IDENTIFYING QUARANTINE CENTRE LOCATION AND RESOURCE ALLOCATION USING OPTIMIZATION TECHNIQUES

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Introduction to optimization techniques

- An optimization problem consists to find the best solution among all possible ones.
- An optimization problem can be defined as a finite set of variables, where the correct values for the variables specify the optimal solution.
- If the variables range over real numbers, the problem is called continuous, and if they can only take a finite set of distinct values, the problem is called combinatorial.

Problem statement

The main aim is to apply multi criteria decision making techniques to find optimal location for quarantine centers for covid 19 patients based on various decision factors such as

1. Distance from more covid prone area
2. Availability of hospitals
3. Appropriate for facilitating emergency situation
4. Route and vehicle

Further we would be working upon the area to predict appropriate number of resources required according to emergency prone and red alert areas.

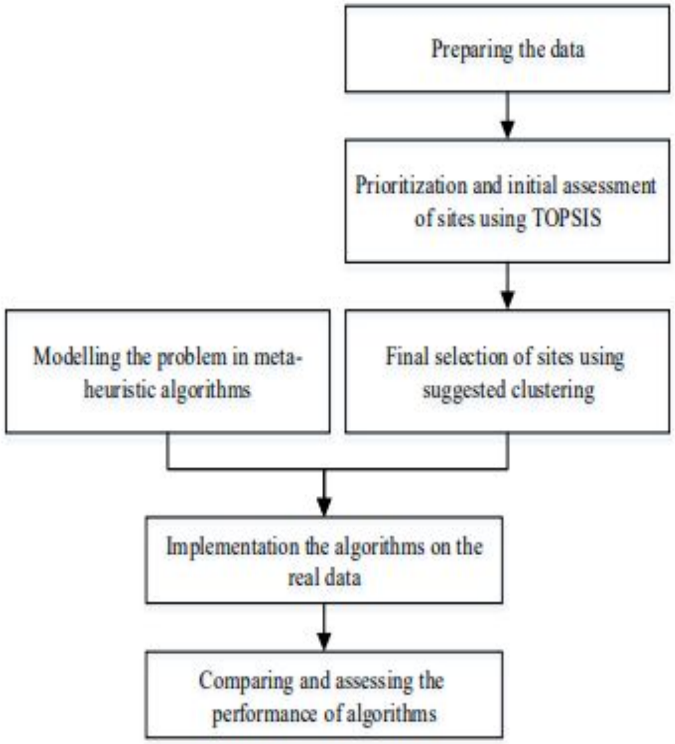
Working methodology

We would be working upon the given algorithms so far concerned:

- Considering the requirements of the methods to be used, the data was collected and prepared.
- Selection of centres
- TOPSIS and the proposed clustering method was used to prioritize the sites and to choose centers with higher priority and an appropriate distribution in the district.
- Then, meta-heuristic algorithms were used to choose the final centers.

Initially we would be working upon TOPSIS, PSO and ACO algorithms and further we would be exploring data in accordance to the dataset

Brief Working Sketch



TOPSIS(Technique for Order Preference by Similarity to Ideal Solution)

Topsis is a technique for taking decisions in real life MCDM problems by generating ranks.

The steps are as follows:

1. Calculation of normalized matrix

   $X_{i\,j} = x_{ij} / ([\Sigma_{j=1} X_{ij}]^{0.5})$

2. Calculate Weighted normalized matrix
3. Calculate ideal best and ideal worst value(will vary according to beneficial parameter)
4. Calculate Euclidean distance from ideal best: $si+ = [\Sigma_{j=1}(vij-vj+)^2]^{0.5}$
5. Calculate Euclidean distance from ideal worst $si- = [\Sigma_{j=1}(vij-vj-)^2]^{0.5}$
6. Calculate performance score $pii = si^- / (si^+ + si^-)$ subsequently rank will be generated

PARTICLE SWARM OPTIMIZATION

In PSO, every particle i has a position xi (representing a solution to the problem at hand) and a velocity vi (velocity indicates the movement of a particle from a position to another), which are updated in every repetition. The velocity is calculated by

Equation (1) $\rightarrow v\, i = w \rightarrow v\, i + c1 \rightarrow \phi 1i\, (\rightarrow p\, i - \rightarrow x\, i) + c2 \rightarrow \phi 2i \rightarrow p\, g - \rightarrow x\, i$,

(1) In the above equation, w is the inertia weight, pi is the PB of particle and pg is the GB. The $\Phi 1$ and $\Phi 2$ weights in each step are randomly selected for the particles. c1 and c2 are constant positive parameters which are called acceleration coefficients.

(Equation (2)) [63]. $\rightarrow x\, i = \rightarrow x\, i + \rightarrow v\, i$, (2) .

