Research on Optimization of Enterprise Production Line Based on Genetic Algorithm

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Abstract. The purpose of this paper is to study how to optimize the production line of enterprises by using genetic algorithm, so as to improve the production efficiency and economic benefit of enterprises. In this study, we apply genetic algorithm to the production line optimization problem. Through the understanding and application of basic genetic algorithm, the optimization objective is transformed into a fitness function, and the operation of crossover, mutation and selection is used to optimize the fitness function. We divided the optimization process into two stages: the generation of initial population and the iterative optimization of genetic algorithm. Through experiments, we verify the effectiveness of genetic algorithm in the production line optimization problem, and draw a conclusion: genetic algorithm can effectively optimize the production line, improve production efficiency and economic benefits.

Keywords: Genetic algorithm · Enterprise production line · Optimization · Fitness function · Cross over · Variation · To choose · Iterative optimization · Production efficiency · Economic benefits

1 Introduction

With the intensification of market competition, the production efficiency and economic benefit of enterprises become important indicators to measure the competitiveness of enterprises. In the production process of an enterprise, the production line is one of the most core links [1]. Therefore, optimizing the production line of enterprises can significantly improve the production efficiency and economic benefits of enterprises. However, production line optimization is a complex combinatorial optimization problem, which needs to consider many factors, including equipment arrangement, worker arrangement and production process. It is difficult for traditional optimization methods to solve this problem, so advanced optimization algorithms are needed [2].

Genetic algorithm, as an optimization algorithm based on biological evolution, has been widely used to solve combinatorial optimization problems. The purpose of this paper is to study how to optimize the production line of enterprises by using genetic algorithm, so as to improve the production efficiency and economic benefit of enterprises.

S. H. B. D. M. Zailani et al. (Eds.): ICMSEM 2023, 259, pp. 512–517, 2024.
https://doi.org/10.2991/978-94-6463-256-9_52

In this study, we apply genetic algorithm to the production line optimization problem [3]. Through the understanding and application of basic genetic algorithm, the optimization objective is transformed into a fitness function, and the operation of crossover, mutation and selection is used to optimize the fitness function. We divided the optimization process into two stages: the generation of initial population and the iterative optimization of genetic algorithm. Through experiments, we verify the effectiveness of genetic algorithm in the production line optimization problem, and draw a conclusion: genetic algorithm can effectively optimize the production line, improve production efficiency and economic benefits. This study provides a new idea and method for the optimization of enterprise production line, which has important theoretical significance and practical value [4].

2 Production Line Optimization Model Based on Genetic Algorithm

The optimization model of enterprise production line based on genetic algorithm is an optimization algorithm based on genetic algorithm, which is used to solve the optimization problem of enterprise production line. The core idea of this model is to transform the optimization problem of production line into a fitness function and optimize it by genetic algorithm. The model convergence calculation method is shown in Formula 1:

$$y = \sigma(\omega x^T + b) \tag{1}$$

The basic steps of the model include: Determine the optimization objective: Determine the optimization objective of the production line, such as maximizing output, minimizing production cost, etc. Establish fitness function: Transform the optimization objective into a fitness function, and the larger the output value of the function, the better the optimization effect. The design of fitness function should take into account the specific situation of production line and optimization objectives. Determine the coding mode: the parameters of the production line are encoded into genes to form a chromosome, which is easy to operate by genetic algorithm. The coding method needs to take into account the specific parameters of the production line. Generate initial population: Build initial population by randomly generating a certain number of chromosomes to facilitate subsequent optimization operations [5]. The model convergence calculation method is shown in Formula 2:

$$\partial_j^L = \frac{\partial C}{\partial z_j^L} = \frac{\partial C}{\partial a_j^L} \times \frac{\partial a_j^L}{\partial z_j^L} = \frac{\partial C}{\partial a_j^L} \sigma'(z_j^L) \tag{2}$$

Iterative optimization: Genetic algorithm is used for iterative optimization of the initial population, including selection, crossover, mutation and other operations, in order to gradually optimize the fitness function and obtain the optimal solution. Figure 1 shows the flow of genetic algorithm.

The optimal production line scheme. The advantage of this model is that it can solve the complex optimization problem of production line and has high optimization efficiency and accuracy. However, there are also some shortcomings, such as the need for appropriate fitness function and coding mode to get good optimization results, and the need to adjust and optimize the parameters of genetic algorithm [6].

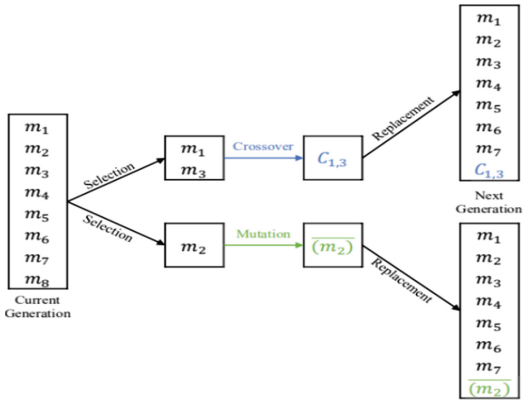

Fig. 1. Genetic algorithm flow

3 Enterprise Production Line Optimization Simulation Experiment

3.1 Data Preparation and Environment Construction

In the solution of this paper, we choose to use binary coding as the encoding mode of genetic algorithm, and each chromosome is a cargo location allocation scheme. After the fitness function analysis of each scheme, the fitness value of the scheme (that is, the chromosome) is obtained, and the optimal shelf storage arrangement scheme is obtained through continuous iteration. Setting of initial population. For the practical problems in this paper, we choose to convert some prior knowledge into A set of requirements that must be met, and then randomly select appropriate initial population from the solutions that meet these requirements. We investigate the data and rules of relevant warehousing of Enterprise A and summarize its generality [7]. As the first generation of our algorithm iteration. Determination of fitness function Fitness function has three requirements: (1) analytical property: continuous and non-negative; (2) fitness function -- designed according to the objective function; (3) Rationality: fitness function design should be as simple as possible. Under this requirement, standardized unified dimension is used to construct appropriate. Figure 2 shows the process of genetic algorithm.

