

# 3D Models Preparation

Single-res, Mutires, Point-clouds

<http://3dhop.net> 13/7/2016

# 3DHOP and 3D models

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3DHOP can manage three types of geometries:

- ◆ **Single resolution 3D model**

Triangular meshes, ideally <1MB, PLY file format, whole file downloaded from remote and directly rendered without optimization.

- ◆ **Multiresolution 3D model**

Triangular meshes, large to huge sizes are supported (1-100 million triangles), converted in pre-processing to the NXS multiresolution format, progressively streamed from remote and adaptively rendered.

- ◆ **Point-clouds**

Unstructured set of points, point color and normal are supported, large to huge sizes are supported (1-100 million vertices), converted in pre-processing to the NXS multiresolution format, progressively streamed from remote and adaptively rendered.

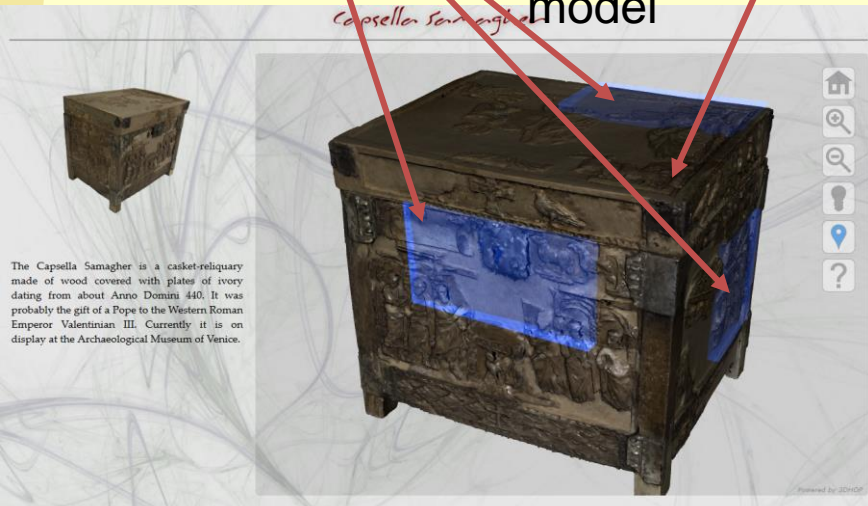
# Instances & hotspots

Any geometry (single-res, multires, pointcloud) may be used for both INSTANCES and clickable HOTSPOTS.

Geometries may be replicated in the scene (many instances or spots using the same geometry).

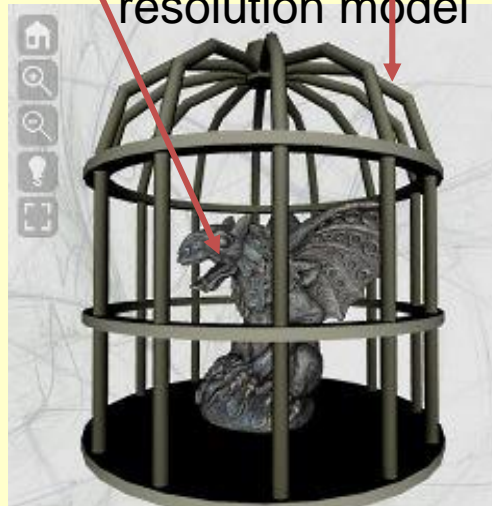
Same single resolution model used in multiple hotspots

