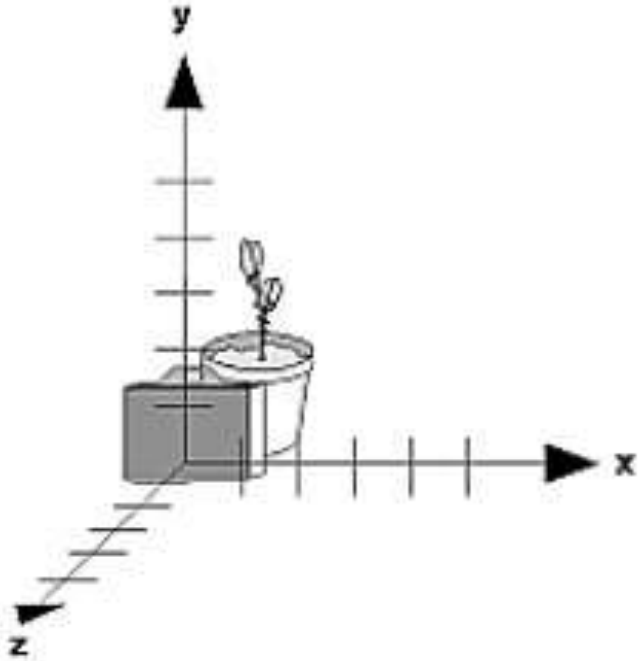
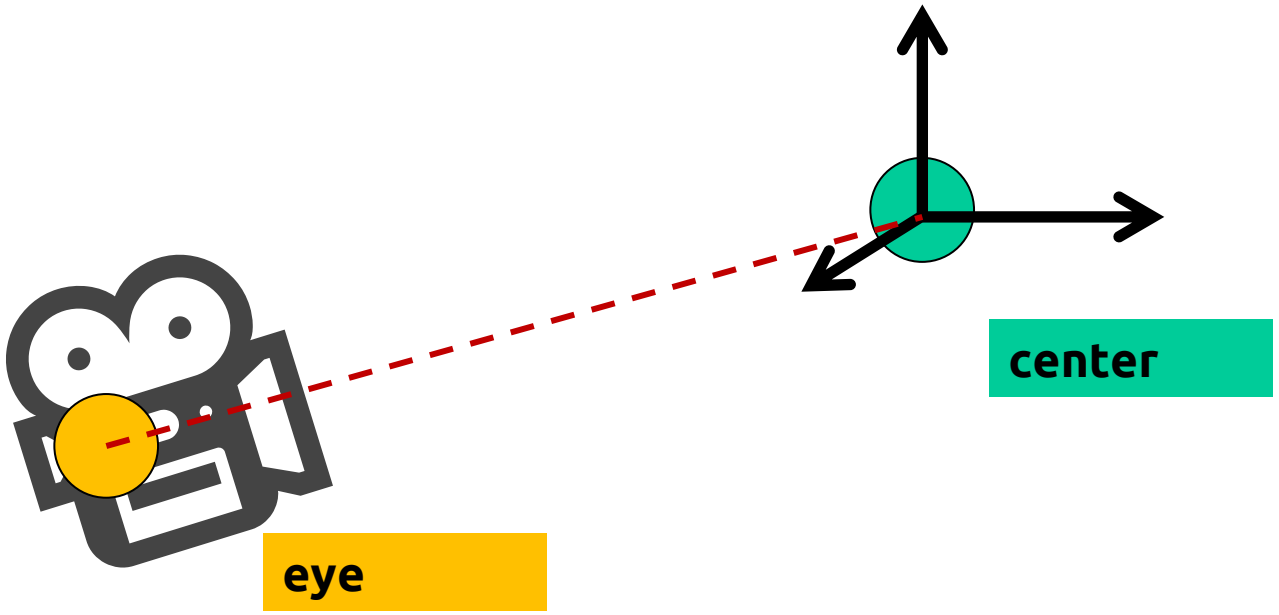
Posição da câmara

- Por omissão a câmara está colocada na origem (0, 0, 0) dirigida para o eixo negativo dos zz



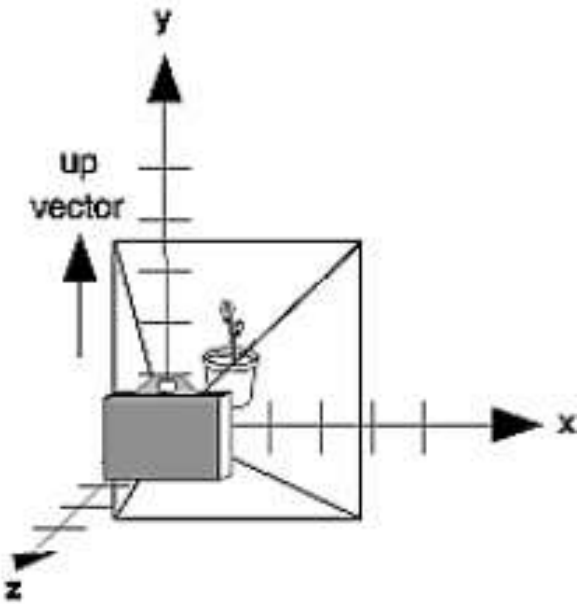
Posicionamento da câmara

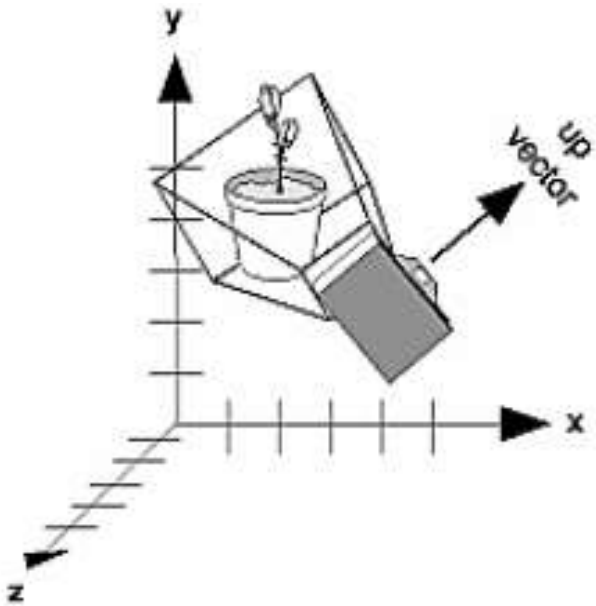
- `void gluLookAt(`
  `eyex, eyey, eyez,`
  `centerx, centery, centerz,`
  `upx, upy, upz)`



Posicionamento da câmara

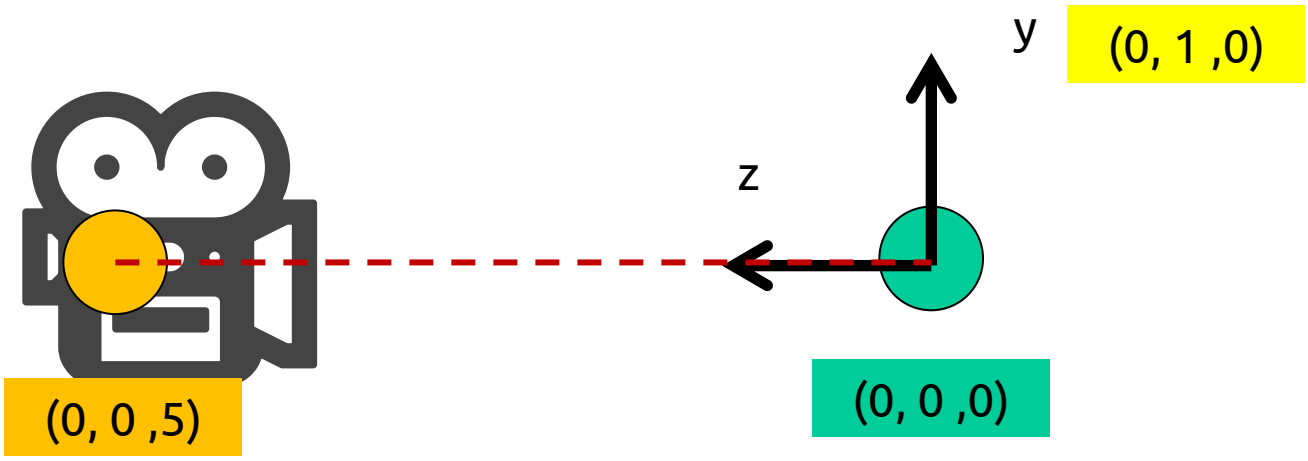
- `void gluLookAt(eyex, eyey, eyez, centerx, centery, centerz, upx, upy, upz)`





