'Z-ANATOMY'

THE LIBRE 3D ATLAS OF ANATOMY

THE DOC

WHAT IS Z-ANATOMY?

It is:

- a modified version of the model created by 'BodyParts3D' that thas is gathered in Blender,
- the name of the website 'z-anatomy.com' that shares this model since April 2022,
- the app 'Z-Anatomy' that has been created in Unity and uses the same model and definitions,
- the french non lucrative association 'Z-anatomy' created the 5 August 2023.

The purpose of this association is to produce and share an open source (CC-BY-SA) complete 3D atlas of anatomy.

Several tools have been used to promote the atlas and facilitate the collaboration:

- a linkedin page for promotion (https://www.linkedin.com/company/z-anatomy/),
- a youtube channel for promotion and tutorials (https://tinyurl.com/ybfvsxee),
- a discord server to chat with the contributors (https://discord.gg/QkDMuZV32V),
- a Taiga project to list and assign the tasks; it is an open source team management tool,
- a spreadsheet (Google sheets) containing the lexicon, its translations and that tracks the progress and validation of the anatomical 3D representation,
- a documentation called 'Z-DOC' (https://tinyurl.com/yeyrfcu4)
- two gitHub pages (https://github.com/Z-Anatomy/The-app-PC) and (https://github.com/LluisV/Z-Anatomy/tree/PC-Version)

GOALS: WHAT ARE WE TRYING TO DO?

We try to create a user-friendly coherent 'best-of' the open-source models of anatomy.

INTENTIONS: WHY DO WE DEVELOP AN OPEN SOURCE 3D ATLAS OF ANATOMY?

Because we think that public money should produce free and open source learning tools.

PLANS: HOW ARE WE TRYING TO DEVELOP IT?

- Creating a non-profit association
- Calling for volunteer contributors
- Applying for subsidies and donations (crowdfunding) to pay the contributors
- Defending the CC-BY-SA 4.0 license

RESOLUTIONS: WHAT DO WE WANT?

We want to connect science, art and technology in order to increase the interoperability of knowledge and to make the learning process funnier.

We want to defend 'the Commons'.

WHAT DEVELOPMENTS ARE UNDERWAY?

On the CONTENT/BLEND:

- Create and share more translated versions of the official lexicon of anatomy (shared in the spreadsheet and integrated in the blend and the app),
- Correct, complete and validate the anatomical representation of the anatomical structures,
- Retopo the objects and create normal maps of a more complex version to make it easier to compute,
- Improve the visual quality of the model
- Create a female model (best after the completion of the male model to only do the conversion once)

On the VIEWER/APP:

(This app only works on desktop computers with Windows with any 64-bit architecture.

- Adapt it to Mac and Linux
- Create a web viewer (a lighter model and dynamic way to load the model would ensure a more responsive tool)
- Create a URL system that allows to open the atlas-web viewer (not yet available) on a specific structure and to keep on navigating in the atlas,

- like this (https://ta2viewer.openanatomy.org/?id=3853)
- Create a game mode
- (Adapt it to the mobiles?)

WHAT OTHER DEVELOPMENTS ARE POSSIBLE?

- Develop further the representation of the physiological movements of the bones (//biomechanics): See 'Z-Anatomy_biomechanics.blend'.
- Create animal models using the same tools and techniques
- ...

HOW TO GET INVOLVED?

- Join the Discord server (https://discord.gg/QkDMuZV32V) and introduce yourself and what you want to do on the channel #presentation
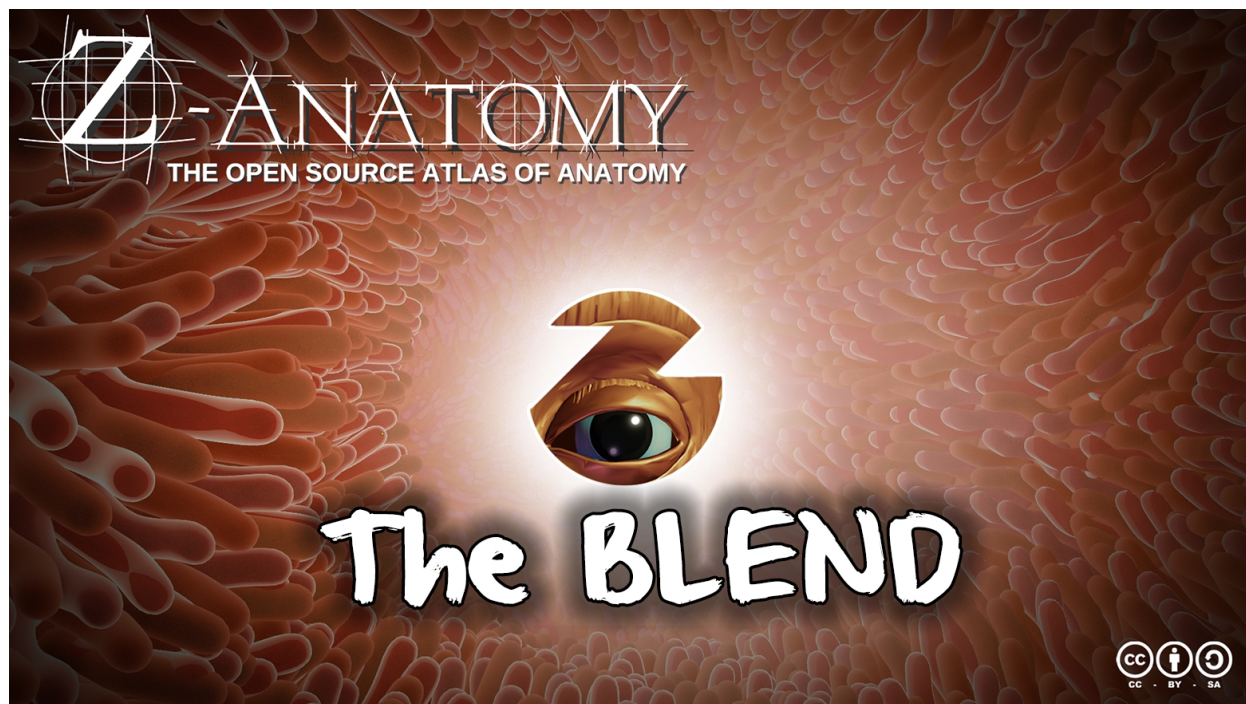- Choose which task(s) of the list you want to work on (https://tinyurl.com/4drfbbb9)

THE LICENSE

The complete license is shared publicly here.
Please read it carefully.

THE BLEND

INSTALLATION

The blend is an anatomy-viewer that can also be used as the workshop where to modify the content.

Download the latest version from page 'Atlas' of the website

For WINDOWS

PORTABLE VERSION

1. Click on the orange 'Portable version' to download it
2. Store it on your computer or a USB-key
3. Unzip it
4. Open the folder 'Anatomy Blender'
5. Double-click on 'Blender.exe'
6. The file opens

7. Allow the execution of the scripts

You're done

To run the atlas with less RAM, instead of double clicking on 'Anatomy Blender':

1. Right-Click on 'Z-Anatomy-lite.blend'>Open with>
2. Choose the version of Blender contained in the same folder
3. You can then only import the layers that you need by clicking on their name.

