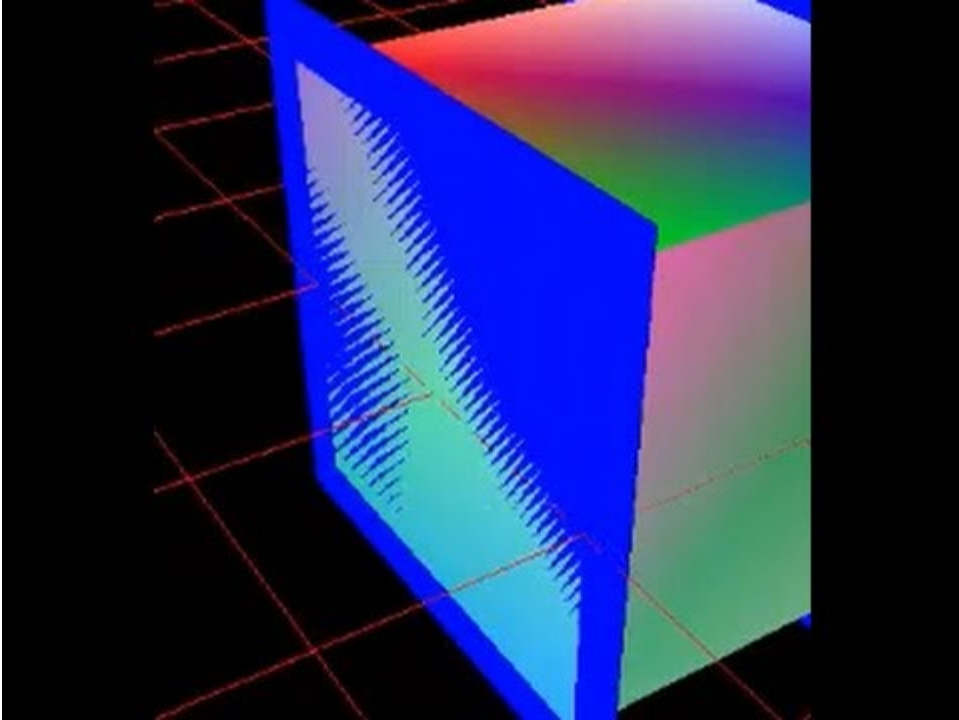# Hidden Surface Removal and Z-Fighting

Can occur when 2 surfaces are co-planar or close to co-planar

The "Z" refers to depth…distance from the camera

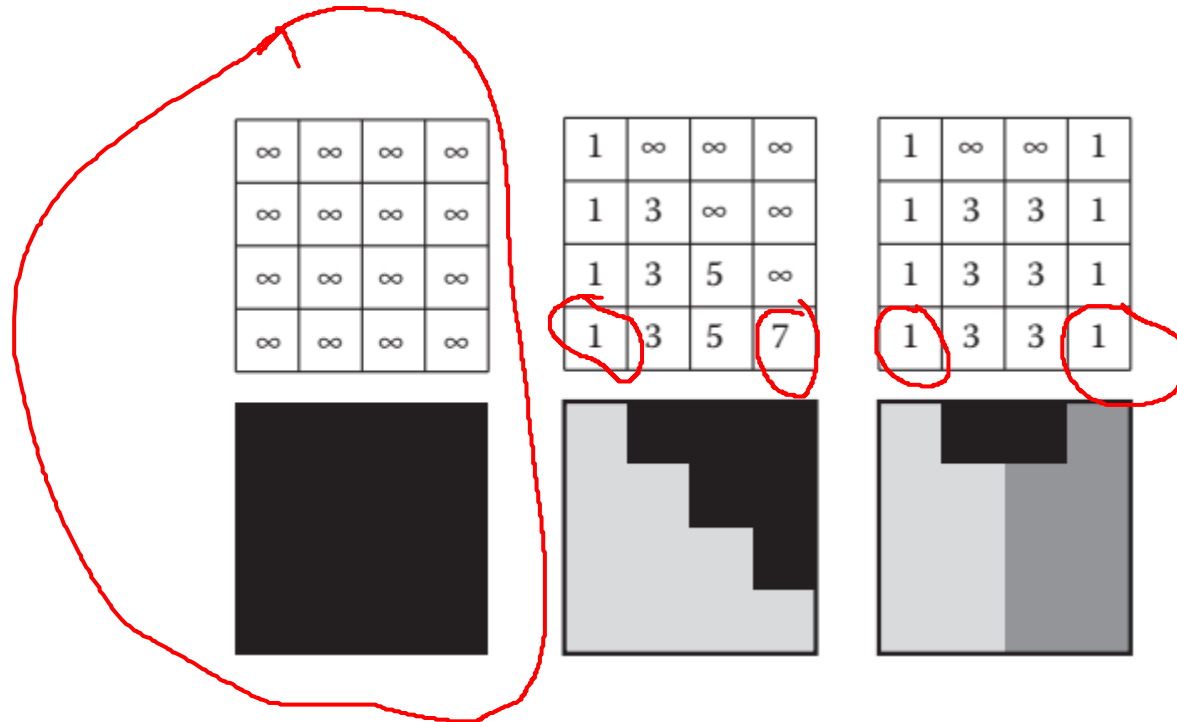The rendering engine inconsistently determines which surface is closest

Why?

