THE ZOO SIMULATION WITH ANIMAL BEHAVIOR OPTIMAZATION BASED GENETIC ALGORITHM

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Abstract

The character and behavior simulation of archipelago animals in the era of globalization is very interesting when applied to the school children learning and it can be further developed to research about the behavior of endangered species which now they are very difficult to find. With the optimization of the use of behavior-based Genetic Algorithm (GA) in the zoo simulation will provide a diversity of local wildlife movements are optimized in accordance with good range between the minimum and maximum values from a data bank of animal behavior. The range of values from minimum to maximum to will make a difference between the behavior of individual animals within a species is virtual so that it looks natural in a real environment.

Keywords: *behavior, genetic algorithm, animal, zoo simulation, virtual.*

1. Introduction

The Indonesia archipelago have many more native animal where they are very unique and good looking. We can feel happiness if they can live with us but other peoples doesn't responsible about their lives. Sometime peoples hunt the native animal for eaten and personal pleasure, so they will make its population become threatened and die. If people don't change his lifestyle to continue and never stop for hunting then the native animal will gone and the next generation of our children never see it again. May be, we can find the native animal in the zoo but not in the wild.

In this paper, we very interested to research about the behavior and characteric of the native animal because Indonesia as a tropic country have islands, forest and sea where the ecosystem and habitat of the native animal is very good to live. Preservation of nature and diverse of wildlife needs to be maintained especially endangered species to avoid extinction. So, we need a tool that can be used as a place of learning for our community awareness of environmental sustainability in order to remain well preserved. The Zoo Simulation is the right way as a place of learning because it can save the cost of visits and time efficiency. In The Zoo Simulation, we can know behavior of animals without come to real zoo for minimize money and time. For further realistic about behavior of animal, we use The Genetic Algorithm with parameter range value between minimum to maksimum scale.

The Genetic Algorithm can be optimazing a behavior of animal more varied gene in a population. Variation of gene can be called by the name of allel and genes located in a chromosome. The chromosome is a bit data string of individu where each of the blocks represent genes. The bit data containt value ‘0’ (zero) or ‘1’ (one) and it will fill in all space of gene.

In this paper, we use triploide chromosome with determinan values from nominal, minimal and maximal of allel (variant gene). This metode will make species more real because population of individu have a unique of animal behavior.

2. Discussion

We use a Genetic Algorithm (GA) to resolve the behavior optimazation of animal in zoo simulation. The GA has phase where it be used to design system more near real.

Five Phase For GA:

1) Population Initial
2) Fitness Function
3) Selection Operator
4) Crossover / recombine Operator
5) Mutation Operator

2.1. Population Initial

Begin with generate random population. The population is individu who has parameters. Individu can be called with name chromosome and parameter can be called with name gene. Using the best state to problem solve. The state is a generation where individu can be survive.

2.2. Fitness Function

The fitness function produce the next generation of state and return a good state. Fitness function give scores for each states and can be selected to reproduce from fitness score.

Formula:

$$(\quad , h) = \frac{\sum \quad (\quad . h)}{\sum \quad (\quad)}$$

$$h = \frac{h \quad - h}{h \quad - h}$$

Description:

: h

:

: h h

h : h

: h

: h

: h

2.3. Selection Operator

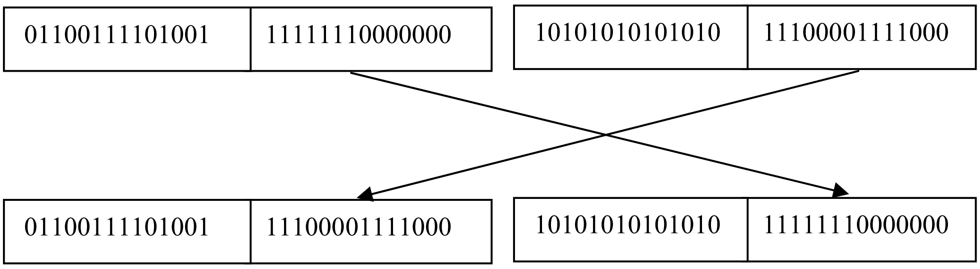
Select two pair with random to reproduce follow each score of fitness function and selection can be more than one or nothing.

