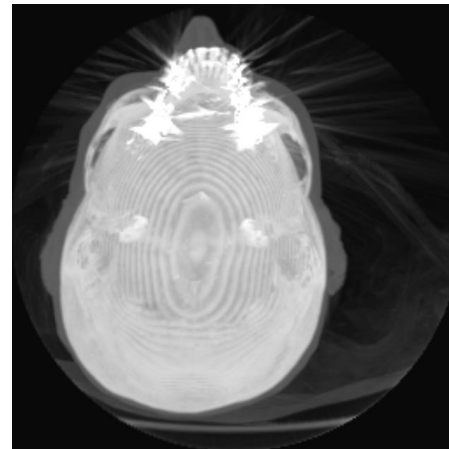


# Maximum Intensity Projection

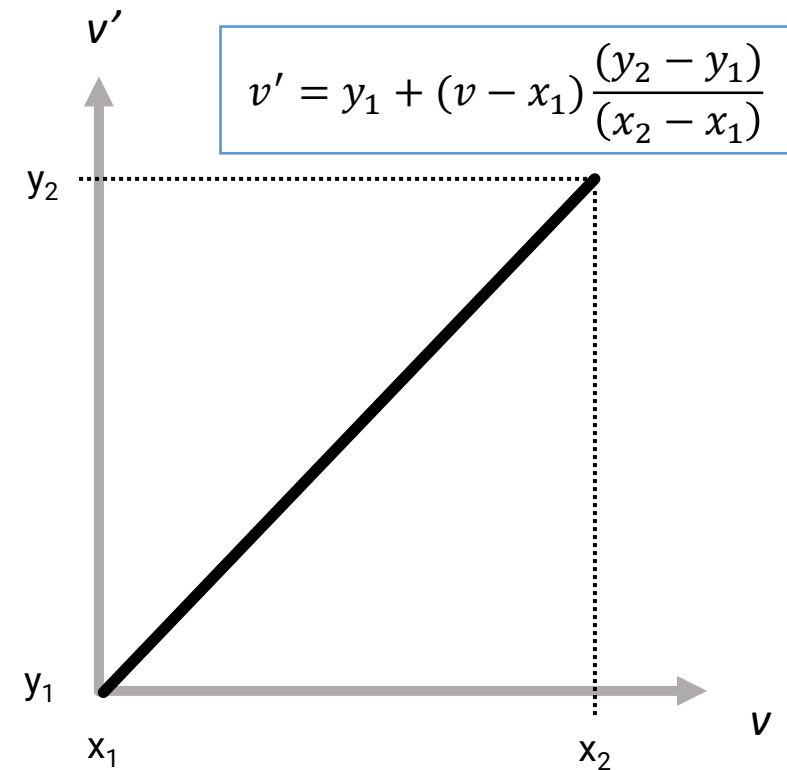


- Example for side view from CThead
- Rays are traced through the data set
- For each ray find the maximum value
- Map it from  $[x_1 = \min, x_2 = \max]$  to  $[y_1 = 0 \text{ to } y_2 = 1]$