Hidden Surface Removal and Z-Fighting

Each fragment has a z-value (positive depth from camera)

Hidden surface removal compares the z-values of fragments at same screen location

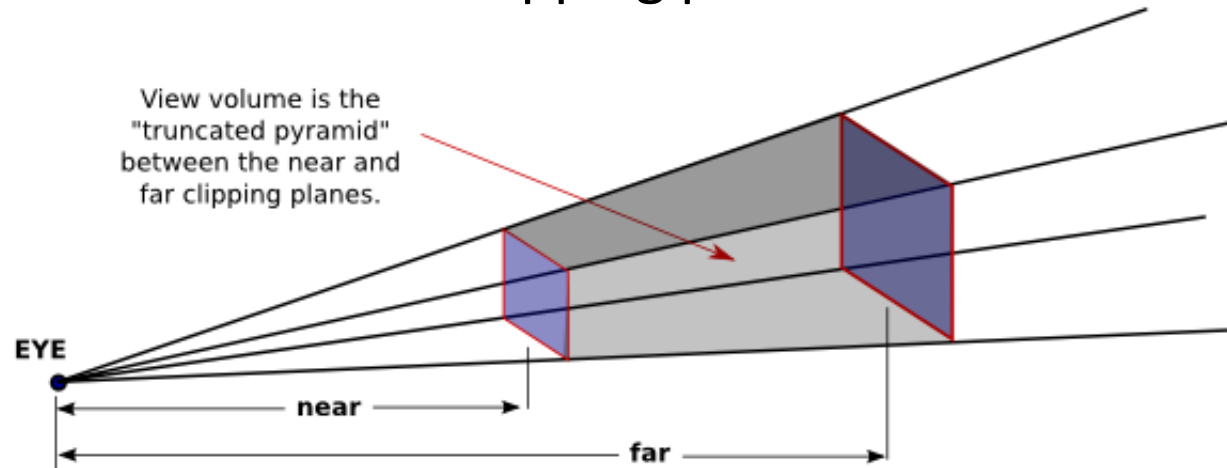Fragment with least z-value is retained

Hidden Surface Removal and Z-Fighting

Depths from the camera lie in the range [*n*, *f*]

n is the positive distances to the near clipping plane

f is the positive distance to the far clipping plane

View volume is the
"truncated pyramid"
between the near and
far clipping planes.

EYE

near

far

To simplify things, assume depths are positive integers {0,1,...B-1}

Map *n* to 0 and *f* to B-1 →each integer in our range corresponds to a bucket of depth $\Delta z = \frac{f-n}{B}$

Hidden Surface Removal and Z-Fighting

To simplify things, assume stored depths are positive integers {0,1,…B-1}

Map **n** to 0 and **f** to B-1 →each integer in our range corresponds to a bucket of depth $\Delta z = \frac{f-n}{B}$

If you render a scene in which surfaces have a separation of 1 m, if $\Delta z < 1$ then there should be no z-fighting

