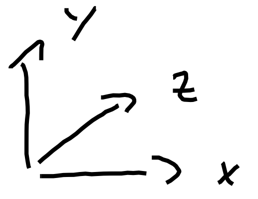
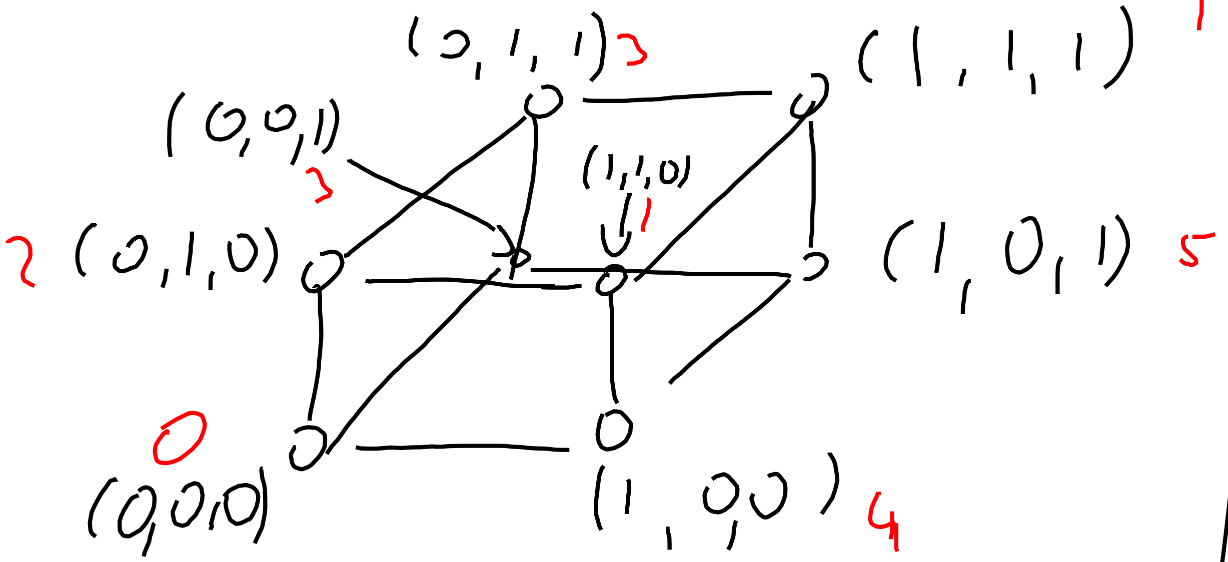
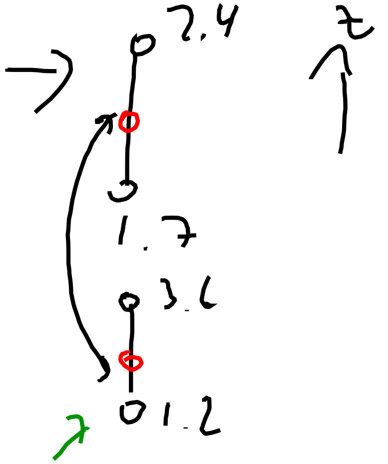
Interpolation

interpolate trilinearly at location $x = \begin{pmatrix} 0.3 \\ 0.7 \\ 0.4 \end{pmatrix}$



