Group strategy of dissertation defense based on greedy retrospective hybrid algorithm

Pei Su¹, Bing Xue Luo¹, Fang Yi Deng¹, Ai Xue Xia¹ and Yan Guo¹*

¹ College of Information Engineering, Sichuan Agricultural University, Yaan, Sichuan, 625000, China.
*Corresponding author’s e-mail: 14403@sicau.edu.cn

Abstract. Thesis defense is an important link to examine the quality of graduate thesis. In order to ensure the fairness of evaluation, the examiners and students are subject to many restrictions when the thesis defense is grouped. Meanwhile, with the popularization of higher education and the increasing number of graduates, grouping becomes very complicated. This paper designs a paper defense grouping strategy based on greedy backtracking hybrid algorithm. In this paper, the best solution of the group of judges and the group of students is found by using the idea of greed, and then the solution space tree is established. Then combined with the idea of backtracking algorithm, the search was carried out from the root node, and the schemes that did not meet the constraints were eliminated until all the results that met the requirements were found. In this way, a grouping strategy can meet the constraints of the arrangement of thesis defense in universities and improve the efficiency and fairness. Finally, the correctness of the algorithm strategy is verified by experiments.

1. Introduction

Thesis defense is the last check of students’ graduation thesis, and it is also a test that can reflect students' real investment in the process of thesis writing. And the group scheduling of thesis defense is an important work in thesis management. In the past, it was easy to make mistakes and difficult to ensure the efficiency of the grouping process and the fairness of the grouping results, which greatly affected the smooth development of the defense.

The first part of this paper fully considers the possible constraints of group defense in colleges and universities, and the second part establishes the mathematical model of algorithm to realize the grouping of judges through greedy thoughts and the optimal solution of the grouping of defense students without considering teachers and students. Greedy algorithm is a common method to solve optimization problems. It always chooses the best individuals at present. However, if only such a choice is made, the final convergence speed of the algorithm will be too fast. Therefore, combined with the idea of backtracking, this paper designs an improved hybrid algorithm strategy of greedy backtracking. In the last part, some graduates from a university in Sichuan are taken as examples to analyze and experiment the actual situation and verify the correctness of the algorithm strategy.

2. Literature review

The problem of defense group arrangement is NP-hard [¹]. Battistutta, M, Ceschia, S. et al provided three solutions based on integer programming, constraint programming and local search for the dissertation defense schedule [²]. She J Y, Tong Y X, Chen L propose a general framework for carnoise reduction of pollutants of Exponential family [³]. Al Aqel G, Li X Y, Gao L et Al.

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Liu Z proposed an improved iterative greedy algorithm [4]. Based on the idea of retrospective integrated pruning algorithm, they proposed an improved retrospective algorithm (ModEnPBT), which can systematically solve the depth-first search solution and is suitable for solving large-scale combinatorial optimization problems [5]. Zhou J Z, Zhang C, Peng T et al. used the function of asynchronous backtracking algorithm to measure the prediction of financial performance [6]. At present, there are few research literatures related to the problem of defense grouping scheduling, and due to the complexity of the problem and the size of practical examples, it is impossible to use an accurate method. The above literatures show that greedy algorithm and backtracking algorithm have strong applicability. Based on the thought of greedy strategy and the thought of backtracking, this paper designs an algorithm strategy for the grouping of graduation theses.

3. Model building

3.1. Problem Description
In the process of grouping graduation thesis defense, a series of constraints should be met:
- The defense time shall be the teaching time
- Each defense team has only one designated leader
- The number of judges in each defense group is balanced
- The number of students to be evaluated in each defense team is balanced
- Principle of withdrawal of assessor (there is no relationship between the assessor and the respondent in this group)
- The proportion of male and female students in each defense group is balanced
- Students supervised by one judge cannot all be grouped together
- Each student can only participate in a defense group (a certain time in a certain place)

3.2. Algorithm Flow

3.2.1. Grouping of reviewers
Set the teaching time as $y$ days and divide into $k$ groups. Set up $k$ group leaders and rank them according to the number of students instructed.