The selection of the operator, we use the fitness ratio method, also known as the wheel selection. Calculate the fitness of different chromosomes, and calculate the fitness proportion of their fitness in the whole population, as the selection probability basis. Crossover and mutation operator Crossover operator We choose the way of single point crossover, because our chromosome length is short and the length of the gene carried is not long, single point crossover is more simple and convenient [8]. The model calculation method is shown in Formula 3:

$$\partial_j^l = \frac{\partial C}{\partial z_j^l} = \sum_k \frac{\partial C}{\partial z_k^{l+1}} \times \frac{\partial z_k^{l+1}}{\partial z_j^l} = \sum_k \delta_k^{l+1} \frac{z_k^{l+1}}{\partial z_j^l} \tag{3}$$

The crossover rate of Pc was set at 0.66 to ensure the crossover ratio of two-thirds and improve the iteration speed. For the selection of mutation operators, Pm (mutation

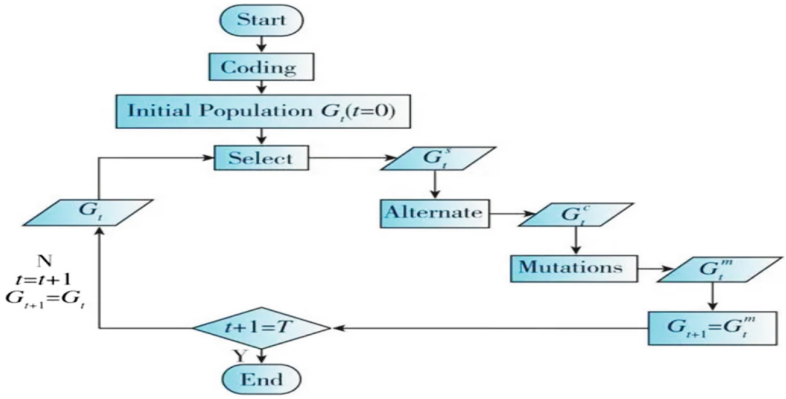

Fig. 2. Personalized education experiment data preparation

rate) was selected as 0.01 in order to prevent the mutation degree from being too large and the population diversity from being too complex, as well as to prevent the simple population gene structure caused by too low mutation rate. 6.7 Description of Other Parameters The population size of 1000 is selected to ensure the diversity and efficiency of calculation. The termination condition of the algorithm uses 4 0 0 as the upper limit of iteration times. After reaching the upper limit of iteration test, it automatically exits iteration and terminates operation. It has been proved that the optimal solution tends to converge after 250 times, so the design of termination condition adopted in our paper is reasonable and effective [9].

3.2 Experimental Results and Comparison

In the above—built test environment, combined with genetic algorithm, the specific determination of the demonstration. Within the preset interval, the management of the production line operation of the enterprise is processed hierarchically.

$$z_k^{l+1} = \sum_j w_{kj}^{l+1} a_j^l + b_k^{l+1} = \sum_j w_{kj}^{l+1} \sigma\left(z_j^l\right) + b_k^{l+1} \tag{4}$$

$$\delta_j^L = \sum_k w_{kj}^{l+1} \delta_k^{l+1} \sigma\prime(z_j^l) \tag{5}$$

and the linear conversion method is used to improve the efficiency of the production line of the enterprise. The capital in the corresponding interval is evaluated by the single quality conversion, and the actual evaluation conversion ratio is calculated [10].

4 Conclusions

Genetic algorithm is a kind of optimization algorithm which simulates the natural evolution process. It optimizes a strategy or solution to a problem through continuous evolution and selection. Computer mathematical modeling is a process of abstracting practical

problems into mathematical models and solving them with computer technology. Genetic algorithm combined with enterprise production efficiency management can effectively solve practical problems, has a broad application prospect.

Genetic algorithm can be applied to combinatorial optimization, machine learning, artificial intelligence and many other fields. Through constant evolution and choice, can get the optimal solution. Production line management can transform practical problems into mathematical models and solve them. A combination of both can make problem solving more efficient, more accurate, and can be applied to more complex problems.

In the future, with the development of computer technology, the application of genetic algorithm and the enterprise production line optimization will be more and more widely. For example, in areas such as finance, transportation, medical, production line optimization, through the enterprise can improve the management level and work efficiency, improved product quality and efficiency. At the same time, in artificial intelligence, machine learning and other fields, genetic algorithm can be used as an optimization algorithm to help the model learn and optimize better, and improve the accuracy and generalization ability of the model.

In short, the combination of genetic algorithm and enterprise production line optimization has great application value and prospect, and will be widely used and popularized in various fields.

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