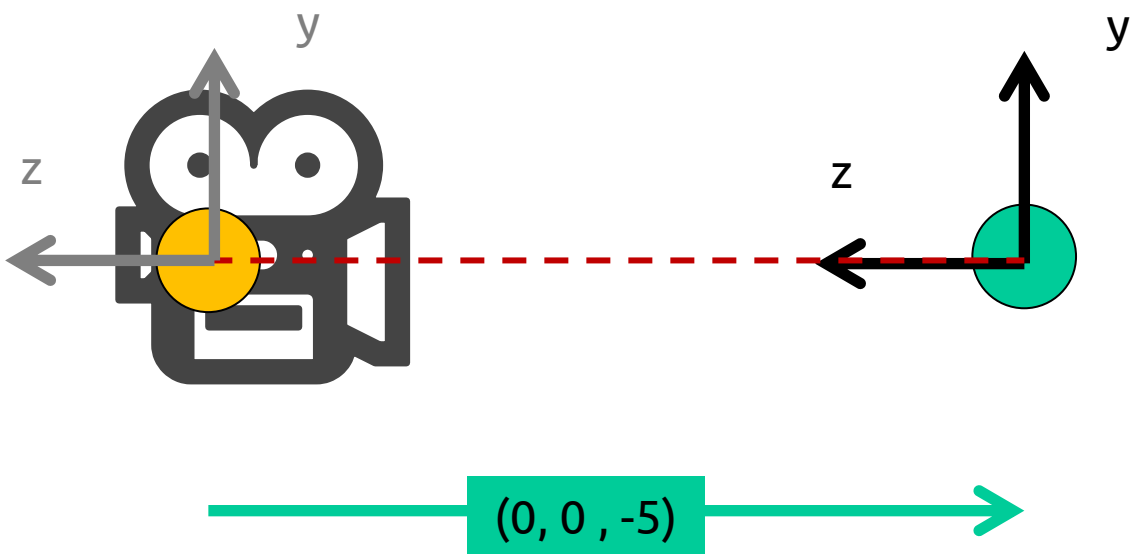
Posição da câmara

- Mover a câmara ou mover a cena têm o mesmo resultado
  - `gluLookAt(0,0,+5, 0,0,0, 0,1,0)`
  - `glTranslatef(0, 0, -5)`



Posição da câmara

- Mover a câmara ou mover a cena têm o mesmo resultado
  - `gluLookAt(0,0,+5, 0,0,0, 0,1,0)`
  - **`glTranslatef(0, 0, -5)`**

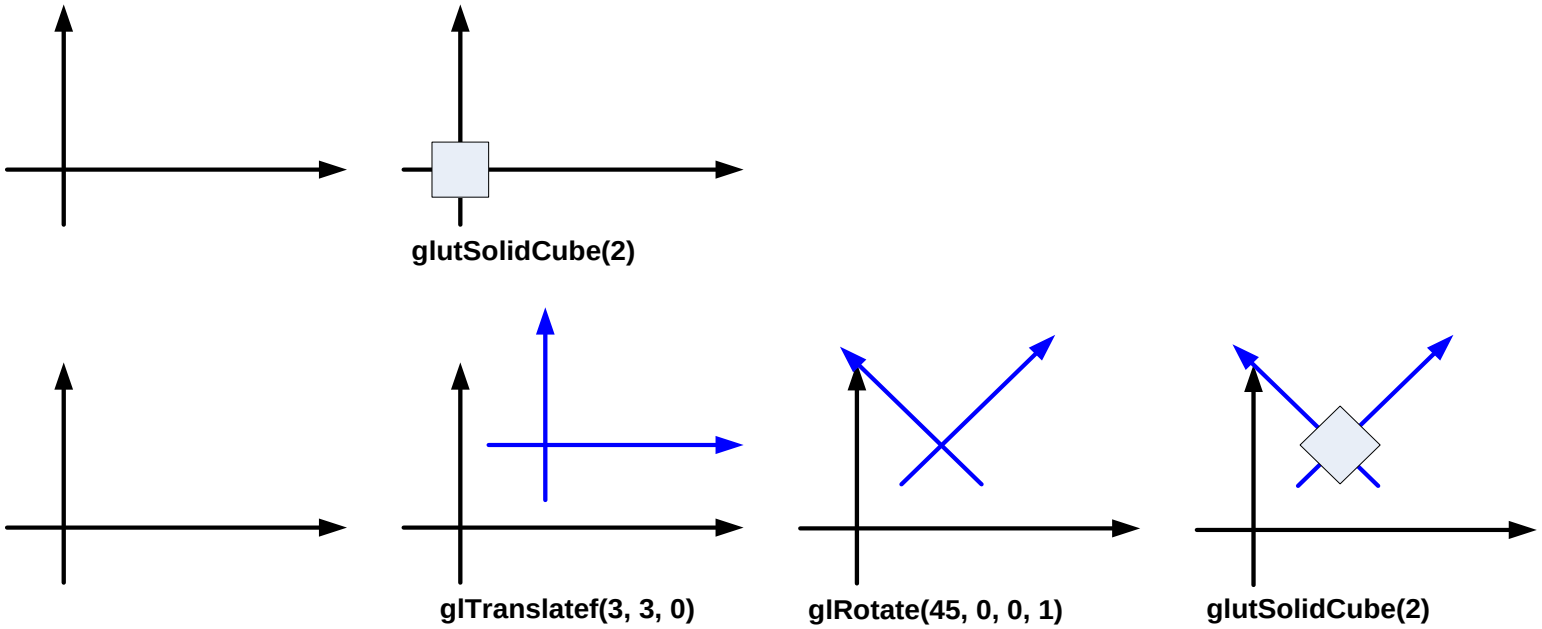


Posição da câmara

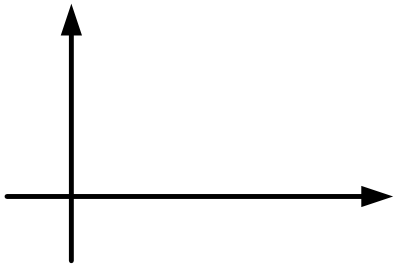
- Podem usar **`gluLookAt`** ou construir a vossa própria rotina de visualização, por exemplo, **câmara** com movimento **polar** usando as operações básicas de transformação

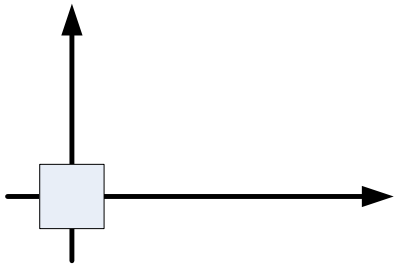
O sistema de coordenadas local

- Ao aplicar uma transformação estão na realidade a mover um sistema de coordenadas "agarrado" ao modelo

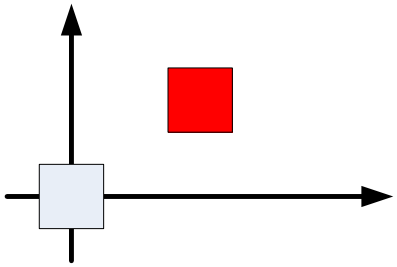


O sistema de coordenadas local

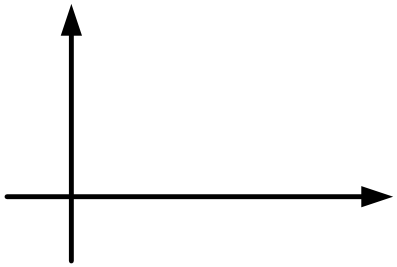


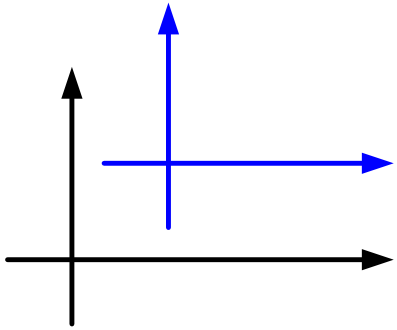


glutSolidCube(2)

