CAA2023 50 years of Synergy

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Abstract Book

Table of Contents

Table of Contents		65. Building Persistent Online Open Databases in Archaeology: Bulgarian Perspective and Experience 30
Celebrating 50 years of CAA in Amster	rdam!	95. Photogrammetry and 3D point cloud processing software as a tool against looting: an efficient combination to create a catalog of stolen objects 31
	20	117. Spatial soil information as a proxy for archaeological predictive modelling in arid regions: the Serevani plain example (Kurdistan, Iraq) 31
Venues and Events	21	134. Predicting the Biome: a new machine learningapproach to animal depictions in rock art32
Workshops at the Vrije Universiteit Amsterdam	21	157 Modeling landscape evolution and archaeological
Sessions at the RAI Congress Centre	21	site distributions in eastern South Africa: a geo- archaeoinformatic approach 32
Icebreaker Reception at Zuiderkerk	21	158. Diaitization as a Form of Protection of pre-Columbian
Conference Dinner at House of Watt	21	Mummified Human Remains 33
		159. CORPUS NUMMORUM – A Digital Research Infrastructure for Ancient Coins 33
RAI Amsterdam Map	22	161. Implementing Digital Documentation Techniques for Archaeological Artifacts to Develop a Virtual Exhibition: the Necropolis of Baley Collection 34
Preliminary Schedule	24	202. Archaeoriddle discoveries: On the relationship betweenrabbit-skinners and poppy-chewers34
Posters	29	206. Use and contribution to the field methodology of Mobile Gis in forest contexts. The case study of boreal forests (Skåne, Sweden) 35
East Africa	29	209. The old abbey church of Notre-Dame de Bernay: a
		$\mathbf{S} \mathbf{C} \mathbf{C} \mathbf{C} \mathbf{C} \mathbf{C} \mathbf{C} \mathbf{C} C$

231. Photogrammetric terrain model of the San Isidro site in El Salvador. Data processing and archaeological analysis 36

262. Multiproxy modelling of urban demography – the case study of Palmyra, Syria 37

268. The application of CLR and ILR transformations in the compositional analysis of geochemical data 37

278. The use of Photogrammetry and Computer Vision with Python programming language for plotting lithic surface scatters 38

298. Archaeoriddle discoveries: Granalejos II-b, the ultimate revelations 38

360. Generative models applied to the reconstruction of
profiles of iberian pottery fragments39

363. The preliminary results of application of remote sensing and machine learning methods in the studies of flint mining landscape in Egypt 39

366. Inferring shellfishing seasonality from the isotopic composition of biogenic carbonate: a Bayesian approach 40

Workshops (Monday) 41

A Basic Introduction to O	pen Source GIS usin	g QGIS 41
---------------------------	---------------------	-----------

CRMarchaeo Workshop: a stepping stone to FAIR practice 41

3D Artifact Documentation with the GigaMesh Software Framework

Introduction to deep-learnin	g	41
Sharing and maintaining sof	tware with GitHub a	and Git 42
Realistic material modelling archaeological artefacts in B	and rendering for 3 llender	D scanned 42
Developing 3D Scholarly Edit Dimensions	tions. Storytelling in	Three 42
Documentation of cultural h	eritage data with Fi	eld 43
Agent-based modelling for a	rchaeologists	43
ssions (Tuesday-Thu	rsday)	45
uesday		45
01. Integrating mobile comp traditional archaeological m	uting technologies i ethods	nto 45
310. Field trial of using a custon collection of wall structures	n mobile application fo	r data 47
379. FAIR data in the field		48
316. Utilizing mobile application archaeological interpretations	ns for LiDAR data field s	surveys and 48
364. Archaeological 3D models: and techniques in archaeologica	mobile devices vs class al documentation and p	sical devices presentation 49
166. Applying Mobile GIS and the Monitoring Stone Decay of Exca	he Cultural Stone Stabil avated Structures at Arc	ity Index to

Se

41

Т

ion ary
66
ar statistics
conomic (1 st Millenium 68
g weaning age 69
ogy 71
l approaches
71
e Past
luology 73
es 76
its effects on eaning 78
ased 79
or synergistic study of
ween 625-200 80
82
F

aning Age FiNder (WEAN): A tool for estimating weaning quential isotopic analysis of dentinal collagen	age 69
it: recent thoughts on archaeological epistemology	71
ere is no epistemology without creativity, or how to comb ative methods, material culture, and theoretical approach	ine es 71
Are Archaeological Narratives about the Past cted? – Analysing Argumentation in Archaology	73
constructing the constructed: Focused coding as a ological tool to analyze archaeological narratives	76
gueness and Uncertainty in Linked Open Data - its effects of modelling, performance, classification and meaning	on 78

