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Status	Advisors	Project
Assigned	İ. Kuban Altınel	**Scheduling Traffic Lights at Mecidiyeköy Square** (3-4 students) This project aims to determine a green-red light schedule that optimize pedestrian and vehicular traffic flows at Mecidiyeköy square over a fixed planning horizon. Students will be responsible for the development and solution of an optimization model. The determination of model parameters will require the collection of data and its analysis. After its validation the model will be used to evaluate possible future scenarios.
	İ. Kuban Altınel	**Assignment Problem with Conflicts** (3-4 students, prerequisite: IE 456 or a basic background in graph algorithms) A variant of the ordinary assignment problem, the Assignment Problem with Conflict Constraints (APC) will be considered in this project. A conflict constraint states that a certain pair of edges cannot be contained simultaneously in a feasible solution. It is convenient to represent these conflict constraints in terms of the so-called conflict graph whose vertices correspond to the edges of the original graph, and whose edges represent conflict relations. Then, every stable set of the conflict graph is a conflict-free subset of edges. Hence, APC becomes the determination of a stable set of the conflict graph whose elements represent a perfect matching of the original bipartite graph with minimum or maximum total weight. The goal of this project is to develop and implement Lagrangean heuristics for APC.
Assigned	Necati Aras	**Prediction of Audit Results** (2-3 Students, the team members are required to have taken a data mining course) bestERA Intelligent Solutions is founded to enhance smart and value-added solutions in complicated business processes with its staff of engineers and academics in process consultancy and process design in local and global projects conducted and it continues operating in Boğaziçi University Technopark. bestERA develops solutions for its customers' corporate problems in complex business processes for 32 years. The offered solutions are designed within the framework of information sharing, efficient joint work of business units and, the right distribution of authority in the form of turnkey projects. One of their software products, DENETI, helps companies to gather business critical data from the stores, customers, suppliers, sources, warehouses and field assets using audit forms. DENETİ is suitable for Quality Assurance Managers, Food Safety and Hygiene Experts, Store Managers, OHSAS Managers, Sourcing Managers. It runs on smart phones, tablets or computers, and is accessible both via a web platform and a mobile application which supports both ANDROID and IOS operating systems. At the end of a quality audit, some reports are generated such as frequency analysis of non-conformities, score charts, regional analysis and heat maps. In this project, the focus will be on the data collected from a company's audits. Using machine learning techniques, the audit results will be tried to be predicted. The ultimate goal is to eliminate the need of some audits by predicting the results, which will reduce the costs associated with performing the visits. The data will be supplied by bestERA.

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Assigned	**Yaman Barlas Gönenç Yücel**	**Interactive dynamic 'diving simulator' to train novice scuba divers** (3 students) In scuba diving, the body is subject to several forces, some of which being non-linear and delayed. Thus, smooth scuba diving and stabilization is not trivial, which can be risky for the diver. The most essential factor in this process is the force exerted by the jacket (buoyancy compensator), so the diver regulates buoyancy by deflating air from or inflating air into the jacket. The basic forces and feedbacks involved in this process were already modeled in a M.S. thesis by Evrim Dalkıran (2006) and a simple interactive simulator was built. The purpose of this new project is to extend this prior work in two directions: i- to include and model other realistic factors and forces, such as the hand and fin movements of the diver, position and other diver characteristics, ii- to create a more realistic and richer scuba diving game, environment, by using more advanced software, preferably with extensive web-based and animation features. Firstly the original model will be improved, then the interactive game will be built using the improved model, and finally the game will be thoroughly tested by players. The ultimate purpose is to develop a 'diving' simulator to help diving schools/clubs in training novice divers. Some scuba diving experience by the project team members would be an important advantage. The project will involve substantial amount of system dynamics simulation and general computer programming.
Assigned	**Ümit Bilge, Necati Aras**	**Production Planning for Pressure Casting Machines** (3 students) In this project, an analytical method will be developed in the production planning of high-pressure casting machines for a production facility producing ceramic sanitary ware. The goal is to minimize the losses caused by the delays in the delivery times of the orders and the mold changes. The method will decide on the mold combination for each machine in each shift and when to change the molds during a planning period. As a result, it will be determined how much of the orders in different priority groups can be completed during the planning period. The solution methodology will be to develop a mixed integer linear programming model, and solve it exactly. The parameters of the model will be data such as technological information, including mold compatibility of castings and products, and the breakdown of orders by product and priority. The model will be run with real data after first validating it on small-sized instances via solvers. The solutions obtained will be evaluated in terms of their time performance. In addition, it is planned to make different analyses by using the model as a decision support system. **Keywords**: Unrelated parallel batch production, multi-die casting, die change minimization, mixed-integer programming