Multiresolution model



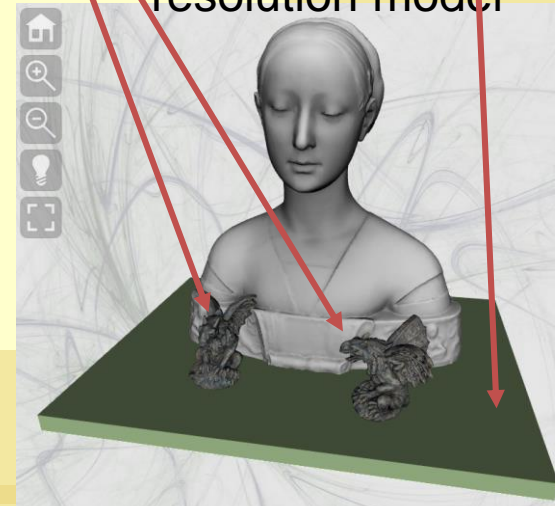
Multiresolution model

Small (86KB) single resolution model

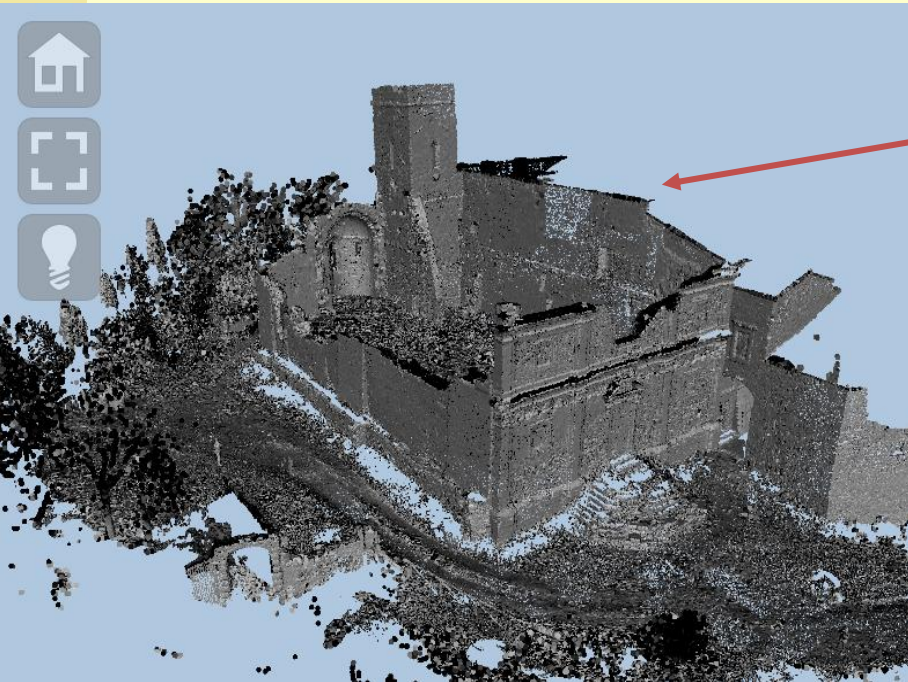


Same multiresolution model instanced 2 times

Small (2KB) single resolution model



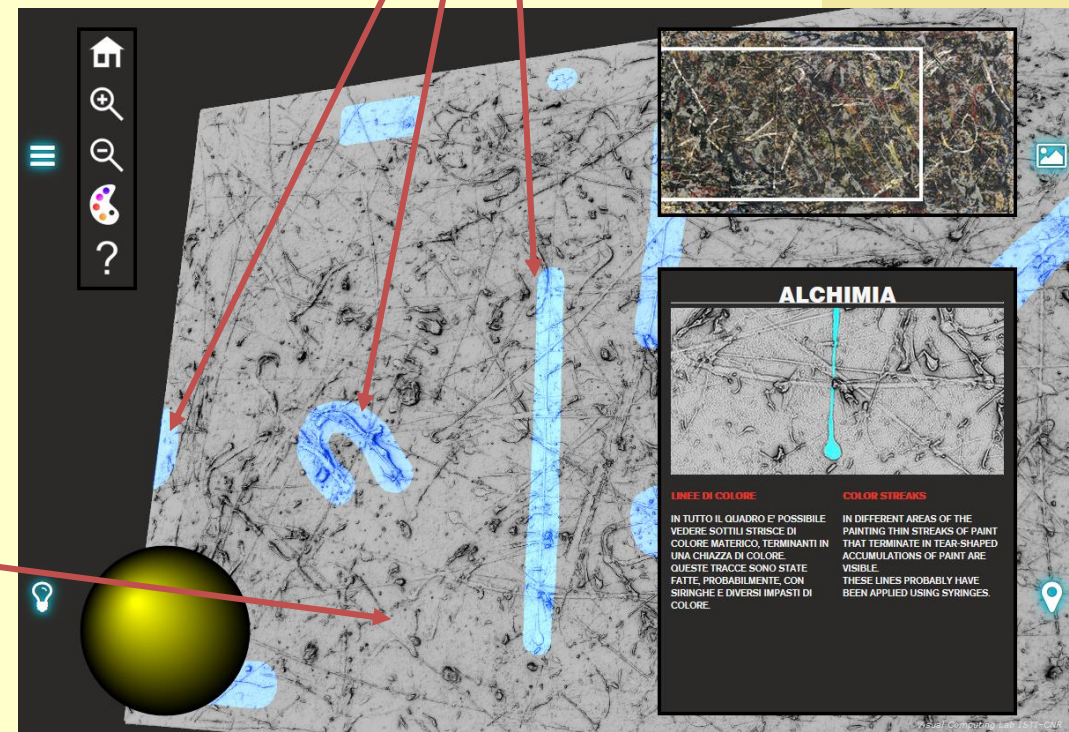
# Instances & hotspots



Point-cloud  
multiresolution  
model with normals

Multiresolution models (1M faces each)  
used as clickable hotspots

Huge Multiresolution model (80M faces)



# Single Resolution

Small geometries



# Single resolution

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Standard 3D model: a mesh of triangles.

The file is downloaded from remote in a *single chunk* and rendered inside 3DHOP.

Per-vertex color is supported, texture is at the moment NOT supported.

Vertex normals *have* to be included in the file.

# Small geometries, please

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Single-resolution models are read from the server as a single file, and have to be COMPLETELY DOWNLOADED before they appear on the webpage.

NO optimization is used during rendering, everything is drawn as it is.

Any model that is above the 1 MB limit should be *ideally* converted into the multiresolution format !

# Model preparation

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PLY file format is used for single resolution.

Use MeshLab to convert your 3D model in PLY from other formats.

