The interaction between mathematical modeling and computer

Zhiming Yang^{1, a}, Fang Yin^{2, b}

¹College of Information Science, Yunnan University of Finance and Economics, Kunmiong, 650221, China

²College of Energy and Environment Science, Yunnan Normal University, Kunming, 650500, China

^aemail: kmyzm@sina.com, ^bemail:yf6709@sina.com

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Abstract. According to interaction between mathematics modeling and computer, example the shortest path problem signed directed graph by principle of dynamic planning & introduction of the dynamic programming.

Introduction

Mathematical modeling is the process of simplifying the practical problems, rationalizing the assumption, then solving it with mathematics methods, which is also based on actual problem of abstract, simplify, variables and parameters, applied certain rules to establish the relationship between variables and parameters of mathematics model, and took computer to solve it, explaining, inspecting, and evaluating the solution obtained, then decided whether it can be used to work out the practical problem of circulation and deepening.

Characteristic of Mathematics Modeling

Mathematical modeling is aimed on construction of mathematics modeling consciousness and cultivation of creative thinking activity. In mathematics teaching process, the construction of mathematics modeling consciousness is actually to cultivate and develop the students' creative thinking activity because modeling activity itself is a creative thinking activity, which has both certain theoretical property and strong practicality. It also requires thinking profundity and flexibility. In the process of modeling, it can train students' independence and self-consciousness to apply the condition to seek the best ways for solving problems, as well as students' imaginative ability, presentative feeling, transformative guessing, and constructive ability, which all of these mathematics abilities are the most basic characteristic for creative thinking. In the process of training creative thinking, it is necessary to have certain computer knowledge. The computer knowledge is the foundation for further data compilation, inner link discovery, intellectual conversion, and optimal model construction. In a word, the computer knowledge is the key to cultivate modeling consciousness and the premise to develop innovative ability.

Since 1992 the first China Undergraduate Mathematics Contest In Modeling, CUMCM has become one of the important projects of national undergraduates' science and technology competition. It is geared to the needs of national undergraduates' popular science and technology activities, which is beneficial to improve students' quality and promote the university teaching reform of mathematics and computer.

Due to the above characteristic, mathematics modeling is a close relation with computer. It is different from pure mathematics competition. It will live with computer, even can't do without computer, but not a kind of pure mathematics competition, involving physics, chemistry, biology, medicine, electronics, agriculture, military, management and so on various fields and subjects. It will be not subject to any restrictions in the field of a specific subject. The relevant computer technology mainly included two parts: one is how to turn practical problems or model expression to the available computer software or programming algorithm; the second is what kinds of application software or programming technology can be used to solve these problems.

The Relationship between Mathematics modeling and Computer

Computer is a product of mathematical modeling. In 1940s', for the sake of study the problem of ballistic missile flight trajectory, American was urgent to need a calculation tool to replace manual calculation, which was the reason for computer in response to the proper time and conditions. Computer played an important role in mathematics modeling ideology, mainly providing powerful tools and technical support, which was the foundation for better and quicker modeling. The level of computer decided to the whole level of modeling team.

The generation and development of computer has greatly promoted the mathematics modeling activities. High-speed operation ability of computer is suitable for numerical calculation in the process of mathematics modeling. Large storage capacity and network communication function make data storage and retrieval easy and effective in the process of modeling. Multi-media make some problems more realistic and simulated. Intellectualized system can remind and help us the solution method of mathematics modeling. In addition, the emergence of a series of excellent mathematical software, such as Mathlab, Maple, SAS and SPSS make mathematics modeling like a tiger with wings. Furthermore, mathematics is closely related to actual life. Some a amount of collected and complicated data, which was needed large amount of calculation, such as online DVD rental, the Yangtze River evaluation and prediction of water quality, bank loans and installment and so on, often complete quickly and easy with the aid of computer.

Mathematics modeling is a technique course, rather than the foundation education course. It emphasize how to solve the problem better and faster, and how to make full use of various means of science and technology as a technical assistance. The application of computer has become an integral part of mathematics modeling form. The use of computer in mathematics modeling methods makes mathematics modeling greater power, the use of mathematics modeling methods in computer makes computer technology increasing, and the combination of computer technology and mathematical modeling will promote the rapid expansion of both.

Modeling for Multistage Decision

(1) Introduction of the dynamic programming

Dynamic programming is an optimized mathematical method to solve multi-stage decision. The special characteristic of dynamic programming is its definite stages, which can be divided into several different stages in some manner, and can provide a number of different options. In the multistage decision process, particularly for each stage decision, it is necessary not only to investigate the effect of a certain stage according to sequence, but also to consider the impact of this decision on each stage, especially its influence on later stages process. In this system, the optimal decision should be selected among a variety of solutions (decision) to meet requirements for the whole system' optimal effect.

(2) Principle of dynamic planning

Real life problems, if by constructing a mathematical model, can be given with a special process of dynamic system, as well as based on some kind of way, which is divided into several interconnected stages, to make appropriate decisions in each stage, then to achieve the best effect. At the same time, the decision-making at various stages is depended on this stage' condition and its stage' change former or later. After decision-making, a decision sequence is determined, thus forming a chain structure having linkage function between former and later process, called sequential decision-making. First of all, the key of dynamic programming lies in how to structure the real life problem to form a multi-stage system, then in each stage to make best sequential decisions for the optimal decision in the whole system through step by step going.

(3) Example: the shortest path problem signed directed graph

A company has its branch in the six cities C_1 , C_2 , C_3 , C_4 , C_5 , C_6 . The company members often come and go among them. It is known the ticket prices of direct flights from Ci to Cj. The company would like to calculate a cheapest fee table between any two cities route.

Firstly, the data abstraction of flight fares between any two cities.

It is composed of the following matrix. The ticket price of direct flight is given by i line and j list, while ∞ means no direct flight.

 $C_{i,j}$: the flight fares from C_i to C_j

0	50	∞	40	25	10
50	0	15	20	∞	25
∞	15	0	10	20	∞
40	20	10	0	10	25
25	∞	20	10	0	55
10	25	∞	25	55	0

Secondly, mathematical methods for problem solving: from dynamic planning to multistage decision-making

Thirdly, algorithm for problem solving: Floyd, for any two points of the shortest path algorithm

d(i,j) : distance from i to j;

path(i,j): subsequent point onj the path i to j;

Input the weighted adjacency matrix C(i,j)

a) initalization

for all i,j, d(i,j)=C(i,j), path(i,j)=j $\Box_{j,k=1}$.

b) path(i,j) updating d(i,j), path(i,j)

for all i,j, if d(i,k)+d(k,j) < d(i,j), then

d(i,j)=d(i,k)+c(k,j), path(i,j)=path(i,k)+k; k+1

c) repetition process 2) until k=n+1

Conclusion

Computer has been widely used in today, and many problems become simple, convenient and fast to solve with the assistance of computer. We have a more unified view on the relationship between mathematical modeling and computer that computer has played a pivotal role for complex calculation of mathematical modeling.

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