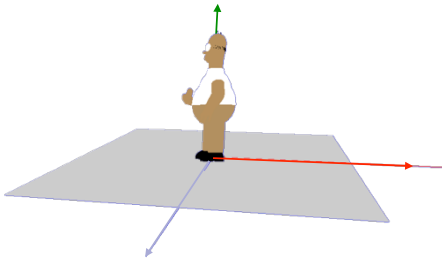
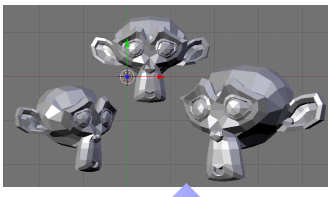
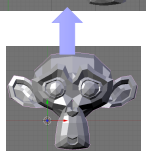
Classe 2: Contingut

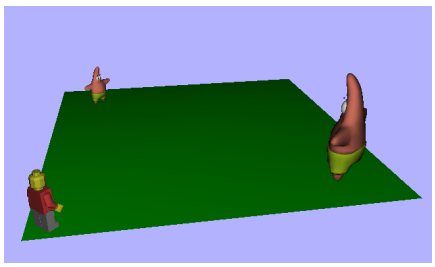
- Introducció a hardware gràfic de sortida
- Breu repàs de models geomètrics
- **Transformacions geomètriques**
- Exercicis

MOTIVACIÓ: càlcul de la TG a aplicar a models

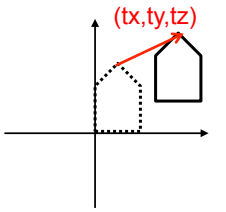




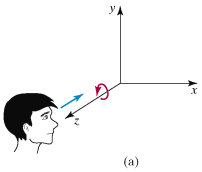


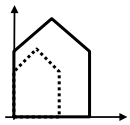


Transformació geomètrica → [ ] → Matriu 4x4 TG



x' = x+tx; y'=y+ty; z'=z+tz





T(tx,ty,tz)

$$\mathcal{T}(t_x,t_y,t_z)=\begin{bmatrix}1 & 0 & 0 & t_x\\ 0 & 1 & 0 & t_y\\ 0 & 0 & 1 & t_z\\ 0 & 0 & 0 & 1\end{bmatrix}$$

R_z(angle)

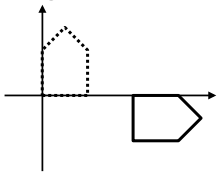
$$\begin{bmatrix}\cos\alpha & -\sin\alpha & 0 & 0\\ \sin\alpha & \cos\alpha & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\end{bmatrix}$$

S(sx,sy,sz)

$$S(s_x,s_y,s_z)=\begin{bmatrix}s_x & 0 & 0 & 0\\ 0 & s_y & 0 & 0\\ 0 & 0 & s_z & 0\\ 0 & 0 & 0 & 1\end{bmatrix}$$

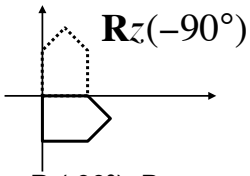
Composició de Transformacions

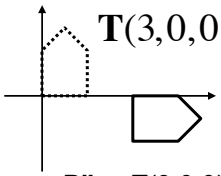
- Imaginem que volem



No es pot fer amb cap de les matrius anteriors

- Cal composar/efectuar dues transformacions





M = T (3,0,0) · R_z (-90º)

P' = R_z(-90º) ·**P**

P" = T(3,0,0) · **P'**

P" = T(3,0,0) · (R_z (-90º) · **P**) = (T (3,0,0) · R_z (-90º)) · **P** = M · **P**

4

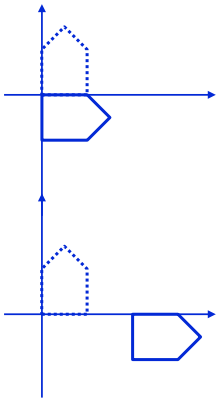
Composició de Transformacions

T (3,0) · **R**(-90º) ≠ **R**(-90º) · **T** (3,0)

