A Master-Apprentice Evolutionary Algorithm for the Flexible Job Shop Scheduling Problem

Abstract

This paper presents an evolutionary algorithm based on two individuals (called master-apprentice evolutionary algorithm, MAE) for solving the flexible job shop scheduling problem, which distinguishes itself from both single solution-based and traditional population-based metaheuristics. MAE integrates a tabu search procedure, a path-relinking recombination operator, and an individual updating strategy. At each generation, a path relinking recombination operator is applied on the two individuals to generate two child solutions. The individual updating strategy is conducted once a given number of generations (called a cycle) is reached: one of the two individuals is updated at the end of a cycle with the best solution found in the previous cycle. The other individual is initialized when the two individuals are close to each other at each generation. Computational experiments on 178 public instances show that MAE achieves highly competitive results in terms of both solution quality and computational efficiency compared with the state-of-the-art algorithms in the literature. Specifically, it improves the previous best known results for 47 instances while matching the best known results on all except 5 of the remaining instances with short computational time.

Keywords: flexible job shop scheduling problem, master-apprentice evolutionary algorithm, path relinking.

1. The computational results of MAE

This paper is an appendix of the paper submitted to IJCAI-2018, which provides the overall computational results of MAE on the benchmark sets (*DPdata* (Dauzre-Prs and Paulli, 1997), *BCdata* (Barnes and Chambers, 1998), *BRdata* (Brandimarte, 1993), and *HUdata* (Hurink et al., 1994)) and make comparisons with the recent state-of-the-art algorithms (SSPR Gon-

zlez et al. (2015) and GRASP-mELS Kemmo-Tchomt et al. (2017)) in the literature.

1.1. The results of MAE on DPdata set

Table 1: Comparison between MAE and other reference algorithms on *DPdata* instance set

Ins.	Qunitiq		SSPR		GRASP-mELS	MAE
	LB	UB	LB	best	best	best
01a	2505*	2505	2505	**2505**	**2505**	**2505**
02a	2228*	2228	2228	2229	2229	2228
03a	2228*	2228	2228	**2228**	**2228**	**2228**
04a	2503*	2503	2503	**2503**	**2503**	**2503**
05a	2192	2204	2189	2211	2212	2207
06a	2163	2171	2162	2183	2195	**2181**
07a	2216	2264	2187	2274	2276	2267
08a	2061*	2061	2061	2064	2069	2063
09a	2061*	2061	2061	**2062**	2069	**2062**
10a	2212	2241	2178	2269	2263	2247
11a	2018	2037	2017	2051	2065	2048
12a	1969	1984	1969	2018	2039	2011
13a	2197	2239	2161	2248	2252	2247
14a	2161*	2161	2161	2163	2170	2163
15a	2161*	2161	2161	**2162**	2172	**2162**
16a	2193	2231	2148	2244	2243	2242
17a	2088	2105	2088	2130	2145	2123
18a	2057	2070	2057	2119	2146	2112

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