HARMONY SEARCH HYPER-HEURISTIC WITH DIFFERENT PITCH ADJUSTMENT OPERATOR FOR SCHEDULING PROBLEMS

Khairul Anwar, Mohammed A. Awadallah, Mohammed Azmi Al-Betar

KHAIRUL ANWAR

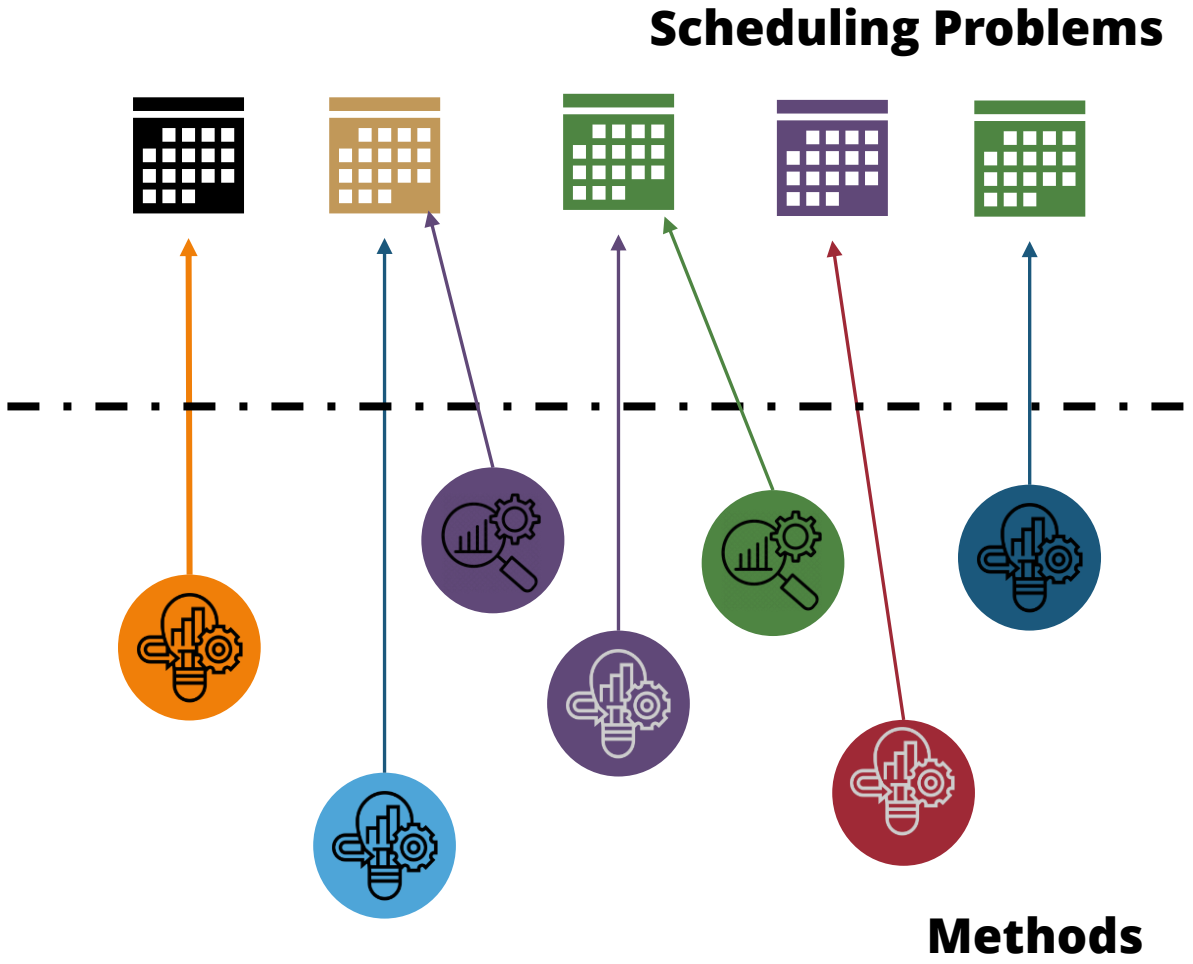
Universiti Teknologi MARA (UiTM) Cawangan Sabah, Kampus Kota Kinabalu
Beg Berkunci 71, 88997 Kota Kinabalu, Sabah, MALAYSIA.

