IA 301
Logics and ontologies.
Project on ontologies : from the labor to the muscle

Introduction:

We are a team of four students, Basset Aymeric, Gomez Louis, Pineau-Ferrand Emeline and Quach Alexandre.

The four of us practice a lot of sport, so we were thrilled to create a dedicated sport ontology focused on fitness and muscle building workout. The idea is to classify gym exercises to help users create their workout program, according to the muscles they want to focus. It should also be possible to add criteria such as the difficulty or the equipment required to perform the exercises since not everyone has the same level or has access to a gym.

I/The genesis of the idea

With all our different sports backgrounds, we realized that such an ontology could be useful to other sports practitioners who want to train efficiently. Indeed, In each different sport, different muscles or groups of muscles are involved, and thorough training leads to reinforced them specifically. For example quadriceps in skying, deltoids in handball, back in rowing, gluteus in curling, forearms in Judo and so on. In most of these sports, overall strength and cardio reinforcements are executed, but to reach top-level it can be worth to target specifically a muscle with weightlifting. Indeed, every great skier or cyclist squats a lot and that every boxer benches. For a sports addict, it becomes necessary to gain knowledge in musculation exercice. Yet with no antecedent of weightlifting, it can be hard to know what to do to progress according to your needs and goals. All of this applies to either a person unhappy with his body shape, to a weightlifting beginner willing to create his program with a little help, or to a person who wants to improve his overall well being and health through muscular reinforcement and sport exercises. This last point is quite important, since our project is built with the United Nations sustainable development goals in mind. This is our own answer to the good-health and wellbeing issue.

The goal of our ontology is, for all these different reasons, to answer the problematic: "How could I improve my strength and efficiency, with the material I have, on this muscle(s)?".

II/The conceptualization

We started with this broad idea of an ontology to classify various gym exercises. At first, we decided to create a list of the trainable muscles in the body. This body map is a key element of our reasoning and provides a broad vision for the required exercises. Of course, this is a simplified overview of the muscular system based on human anatomy resources available on the internet, and it is not perfect nor exhaustive.

The main criteria are that some muscle groups are too small or too complex to train separately, so we avoid going too deep in the description.

