A Logic-Based Benders Decomposition of an Assembly Line Balancing and Scheduling Problem

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Abstract Since the 1910s when Henry Ford revolutionised the large-scale production of automobiles, assembly lines have become an integral part of the manufacturing industry. The basic assembly line balancing problem has had numerous variants over the last hundred years, however there is still a large gap between an abstract assembly line in the academic literature and one in real life. A recent extension to the classical problem aiming to reduce this gap, adds the consideration of sequence-dependent setup times between tasks. This addition leads to a planning and scheduling problem which has proven to be difficult to solve exactly using the standard techniques of mathematical programming. We propose a logic-based Benders decomposition of the problem to exploit the comparative advantages of both mathematical and constraint programming. Through this combination and breaking the problem down into its basic combinatorial components, we are able to beat the best existing approaches from the literature and close over 100 open instances. The decomposition framework and Benders cuts we propose could be applied a range of other assembly line balancing problems which contain a scheduling component.