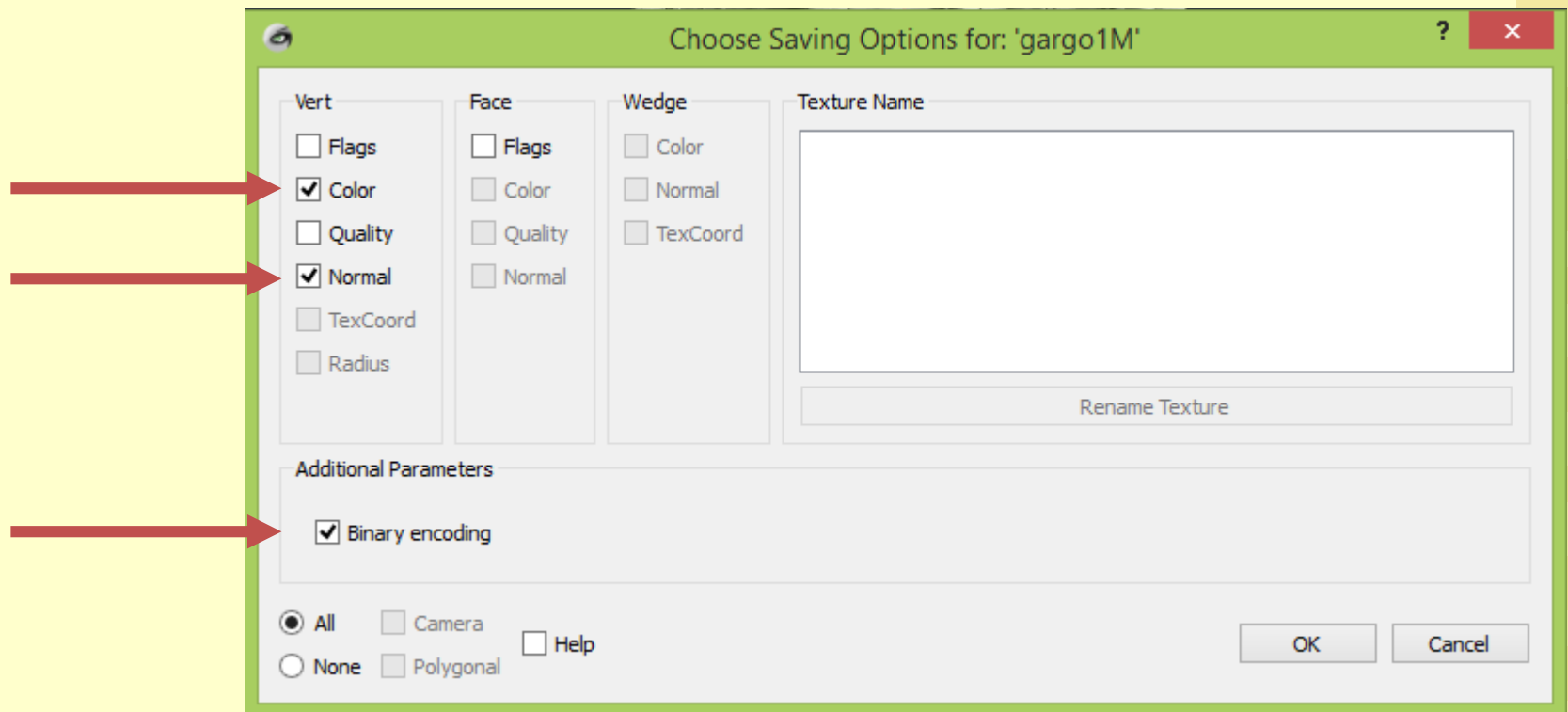
**<http://meshlab.sourceforge.net/>**

Some PLY exporters available in different tools save in ASCII format (much larger) or may have small incompatibilities, loading the file in MeshLab and then exporting does generally solve the problem.



# Model preparation

When exporting, remember to check “normal” for vertices. If the mesh has vertex color, check “color” for vertices. Save in binary format to save space.



# Multiresolution

Lots of geometry

# High-res geometry

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Multiresolution is used to manage high-resolution triangular meshes inside 3DHOP.

Multiresolution models are streamed from remote and adaptively rendered and optimized according to viewpoint and view distance.

Very large 3D models (1-10-100 millions of triangles) can be efficiently rendered.