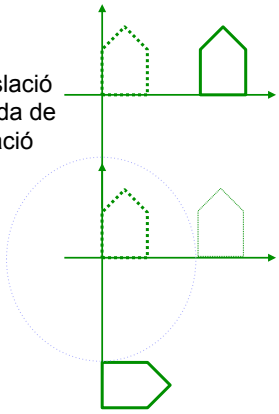
❷ ❶ ❷ ❶

- Multiplicació de matrius no és commutativa

Rotació seguida de translació



Translació seguida de rotació



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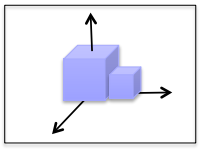
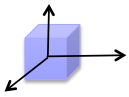
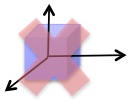
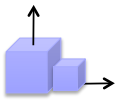
- **Exercicis**

Exemple simple de TG (1)



- Visualitzar una escena como la de la figura de l'esquerra
- Utilitzant el mètode pinta_cub() que indica a OpenGL que ha de visualitzar/pintar el VAO que conté el model de triangles d'aquest cub:

```
…
CreateBuffers();
…
modelMatrix_cub1();
pinta_cub();

modelMatrix_cub2();
Pinta_cub();
```

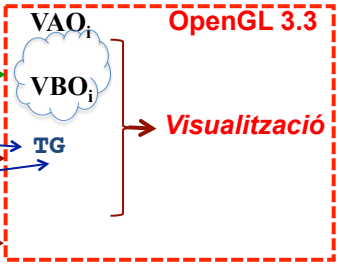
Crea i envia informació pel VAO i VBO del cub/

TG1

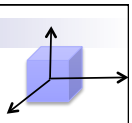
glDrawArrays(…)

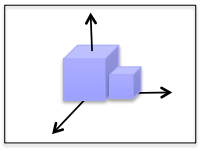
TG2

glDrawArrays(…)

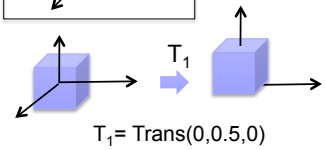


Exemple simple de TG (1)

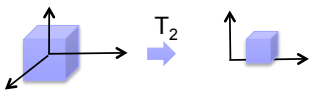




Escena a visualitzar



T$_1$= Trans(0,0.5,0)



T$_2$= Trans(0.75,0.25,0)*S(0.5,0.5,0.5)

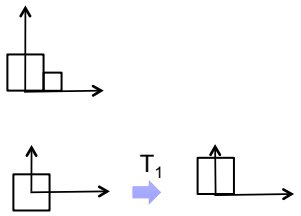
Pseudo-codi

```
TG= Translate(0,0.5,0);
modelMatrix(TG);
pinta_cub ();
TG= Translate(0.75,0.25,0);
TG= TG*Scale(0.5,0.5,0.5);
modelMatrix (TG);
pinta_cub();
```

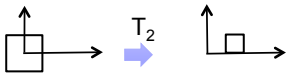
```
glm::mat4 TG;
TG= glm::translate (glm::mat4(1.f),glm::vec3(0,0.5,0));
glUniformMatrix4fv (transLoc, 1, GL_FALSE, &TG[0][0]);
pinta_cub ();

TG= glm::translate (glm::mat4(1.f), glm::vec3(0.75,0.25,0));
TG= gml::scale(TG, glm::vec3(0.5,0.5,0.5));
glUniformMatrix4fv (transLoc, 1, GL_FALSE, &TG[0][0]);
pinta_cub();
```

Com faríeu per a girar tota l'escena alfa graus respecte l'eix x?

Exemple simple (2)



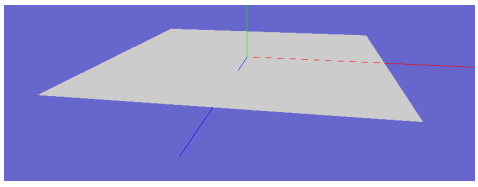
$T_1 = R_x(alfa)^* \text{ Trans}(0,0.5,0)$

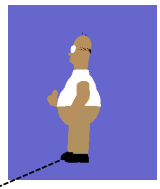



```
glm::mat4 TG, AUX;
AUX=glm::rotate (glm::mat4(1.f), alfa, vec3(1,0,0);
TG= glm::translate (AUX, glm::vec3(0,0.5,0));
modelMatrix (TG);
pinta_cub ();
TG= glm::translate (AUX, glm::vec3(0.75,0.25,0));
TG= gml::scale(TG, glm::vec3(0.5,0.5,0.5));
modelMatrix (TG);
pinta_cub();
```