2.4. Crossover Operator:

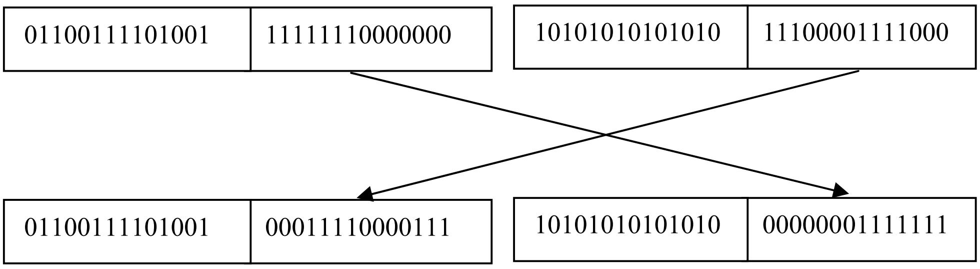
Each pair to be crossover with random in the bit string and the center of crossover to be exchanged between parents. The first population will cause crossover become bigger but this case will be converging on the next generation.

we use three types of crossover operators, namely: sequence, reverse and random.

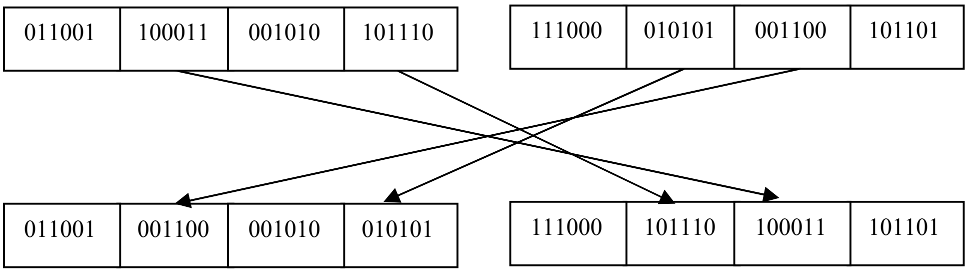
a) Sequence Crossover



b) Reverse Crossover



c) Random Crossover

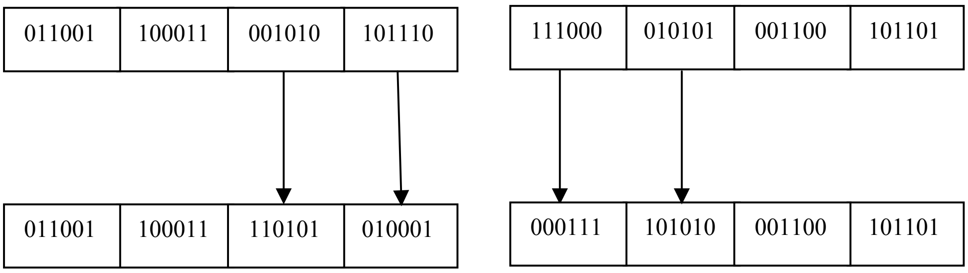


2.5. Mutation Operator:

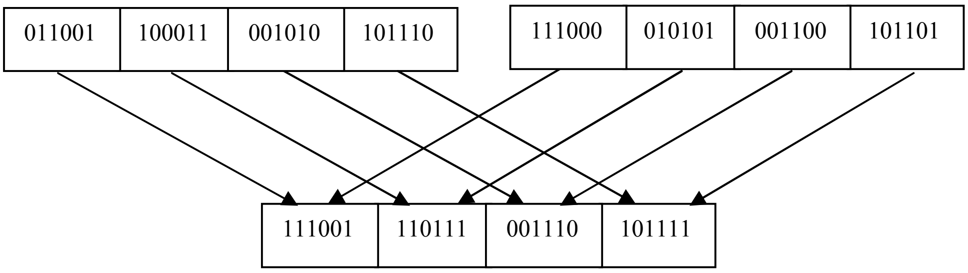
Mutation also plays a role in the process of changing the genetic information in this case changes the data directly on certain parts. There are two models of mutation operation in Genetic Algorithm, namely: random and non-random. From both models the mutation operation is better to use a non-random. Every location of bit string can be mutate with a little random.

we use seven bitwise types of mutation operator, namely: NOT, OR, AND, XOR, COPY, INSERT and DELETE.

