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An artificial intelligence approach to classify archaeological wood charcoals: introduction of a case study with southern African Prehistoric charcoals

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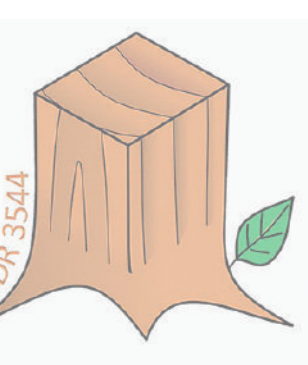
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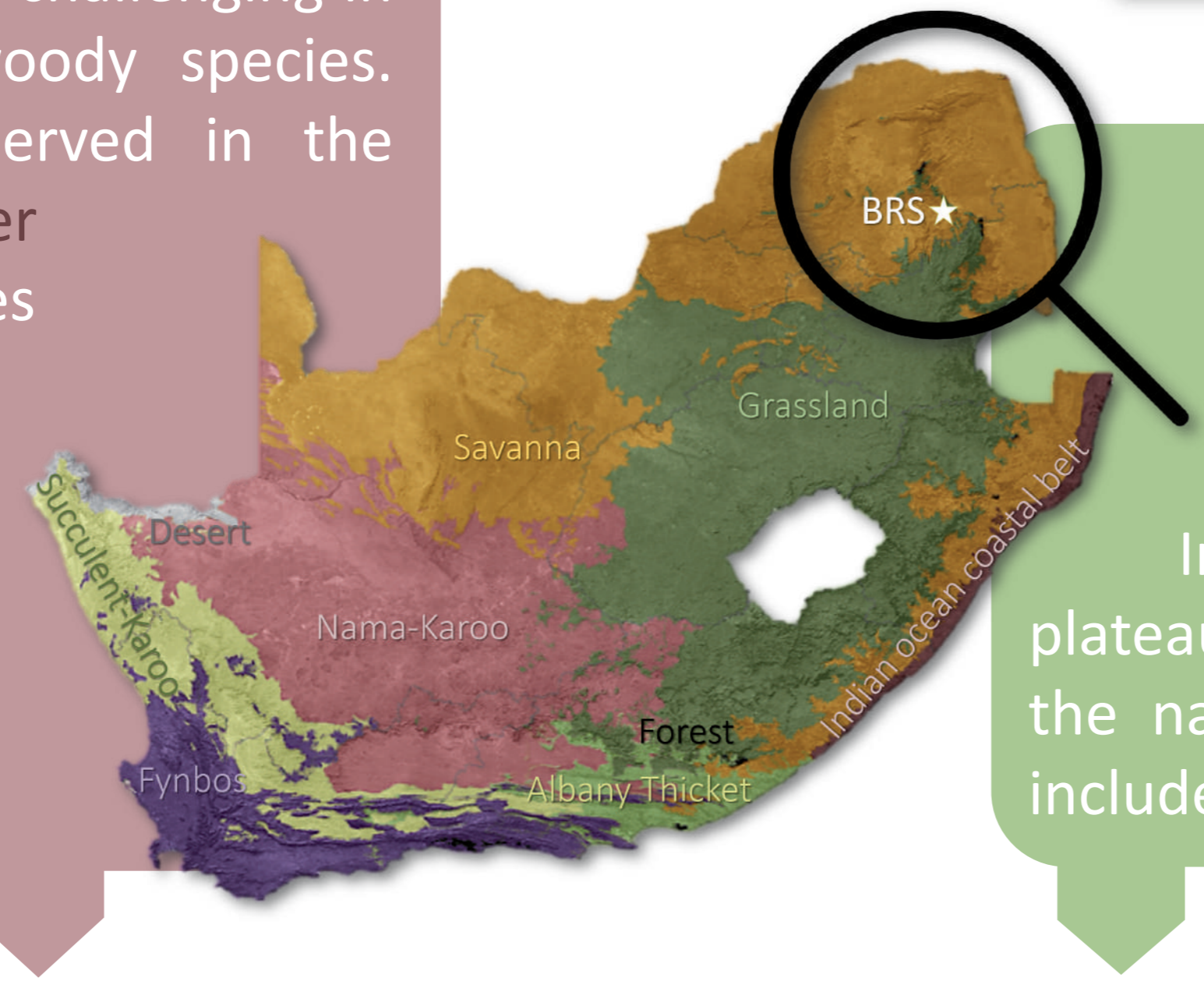
An artificial intelligence approach to classify archaeological wood charcoals: introduction of a case study with southern African Prehistoric charcoals