3DHOP uses the NEXUS multiresolution format (.nxs) (more info at <http://vcg.isti.cnr.it/nexus/>).

# High-res geometry

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Per-vertex color is supported.

Texture mapping is supported:

- a 3D model should have **only 1** texture image. Multi-image texture mapping is at the moment not supported
- Texture image should be PNG or JPG
- Texture mapping should be per-wedge; there is a filter in MeshLab to convert per-vertex UV to per-wedge UV  
(filters->texture->convert PerVertex UV into PerWedge UV)

# NXS

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An NXS file is created starting from a standard single-resolution model, using a conversion tool.

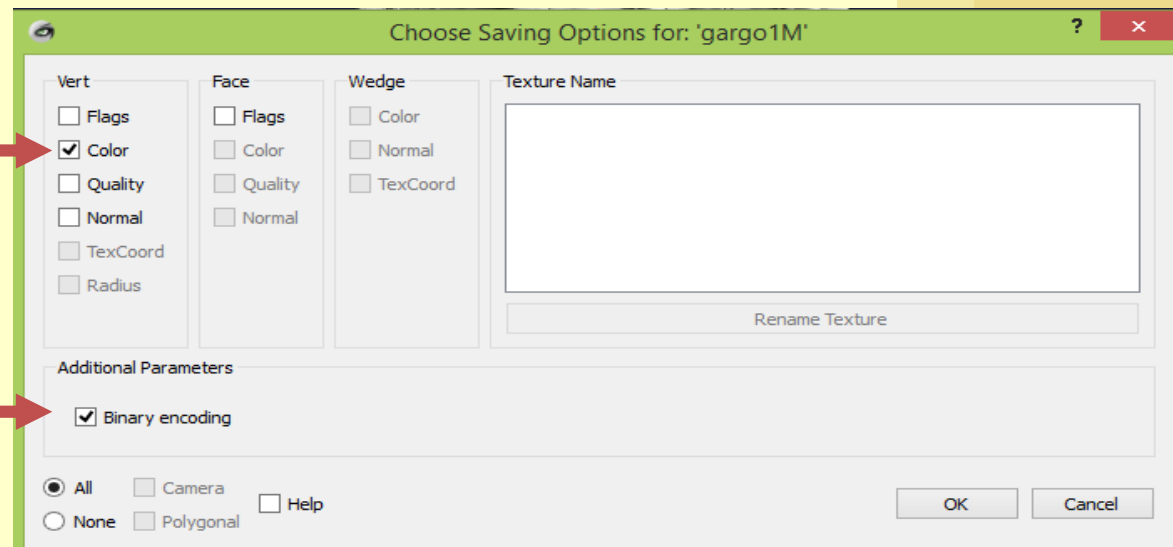
NXS may be compressed for smaller server occupation and better network performances.