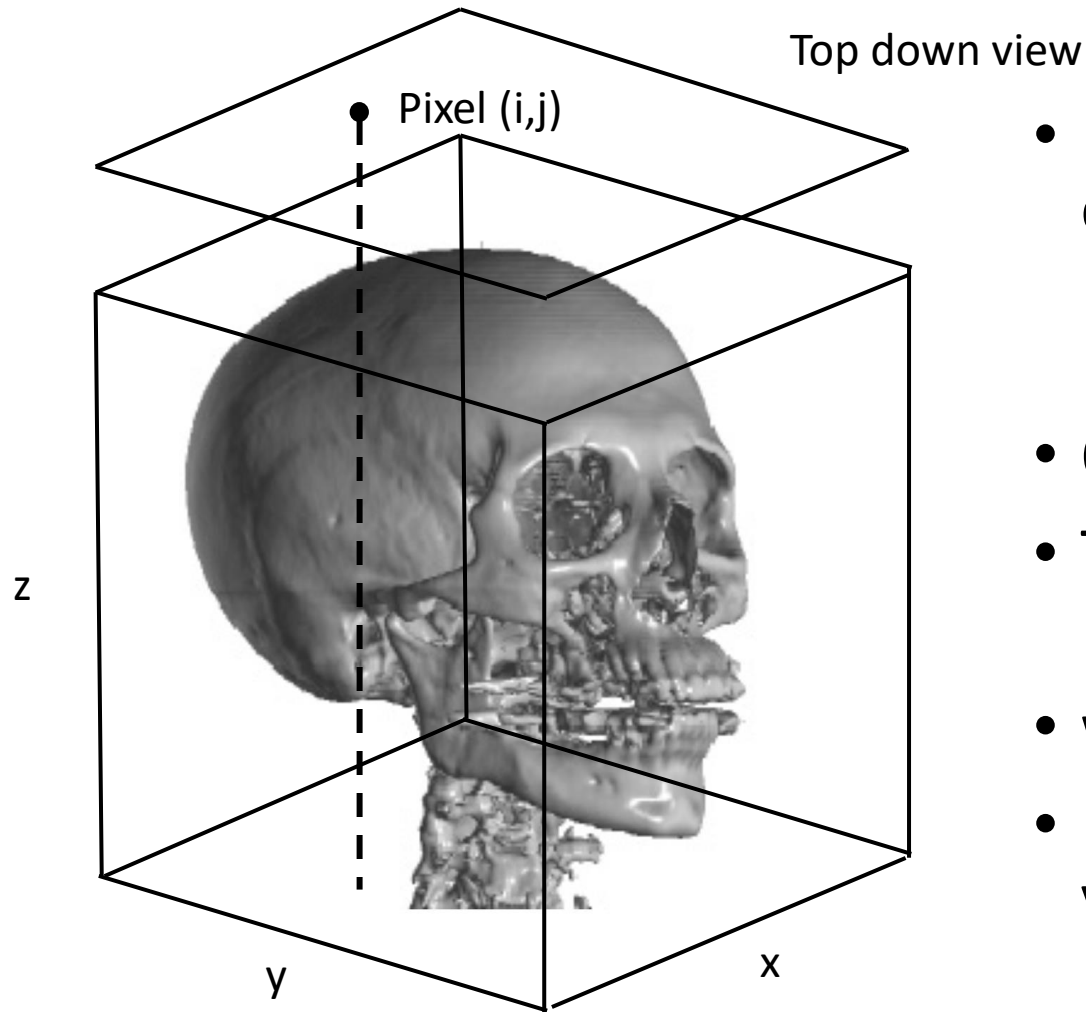


# Mapping (Linear)

- Goal: Map a value,  $v$ , from a range  $x_1$  to  $x_2$  (can be negative)
- To a new value  $v'$  on a range  $y_1$  to  $y_2$
- $v' = y_1 + (v - x_1) \frac{(y_2 - y_1)}{(x_2 - x_1)}$
- e.g., if the new range is 0 to 1 ( $y_1=0$ ,  $y_2=1$ ):
- $v' = \frac{(v - x_1)}{(x_2 - x_1)}$



# Casting rays through the volume



- Have the usual two outer loops to range over every pixel of the top down image  
for  $j = \text{row } 0 \text{ to image height}$   
for  $i = \text{column } 0 \text{ to image width}$
- One example pixel is shown (i,j)
- Then an inner loop  
for  $k = \text{slice } 0 \text{ to slice } 112$
- will range over every voxel along the ray
- Find the maximum  $\text{cthead}[k][j][i]$  voxel value along the ray

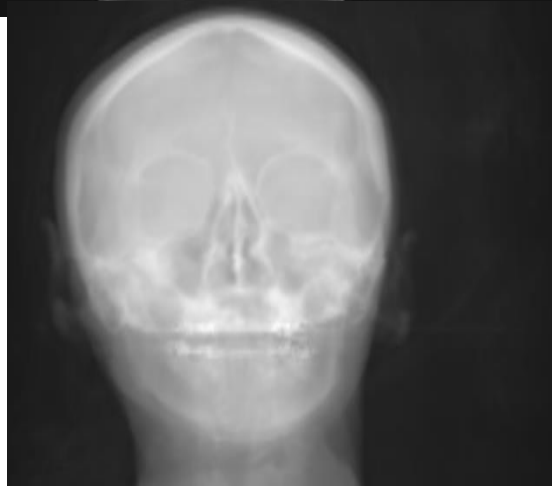
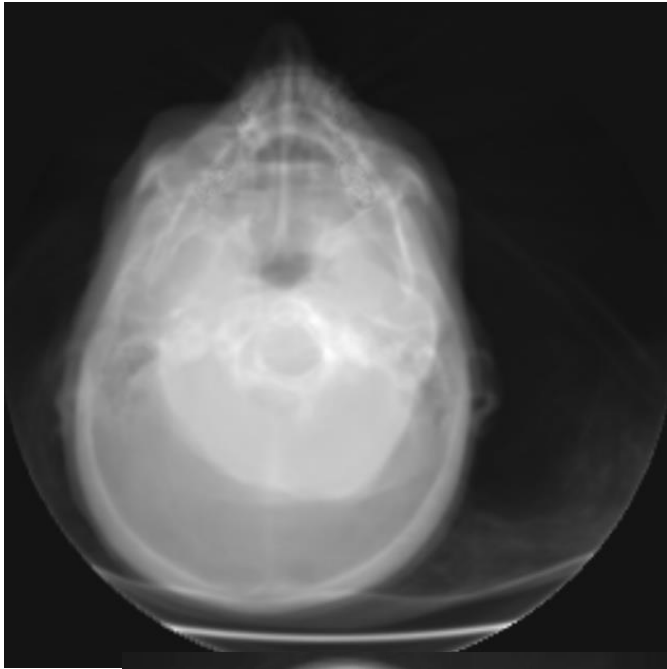
# Maximum Intensity Projection

- To find the maximum for each pixel:
- Initialise the maximum found so far to the minimum of the data set
- For the ray going from pixel (i,j) through the data, find the maximum
- Ray loop: for k=0 to axis\_max (e.g., 256 if going from front to back)
  - $\text{maximum} = \max(\text{datum}, \text{maximum})$  where datum is the appropriate value for i,j,k from the CThead – e.g., `cthead[k][j][i]` for top down.
- The maximum along the ray for pixel (i,j) has been found.
- Set the colour of that pixel as usual.

# Maximum Intensity Projection

- Each position in the 3D data set is known as a voxel
- Maximum intensity projection (MIP) has the advantage that it is close to a doctors understanding of an X-Ray
- Its disadvantage is that the depth of the structure is hard to distinguish (sometimes depth weighting is used)

# Average Intensity Projection



- Sum all the values along the ray (either remap the values to zero to one, or sum the original voxel values).
- Put this into a temporary buffer / array of the size of the image.
- Keep track of the maximum and minimum sum.
- For each pixel, take the corresponding value from the buffer and map it to 0 to 1 range.