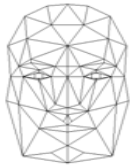
Graphics engines and their APIs

Code packages with a well-defined interface

2D or 3D

2D: Usually pixel-graded coordinates

3D: Normalized coordinates, world-graded coordinated, scalable

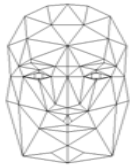


Features in a 2D API

Examples from two commercial 2D API's:

GDI (Graphics Device Interface)
(Microsoft, MS Windows)

QuickDraw
(Apple, MacOS)



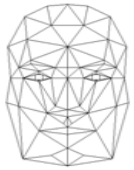
Graphics environments

Information about pens, colors, clipping etc.

GDI:
Drawing Context (DC)

QuickDraw:
GrafPort

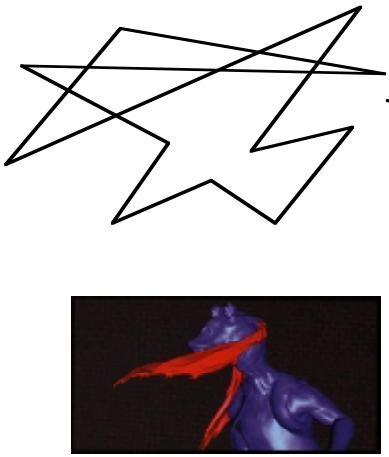
OpenGL:
The OpenGL current context



Data structures

x,y)

Points
Rectangles
Polygons
Regions
Pixel maps
Patterns
Fonts



Woman without her man, is nothing.

Woman! Without her, man is nothing!

Drawing operations

raw points, lines, rectangels, ovals, rounded-corner rectangles, polygons, regions.

Drawing variants applicable on one shape: frame, paint, fill, invert, erase

Draw text.

Bit blitting.

Metafiles

A metafile is a sequence of recorded drawing commands. Not necessarily a disk file.

WMF, EMF, PICT, EPS.

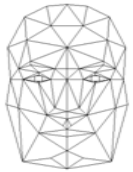
WMF = Windows Metafile

EMF = Enhanced Metafile

PICT = Macintosh Picture

EPS = Encapsulated Postscript

In OpenGL: Display lists



2D versus 3D

2D: Points, lines, text

3D: Polygons, surfaces, camera

2D has more different primitives

3D builds everything from polygons

Features in a 3D API

Geometrical:

Polygons (triangles)

(Points and lines exist but are rarely used.)

Rendering:

Light sources, Textures, Shading

Camera specification

OpenGL

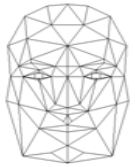
Portability: Excellent!

Performance: Good

Source: Yes, at least through Mesa

Language: Any

Fairy low-level, add scene graphs etc on top



Direct3D

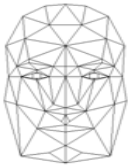
Portability: Poor

Performance: Good

Source: No

Language: Any

Includes many utilities



Java3D

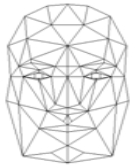
Portability: Good!

Performance: So-so

Source: No

Language: Java only

High-level, scene graph mandatory



Do you need extreme low level graphics programming these days?

Mobile phones

Special-purpose systems

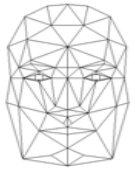
Other future low-power devices

OpenGL ES helps on mobile systems

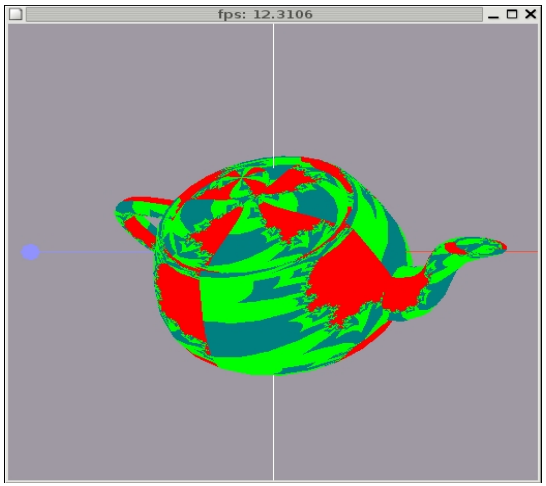
The new low level: Shader programming

Modern GPUs support “shader programs”, short programs executed on the GPU. They allow more freedom in shading and texturing.

You will write your own in lab 3!



Shader programming example: Texture generated in real time, Mandelbrot fractal



**Can’t be done in real time on this computer,
but I will bring one that can**