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Assigned	**Taner Bilgiç**	**Analyzing Olive Oil Production in Turkey** (3 students) Today, olive oil is truly a global product but it is mainly produced and consumed in Europe. Turkey accounts for 12% of the production and 11% of the consumption in the EU. Turkey has been increasing its production and consumption in recent years and the market seems to have quite some potential. In this project you are going to use time series data for production, consumption, import and export of olive oil in the world and come up with an analysis (possibly using forecasting and/or simulation) for the Turkish olive oil market. Data analysis, statistics, time series analysis and simulation skills are required.
Assigned	**Taner Bilgiç**	**Simulating Supply Chains under Disruption** (3 students) A recent approach is proposed in the literature to build and analyze the risk-exposure index (REI) of supply chains under disruption. This approach can capture the cascading effects of disruptions in the supply chains. In this project, you are going to analyze the proposed REI model in the literature and analyze different scenarios using discrete event simulation of it. Python and SimPy skills are required.

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	Tınaz Ekim	**Generating Random Perfect Graphs** (3 students) (Requirements: IE 456 and/or IE 518, good programming skills) While real-life problems are modeled with graphs, the resulting graphs have certain structural features coming from the nature of the problem. Perfect graphs and their subclasses such as chordal graphs and interval graphs are at the forefront of the graph classes that stand out with their structural features coming from applications. Many algorithms have been proposed in the literature to solve real-life problems modeled by these graphs. However, examples of graphs belonging to related graph classes are often not available to measure the performance of these algorithms empirically. Using general graphs when testing an algorithm specially tailored for a particular graph class does not accurately reflect the actual performance of that algorithm. In some cases, tests are conducted on graphs that are known to belong to the related graph class, but it is not known whether these graphs are randomly selected from that graph class and reflect all its diversity. In this case, assessments may be biased. In this study, students will work on the random generation of perfect graphs. This study will include the following items. 1. Implementing and testing various perfect graph recognition algorithms; the one based on exhaustive search of induced odd cycles used in [1] and the polynomial time recognition algorithm suggested in [2] and implemented by Kadir Pehlivan. (both codes will be available to the students for further improvements) 2. Designing a Markov Chain Monte Carlo algorithm that will generete a C5-free graph using the ideas in item 1 and make random changes until it becomes perfect 3. Improving the perfect graph generator in [1] 4. Comparing experimentally the perfect graph generators developed in items 2 and 3 both with respect to the run time and the sizes of the generated graphs, and other related parameters of the generated graphs such as number of maximal cliques, clique number, independence number etc.) Integer programming formulations might be useful at this stage. References: [1] Oylum Seker, Tınaz Ekim, and Z Caner Taskın. An exact cutting plane algorithm to solve the selective graph coloring problem in perfect graphs. European Journal of Operational Research, 291(1):67–83, 2021. [2] Maria Chudnovsky, Alex Scott, Paul Seymour, and Sophie Spirkl. Detecting an odd hole. Journal of the ACM (JACM), 67(1):1–12, 2020.
Assigned	**Mahmut Ekşioğlu**	**Productivity and Safety Improvement Of A Work System** (3-4 students, IE 430 Ergonomics & Human Factors Engineering required for all members) Application of ergonomics, lean six sigma and other industrial engineering principles to the work systems enhances productivity, quality, and safety and health. This project involves application of these principles in the evaluation and redesign of a selected work system. Project consists of three main parts: (1) data gathering for identification of productivity, safety and health issues, (2) solving the identified issues, and (3) cost-benefit analysis.

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Assigned	**Mahmut Ekşioğlu**	**A Human-Computer Interaction Design** (3-4 students, IE 48L Human-Computer Interaction Design required for all members) For this project, students will choose an interface problem and go through a design process to brainstorm, conceptualize, develop, test, develop, prototype, test, and report on your new or revised interface. Students will apply the design process, methods and principles learned in IE 48L course. You are to decide on a specific application within the selected domain, perform a literature search or background review on the topic, design an interface for the particular application chosen, and test and evaluate your design. Project Domains: • Education • Medicine & Health Systems • Transportation • Home • Crime • Entertainment • Design • Manufacturing • Service • Banking • Business • Food Services • Agriculture • Sports • Other domains? Some project ideas: • Curated maps and routes (e.g. Spotify for walking or biking) • Garden guide (e.g. planning, managing and tracking a garden) • Back-end system for an animal shelter (for employees to manage animals) • Back-end of restaurant menu ordering system (e.g. employee interface for adding inventory) • Catalog store shopping assistant • Recreation Centre app • Ski hill application • Mobile field guide for a park (e.g. for mushrooms, flowers, etc.) • Driving data app • Period tracking app • Farmer market vendor app • Something of your choosing
Assigned	**Refik Güllü**	**Portfolio Optimization with New Risk Measures by using Python** (3-4 students with fluency in Python) Portfolio Optimization is a strategic allocation of money to a given set of candidate financial instruments. The optimized portfolio minimizes a certain risk measure and provides an acceptable level of return. Riskfolio-Lib is a Python library for portfolio optimization whose objective is to help students build investment portfolios based on mathematically complex models with low effort. In this project, using Riskfolio-Lib, students will learn, implement and compare portfolio optimization models that utilize recently developed risk related measures and concepts. Some of these measures and concepts are: Conditional Value at Risk, Omega Ratio, Drawdown Optimization, Hierarchical Risk Parity, Factor Models, and the Black-Litterman Algorithm. The project is a collaboration with the start-up company RiskOptima Financial Technologies and the project team will implement portfolio optimization problems using data from industrial-metals-importing companies.