4 - 5 AUGUST 2021

CONTENTS

Introduction

Scheduling problems occur in almost all fields or domains related to services especially in health, transportation and educational institutions.

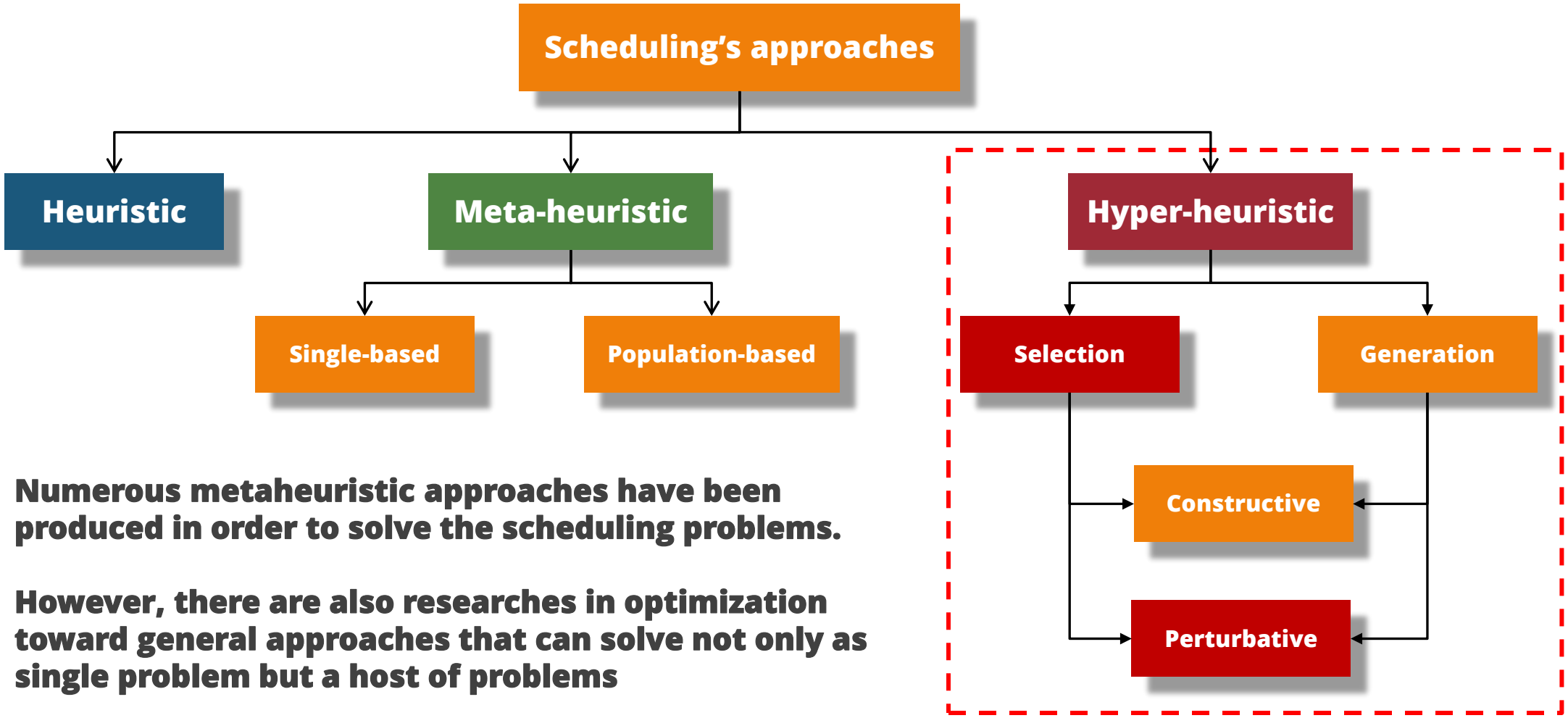


Objectives

To produce a general method that able solve various scheduling problems

HYPER-HEURISTIC

Literature Review



Numerous metaheuristic approaches have been produced in order to solve the scheduling problems.