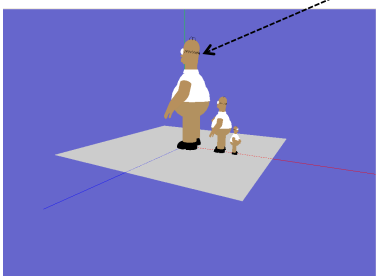
$T_2 = R_x(alfa)^* \text{ Trans}(0.75,0.25,0)^*S(0.5,0.5,0.5)$

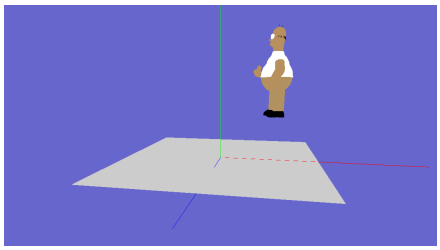
Exercici 3

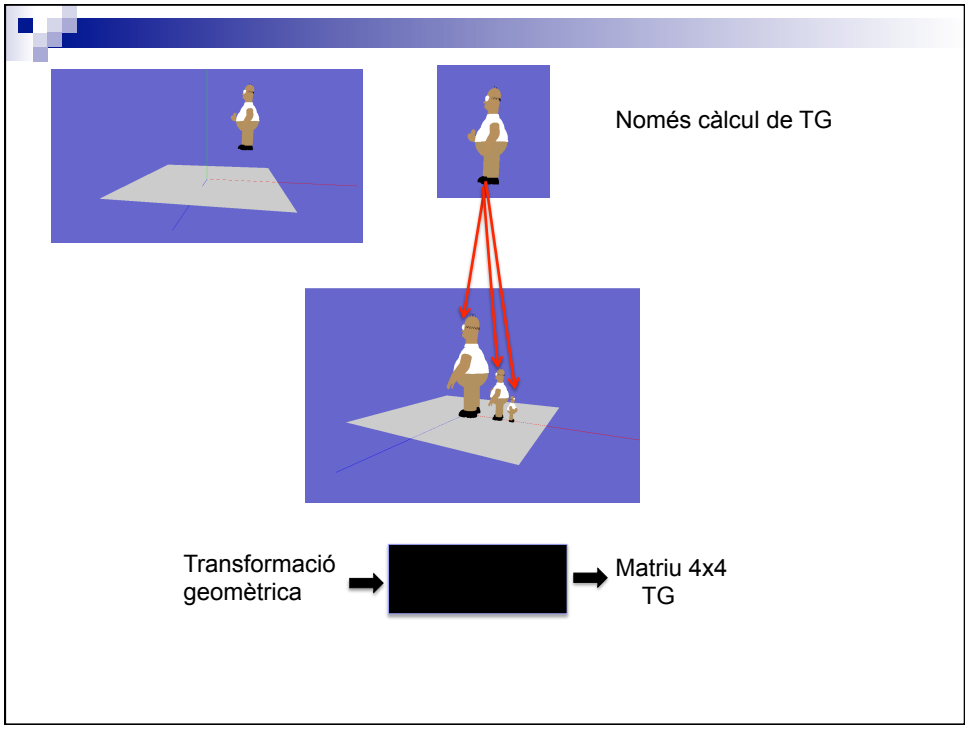


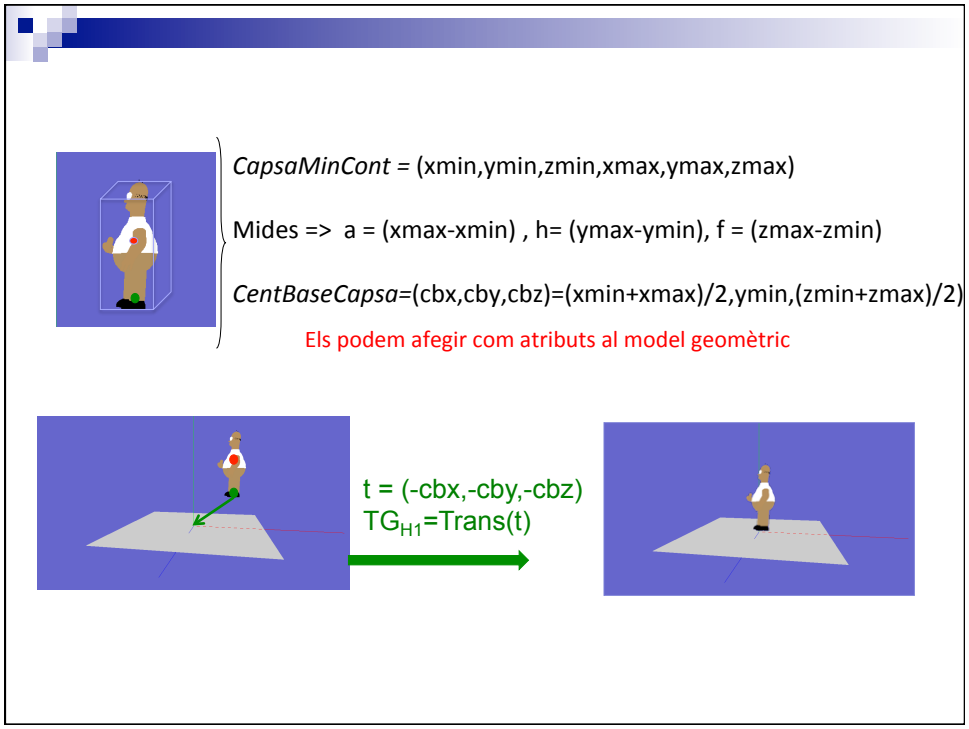


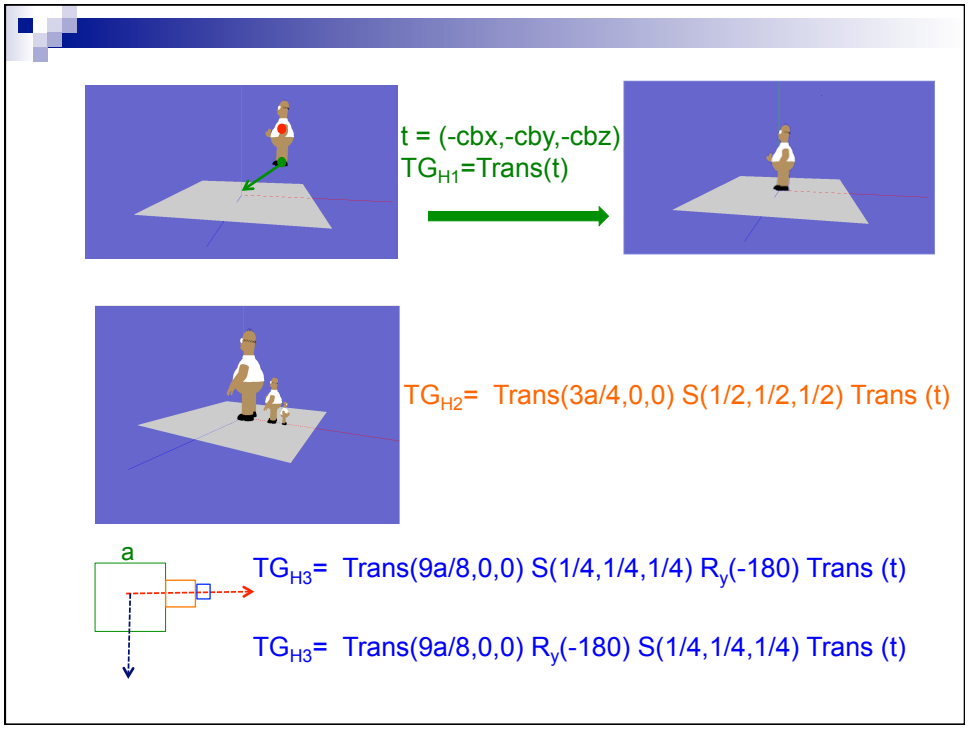
Mateixa grandària

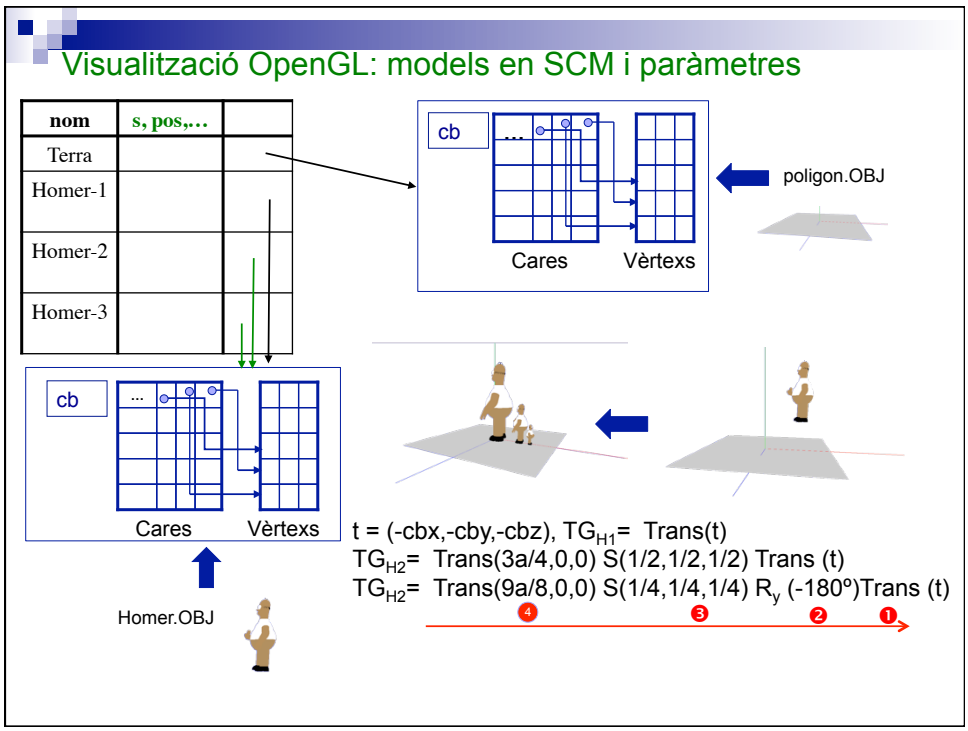





Només càlcul de TG
Transformació geomètrica
Matriu 4x4 TG


CapsaMinCont = (xmin,ymin,zmin,xmax,ymax,zmax)
Mides => a = (xmax-xmin) , h= (ymax-ymin), f = (zmax-zmin)
CentBaseCapsa=(cbx,cby,cbz)=(xmin+xmax)/2,ymin,(zmin+zmax)/2)
Els podem afegir com atributs al model geomètric
