HAIMLC701 AI & ML in Healthcare

2.0		**AI, ML, Deep Learning and Data Mining Methods for Healthcare**	10
	2.1	Knowledge discovery and Data Mining, ML, Multi classifier Decision Fusion, Ensemble Learning, Meta-Learning and other Abstract Methods.	
	2.2	Evolutionary Algorithms, Illustrative Medical Application-Multiagent Infectious Disease Propagation and Outbreak Prediction, Automated Amblyopia Screening System etc.	
	2.3	Computational Intelligence Techniques, Deep Learning, Unsupervised learning, dimensionality reduction algorithms.	

Multi-agent simulation model for the evaluation of COVID-19 transmission

- An agent-based model to analyze the spread processes of the COVID-19 epidemics in open regions and based on hypothetical social scenarios of viral transmissibility
- achieved by modeling an individual as an agent with a wide range of features (health condition, purchasing power, awareness, mobility, professional activity, age, and gender)
- Simulation results show that it can be applied to support decision-makers to better understand the epidemic spread and the actions that can be taken against the pandemic

- A multi-agent system is an organization of autonomous agents interacting with each other within a shared environment
- Differently from other works on modeling COVID-19 spread dynamics, the proposed model is able to represent individuals' heterogeneity, environmental diversity and social interaction
- . An agent has several features to express age, comorbidities, disease presentation (asymptomatic, mild or severe) among others.