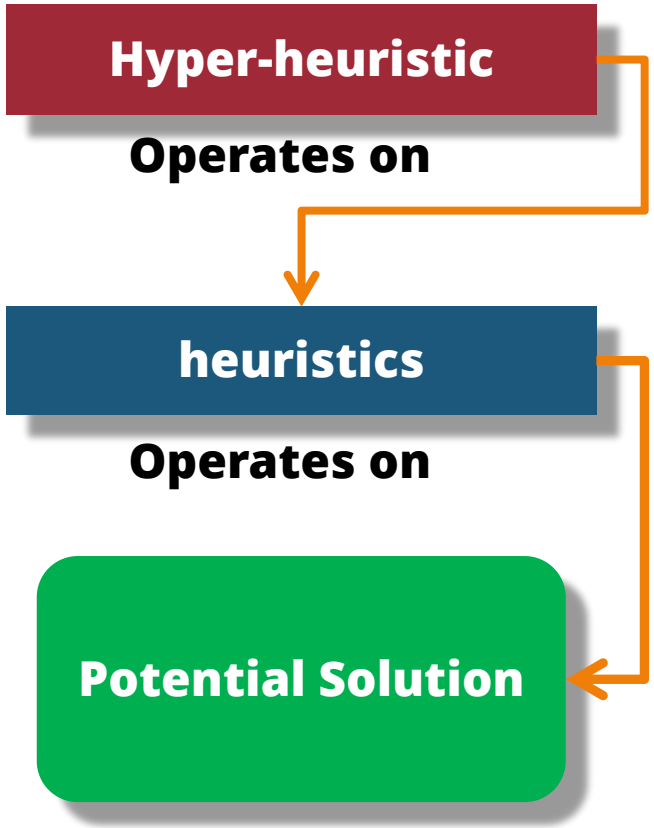
However, there are also researches in optimization toward general approaches that can solve not only as single problem but a host of problems

Hyper-heuristic

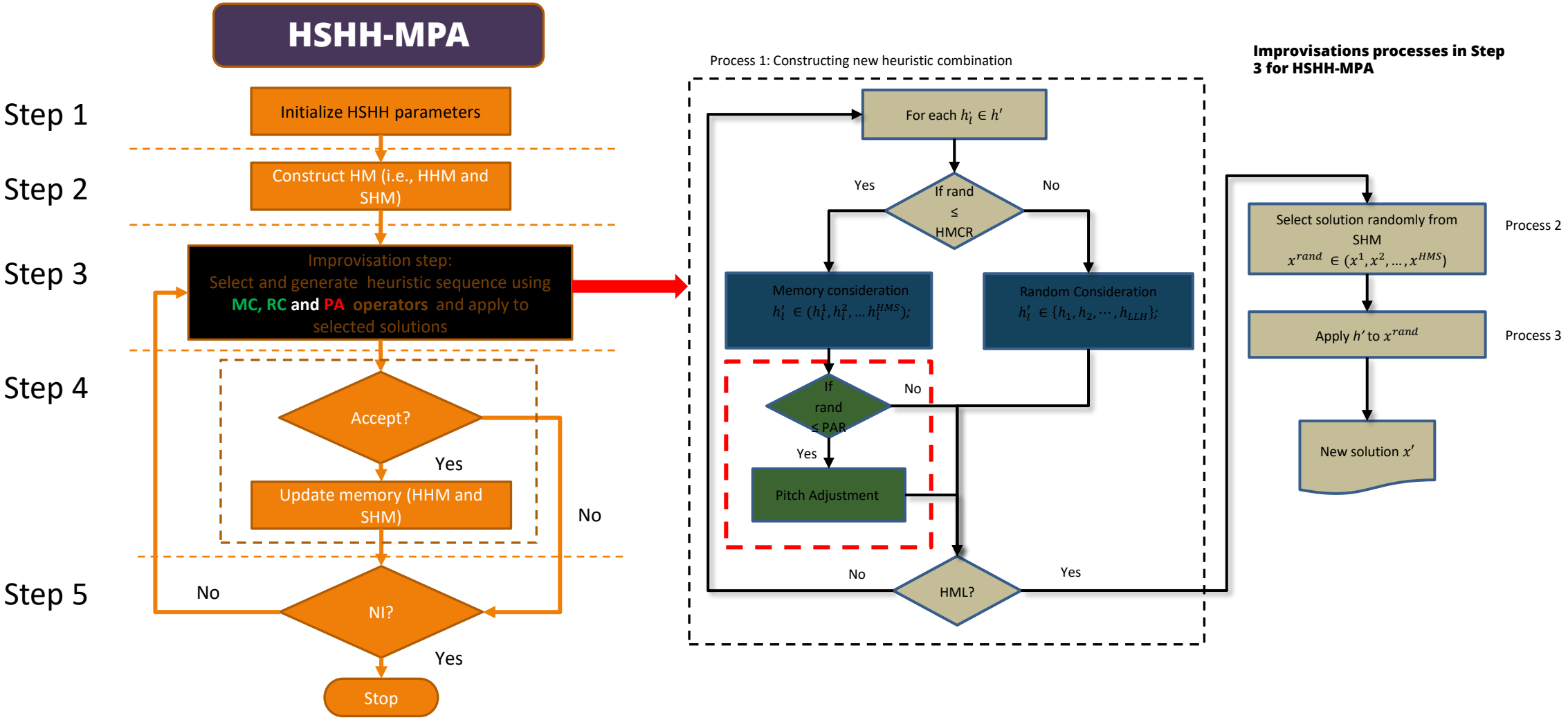
Originally define as *"heuristics to choose heuristics"*.

