AN ANALYSIS OF FORGETTING BEHAVIOR OF HUMAN BRAIN USING QUEUING MODEL

Thaneshwar Lal Verma* and D. K. Gangeshwar

*Research Scholar, Department of Applied Mathematics,
Bhilai Institute of Technology, Durg, (C.G), India
vermathaneshwar@yahoo.com

Associate Professor, Department of Applied Mathematics,
Bhilai Institute of Technology, Durg, (C.G), India
dk.gangeshwar@bitdurg.ac.in

Abstract:

Thinking is natural process of human brain. The generation of thought andnext though are coming in to human Brain. Hence, amount of thought arising and going away from brain is queuing process. Whenever the bulk ideas comes in mind for a specific purpose, some of the thought forgot(or unable to recall suddenly) from human brain. The present paper describes numerically the forgetting behavior of thoughts generated in Human brain. Thus, with the applications of waiting line models.

Keywords: Queue Model, M/M/1, Little's Theorem, ForgettingBehavior.

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1. Introduction

Queuing theory is a vast field and its origin can be traced to the beginning of 20th century. The pioneer work in the field of queuing theory was done by Erlang (1909). Several researchers namely Fry (1928), Kasturi and Lakshmi (2003), Pandey and Gangeshwer (2019), Armony et al. (2005), Morse (1958), Gumbel (1960), Lakshmi and Iyar (2013), Taori andRathi (1996), Pandey and Gangeshwer (2019), have worked on queuing theory. Borodin et al. (2001) remarked that 'New applications in communications networks and complex manufacturing systems have recently led to significant advances in queuing theory. Now a day, queuing theory became a field of applied probability and many of its results have been used in operations research, computer science, telecommunication, traffic engineering, and reliability theory.

Shanthikumar and Sargent (1983) definedhybrid simulation/analytic models and modeling.Srinivasan et al.(1994) studied about simulation of driving performance with selected route guidance systems.Stretz and Berkbigler (1998) studied about transportation analysis simulation system.Rusta (2008) studied on using Little's Law to estimate cycle time and cost and well designed models can provide timely answers and summarize understanding ofcomplex systems. Simple use cases can illustrate the applicability and inferences possiblewith even the most general models.Barcelona (2010), wrote a book about Fundamentals of Traffic Simulation. Hong (2010) found a GMDH (Group Method of Data Handling)based Traffic

Flow Forecasting Model.Mahajan et al.(2013), studied about new concept of traffic rotary design at road intersections. They discussed designing rotaries at road intersections and a software package is developed to be used in road works. Bogers and Horst (2013) studied about collaborative prototyping: cross-fertilization of knowledge in prototype-driven, problem solving.The study, moreover, shows how, at various stages of the prototyping process, the actual prototype was used as a tool for communication or development, thus serving as a platform for the cross-fertilization of knowledge.

Hayes et al. (2020), worked on remind your neural network to prevent catastrophic forgetting. They propose 'REMIND' a brain-inspired approach that enables efficient replay with compressed representations. Recently, Li et al. (2024)found that a queuing evacuation model with yielding behavior. Finally due to its higher safety and easier management process, a queuing and yielding evacuation can be a safe and relatively efficient method for real evacuations.On the basis of literature review we can say the simulation models can be categorized into three part namely, microscopic modeling, macroscopic modeling and macroscopic modeling.

Now, being human we also are thinking and /or communicating /promising others on some matter but may be due to business we couldn't remember all the matters up to long duration, forget some of the communications or dialogues. Recalling the dialogue before use so many are coming in mind but applying one by one i.e. entering dialogues in mind or recalling from memory can consider in queuing discipline. Therefore, The present paper describes numerically the forgetting behavior of thoughts/ ideas generated in human brain with the applications of waiting line models. The model explains in twosituations, first Individual observation, and second group observation. Further, section two deals forgetting behavior model for Individual Observations. Section three explains Numerical Example of Proposed Model. Section four explained about the analysis of Group observation for thoughts**.** finally, section five concludes about the proposed model.

2. ForgettingModel ForIndividual Observation:

In general, many thoughts came one after another, after few minutes; people may forget some thought when news thought generated. Therefore, thinking and forgetting may be the example of Probability and also itfollows the waiting line theory. Researchers state that from 20,000 to 50,000 thinking observed in normal human brain, but many cannot recall. So in this paper wetried to study about the forgetting behavior of human brain through queuing theory.If human brain is thinking at a time than other thoughts are waiting. So human brain is a system and thoughts are considered as customers with the help of following figure 2.1 we can understand easily. Patel and Bhathawala (2013) remarked that Queuing theory is suitable to be applied on human brain analysis. Based on M/M/1 queuing model can be applying and can calculating the probability to gate the outgoing thoughts from human brain.

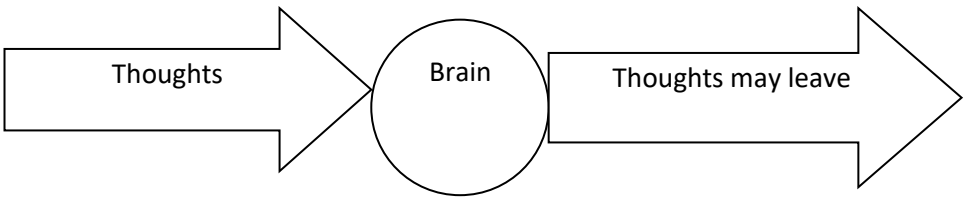

Figure 2.1: M/M/1 Queuing Model for Human Behavior

According to Littles Law (1961)Suppose 'L' be the expected number of customers for a system in steady state ,'λ' is the average customer arrival rate and 'W' is the average service time then according to little's Law L = λ. W. Suppose, The mean customers (thoughts) arrival rate = λ and The mean service (thinking process) rate = μ Thought intensity or utility ratio ρ = λ/μ. Therefore, the following formula have been derived