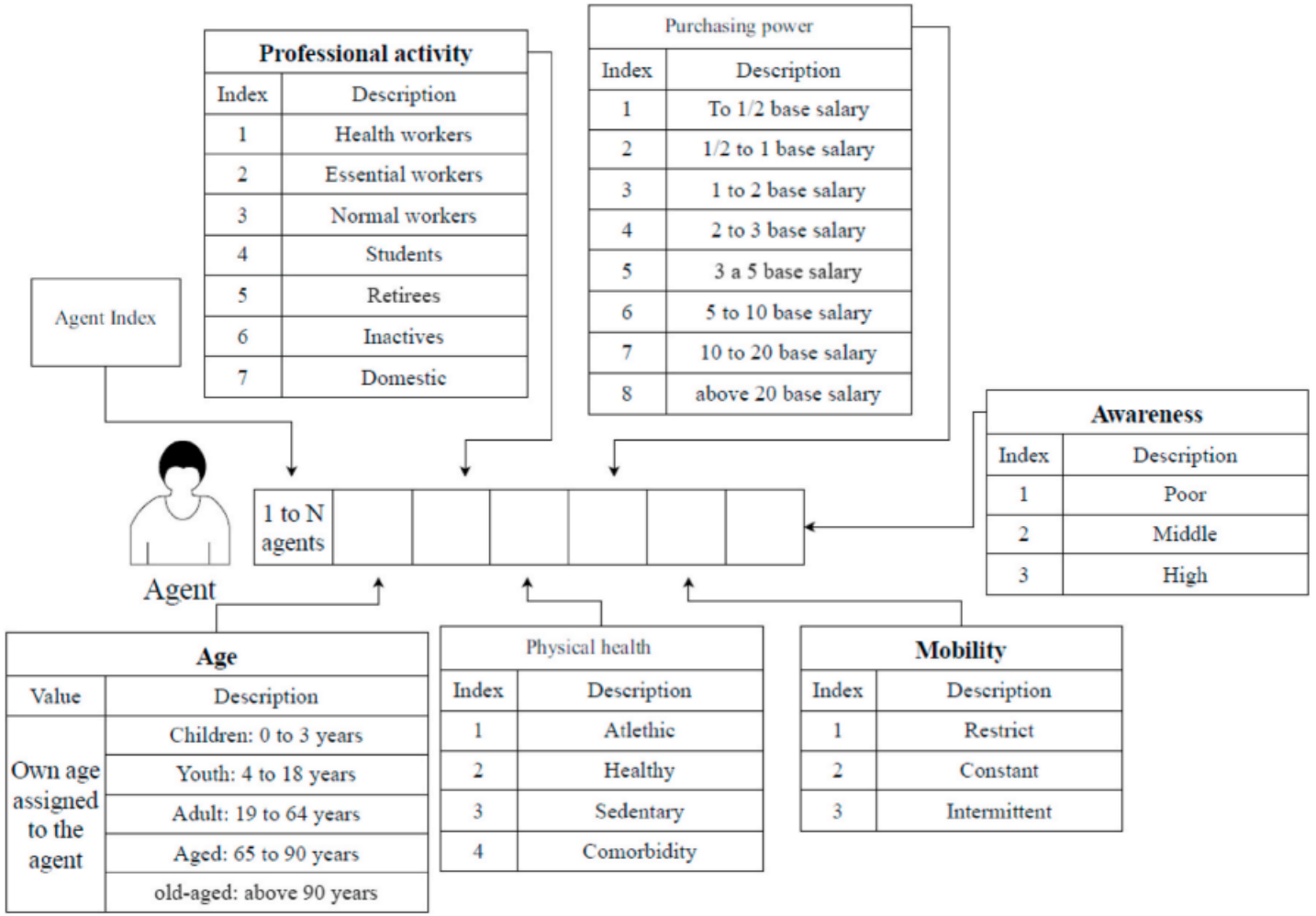

Fig. 2. Classification of the attributes according to their respective aspects for the elaboration of the matrix that stores the agents' attributes in the model.

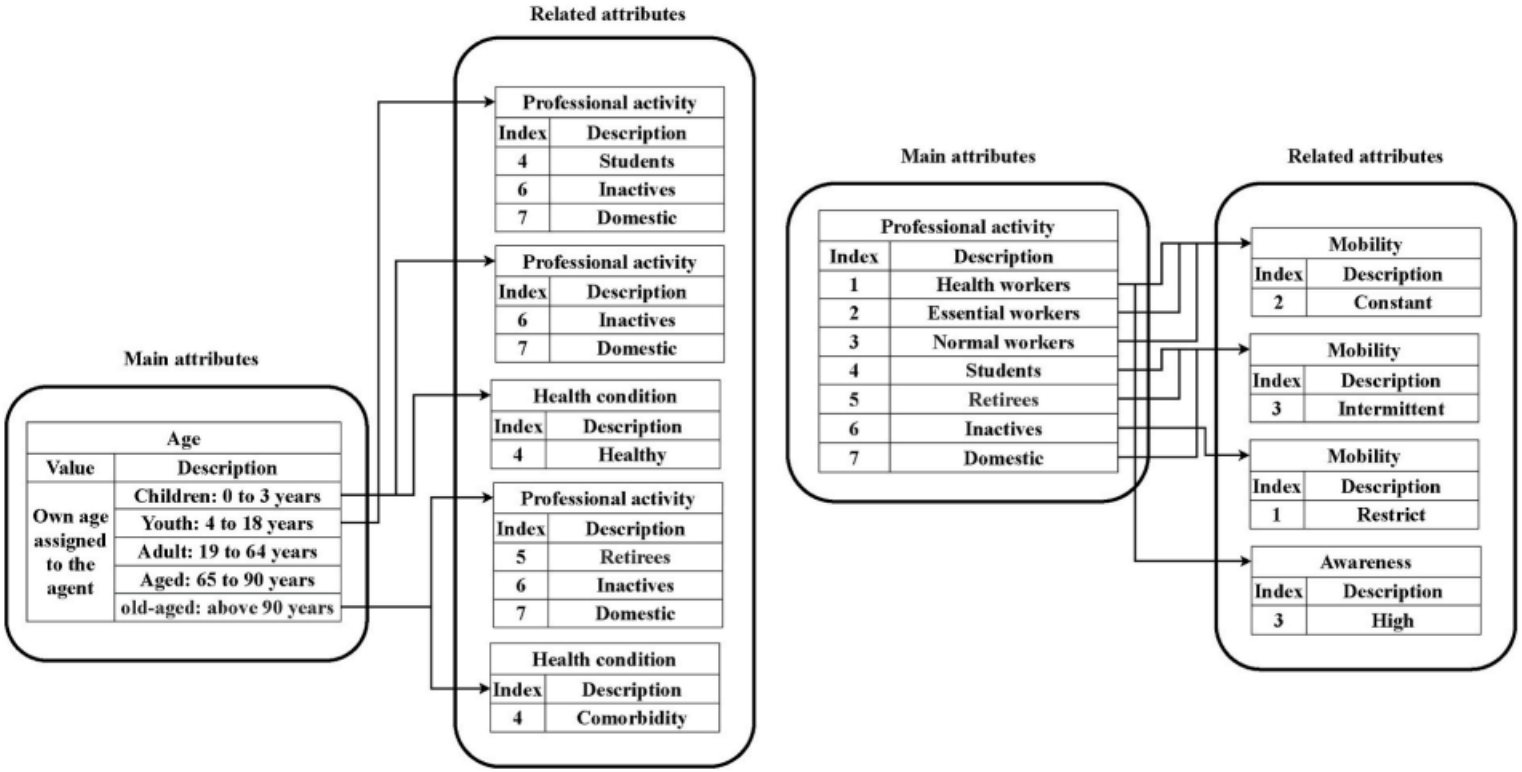

Fig. 3. Attributes and hypotheses related to the agents' age and professional activity classification.