within the cell given as

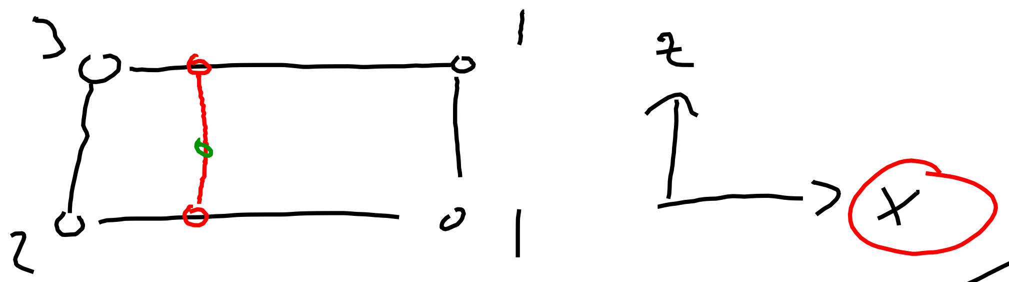




$1.7 \cdot 0.6 + 2.4 \cdot 0.4 = 1.98$

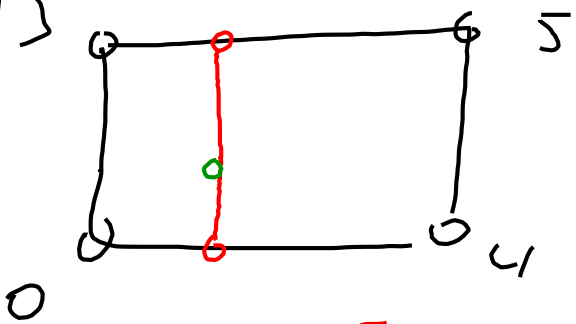
$1.2 \cdot 0.6 + 3.6 \cdot 0.4 = 2.16$

Solution:



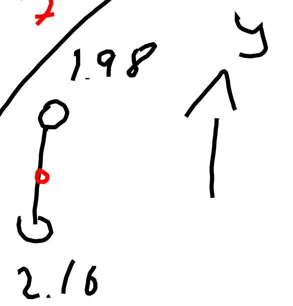
$3 \cdot 0.7 + 1 \cdot 0.3 = 2.4$

$2 \cdot 0.7 + 1 \cdot 0.3 = 1.7$



$3 \cdot 0.7 + 5 \cdot 0.3 = 3.6$

$0 \cdot 0.7 + 4 \cdot 0.3 = 1.2$



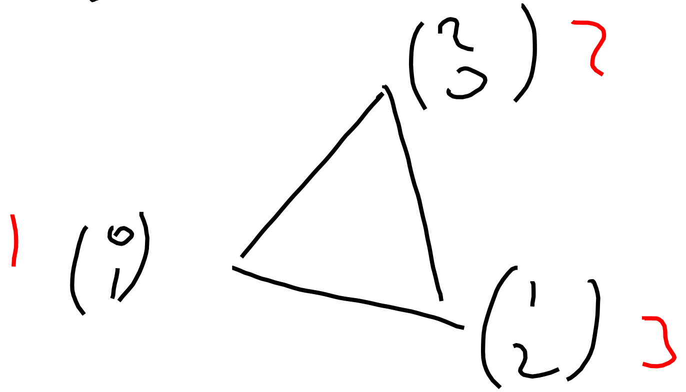
$2.16 \cdot 0.8 +$

$1.98 \cdot 0.2$

$= 2.124$

interpolate inside a triangle at location $x = \begin{pmatrix}1.2\\0.7\end{pmatrix}$. The triangle has vertices $t_1 = \begin{pmatrix}0\\1\end{pmatrix}, t_2 = \begin{pmatrix}1\\2\end{pmatrix}, t_3 = \begin{pmatrix}2\\0\end{pmatrix}$

and scalar values $v_1 = 1$, $v_2 = 3$, $v_3 = 2$



solution: compute the barycentric coordinates

$$\left.\begin{array}{l} b_1 + b_2 + b_3 = 1 \\ t_1 b_1 + t_2 b_2 + t_3 b_3 = x \end{array}\right\} \Rightarrow \begin{array}{l} b_1 + b_2 + b_3 = 1 \\ 0 \cdot b_1 + 1 \cdot b_2 + 2 b_3 = 1.2 \\ 1 \cdot b_1 + 2 \cdot b_2 + 0 \cdot b_3 = 0.7 \end{array}$$

