Introduction to Graphics

Lecture 8:

Polygon Rendering

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Lecture Overview

- Polygon Renders
- Data Flow
- Scene Layout
- Terrain
- Texture
- Shading

Polygon Renders

Most real time animation systems today are based on polygon rendering,

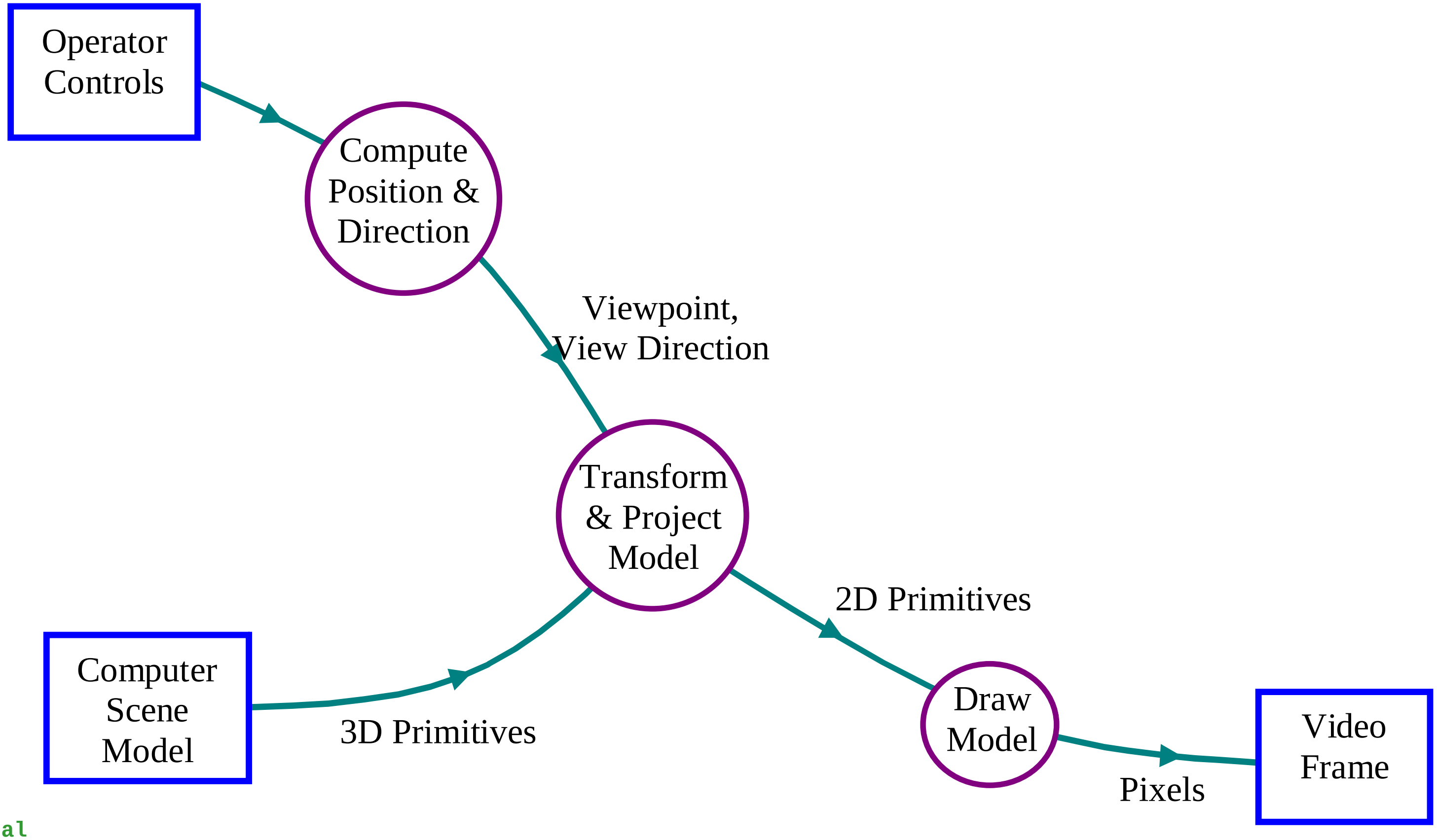
i.e. they use only 3D planar polygons to build a scene.

