Blender

Francesca Delli Ponti - f.delliponti@cineca.it
SuperComputing Applications and Innovation Department
BLENDER FOUNDATION

BLENDER
http://www.blender.org
http://www.blender.org/features/demo-reels/
http://www.blender.org/features/projects/

http://gooseberry.blender.org/

http://elephantsdream.blender.org/
“Blender is a free and open-source 3D computer graphics software product used for creating animated films, visual effects, art, 3D printed models, interactive 3D applications and video games. Blender’s features include 3D modeling, UV unwrapping, texturing, rigging and skinning, fluid and smoke simulation, particle simulation, soft body simulation, sculpting, animating, match moving, camera tracking, rendering, video editing and compositing. It also features a built-in game engine.”

http://en.wikipedia.org/wiki/Blender_(software)
"The Dutch animation studio Neo Geo and Not a Number Technologies (NaN) developed Blender as an in-house application. The primary author was Ton Roosendaal, who previously wrote a ray tracer called Traces for Amiga in 1989. The name Blender was inspired by a song by Yello, from the album Baby.

Roosendaal founded NaN in June 1998 to further develop and distribute the program. … The Blender Foundation initially reserved the right to use dual licensing, so that, in addition to GNU GPL, Blender would have been available also under the Blender License that did not require disclosing source code but required payments to the Blender Foundation. However, they never exercised this option and suspended it indefinitely in 2005.[5] Currently, Blender is solely available under GNU GPL.

**Suzanne**

... As a sort-of easter egg, a last personal tag, the artists and developers decided to add a 3D model of a chimpanzee. It was created by Willem-Paul van Overbruggen (SLiD3), who named it Suzanne after the orangutan in the Kevin Smith film Jay and Silent Bob Strike Back.

Suzanne is Blender's alternative to more common test models such as the Utah Teapot and the Stanford Bunny. A low-polygon model with only 500 faces, Suzanne is often used as a quick and easy way to test material, animation, rigs, texture, and lighting setups, and is also frequently used in joke images[citation needed]. Suzanne is still included in Blender. The largest Blender contest gives out an award called the Suzanne Awards.”

http://en.wikipedia.org/wiki/Blender_(software)
BLENDER - CINECA APPLICATIONS

- SCENE:

Apa the Etruscan and 2700 years of Bolognese History
(in ACM SIGGRAPH ASIA 2011, Posters and Sketches Proceedings, Hong Kong, 2011)
BLENDER - CINECA APPLICATIONS

- RENDER:

Apa the Etruscan and 2700 years of Bolognese History
(in ACM SIGGRAPH ASIA 2011, Posters and Sketches Proceedings, Hong Kong, 2011)

http://www.cineca.it/it/video/apa-alla-scoperta-di-bologna-i-primi-minuti-del-cartoon-3d
Basis of Modeling
SCENE

The scene includes points, lines and polygons that exist inside a three dimensions space defined by X, Y, Z axis.

In order to compose a scene is necessary:

- define 3D object geometry - OBJECT MODELING
- define texture and material of all objects - SHADING AND TEXTURING
- define scene light for realistic final render - LIGHTING
- realize frame (RENDERING) or export created models in format file for real time navigation
OBJECT MODELING

- 3D models created with Blender
- 3D models created with other software and imported in Blender
- 3D models from laser scanner
  software to manage point clouds
  http://meshlab.sourceforge.net/
- 3D models from photographs
  software to create models from photographs
  http://www.photomodeler.com
  http://www.arc3d.be/
OBJECT MODELING

Example of imported models in Blender:

- terrain created with osgdem
  http://openscenegraph.sourceforge.net/documentation/OpenSceneGraph/doc/osgdem.html

- building with the software City Engine
  http://www.esri.com/software/cityengine
A representation of 3D OBJECTS by using points connected each others by curves that define surfaces like triangles, quadrilaterals or other type.

A number of polygons linked together is called polymesh (mesh) and so can define a 3D object.

The coordinates are the geometric information, while the way in which the faces are made from the vertices are the topological information.

→ The set of faces is called Mesh.
BLENDER MESH PRIMITIVES
# OBJECT MODELING

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<td>Box modeling</td>
<td>Suited for simple and organic shapes</td>
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- **Box modeling**
  - Suited for simple and organic shapes
  - Starting from simple Mesh type objects (i.e. cube, sphere, ...) by changing vertices, edges and/or polygons 3D complex object can be created

- **Spline modeling**
  - Suited for the design and mechanical models
  - Starting from a 2D Spline, like a building’s plant, with specific operations like extrusion it is possible to obtain 3D object
OBJECT MODELING

Example of BOX MODELING from “MUVI”, house of the Thirties
OBJECT MODELING

Example of SPLINE MODELING, extruded surface:

surface created by extending a curve along a direction.

Example of extruded surface from “MUVI”, house of the Thirties:
Example of SPLINE MODELING, revolved surface:

surface created using a simple curve, which is rotated about an axis to define a shape.