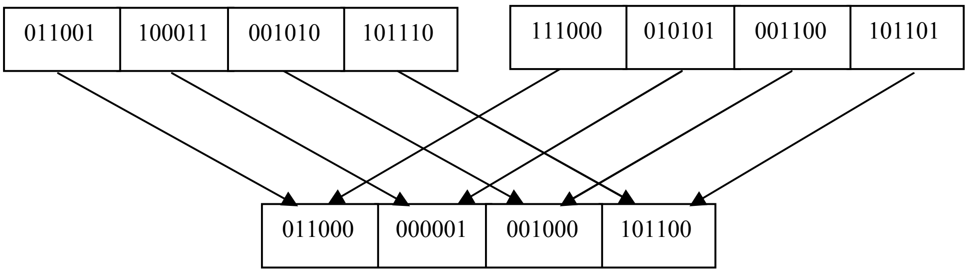
a) NOT Bitwise



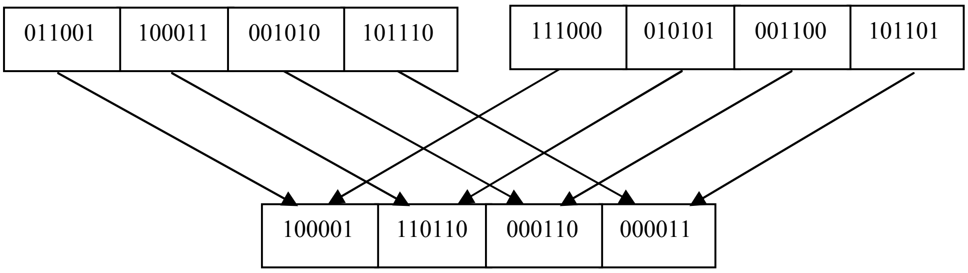
b) OR Bitwise



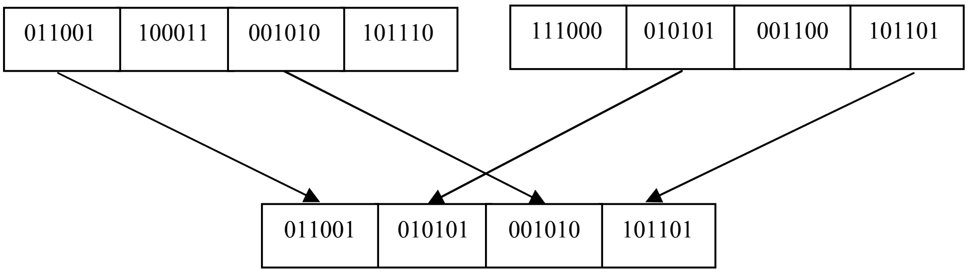
c) AND Bitwise



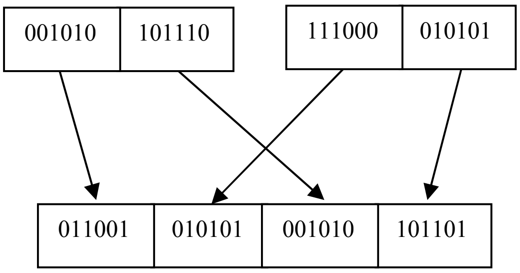