Also, some muscles need specific equipment to be focused or just can't be focused, and we want to keep this ontology specific yet broad and usable, so again some muscles are "simplified" or skipped., as you can see below.
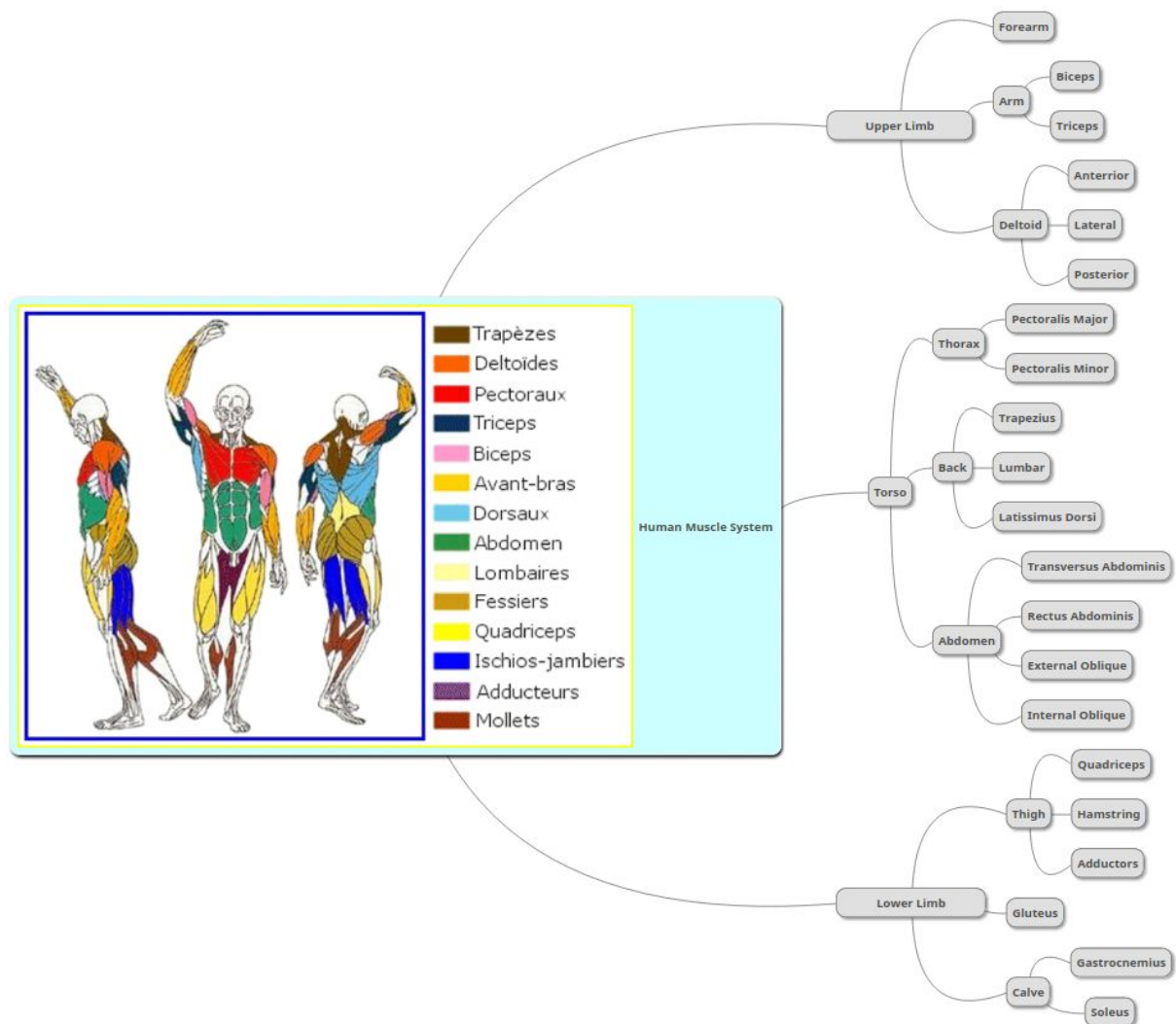
We then considered other filters such as the difficulty and the equipment required to perform an exercise, which were relevant criteria for us.

III/ The intuition of relations and classes

Knowing what would characterize our ontology, we then builded from scratch a list of various exercises.

The result of our research is a double entry tab, checking all the muscles impacted, and addressing the difficulty and material needed. Here is the tab:

exercise	material nothing/minimal/total	difficulty 1/2/3	forearm	biceps	triceps	anterior	lateral	posterior	pectoralis major	pectoralis minor	trapezius	lumbar	latissimus dorsi	transversus abdominis	rectus abdominis	external oblique muscles	internal oblique muscles	quadriceps	ischio	adductors	maximus	medius	minimus	gastrocnemius	soleus
bench press	3	2			X	X			X	X															
australian pull up	2	2	X	X							X		X												
rowing	3	3	X	X							X														
deadlift	3	3	X						X		X	X	X		X	X	X	X	X	X	X	X		X	
inclined bench press	3	3			X	X			X	X															
skullcrusher	3	2			X																				
biceps curl	3	1		X																					
andrieu's coil	3	1	X																						
lateral raise	3	2					X																		
L-fly	3	2						X																	
front raise	3	2				X																			
chin pull	3	2	X				X				X														
overhead press	3	3		X	X	X					X														
squat	3	3									X				X		X	X	X	X	X	X		X	
leg extension	3	1														X									
pistol squat	1	3														X		X	X	X	X		X		
leg curl	3	1															X						X		
lunges	1/3	2														X	X	X	X	X	X	X			
press	1	2														X	X								
stiff legged deadlift	3	3	X							X	X		X	X	X	X	X	X	X	X	X	X		X	
deadlift	3	3	X						X	X	X	X	X	X	X	X	X	X	X	X	X				
seated camel	3	1																						X		
standing camel	3	2																						X	X	
dips	2	2			X				X																
crunches	1	2													X	X									
good morning	3	2									X								X		X	X			
body raise	3	2									X														
lateral plank	1	1														X	X								
plank	1	1											X	X											
assisted crunches	3	2											X	X		X									
lateral crunches	1	2													X										
handstand press	1	3			X	X	X			X	X														
front lever	2	3	X	X						X	X	X													
Superman	1	1									X														
Nordic Curl	1	2																		X					