80

82

66

68

	314. Digital surface models of crops used in archaeological feature detection -case study at the site of Tomašanci-Dubarava in Eastern	e :
	Croatia	83
	282. The Art of Dimensional Space - starlight, star bright	84
	137. From shape to grow conditions: a workflow combining micro- 3D scanning, geometric morphometrics and machine learning for analysis of past agricultural strategies.	the 86
	88. Grouping artefacts from archaeological deposits: 3D GIS and the interpretation of site formation	ne 87
	99. Re-visualising Glazed Bricks of Ashur: From a puzzle to a 3D model	87
	271. Best of both worlds: Visibility analysis of objects of different sizes based on algorithms and experimental studies	88
	54. Topology-based Scar Detection on Paleolithic Artifacts in 3D	88 18
	20. Theorizing Time and Change for 3D GIS	89
	352. Photogrammetric documentation in 3D analysis of an Early Medieval burial mound in Kazimierzów, Poland.	90
	377. Building and using an integrated 3D database	91
	33. All datasets are Meshes: Towards a new Ontology for 3D GIS	92
0 11	7. Open Analytical Workflows and Quantitative Data ntegration in Archaeological Prospection	94
	331. Conducting soil surveys – orchestrating change: developing practices to enable an integrated approach to agricultural and archaeological management	95

353. Taming Complexity: the rocky road from qualitatively accurate to quantitatively precise data analysis and interpretation in archae geophysical survey	te eo- 96
109. Documenting drone remote sensing: a virtual reconstruction approach	98
18. Survey Planning, Allocation, Costing and Evaluation (SPACE) Project: Developing a Tool to Help Archaeologists Conduct More Effective Surveys	98
343. Field survey and environmental proxy data to asses the Roma Rural world in Lusitania.	an 99
264. Machine Learning approaches for a multi-scale and multi- source detection and characterization of archaeological sites: the case of the funerary tumuli at Abdera (Thrace, Greece, 6 th – 2 nd C. BCE, aprox.)	99
8. Modelling Ancient Cities: methods, theories and tools:	101
135. Modelling long-term patterns of urbanism in Anatolia: Conceptual and computational approaches	103
80. Does economic exchange drive settlement persistence pattern Simulating patterns between Cyprus and the Levant during the La Bronze Age	s? te 103
120. Connecting ports and territories: examples from Asia Minor	104
323. The part and parcels of a city. The impacts of urbanization on the population of ancient Thessaloniki	ı 105
9. Visual communication on Hellenistic and Roman squares - The public spaces of Priene and Pompeii explored with 3D vector visibility analyses	107

128. A multi-scale quantitative and transferable approach for the
study of hillfort communities.108

378. A GIS approach to morphology and transformations of ancient cities. Some reflections from historical sources to spatial analysis 109

192. Inequality of a townscape. Problem of assessment of living
space in preindustrial cities.110

207. The urban side of child rearing: application of machine learning on sequential isotopic dentine data for pattern recognition related with weaning and physiological stress 111

12. Chronological modelling: formal methods and research
software113

105. Aoristic temporal study of heterogeneous amphora data in Roman Germania reveals centuries-long change in regional patterns of production and consumption 115
124. Temporal Modelling of the Roman Marble Trade 116
123. Beyond chronological networks: a comparison of formal models for archaeological chronology117
189. Dendrochronological networks: from time series to networks and back to spatio-temporal patterns again117
70. Conventions for Archaeological Stratigraphic and Chronological Data118
57. Automating chronology construction and archiving (FAIR)ly along the way 119
285. ChronOntology for periodisations in Entangled Africa 120