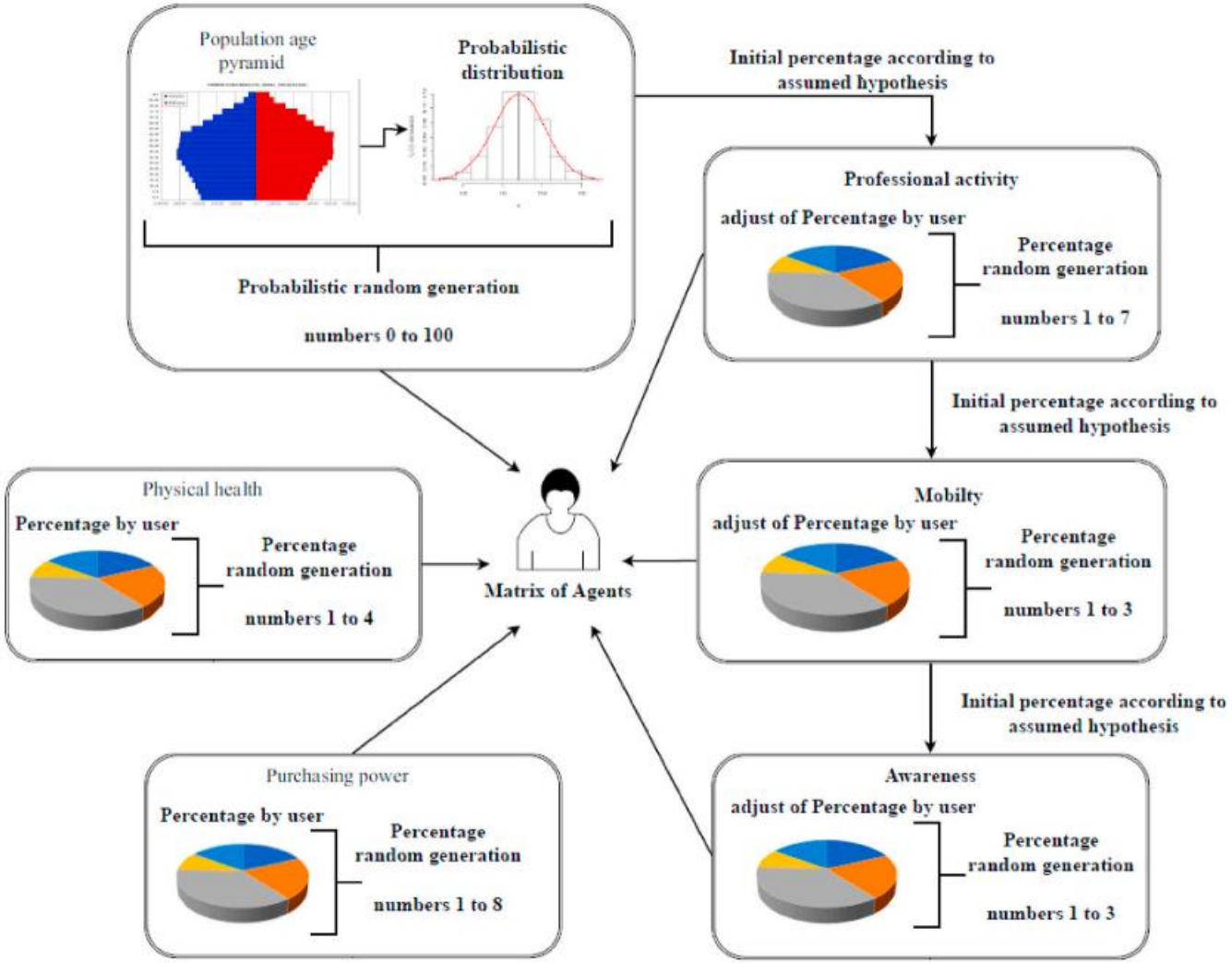

Fig. 4. Attribute classification process and agent attributes matrix elaboration.

Table 1
Scores assigned to each aspect of agents' attributes.

Professional activity		
Index	Description	Weigth
1	Health workers	75.39
2	Essential workers	62.98
3	Normal workers	59.13
4	Students	58.71
5	Retirees	54.12
6	Inactives	52.07
7	Domestic	52.07

Purchasing power		
Index	Description*	Weigth
1	up to 1/2	60
2	1/2 to 1	55
3	1 to 2	50
4	2 to 3	45
5	3 a 5	40
6	5 to 10	35
7	10 to 20	32
8	above 20	30

Physical health		
Index	Description	Weigth
1	Atlethic	30
2	Healthy	25
3	Sedentary	45
4	Comorbidity	50

Mobility		
Index	Description	Weigth
1	Restrict	20
2	Constant	60
3	Intermittent	40