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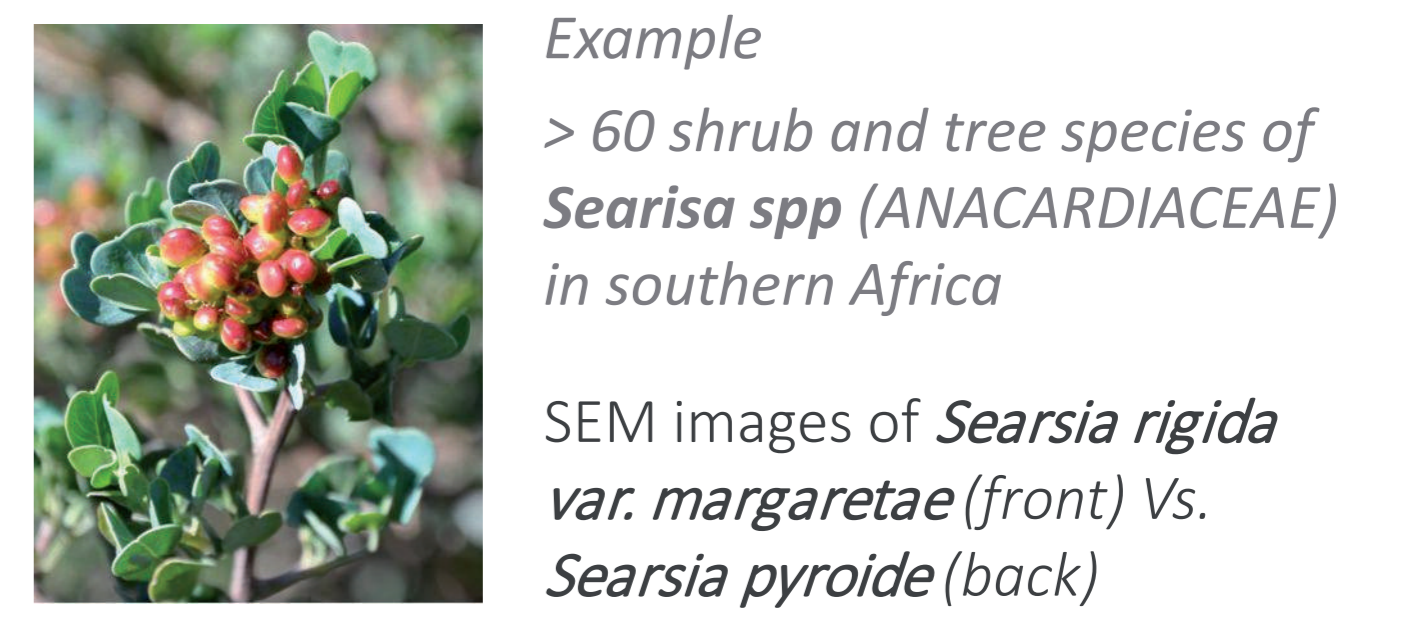
ANTHRACOLOGY AS A CHALLENGE ?

The study of archaeological wood charcoal remains allows documenting past vegetation (PALAEO-ECOLOGY), as well as fuelwood management (PALAEO-ECONOMY) of past societies. The taxonomic identification of charcoal is an inherent step, which can be challenging in some parts of the world with rich woody species. Charcoal remains are remarkably preserved in the archaeological site of Bushman Rock Shelter (BRS), Limpopo, South Africa. Their analyses in the *Later Stone Age* layers aims to provide information on human behaviour regarding wood use as a fuel during the critical climatic period of the Late Pleistocene / Early Holocene transition *ca.* 11 700 yrs. cal. BP.