	283. Discussing the need for a new CAA Special Interest Group or chronological modelling	120
1 C	3. An inventory of the Sea: our shared marine heritage hallenges and opportunities	1 22
	12. Aggregating the UK's maritime data in Unpath'd Waters	123
	210. Embedding heritage data within a broader marine context	123
	273. Shifting Sands: a review of the marine archaeological record Scotland.	in 124
	34. Recording Davy Jones' Locker: Reimagining the National Mari Heritage Record for England	ne 125
	248. Modest Doubt: Enabling Discovery Across Maritime Heritage Records	9 126
	345. The CHERISH Project: Integrated survey of the marine histor environment	ic 126
	229. Unpath'd Waters: Values and co-design in large scale maritin immersives	ne 127
	94. Photogrammetry As An Accurate Tool To Document Our Hidde Submerged Heritage: Methodological Approach And Examples Fr Swiss Lakes	en om 128
	6. Dealing with data about, but not from, Doggerland	128
1 E S	9. Building a Collaborative & Interoperable Information cosystem: A conversation to bridge archaeological data ystems and infrastructures	1 30

32. A Bridge too Far. Heritage, Historical and Criminal

Network Research	131	prehistoric data analysis and predictive modelling	146
141. Networks of Hittites: Rivers, Mountains, and Cities	134	198. Characterizing stylistic evolution via Approximate Bayesian Computation and Random Forest Adjustment	14
121. Challenges in Building Akkadian Co-Occurence Networks for	or		
Comparative Research	135	328. Amphoraefinder - Roman amphorae identification through Convolutional Neural Networks	149
257. Characterising Peasant Economies in the north of Roman S	Spain		
through Network Science	136	233. A comparison of machine learning and rule-based approach for text mining in the archaeology domain, across three language	nes es
242. Travelling the wine dark sea – Networks of Mobility in the	Late		149
Bronze Age Mediterranean	137		
78. Why did cities evolve in Gharb Al-Andalus? Network analys	is as a	Assyriological Dataset for ML applications: is it for all?	150
potential method for charting city growth	138	47 Machina Learning for archaeological site detection. An Irish	
112. The impact of Levantine transit trade on 16 th century Transylvania, Wallachia and Moldova	138	study	15:
279. Disentangle the Net: How Social Network Analysis Can He	lp 140	58. Automated detection of archaeological sites using LiDAR - addressing False Positives	153
onderstand and right the mole frameking in Antiquities	140	113 HillfortFinderApp and site detection across Europe – latest	
Wednesday	142	results from a Deep Learning based hillfort search	154
		238. Automated Recognition of Archaeological Traces in Southea	ast
22. Machine and deep learning methods in archaeologi	cal	Asia from Airborne Lidar	15
research – creating an integrated community (Part 1)	142	68. Automated Archaeological Feature Detection Using Artificial	
217. From unsupervised to supervised: Supporting the analysis large coin hoard with Al-based methods. Part 2	of a 144	Intelligence on UAV Imagery: Preliminary Results	157
		376. Machine learning for UAV-captured imagery: an outgrowth	of
3. From Fragment to Reconstruction using Neural Networks and	d	XRchaeology 2019-2022	158
Associative memories	145	351. Generalisation Canability of Semantic Segmentation Metho	bds
53. Chasing social complexity through body ornaments in the r	ecent	for the Identification of Archaeological Structures on Remote	10
prehistory of Iberia. Implemantation of an archaeochemical to	ol for	Schong Data	12:

	155. Building a toolkit for ML-integrated archaeological workflow the contribution of human-centred approaches	vs: 160
	17. Al-on-Demand (AIOD) platform and its uses for cultural herita	ge 161
	160. Creating an additional class layer with machine learning to counter overfitting in an unbalanced ancient coin dataset	162
0	8. Where do you draw your lines? Mapping transformat f archaeological practice in the digital age	ion 164
	333. Current approaches to computational archaeology at GIAP-I	CAC 165
	110. With great power comes great responsibility: rethinking the role of new technologies in the archaeological recording workflow	w 166
	307. The transformation of an archaeological community and its resulting representations in the context of the co-developpement open Archaeological Information Systems	t of 167
	151. Body Mapping the Digital: visually representing the impact of technology on archaeological practice	of 168
	173. Aligning procedures to map archaeological practice: the Tradition in Transition methodology	169
	142. Cultural significance assessment of archaeological sites for Heritage Management in the Digital Age: from text to spatial networks of meanings	170
	234. Mapping transformation of archaeological practice through digital data curation by using the Archaeological Interactive Repo (AIR)	rt 171