Awareness		
Index	Description	Weigth
1	Poor	60
2	Middle	40
3	High	20

* using minimum wage as base

Summary

- Presented an agent-based model to analyze the
- spread processes of the COVID-19 epidemics in open regions

- The model incorporates aspects of social dynamics through simple rules based on statistical principles
- From these models, a diversity of scenarios and hypotheses can be modeled to obtain the conditions of coexistence, habits and behaviors that need to be avoided and that corroborate the spread of the virus

Automated Vision Defect Detection Supported Deep Convolutional Neural Networks

- detect abnormalities in the refractive error
- used to prevent the children of amblyopia, which can lead to permanent visual impairment, but at first it was detected.
- A tele amblyopia dataset is used for detection. Then proposed deep convolutional neural networks are used for automated amblyopia detection on tele amblyopia dataset. The proposed algorithm comprises of 2 phases.
- In the first phase, the Enhanced Firefly Algorithm (EFA) is used to segment the eye region.
- In second phase, a DCNN is designed and trained to classify the segmented eye areas as amblyopia or normal

The EFA divides into multiple eye regions, edited to 224 × 224 × 3 and fed into the defined CNN. igure 1 and Figure 2 illustrate several segmented areas with amblyopia and normal label.

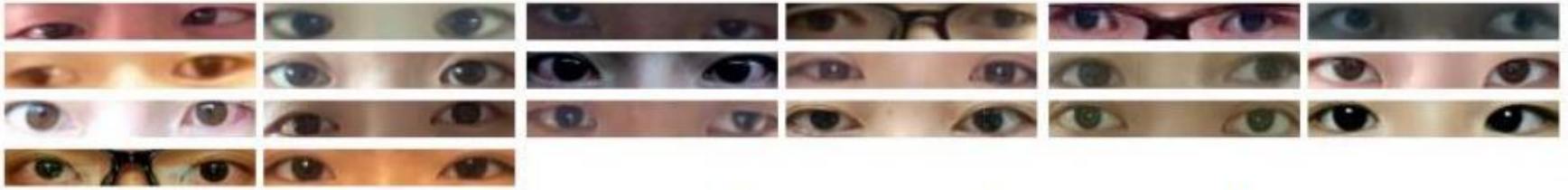

Figure 1: A few model occurrences of fragmented eye districts with amblyopia names

Figure 2: A few commendable occurrences of fragmented eye locales with typical names

Phases

- Eye Region Segmentation
  - Firefly Algorithm (FA)
- Deep Convolutional Neural Network (DCNN)

Firefly algorithm

- In mathematical optimization, the firefly algorithm is a metaheuristic proposed by Xin-She Yang and inspired by the flashing behavior of fireflies
- FA uses the following three idealized rules:
  - Fireflies are unisex so that one firefly will be attracted to other fireflies regardless of their sex.
  - The attractiveness is proportional to the brightness, and they both decrease as their distance increases. Thus for any two flashing fireflies, the less brighter one will move towards the brighter one. If there is no brighter one than a particular firefly, it will move randomly.
  - The brightness of a firefly is determined by the landscape of the objective function

Firefly algorithm

$$\beta = \beta_0 e^{-\gamma r^2},$$

where β0 is the attractiveness at r = 0

The movement of a firefly i is attracted to another more attractive (brighter) firefly j is determined by

$$\boldsymbol{x}_i^{t+1} = \boldsymbol{x}_i^t + \beta_0 e^{-\gamma r_{ij}^2}(\boldsymbol{x}_j^t - \boldsymbol{x}_i^t) + \alpha_t\, \boldsymbol{\epsilon}_i^t,$$

where the second term is due to the attraction.
The third term is randomization with αt being the randomization parameter, and ǫ t i is a vector of random numbers drawn from a Gaussian distribution or uniform distribution at time t

Firefly Algorithm

Begin

1) Objective function: $f(\mathbf{x}), \quad \mathbf{x} = (x_1, x_2, \ldots, x_d)$;
2) Generate an initial population of fireflies $\mathbf{x}_i \quad (i = 1, 2, \ldots, n)$;.
3) Formulate light intensity I so that it is associated with $f(\mathbf{x})$
   (for example, for maximization problems, $I \propto f(\mathbf{x})$ or simply $I = f(\mathbf{x})$;)
4) Define absorption coefficient γ

```
while (t < MaxGeneration)
    for i = 1 : n (all n fireflies)
        for j = 1 : i (n fireflies)
            if (I_j > I_i),
                Vary attractiveness with distance r via exp(−γ r);
                move firefly i towards j;
                Evaluate new solutions and update light intensity;
            end if
        end for j
    end for i
    Rank fireflies and find the current best;
end while
end
```