ANT COLONY OPTIMIZATION

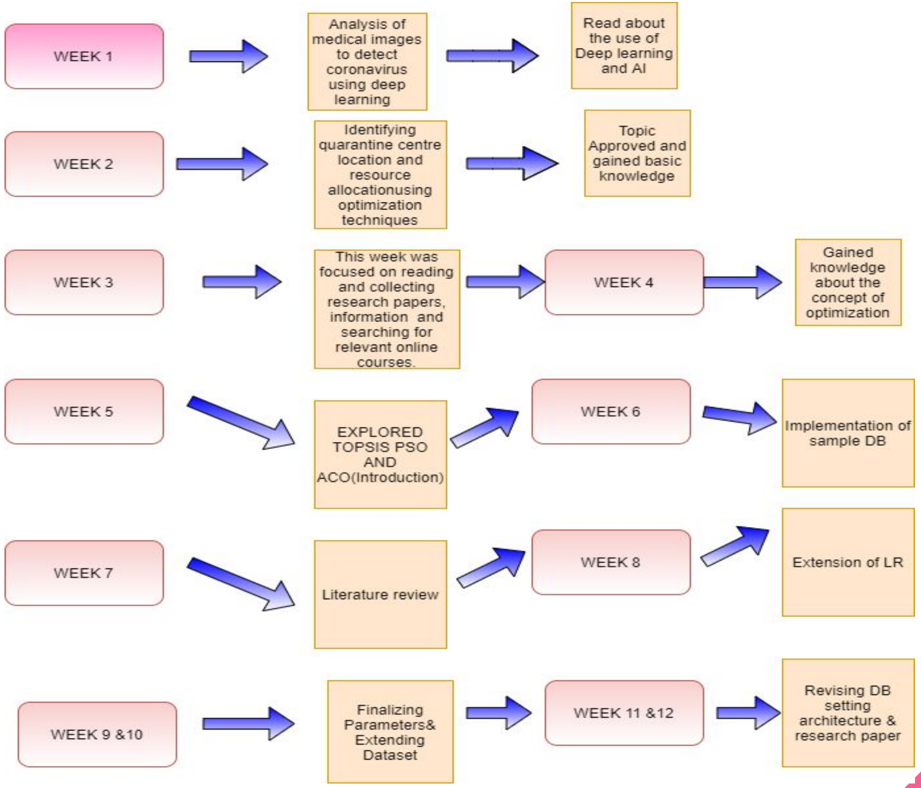
- **Ant colony optimization** (ACO) is used to find approximate solutions to difficult optimization problems. To apply ACO, the optimization problem is transformed into the problem of finding the best path on a weighted graph.

- The artificial ants (hereafter ants) incrementally build solutions by moving on the graph. The solution construction process is stochastic and is biased by a pheromone model, that is, a set of parameters associated with graph components (either nodes or edges) whose values are modified at runtime by the ants.

The steps of ACO model are :

1. Initialize the parameters (pheromone, etc.)
2. Insert the origin city for each ant in its forbidden list, in order to prevent it from going back to that city
3. Calculate the probability of selecting the next city, at each city, for any ant
4. Adjust the population of cities for the selection of each ant to the forbidden list of the ant
5. Add the selected city of each ant to its forbidden list
6. Determine the best path
7. Update pheromones based on the path quality
8. Evaporate the pheromone
9. Go to step 3 (if the stop condition is not met).

Work Plan


WEEK 1
Analysis of medical images to detect coronavirus using deep learning
Read about the use of Deep learning and AI
WEEK 2
Identifying quarantine centre location and resource allocationusing optimization techniques
Topic Approved and gained basic knowledge
WEEK 3
This week was focused on reading and collecting research papers, information and searching for relevant online courses.
WEEK 4
Gained knowledge about the concept of optimization
WEEK 5
EXPLORED TOPSIS PSO AND ACO(Introduction)
WEEK 6
Implementation of sample DB
WEEK 7
Literature review
WEEK 8
Extension of LR
WEEK 9 &10
Finalizing Parameters& Extending Dataset
WEEK 11 &12
Revising DB setting architecture & research paper

Research Paper

https://docs.google.com/document/d/1KYwLIHjn4jLpIBEHrRHMQKON-fHOZddRG6JkWkH78B4/edit?usp=sharing

Dataset

https://docs.google.com/spreadsheets/d/1bQU-CyQ8hEsJFB8kZwlyqplPWIcb97NbFL9kMN5g8h4/edit?usp=sharing

Parameters for optimization (ACC TO RANKING)

1. Location:

- preferably placed in the outskirt of the urban/ city area (can be a hostel/unused health facilities/buildings, etc.)
- away from the people's reach, crowded and populated area
- well protected and secured (preferably by security personnel/ army)
- preferably should have better approachability to a tertiary hospital facility having critical care and isolation facility

2. Access considerations

- Parking space including Ambulances etc.
- Ease of access for delivery of food/medical/other supplies
- Differently-abled Friendly facilities (preferably)

3. Ventilation capacity: Well ventilated preferably natural

4. Basic infrastructure/functional requirements:

• Rooms/Dormitory separated from one another may be preferable with in-house capacity of 5-10 beds/room

• Each bed to be separated 1-2 meters (minimum 1 metre) apart from all sides. • Lighting, well-ventilation, heating, electricity, ceiling fan

• Potable water to be available

• Functional telephone system for providing communications.

• Support services- fooding, snacks, recreation areas including television

• Laundry services

• Sanitation services/Cleaning and Housekeeping

• Properly covered bins as per Bio Medical Waste may be placed

5. Space requirements for the facility:

- Administrative offices- Main control room/clerical room
- Logistics areas/Pharmaceutical rooms
- Rest rooms- doctors/nurses/supporting staffs
- Clinical examination room/ nursing station / Sampling area
- Laundry facilities (on- or off-site)
- Mess/Meal preparation (on- or off-site)
- Holding area for contaminated waste
- Washroom/Bathroom/Toilet

6. Social support resources/ Recreational areas : Television and radio / Reading materials/ indoor plays

7. Monitoring the health of contacts: During that period, contacts should be monitored at least daily for fever and respiratory symptoms.

Further Work

1. MCDM techniques

(i) Multi-Attribute Utility Theory (MAUT)

(ii) Analytic Hierarchy Process (AHP)

(iii) Fuzzy Theory

(iv) Case-Based Reasoning (CBR)

(v) Data Envelopment Analysis (DEA)