d) XOR Bitwise



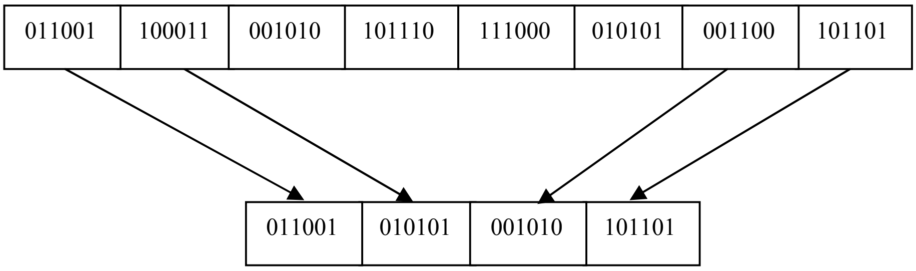
e) Copy Bitwise



f) Insert Bitwise



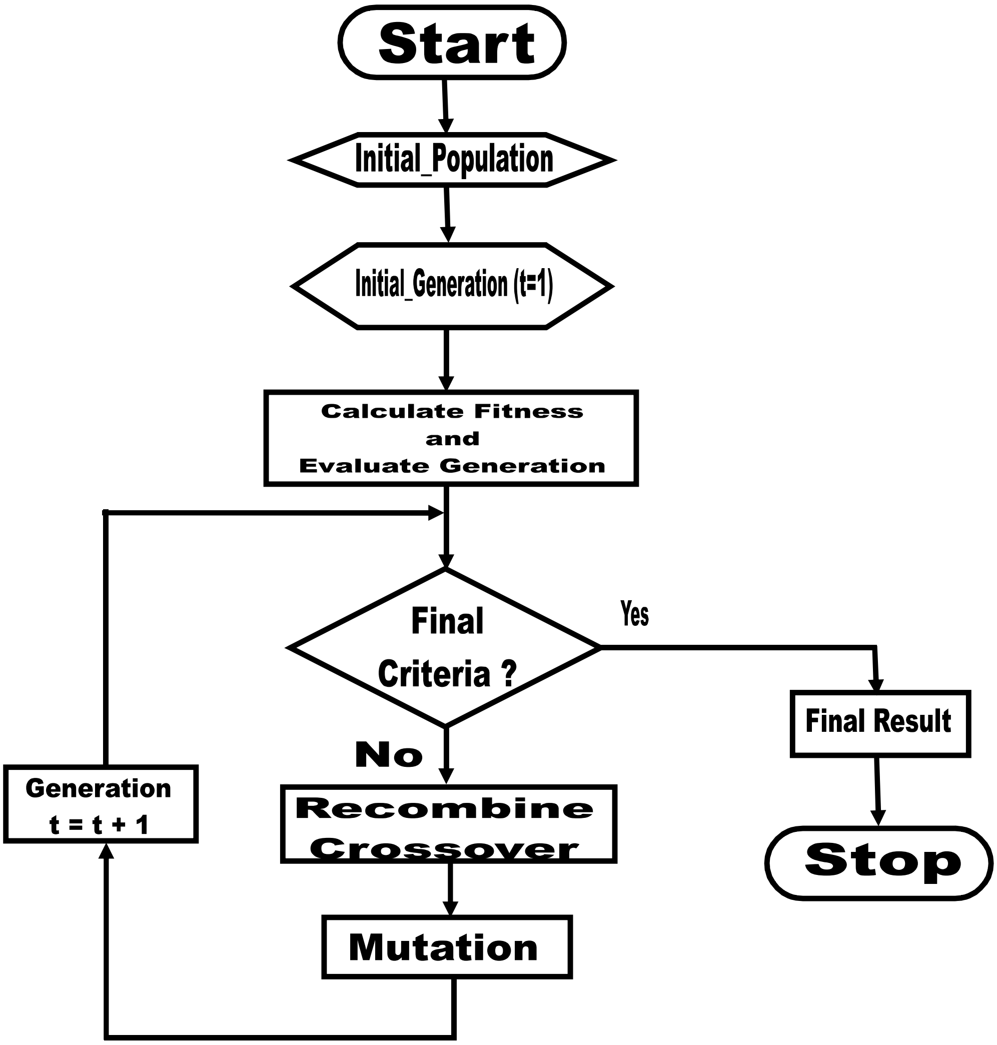
g) Delete Bitwise



2.6. Procedure:

Step by step for design.

