A Case study - Neural Style transfer to Identify the infection sample and Markov chain model in CORONA infection spreads

**Abstract:** The objective of this paper is to identify the force of mortality for each age due to COVID -19 pandemic. We have using some Neural Style Transfer, to identify the infection spread-out in human lungs due to CORONA infection. Markov chain model is used to determine in Discrete Sate Space what the probability of state transition is. Kolmogorov equation to find [joint probability distributions](https://en.wikipedia.org/wiki/Joint_probability_distribution) of different sets of coordinates on a stochastic process. Stationary probability distribution is used to determine for a long period of time how many people will exist in each state.

By using Transition and survival probability we have find out the age group in individual transition state.

**Keywords:** COVID -19, Probability, Stationary probability distribution, Kolmogorov equation, survival

Probability

**Introduction**:

**Literature review:**

**Chapter 1:**

**Chapter 2:**



Fig1: Normal Healthy human lungs image

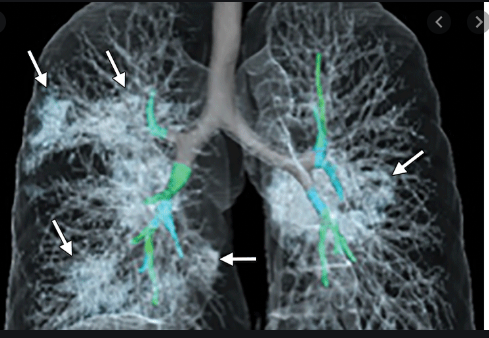


Fig 2: CORONA affected human lungs image

**Neural Stile transfer:**

Let

i = indexes high

j = indexes width

k= indexes different channel

Open the 3D array (56 x 56 x 256) and reshape it to a matrix of (256x3136) where 56x56 = 3136

Transpose of the Gram matrix M

Gram matrix

[*M*].

Each element in matrix G represents correlation measure

Between channel i and j.

K’ is the index of different channel

**Stile loss for single layer:**

Now as it can see how each element of this gram matrix contains correlation measure of all the channels with respect to each other. Moving forward, how this computed Gram matrix G to calculate the style loss. Let’s denote the gram matrix of style image of layer l as and gram matrix of generated image of same layer as . Both the gram matrix were computed from the same layer hence using the same number of channel leading it to be a matrix of size ch x ch, Now if we find sum of square difference or L2\_norm of element subtraction of these two matrices and try to minimize it, Then this will eventually lead to minimizing the difference between the style of style image and the generated image. It might take some time to settle in but when it does, it will be mesmerized by how simple yet effective this is.

Where C = Cost image

S = Style image

G = Generated image

**Loss Function:**

 alpha and beta hyper parameters which are used to provide weights to each type of loss i.e these parameters can be thought of simply as knobs to control how much of the content/style we want to inherit in the generated image

To monitor the spread out of the infection in lungs

We have thought to modify the formula for multiple channel

n > 1 , 2 , 3 …….

n= channel

Make diff(C, G) high and minimized C from S.

S = Diseases lungs image

C = Healthy lings image

G = (S- C) = Image of the infection

Patient age:

No of patient in every category:

Application of Markov Chain:

**Stochastic process:**

A stochastic process {(𝑡), ∈ 𝑇} is a collection of random variables. That is, for each 𝑡 in the index set 𝑇, (𝑡) is a random variable. If the time parameter 𝑇 is a countable set 𝑇 = {0,1,2, … }, the process {𝑋(𝑛), 𝑛 = 0,1,2, … } is called a discrete-time stochastic process, and if 𝑇 is a continuum, the process {𝑋(𝑡),𝑡 ≥ 0} is called a continuous stochastic process. For a stochastic process {(𝑡), ∈ 𝑇}, a set of all values of (𝑡) is called a state space [

**Discrete time set:**

Discrete Sate Space

Markov Property

Corona

Health

Dead

Fig 3 : Basic Markov Transition diagram

**Transition Probability**

V ≥ µ

Future present of the present state.

**Estimation of the Transition Probability**

So, if we consider the healthy state someone either can stay healthy or can be infected by CORONA or can Die.

**Chapman – Kolmogorov equation to find** [**joint probability distributions**](https://en.wikipedia.org/wiki/Joint_probability_distribution)

specifically in the theory of Markovian [stochastic processes](https://en.wikipedia.org/wiki/Stochastic_process) in [probability theory](https://en.wikipedia.org/wiki/Probability_theory), the Chapman–Kolmogorov equation is an identity relating the [joint probability distributions](https://en.wikipedia.org/wiki/Joint_probability_distribution) of different sets of coordinates on a stochastic process

I,j State Space and *m ≤ l ≤ n* integer time set

K is the Intermediate state where the patient can healthy or also can affected by CORONA.

The probability that a patient die over a specific time given that he is healthy is equal to the probability that he stay healthy and then die Add (+) with the probability that he 1st get sick and then die over a specific time.

**Transition Matrix:**

Healthy = H

CORONA = C

Dead = D

P =

1

From the collected data

p =

from the above matrix

P() = 0.05

P() = (Die X Stay Dead) + (Stay Healthy x Die) + (Get sick X Die)

=(0.05x1)+(0.7x0.05)+(0.25x0.15) = 0.1225

P() = P x P x P

State modification:

Modified Transition Matrix

Healthy = H

CORONA = C

Recovered = R

Dead = D

P =

Stationary probability distribution

How Many people are in each state over the long run

Recovered

Corona

Health

Dead

Fig 4 : Modified Markov Transition diagram

Over the long run what will be the distribution going to be?

Is the stationary distribution and it is given as a vector

= is the percentage of people in stage 1

= is the percentage of people in stage 2

=is the percentage of people in stage 3

2

1

3

Fig 5: State Transition diagram for Stage 1,2 & 3

Transition and survival probability

**Transition probability**

Probability that someone alive at age x will die before the reach age (x+t)

**Survival probability**

It can be signify the probability that someone alive at age x,

Survives to the age (x+t)

**Kolmogorov forward differential Equation**

Assume has Markov Probability for small value of h ,

Where, and , 0

h says that the probability of dying over a small period is equal to the small

Period of time the transmission

i.e

So, 1st thing we can say the probability that someone lived at age X survives for a time (t+h) is going to be equal to the probability that a person alive at age x, survives till time t times the probability that other person alive at age (x+t) survive for a little bit of time which is denoted by h.

[As the sum of probability is one]

**Application of the Markov Jump**

Dead

Alive

Fig 5 : Markov Jump State diagram for two ultimate stage

if force of mortality at age x.

=>

=> -

Hence the Kolmogorov differential equation is derived from the above expression

i.e = -

The derivative of the survival of the probability is equal to the –ve survival probability multiplied with force of mortality.

**Solution of the differential equation.**

= -

Intriguing both side w.r.t t

Within the limit t= 0 and t =n

Considering a constant force of mortality for each age

Assume for

The value of

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