Compression is slightly lossy, on smaller 3D models (1 million triangles or less) this can be visible and compression should be avoided; on the other hand, for models above the 10 million triangles limit, compression is strongly advised.

For local, non-network use (e.g. local kiosks), uncompressed NXS has better performances, for every size of 3D model.

# Model preparation

Conversion to multiresolution requires PLY file format. Use MeshLab to convert from other formats. Some PLY exporters available in different tools save in ASCII format (much larger) or may have small incompatibilities, loading the file in MeshLab and then exporting it is safe. Save in binary format, if the mesh has vertex colors, check “color” for vertices when exporting.

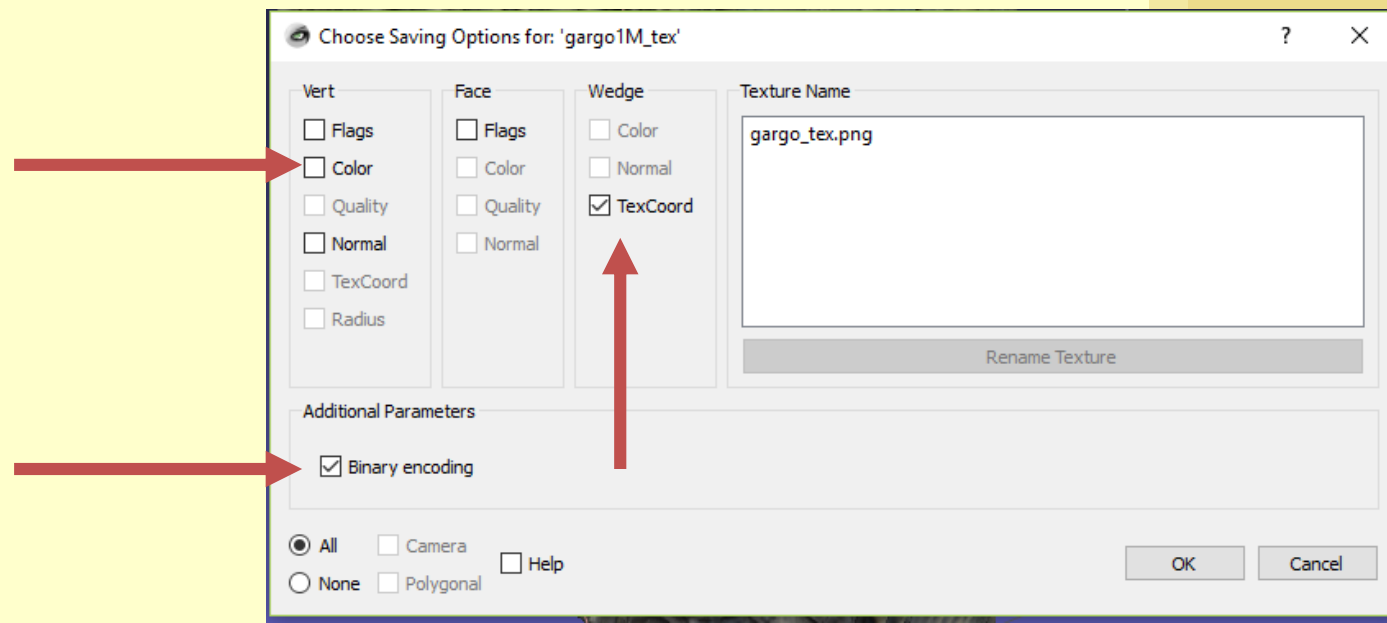




# Model preparation

If the mesh has a texture, check "TexCoord" under the WEDGE tab. Be sure the texture file name is correct.

You may uncheck "color" under the VERT tab. If you keep the check, and the model has per-vertex color **AND** texture, in the 3DHOP rendering the two colors will be multiplied



# Conversion

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Conversion tool is available from the download page of the 3DHOP website.

**`http://3dhop.net/download/Nexus.zip`**

Download and unzip in a folder.

