ARCHEOSEMA (AS), a meta-disciplinary project of theoretical, analytical and experimental archaeology, has been recently awarded by La Sapienza University of Rome. The project title is an acronym which sums up its two main theoretical foundations: the openness of modern archaeology (ARCHEO) to the analysis of physical, historical, linguistic signs (SEMA) underlying natural and cultural systems reconstructed and simulated through Artificial Sciences (Fig. 1).

The project is therefore connected to the construction of models conceived as both epistemological and methodological tools: indeed, on the epistemological level, ARCHEOSEMA is an interdisciplinary research program founded on the constructive dialogue between theoretical and experimental Archaeology with Physics, Mathematics, Statistics, Geography and Linguistics (Ramazzotti 2010); on the methodological level, it aims to solve problems of classification, organisation and structure of alphanumeric data; to implement dynamic simulation of the variables that constitute natural organic systems and/or cultural systems; to identify new rules for spatial organisation and, in addition, to explore the physical, aesthetical, linguistic and cognitive phenomena underlying isomorphism, self-organisation, entropy, learning and translation (Ramazzotti 2012, 2013a, 2013b, 2013c, 2013d).

The design of these models is based on a computer-programmed architecture that integrates relational capabilities of Database Management Systems (DBMS), Geographic Information Systems (GIS) and Artificial Adaptive Systems (AAS). Analysis, applications and experiments are currently being conducted by a team of young archaeologists, physics, geographers and linguists at the LAA&AAS: Laboratory of Analytical Archaeology and Artificial Adaptive Systems (Luca Deravignone, Alessandro Di Ludovico, Benedetta Pancirolii, Irene Viaggiu, Claudia Di Fede, Juliette Wayenberg, Massimiliano Capriotti). The LAA&AAS has been inaugurated in the Faculty of Letters and Philosophy of La Sapienza University of Rome thanks to the joint institutional efforts of the Department of Sciences of Antiquity, Department of European, American and Intercultural Studies, Physic Department and Semeion Research Center. The disciplines involved in the research programme are those of Artificial Intelligence and Mathematical Biology (prof. Paolo Massimo Buscema and dr. Massimiliano Capriotti), Physics of Complex Systems (prof. Vittorio Loreto and prof. Alessandro Londei), Computational Linguistics and Dynamic Philology (prof. Paolo Canettieri and prof. Simone Celani), Economical Geography and Spatial Analysis (prof. Armando Montanari and prof. Barbara Staniscia), Physical Anthropology and Human Population Genetics.
M. Ramazzotti

(prof. Alfredo Coppa, prof. Franz Manni and prof. Francesca Candilio) and Mathematical and Multivariate Statistics (prof. Giorgio Alleva, prof. Maria Felice Arezzo and prof. Filippo Belloc). Finally, it is worth mentioning that this experimental integration between Analytical Archaeology, Geographic Information Systems and Artificial Adaptive Systems has become a core of two European projects of the 7th Framework Programme (FP7) recently acquired by La Sapienza University of Rome: the contribution of the LAA&AAS to the achievement of the objectives of these two international research projects was recently published (Ramazzotti 2013b, 2013c).

This Supplement to «Archeologia e Calcolatori» is a special issue dedicated to the memory of the English archaeologist David Leonard Clarke (3 November 1937-27 June 1976), and is a further attempt to collect some applicative studies of complex natural and cultural phenomena following the Artificial Intelligence computational models through the lens of Analytical Archaeology (Clarke 1968). In fact, these complex phenomena are essentially understood to be the product of cognitive behaviour, in other words systems and ideal-types which represent it and can be analysed on a formal logical level. This preface leads the historiographical tribute to Clarke’s reasons of his “collected papers” (Clarke 1979) and a syntactic classification of the main logical inferences to trace archaeological reasoning back to the simulation of cognitive complexity. Artificial Adaptive Systems, as new mathematical tools

Fig. 1 – Photo by G. Azali (de Kerchove 1996).
expressing the emulative properties of such cognitive complexity, motivated
the “connectionist” reaction to “behaviourism” and therefore could effectively
impact on the epistemic nature of contemporary archaeological thought, since
systems complexities are developed by our brains and analysed by simulating
variables nets with non-linear and dynamic computational models of Artificial
Intelligence, Computer Science and Computer Semiotics.

During the 1970s Cybernetics, introduced by D.L. Clarke in the archaeo-
logical research essentially as Systems Theory, contributed to consolidate, in
the UK, in the USA and in Europe, the idea that the archaeological, linguis-
tic and anthropological cultures work as natural organisms and that their
organic-biological function could be simulated as a mechanical operation of
interconnected parts, driven by an input. These parts would be able to report
the whole process that caused the balance alteration, and such alteration would
not be that different from those observable in the so-called cultural systems.

However, this mechanisation of cultural complexity has turned the
research away from other possible analogies that could contribute to resolve
highly complex problems, and has especially radicalised a single meaning of
complexity, as a factual dimension outside the man, a cognitive nature inde-
pendent of human existence itself. But since the late 1980s, a large number of
studies have been conducted in an attempt to understand the complexity of
archaeological, linguistic and anthropological contexts not as being external to
the human being, not as passive objects of his research, but rather as a dynamic
expression of his own perceptual constructs. In this sense, this complexity
has been almost subtracted from the uncontested historiographical domain
of being interpreted as an external object investigable through mechanical
and linear systems, and has become the subject of specific researching that are
traced back to the cognitive capacity of man to create it.

There is thus the possibility to organise, by analogy between cultural
and cognitive complexity, a new apparatus of theoretical knowledge, methods
and applications that connects analytical research and Artificial Intelligence
(RAMAZZOTTI 2010, 171-198). The researcher who simulates the dynamic
behaviour of a complex system through these models of Artificial Intelligence
will therefore explore the configuration data (which have been learned) as
a hypersurface of trained connections. Therefore, instead of describing the
purely systemic complexity of a given context, the researcher will tend to act
on that context translated in alphanumeric matrices and trained by means of
Artificial Adaptive Systems in order to test every possible combination of the
trained hypersurface. An analytical and computational study of archaeological
complex systems that would benefit from Artificial Intelligence is, ultimately,
a study that evaluates the “meaning” of data relationships as an essentially
human learning, physically connected to the computational capacity of the
neural networks.
This type of study would therefore repeat a still strong Analytical Archaeology position but would also update this position to the progresses made by Artificial Intelligence in surpassing the limits imposed by Systems Theory, on the basis of the progresses achieved every day by Cognitive Sciences in recognition, in play, in simulation and classification of some of the principles governing memory, orientation and language.

Marco Ramazzotti
Dipartimento di Scienze dell’Antichità
LA&AA&S
Sapienza Università di Roma

REFERENCES