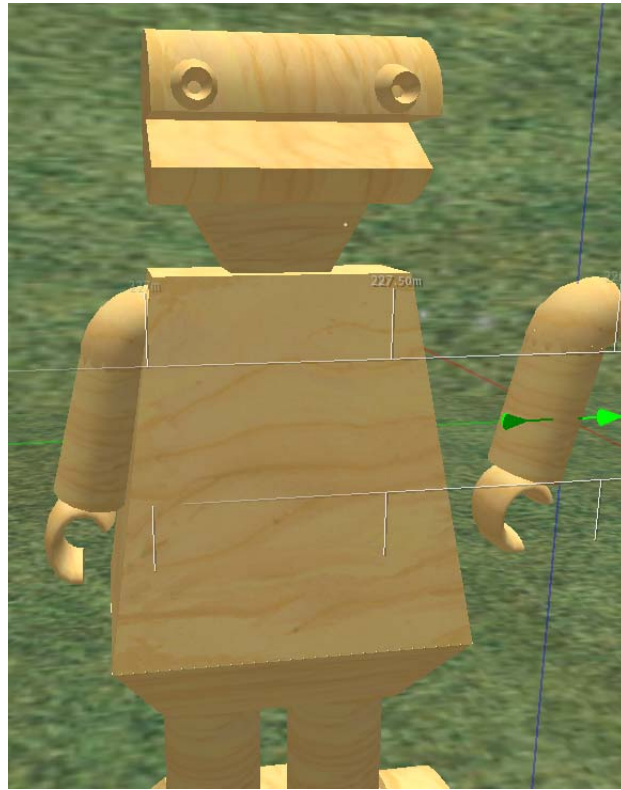
Rotation: **X:** 345.0 **Y:** 0.0 **Z:** 0.0

Path Cut: **Begin:** 0.1 **End:** 0.8

Hole Size: **X:** 1.0 **Y:** 0.25

Almost done, Change your ruler mode back to '*World*', select the hand, arm and shoulder and duplicate them;

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Move your camera so it is looking down on the robot, and rotate the arm along the Blue axis and use the snapping. Now move the arm in and you should have a completed model.

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Now before we dance round and cheer that our creation is finished we need to link it together. Before taking this step ensure that “*Tools → Select Only My Objects*” is on (should have an *X* to the left of it).

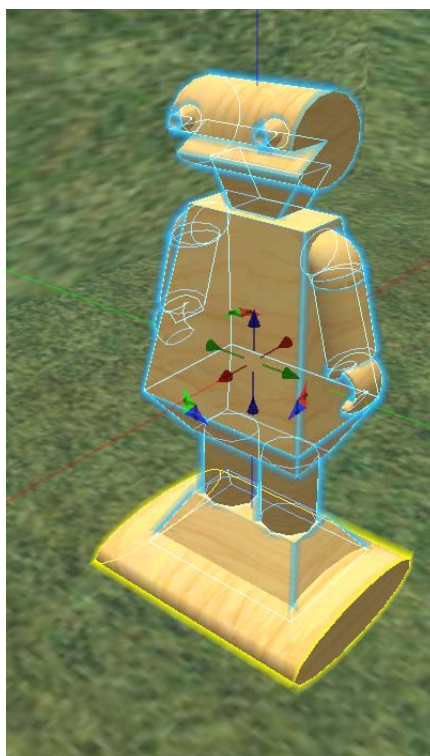
Hold down your mouse button and drag a box around the whole robot;

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Using *shift*, deselect the roller at the bottom of the robot and select it again. This means that this is the last object you select, which will be the parent object of all the objects when it is linked.

Link the objects using *Ctrl+L*. You will now see the parent object with yellow around it, and its children with blue;



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Now before we go any further, under the 'General Tab', give your robot a name so you can find it easily in your inventory later.

On this tab we would also change the 'Next owner can' to include modify and copy if we were going to give it to someone else in our group, so that they could adjust it. But for now this should just be for your own use. You can also change these properties when the object is in your inventory by right clicking it and selecting properties.

Texturing the Robot

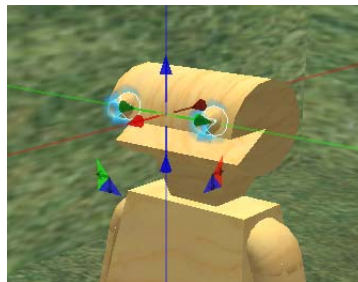
Now that you have an exciting wooden robot, it might be worth adding some textures to make it a little more believable.