If the separation is less than the bucket depth…you can have z-fighting
- Cannot determine which surface is closest
- Rounding errors may switch which surface is chosen as closest in different parts of the scene
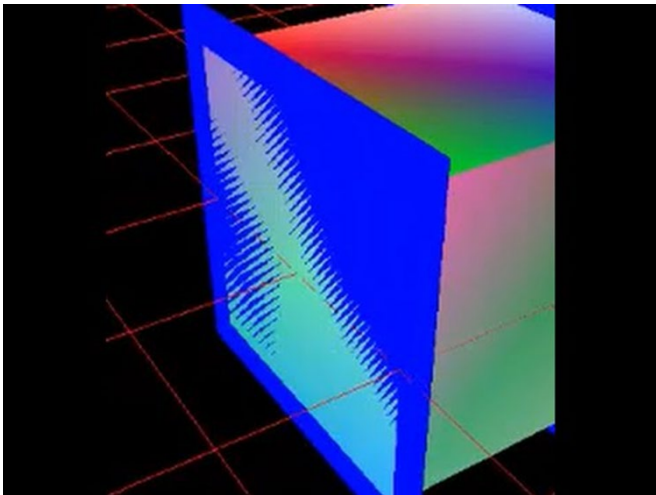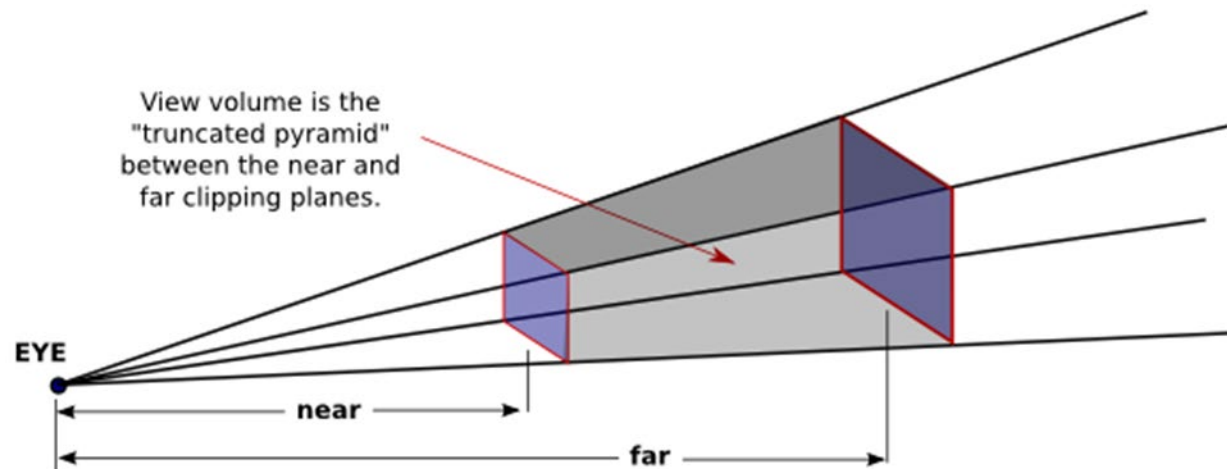
Hidden Surface Removal and Z-Fighting
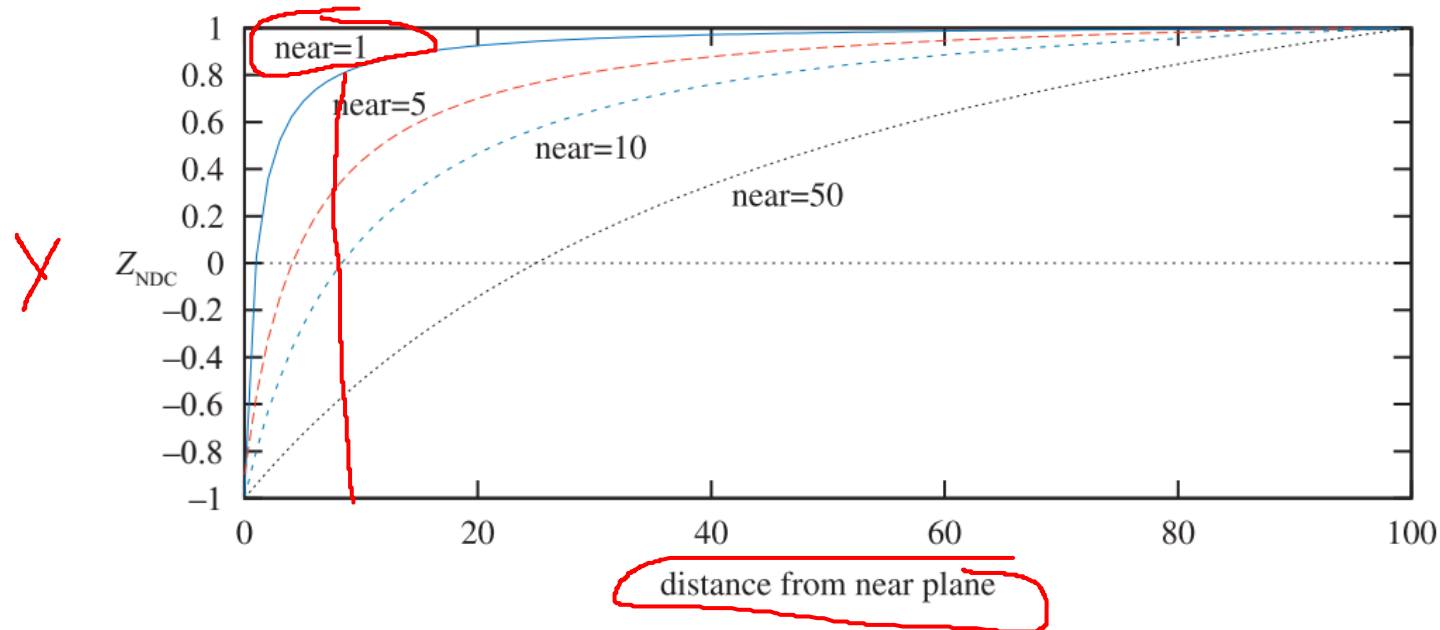
Some fixes for z-fighting

- Move the near and far planes closer together
- Move surfaces apart

$$\Delta z = \frac{f - n}{B}$$

View volume is the "truncated pyramid" between the near and far clipping planes.

EYE

near

far

Hidden Surface Removal and Z-Fighting

In actuality, bucket sizes will vary by depth due to perspective projection

Here, **f-n** = 100 and each distance in the range is mapped into [-1,1]

- Cannot choose **n**=0 as that results in an infinitely large bucket

- Larger bins at greater depths
  - Ability to do hidden surface removal degrades with distance