SOUTHERN AFRICA : A LUXURIOUS WOODY VEGETATION

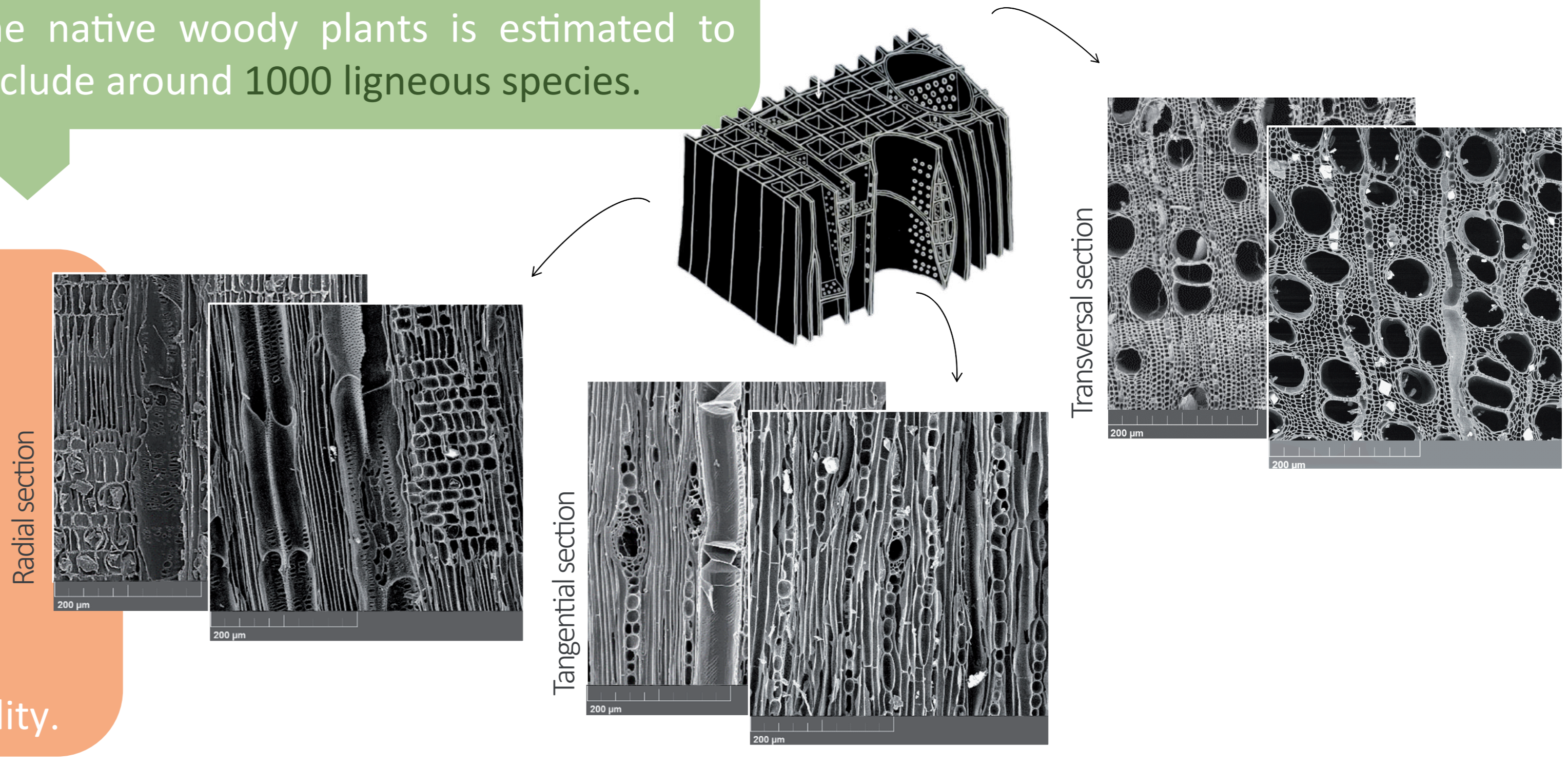
In the southern African interior plateau in central Limpopo, the richness of the native woody plants is estimated to include around 1000 ligneous species.



SEM images of *Searisia rigida* var. *margaretae* (front) Vs. *Searisia pyroide* (back)

HIGH VARIABILITY OF WOOD ANATOMY

Diverse climatic regimes and landforms contribute to the high *inter- and intra-specific variability and similarity* in wood anatomy that limit wood identification at the family/genera level. The *accuracy of identification and reliability of reconstruction of past woody vegetation* depend on the degree of knowledge of the anatomy of the taxa and the ecology of the current vegetation. There is currently no comprehensive atlas or identification key for the study area that takes into account both the wide diversity of woody species and their anatomical variability.



EXPLORING AN ARTIFICIAL INTELLIGENCE APPROACH

New methods of artificial intelligence (AI) recently contributed to raise the interpretative potential of historical and archaeological data. In this regard, the research project *Arch-AI-Story* aims to automate the identification of diverse remains by deploying shape recognition and classification algorithms in the context of supervised learning.