For MAC/LINUX

TEMPLATE VERSION

1. Click on the orange 'Z-Anatomy.7z' to download it
2. Store it on your computer or a USB-key
3. Unzip it
4. Go to 'https://www.blender.org/download/'
5. Download the latest version of Blender for your OS
6. Install it
7. Open Blender
8. Go to File>Open>choose 'Z-Anatomy.blend' on your computer
9. Go to Edit>Preferences>Keymap>Import
10. and follow the instructions on the site to get the same user preferences

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HOW TO USE THE BLEND?

(**Z**)	= COLORS
(**ALT** + **Z**)	= X - RAY
(**ALT** + **B**)	= CLIPPING BOX
(**SHIFT** + **ALT** + **Z**)	= KEY COLORS
(**N** > Z-ANATOMY > ...)	= STORED VIEWS
	= CROSS SECTIONS
	= LANGUAGES
	= COMIC SHADER
	= GROUP LABELS
(**SHIFT** + **%**)	= GROUP LABELS
(*MMB*) or	= ORBIT
(**Numpad 4 / 6 / 2 / 8**)	
(**SHIFT** + *MMB*) or	= PAN
(**SHIFT** + **Num 4 / 6 / 2 / 8**)	
(**Numpad 1**)	= FRONTAL VIEW
(**CTRL**+ **Numpad 1**)	= DORSAL VIEW
(**Numpad 3**)	= LEFT VIEW
(**CTRL** + **Numpad 3**)	= RIGHT VIEW
(**Numpad 7**)	= CRANIAL VIEW
(**CTRL** + **Numpad 7**)	= CAUDAL VIEW
(**ALT** + *MMB*) Click & drag	= ORTHOGONAL VIEWS
(**Numpad 9**)	= FLIP POINT OF VIEW
(**Numpad .**)	= FRAME SELECTION
(**HOME**)	= FRAME ALL
(**CTRL** + **SPACEBAR**)	= MAXIMISE WINDOW

(**1 / 2 / 3 / ...**)	= CHANGE LAYE
(**SHIFT** + **1 / 2 / 3 / ...**)	= COMBINE LAYE
(**A**)	= SELECT ALL
(**A A**) or (**ALT** + **A**)	= DESELECT ALL
(*LMB*)	= SELECT
(**SHIFT** + *LMB*)	= SELECT MULTI
(*LMB*) Click & drag	= BOX SELECT
(**C**)	= BRUSH SELEC
(+ *MMB*)	= CHANGE RADI
(*RMB*) with selection	= COLLECTIONS
(**H**)	= HIDE
(**SHIFT** + **H**)	= ISOLATE
(**ALT** + **H**)	= SHOW ALL
(**CTRL** + **SHIFT** + **H**)	= ISOLATE / LAYE
(**CTRL** + **SHIFT** + **ALT** + **H**)	= REVEAL LAYER
(**%**)	= LANGUAGE
(**G**) + X/Y/Z or SHIFT X/Y/Z	= GRAB (MOVE)
(**ALT** + **G**)	= RESET POSITI
(**R**) + X/Y/Z or SHIFT X/Y/Z	= ROTATE
(**ALT** + **R**)	= RESET ROTATI
(**S**) + X/Y/Z or SHIFT X/Y/Z	= SCALE
(**ALT** + **S**)	= RESET SCALE
(**CTRL** + **Z**)	= UNDO
(**CTRL** + **SHIFT** + **Z**)	= REDO
(**CTRL** + **ALT** + **Z**)	= UNDO HISTOR

WATCH TUTORIAL

This section is a reminder but most users will probably prefer to watch the video tutorial

- OUTLINER

The outliner is the organized lexicon of Blender that shows all the objects contained in the scene; its organization is very close to the TA2 (cfr. 'About').

Type a name in the search bar to find the anatomical structures.

With the cursor over the Outliner, press '+' or '-' to develop or collapse all.

Press the arrows of your keyboard to navigate and develop/collapse each line.

Press the eye icon to show/hide the underlying visible collection

Press 'Shift + the eye icon' to show/hide all the objects inside a collection

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COLLABORATION

WE HAVE many references ([2D](#), [3D](#), [txt](#)), a [discord](#) server, a [spreadsheet](#) of the content, a [to-do list](#), a navigable [blend](#), an [app](#) (PC-Windows 10), a [website](#), a [linkedin](#) page, [3 videos](#), a non-profit [association](#), a draft for a crowdfunding campaign on [indiegogo](#).

WE NEED active hardworking skilled contributors in the fields mentioned below.

YOU GET support to grow your professional skills, public recognition for your contribution, a voice in decision-making and the integration of your contribution in the atlas. You can charge for your service if there is a demand but the result must remain under the same [license](#).

HOW TO IMPROVE THE CONTENT?

AS AN ANATOMIST

You verify the anatomical content's accuracy of the model and reports the errors.

The 'Terminologia Anatomica' (TA2-2019) is the lexicon of all the anatomical structures.

Anyone can report an error adding a comment in the Spreadsheet : Right click>Comment

To do a systematic verification:

1. Send me your email address to get an editor's access to the lexicon
2. Open the blend or the app (later only the blend will be up-to-date)
3. Open the TA2-lexicon
4. When the cell in column A is white, it needs a verification
5. Use a book of reference (see links at the bottom of the page Atlas)
6. If there is an error, set it to '**Mesh edition needed**', add a comment to describe the error
7. If it is good, set it to '**Mesh correct**'
8. To order more details, set it to '**Normal map needed**'
9. If you see a yellow cell **Normal verification**, the details need to be verified
10. Set it to '**Ready**' if everything is perfect.

When a whole chapter is **Ready**, a post is shared on social media and the chapter is set to (**Shared !**)

N.B.1: Practice in the page 'HOW TO' of the Spreadsheet.

N.B.2:The anatomists are invited to learn to edit the curves (see this section in the paragraph for 3D modelers)

AS A CONTENT WRITER

You import, extract, create, clean and update the definitions from Wikipedia and other sources to fit the latest nomenclature of gross anatomy, the TA2.

Please download and use this file and follow the instructions that it contains to import/edit or create new definitions.

- ● DEFINITIONS

The definitions are automatically displayed when an object is selected in the .blend file.

The script 'z-anatomy.py' opens the text file named as the mesh/curve (content) of the selected object.

(the suffixes '.l', '.r', '.t', '.g' and '.j' are ignored; see 'Naming.txt')

These definitions can be created as a new text in the Text Editor

Trick:

1. -Select the object
2. -Press (F2), copy its name with (Ctrl+C)
3. -Paste the name in the new text's name (Ctrl+V)

All the definitions are in English, and only in English, because translating them is too much work.

Most of them are a direct copy of Wikipedia's page.

These pages are often very long, and should be summarized to fit the user's needs.

The anatomical structures are often described under another name, or inside the page of other definitions.

In order to work in the atlas, these contents need to be renamed and separated.

Certain anatomical structures will have to be described using other sources.

In order to respect the copyrights, each sentence should be reformulated in an original way.

- ### HYPERTEXT

A particular attention can be given to the use of anatomical names that are part of the TA2 (see 'Translations.txt'):

These names are automatically recognised in the app and allow you to jump from one page to another.

- ### IMPORT FROM WIKIPEDIA

The script also allows importing one or several definitions from Wikipedia.

To do so:

1. Open the text file 'Wiki Phrases'
2. Write on each line the name of the wikipedia's page title that you want to import
3. With the cursor above the 3D view, press (Ctrl+0)

If the page exists, a new text file is created, with the right name and setup.