Probability of zero thoughts in brain (or brain is idle) =>$P_0 = 1 – \rho$
The probability having n thoughts in the brain P_n => $P_0\rho^n = (1 - \rho)\ \rho^n$
Average number of thoughts in the brain Ls=>L = ρ/ (1 - ρ)or = λ/(μ - λ)
Average number of thoughts in the waiting line Lq = ρ^2/ (1 - ρ)= λ^2/μ (μ - λ)
Average waiting time in the quereW_q=> λ/μ(μ - λ)= ρ/(μ – λ)
Average waiting time in system W_s= (*L* / *L* > 0) =1/(μ - λ) = W_q= L_s/ λ

3. Numerical Example of Proposed Model:

Suppose, 10 thoughts comesin a human brainwithin 20 seconds.As per the result arrival rate λ = 10/ 20 = 0.50 thoughts/sec.On and average every thought remains 2 seconds in brain , hence we can say that one thought is in queue i.e. L_q = 1 and average waiting time for a thought is W_q = 2 sec. which can verify by above arrival rate also $W_q = L_q/ \lambda$ = W_q = 1/ 0.50 = 2 sec.
Now, thecalculation of average number of thoughts in the brain L = λ × W,
L = 0.50×02 Sec. = 1 thought
Similarly, the thinking process rate (μ) can be calculate using the relation
L = ρ/ (1 - ρ),or L = λ/(μ - λ)
L = λ/(μ - λ)
μ - λ = λ/L
μ = λ(1 + L)/L
μ = 0.5(1 + 1)/1 = 0.5 × 2 = 1tps

Hence Thought intensity or utility ratio (ρ) = λ/μ = (0.50 thoughts/sec)/ 1tps = 0.50

Now the probability of zero thoughts in the brain (P_0) = 1 – ρ = 1 – 0.50 = 0.50

The probability if n thoughts in system (human brain) = $P_n = P_0\rho^n$ = 0.50 × $(0.50)^n$

Above calculation completed assuming 1 thought goes to brain and one thought is waiting that is two thoughts in system.
Probability of entering thoughts is = $P_0 + P_1 + P_2$ = ½ + ½ × ½ + ½ (½)^2
The thoughts will go away from brain if more than two thoughts will be in queuek
Probability of thoughts going away = $P_{>3 \text{ to } k} = \Sigma P_n = 1 – \{½ + ½ \times ½ + ½ (½)^2\}$
= 0.125
This implies that for a human being in the normal position about 12.5% thoughts forgot by brain. Now M/M/1 Queing model applied in simulation model for human brain. Following table2.1 shows ansimulation observation on the line of Patel and Bhathawala (2013):

No. of thoughts	Arrival time in system	Entry time in system	Departure time	Service time (Sec)	Waiting time Wq	Total time in system Ws (Sec)	Service rate μ= no.of thought/service time
1	3:4:20	3:4:20	3:5:29	0.59	0.00	0.59	1/0.59 = 1.6949
2	3:4:20	3:5:29	4:0:13	0.54	0.59	1.13	2/1.13= 1.7699

Table 2.1 Simulation Observation Table

Average service rate = (1.6949+ 1.7699)/2 = 1.7324 which supports the theoretical values service rate one thought par seconds.

4. Group observation for thoughts:

In the generalization,survey has been conducted in one class about the positive and negative behavioral thinking for self and the others. The taskgiven to the students that, you think and write your good qualities and bad qualities. The allotted time 3 minutes for each qualities for both self and others. The most general answer is students are not able to write all points which comes in their minds. That's means while writing they forget some thoughts to write and it was taking time to recall. When some thought comes in mind while writing, one in process others are waiting, after writing one it goes out from mind/process then other entre and third was in queue. In this process some qualities already came in mind are skipped. Hence queue can be form in assessment process, and it is important to study the proposed model.

Table 5.1 Group observation

S. No.	**Name of student**	**Information about other**				**Information for self**			
		Good values		**Negative values**		**Good values**		**Negative values**	
		Thought in mind but couldn't write i.e. in queue	Could able to write on sheet i.e. in server	Thought in mind but couldn't write i.e. in queue	Could able to write on sheet i.e. in server	Thought in mind but couldn't write i.e. in queue	Could able to write on sheet i.e. in server	Thought in mind but couldn't write i.e. in queue	Could able to write on sheet i.e. in server
1	A	2	3	3	7	2	6	1	2
2	B	2	4	3	8	3	7	1	2
3	C	3	2	2	7	2	6	2	3
4	D	1	4	3	5	3	5	2	2
5	E	2	3	2	8	1	6	1	3
Total		10	16	13	35	11	30	7	12
Average		**2**	**3.2**	**2.6**	**7**	**2.2**	**6**	**1.4**	**2.4**
		λ= .4	μ = .64	λ = .52	μ = 1.4	λ = .44	μ = 1.2	λ = .28	μ = .48
ρ = λ/μ		0. 625		0.3714		0.3667		0.875	

5. Conclusion:

This paper we discussed the functions of human brain about thought process, its generation and delivery It has been observed that on and average every human brain forgot 12.5% thought generated in mind during the delivery.The same is used to calculate to understand behavioral studies of human being about the self and others how they are differ .by calculation it is found that good thought generates and delivered for self the is more than the other while negative thought is adverse. The utilization parameters are less than one for all the sinario.

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