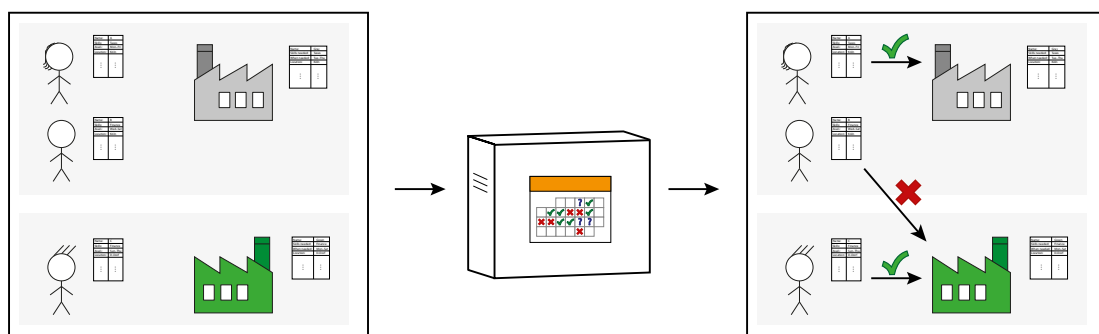


# Optimizing Project Schedules

**Background.** All medium and large corporations are required to have their financial statements reviewed by an auditor. KPMG is one of the world's largest companies providing advisory services in the area of financial and tax audits. KPMG International employs more than one hundred thousand people with very different backgrounds at many locations worldwide. If we consider the task of a financial audit of a particular client, we see it consists of several subtasks. These need to be accomplished by different consultants according to a set of dependencies. Additionally, the financial audit needs to be completed before a given deadline. The assignment should fulfill a number of hard and soft constraints, such as the availability of an employee, the work in established teams, personal preferences and travel times. Moreover, for maximum customer satisfaction, the assignment should optimize the fit between the skills of the employees and the requirements of the project.

**Challenge.** The assignment of consultants to locations, times, projects and subtasks is currently done manually. This bachelor project will develop an algorithm to solve this problem algorithmically. From a computational point of view, we are confronted with a highly constrained scheduling problem. Due to the computational hardness of the problem at hand, finding an optimal solution is unlikely. However, meta-heuristics, like evolutionary or genetic algorithms, have been shown to be well-suited for such problems. Thus, the aim of the project is to find and implement several heuristics that solve the scheduling problem as well as possible in the given amount of time.



**Figure 1:** An example situation: employees have different skill profiles with different time constraints. Each client requires different skill sets during a given time frame. The scheduling algorithm satisfies the skill and time constraints very well, but one consultant has to change cities.

**Vision.** We seek to develop a prototype that yields human-competitive results for medium-sized scheduling problems in several hundred projects. During the course of the project, you will implement different general-purpose solvers and customize them with problem-specific operators to exploit the problem structure. The output of the optimization process will be a set of solutions, therefore, it is important to develop appropriate visualizations of the high-dimensional search and objective space.

**Industry partner contribution.** The sponsor of this project is the managing board of KPMG Deutschland. Our contact people are in Düsseldorf, Hamburg and Berlin. They provide an anonymized real-world data set and a simple greedy solution. KPMG will support the project from kick-off to software prototype completion. Our prototype will be tested in one or two KPMG locations for the audit scheduling period of 2018/2019.

**Our contribution.** The Algorithm Engineering Group will work closely with you on this project and provide expertise in optimization and support in implementing meta-heuristics. We will help you to find the right data representation, choose appropriate algorithms, develop efficient implementations and come up with ideas to tune and optimize each framework. As in previous bachelor and master projects of our group, we offer to write a joint scientific publication about our research findings.

**Your contribution.** In your work as a team, you will develop and customize a bundle of prototype algorithms for the scheduling problem in an agile manner. Developing the prototype means creating a code infrastructure that is flexible enough to run various tests and different algorithms. You start from scratch and are free to decide your programming environment and language. We suggest starting with a theoretical foundation and creating a flexible code base that can be easily tweaked once new ideas show up. Hence, an interest in algorithm theory is very welcome, in addition to coding ability.

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