Please make sure that there is an empty line between each phrase, for more readability.

Sometimes, it is needed to delete 'Additional images' or 'References' at the end of the text file.

- ## HOW TO CREATE A DEFINITION

If it has no definition yet, it means that there is no wikipedia page with the exact same name,

but there may be one under a synonym, or defining it within the page of a parent anatomical structure.

1. Find an anatomical structure that has no definition (the most important are a priority)
2. Look in wikipedia using synonyms
3. Check the hypertext links
4. Same method using another language
5. Check the direct parent or grand-parent definition/wikipedia's page and see if a part of it can be used/recycled into a definition of the term you need to define.
6. Other option: Google it, copy-paste a proprietary definition or a book and modify something in each sentence without altering the meaning.
7. Same technique but with a translation from another language.

HOW TO UPDATE A DEFINITION TO MATCH THE TA2

Every time that another anatomical structure is mentioned in the definition, it should appear in light blue in the app. If this hypertext is missing:

1. Open the app, the blend, the TA2 lexicon (https://tinyurl.com/mhbe85b9) and 'Definitions sketchbook.blend' (https://tinyurl.com/4ccp55sz) (or a notepad)
2. Read a definition of your choice in the app, open it in the blend
3. Find what is the name of the anatomical structure in the TA2 using 'Ctrl + F' in the spreadsheet and look for the parent.the synonyms, singular/plural, etc.
4. Copy paste the definition from the blend in 'Definitions sketchbook.blend' (or pasting them all in a common notepad, keeping the same structure)
5. Modify the body of the text in order to have the complete name (string) with the very same writing for as many structures as possible.
6. If a wrong match is created, it would be good to find a solution but it depends on the situation..

AS A 3D MODELER

The purpose of the atlas is to reproduce an accurate model of the human anatomy.

Particular techniques are used to meet the needs of a functional complete 3D atlas of anatomy, but what matters most is the attention to the anatomical accuracy.

Your missions are:

- To edit the 3D content following the instructions of the anatomists or a book of reference
- To complete the missing anatomical structures, using the same principles
- To improve the visual quality while keeping a light file weight that allows most users to navigate smoothly (using a normal map or not).

The file weight and RAM needed are essential: If the file is too heavy, it won't run on many devices.

1. Send your email address to a coordinator to get an editor's access to the TA2-lexicon.
2. Open the latest blend
3. Open the TA2-lexicon
4. Add you initials in cell C of each structure that you edit
5. When the cell in column A is red, or blue, the structure needs to be edited
6. Open a good reference (see links in the page '**TOOLBOX**')
7. When you have created or modified a series of parts, paste them in this file.
8. Upload it and paste the link in answer to the comment of cell A
9. Set cell A to '**Anatomist needed**'.

When all the structures of a chapter are green 'Ready', a post is made on the social media where the contributors are mentioned and the chapter is set as 'Shared' !

N.B.: Here is how to manage the the email notifications from the spreadsheet

You can work directly inside the .blend (create a copy if you want to keep the original available), copy paste or append the elements of interest in an empty blend file and use any software

Follow the color code and change the content of the column 'A' when you have finished.

Send a link to your modified/created parts in an empty .blend file.

The following techniques are necessary to for the existing functions to work properly:

- HIERARCHY

The [Terminologia Anatomica](#) (TA2) is organized as a tree, with main branches/systems and sub-folders:

In order to be imported inside Unity (the software used to create the app), this hierarchy needs to be reproduced through parenthood relationships.

1. Select the new object
2. Shift-Select his parent-object
3. Parent them (Ctrl+P>Object)

In case of need, select the child-object and press (Alt+P>Unparent) to remove the parenting

These relationships are also used to define the behavior of the labels and group-labels

N.B.: For the moment, only the internal relationships of the newly created/modified content can be imported when the contribution is merged with the rest; the links between the imported parts and the rest of the model will have to be recreated when a contributor sends modified part that have to be integrated in the model shared on the website.

- ### COLLECTIONS

In the same principle, although the collections are widely used in the atlas, the person who merges the contribution to the main file has to recreate them every time he adds something.

Only the 9 collections corresponding to the main systems/layers are visible in the outliner; all the other collections are gathered in a hidden collection called 'Bonus collections'.

The user can reach the collections to which the active object belongs by Right-clicking (RMB) and selecting the one he wants to select.

To display these collections, go to Outliner>Filter icon>check the Checkbox icon

- ### ORIGIN & LOCATION

In order to behave correctly (Orbit Around Selection; Rotate around origin), the origin of the object is set to the Geometry: Select the object(s)>Object>Set Origin>Origin to Geometry

To 'save' the position of the object: Press (Ctrl+A>All Transforms to Deltas)

This technique allows to move the objects (G; move mouse, LMB) and to recover their initial position (Alt+G).

The scale and rotation just have to be applied: Press (Ctrl+A>Rotation and Scale)

- **SYMMETRY**

All the even symmetrical structures of the atlas share a common mesh/curve that is only inverted on the X-axis.

The mesh/curve is created on one side.

In order to get their symmetrical twin:

1. Set the 'Transform pivot point' to 3D 'Cursor' (on the upper side of the 3D view)
2. Set the 3D cursor to the world origin (Shift+C)
3. Select the structures to symmetrize
4. Linked-duplicate them (Alt+D)+Esc ((instead of Shift+D))
5. Mirror them on the X-axis (Ctrl+M+X)+Enter or (S+X+'-'+'Numpad1')+Enter
6. Make sure to name (F2) both sides with the respective '.l'/'.r' (*)
7. and that the mesh is named without any of these suffixes

The name of the mesh is not visible directly but it is used by the script to drive the translations.

Therefore, the name of the mesh must match with the content of the 'Translations.txt' file in order to translate the name.

(*)To rename several objects at the same time, press (Ctrl+F2) and for exemple replace 'l.001' by 'r' on all the selected objects. Here is a [video tutorial](#) about this technique.

Attention: if you modify the origin of the object, the opposite symmetrical object will lose its location;

you can then delete it (X>ok), and recreate it from the other side as explained above.

The uneven/odd anatomical structures that are symmetrical (vertebraes, mandible, etc.) are symmetrized in edit mode:

Mesh>Symmetrize>'-X to +X' or '+X to -X'.

This function applies the symmetry around the origin of the object; make sure that the origin is located on a X=0 location.

- **NAMING**

Any 3D object in Blender has two names: one for the object (the container) and one for the mesh/curve/text/... (the content).

The filter of the outliner is set by default to show only the name of the object (the container).

The name of the object is the name of the corresponding anatomical structure of the TA2 (https://ta2viewer.openanatomy.org/).

1. **.L/.R: LEFT AND RIGHT** 'Example.l'/'Example.r'

It also means that the structures are linked-duplicated (they share the same mesh) and symmetrized (Scale '-1' on the X-axis). The object's name of all the symmetrical structures is followed by either '.l' (left) or '.r' (right); while their mesh/curve, that needs to have the same name, is not (See SYMMETRY).

2. **.T/.S: LABELS** 'Example.t' (text); 'Example.s' (text-left side)

This suffix is used for all the regular labels; and the ones on the right side of the body when they are symmetric. These labels follow the visibility of their parent and are only shown on demand in the app (spacebar). They always face the viewport.