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Assigned	**Refik Güllü**	**Vehicular Data Analytics and Maintenance Prediction** In this project the students will analyze real time data collected from a fleet of vehicles on vehicle and driver performance and working condition of parts and components. Using the data, students will develop models for safe and economic preventive maintenance and replacement of various parts and components.
	Aybek Korugan	**Determination of Group Size and Strategy for Disaster Coordination in a Neighborhood** The objective of the study is to find the optimal team size that collaborates in a neighborhood when disaster strikes. Consider a subset of k families in a neighborhood of N families that collaborate to survive a disaster. The plan is to communicate with team members starting right after disaster strikes and care for each other until a stable environment is reestablished. Communication, first aid, finding help, nourishment, lodging and similar needs have to be considered under temporary conditions that have random duration and difficulty levels. The interaction of the team with the remainder of the population also needs to be considered. This project will have two versions according to the population density of the considered area. **Project 1:** Consider the above problem with k of N for a densely populated area. (2-3 Students) **Project 2:** Consider the above problem with k of N for a sparsely populated area. (2-3 Students)
Assigned	**Z. Caner Taşkın, A. Tamer Ünal**	**Incorporating lead time variability and risk in order promising** (4 students) Order promising is an important business process for manufacturing companies. When a customer requests a quotation for an order that they are planning to place, the company needs to identify a reliable date that they can promise delivery of the order. The promised due date needs to be late enough so that sufficient capacity and materials are available for the manufacturing of the product without delaying other customer orders. On the other hand, the promised date needs to be early enough so that the customer is likely to accept the quotation instead of seeking alternative suppliers. This decision needs to be made under uncertainty such as material purchase and manufacturing lead times, which implies on-time delivery risk on promised orders. In this project the project team will investigate ways of measuring and incorporating lead time variability and risk in optimization models and heuristics.

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Assigned	**Z. Caner Taşkın, A. Tamer Ünal**	**Optimal material purchasing and blending** (4 students) Optimal blending problem arises in various industries such as tea / coffee production, where the company purchases unprocessed materials (such as green tea leaves) from various markets around the world and processes them in its global network of blending facilities. Raw materials have different attributes such as taste, color and scent that vary depending on the producer and the season, and can be purchased at different price levels subject to market conditions. They are mixed in blending facilities in appropriate quantities to achieve desired attributes of blended products (such as earl grey tea). In this project, the project team will formulate and solve the optimal material purchasing and blending problem as an optimization problem and using heuristics.
Assigned	**Gönenç Yücel**	**Development of a SCUBA Diving Day Planning Tool** (3 students) Typical diving trips of BÜSAS (Boğaziçi University Underwater Sports Club) consists of 4 to 6 consecutive diving days. Given the divers in the trip, a diving plan that specifies the diving groups has to be developed for each day. Each diver has certain attributes such as level (1* candidate, 2* diver, 3* diver, instructor, etc.) and experience. There are a set of regulations and rules about the composition of each diving group. In this project, the project group is expected to develop a planning tool that develops a daily diving plan considering all the rules and regulations. **Keywords:** Assignment Problem, Optimization, Heuristic Algorithm
Assigned	**Gönenç Yücel**	**Simulation-based Evaluation of Alternative Course Registration Systems** (3 students) The current course registration system in Boğaziçi University is a first-come first-served system. However, it can be claimed that alternative course-student matching systems may yield a higher overall satisfaction and better student-course match. In this project, the team is expected to develop an agent-based simulation model that captures the fundamental aspects of the registration problem in order to evaluate alternative registration systems under different student preference distributions. **Keywords:** Agent-based simulation