Example of revolved surface from “MUVI”, house of the Thirties:
Each object must be better identified with its own material. In particular, the material must be defined with different attributes and properties, which identify the material behavior to light. The shadow and the light parts make an object appear three-dimensional, other information, such as transparency, refraction, roughness or smoothness, give more information of objects.

The following are lighting components:

- Ambient (3), color of the shaded part of the material that is still affected by the indirect light;
- Diffuse (2), color of the part directly affected by the light;
- Specular (1), color of the part of a glossy object.

In reality, Ambient and Diffuse are the same color!
Examples of Blender shading:

- Oren-Nayer Diffuse Shader (Reflect 0.8, Rough 0.5)
  - Cook-Torr Spec 1.0, Hard 100
  - Phong Spec 0.5, Hard 50
  - Blinn Spec 1.5, Hard 100, Refraction 5.0

- Toon Diffuse Shader (Ref 0.8, Size 1.5, Rough 0.5)
  - Cook-Torr Spec 1.0, Hard 100
  - Phong Spec 0.5, Hard 50
  - Blinn Spec 1.5, Hard 100, Refraction 5.0

- Wardisco Spec 1.0, rms 0.1
  - Toon Spec 0.5, Size 0.5, Smooth 0.5

The texture must be elaborated in order to have continuity up-down and left-right to be able to be repeated it over the entire object without discontinuity.
Procedural texture

a computer-generated image created using an algorithm in order to create a realistic representation of natural elements.

Blender procedural texture:
TEXTURING

In order to correctly apply a texture must be set up texture coordinates, that define how is visualize on a object:

- projection method,
- orientation,
- ripetition.

Example of a spheric projection
Example from “MUVI”, house of the Thirties
SHADING/TEXTURING

Example from “MUVI”, house of the Eighties
Lighting is a necessary step and is recommended even before the definition of the materials, in this way (with neutral material for all objects in the scene) can be better valued the effect of the lights. Below three general types of light that can be used:

- **Omni** (points of light that emit in all directions);
- **Spot** (cones of light used for simulate lamps or projectors);
- **Direct** (cylinders of light, usually used to simulate sunlight).

Each light can be customized by location and illumination intensity parameters, like decay, color, ...

For real-time navigation is useful to develop the textures so that they contain lighting and rendering information through a procedure called Render to Texture:

shadows and multi-texture are compacted into a single texture.
The set of operations required to transform a three-dimensional model (all 3D objects in the scene and their properties) in a two-dimensional visual representation (bitmap), depending on the view parameters and the type of the chosen mode of visual presentation. By using algorithms that allow to make the effects of Global Illumination it is possible to achieve realistic effects of the scene.

GLOBAL ILLUMINATION definition:
It is a method (algorithm) of computation for light calculation in the scene which, takes into account the light bounces from the neighboring surfaces, along with the normal illumination of direct lights. In other words GI calculates the Indirect light also, thus it makes the renders more photo-realistic.
RENDERING

YafaRay
http://www.yafaray.org/

LuxRender
http://www.luxrender.net/

Aqsis Renderer
http://www.aqsis.org/
Render to Texture
This operation allows to precompute light and shadow information on the individual objects, necessary for real-time navigation.
By exporting models in format x3d it is possible to put the model in a html page and navigate it freely (http://www.x3dom.org/).

https://hpc-forge.cineca.it/files/visit_3Dmodels/public/ChiostroIII_X3D/ChiostroIII.html
Blender
INTERFACE

Default scene:

Camera

Lamp

Cube
File - Open...:
- Ctrl+O or F1

File - Save As...:
- Shift+Ctrl+S or F2

File - Save:
- Ctrl+S
INTERFACE

Default Settings

3D View

3D space axis

Timeline
**INTERFACE - USER PREFERENCES**

Modules of import or export different file format can be chosen in the User Preferences window and let them visible in the Info window (File - Import, Export)
SHORTCUT

Combinations of keys that are used for a lot of commands (keyboard and/or mouse) instead of using tool bar, faster in the modeling stage.
Some factory windows settings
By putting mouse on window border will appear a double arrow, with click right button mouse it is possible to chose between:
- SPLIT → split selected area into new windows
- JOIN → join selected areas into new window

Drag the windows corner when highlighted
 INTERFACE

Tool bar View or

Numpad 1 → Front
Numpad 3 → Right
Numpad 7 → Top
Ctrl and one of previous shortcut for the opposite view (Back, Left, Bottom)

Numpad 0 → Active camera
Numpad 5 → perspective or orthographic
INTERFACE

T → Tool Shelf
(or View - Tool Shelf)

N → Properties
(or View - Properties)
The position of the 3D cursor can be defined manually or by clicking the left mouse button.
Orange border identifies selected objects

Selection can be done with right mouse button → SHIFT for multiple selection
Or with Select from 3D View tool bar

