GED Assignment 5 Questions:

Indexbuffer:

Triangle 0: $(0,2,1)$: $c=\begin{pmatrix}2-2\\1-2\\0-0\end{pmatrix}\times\begin{pmatrix}1-2\\1-2\\0\end{pmatrix}=\begin{pmatrix}0\\-1\\0\end{pmatrix}\times\begin{pmatrix}-1\\-1\\0\end{pmatrix}=\begin{pmatrix}0\\0-0\\0-1\end{pmatrix}=\begin{pmatrix}0\\0\\-1\end{pmatrix}$

Triangle 1: $(0,3,2)$: $c=\begin{pmatrix}3-2\\1-2\\0-0\end{pmatrix}\times\begin{pmatrix}2-2\\1-2\\0-0\end{pmatrix}=\begin{pmatrix}1\\-1\\0\end{pmatrix}\times\begin{pmatrix}0\\-1\\0\end{pmatrix}=\begin{pmatrix}0\\0-0\\-1-0\end{pmatrix}=\begin{pmatrix}0\\0\\-1\end{pmatrix}$

Triangle 2: $(2,3,5)$: $c=\begin{pmatrix}3-2\\1-1\\0-0\end{pmatrix}\times\begin{pmatrix}3-2\\0-1\\0-0\end{pmatrix}=\begin{pmatrix}1\\0\\0\end{pmatrix}\times\begin{pmatrix}1\\-1\\0\end{pmatrix}=\begin{pmatrix}0\\0-0\\-1\end{pmatrix}=\begin{pmatrix}0\\0\\-1\end{pmatrix}$

Triangle 3: $(2,5,4)$: $c=\begin{pmatrix}3-2\\0-1\\0-0\end{pmatrix}\times\begin{pmatrix}1-2\\0-1\\0-0\end{pmatrix}=\begin{pmatrix}1\\-1\\0\end{pmatrix}\times\begin{pmatrix}-1\\-1\\0\end{pmatrix}=\begin{pmatrix}0\\0\\-1-(+1)\end{pmatrix}=\begin{pmatrix}0\\0\\-2\end{pmatrix}$

Triangle 4: $(1,2,4)$: $c=\begin{pmatrix}2-1\\1-1\\0-0\end{pmatrix}\times\begin{pmatrix}1-1\\0-1\\0-0\end{pmatrix}=\begin{pmatrix}1\\0\\0\end{pmatrix}\times\begin{pmatrix}0\\-1\\0\end{pmatrix}=\begin{pmatrix}0\\0\\-1\end{pmatrix}$

Indexbuffer I: $[0,2,1,0,3,2,2,3,5,2,5,4,1,2,4]$

Normalized direction in $P_0(0,0,0)$:

no cross-prod.

Plane: $(x,y,z)\cdot(1,2,0)=0 \Rightarrow 1\cdot x+2\cdot y+0\cdot z=0 \Rightarrow x+2y+0\cdot z=0$

Light $L(-10,0,0)$

find two more points: $P_1:(2,-1,1)$; $P_2:(2,-1,-1)$ (z: free)

$v_1=\overrightarrow{P_0P_1}$; $v_2=\overrightarrow{P_0P_2}$
$=(2,-1,1)$ $=(2,-1,-1)$

$\Rightarrow \vec{n}=v_1\times v_2=\begin{pmatrix}2\\-1\\1\end{pmatrix}\times\begin{pmatrix}2\\-1\\-1\end{pmatrix}=\begin{pmatrix}(-1)\cdot(-1)-(1\cdot(-1))\\1\cdot 2-(2\cdot(-1))\\2\cdot(-1)-((-1)\cdot 2)\end{pmatrix}$

$=\begin{pmatrix}2\\4\\0\end{pmatrix}$

(using v_1 and v_2 as vectors in the plane in order to get the normal vector of the plane : cross product of v_1 & v_2)

$\vec{l}=\overrightarrow{LP_0}=\begin{pmatrix}10\\0\\0\end{pmatrix}$

$$\vec{r} = 2\cdot(\vec{n}\cdot\vec{l})\cdot\vec{n} - \vec{l} = 2\cdot(n_1\cdot l_1 + n_2 l_2 + n_3 l_3)\cdot\vec{n} - \vec{l} =$$

$$= 2\cdot 20\cdot\vec{n} - \vec{l} = 40\cdot\vec{n} - \vec{l} = \begin{pmatrix}80\\160\\0\end{pmatrix} - \begin{pmatrix}10\\0\\0\end{pmatrix} =$$

$$= \begin{pmatrix}70\\160\\0\end{pmatrix}$$

Normalize now:

$$|\vec{r}| = \sqrt{70^2 + 160^2 + 0^2}$$

normalized_r $= \begin{pmatrix}70/|\vec{r}|\\160/|\vec{r}|\\0\end{pmatrix}$ = vector of reflected light at Point P_0.

Explanation: $2(\vec{n}\cdot\vec{l})\cdot\vec{n} - \vec{l}$;

$\vec{n}\cdot\vec{l}$: scalar of both vectors

$(\vec{n}\cdot\vec{l})\cdot\vec{n}$: $\vec{n}$ scaled with the scalar $\rightarrow$ height (y-) difference ~~between~~ ~~between~~ between Point P_0 & L

$2\cdot(\vec{n}\cdot\vec{l})\cdot\vec{n} - \vec{l}$: Starting from Point P_0 you have to go $-\vec{l}$ to be at the x-position of the reflection vector.
Now you have to take the y-difference two times (because of $-\vec{l}$) to be at the correct y-Position