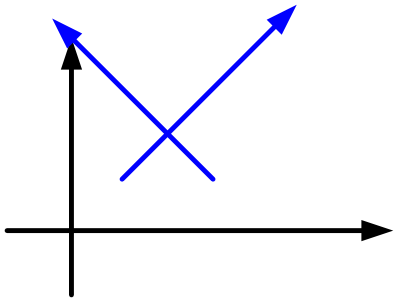


glRect(3, 2, 0, 5, 4, 0)

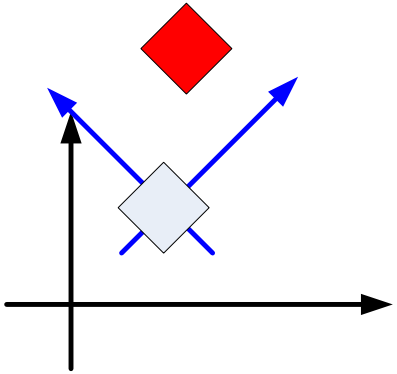




glTranslatef(3, 3, 0)



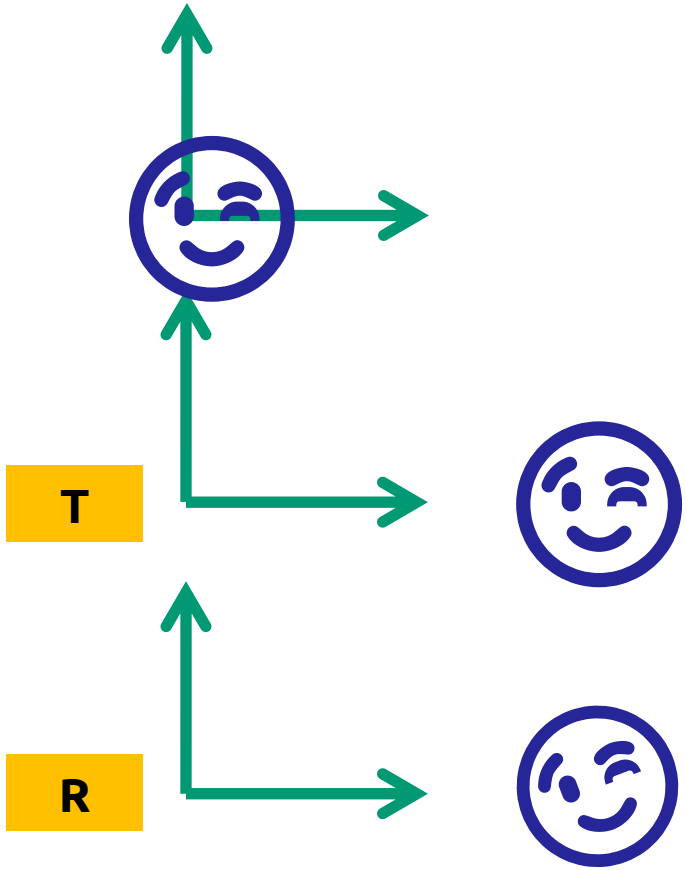
glRotate(45, 0, 0, 1)



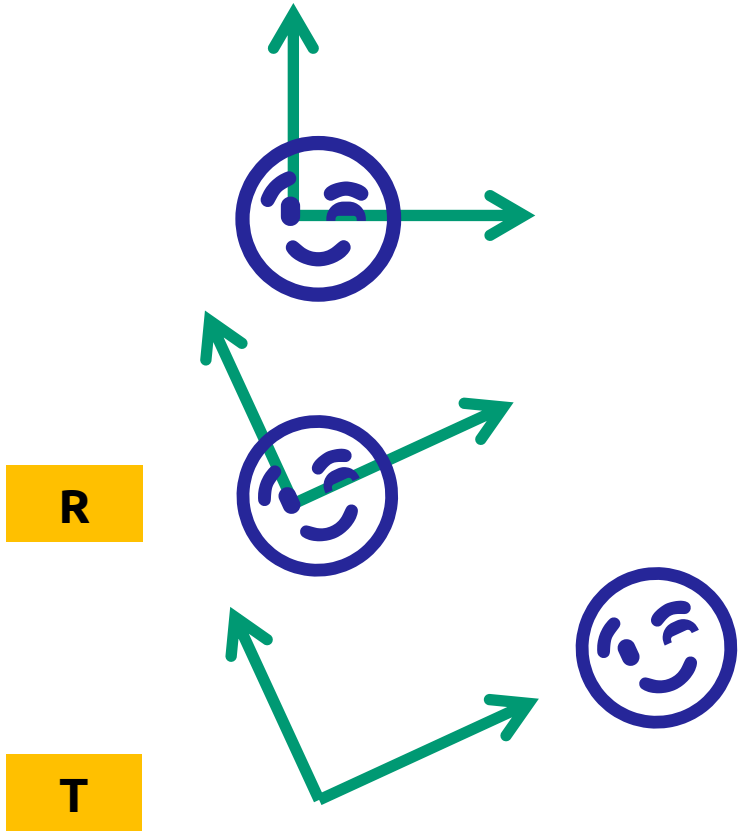
glutSolidCube(2)
glRect(3, 2, 0, 5, 4, 0)

Efeito cumulativo de transformações

- Translação + Rotação

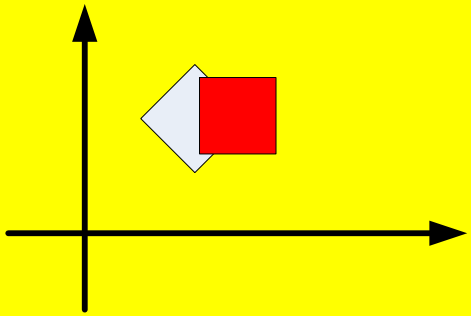


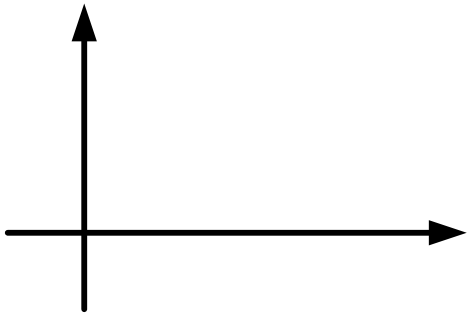
- Rotação + Translação



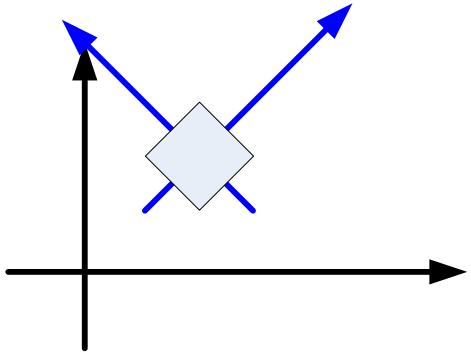
PushMatrix + PopMatrix

Cena final desejada

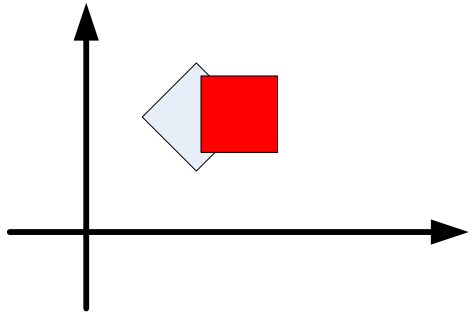




glLoadIdentity()



glPushMatrix()
  glTranslatef(3, 3, 0)
  glRotate(45, 0, 0, 1)
  glutSolidCube(2)
glPopMatrix()