Examples:

Flight Simulation

Games

Data flow in a computer Game


Operator Controls

Compute Position & Direction

Viewpoint, View Direction

Transform & Project Model

Computer Scene Model

3D Primitives

2D Primitives

Draw Model

Pixels

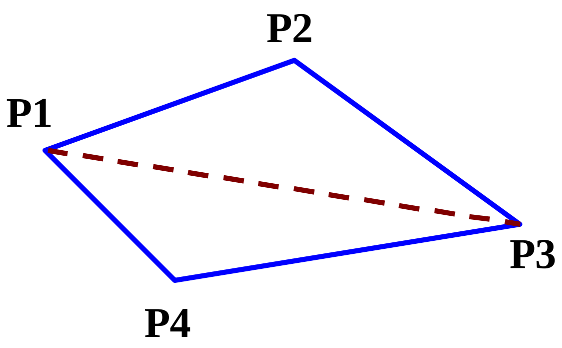
Video Frame

Scene Layout

Most scenes are built from planar polygons

Quadrilaterals are a common choice,

Triangles are safer!

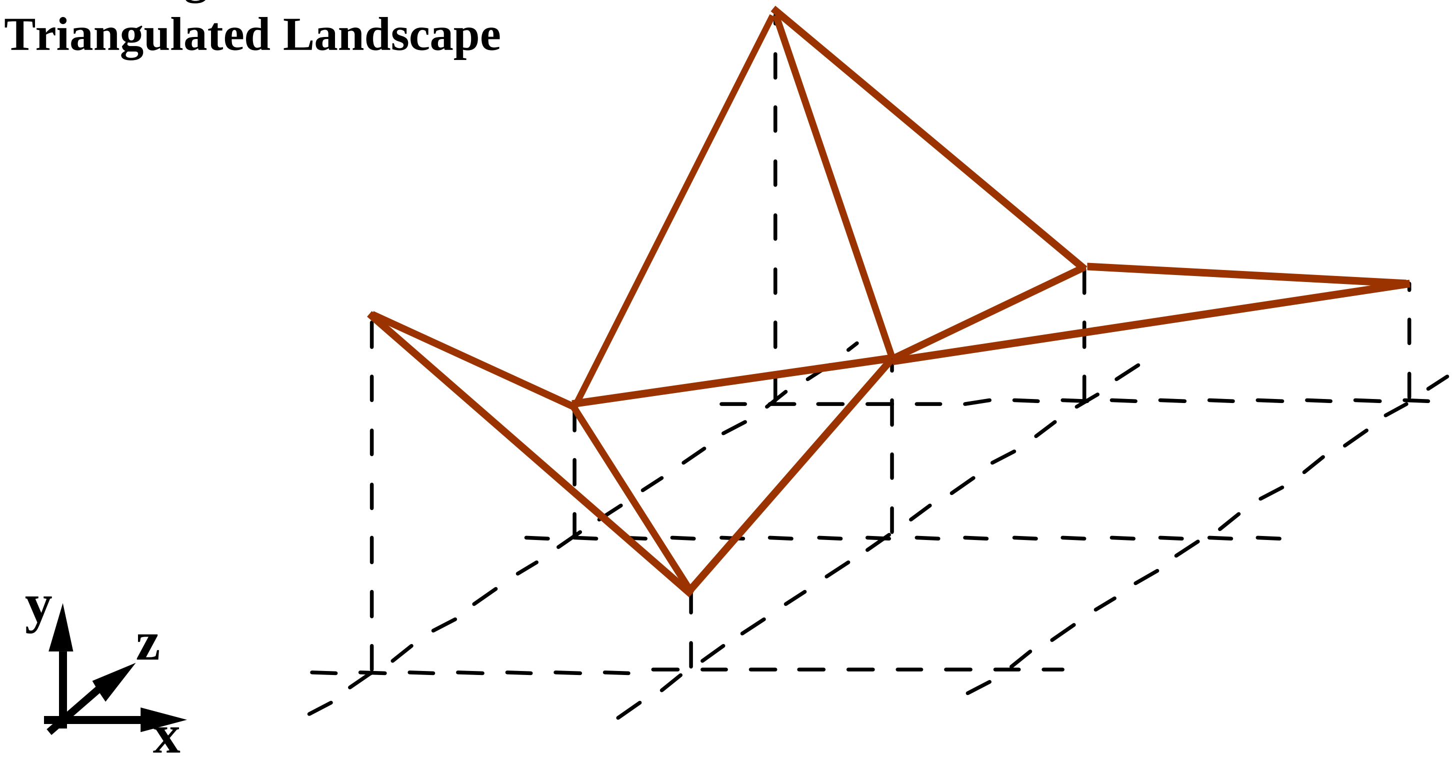


Four points are not necessarily coplanar

Triangles always are.