Inside the folder you will find:

- *readme.txt*, with instructions
- *nxsbuild.exe*, for the PLY→NXS conversion
- *nxsedit.exe*, for NXS compression
- *nxsview.exe*, for the NXS files visualization
- A batch file (*Build\_Nexus.bat*), for easier conversion
- A batch file (*Compress\_Nexus.bat*), for easier compression
- A PLY example file (*gargo.ply*), to test if everything works
- DLLs and support files

# Conversion tool

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The conversion tool is available, at the moment, only for the Windows platform.

Mac and Linux users may use a windows emulator, or build from the source code available from:

<http://vcg.isti.cnr.it/nexus/>

3D models may be converted in two ways, absolutely equivalent (choose the simpler for you):

- using the .bat file for a batched conversion
- directly launching the executable from command line

# .BAT batch conversion

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This is the easier method:

- Put the PLY(s) to be converted in the folder where the NEXUS tool is located.
- Open the **Build\_Nexus.bat** file with a text editor.
- Change the name of the source and target file, from this:

```
nxsbuild gargo.ply -o output.nxs
```

To this:

```
nxsbuild YOURMODELNAME.ply -o YOURMODELNAME.nxs
```

- Save and close
- Double-click on Build\_Nexus.bat. A command line window will appear; when the window closes, the conversion is finished

# .BAT batch conversion

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To convert multiple files, just add other lines in the .bat file:

```
nxsbuild MODEL1.ply -o MODEL1.nxs  
nxsbuild MODEL2.ply -o MODEL2.nxs  
nxsbuild MODEL3.ply -o MODEL3.nxs
```

The batch will convert one model at a time

# Command line conversion

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- Put the PLY to be converted in the folder where the NEXUS tool is located.
- Open a command prompt (cmd.exe), then go in the NEXUS folder.
- On the command prompt write this command line:  
**`nxsbuild YOURMODELNAME.ply -o YOURMODELNAME.nxs`**
- When the program terminates, the conversion is done.



# NXS Compression

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Compression has to be applied *after* conversion in NXS. Again, it is possible to use the provided .bat file, by changing

```
nxsedit gargo.nxs -z -o gargo_c.nxs
```

To

```
nxsedit MYFILE.nxs -z -o MYFILE_COMPRESS.nxs
```

Saving and double-clicking it.

Or by using command line

```
nxsedit MYFILE.nxs -z -o MYFILE_COMPRESS.nxs
```

The new .NXS file is now compressed and may be used normally inside 3DHOP.

# Troubleshooting

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- ◆ Drag the .NXS file on nxsview.exe: if the model is visible, the conversion ended ok.
- ◆ Try converting the example PLY (gargo.ply) and check the result. If you receive no error, the converter works on your machine.
- ◆ If your PLY file makes the converter crash, try opening it and saving it again with MeshLab after cleaning (see MeshLab videotutorials <https://www.youtube.com/playlist?list=PLBBF41579E4B65566>).

# Point-clouds

Lots of points

# Point-clouds

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A pointcloud is an unstructured set of vertices.

Point color is supported, point normal is supported.

Pointclouds are managed inside 3DHOP using the multiresolution format, they are streamed from remote and adaptively rendered and optimized according to viewpoint and view distance.

Very large clouds (10-100 millions of vertices) can be efficiently rendered.

# Importing clouds

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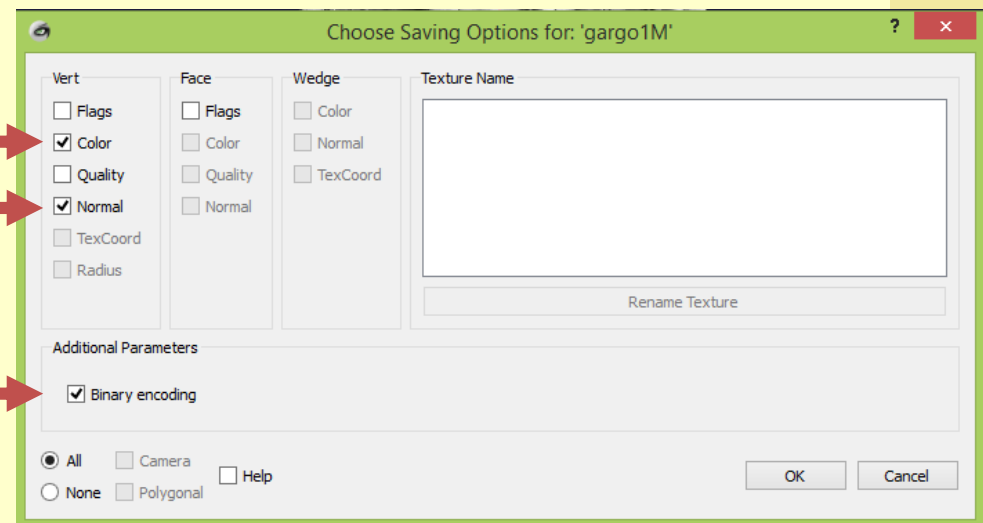
Pointclouds has to be transformed in PLY file format, and then converted in the NXS multiresolution format using the same tool used for triangular meshes.