t = (-cbx,-cby,-cbz)
TG$_{H1}$=Trans(t)


t = (-cbx,-cby,-cbz)
TG$_{H1}$=Trans(t)
TG$_{H2}$= Trans(3a/4,0,0) S(1/2,1/2,1/2) Trans (t)
a
TG$_{H3}$= Trans(9a/8,0,0) S(1/4,1/4,1/4) R$_y$(-180) Trans (t)
TG$_{H3}$= Trans(9a/8,0,0) R$_y$(-180) S(1/4,1/4,1/4) Trans (t)


Visualització OpenGL: models en SCM i paràmetres
nom
s, pos,...
Terra
Homer-1
Homer-2
Homer-3
cb
...
Cares
Vèrtexs
poligon.OBJ
cb
...
Cares
Vèrtexs
Homer.OBJ
t = (-cbx,-cby,-cbz), TG$_{H1}$= Trans(t)
TG$_{H2}$= Trans(3a/4,0,0) S(1/2,1/2,1/2) Trans (t)
TG$_{H2}$= Trans(9a/8,0,0) S(1/4,1/4,1/4) R$_y$ (-180º)Trans (t)
4
3
2
1

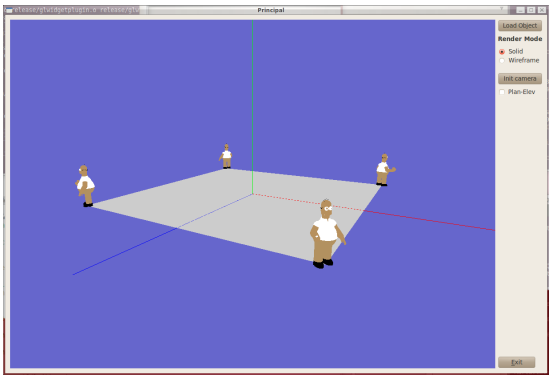
Visualització OpenGL: models en SCM

```
per cada objecte_i
  //Càlcul TG_i i enviar a OpenGL
  modelTransform_i()
  pinta_model_i();
fper
```

TG_{H3}= Trans(9a/8,0,0) S(1/4,1/4,1/4) R_y (-180º)Trans (t)

```
modelTransformHomer3()
//tercer homer
{
TG=I;
TG= TG*Translate(posx,posy,posz));
TG= TG*Scale(s,s,s);
TG= TG*Rotate (-180, (0,1,0));
TG= TG*Translate (-cb.x,-cb.y,-cb.z);
modelMatrix(TG); //enviar uniform
}
```

Exercicis



Mireu la col·lecció de problemes del racó.
Proposta de mínims: 16, 19, 24, 25 de la col·lecció

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