Terrain

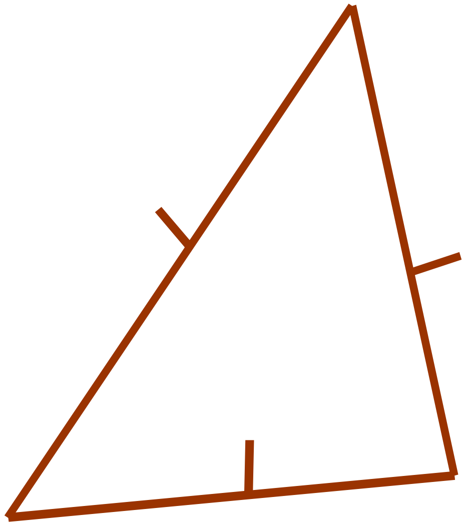
Diagram 6.2:
Triangulated Landscape



Making more complex terrain

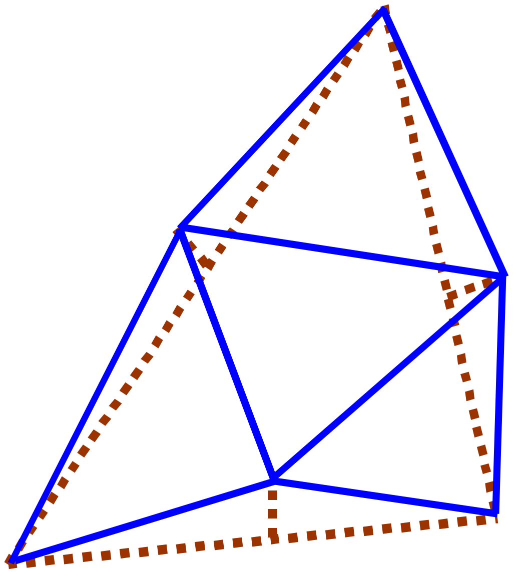
- Defining a complex terrain is time consuming
- One trick is to define a simple terrain and make it more complex using ‘fractals’
- A simple geometric algorithm does it

For each triangle of the simple terrain



Displace each triangle mid-point

Join up the new points and the old vertices



Join up to form four new triangles

Texture

- The visual appearance of a graphics scene can be greatly enhanced by the use of texture.

- Consider a brick building, using a polygon for every brick require a huge effort in scene design.

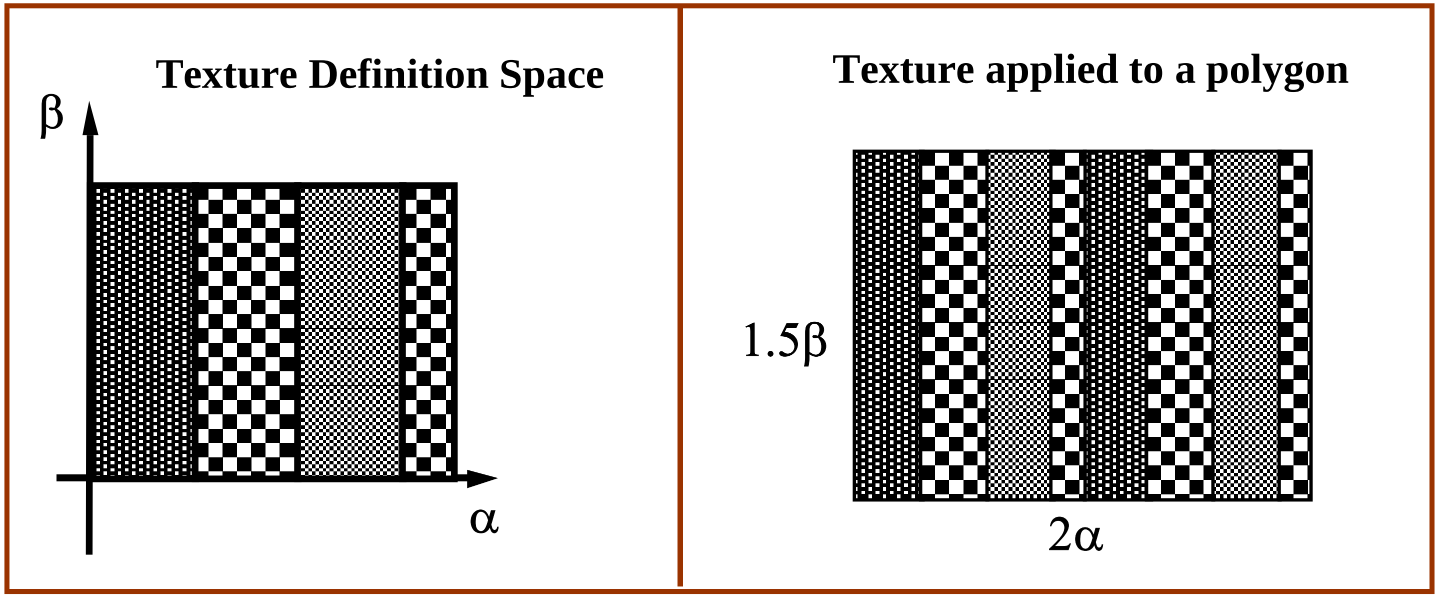
- So why not use one polygon and draw a repeating brick pattern (texture) onto it?