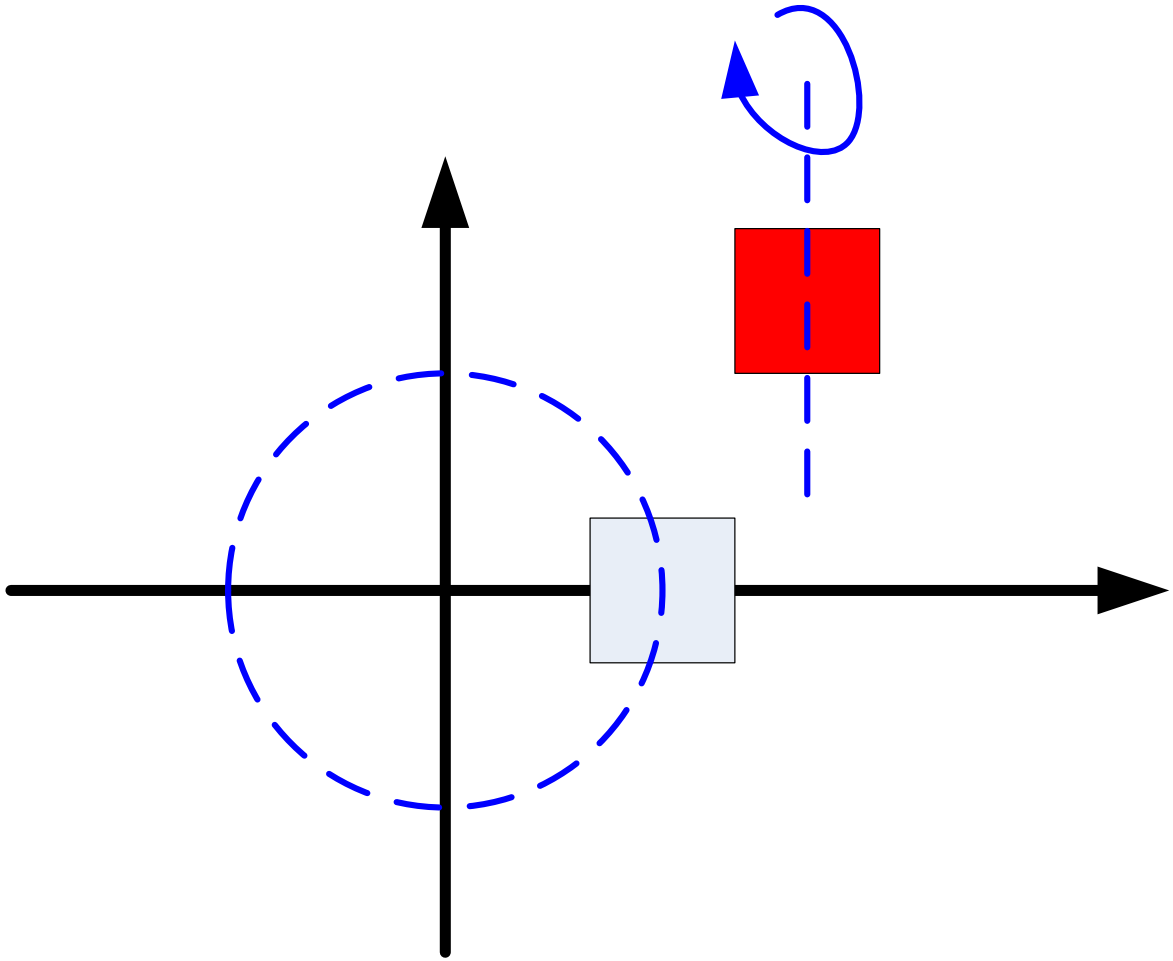


glRect(3, 2, 0, 5, 4, 0)

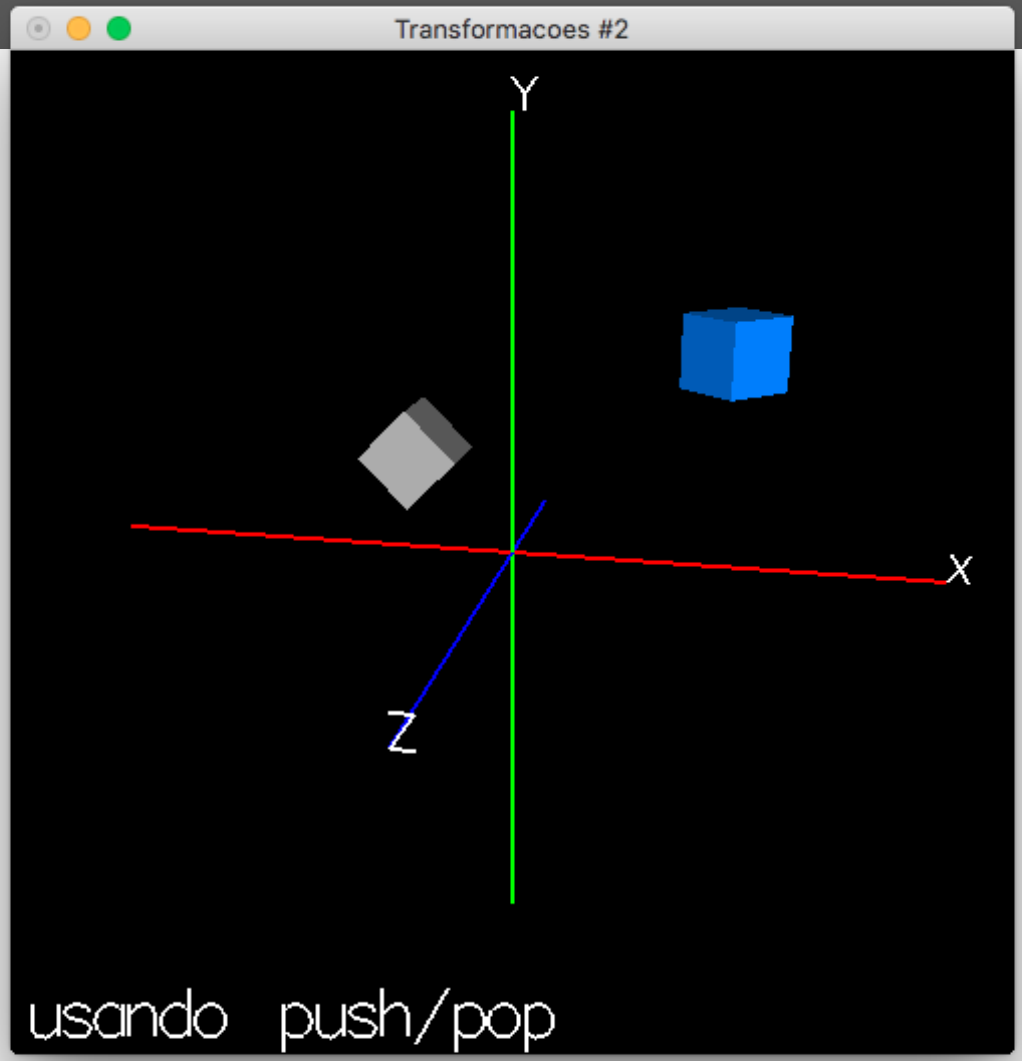
Transformações "locais"

- Guardar a matriz de transformação usando **`glPushMatrix()`**
- Recuperar a matriz anterior usando **`glPopMatrix()`**
- **glPushMatrix** e gl**PopMatrix** podem ser usados para a matriz de projeção ou para a matriz de modelo/vista
  - Devem ter em atenção, qual a matriz ativa no momento

Transformações (in)dependentes



Demo



Texto em GLUT

- Desenhar um carácter
  - glutStrokeCharacter(*fonte*, *caracter*)
  - glutBitmapCharacter(*fonte*, *caracter*)
- Fontes
  - GLUT_STROKE_ROMAN
  - GLUT_STROKE_MONO_ROMAN
  - GLUT_BITMAP_9_BY_15
  - GLUT_BITMAP_8_BY_13
  - GLUT_BITMAP_TIMES_ROMAN_10
  - GLUT_BITMAP_TIMES_ROMAN_24
  - GLUT_BITMAP_HELVETICA_10
  - GLUT_BITMAP_HELVETICA_12
  - GLUT_BITMAP_HELVETICA_18