$$\begin{array}{ll} ① & b_1 + b_2 + b_3 = 1 \\ \Rightarrow ② & b_2 + 2 b_3 = 1.2 \\ ③ & b_1 + 2 b_2 = 0.7 \end{array} \Longrightarrow \begin{array}{l} ① - ③ : \quad -b_2 + b_3 = 0.3 \\ +② : \quad 3 b_3 = 1.5 \Rightarrow b_3 = 0.5 \\ ② \Rightarrow b_2 = 0.2 \\ ③ \Rightarrow b_1 = 0.3 \end{array}$$

$$b_1 + b_2 + b_3 = 1$$
$$b_2 + 2b_3 = 1.2$$
$$b_1 + 2b_2 = 0.7$$

$$Dx = d \quad , \quad x = \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$$

$$d = \begin{pmatrix} 1 \\ 1.2 \\ 0.7 \end{pmatrix} \quad , \quad D = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 2 \\ 1 & 2 & 0 \end{pmatrix}$$

$$\det(D) = |D| = \det\begin{pmatrix} 1 & 2 \\ 2 & 0 \end{pmatrix} + \det\begin{pmatrix} 1 & 1 \\ 1 & 2 \end{pmatrix}$$
$$= 1 \cdot 0 - 2 \cdot 2 + 1 \cdot 2 - 1 \cdot 1 = -3$$

$$D_1 = \begin{pmatrix} 1 & 1 & 1 \\ 1.2 & 1 & 2 \\ 0.7 & 2 & 0 \end{pmatrix} \quad , \quad D_2 = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 1.2 & 2 \\ 1 & 0.7 & 0 \end{pmatrix} \quad D_3 = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 1.2 \\ 1 & 2 & 0.7 \end{pmatrix}$$

$$\det D_1 = \det\begin{pmatrix} 1.2 & 1 \\ 0.7 & 2 \end{pmatrix} - 2\det\begin{pmatrix} 1 & 1 \\ 0.7 & 2 \end{pmatrix}$$
$$= 2.4 - 0.7 - 2(2 - 0.7)$$
$$= 1.7 - 2.6 = -0.9$$

$$D_2 = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 1.2 & 2 \\ 1 & 0.7 & 0 \end{pmatrix}$$

$$\det(D_2) = \det\begin{pmatrix} 1.2 & 2 \\ 0.7 & 0 \end{pmatrix} + \det\begin{pmatrix} 1 & 1 \\ 1.2 & 2 \end{pmatrix}$$

$$= -1.4 + 2 - 1.2 = -0.6$$

$$D_3 = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 1.2 \\ 1 & 2 & 0.7 \end{pmatrix}$$

$$\det(D_3) = \det\begin{pmatrix} 1 & 1.2 \\ 2 & 0.7 \end{pmatrix} + \det\begin{pmatrix} 1 & 1 \\ 1 & 1.2 \end{pmatrix}$$

$$= 0.7 - 2.4 + 1.2 - 1 = -1.5$$

$$\Rightarrow b_1 = \frac{\det(D_1)}{\det(D)} = \frac{-0.9}{-3} = 0.3, \quad b_2 = \frac{\det(D_2)}{\det(D)} = \frac{-0.6}{-3} = 0.2$$

$$b_3 = \frac{\det(D_3)}{\det(D)} = \frac{-1.5}{-3} = 0.5$$

$$v = b_1 u_1 + b_2 u_2 + b_3 \cdot u_3$$

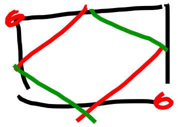
$$= 0.3 \cdot 1 + 0.2 \cdot 3 + 0.5 \cdot 2$$

$$= 1.9$$

What are the strengths of the pipeline concept in visualization software packages?

- modularity → can apply algorithms at different stages
  → less redundancy
- Universal → freedom in applicability of applications
- flexibility → pipeline can be set up based on needs

How can we solve ambiguities in the marching cubes algorithm?



Use of alternate cases based on neighboring cells

What is the advantage of the radial layout for graphs?

area increases with every level

What concepts did we discuss for maintaining context when visualizing graphs/trees?

hyperbolic layout, fish eye lens/view

What is preattentive processing and why is it important for visualization?

- can be picked up in less than 200 ms
- important for highlight or drawing attention/focus