3. **.J/.I: LINES** 'Example.j' (joining-line); 'Example.i' (idem on the left side)

The line that links the label and the object is named with the same name as the label (although it has no influence); so does its mesh. The line is always made of only two vertices forming an edge (to be importable in Unity). The vertex that is on the object side is hooked to its current position relatively to the object's origin. The creation and edition of the labels use particular macros (see further paragraph)

4. **.G: GROUP LABELS** 'Example.g'

This suffix is used to give a 3D/lexicon existence to what would otherwise be stored as a collection.

The selection of a group-label automatically select all the descendants

'.ol', '.o5r' (origin), '.er', '.e24l' (end)

this suffix designate that the object is a muscular insertion, and if is on the left or the right side.

The number allows to have separate objects linked to different bones but to find them easily with the name of their muscle and to translate their names without duplicating the translations

5. **.ST: SIMPLE TEXTS** 'Example.st'

This suffix is very similar to the '.t' but used to display the 'HOW TO...' options

It was necessary because as they are children of an object that already faces the viewport, they don't need to modify their rotation any more

- COLLECTIONS

Initially, the hierarchy was created through the collection system but, in order for this organization to be importable inside Unity, it has been replaced by parenthood relationships. This conversion provided unexpected options and made the navigation inside Blender better. The person who merges the contributions to the main file has to recreate the links between the added parts and the collections to which it belongs each time that he adds something.

Only the 9 collections corresponding to the main systems/layers are visible in the outliner.

All the other collections are gathered in a hidden collection called 'Bonus collections'.

The user can reach the collections to which the active object belongs by Right-clicking (RMB) and selecting the one he wants to select.

To display these collections, go to Outliner>Filter icon>check the Checkbox icon.

These nonlinear/rhizomatic groups have been recreated inside Unity thanks to a system of text-lists (It is explained here).

It is not possible for the moment.

The same principle can be reproduced manually inside Unity, though.

- MATERIALS

When an object is imported inside blender, it comes with its material(s).

If the same material/nodegroup is already present in the main file, these materials will be duplicated (Material1.001; Material2.001, etc.). It is therefore easier for the moment to share the objects with vertex groups but without materials. There will hopefully be a solution in the future to recognize and overwrite the materials and nodegroups that have the same as the ones of the imported/pasted parts.

The coordinator is responsible to re-link the corresponding materials and node-groups when he merges the modification in the main file and to get rid of the duplicates.

All the materials of the atlas use nodegroups and attributes.

If a particular function (key-color, comic shader, cross section) does not work on certain objects/materials, it is probably due to an inadequation between a material nodegroup and the custom properties of the objects.
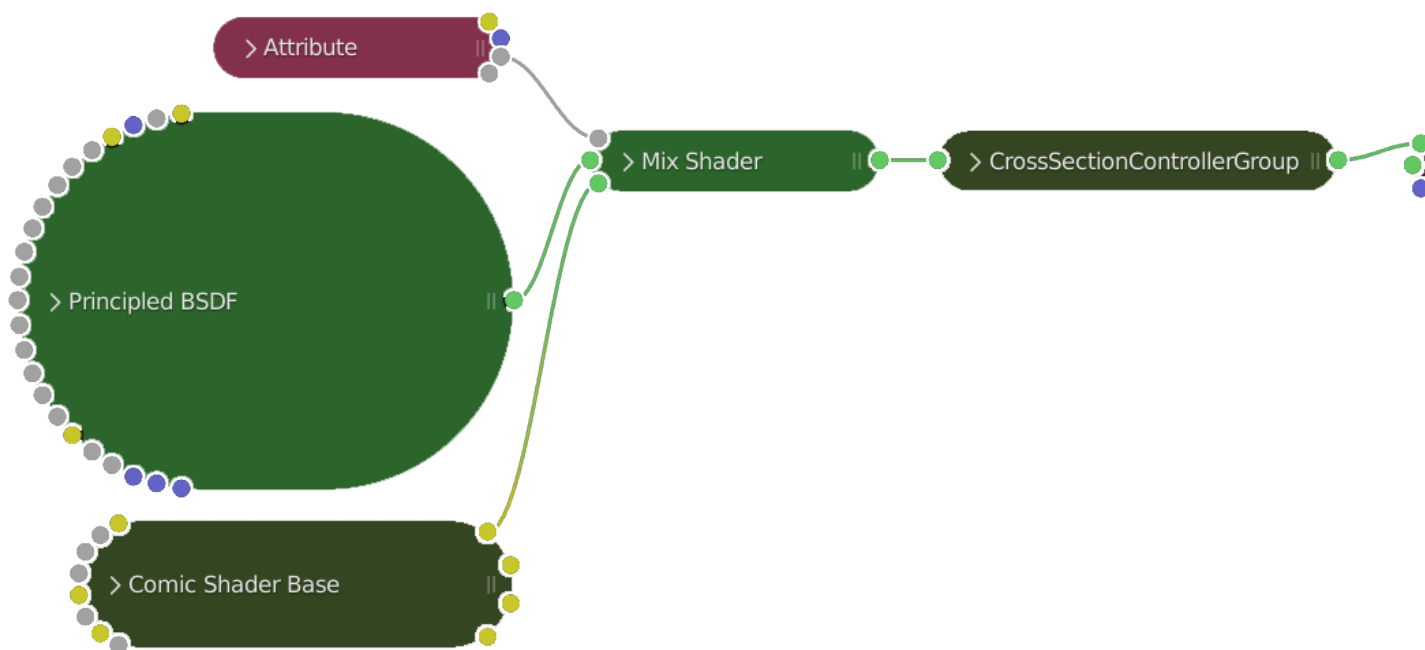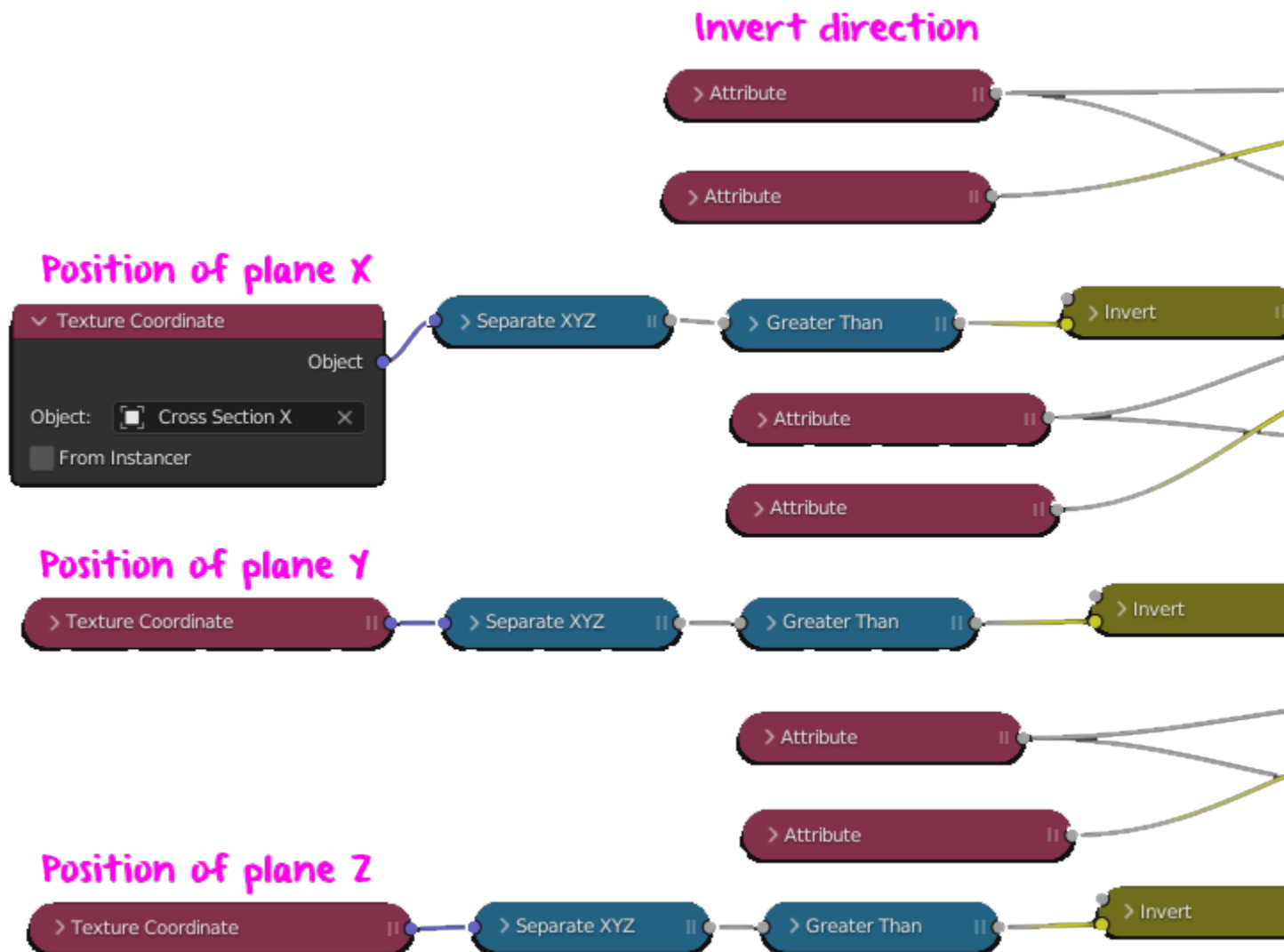