a) GA Flowchart

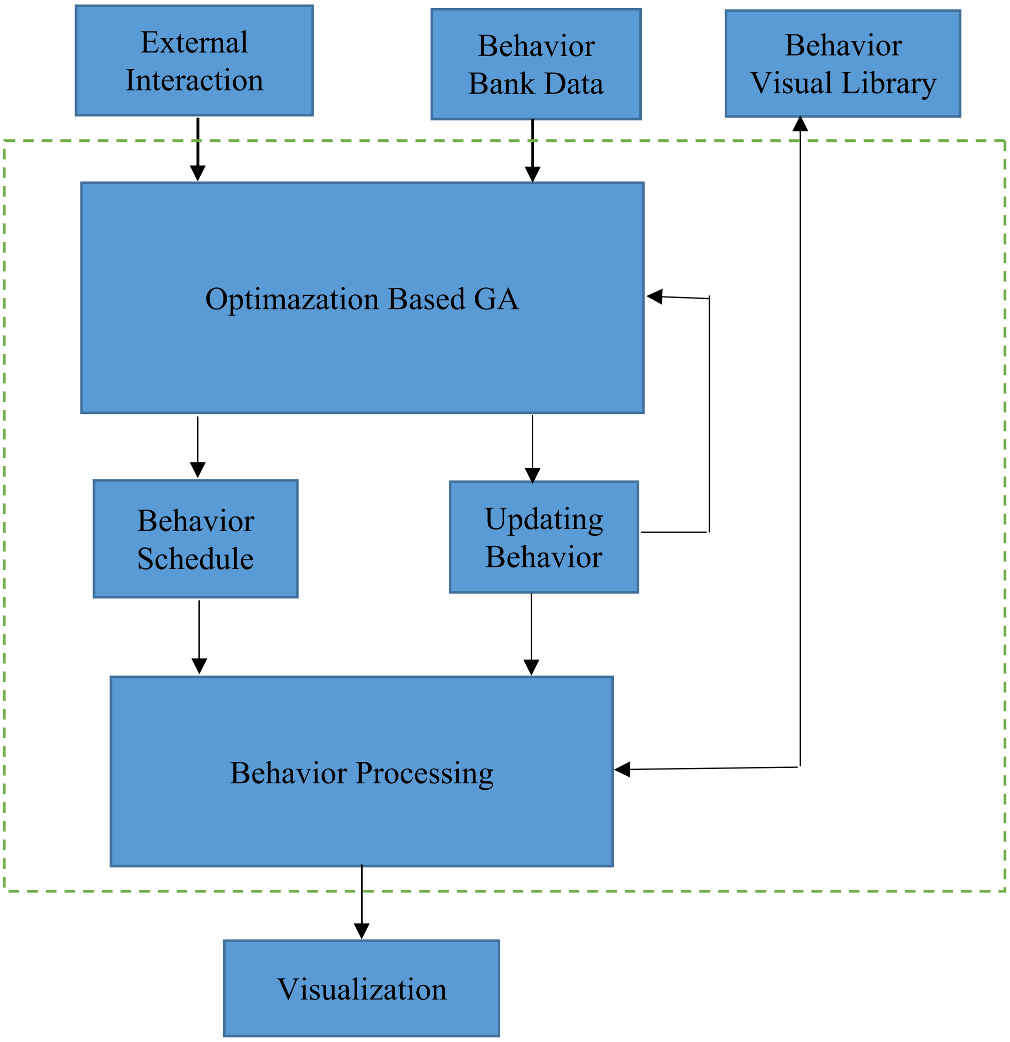


b) **GA Pseudocode**

```
// start dengan inisial waktu
t := 0;
// penginisialan secara acak populasi
initPopulation P (t);
// evaluasi fitnes dari semua individu dari populasi
evaluate P (t);
// test untuk kriteria (waktu, fitnes, dll.)
WHILE not done DO
    // tambah waktu hitungan
    t := t + 1;
    // select a sub-population for offspring production
    P' := select parents P (t);
    // rekombinasi gen dari induk terpilih
    recombine P' (t);
    // mutasi gen menggunakan stochastic
    mutate P' (t);
    // evaluasi fitnes baru
    evaluate P' (t);
    // Memilih survisor dari aktual fitnes
    P := survive P,P' (t);
```

```
END of WHILE
END of GA.
```

c) GA Engine of Animal Behavior Optimazation.



Description:
External Interaction : input data from player and enviroment (Chromosome 1).
Behavior Bank Data: the original data from animal behavior (Chromosome 2).
Behavior Visual Library : the graphic object for species.
Optimazation Based GA : behavior optimazation engine based Genetic Algorithm.
Behavior Schedule : containt duration time of behavior.
Updating Behavior : containt new generation of behavior.
Behavior Processing : execute behavior schedule with behavior action.
Visualization : change behavior to visual animation

d) Parameter of External Interaction (Chromosome 1):

i.	Touch Area	= -1 .. 0 .. +1	(Tarikan 100%, Kosong 0%, Dorongan 100%)
ii.	Pos X Area	= -1 .. 0 .. +1	(Kiri 100%, Simetris 0%, Kanan 100%)
iii.	Pos Y Area	= -1 .. 0 .. +1	(Depan 100%, Pusat 0%, Belakang 100%)
iv.	Pos Z Area	= -1 .. 0 .. +1	(Bawah 100%, Tengah 0%, Atas 100%)

