

# *Computer Graphics*

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(Motivation and Course Outline)  
Lecture 001

Sandro Spina

# *A brief history of shaded imagery*

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- Since the mid-70's the developmental motivation has been photorealism or the pursuit of techniques that make a graphics image of an object or scene indistinguishable from a photograph.
  - The foundation of photo-realism is the calculation of light-object interaction.
  - Objects represented as polygon meshes.
  - Splits into two fields
    - The development of local reflection models (only the first reflection of light from the object is considered),
    - The development of global models (considers also how light reflects from one object and travels onto another).
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# *Local (Direct Reflection) Models*

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- ❑ Two early algorithms were hidden surface removal and shading (simulating the interaction of an object with a light source)
  - ❑ For hidden surface removal (most of the work carried out in the 70's), the most common algorithm is the Z-Buffer algorithm
  - ❑ In shaded imagery the major players are Phong shading (better but more CPU intensive) and Gouraud shading (easier however less aesthetically pleasing)
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# *Global (Direct Reflection) Models*

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- Light reflection models attempt to evaluate the interaction between objects. The light intensity within a shadow area can only be calculated from global interaction.
  
  - Two models
    - Ray Tracing (attempts to perfect specular reflection i.e. very shiny objects reflecting on each other)
  
    - Radiosity (models diffuse interaction which is light reflecting off matte surfaces to illuminate other objects). Areas which cannot see the light source are illuminated by diffuse interaction.
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# *Graphics Primitives (Line and Circle Drawing)*

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- Scan Conversion, that is the task of displaying graphics primitives (such as lines and circles) on a *raster scan* system.
  
  - Line Drawing Algorithms:
    - $y = mx + c$
    - Basic Line Drawing Algorithm
    - Incremental DDA Algorithm
    - The Midpoint Line Drawing Algorithm (Bresenham)
    - The Double Step Midpoint Line Drawing Algorithm
  
  - Circle Drawing Algorithms: (at centre  $x_c, y_c$ ):
    - $(x - x_c)^2 + (y - y_c)^2 = r^2$
    - Basic Circle Drawing Algorithm
    - The Midpoint Circle Drawing Algorithm
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# *Graphics Primitives (Filled Areas)*

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## ☐ Filling Polygons

- The scan-line polygon filling algorithm
  - Boundary-fill algorithm
    - ☐ 4-way
    - ☐ 8-way
  - Flood-fill Algorithm
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## *Clipping (against the clip window)*

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- The Cohen-Sutherland algorithm
    - For line clipping
    - For polygon  $[v1; v2; v3; \dots; vn]$  clipping
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# *Geometrical Transformations*

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- ❑ Vectors and matrices
  - ❑ 2D transformations (ex. translation, scaling, rotation)
  - ❑ Matrix multiplications
  - ❑ The viewing pipeline (both 2D and 3D)
  - ❑ 3D transformations
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# *Hidden Surface Removal*

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- Hidden surface removal is the process of removing surfaces (lines) which are not visible from the chosen viewing position
    - Object space: algorithms which work on object definitions directly (ex. back-face culling)
    - Image space: algorithms which work on the projected image (ex. Z-buffer algorithm)
    - Scan-line method
    - Depth-sorting method
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# *OpenGL / DirectX 9*

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- Introduction to DirectX programming
  - (If necessary) 3 lab session
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