$$H_1 \geq H_2 \geq H_3 \geq \cdots \geq H_k$$ (1)

The remaining $t$ judges will be ranked according to the number of students except the group leader.

$$D_1 \leq D_2 \leq D_3 \leq \cdots \leq D_t$$ (2)

$$p = \lceil \frac{t}{k} \rceil$$ (3)

$p$ said review the number of people in each group, the group, each group will guide the students more first review, in turn, to guide the students less group leader of group, so that we can guarantee not to join the number of students, won't cause a defense group do not add too much or too little number of students, who review group results are as follows:

$$G_1\{H_1, D_1, D_{k+1}, D_{2k+1}, D_{3k+1}, \cdots, D_{(p-1)k+1}\}$$

$$G_2\{H_2, D_2, D_{k+2}, D_{2k+2}, D_{3k+2}, \cdots, D_{(p-1)k+2}\}$$

$$G_3\{H_3, D_3, D_{k+3}, D_{2k+3}, D_{3k+3}, \cdots, D_{(p-1)k+3}\}$$

$$\vdots$$

$$G_k\{H_k, D_k, D_{2k}, D_{3k}, D_{4k}, \cdots, D_{pk}\}$$

(4)
3.2.2. Group the students

$M$ is the total number of boys, $F$ is the total number of girls, $m$ is the number of boys that should be assigned to each group, and $n$ is the number of girls that should be assigned to each group.

\[ m = \left\lceil \frac{M}{k} \right\rceil \tag{5} \]
\[ n = \left\lceil \frac{F}{k} \right\rceil \tag{6} \]

In this paper, the teacher-student relationship is not considered at first. When male students join the defense group, formula (3.7) should be satisfied, while when female students join, formula (3.8) should be satisfied. Where $m_i$ is the current number of male students in the group when the $i$th male student is joined, and $n_i$ is the current number of female students in the group when the $i$th female student is joined. The results of group $k$ students were obtained.

\begin{align*}
\{ m_i < m \\
m_i + n_i < m + n \\
n_i < n \\
m_i + n_i < m + n \}
\end{align*} \tag{7}

\begin{align*}
\{ m_i < m \\
m_i + n_i < m + n \}
\end{align*} \tag{8}

3.2.3. Based on backtracking adjustment

The solution space tree is established according to the results of greedy algorithm, and the correctness of the solution space tree is judged retrospectively.

- First, find group $G_f$ with student relationship of judges, and then find student $A$ with student relationship of judges. Student $A$ should be replaced from the group. See Figure 2.
- Longitudinal search is conducted from the branch where $A$ is located to find student $B$ whose gender is the same as that of student $A$ and who does not have a relationship of guidance and instruction with the reviewer in $G$, then student $B$ can be exchanged with student $A$. See Figure 3.
- Go back to the layer where node $A$ is and conduct horizontal search. When no student has a relationship of guidance and instruction with the reviewer in his group, the termination condition of backtracking is met, namely, the grouping is completed.

![Figure 1. solution space tree.](image)
Figure 2. There are solutions to the teacher-student relationship.

Figure 3. The commutative solution

4. Experiment

4.1. Experimental process

In this paper, an instance of the data collected from a university in Sichuan province one bachelor's plea database, describes a year 291 defense students, 35 people review (each judge guide several student graduation thesis), defense group will be divided into nine groups, including T1-T9 specified respectively to rejoin the group leader, rejoin job requires completion within 2 days, considering the workload and each judge people of people to participate in a group only requires every review work. Teachers from each group should be selected from the remaining judges (randomly selected) to form a defense group of 4, and the last group can be less than 4.

