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# The Role of Knowledge in Multi-Layered Social Network Formation

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## Extended Abstract

Social networks as a communication media are in the centre of the public's attention and provide great sources of information for researchers. Having profiles on multiple social network sites and performing various activities in more than one network at the same time by users of these networks have highlighted the need of multi-layer social network analysis tools. In fact, we assume that people or social actors can link together in different ways and can be members of different networks at the same time. Therefore, a multi-layer model is needed to represent these networks where each layer corresponds to a particular network. Thus, each layer has its own population. In turn, each population has a Cultural Algorithm driving it with a distinct belief space. The belief space contains knowledge structures, such as normative knowledge, which is accepted and followed by its underlying population. The population at each layer consists of unique members of that layer and also members who are shared with other layers.

A social network can be modelled by a weighted graph, G(V,E,W), where V is a set of nodes which represent actors of the network and E is a set of edges that demonstrate the existence of a link between a pair of actors [1]–[3]. Each edge has a weight, *w*, which measures the strength of this relationship. Accordingly if $G_i(V_i, E_i, W_i)$ represents a layer and $n$ represents total number of layers, the network can be defined as:

$G(V, E, W) = G_1(V_1, E_1, W_1) \cup G_2(V_2, E_2, W_2) \cup \dots \cup G_n(V_n, E_n, W_n)$ While $V_i \cap V_j \neq \emptyset \; if \; i \neq j$.

In this research, the role of knowledge on dynamics of different layers has been studied. Our hypothesis is that, as layers have shared members, any change in the structure of one layer must have some sort of reflection on the others. Meanwhile, as the members of these networks are intelligent, they use their own knowledge to make the decision to choose suitable actions in response to various events they are coped with in the different layers.

To model the network we have adapted the idea of Multi-Population Cultural algorithm (MPCA). In this evolutionary algorithm, knowledge plays a critical role in directing the search process to find the optimal solution. Consequently, it has two main spaces, a population and a belief space which evolve each other in every iteration. The population space consists of individuals who present various solutions to solve the problem and the belief space is a knowledge repository that stores some sorts of knowledge about this population [4], [5].

In our model, for each layer, we make a population and a belief space. Each belief space stores normative knowledge of its own population which has two types of members, unique members and shared members. Shared members can be a member of more than one population while the unique members are just members of a specific population. Therefore, each population has automatic impact on other populations. Actions that members will take in different layers will be captured and the normative knowledge will be extracted from it.

By using this model it is possible to evaluate the role of knowledge that each member has, on his/her own decision-making process in various layers. It is also possible to study the impact of this knowledge on the decision-making process of other members. Consequently, the role of knowledge on the formation of multi-layered social networks can be studied which can be useful for further social network analysis tasks.

## References

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