Hard random instances generator for the open shop scheduling problem

January 8, 2021

The random instances generator takes the number of jobs n and the number of machines m as input and requires three parameters k, p and f.

An instance is generated in two steps, the first step creates the $n \times m$ matrix P of processing times using the parameter k such that all elements of P are equal to $\frac{k}{m}$ (rounded down to the nearest integer). The second step performs a number of perturbations p to the matrix P.

A parameter f is used to calculate v: a fixed value *to be subtracted* and mv: a *maximum subtractable* value. The parameters k, p and f are described by:

- k: integer number, such that the sum of each line of P is equal to k. The value $k \mod m$ is added to the diagonal of P.
- p: number of perturbations, such that for each perturbation, two task's processing times P_{ij} and P_{kl}, $i \neq k$ and $j \neq l$, are randomly selected from P, from which is subtracted the value of v.
- $f = \{f \in \mathbb{R} \mid 0 < f < 1\}$, such that:

  $mv = \max\{P_{ij}, P_{kl}\} - 1$ (subtract 1 to avoid tasks of length 0).

  $v = (f \cdot mv) + r$, with r: a random value between 0 and $f \cdot mv$.

The value subtracted from P_{ij} and P_{kl} is added to P_{il} and P_{kj} to keep the sum of all rows equal to k.

For numerous generated instances the parameters k, p and f are randomly generated as follows:

- k: random value between $n \times m$ and $n \times m \times 100$
- p: random value between $n \times m$ and $n \times m^2$
- f: random value between 0 and 1

Note that in the case of $n \neq m$, $k \mod m$ is added the diagonal of top-down square sub-matrices of size $\min\{n, m\}$ of P. The main diagonal is used on the remaining rectangle ensuring the sum of all rows of P are equal to k.

References

[1] Guéret, C., & Prins, C. (1999). A new lower bound for the open-shop problem. Annals of Operations Research, 92, 165–183. https://doi.org/10.1023/A:1018930613891.