Table 1. Students supervised by 9 group leaders.

| assessor | Supervised student |
|----------|--------------------|
| T1       | S82, S139, S143, S153, S166, S192, S201, S202, S229, S243, S266, S288 |
| T2       | S138, S189, S194, S214, S225, S235, S244, S248, S253, S257, S262 |
| T3       | S93, S156, S206, S208, S210, S221, S251, S269, S283 |
| T4       | S140, S141, S142, S144, S149, S178, S179, S186, S203, S204, S212 |
| T5       | S217, S239, S254, S255, S263, S265, S266, S278, S285, S289 |
| T6       | S136, S131, S158, S160, S163, S165, S167, S168, S173, S190, S205, S222, S223 |
| T7       | S224, S234, S238, S245, S258, S264, S267, S270, S273, S291 |
| T8       | S2, S31, S52, S88, S106, S108, S115 |
| T9       | S17, S50, S56, S64, S101, S113, S117, S119, S130, S137, S175, S199, S239, S261, S287 |
| T10      | S4, S15, S32, S51, S59, S62, S70, S74, S76, S84, S112, S121, S126, S132 |
| T11      | S30, S42, S49, S53, S61, S72, S83, S90, S91, S97, S98, S99, S100, S103, S110, S116, S124, S127, S131, S219 |

Table 2. The number of students supervised by judges T10-T35 is distributed.
4.2 Experimental Results

| forelady | crew | Male-female ratio | Student number of defense candidate |
|----------|------|------------------|------------------------------------|
| T1       | T12  | 20:13            | 4091,4086,0313,0375,4087,4092,4044,4049,4066,4071,4076,4081,3943,3948,4065,3959,3964,3970,3982,3987,4212,4208,4204,4200,4195,4119,4176,4171,4167,4163,4158,4139,4143,3992,3997,4008,4002,4024,3953,4034,4039,4040,4035,4030,4025,4003,3998,3993,3995,3983,4109,3960,4129,4124,4173,4100,4052,4057,3974,3980,4016,4017,4012,3976,4131 |
| T1       | T14  | 20:13            | 3954,3949,3944,4082,4077,4029,4067,4050,4045,4088,8976,4089,4046,4051,4068,3988,4078,4083,3945,3950,4053,4101,4096,4097,4102,4054,4095,3977,4013,4018,4020,4041,4059 |
| T1       | T15  | 20:13            | 4117,4156,4150,4141,4106,4111,0522,8357,1375,1371,4112,4107,4145,4151,4179,4118,4190,4194,4219,4223,4227,4209,4213 |
| T2       | T18  | 20:13            | 4234,4239,4243,4247,4251,4252,4248,4244,4240,4236,4214 |
| T2       | T13  | 20:13            | 4072,4073,3965,4114,4149,4155,4181,4187,4192,4217,4221 |
| T3       | T11  | 20:13            | 4225,4230,4231,4226,4222,4218,4193,4189,4182,4060,3978,4130,4136,4140,4160,4164,4168,4172,4177,4196,4201,4205 |
| T3       | T17  | 20:13            | 3955,3961,3966,3984,3989,3994,3999,4010,4004,4026,4031,4036,4041,3239,3971,4061,4055,4098,4093,4094,4099,4056,4062,3973,3979,4015,4021 |
| T3       | T22  | 14:13            | 4069,4074,4079,4220,3946,3951,3956,3962,3968,3985,3990,4108,4000,4011,4022,4027,4032,4037,4038,4033,1087,4123,4128,4132,4138,4157,4162,4166,4170,4175,4199,4202,4207 |
| T4       | T20  | 20:13            | 4028,4023,4001,4007,3996,3991,3986,3981,3969,3963,3957,3952,3947,3942,4080,4075,4070,3941,4048,4043,4211,4215,4232,4237,4241,4245,4249,4253,4250,4246,4242,4238,4233 |
| T7       | T26  | 20:13            | 4185,4186,4228,4224,0302,4216,4191,4180,4152,4146,4104,4113,9039,1576,4005,4085,4090,4042,4047,4063,4210,4206,4202,4198,4178,4120,4169,4165,4161,4137,4125,4127,4122 |

5. Conclusion

Aiming at the problem of college graduates' thesis defense grouping, this paper analyzes the characteristics of the problem in detail according to the situation, designs the algorithm flow through the greedy strategy and combined with the idea of backtracking, and verifies the reliability of the algorithm and the rationality of the solution results through examples, so as to solve the problem of college thesis defense scheduling well. It is beneficial to improve the efficiency of graduation project group work and promote the development of network and modernization in the process of graduation thesis management.

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