The 'Attribute' is set to the custom property 'comic_shader' (that all the objects need to have in order to trigger the 'Comic Shader' option). The value of this property is driven by the shortcut 'Shift+Alt+Z' thanks to the add-on 'z-anatomy.py'. It drives the mix (0 or 1) between the regular material (Principled BSDF) and the illustration-like one (Comic Shader Base).

'CrossSectionControllerGroup' is a nodegroup (it can be developed by selecting it and pressing 'Tab'); it is the part of the material that allows the 'Cross section' function to work.

Let's see what's inside this nodegroup:

Invert direction

> Attribute ‖

> Attribute ‖

Position of plane X

∨ Texture Coordinate

Object

Object: ▣ Cross Section X ✕

☐ From Instancer

> Separate XYZ ‖

> Greater Than ‖

> Invert

> Attribute ‖

> Attribute ‖

Position of plane Y

> Texture Coordinate ‖

> Separate XYZ ‖

> Greater Than ‖

> Invert

> Attribute ‖

> Attribute ‖

Position of plane Z

> Texture Coordinate ‖

> Separate XYZ ‖

> Greater Than ‖

> Invert

The position of each cross section plane is a custom property and its value is used to define the parts of the object whose material has to be transparent.

- ### TEXTURES and NORMAL MAPS

Many anatomical apps use textures and although this technique has been avoided so far to concentrate on other matters, it can be added. Besides the addition of complex colors, the use of normal maps is particularly interesting to get more details without saturating the RAM/GPU.

The anatomical structures of the spreadsheet whose cell A is set to Retopo/Normal map are meant to integrate this additional layer of details provided by an image that captures a HD sculpt and displays it on a low-poly model. Here is how it works

As it involves a thought on the topology, the RAM needed and the file size, please discuss with the team on Discord if you want to make sure that they will be integrated.

Some materials use procedural textures, which are very flexible and do not augment the file size.

They can easily saturate the RAM when they are used too intensively, though (no microscopic details everywhere, sorry).

- ### GEOMETRY NODES

Many organs have several layers (mucosa, serosa, musculous, ...). See the stomach for example.The GEONODES can be useful to create several linked objects with an offset. In this way, editing one object will affect the others, but each one will have its own name and mesh, which is needed to get the translations working, to respect the organization, etc.

- ### ARTERIES/VEINS/NERVES as CURVES

These tube-shaped anatomical structures are represented by curves because they are much lighter and easier to edit than meshes.

This tutorial explains how to edit the curves.

VOLUME/RADIUS

In edit, you will notice that the curves have no volume.

Their 'initial volume' is given in Properties>Curve>Geometry>Depth and is always set to 0.5.

Pass in edit mode (Tab),

Select a node (LMB)

Menu panel (N)>Item>Transform>Radius

BRANCHES

To create branches to the main curve:

1. Select one node
2. Duplicate it (Shift+D)+Esc
3. Extrude the duplicated point (which is already selected) (E+move mouse)

CREATE NEW

The fastest way to create a new object within a complex system of vessels/nerves is to:

1. Extend the previous segment in edit mode (E to extrude, G to move, G+X/Y/Z to move on an axis)
2. Edit the radius of the junction node
3. Make this node 'Aligned' (V>Aligned)
4. Select the nodes of the new segment and separate them (P>Separate)

This will guarantee that the extremities of both segments share the same radius, and the exact same orientation.

1. Pass in Object mode (Tab),
2. Select the newly created object, named as the previous one + '.001'
3. Rename it (F2)SNAPPING
4.

This tutorial explains the several options of the snap tool, that is very useful to get precise connexions

N.B.1:(Ctrl+G) activate the snap option temporarily.

-to follow the surface of an object

N.B.2:When following the surface of an object,

the points may need to be moved a bit to avoid the vessel to be visible on both sides of the surface.

For little movements, Press (Shift+G)

POSITION

When you have finished editing the object:

1. Pass in Object mode (Tab)
2. Go to Object>Set origin>Set origin to geometry
3. Then (Ctrl+A>All transforms to deltas)

This makes the objects recover their position when their position is reset (Alt+G) after being moved (G),

and allows to orbit around their center of gravity when they are selected.

N.B.: if this step is done after the mirroring (See 'Left/Right' below),

delete the opposite structure and follow the 'left/right' steps again.

FIX JUNCTIONS

When two tubes are supposed to share a common node setting (radius+orientation) but do not:

1. Select one of them
2. Pass in Edit mode (Tab)
3. Select the end node (LMB)
4. Duplicate it (Shift+D)
5. Separate it (P>Separate)
6. Pass in Object mode
7. With the mouse cursor above the outliner (upper right window), press 'Numpad .'
8. Then find the object named with the same name but followed by '.001' (should be below the first one)
9. Select this one in the outliner (LMB)
10. Rename it (F2) or double-click its name in the outliner

LEFT/RIGHT

All the symmetrical structures of the atlas share a common mesh that is only inverted on the X-axis.

The vessels are only created on one side.

