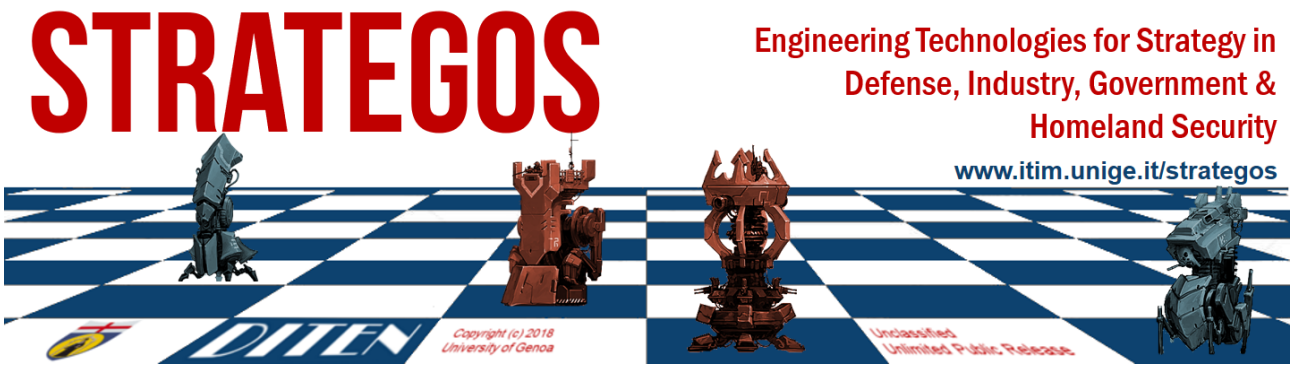

STRATEGOS

Master of Science on Modelling, Engineering and Strategies on Operations and Systems

Course: Strategic Decisions: Models, Methods

SSD MAT09

Credits: ***8***

Tentative Schedule:

1 Lecture of 4 hours in a row per week for 20 weeks to support Class Exercises and Lab Activities.

Teachers, Email, URL:

- ***Anna Sciomachen, sciomach@economia.unige.it,***
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  www.itim.unige.it/cs/strategos/year/2019/strategos_cv_carminecerrone.pdf

Education Objectives:

This Course provides students the operations research and decision support methods, which are the most relevant to the Strategic Decisions, for the Planning and Control. Problem solving skills will also be provided.

The Course is aimed at developing optimization models and providing methods for decision making problems. Particular emphasis is given to logistics and transportation problems.

Case studies concerning relevant strategic problems, such as facility location, network design, optimal sizing, are presented, developed and analyzed in a computer classroom using ad-hoc software environment(e.g. Spread sheet Excel, Lindo, MPL, Python).

Course Program & Elements:

1. *Introduction to Operations Research (OR). The origin of OR. The role of the Air force group in the II world war period. The OR modelling approach, Main components of a decision problems. Overview of the main OR methods. Continue and discrete optimization problems.*
2. *Strategic Decision Problems:*
   a. *Facility location problem: definition, location in the space, facility location in networks, strategic nodes in a network (center, median and p-median). Linear Programming (LP) formulation. Solution of the problems with Excel. Basicheuristic approach. Facility location game.*
   Optimal routes and connections problems on networks, Reliability routes. Optimal path problem. External factors (reliability, sustainability, geopolitics) in route definition problems. Case study: merchant ship routes. Network design problem. The minimum spanning tree problem.
3. *Network models for optimizing projects' time-cost trade off: the critical path; crashing decisions.*
4. *Decision problems with Boolean variables: Either-or constraints, functions with N possible values. The fixed charge problem. Covering problems. Example of the Boolean variables usage through facility location problems and their main decision components.*
5. *Decision problems with more than one objective: multi-objective optimization approaches; Pareto optimal solutions. Some examples.*
6. *Decision problems with uncertain outcomes:*
   a. *Decision analysis: decision making without and with experimentation, probability tree. Decision trees using Excel.*
7. *Python basic concepts for decision problems. Graph data structure, develop a data parser, test cases creation. Use PI and PLI solvers in Python: define decision variables, create the objective function, add constraints to the model, analysis of the solutions.*
8. *Algorithms and complexity classes. Exact, heuristic, meta-heuristic, approximate approaches. The Vertex Cover problem, constructive algorithm, 2-OPT algorithm, Branch and Bound. Implementation of the proposed algorithms.*
9. *Constructive Algorithms, Greedy Algorithms, selection function. The Iterated Greedy, the Carousel Greedy. Local Search, definition of neighborhood, implementation of a neighborhood. Escape from the local minima, the Tabu Search, the Tabu list, the reactive Tabu list. Implementation of a Local Search.*
10. *Genetic Algorithms in decision problems, chromosome, population, crossover, mutation, selection function. Population diversity, speciation heuristic and strong mutation. Memetic Algorithms.*
    Implementation of a Genetic Algorithm in decision problems

A specific independent ad hoc **STRATEGOS** Workshop on ***Game Theory*** integrates this course on this subject

Learning outcomes:

At the end of the course, students

1) *will know*
    a. *the proposed models and methods useful to solve real strategic decision problems*

2) *will be able to:*
    a. *to analyse a real-world problem, a strategic decision problem, and to understand how to tackle it;*
    b. *to implement a mathematical model and to solve it either by a commercial solver or to define and implement a heuristic approach*
    c. *to critically analyse the solution(s) obtained by assessing their correctness and feasibility*
    d. *to work in a team, specifically, to solve large problems.*

Teaching Approach:

Lessons will be held in a computer classroom. Frontal Lectures presenting theory and practical applications of the proposed methodologies and strategic problems are planned together with both individual and team work exercises. *Traditional lessons will be integrated with the analysis of case studies approached by students by using software environments and internet search engines.*

Evaluation and Final Exam:

During class hours, students will be asked to solve exercises or case studies in the classroom that will contribute to the final evaluation of the exam. Therefore, in case of students attending classes for the final assessment it will be necessary to present and discuss orally a case study agreed with the teachers.

Students who will not attend the lessons will have to take a written test and present and discuss orally a case study agreed with the teachers.

Timetable:

I semester: Thursday, 14-18

II semester: Wednesday, 14-18

Office hours for students:

I semester: Thursday, 13-14

II semester: to be defined

Time Zone: *CET (GMT+1)*

Prerequisites:

The Course does not require specific prerequisites, being accessible to University students and including all the elements and references necessary for the Candidates; therefore basics know-how in mathematics, statistics and computer use could be useful to improve the Candidate learning curve and performance.

References

- S.Hillier, G.J.Lieberman, “Introduction to Operations Research”, McGraw Hill, 2016.
- Robert T. Clemen & Terence Reilly, “Making hard decisions” , 3rd edition
- A. L. Jaimes, S. Zapotecas-Martinez, C.A. Coello Coello, An introduction to multiobjective optimization techniques, in Optimization in Polymer Processing, A. Gaspar-Cunha, J.A. Covas (Editors), Nova Science Publishers, 29-57 (2009)
- M. Ehrgott, A discussion of scalarization techniques for multiple objective integer programming, Annals of Operations Research, 147, 343-360 (2006)
- M. Ehrgott, Multicriteria optimization, Springer, Berlin-Heidelberg (2005)
- M. Ozlen, M. Azizo˘glu, Multi-objective integer programming: A general approach for generating all non-dominated solutions, European Journal of Operational Research, 199, 25-35 (2009)

Course booklets and other material will be provided on the aulaweb pages.