A → Select/Deselect All
B → Border Select
C → Circle Select

SHIFT + G → similar selection
**LAYER**

- **M** → to move selected objects from a layer to another

- **Shift+click on layer** → to visualize more layer at the same time

- Only objects on visible layers are renderized.
INTERFACE

UNDO:
- Ctrl+Z

REDO:
- Shift+Ctrl+Z

HISTORY:
- Ctrl+Alt+Z

All action are visualized and it is possible to choose from which action restart modeling.
Z → Wireframe or Solid Viewport Shading
Movement inside windows

Center mouse button pressed → View rotation
Shift+center mouse button pressed → View translation
Ctrl+center mouse button pressed → View zoom
Some keys have multiple choices (Slider Button) and are recognized by the double arrows on the side:
INTERFACE

PYTHON CONSOLE - to directly use python in Blender
FILE BROWSER - used to organize, load and save files
INFO - provides information and options for managing files, windows and engines
USER PREFERENCES - customize Blender to your work style and computer
OUTLINER - helps you find and organize your objects
PROPERTIES - shows the several attributes of the currently selected object
LOGIC EDITOR - a game logic editing window
NODE EDITOR - allows you to use nodes for texturing, materials and compositing
TEXT EDITOR - keep notes and documentation about your project, and write Python scripts
VIDEO SEQUENCE EDITOR - assemble video sequences into a film strip
UV/IMAGE EDITOR - an image editor with advanced UV management tools
NLA EDITOR - manage non-linear animation action sequences
DOPE SHEET - combine individual actions into action sequences
GRAPH EDITOR - manage animation keys (and drivers) and inter/extrapolation of these
TIMELINE - controls for animation playback
3D VIEW - a graphical view of your scene
>>> import bpy
>>> for obj in bpy.data.objects:
    ...    print(obj)
...    "Camera"
...    "Cube"
...    "Lamp"
ADD MESH
Objects can be modified with two main methods:

- **OBJECT MODE**: on the whole object
- **EDIT MODE**: on vertices, edges, and/or faces

**TAB** ➔ Object Mode or Edit Mode
OBJECT MODE
OBJECT MODE

Object - Transform
G → Grab/Move
R → Rotate
S → Scale
SNAP

Shift+S → Snap

Set Origin
- Geometry to Origin: Shift Ctrl Alt C
- Origin to Geometry: Shift Ctrl Alt C
- Origin to 3D Cursor: Shift Ctrl Alt C

SHIFT + CTRL + ALT + C → set origin
An object transformation (scale or rotation) are made respecting a pivot point
3D MANIPULATOR

Use a 3D manipulator widget for controlling transforms.

Translate, Rotate, Scale manipulator

Translate manipulator

Rotate manipulator

Scale manipulator

No manipulator
EDIT MODE

Edge
Vertex
Face
Mesh - Transform
G → Grab/Move
R → Rotate
S → Scale
OBJECT MODE - SMOOTH SHADING
In Edit Mode it is possible to select only part of the sphere to render it smooth.
EDIT MODE - FACES - SUBDIVIDE

W → special commands panel
EDIT MODE - VERTEX - MERGE

Alt+M ➔ Mesh - Vertices - Merge
EDIT MODE - EXTRUDE

E \rightarrow \text{Extrude Region}

Extrude and move along normals
EDIT MODE - EXTRUDE

Extrude Individual
Extrude individual elements and move
EDIT MODE - SPIN

Spin parameters
EDIT MODE - KNIFE

Options:
- Left mouse button to define cut lines
- Return/Spacebar to confirm
- ESC or right mouse button to cancel
- E for a new cut
- Ctrl to turn on midpoint snap
- Shift to ignore snap
- C to turn on angle constraint
- Z to turn on cut through
ADD LAMP

Sun, Point, Hemi, Area, Spot
ADD CAMERA
PROPERTIES

- Render
- Scene
- World
- Object
- Object Constraints
- Modifiers
- Object Data
- Material
- Texture
- Physics
- Particles
PROPERTIES - MODIFIERS
MODIFIERS - BOOLEAN
MODIFIERS - SUBDIVISION SURFACE
PROPERTIES - MATERIAL

PROPERTIES - TEXTURE
PROPERTIES - MATERIAL
PROPERTIES - MATERIAL
PROPERTIES - RENDER

Image resolution

Output format file

Render
F3 ➔ to save render
Two open source rendering engines included in Blender:

Blender Internal, fast biased engine, for animation and cartoon rendering of scenes, which we used for the production of Apa;

Blender Cycles, new unbiased engine, in development since 2011, with a propensity for photorealism. The engine manages the actual light bounce and limits the use of tricks for creating realistic lighting on stage, thus creating convincing effects with less effort. This engine should be optimized to achieve optimal results for animation and needs more computational power, but thanks to the Cineca computing resources and to the implementation of the new RenderFarm, it will be an affordable choice for future productions.
Official website:
- http://www.blender.it
- http://www.blender.org

Library:
- http://www.blendswap.com/
- http://matrep.parastudios.de/

Documentation:
- http://www.blendermagazineitalia.it/