Módulo 8

Sistemas Gráficos e Interação

Instituto Superior de Engenharia do Porto

Filipe Pacheco

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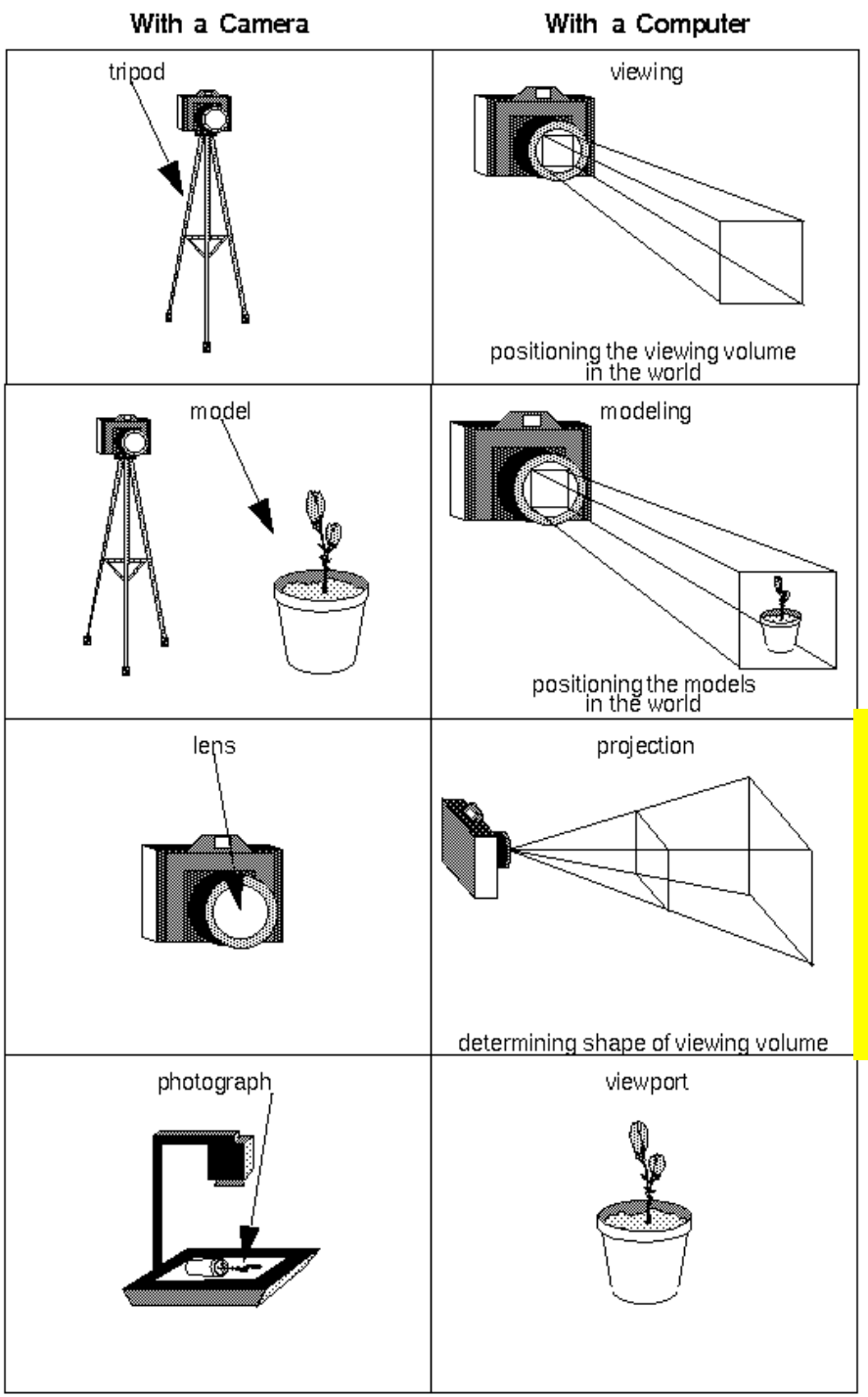
Projeções

Relembrando...

1. Apontar a câmara à cena (viewing transformation).
2. Compor a cena (modeling transformation).
3. **Escolher o tipo de lente e acertar o zoom (projection transformation).**
4. Determinar o tamanho físico da cena (viewport transformation).



Esqueleto de código

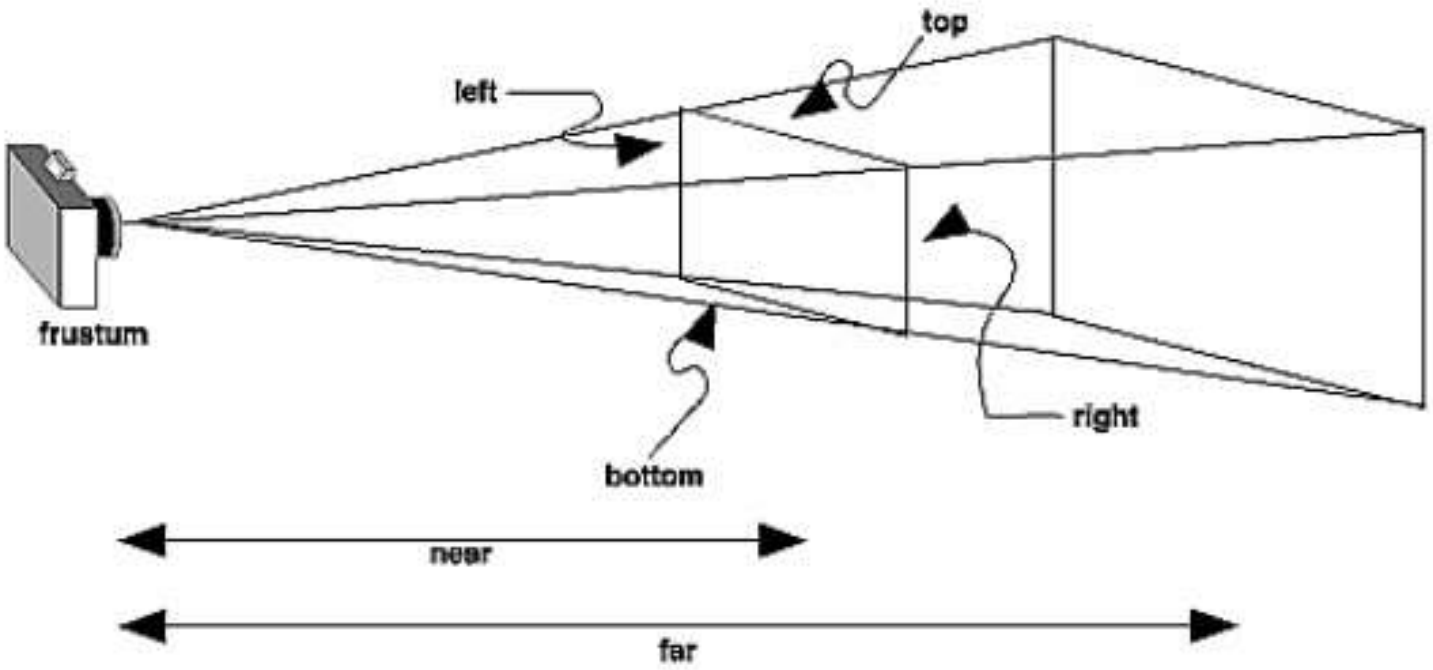
```
void reshape(int w, int h) {
    // viewport transformation
    glViewport(0, 0, w, h);
    // projection transformation
    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    projeccao();
    ...
}
void display() {
    // modelview transformation
    glMatrixMode(GL_MODELVIEW);
    glLoadIdentity();
    // posicionamento da câmara
    camara();
    // transformações do modelo
    ...
}
```

O que é a transformação de projeção?

- A finalidade da transformação de projeção, é a definição do *volume de visualização*, que é usado de duas maneiras:
  - Determina como um objecto é projetado no ecrã (usando uma projeção em perspetiva ou ortográfica), e
  - Define que objetos ou partes destes são eliminados da imagem final.