v.	Mass / Weight	= -1 .. 0 .. +1	(Ringan -100%, Sedang 0%, Berat 100%)
vi.	Food Type	= -1 .. 0 .. +1	(Racun 100%, Netral 0%, Pakan 100%)
vii.	Temperature	= -1 .. 0 .. +1	(Dingin 100%, Normal 0%, Panas 100%)
viii.	Material	= -1 .. 0 .. +1	(Gas 100%, Cair 100%, Pejal 100%)
ix.	Frequency	= -1 .. 0 .. +1	(Jarang -100%, Biasa 0%, Sering 100%)

e) Parameter of Behavior Schedule (Chromosome 2):

i.	Food Time	= -1 .. 0 .. +1	(Empty 100%, Normal, Full 100%)
ii.	Fit Time	= -1 .. 0 .. +1	(Sick 100%, Normal, Health 100%)
iii.	Character Time	= -1 .. 0 .. +1	(Angry 100%, Normal, Calm 100%)
iv.	Speed Time	= -1 .. 0 .. +1	(Slow 100%, Normal, Fast 100%)
v.	Power Time	= -1 .. 0 .. +1	(Weak 100%, Normal, Strong 100%)
vi.	Spontan Time	= -1 .. 0 .. +1	(Sad 100%, Normal, Happy 100%)
vii.	State Time	= -1 .. 0 .. +1	(Fear 100%, Normal, No Fear 100%)
viii.	Activity Time	= -1 .. 0 .. +1	(Sleep 100%, StandUp, Run 100%)
ix.	Body Temp	= -1 .. 0 .. +1	(Cold 100%, Normal, Hot 100%)
x.	Posture/Weight	= -1 .. 0 .. +1	(Thin 100%, Normal, Thick 100%)
xi.	Color	= -1 .. 0 .. +1	(Cyan 100%, Grey , Red 100%)
		-3 .. 0 .. +3	(Magenta 100%, Grey , Green 100%)
		-9 .. 0 .. +9	(Yellow 100%, Grey , Nlue 100%)
		-13..0..+13	(Black 100%, Grey , White 100%)

f) Parameter of Behavior Action (Chromosome 3):

Behavior Schedule = <Duration> <Action>

g) Translation and Rotation of Animal Transform Table.

Head						Neck		Body			Leg				Tail
Left		Midle		right							Left		Right		
Ear	Eye	Nose	Mouth	Ear	Eye	Top	Bottom	Breast	stomach	hip	Front	Rear	Front	Rear	
RX	RX	-	-	RX	RX	RX	RX	-	RX	RX	RX	RX	RX	RX	RX
RY	RY	-	-	RY	RY	RY	RY	-	RY	RY	RY	RY	RY	RY	RY
RN	-	-	-	RN	-	RN	RN	-	RN	RZ	RN	RN	RN	RN	RN
-	-	TX	TX	-	-	-	-	-	-	-	TX	TX	TX	TX	TX
-	-	TY	TY	-	-	-	-	-	-	-	TY	TY	TY	TY	TY
-	-	-	TN	-	-	-	-	-	-	-	TN	TN	TN	TN	TN

Description:

R : rotaion
T : translation
N : neutral axes or Z axes
Y : Y axes
X : X axes

h) Recommendation:

i. *Crossover rate* : keep to high, generally 80 – 90%
ii. *Mutation rate* (laju mutasi): keep to low, generally 0.5 – 1%.
iii. Population Number: Keep to normal, enough have genetic varian but not to mus because they will reduce time processing when generated new generation. Generally 25 – 50 organisme.
iv. Method (selection, crossover, mutation): choice a good scheme to solution of problem and experiment with different rate for crossover and mutation option.

3. Conclusion

The animal behavior optimazation based Genetic Algorithm give variant of animal in a species. Behavior between individu of population in one species will be varied because parameter have range from minimum until maximum value. The gnome (genetic information) can change because the Genetic Algorithm permit gene to recombine (crossover) and mutation until get the best individu on the next generation where fitness function to control score of population.

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