Texture Definition

Textures may be defined as:

Bitmaps - Arrays containing the actual pixel values to be mapped to the polygon. The data can be derived from photographs for example.

Procedures - Suitable for repeating patterns.



Texture Definition Space

Texture applied to a polygon

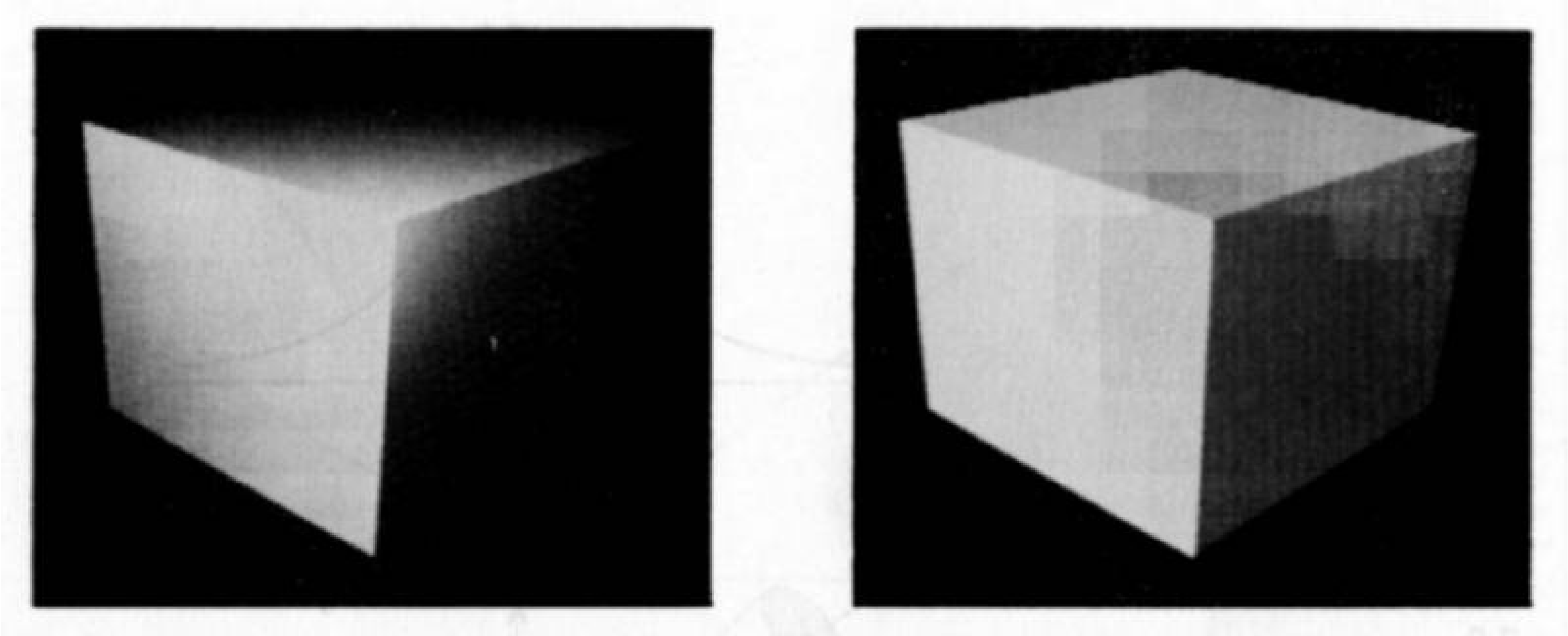
Photographs as Textures

- Photographs can be used to enhance reality with virtually no design effort.
- For a flight simulator landing at an airport the distant landscape can be presented as a photograph which forms the back clipping plane
- This is similar to the "Blue Screen" technique used in films