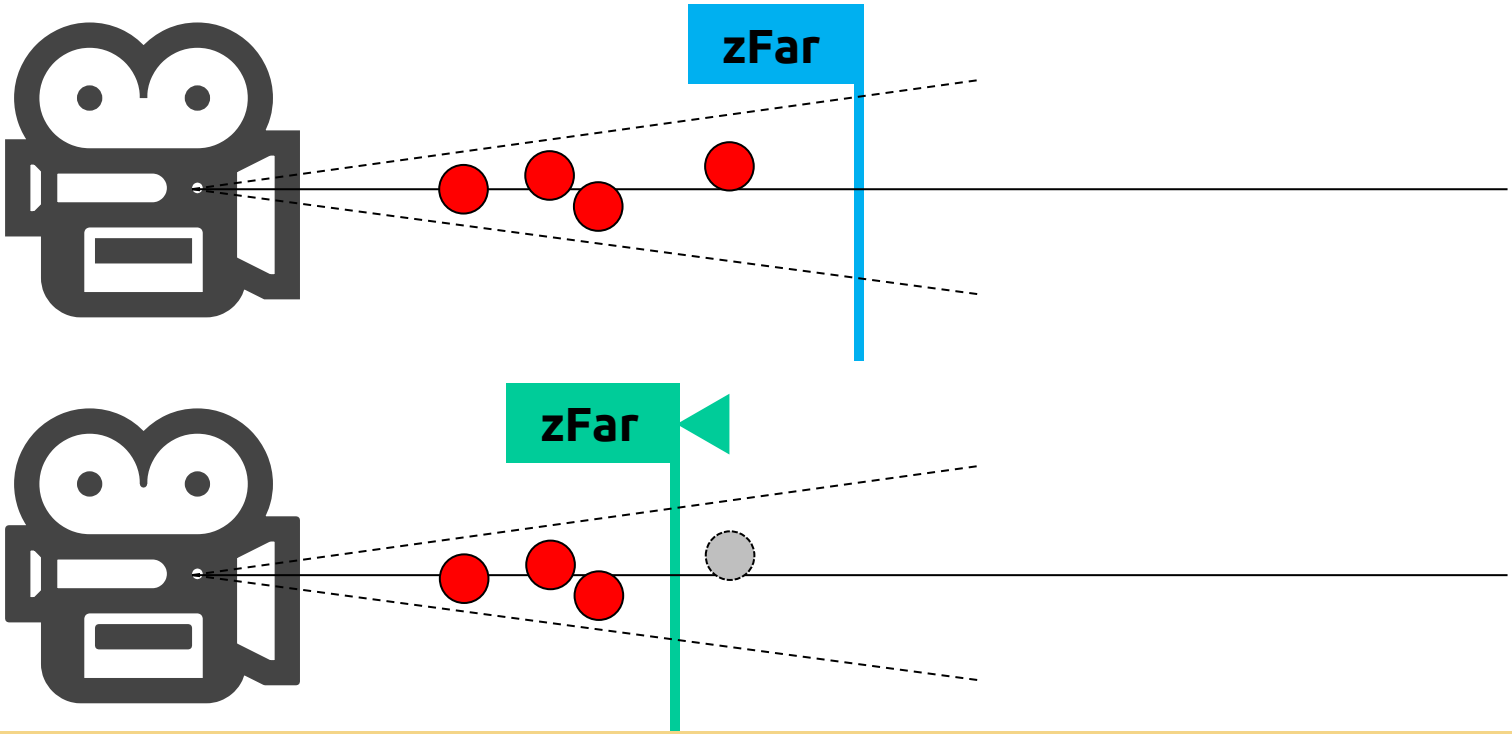
Perspetiva

- `void glFrustum(GLdouble left, GLdouble right, GLdouble bottom, GLdouble top, GLdouble zNear, GLdouble zFar)`



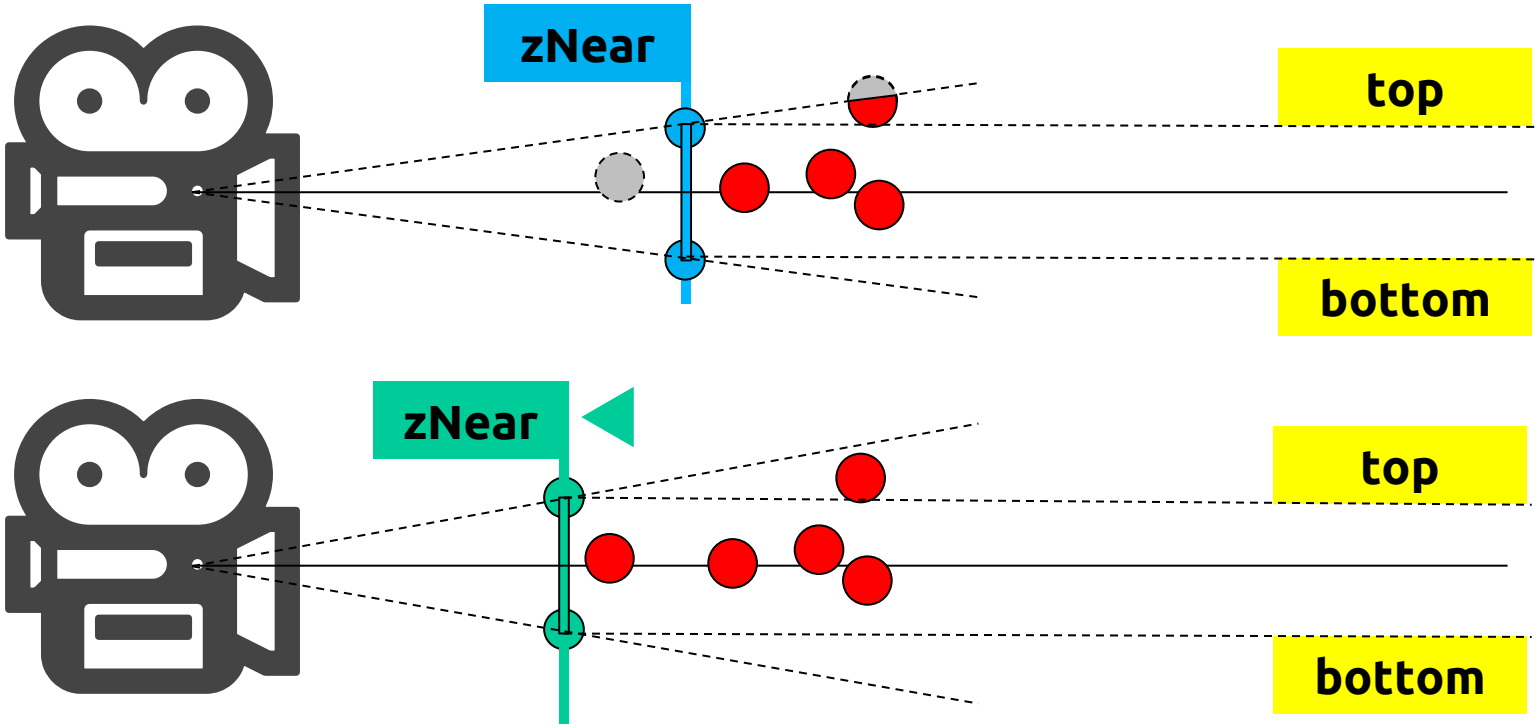
Perspetiva

- `void glFrustum(GLdouble left, GLdouble right, GLdouble bottom, GLdouble top, GLdouble zNear, GLdouble zFar)`