Now because our Robot is linked, when we select it we select all the objects. We could unlink the object using *Ctrl+Shift+L*, but it is much better to select "*Edit Linked Parts*" checkbox. Now we can select individual parts of the object and adjust them.

Let's start by giving the Robot some beaming red eyes.

- ***Please note, the following screenshots were taken using the release candidate of Second Life Viewer, so some visuals, such as Glow, may not be available to the default client.***

Select the two rings we used for eyes;



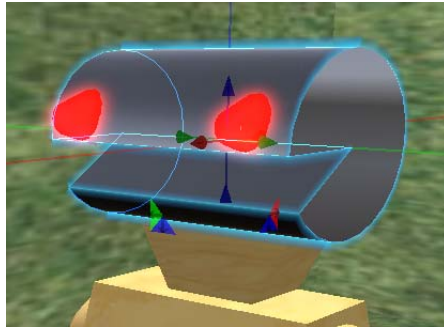
Now select the texture tab and click on the wood texture. This will bring up the texture browser, but because we just want these to glow red, we'll select "Blank" below the image preview, and press ok. Next check the 'Full Bright' checkbox, this will stop the object from shading so that it is a nice solid colour. Finally click the colour box (which should be white) and change it to red.



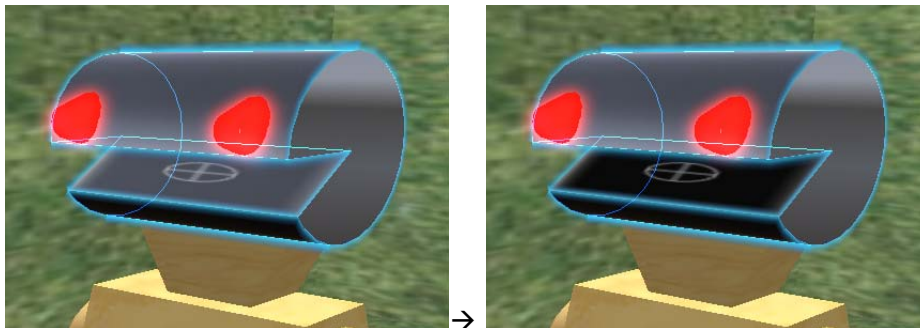
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This version includes glow, to make the objects look lit which may not work or be available in your client.

Select the head, this time apply a metal texture to it. This robot uses the texture found underneath “Library → Textures → Misc Textures → Gray Metal Scratched”. From the drop down set the shininess to ‘High’. It should look something like;

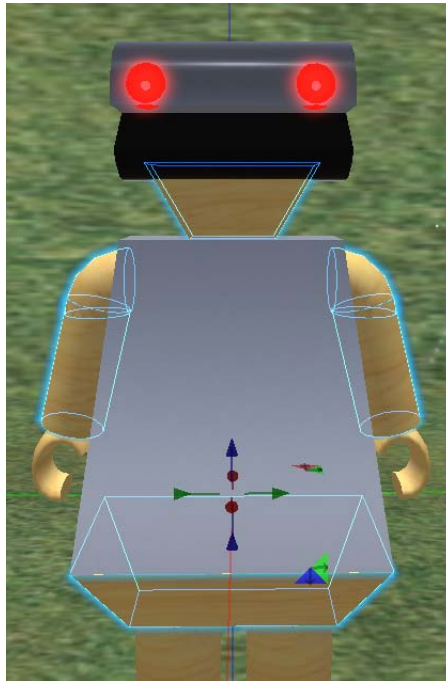


The inside of the mouth looks a little funny. What would look better is if those two flat faces were different. If you select “Select Texture”, in the radio buttons it will allow us to select individual ‘faces’, this is indicated by a white circle cross arrow and white edges on the face selected. Like all other selection you can use *shift* as well to select multiple faces. Select the two inside faces and darken the colour.



Turn of face select mode by choosing position from the radio buttons instead. Now select the torso, go to change the texture, but this time instead of finding it in the library, click the eyedropper tool and click the head to automatically set it to the same texture. Now set shininess to high, and it should look the same.

