同济经管 TONGJI SEM

《Production Scheduling Management》

1. Course Description

Scheduling deals with the allocation of scarce resources to tasks over time. It is a decision-making process with the goal of optimizing one or more objectives.

The resources and tasks in an organization can take many forms. The resources may be machines in a workshop, runways at an airport, crews at a construction site, processing units in a computing environment, and so on. The tasks may be operations in a production process, take-offs and landings at an airport, stages in a construction project, executions of computer programs, and so on. Each task may have a certain priority level, an earliest possible starting time, and a due date. The objective may be the minimization of the completion time of the last task, and another may be the minimization of the number of tasks completed after their respective due dates.

In the current competitive environment of manufacturing and service industries, scheduling has become a necessity for survival in the marketplace. Companies have to meet shipping dates that have been committed to customers, as failure to do so may result in a significant loss of goodwill.

2. Course Objectives and Requirements

1. Objective: The purpose of this course is to teach the theory of scheduling. This part deals with the detailed scheduling of jobs. Given a collection of jobs to be processed in a certain machine environment, the problem is to sequence the jobs, subject to given constraints, in such a way that one or more performance criteria are optimized. The scheduler may have to deal with various forms of uncertainties, such as random job processing times, machines subject to breakdown, rush orders, and so on. One important thing is to equip the students with the basic knowledge to learn and further study some specific scheduling problems.

2. Requirement: Prerequisite knowledge for this course is an elementary course in Operations Research. Students need to complete the homework and a final project on time.

3. Course Arrangement

Unit 1	Topics Preliminaries
Session 1-2 (4 hours)	• Introduction to scheduling • Machine environment • Processing characteristics and constraints • Objective functions • Classes of scheduling
Group work	What are the Characteristics of Scheduling?
Required Readings	Chapter 2 in book of <Scheduling: Theory, Algorithms, and Systems (Second Edition)> SAP's Advanced Planner and Optimizer(APO)

Unit 2	Topics Single Machine Model
Session 3-4 (4 hours)	• The total weighted completion time • The maximum lateness • The number of tardy jobs • The total tardiness • The total weighted tardiness
Group work	What are the difficult objectives in single machine model?
Required Readings	Chapter 3, in book of <Scheduling: Theory, Algorithms, and Systems (Second Edition)> IBM's independent agent architecture

Unit 3	Topics Computational Complexity
Session 5-6 (4 hours)	• Decision problem v.s. Optimization problem • Class of P • Class of NP • NP-Complete v.s. NP-hard

Group work	How to show a problem is NP-hard?
Required Readings	Book of <Computers and Intractability: A guide to the Theory of NP-Completeness> Travelling Salesman Problem

Unit 4	Topics Parallel Machine Model
Session 7-8 (4 hours)	• The makespan without preemptions • The makespan with preemptions • The total completion time without preemptions • The total completion time with preemptions
Group work	How to apply the parallel machine model in practice?
Required Readings	Chapter 5, in book of <Scheduling: Theory, Algorithms, and Systems (Second Edition)> i2's tradematrix production scheduler

Unit 5	Topics Shop Machine Model
Session 9 (2 hours)	• Flow shop • Job shop • Open shop • Heuristics • Branch and bound algorithm
Group work	How to apply approximation algorithms in shop model?
Required Readings	Chapter 6-8, in book of <Scheduling: Theory, Algorithms, and Systems (Second Edition)> An implementation of cybertec's cyberplan

4. Teaching Methods

Lectures、Discussions、Case Analysis, etc.

5. Learning Outcomes

Category	Learning Outcomes
Knowledge Learned	1. Basic framework and notation 2. Basic concept in complexity 3. Complexity hierarchy in scheduling 4. Analysis method: adjacent pairwise interchange 5. Analysis method: the smallest counterexample 6. Johnson algorithm 7. Dynamic programming in scheduling 8. Heuristic methods 9. Branch and bound algorithm
Intellectual abilities Improved	1. Modeling 2. Searching related references 3. Application of heuristic methods 4. Design of dynamic programming 5. Design of branch and bound algorithm 6. Analysis of approximation algorithms
Practical skills improved	1. Cautious attitude in work 2. Creative thinking 3. Application-oriented research 4. Sustainable study 5. Communication and cooperation 6. Oral presentation 7. Team working
Personal competences and characters Cultivated	To develop critical thanking

6. Performance Evaluation: Means & Ratio

Evaluation	Ratio	Link with learning outcomes expected

Means	(%)	
Class Participation	10	All Category
Home work	10	All Category
Group Work	10	All Category
Final Assignment	70	All Category

Requirements of Individual Final Assignment

1. Based on their interest, the students are free to choose a topic of scheduling to research. They must use their creation to establish the model on the basis of application.
2. They must use searching engine to obtain literature, such as google, elsever and sciencedirect database.
3. Within two weeks, the students should submit the final assignment, which should give the comment on the advantages and disadvantages on the mathematical models and solution approaches, as well as improvement suggestions.

Policy on attendance and participation:

Since most class meetings will include the discussion, students are expected to attend and participate in all classes (if you miss some session, you will get points off according to your handbook).

Feedback:

Any feedback, whether verbally or electronically, on anything that concerns you *is always appreciated*.

Preparation:

Students are requested to read all the cases marked with MUST PRIOR to the first classes.

7.Textbook，References and Reading Materials

Textbook

[1] Michael Pinedo, *Scheduling: Theory, Algorithms, and Systems (Second Edition)*, Prentice-Hall, Inc, 2005.

[2] Peter Brucker, *Scheduling Algorithms (Fourth Edition)*, Springer, 2004.

[3] Michael R. Garey and David S. Johnson, *Computers and Intractability: A guide to the Theory of NP-Completeness*, Freeman & Co., San Francisco, 1979.

Online resources

[1] Library of Tongji University：http://www.lib.tongji.edu.cn/

[2] Sciencedirect：http://www.sciencedirect.com/

[3] Google：http://www.google.com/

[4] European Journal of Operational Research

[5] Operations Research

[6] Management Science

8. Cases

[1] Michael Pinedo, Scheduling: Theory, Algorithms, and Systems (Second Edition), Prentice-Hall, Inc, 2005.

9. Assignment Requirements

The criteria of assignment evaluation (100 points)

Assessment Criteria Grid	Max. points	Points Attributed
Comprehension of key issues: • Understanding of concepts treated in class • Ability to apply concepts to new context/s • Proper use of subject matter vocabulary • Addressed fully the assignment requirements	20%	
Analysis: • Display of critical thinking relative to subject matter • Application of key models and concepts to the analysis • Ability to apply concepts/models from other disciplines to the analysis	20%	
Structure & presentation: • Well-structured ideas and information	20%	

• Clarity of presentation • Professional layout – tables, figures, images, headings, hierarchy of information • Use of transitions and interim conclusions		
Conclusions & recommendations: • Logical continuation of reasoning/ideas/analysis developed in assignment • Concision and relevancy to the analysis • Relevance to the analysis	**20%**	
References & citation: • Citations within paper • Proper format of citation and no acts of plagiarism (intentional or unintentional) • Reference/Bibliography section • Depth and breadth of sources	**10%**	
Other: • Elements of assessment at Professor's discretion relative to the discipline • Creativity and originality of ideas/approach/analysis/findings • Demonstrated general attainment of module learning objectives	**10%**	
TOTAL	**100%**	

Appendices:

1. The course SLIDES
2. Teaching material (such as reading materials, the articles)