New definition - *"search method or learning mechanism for selecting or generating heuristics to solve computational search problem"* (Burke et al.,2009).

HH different with meta-heuristics which HH operates on the search space of heuristics rather than directly on the search space of solution



HSHH with Modified Pitch Adjustment (HSHH-MPA)



HSHH with Modified Pitch Adjustment (HSHH-MPA)

Three different heuristic selection in pitch adjustment

First selection *(PAType1)*
- Simple adjustment which the new index of h_i' will be added/ subtracted by 1.

Second selection *(PAType2)*
- The new index of h_i' will be selected from the best heuristic sequence in the HHM.

Third selection *(PAType3)*
- The new index of h_i' will be selected based on the lowest heuristic's usage in the HHM

Experimental and results

Three scheduling problem were used to test the proposed method.

- **1. Un-capacitated examination timetabling problem (Carter's)**
- **2. Nurse rostering problem (INRC2010)**

Constraints – typically divided into two types:

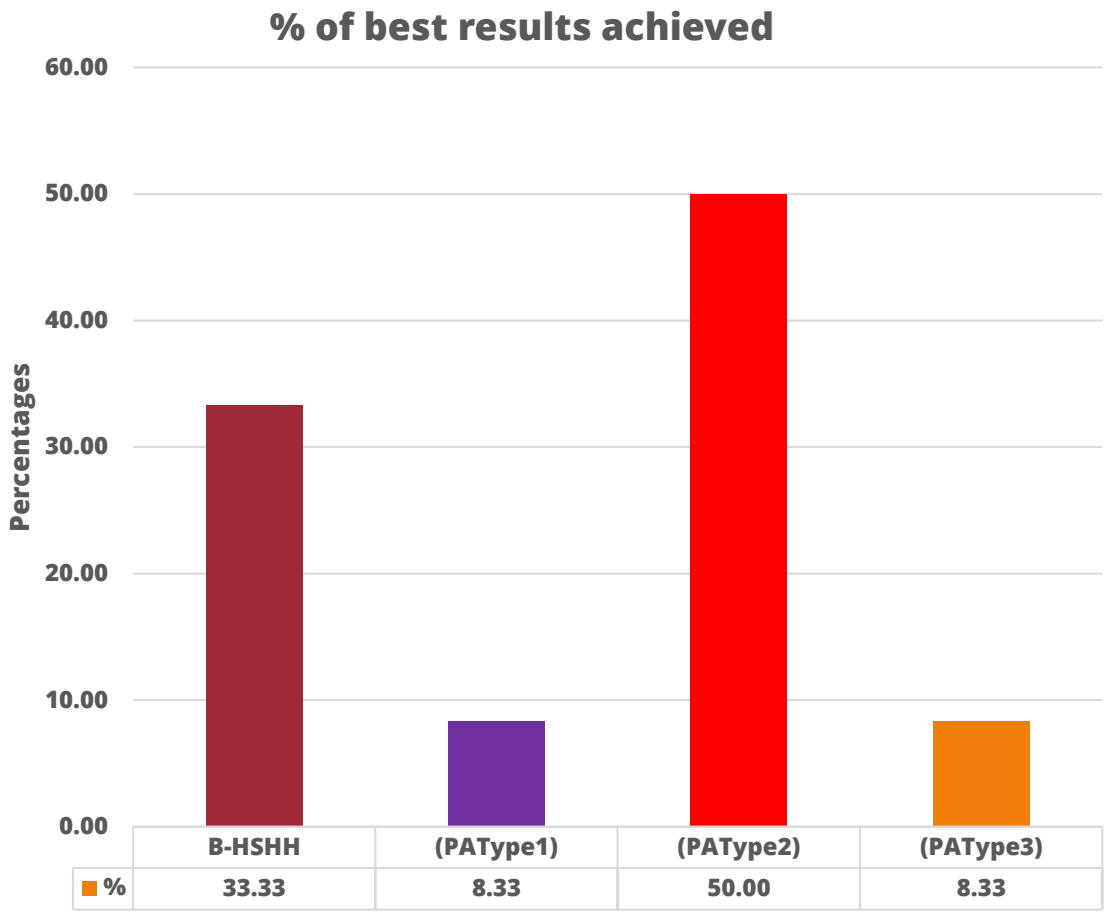
- **Hard constraints – must be satisfied.**
- **Soft constraints – are desired but not absolutely necessary.**

The objective is to satisfied all the hard constraint and minimize the penalty value of the soft constraint violation in order to produce a quality timetable.

Experimental and results

Comparative results of the proposed methods with B-HSHH for Carter dataset

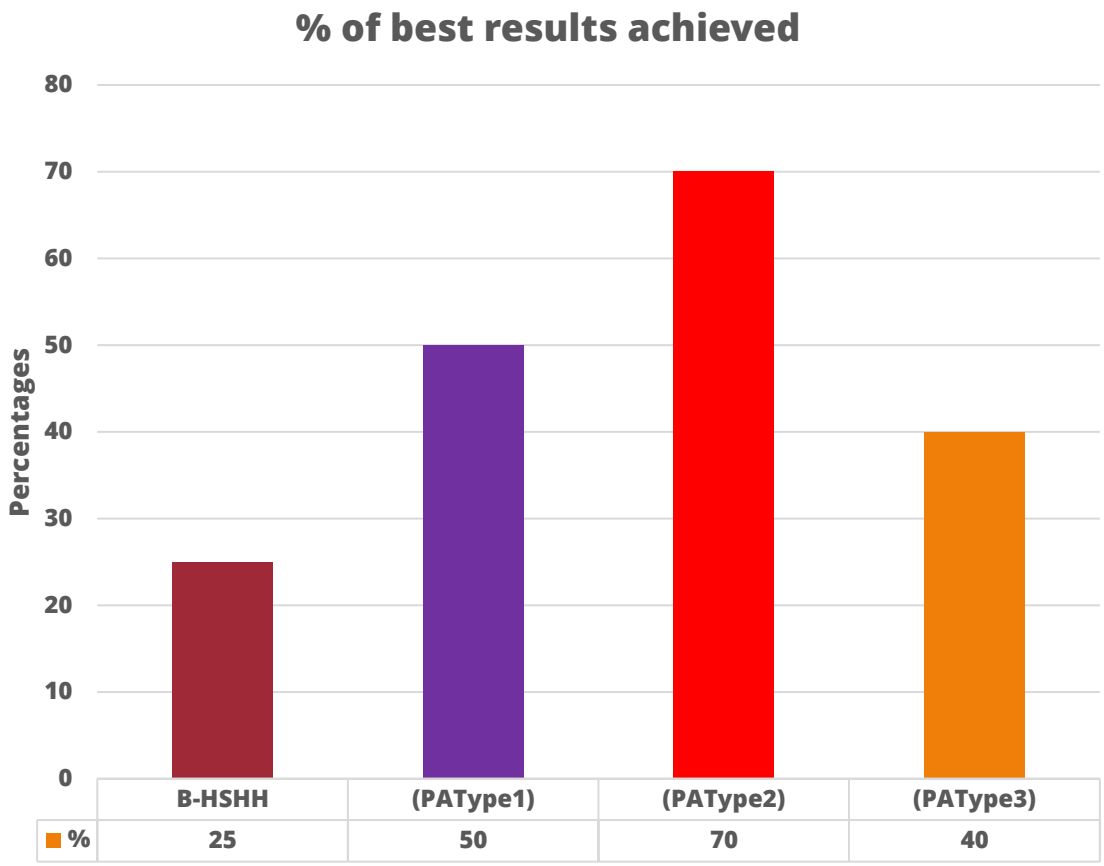
Instance	B-HSHH	(PAType1)	(PAType2)	(PAType3)
CAR-S-91-1	6.09	6.13	**6**	6.04
CAR-F-92-1	**4.88**	4.92	**4.88**	4.97
EAR-F-83-1	38.71	**37.22**	38.22	37.26
HEC-S-92-1	11.16	10.75	**10.74**	11.05
KFU-S-93	**14.71**	14.82	14.78	14.87
LSE-F-91	**11.97**	12.37	12.02	12.09
RYE-S-93	10	10.04	**9.83**	9.84
STA-F-83-1	**157.31**	157.38	157.4	157.32
TRE-S-92	9.25	9.1	9.2	9.05
UTA-S-92-1	3.84	3.82	**3.76**	3.82
UTE-S-92	27.07	26.89	**26.58**	27.14
YOR-F-83	39.53	38.92	**38.9**	39.85