246. The gap in the line - digital impact on fieldwork practices	173
225. Using In-Person and Remote Methods of Co-Design to Bu Research-Oriented VR Programs.	ild 174
361. Re-thinking Our Digital Archaeological Practice through 3 Data-driven Analysis and Interpretative Visualization: Lessons Learned at Çatalhöyük and Palenque	D 175
84. Mapping the impacts of photogrammetry on workflow and dataflow in archaeological excavation	176
170. Landscape Heterogeneity at the Acheulean Site of Rodafr (Lesbos, NE Aegean): Connecting sites and continental models through intermediary scales	iidia 176
247. 1-Draw And 3-Dimensions: A Methodological Proposal Fo Recovery Of Archaeological Finds	r The 177
11. The Age of #Archaeogaming: The Past and Future of Archaeology + Video Games	of 180
 11. The Age of #Archaeogaming: The Past and Future of Archaeology + Video Games 340. 10 years of Archaeogaming; Good Hits & Bad Misses 	of 180 182
 11. The Age of #Archaeogaming: The Past and Future of Archaeology + Video Games 340. 10 years of Archaeogaming; Good Hits & Bad Misses 19. Creating Archaeogames – Experiences and results of a joint course in digital archaeology and digital humanities 	of 180 182 t 183
 11. The Age of #Archaeogaming: The Past and Future of Archaeology + Video Games 340. 10 years of Archaeogaming; Good Hits & Bad Misses 19. Creating Archaeogames – Experiences and results of a joint course in digital archaeology and digital humanities 22. Student Feedback on Archaeogaming: Perspectives from a Classics' Classroom 	of 180 182 183 183
 11. The Age of #Archaeogaming: The Past and Future of Archaeology + Video Games 340. 10 years of Archaeogaming; Good Hits & Bad Misses 19. Creating Archaeogames – Experiences and results of a joint course in digital archaeology and digital humanities 22. Student Feedback on Archaeogaming: Perspectives from a Classics' Classroom 228. Designing Stories from the Grave: Reviving the History of through Human Remains and Serious Games 	of 180 182 t 183 184 a city 186

2018). A low fidelity prototype interface was designed based on interviews with professional archaeological surveyors working in heritage management. The design was also informed by a rapid review of existing ML-powered tools. The prototype was tested in two online workshops with aerial archaeology specialists. The resulting data was analysed using qualitative coding to produce insights grounded in stakeholder feedback.

Results

Key findings of the prototype testing show that trust, accountability, and the provenance of outputs are significant issues for the integration of ML tools into professional practice. For example, an essential requirement for heritage management applications of ML is an audit trail which documents all stages of analysis and interpretation. The prototype testing also presents GIS as a key site of focus for the development of ML-augmented archaeological topographic survey practice. This is in contrast to research which situates automated workflows outside of GIS in notebooks or other code development locations.

Discussion and Conclusions

The implications of these results are that human-centred research is beginning to build a set of features essential to the design of successful ML-integrated topographic survey toolkits and workflows for archaeology.

To develop these resources, insights from the prototype testing will be mapped against an a framework for human-centred ML system design which is based on a synthesis of 30 published guidelines from across communities who research humancentred and social computing (human-computer interaction and computer-supported cooperative work) as well as technological implementation and deployment in realworld scenarios (MLOps). These guidelines are applicable to the archaeological use case because they consider applied ML from a domain-agnostic standpoint.

The ML systems design framework can be used as a basis to produce joined-up understandings of the challenges related to ML tool design, which will help the archaeological ML community make progress by providing practical steps on how to approach solving common problems in human-centred ML. A shared understanding of the challenges of developing ML tools from across disciplines and applications will help to define what problems have common solutions, and what problems are specific to archaeological or wider cultural heritage use cases.

Work-in-progress on future elements of the development of this toolkit will be presented, specifically the development of an open source catalogue of models and datasets as a trust- and accountability-building resource for the archaeological ML community and stakeholders.

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17. AI-on-Demand (AIOD) platform and its uses for cultural heritage

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Theme: Education of ML in archaeology

Archaeologists' interest in artificial intelligence (AI) and its subfield of machine learning (ML) is growing exponentially, e.g., (Bickler 2021; Fiorucci et al. 2020; 2022). We agree with the session authors that as archaeologists using ML we need to move beyond isolated case studies and explore how best to combine our efforts. We also share the ultimate goal of building an integrated community of practitioners. This session offers a bottom-up approach to community building, which is almost always the best approach. However, the top-down approach also has its benefits, for example, in providing infrastructure and other resources. We are convinced that the best results are achieved when the bottom-up and top-down approaches can be combined.