In order to get their symmetrical twin:

1. Set the 'Transform pivot point' to 3D 'Cursor' (on the upper side of the 3D view)
2. Set the 3D cursor to the world origin (Shift+C)
3. Select the structures to symmetrize
4. Linked-duplicate them (Alt+D)+Esc ((instead of Shift+D))
5. Mirror them on the X-axis (Ctrl+M+X)+Enter or (S+X+'-'+'Numpad1')+Enter
6. Make sure to name (F2) both sides with the respective '.l'/'.r'
7. and that the mesh is named without any of these suffixes

The name of the mesh is not visible directly but it is used by the script to drive the translations.

Therefore, the name of the mesh must match with the content of the 'Translations.txt' file in order to translate the name.

- ## CREATE LABELS

To create a label on an object,

1. Select the object with LMB
2. Pass in Edit mode (Tab)
3. Select the vertex towards which the label must point
4. Press (Shift+Ctrl+5)

By default, the label has the name of the text opened in the Text Editor.

To create a custom label, instead:

1. Extend the box 'Make label' on the lower left corner of the 3D view
2. Click on 'Use Custom Property'
3. Enter a name, press 'Enter'

To change the name of a label,

1. Press (F2),
2. Enter the new name, press 'Enter'

HOW DO THE LABELS WORK?

The labels are text-objects; as the other objects of the atlas, their content (curve for texts) has the same name as the object (see 'Naming.txt')

Being sub-structures of the object that they describe, they are set as children of it.

The line that joins the label to the described (parent) object is a mesh with only two vertices and one edge.

Its name is ended by '.j' (both the object and the mesh)

It is the child of the label; one of its vertices is 'hooked' (see Hook modifier) to the parent object.

LOCATION & SIZE

Ideally, all the labels of an object should be readable when the object is 'framed' (Numpad.), when the user centers the viewport specifically on this particular object. In other words, the labels should not be covering each other from the orthogonal views.

Move them (G) and resize them (S+0.5/0.3/...) as you want.

When you are satisfied with the disposition,

-select the labels one by one

-press (Ctrl+Shift+Alt+5) or (Ctrl+A>All transforms to Deltas)

This last step will allow the label to jump back in its original position

if it is moved and that the location is reset (Alt+G).

AS A TRANSLATOR

You verify the automatic translation of the 'TA2' and set the font to green when it is correct.

The 'TA2-2019' is the second edition of the 'Terminologia Anatomica' made in 2019.

It has been recreated in this Spreadsheet for this project and the automatic translations (in black) were generated with 'Google translate'.

To correct them:

1. Tell the coordinator which part you plan to correct and receive an editor access.
2. Compare the TA1 to the TA2 whenever you can; most of the terms remain identical.
3. Each cell of a column should be unique; the duplicates should be automatically highlighted in blue
4. The cells should have maximum 61 bytes (//characters), the cells highlighted in pink should be reduced with abbreviations

ADD A LANGUAGE (for the coordinator)

In order for a new language to be added and visible in the blend:

1. Adapt the formula used in cell B2 of the page 'Export' of the TA2-lexicon to include the new column (not the synonyms) (Adding ,'TA2'!P1 before the last parenthesis for italian, for example)
2. Copy the content of the right column (starting with B2) and replace the body of the text file called 'Translations' inside the .blend with it
3. Add this option in the lin 566 of the add-on
4. Replace the previous version on the website
5. The users need to download the new version, unzip and open it.

To get them in the app, see with Lluis.

THE FUNCTION 'TRANSLATE' in Blender

Five conditions are needed for the translation function to work:

- ### 1) The Mesh/Curve has to be named as the parent

(As the symmetrical structures are sharing the same mesh/curve; the '.l'/'.r' suffix is removed.)

Another condition is needed to translate the object's name by pressing (%):

- **2) The text file named 'Translations' (in the Text Editor on the lower right corner of the default screen)**

needs to have a line starting with this object's name; followed by its translations, separated by ','.

An external spreadsheet is used to edit the translation.

- **3) The script 'z-anatomy.py' (in the Text Editor) must be running**

On windows, it should be automatic (allow the automatic execution on opening)

Otherwise press the 'play' icon on the top bar of the Text Editor.

This 'play' icon' may be hidden on the right; scroll with the cursor on the header of the Text Editor to find it.

On the line 560, this script lists the different languages available;

the number corresponds to the position (the ';' separates each unit) of the translation on the line.

- **4) The anatomical structure's name must have maximum 60 bytes/characters**

The (=LEN(A11)>61) formula is used in all the spreadsheet to highlight the >60 characters names.

Blender's object's name's field has a limited number of characters.

Exceeding the number of characters will lead to an impossibility to re-translate the name after choosing this translation.

The cells highlighted in Fuschia must therefore be shortened using abbreviations.

Prefer to abbreviate the generic terms at the end of the name in order to keep matching most manual searches.

Attention, the languages using another alphabet usually have more than one byte/character.

- **5) Each object must be unique**

The (=COUNTIF(A:A,A11)>1) formula is applied separately in each column of the spreadsheet to highlight the duplicates.

If two names have the same name, one of them will get a '.001' suffix added in Blender, to differentiate them.

The cells highlighted in green must therefore be modified to avoid duplicates.

AS A CODER/DEVELOPER

PYTHON DEVELOPER

You modify the 'z-anatomy.py' script, made by Marcin Zielinski, to add new functions to the atlas.

Join the Discord server and ask to be invited in the project on Taiga where the list of modifications needed is written in the last section of the kanban.

This script is run automatically on opening (on Windows).

The add-on can be found here and the modifications to do are listed here.

UNITY DEVELOPMENT OF THE APP

The open source 3D Anatomy Atlas is organized originally in Blender; Lluis Vinent has created a mobile app from it, and then a PC version (much more advanced). All the main functions are already there and the .blend file is adapted to Unity. The code of the app can be downloaded here.

The three major objectives are:

1. to improve the UI for a user-friendly experience
2. to create a version for the other platforms (iOS, PC/Mac)
3. to create a cloud system to share parts of the model as recorded 'chapters' (classes, study).

Everybody is welcome to ask or propose the modifications; the forum is a good place to discuss these choices publicly. Take contact with Lluis on Discord if you want to get involved in this part of the project.

The proprietary applications can be used as inspirations: 3D4Medical, BiodigitalHuman, VisibleBody, ...

AS AN GRAPHIST

As a medical image exporter

You develop a consistent style that will be used on all the exports and export labeled anatomical illustrations (from the verified content).

The images must be didactic (not only aesthetic); they will be the most accessible content to the public.

As a video creator

You create promotional videos and tutorials adapted to grow the community on different social medias (Linkedin, Facebook, Instagram, Tiktok, Youtube)

Several techniques (montage) can be used or mixed according to the context: Screen capture, Viewport render Animation, Live recording.

There are plenty of subjects to cover and each video can easily become a project in itself

- ### CAMERA SETUP

In order to be user-friendly and efficient, the atlas provides a camera setup that allows to place the camera, using its target object:

Press 'Numpad 0' to pass in Camera view

Show and Select the object called 'Take a picture' in the outliner

Grab it (G), Rotate it (R), Scale it (S)

Press F12 to 'Vewport Render Image' (Ctrl+F12 for an Animation)

Save your image (F3)

- ### VIEWPORT RENDER vs. RENDER

The Viewport Renders are much faster than the regular Renders and the exported images have the same quality.

To keep the same style/visual identity throughout the different exports, a particular attention should be given to the 'Comic shader'.

The regular Render should only be used if you need to use the compositor, or to add special effects like 'Freestyle' (A bunch of line styles are already configured).

