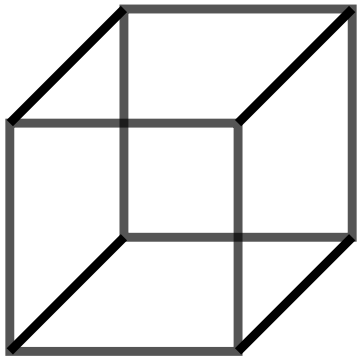
COSC342 Tutorial

Thinking in 3D

This is based on Bob Parslow and Geoff Wyvill's 2008 SIGGRAPH Asia tutorial *Seeing in 3D*. That takes most of a day, so we'll just look at a few highlights.

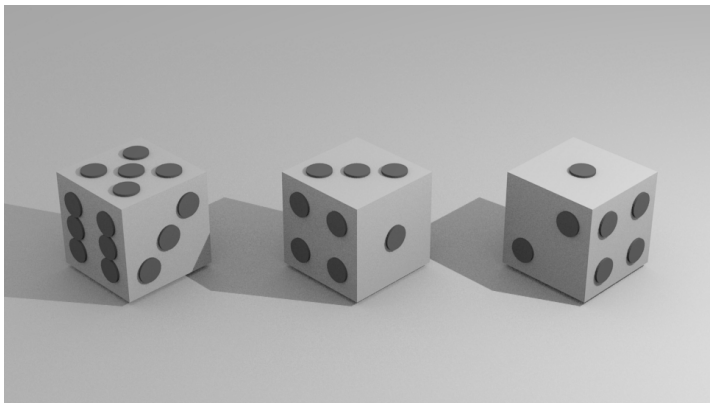
The 'Spinning Dancer' is a famous illusion that sets up an ambiguity between two interpretations. A silhouette of a dancer spinning on one foot is shown. This can be interpreted as a clockwise or anti-clockwise rotation. http://www.echalk.co.uk/amusements/OpticalIllusions/silhouette/silhouette.html has an online version that lets you experiment with it. This illusion arises because we are interpreting a sequence of 2D images as a sequence of 3D poses.

A simple illustration of this problem is the Necker cube, which has two common interpretations – one with the front face of the cube down and to the left, and one with the front face of the cube up and to the right.

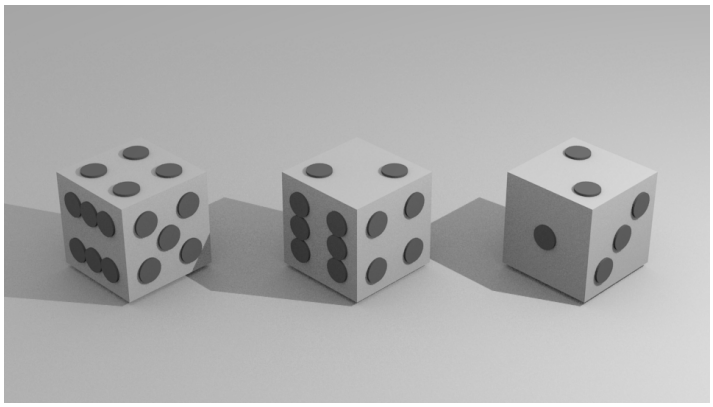


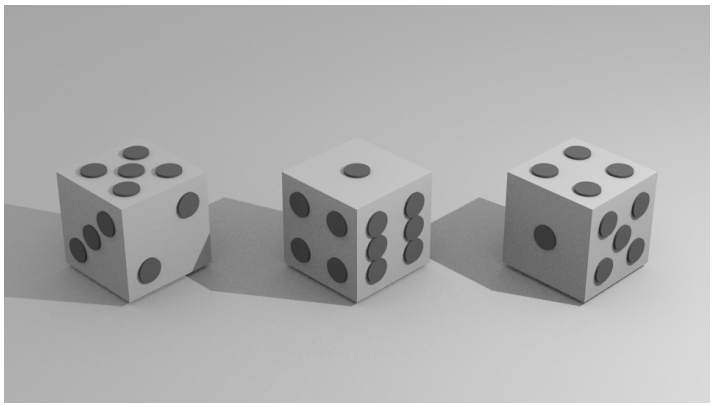
The problem with 3D is that our brains try to interpret things as 3D, but many people are actually quite bad at reasoning about 3D geometry. In this tutorial we'll try some exercises that require visualisation of 3D objects, and to keep it simple, we'll just use cubes.

Here is a picture of 3 cubes:



- Is it possible that these three cubes are identical, and just rotated versions of each other?
- Can you tell this from just two of the cubes, or does it require all three?
- What about these two sets of three:





Now we'll work with an imaginary cube, it may help to close your eyes...

- Imagine a cube on the table in front of you, about 50cm on a side.
- Concentrate on the cube, and reach out and put one hand on each side.
- Pick the cube up, feel how hard it is, tip it from side to side and feel its weight. Is your cube heavy or light?
- What colour is your cube?
- Did your colour have a cube before you asked that question?

Lets start to think about the geometry of your cube. It is easiest to use a fairly light cube for this, so if yours is heavy then get another one, but it will also need to be quite rigid.

- Put the cube on the table in front of you.
- Slide it over to the right, so that one edge is directly in front of you.
- Slowly tip the cube over to the left, so that it is resting on one edge.
- The opposite edge to the one on the table should be at the top. Hold your cube in place with one hand, and run your finger along the top edge.
- Now put your finger on the far corner of the top edge, and tip the cube up towards you, so that it is standing with one corner on the table, and you are holding it up by the opposite corner.
- One corner is on the table, and another is at the top. With your free hand point to each of the other corners of the cube in turn, naming them A, B, etc.
- What is the last letter that you used?
- Now imagine that the table surface is soft, like sand or clay. Slowly push the cube down so that the bottom corner sinks into the surface.
- What shape is the hole that the cube makes in the table?