In this thesis, we consider the classical problems of scheduling jobs on a single machine to minimize weighted flowtime and the unsplittable flow problem on a path. All the problems we study are in the offline setting. For these results, we also rely on discovering novel connections to covering problems and exploiting these through ideas in dynamic programming.

In the weighted flow-time problem on a single machine, we are given a set of \( n \) jobs, where each job has a processing requirement \( p_j \), release date \( r_j \) and weight \( w_j \). The goal is to find a preemptive schedule which minimizes the sum of weighted flow-time of jobs, where the flow-time of a job is the difference between its completion time and its released date. We give the first pseudo-polynomial time constant approximation algorithm for this problem. This resolves a long standing open problem.

In the unsplittable flow problem on a path, we are given a path with capacities on its edges and a set of tasks where each task is characterized by a source and a sink vertex, a demand, and a profit. The goal is to find a subset of the tasks of maximum total profit such that all task demands from this subset can be routed simultaneously without violating the capacity constraints. We make progress towards finding a PTAS for this problem, by resolving natural special cases and obtaining a more efficient QPTAS.