To create this database we worked with our personal knowledge, and diverse books such as Delavier's méthode, as well as some specified websites. It was a very interesting journey through fitness and really uplifting regarding our understanding of the human anatomy and biomechanics.

Through this formalism we had a first glance of what would be our ontology. We then refined this through brainstorming and debates to know exactly what would be in the ontology.

IV/ The creation of the ontology

This ontology was realized using the protege software. Here are some screenshots of important parts regarding the creation part. The main properties (with there reciprocities) are BuildUp (an exercise build a muscle) , HasDifficultyLevel (not all exercice can be perform safely by a beginner), is Needed (if an equipment is required to do an exercise)

Here is the description of an exercise: With the properties:

Description: LegCurl

Equivalent To ➕

SubClass Of ➕
- (BuildUp some Gastrocnemius) and (BuildUp some Ischio) and (Needs only Leg_Curl_Machine) and (HasDifficultyLevel only Easy)
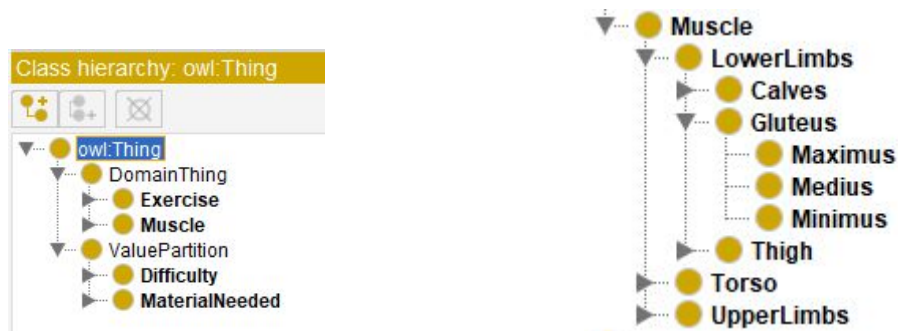- Exercise

Object property hierarchy: owl:topObjectProperty

Asserted

- owl:topObjectProperty
  - BuildUp
  - HasDifficultyLevel
  - IsBuiltUpBy
  - IsNeeded
  - Needs

Here is a glance at the nomenclature: There you can see implanted in protégé the classification of a sample of the muscles, the gluteus (buttocks) as it happens:

Here is a much broader panorama of our classes:

Now the user can use it his way, if he wants to know how to build some muscles in his back:

And here a query for a more specific request:

DL query:

Query (class expression)

Exercise **and** (BuildUp **some** Back **or** BuildUp **some** Abdomen) **and** HasDifficultyLevel **only** Easy

[Execute] [Add to ontology]

Query results

Subclasses (4 of 4)
- ● **LatteralPlank**
- ● **Plank**
- ● **PullDown**

Conclusion:

Overall we are pretty pleased with the results of this project. Of course, this is only a beginning and their similar tools already existed, yet we tried our best to propose a first step towards an open-source tool for muscle training. Regarding our initial problematic and this final ontology, we feel like we have an asset truly answering this problem.

Anybody wanting to shape up his biceps is now one query away from the answer, and this for any level and any equipment available.
Some improvements can already be discussed. Of course incremental upgrades, by extending the database and fine-tuning the granularity of our criteria. But also radical evolutions, by adding new criteria such as outdoor/indoor, risk of injury, need of a spotter etc. Also, we could link our exercises and muscles to a data bank as Wikipedia or a weightlifting specific website, to instruct the users about the exercises that are offered to them. This would come in the V2.

In the end, this is a great start, and our project reaches the conclusion we wanted it to.