Case Study – Master 1 Data Science & Artificial Intelligence
Université Côte d'Azur

Lab: UCA, CNRS, CEPAM UMR 7264 https://www.cepam.cnrs.fr/ Project : Arch-AI-Story, Idex UCA^{JEDI} project (dir. I. Théry-Parisot) https://www.cepam.cnrs.fr/equipes/axe-transversal-arch-ai-story/	**Arch-AI-Story team** **with whom the students will work:** Tutored by Laura Cassard & Vanna Lisa Coli (Post-doctoral fellows) Supervised by Didier Binder (Emeritus Research Director and in charge of the Workshop 3 TRAD-IA)

PROPOSED STUDY

Machine Learning recognition and classification of experimental and archaeological imprinted decorations

Aim: predict the shell and the printing gesture from the 3D models of its imprint

During the 6th millenium BCE in the central and northwestern mediterranean, the first neolithic farmers (Impresso-Cardial cultural complex) settled and their pottery are characterized by imprinted decoration with multiple tools, including marine shells. To learn more about the potters' toolbox, on the basis of experimental material, by analogy of shapes and measurements, the archaeologist is able to identify the types and sizes of the shells. A new 3D imaging analysis method (Cassard, 2020 ; Cassard *et al*., forthcoming) has recently been developed to objectify this method. However, the analogy of the shapes to caracterize the species and printing gesture is still directed by the archaeologist (visual description) and the format of the imprint is still partially processed (length, width, depth) and manually executed.

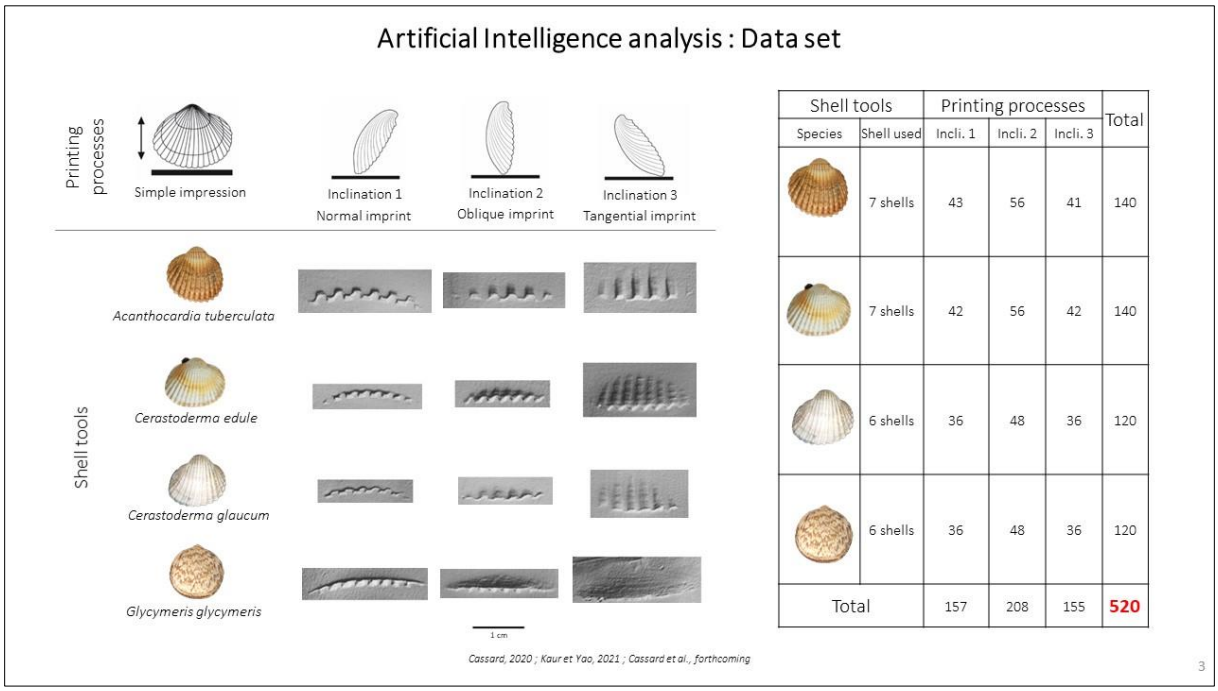
The application of Artificial Intelligence to 3D models of ceramic imprints can be a totally objective method by taking into account the imprint in its entirety in order to recognise and classify, by an automatic procedure, the tool (i.e., shells species) and the printing gesture.

A study was previously done on this subject (Kaur & Yao, 2021). Two deep learning methods (3D CNN method, Point Net ++) applied to 3D model of printed ceramic decorations were tested with quite unsatisfactory results. The dataset was too small for deep learning methods as they require a huge amount of data.

From this experience, the objective is to test other supervised classification methods based on machine learning such as the SVM method which is convenient for small data sets and data of different sizes. In the course of the study, if the results are conclusive on the experimental 3D models students will be able to apply their method to archaeological material.

Data set

For this case study, we selected experimental 3D imprints of the four bivalves most used by Neolithic potters: 3 different species of Cardiidae (*Acanthocardia tuberculata, Cerastoderma edule, Cerastoderma glaucum*) and 1 species of Glycymeridae (*Glycymeris glycymeris*). The students will dispose of a data set of 520 3D models of shell imprints (fig. 1). The 3D models of imprint are meshed and the extension is .ply.



Shell tools		Printing processes			Total
Species	Shell used	Incli. 1	Incli. 2	Incli. 3	
	7 shells	43	56	41	140
	7 shells	42	56	42	140
	6 shells	36	48	36	120
	6 shells	36	48	36	120
Total		157	208	155	**520**

Figure 1: Data set – Experimental 3D imprints are illustrated by the grey 2D pictures

The main steps of the procedure will be the following:

1. Explore the dataset to determine the best data format for the analysis (e.g., Point Cloud) and possibly pre-process the data
2. Investigate Machine Learning methods, from the class of supervised classification methods, which are suitable to apply to the problem of species prediction, select the best model and test its performances.
3. Once the model is validated for experimental imprints, the classifier will be tested on more complex data issued from archaeological samples.