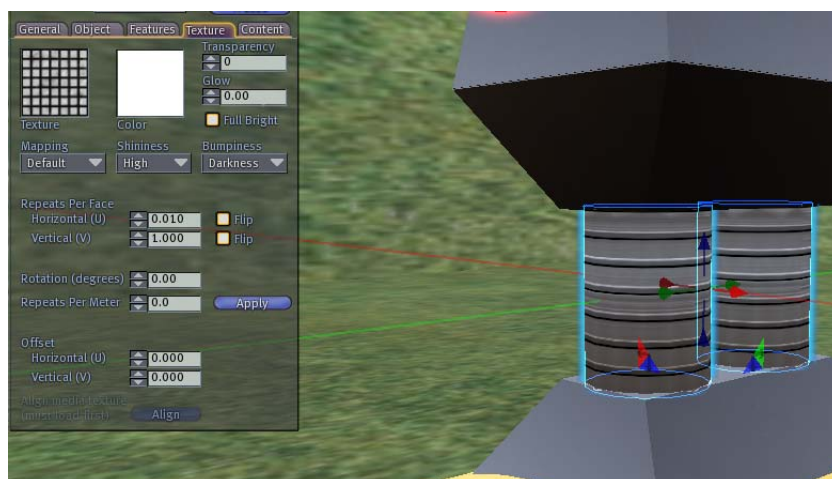
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Select the neck, shoulders, arms, bottom of the torso, and feet box and set it to the same texture using the eyedropper. Likewise this example robot has hands the same as the eyes by using the eyedropper tool to select the same tint colour.

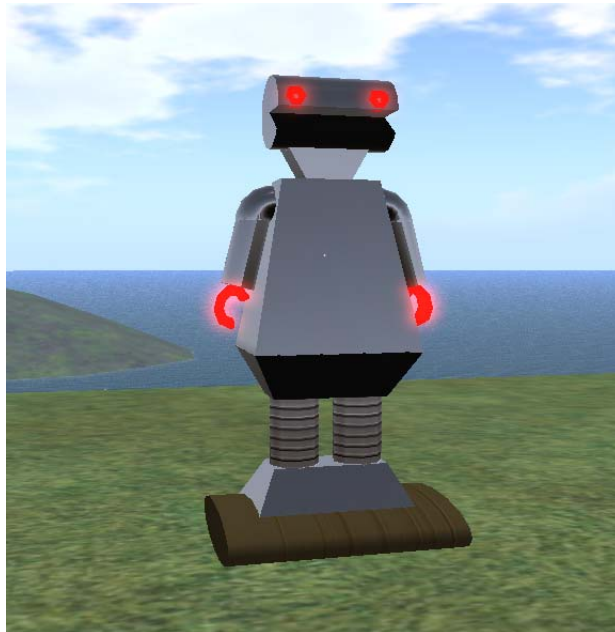
Now we are going to create a ridges look to the legs. Because you do not currently have linden (or you may) we'll do some creative work using the existing textures in the library. Select both the legs, set them to them to High Shininess, change the texture to 'Steel Plate' found in the 'Misc Textures' folder.

What, this looks wrong... we want stripes not a grid! Well if you change the 'Repeats per face', 'Horizontal' from 1.0 to 0.01, it will only use one hundredth of the texture to cover the object, so now a small portion of the texture is stretched over it, creating stripes. Change the 'Bumpiness' to 'Darkness', and now it looks as if there are ridges in the legs;



The final step is putting some marks on the tread. For the final robot seen in this tutorial the default wood texture was stretched the same as above, and a brown colour was applied. Have a play and try to produce the tread you want.

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There you have your completed robot. You should now be confident enough to play with all the primitive settings and experiment with textures. Right click and choose 'take' to save it to your inventory.

Always remember to clean up!

You may, or not, have realised that you can save money on texture by putting multiple things on one texture and then cropping the texture by using the 'Repeats per face', this is a great way to get more for less, but will not work if you want your texture to repeat. So think about how you can include multiple things on one texture, or how you can adjust existing textures to resemble your needs.

Think creatively!

What to do now?

- Edit the robot to make it your own by changing the textures, adding knobs and dials, or anything else you like.
- Consider creating your own textures – you need to keep the dimensions to a combination of width and height being one of these values; 32, 64, 128, 256, 512, 1024. If you save the image as a transparent PNG it will also retain transparency data. To upload or preview an image choose "File → Upload image".
- Start modelling furniture or other assets for your hut