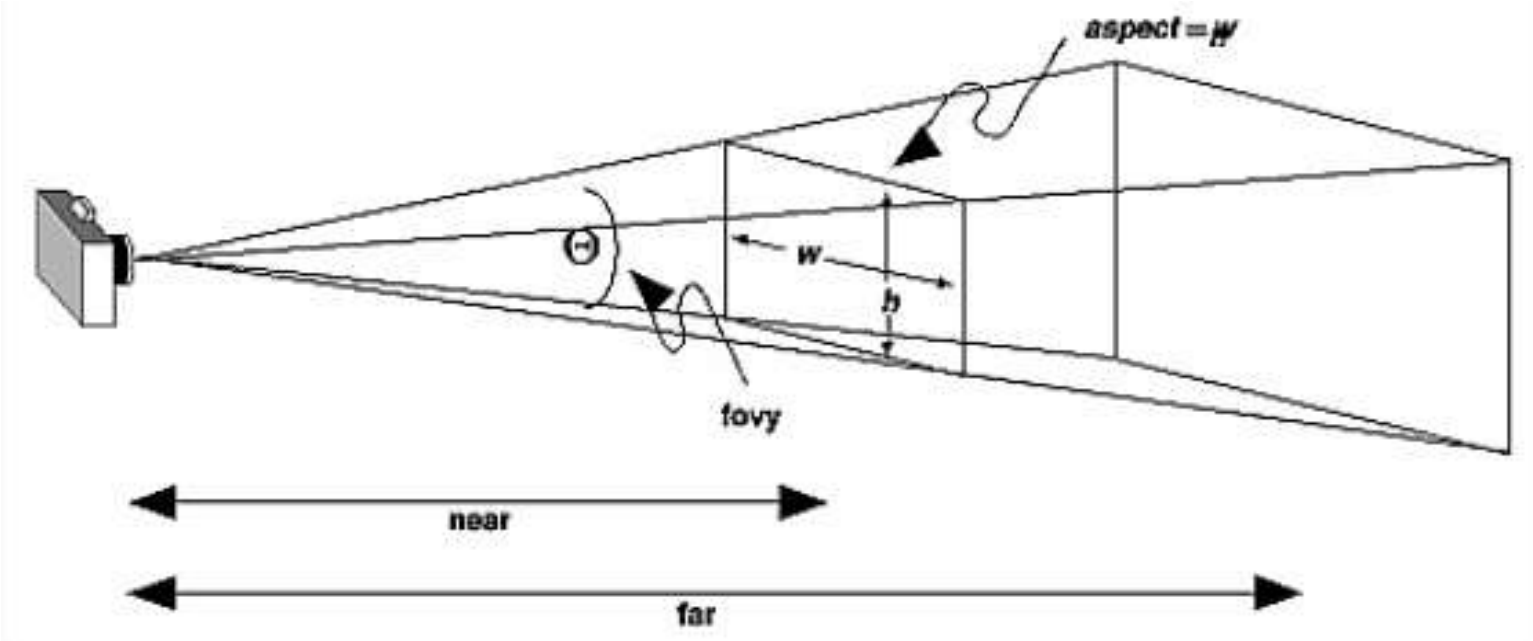
Perspetiva

- `void glFrustum(GLdouble left, GLdouble right, GLdouble bottom, GLdouble top, GLdouble zNear, GLdouble zFar)`



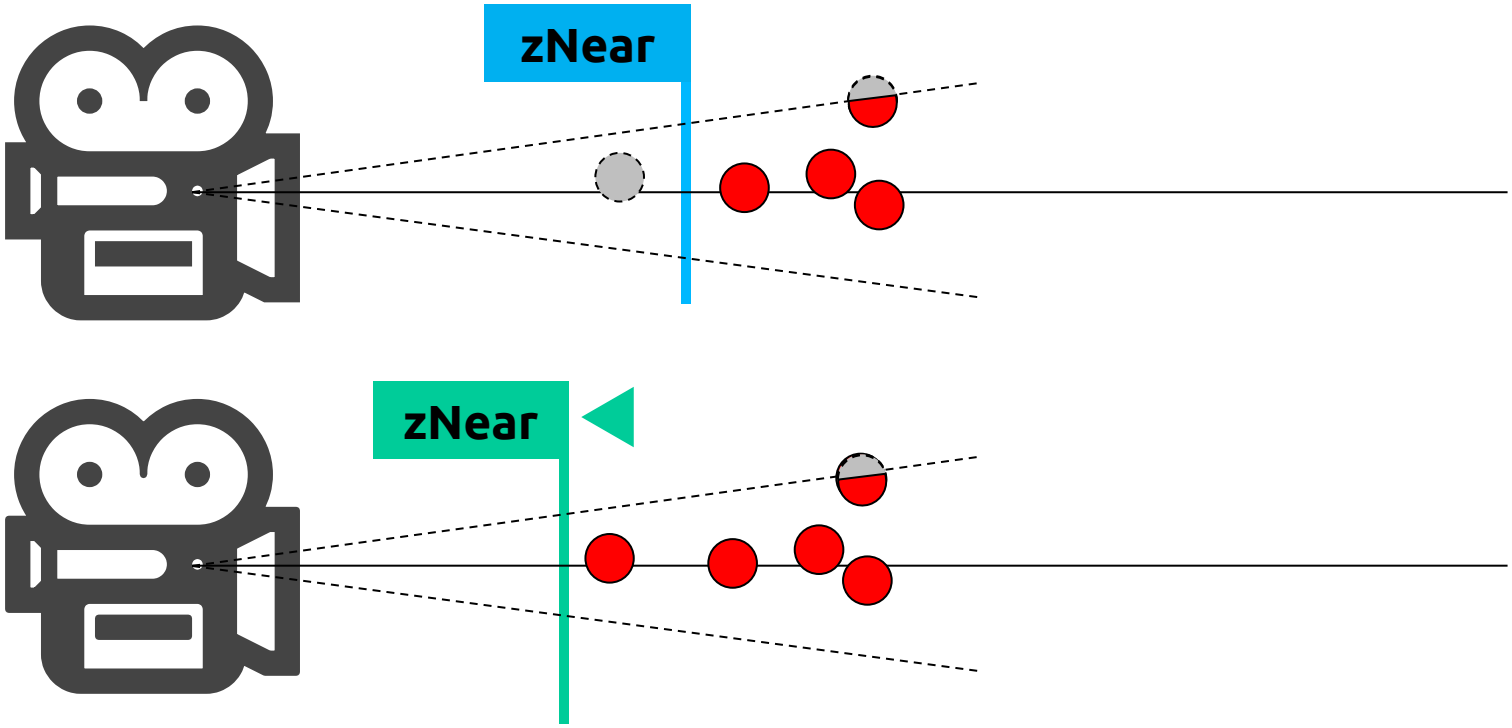
Perspetiva

- `void gluPerspective( GLdouble fovy, GLdouble aspect, GLdouble zNear, GLdouble zFar);`



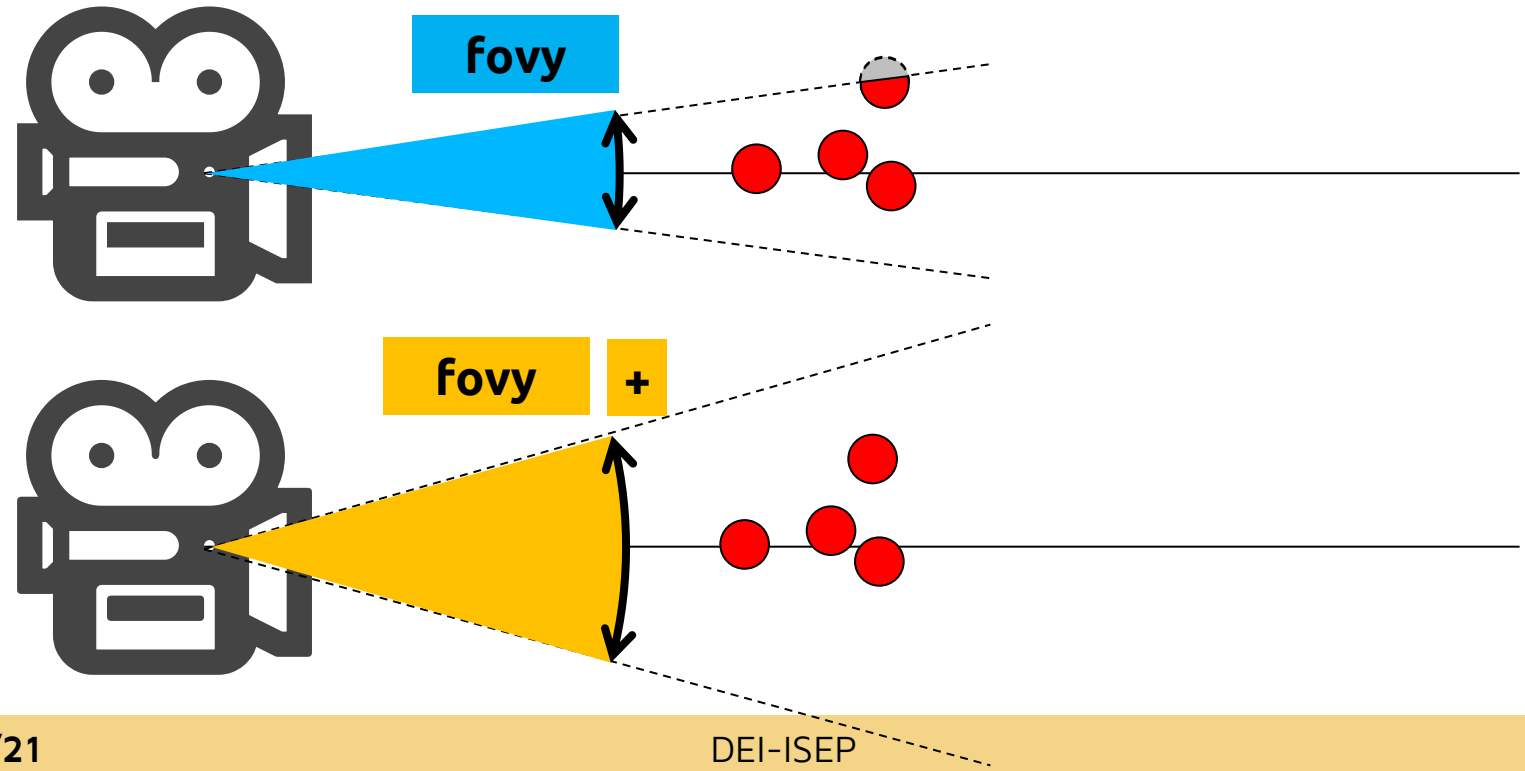
Perspetiva

- `void gluPerspective( GLdouble fovy, GLdouble aspect, GLdouble zNear, GLdouble zFar);`



