Evolving Functional Models of Ancient Urban Centers Using Cultural Algorithms

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Numerous functional models of modern urban centers have been proposed such as the concentric zine model. *The concentric zone model* based upon the growth of modern cities, with a city center surrounded by concentric zones of activity as shown in Figure 1. In the figure Region I is the center of the city surrounded by ring like regions, where each ring presents a particular functional zone.

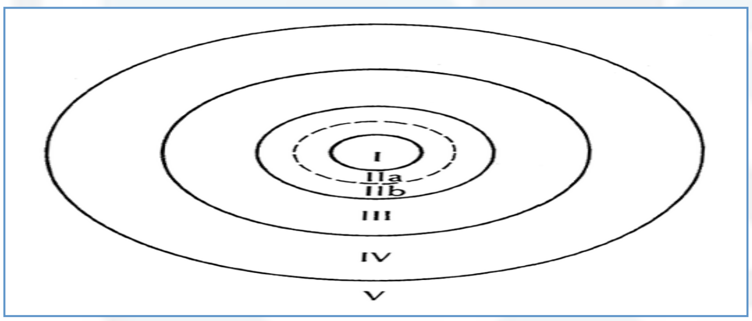

Figure 1: The concentric zone city model. The city center is in area I, surrounded by a factory district and retrogressing neighborhoods in areas IIa and IIb. Areas III, IV, and V are worker residences, middle class residences, and commuter residences respectively [Marcus, 1983].

The goal of this study is to use techniques from Complex Systems, Data Mining, and Computational Intelligence to produce functional models of ancient urban centers such as the one given above. These models can then be compared with models of modern cities like the concentric zone model above. Such comparisons may afford the opportunity to better understand the mechanisms behind the formation of ancient urban centers as well as indicating their similarities to modern cities.

Specifically, Cultural Algorithms are employed to evolve models for ancient cities based upon available archaeological data. This data is collected at the micro- or household level. The households are then used as building blocks to produce emergent neighborhood structures. These abstract neighborhoods are then combined in order to produce a functional model at the level of the ancient site. The combination process is guided by set of rules extracted at each level that constrain how the building blocks can be combined at that level in order to be consistent with basic patterns of occupancy within the site. These rules are extracted via data mining and machine learning techniques. In other words, the system learns to incrementally build a model of a city that is consistent with contextual rules extracted at various spatial scales from the site. Models are evaluated relative to their fit with the extracted rules at each level. Thus, building blocks at the micro-level can be mapped into emergent structures at the meso-level. Those emergent meso-level structures are combined to produce a functional model of the city.

Here, this technique is applied to the modeling of an example archaic urban center, Monte Alban, in the Valley of Oaxaca Mexico as shown in Figure 2. There the basic building blocks are terraces, the combination of terraces produces neighborhoods or barrios, and the combination of these abstract barrios produces a functional model of the ancient city. However, this technology can also be applied to modern cities as well in order to abstract emergent functional patterns where the building blocks may now have different architectural forms.

An advantage of this approach is that it can be used as a ubiquitous process to produce models of cities, ancient or modern, in a standard framework that facilitates their functional and structural comparison. The results of such comparisons can potentially lead to the development of meta-models of urban formation and expansion.

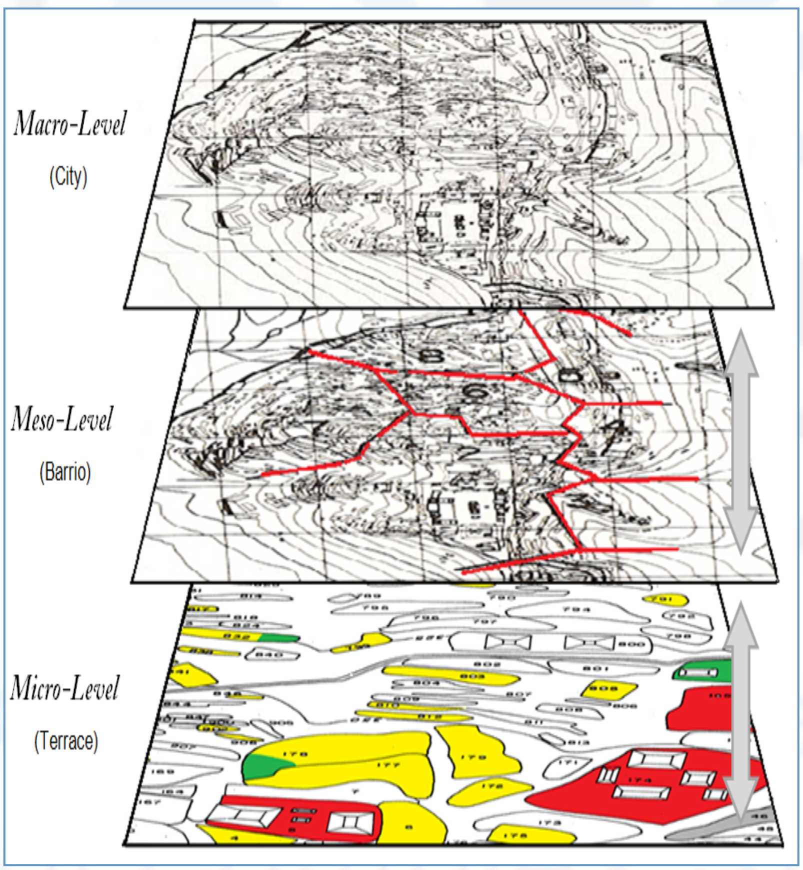

Figure 2: The three different spatial scales: the macro-level (the site), the meso-level (neighborhoods or barrios), and the micro-level (terraces and individual residences) for the site of monte Alban.