One such top-down approach to building an AI community in Europe is the AIon-Demand (AIOD) platform (<u>https://www.ai4europe.eu</u>). It has been under development since 2019 and has just started a new development cycle under the AI4Europe project (Horizon Europe CORDIS ID 101070000; <u>https://www.ai4europe.</u> <u>eu</u>.), whose mission is to further drive the technical development of the platform and build a supportive community to add value to the AI research community.

The AIOD is intended to serve as a resource to promote European research and innovation in AI. The objective of the platform is to support all solutions and tools that contribute to the ecosystem of excellence and the ecosystem of trust. It will mature to add AI assets and tools that can be used by the wider community to upskill and share knowledge with innovation sectors. It will provide new services and a marketplace for non-experts to experiment with and use AI solutions in their own work. The AIOD platform is a community resource and its success depends on the active engagement of end users. The platform is therefore open to any individual or organisation interested in technically developing aspects of the platform, leading or contributing to various components, sharing research outputs or simply sharing news updates or information about upcoming events. There are many opportunities to contribute and help shape the direction and features of the AIOD platform in the years to come.

Cultural heritage, and by extension archaeology, was envisaged from the outset as one of the eleven 'industrial verticals' (user domains) of AIOD. However, this is the first time that it has been included as one of the "model verticals" (case studies). The goal of the cultural heritage model vertical is to showcase success stories and how content can be presented most effectively. In addition, we want to identify the needs of cultural heritage in general and archaeology in particular, to identify where new research can be applied, and to help AI researchers to understand the specific challenges of archaeological applications. Ultimately, the aim is to build and foster a cultural heritage community within the AIOD platform.

In the first part of our presentation, we will introduce the AIOD platform and the plans for its development over the next four years. In the second part of the presentation we will focus on the services most suited to archaeology and how they can be used by archaeologists. The key goal of our presentation is to support the aim of the authors of this session, which is to continue building an integrated community of practitioners.

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160. Creating an additional class layer with machine learning to counter overfitting in an unbalanced ancient coin dataset

Gampe, Sebastian Tolle, Karsten

Machine Learning (ML) applied to ancient coin data brings different challenges. We have discussed some of them already at our talk at CAA 2022 in Oxford. In this paper we want to focus on the problem of dealing with an extremely unbalanced dataset for training a convolutional neural network (CNN) and the progress we have made since then.

One aim of our current project Data quality for Numismatics based on Natural language processing and Neural Networks (D4N4) is to train and improve a supervised CNN in order to recognize types and/or mints for the "Corpus Nummorum" (CN) dataset. This dataset features about 19,000 different coin types and more than 40,000 coin images from four different ancient landscapes ("Thrace", "Moesia Inferior", "Troas" and "Mysia"). One of our main problems is the coin per type ratio which is approximately two coins per type. Our previous tests have shown that a CNN based model cannot learn a type properly without a threshold of about twenty coins. By applying this threshold less than 200 types remain for training (Gampe 2021) (Gampe and Tolle 2019). So, we established another recognition model based on the coins' mints. Every mint class includes all corresponding coin types which increases our training set by a large number of coins (about 5,700 for the coin types and about 37,000 for the mints). This way we cover 94 of our 120 mints in the dataset.

Although we have achieved good results with the mint approach (78% Top-1 Accuracy) new problems have emerged. Some of our mint classes are too dominant due to a high amount of coin images in the dataset. Mints like "Pergamon" and "Perinthos" come with about 3,000 images while other mint classes just passed the 20 picture threshold. Hence, we discovered an overfitting in the model's results. So our idea was to split these "big" classes into an additional class layer without reducing the number of training images in the dataset. The goal is to create a dataset with a better balance between the classes. In addition, these new classes might be potentially interesting for the domain experts as well. Currently, we work on three approaches for generating the additional class layer:

• The first method is the use of the unsupervised "Deep Clustering" (DC) method (Caron et al. 2019) for the distribution of images to smaller classes of the same mint. DC incorporates a k-means approach which creates pseudolabels for a CNN. It also needs a predetermined number of clusters which has to be found in several experiments. However, a manual filtering for clusters with images that are as homogeneous as possible will still be necessary.