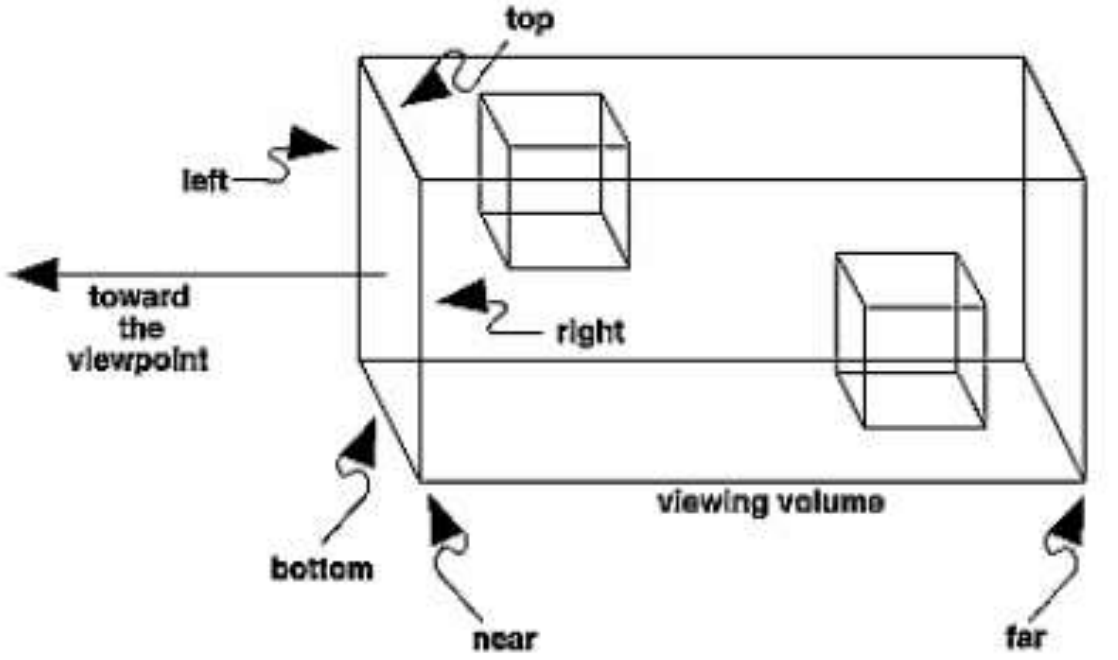
Perspetiva

- `void gluPerspective( GLdouble fovy, GLdouble aspect, GLdouble zNear, GLdouble zFar);`



Ortográfica

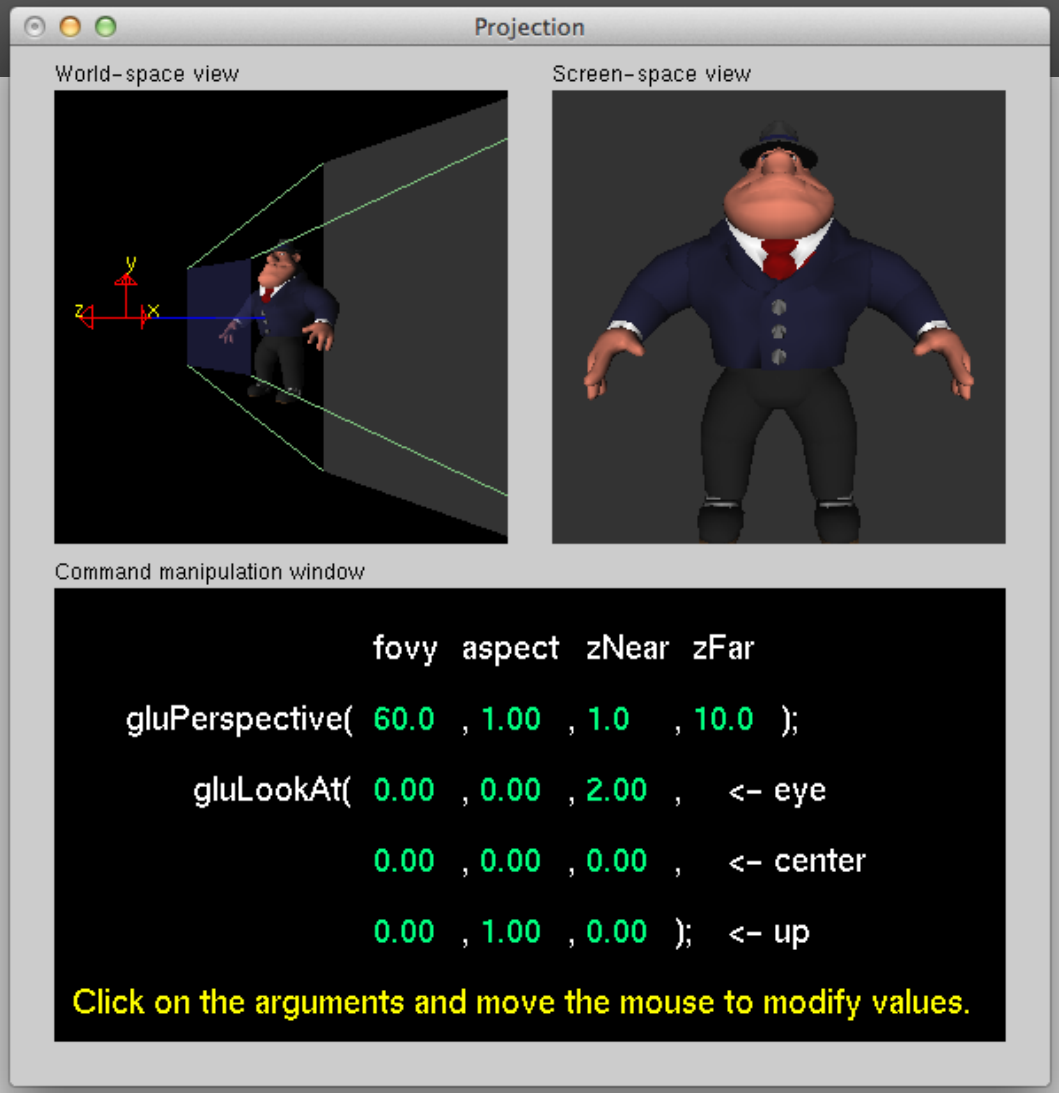
- `void glOrtho(GLdouble left, GLdouble right, GLdouble bottom, GLdouble top, Gldouble near, Gldouble far);`



zNear e zFar na projeção perspectiva

- zNear e zFar definem os planos de corte (*clipping*) **relativos** à posição da câmara
- Exemplo:
  - zNear = 1 & zFar = 3
  - Câmara (0, 0, 0)
    - Só são visíveis objetos com coordenada z no intervalo [-1, -3]
  - Mover câmara para (0, 0, 3)
    - Só são visíveis objetos com coordenada z no intervalo [2, 0]

Demo


Projection
World-space view
Screen-space view
y
z
x
Command manipulation window
fovy aspect zNear zFar
gluPerspective(60.0 , 1.00 , 1.0 , 10.0);
gluLookAt(0.00 , 0.00 , 2.00 , <- eye
0.00 , 0.00 , 0.00 , <- center
0.00 , 1.00 , 0.00); <- up
Click on the arguments and move the mouse to modify values.