In this case, all the functions are default, except a very handy button that synchronizes the Render to the Viewport (What you see is what you get)

It has to be pressed before each Render in 'N>Z-Anatomy>Visibility>Sync visibility'.

AS A BIOMECHANIST

This part implies the combination of a good understanding of the [biomechanics](#) of the [rigging](#) principles and of the [drivers](#) in Blender.

Blender provides plenty of tools to create animations but what this branch of the project is trying to do is to represent the biomechanics of the human body as it is explained in the [books of reference](#).
The techniques of interest are:

1. those meant to create animations
2. the Armatures and constraints
3. the Motion Capture (MoCap) files
4. the drivers that allow to link a value to another, using mathematical formulas

They provide an original approach for the study of biomechanics.(See a demo [here](#))

To be influenced by the armature, the 3D objects are usually parented to the armature.

As these parenthood relationships are already used to represent the hierarchy of anatomical structures in the main file -because this is how a hierarchy can be exported from Blender to Unity- the anatomy and the biomechanics had to be separated.

You will find the 'Biomechanics Blender.7z' file, containing the armature, a series of positions and a few .bvh animations on the 'Atlas' page of this website, beneath the App.

Constraints were added to limit the body in physiologically coherent positions.

A system has been developed to automate the animation of the whole skeleton using .bvh files (standard Motion Capture format).

The reproduction of the physiological movements in Blender implies a good understanding of the biomechanics and of the 'drivers'. The drivers are the mathematical expression of the relation between two segments.

To open the file and create the pose that you want:

1. Open 'Z-Anatomy_biomechanics.blend' in Blender
2. Press the eye-icon in the outliner to hide or display the 'Armature' object,
3. With the mouse over the 3D-view,
4. Press 'Ctrl+Tab' to pass to Pose mode,
5. Left click on a bone to select it
6. Press 'G' or 'R' to move it
7. Go to Properties>Pose library>
8. Press on the '+' icon and name your pose

You can also use or import a motion-capture file to animate the model:

1. (Press 'Alt+H' to show all the bones)
2. Press 'A' to select all the visible bones
3. Press 'Alt+G' to reset the selected bone(s) location
4. Press 'Alt+R' to reset the selected bone(s) rotation
5. In the lower right window (The 'Properties' panel), set the 'Mocap' value to '1'
6. In the lower left window (The 'Dope Sheet'/'Action editor'), click on the icon next to 'New'
7. Choose an action
8. Press on the 'Play'-icon at the bottom of the screen
9. You can adjust the end-frame of the animation on the right of the timeline

To import a new motion-capture file,

1. Go to 'File>Import>Motion capture(.bvh)
2. Choose a .bvh file on your computer
3. In the import-options, set the scale to 0,06
4. And check the 'Scale FPS' option
5. Press 'X' or 'Delete' to delete the imported armature
6. Select the 'Armature'
7. (Press 'Ctrl+Tab' to pass in Pose mode)
8. Select the imported action in the 'Action editor'-list
9. Press 'Play'

PREPARING THE EXPORT

CONTENT OVERVIEW

In the 'Z-Anatomy.blend' (Portable/Template), in the header of the lower-right window (the 'Text editor'):
1. Run the google-sheet/ListCreator.py in the blender
2. It will create `List_Definitions`, `List_3D`, and `List_labels`
3. Copy the three lists and paste into the google sheet, in the columns B, C and D

HOW TO UPDATE THE BLEND FILE ON THE WEBSITE?

Once everything is as it should in the blend:

UPDATE TRANSLATIONS in Blender

1. Open the page Export of the Spreadsheet
2. Select the cell B2, Press 'Shift+ Down arrow' and 'Ctrl+C' to copy the whole column
3. Open the blend
4. In the Text editor (lower right window) press the white sheets-icon
5. Type 'Translations' and select this option to open the text
6. Select all 'Ctrl+A' and replace it by the new content with 'Ctrl+V'
7. Open the sidebar (Ctrl+T) or (View>Sidebar)
8. In the upper search field, type ';'
9. in the lower replace field, type ','
10. Press 'Replace all'

You're done !

PREPARE THE PORTABLE AND TEMPLATE VERSIONS

1. Save the file (from the portable version for the example)
2. Open the folder 'Anatomy Blender' where the file is saved
3. Delete 'Z-Anatomy.blend1' that has been created (it would double the file size)
4. Get out of the folder 'Anatomy Blender', select the folder, the 'Cheatsheet.png', the 'License.txt' and the 'Readme.txt' together
5. Right click>7-zip>Add to 'Portable.7z' (The name depends on the folder where Anatomy Blender is stored; you need to have downloaded and installed 7-zip: https://www.7-zip.org/)
6. Rename the newly created 'Portable.7z' into 'Z-Anatomy_Portable.7z'

7. Return inside the folder 'Anatomy Blender'
8. Copy the file 'Z-Anatomy.blend'
9. Open the folder 'Z-Anatomy'>'Template'>'Z-Anatomy'
10. Select and delete the file 'Startup.blend'
11. Paste the file 'Z-Anatomy.blend'
12. Rename it 'Startup.blend'
13. Get out of the folder, back in Z-Anatomy>Template
14. Select the 'Z-Anatomy.zip' and 'Z-Anatomy_Template.zip' and delete them
15. Select the folder Z-Anatomy; right-click 7-zip>Add to 'Z-Anatomy.zip' (not .7z this time)
16. Select the 'icon.ico', the 'License.txt', the Readme.txt' and the 'Z-Anatomy.zip' together
17. Right click and '7-zip>Add to 'Template.sip' (the name depends on the folder we are in)
18. Rename it 'Z-Anatomy_Template.zip'

This short video shows the process.

UPLOAD THEM ON THE WEBSITE

1. Open the Wix Website Editor (https://tinyurl.com/3xwdxtar)
2. Go to edit the page 'Atlas' (Left part of the header)
3. Click twice on the button 'Portable version' to edit it and then on the green link-icon
4. Click on the light blue button 'Choose a document/Choisir un document'
5. Enter in the folder 'Atlas'; select the file 'Z-Anatomy_Template.zip' and 'Z-Anatomy_Portable.7z'
6. Right click and 'Place in the bin/Placer dans la corbeille'
7. Drag and drop the newly created 'Z-Anatomy_Template.zip' and 'Z-Anatomy_Portable.7z' and wait for them to be fully uploaded (it can take up to 1h according to the connexion)
8. Select the file 'Z-Anatomy_Portable.7z' and press the button 'Ajouter à la page/Add to the page' of the lower right corner
9. Repeat the operation for the other button 'Template version' choosing the 'Z-Anatomy_Template.zip' instead.
10. Press the button 'Sauvegarder/Save' on the right side of the header and 'Publish' or 'Publier maintenant'.

