Probing genetic algorithm considering Black Jack Strategy

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Abstract— This paper presents a new genetic algorithm based on a probing mechanism. The traditional GA operators such as crossover, mutation, selection are employed with certain probabilities. Within each generation, this method generates a solution with binary values (0/1) and a new variable called 'query'. The query actually interacts with users when the algorithm requires a sophisticated status. The number of queries within a particular solutions are controlled by a selection based weighted method where some queries are resolved and avoided. In each generation, the number of queries is updated based on the users' interaction on previous generation. The method is highly user interactive due to its communication with users within the stages. This way the method provides diversity within the solutions. The simulations were run considering the Black Jack strategy.

Keywords- GA, Black Jack, PGA.

1. Introduction

Interactive genetic algorithms (IGAs), proposed in middle 1980s, are effective methods to solve optimization problems with implicit or fuzzy indices [Dawkins 86]. They combine traditional evolution mechanism with human's intelligent evaluation, and human assigns an individual fitness rather than a function that is difficult or even impossible to express explicitly. Up to now, they have been successfully applied in many fields, such as fashion design [Kim et al. 00], face identification [Caldwell et al. 91], music composition [Tokui and Iba 00], hearing aid fitting [Takagi and Ohsaki 07], and so on.

All these fitness functions are based on the current user's evaluation. But a user's evaluation in interactive genetic algorithm is completely subjective and continuously changing with the user's degree of cognition. Hence, the fitness evaluation in interactive genetic algorithm is fluctuant and its deviation will directly affect the reliability of convergent results and restrict the application of these methods. But in the proposed algorithm, compared with early IGAs, human does not assign an individual fitness. The evolutionary system automatically calculates an individual fitness, not just a dominance relationship among different individuals. The key of the proposed algorithm is to determine appropriate order of a chosen individual which is not difficult on condition. Through the interaction with user, our system can effectively suggest the nearest strategy of what the user prefers to. In this paper we develop the Black Jack Strategy with probing genetic algorithm (PGA) using human knowledge.

2. Probing genetic algorithm

IGAs produce satisfactory solutions through human-computer interaction and evolve a population from generation to generation. In our approach we use roulette wheel selection method in conjunction with elite selection scheme. Traditional GA considers a best individual which has the highest fitness value in the elite individual. Then the PGA will prepare questions from best individual after comparing with other elite individuals by the every gene which has the same position in that population.

2.1 Generation of Queries

Within each generation, this method generates a solution with binary values (0/1). For generating queries, PGA scans through each individual. The details are shown in following.

G_{11}	G_{12}	...	...	G_{1m}	->	E_1
G_{21}	G_{22}	...	...	G_{2m}	->	E_2
...	...	...	...	...	->	
G_{n1}	G_{n2}	...	...	G_{nm}	->	En

Fig 1. G – gene, E - elite individuals

We have N number of elite individuals. Let's calculate the relative fitness of each gene position k as follows:

Let E be set of all elite individuals
$\mathbf{A} = \{ E_i G_{ik} \mid 1 \le i \le n \}$
Where $E_i G_{ik}$ refers to gene in position **k** of i^{th} elite individual. N refers to total number of elite individual;

- $E_{best}\, G_{best\,k}$ Be the gene of the best elite individual.

Set all of genes which are inverse value of the best gene.

- **Set** $\bar{A} = \{ E_j\, G_{jk} \mid E_j \in A$ **and** $E_j\, G_{jk} \neq E_{best}\, G_{best\,k} \}$ **(1)**

Total fitness of elite individual in set A is given by

- $F(A) = \sum F(E_i)$ **for all** $E_j \in A$ **(2)**
- $F(\bar{A}) = \sum F(E_i)$ **for all** $E_j \in \bar{A}$ **(3)**

Where $F(E_i)$ refers to the fitness of elite individual E_i.

- $Q = (|\bar{A}| * 100 / N) * W1 + (F(\bar{A}) * 100 / (F(\bar{A}) +$

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F(A)))*W2 **(4)**

W1 and W2 are constant variable between 0 and 1

Where Q refers to the weighted potential of the query. Then a predefined percentage of questions is generated based on higher values of Q.

In each generation the number of queries is determined by the users' input on the previous generation. For the first generation this number is fixed. For instance on a particular generation, if a user provides answer on a query, in next generation the same query will not occur since the query was resolved on the previous generation. Among the queries, some are critical and some are not. For determining which of them are critical, this method provides a matrix containing the critical rating of corresponding dealer hand and player hand (in the context of Black Jack game). The rating is a three leveled measure namely high, medium and low which correspond to the critical level of the particular question.

3. Experiment Result

The proposed method is applied on a portion Black Jack which is a very popular with the public, casinos, mathematicians, game theorists, and computer scientists. Simulation program is carried on a Pentium IV machine with 2.20 Ghz clock with 1 GB memory and in windows visual .NET platform. We have used one-point crossover of 0.6 and mutation of 0.001

The PGA other parameters are shown in following table 2.

Table 1

Parameter	Value
Population	70
Gene length	280
Number of Game	10
Generation	30
Percent of Queries	5
Elite	11

The number of queries on each generation is given in Figure 2. As mentioned before, the number of queries is varied on each generation while in first generation the number is fixed (in that case it is 16). T he chart in Fig 2 depicts the scenario of query quality measurement for Black Jack game for 30 generations.

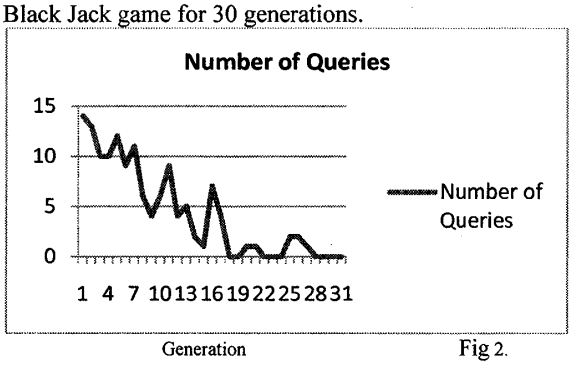

Fig 2.

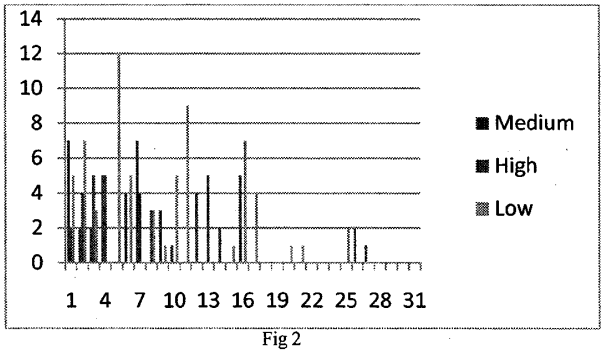

Fig 2

4. Conclusion

This method proposed a genetic algorithm which is user interactive based on a probing mechanism. This method introduces a new variable called 'query' which is calculated using the fitness values for each generation. The number of queries within a particular solutions are controlled by a selection based weighted method where some queries are resolved and avoided. To control the number of queries, this algorithm uses a determined the number of queries in each generation. Moreover the percentage is reduced in each generation in case same the query is occurred in next generations. The Black Jack game strategy is considered in simulation. The performance of PGA is compared with GA to show the effectiveness.

5. References

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