TASK 1

Creation of specific data banks

Mapping of datasets

- 1567 micrographs → reflected light & scanning electron microscopes (SEM)
- 3 wood sections from charcoal ref. coll. of the study area → 83 specimens

Anatom-IA

A collaborative online image bank

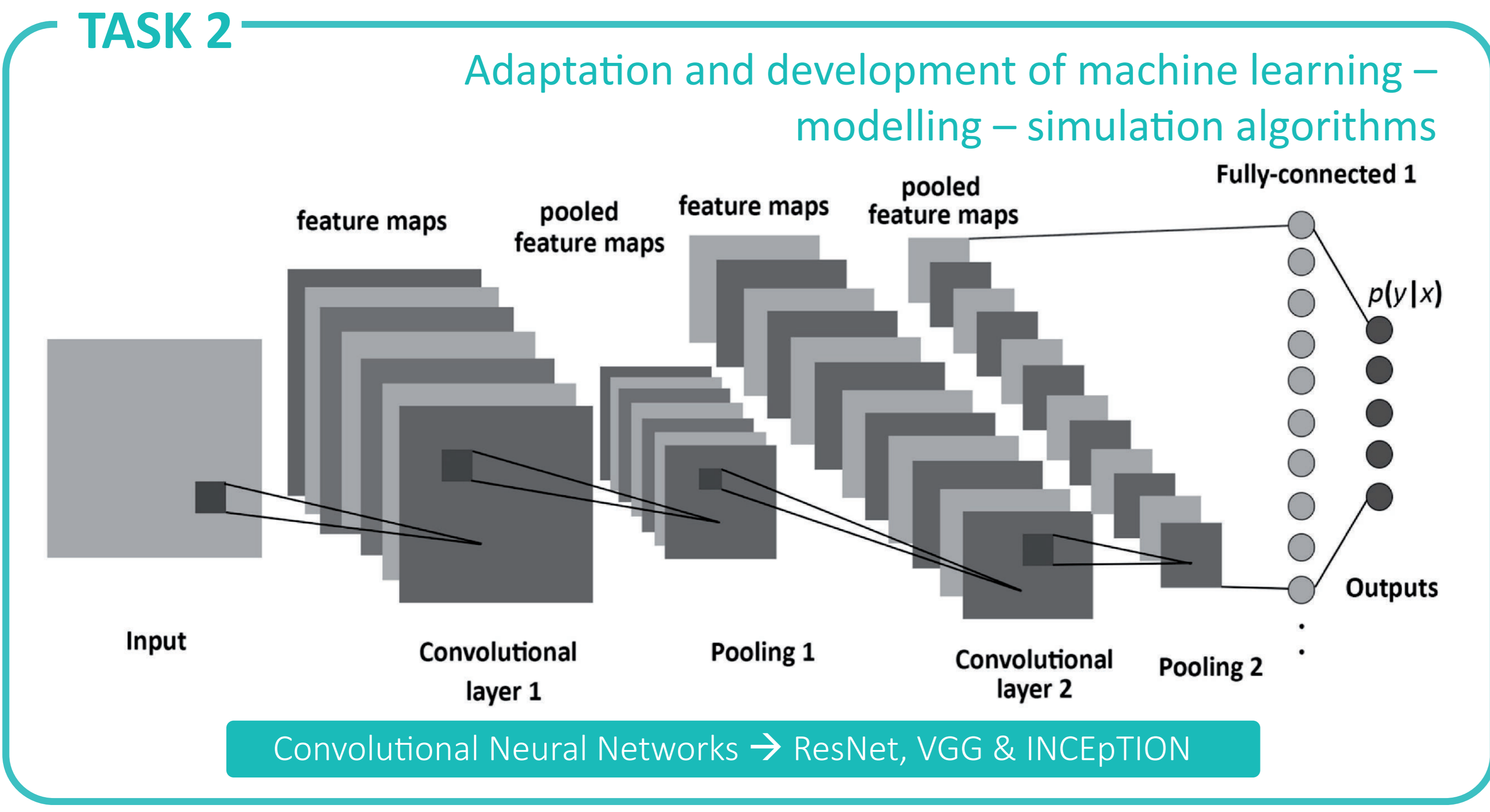
Interoperable tool for anatomical identification based on IA

Corpus standardisation

- Selection to avoid overfitting
- SEM images
- transversal section
- fixed magnification

Image pre-processing

Cropping & data augmentation → subsamples from original images



TASK 3

Classification accuracy & id of biases

- Need of more images & more taxa

Return on the corpus

- Inclusion of all images datasets
- Inclusion of anatomical features

Expectations on the potential reinterpretation of archaeological data

- Clarification on id of selected taxa
- Consideration of charcoal taphonomy in classifier performance

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