0.1 Resource type, timetable, fitness value

Let $T_0$ through $T_{M-1}$ be sets of resources $R_{i,j}$ called resource types.

\[
T_0 = \{R_{0,0}, R_{0,1}, R_{0,2}, \ldots R_{0,n_0-1}\} \\
T_1 = \{R_{1,0}, R_{1,1}, R_{1,2}, \ldots R_{1,n_1-1}\} \\
T_2 = \{R_{2,0}, R_{2,1}, R_{2,2}, \ldots R_{2,n_2-1}\} \\
\vdots \\
T_{M-1} = \{R_{M-1,0}, R_{M-1,1}, R_{M-1,2}, \ldots R_{M-1,n_{M-1}}\}
\]

We can then define a timetable $B$ as a set of $N$ tuples of $M$ resources.

\[
B = \{\langle R_{i,0}, R_{i,1}, \ldots R_{i,M-1}\rangle; \ i \in [0, N-1] \land R_{i,0} \in T_0, R_{i,1} \in T_1, \ldots R_{i,M-1} \in T_{M-1}\} 
\] (1)

Timetable search space $B^*$ is defined as a set of $N$ tuples of $M$ domains.

\[
B^* = \{\langle D_{i,0}, D_{i,1}, \ldots D_{i,M-1}\rangle; \ i \in [0, N-1] \land D_{i,0} \subseteq T_0, D_{i,1} \subseteq T_1, \ldots D_{i,M-1} \subseteq T_{M-1}\} 
\] (2)

A resource type $T_j$ is said to be a constant resource type for the timetable search space $B^*$ if

\[
\text{card} D_{i,j} = 1 \ \forall i \in [0, N-1] 
\] (3)

and a variable resource type otherwise.

A timetable $B$ is said to be an element of the timetable search space $B^*$ if

\[
B \in B^* \iff R_{i,j} \in D_{i,j} \ \forall i \in [0, N-1], \forall j \in [0, M-1] 
\] (4)

Partial fitness functions $f'_i$ through $f'_{K'-1}$ and $f''_0$ through $f''_{K''-1}$ are defined as functions that associate a timetable $B$ with non-negative integers called partial fitness values.

\[
f'_i = f'_i(B) \\
f''_j = f''_j(B)
\]

A partial fitness function can be either mandatory $f'_i$ or non-mandatory $f''_j$.

A fitness function of a timetable $B$ is defined as the weighted sum of all defined partial fitness functions:

\[
f(B) = \sum_{i=0}^{K'-1} W'_i \cdot f'_i(B) + \sum_{j=0}^{K''-1} W''_j \cdot f''_j(B) 
\] (5)

A solution function of a timetable $B$ is defined as:

\[
s(B) = \begin{cases} 
0 & \sum_{i=0}^{K'-1} f'_i(B) > 0 \\
1 & \sum_{i=0}^{K'-1} f'_i(B) = 0 
\end{cases}
\] (6)
0.2 Timetabling problem

A timetabling problem is defined as:

\[ TP = \langle T, B^*, f, s \rangle \quad (7) \]

Where \( T \) is a set of resource types, \( B^* \) is the timetable search space, \( f \) is the fitness function and \( s \) is the solution function.

A solution to the timetabling problem \( TP \) is a timetable \( B \) such that the following is true:

\[ B \in B^* \quad (8) \]
\[ s(B) = 1 \quad (9) \]

An optimal solution to the timetabling problem \( TP \) is a timetable \( B_o \) that also satisfies the following condition:

\[ f(B_o) \leq f(B) \quad \forall B \in B^* \quad (10) \]