FROM BLENDER TO UNITY
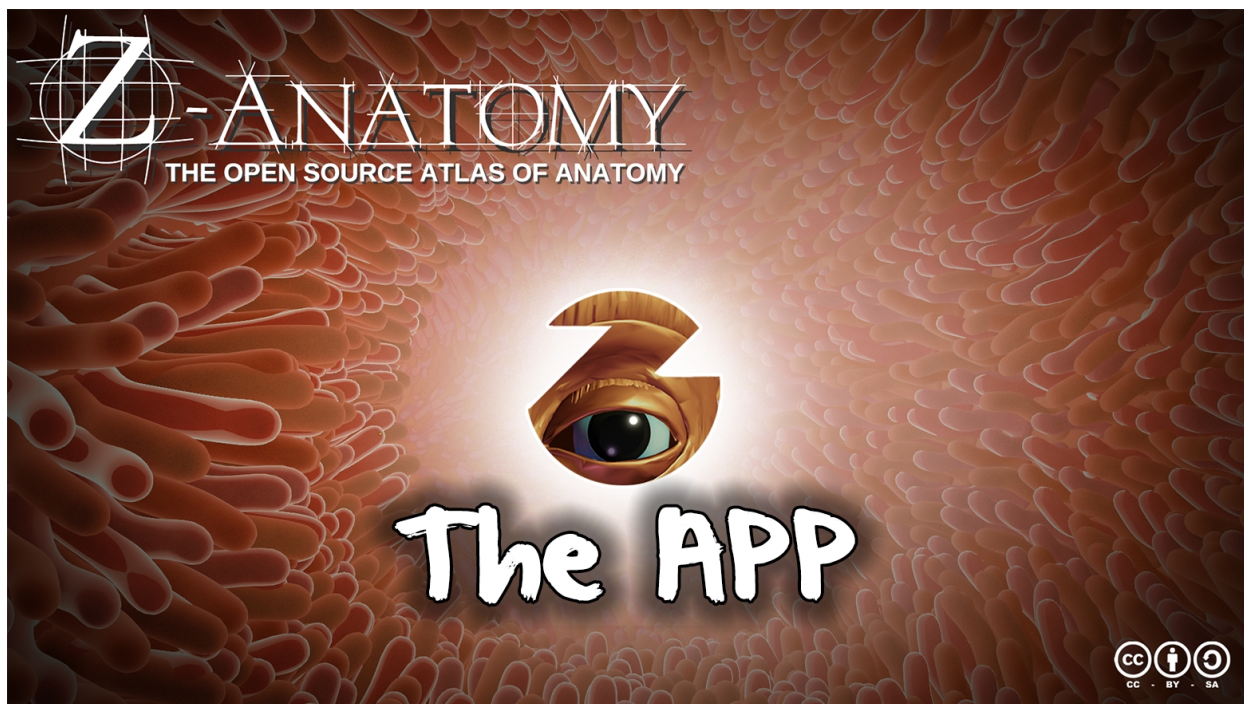
- ### EXPORT THE MODEL

(See with Lluis)

- ### EXPORT THE DEFINITIONS

(See with Lluis)

- ### LAYERS

Creating the layers of each system (tweak to show/hide)

All the special functions created in Unity use lists of objects names to define their particular behavior; these lists are gathered in this spreadsheet.

The Pages: 'Bones', 'Ligaments', ... until 'Skin' are all divided in ten groups corresponding with the order of the ten levels of appearance of the system when using the sliders of the main collections.

In order to create theses lists:

1. open the latest version of the blend
2. create temporary collections named (bone-1, bone-2, etc.; ligaments-1, ligaments-2, etc.)
3. Press '1' to display only the skeletal system
4. Select only the bones that you want to appear in the first level: 'bones-1'
5. In the text editor (lower right window) click on the white pages-icon and type 'layer'
6. Select the option 'Layer-as-list'
7. Inside the body of the text, replace the 'destination folder' by the path to the folder of your choice on your computer
8. Replace the name of the file by 'bones-1' (in this case)
9. With the mouse cursor over the header of the text editor, scroll down to make the 'play-icon' (hidden on the right side of the screen) appear and press it
10. The file has been created in the folder mentioned; find it and open it
11. Copy its content and paste it inside the column 'bones-1) of the page 'Bones' of the spreadsheet 'Collections'

Only one occurence of each object should appear in all the layer pages, and a formula has been added in each page to highlight the doubles:

Format>Mise en forme conditionnelle

Open/set a particular formula on the whole sheet =COUNTIF(A:J;A2)>1

Repeat the same process for all the other lists.

- **BONUS COLLECTIONS**

The page BONUS of the same [spreadsheet](#) gathers extra collections that can be accessed in the app by right clicking(opens the options windows)>Structures>shows the list of bonus collections

The difference with the 'layers' is that the same structure can appear in different collections

- **GROUP MUSCLES**

As the functions 'Show muscle' and 'Show insertions' are based on the fact that the muscles and its insertion share the same name but are differentiated only by their suffix,

These group muscles are the turnaround that has been developed for the muscular insertions that gather several muscles.

The first line gives therefore the name of an insertion where several muscles/heads of muscles are attached, and the following lines give all the elements that appear when this insertion shows its muscles(s)

- **GROUP-NERVE**

These groups gather all the nerves that will appear when the option 'Show nerve' is triggered from one of the muscles of the list.

(The algorithm recognizes the nerves because they all contain the string 'nerve')

They also work in the other direction: Right clicking on a nerve of the list makes the rest of the list appear (to be confirmed).

- **GROUP LABELS**

The Group Labels (ended by '.g') represent groups composed of several objects.

They can be shown/hidden with the shotcut (Shift+%) or (N>Z-Anatomy>Labels>'Enable Group Labels')

Both the object and its curve (text-objects are made of curves) are ended by '.g'

The Group Labels can be created in the same way as the labels ('.t'), but:

1. Parent the Group label to its parent according to the [TA2 hierarchy](#)
2. Develop the filter icon in the header of the outliner (upper right window)
3. Inside the filter options, Enable 'Object Contents' and activate the 'Selection Arrow' icon (next to the eye)
4. Back in the outliner, develop the object's content (Click the triangular arrow-icon)
5. Change the suffixes '.t' of the object by '.g'
6. Select all the direct children of the group label, and then the group label (Shift+LMB)
7. Parent them (Ctrl+P)
8. Change the suffix of the curve '.t' by '.g' (it must be done after parent, otherwise the children get deselected)
9. Enable the selection of the Joining Line (Clicking on the 'Selection Arrow' icon)
10. Select the line
11. Object>Convert To>Mesh (This step will apply the modifier)

The GROUP-LABELS work thanks to the script 'z-anatomy.py' (line >1013),

the selection of an object whose mesh/curve is ended by '.g'

automatically deselects any other object and selects all its children.

NETWORK

As a collaborative project willing to optimize its interoperability, please keep contact with the other contributors through Discord and the other tools available.

INVOLVING NEW CONTRIBUTORS (for the coordinator)

Growing a community requires effort: Most contacts need to be created intentionally.

All the occasions are good to promote the atlas towards the citizens, the professionals, the students and teachers, the hospitals, etc.

Communication templates are used and adapted to create the first contact through email.

1. Invite user to connect on linkedin
2. Invite him to follow the Linkedin page + personalized message
3. Welcome him on Discord in personal message & remind him to introduce himself on channel #presentation
4. Rename him with real first name
5. Set his role to 'Member' and propose in pm to join Taiga
6. Send invitation from Taiga
7. If he accepts, set his role to 'Contributor' and confirm that he understood what it means/involves
8. Add his name + default Discord pseudo + renamed pseudo+email address+linkedin profile+personal website+initials+field of expertise (x=inactive; v=active) in page 'Members' and 'Contributors
9. Re-order the list alphabetically
10. Share editor's access to the spreadsheet
11. Share adapted permission according to his field (anat/modeler or translation)
12. Create a proposed task for him
13. More pm to make sure that he has all the needed information, feels supported in his activity and can work in good conditions.