**MeshLab** does import different formats of pointclouds, which can be later exported as PLY:

- ◆ .PTX (normals are automatically calculated)
- ◆ .PTS
- ◆ .XYZ
- ◆ .txt (generic ascii list of points)

# Importing clouds

If the cloud has normals, when exporting, remember to check “normal”. If the cloud has color, remember to check “color”. In MeshLab, there is a tool to calculate normals for pointclouds; it may not work on your cloud, depending on its shape, but it is worth a try. Save in PLY binary format to save space.





# Conversion

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Conversion is done in the same way it has been described for the multiresolution 3D models, using the Nexus converter command line or the .bat file.

Just follow the same instructions detailed in the previous section.

Multiresolution pointclouds may also be compressed, again following the instructions already detailed in the previous section. Compression for pointclouds is, however, noticeably lossy, and should be used *only* when it is absolutely necessary to save space on the server.

# Straightening

Correctly oriented geometries

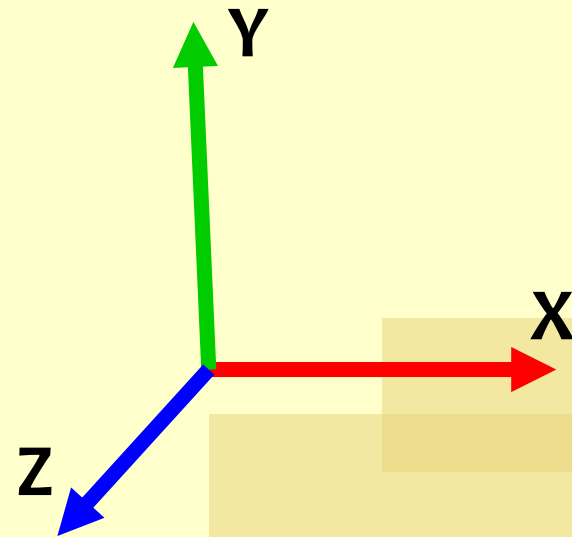
# 3DHOP axis

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3DHOP uses the standard computer graphics reference system (right hand, Y is up).

Looking at the screen:

- **X** is the horizontal axis, growing towards right
- **Y** is the vertical axis, growing in the upward direction
- **Z** is the depth axis, growing towards you



# Model orientation

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Unless a transformation is specified for the mesh or the instance, 3DHOP renders the geometries *as they are loaded*. If your object is not straight, or has a different up vector (architectural models generally uses Z as vertical axis), it may be better to put it in the correct reference space *before* loading it inside 3DHOP.

You may use MeshLab to rotate/translate/scale the model.

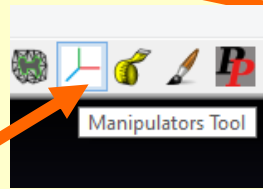
Meshlab uses the same reference system as 3DHOP, if it is straight in MeshLab, it is straight in 3DHOP

# Model orientation

A model may be rotated/translated/scaled using the filters under :

Filters->Normals, Curvatures and Orientation-> Transform: XXXXXX

Or by using manipulators:



<https://www.youtube.com/watch?v=FGaNv23Xvtw>

It is a good idea to have the world axis visualized to see how the model is moving

Remember to freeze matrix before exporting

Filters->Normals, Curvatures and Orientation->Freeze Current Matrix