Shading

- Adding a shade can add considerable realism to graphics scene.
- The shade at each point on a surface is dependent on the positions of the light sources and the position of the viewer.
- The basic law for light rays hiting a physical object is called Lambert’s cosine law.

Shading from different light sources

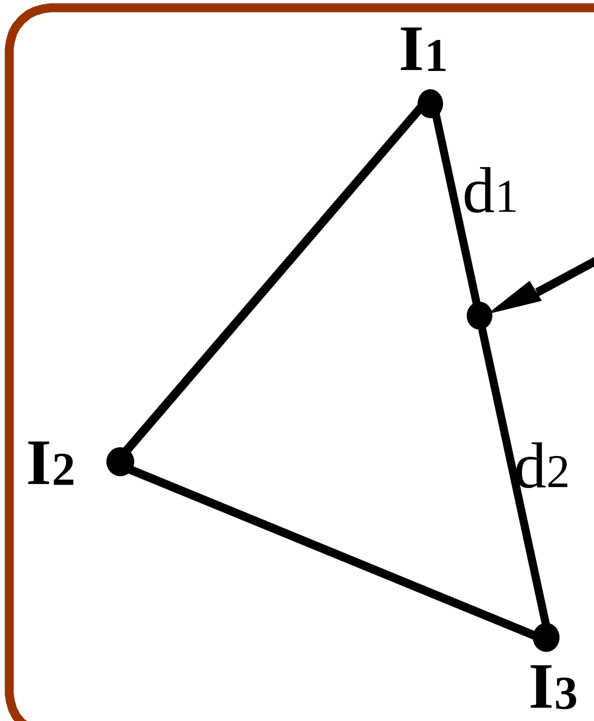


Gouraud Shading

- Suppose that the designer of a game can choose / calculate the shade intensity at each vertex of a 3D object
- The shade at all other pixels of the polygon can be found as follows:

1. Interpolate to find the shade value at the boundary
2. Interpolate to find the shade values in the middle

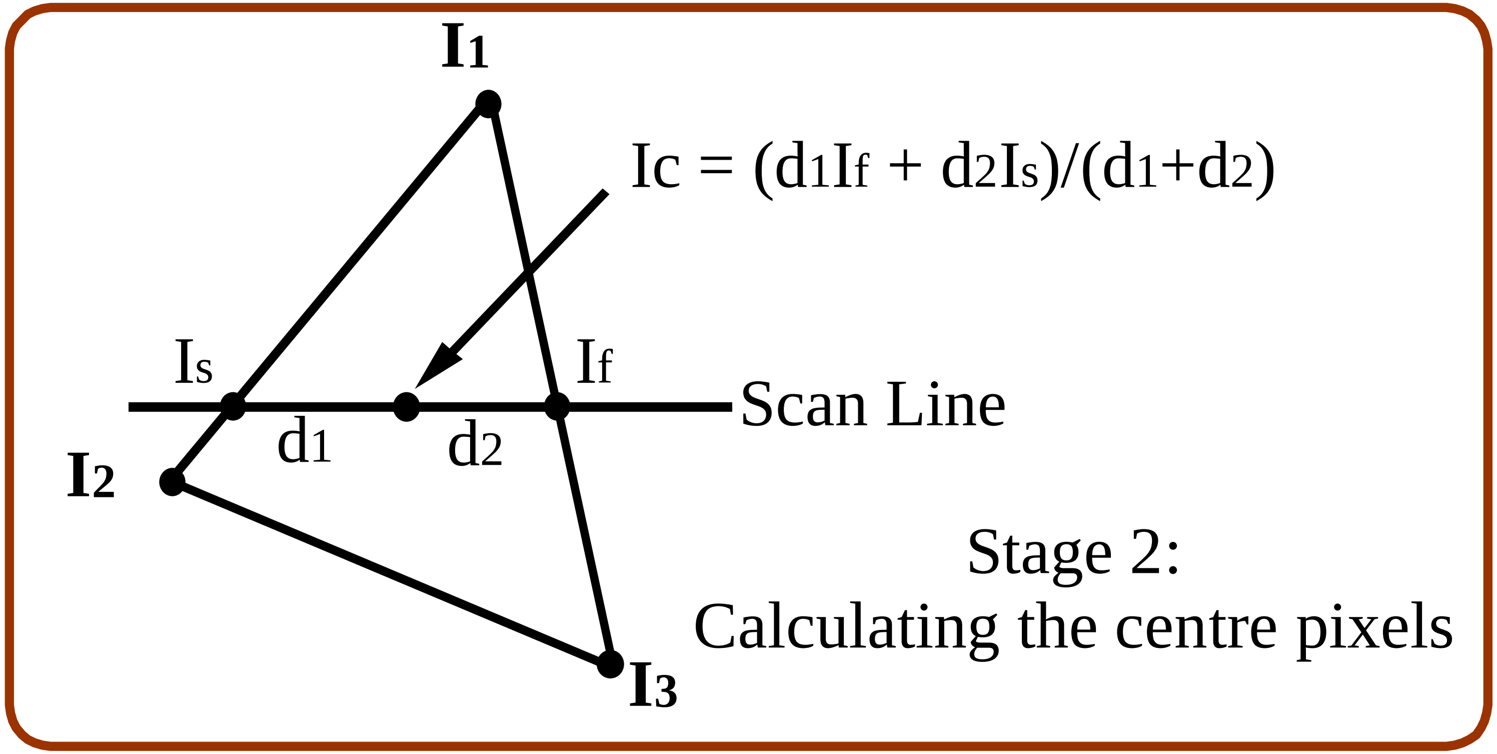
Calculating the shades at the edges



$$I_e = (d_1 I_3 + d_2 I_1)/(d_1+d_2)$$

Stage 1:
Calculating the edge pixels

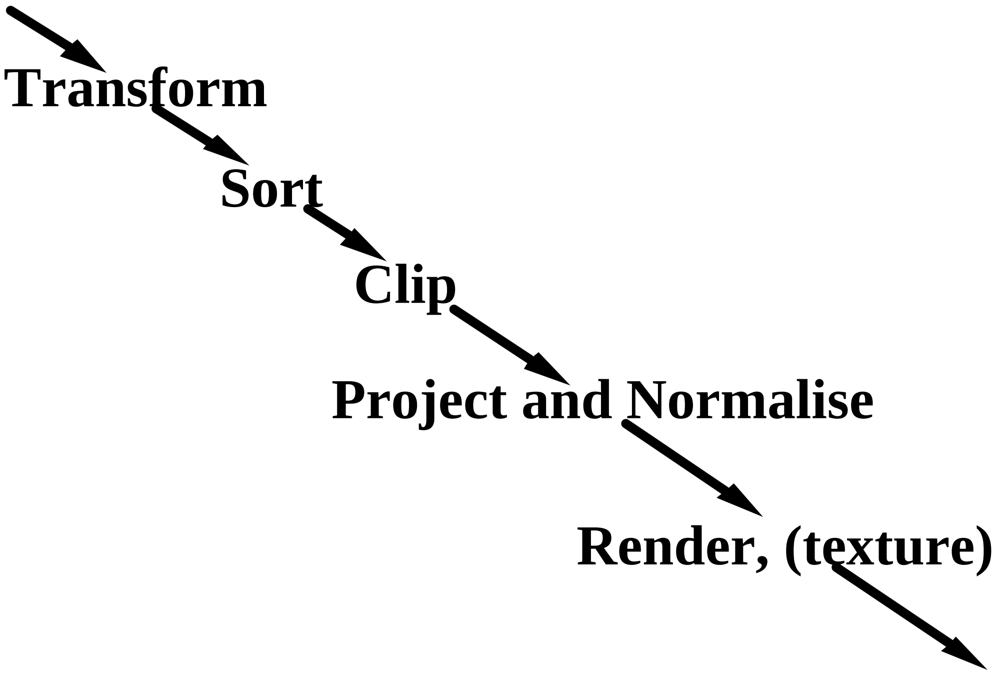
Calculating the internal shades



$$I_c = (d_1 I_f + d_2 I_s)/(d_1+d_2)$$

Stage 2:
Calculating the centre pixels

Hardware support for polygon rendering



Transform

Sort

Clip

Project and Normalise

Render, (texture)

Diagram 8.6: The Graphics Pipeline