Experimental and results

Comparative results of the proposed methods with B-HSHH for INRC2010 dataset

Instance	B-HSHH	(PAType1)	(PAType2)	(PAType3)
sprint early01	58	**57**	**57**	58
sprint early02	60	**59**	**59**	60
sprint early03	53	53	**52**	53
sprint early04	62	62	**61**	**61**
sprint early05	**58**	59	59	**58**
sprint early06	**55**	**55**	**55**	**55**
sprint early07	**58**	**58**	**58**	**58**
sprint early08	**56**	57	**56**	57
sprint early09	57	57	**56**	57
sprint early10	54	54	**53**	**53**
medium early01	**249**	251	250	**249**
medium early02	251	**250**	**250**	251
medium early03	247	**246**	**246**	249
medium early04	248	247	**246**	248
medium early05	315	**312**	313	314
long early01	214	213	214	**212**
long early02	245	242	**241**	243
long early03	248	**245**	246	**245**
long early04	317	**316**	**316**	317
long early05	298	**292**	295	296



Conclusions

In this study, the Harmony search-based hyper-heuristic with pitch adjustment operator (i.e., HSHHMPA) is presented with three types of heuristic selection mechanism (PAType1, PAType2, and PAType3).

The purpose of applying the pitch adjustment operator is to insert a different way of heuristic selection (e.g., using learning mechanism) instead of randomness in the memory consideration operator.

Apparently, by combining the HSHH with pitch adjustment operators (HSHH-MPA), it was slightly better compared to the original HSHH approach (B-HSHH) in most of problem instances in both datasets (Carter and INRC2010).

Based on the experimental performances, HSHH-MPA with PAType2 appeared to be the best selection mechanism. The computational results indicated that selecting the heuristic from best heuristics vector inside HHM, had led the algorithm to select the most appropriate heuristics. Thus, using the most appropriates heuristic at the right time could lead to better results.

The focus of this study is the selection mechanism for choosing low-level heuristics. It can be in the best interest of future work in the same field, to test the effectiveness of different ways of solution selection from solution harmony memory (SHM) and different move acceptance criteria with other methods.

THANK YOU