Προχωρημένη Κατανεμημένη Υπολογιστική

HY623

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Διάλεξη 5η

Heterogeneous Earliest Finish Time – HEFT

List scheduling of tasks in heterogeneous processors

Formal Model

- Direct Acyclic Graph (DAG) G = (V,E) where *v jobs* ϵ V and *e* edges ϵ E
- There are *q* machines
- *Data*: *v x v* matrix; $data_{(i,k)}$: data transferred between job *i and job k*
- *W*: *v* x *q* matrix; $W_{(i,j)}$: processing time of job *i* on machine *j*
- *B*: a *q* x *q* matrix; $W_{(l,m)}$: data transfer rate between machine *l* and machine *m*
- *L*: q dimensional vector; indicates start up time of machine

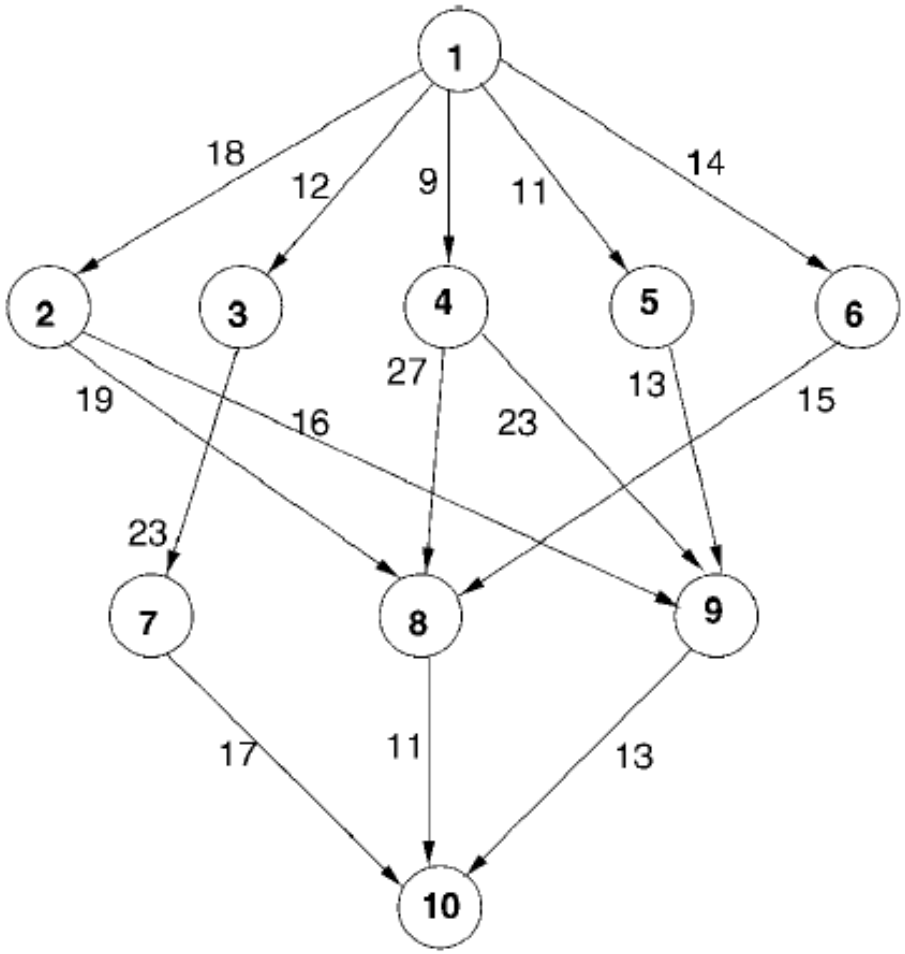
Formal Model (cont.)

- Avg processing time of job i: $\overline{w_i} = \sum_{j=1}^{q} W_{(i,j)}/q$
- Communication cost when job i on machine n transitions to *job j on* machine m:

$$c_{i,k} = L_m + data_{(i,k)}/B_{(m.n)}$$

- $\overline{c_{i,k}} = \bar{L} + data_{(i,k)}/\overline{B}$

Sample input



Computation Costs

Task	P1	P2	P3
1	14	16	9
2	13	19	18
3	11	13	19
4	13	8	17
5	12	13	10
6	13	16	9
7	7	15	11
8	5	11	14
9	18	12	20
10	21	7	16

HEFT Algorithm

- $rank_u(i) = \overline{w_i} + \max_{j \in \text{succ(i)}}(\overline{c_{i,j}} + rank_u(j))$
  - *where* $rank_u(n_{exit}) = \overline{w_{exit}}$
- $EST(i,j) = \max\{avail[j], \max_{m \in \text{pred(i)}}(AFT(m) + c_{m,i})\}$
  - where *EST(entry ,j) = 0, and* $EFT(i,j) = W_{(i,j)} + EST(i,j)$.

Pseudo-code:

1. Set the computation costs of tasks and communication costs of edges with mean values.
2. Compute $rank_u$ for all tasks by traversing graph upward, starting from the exit task.
3. Sort the tasks in a scheduling list by nonincreasing order of $rank_u$ values.
4. **while** there are unscheduled tasks in the list **do**
   - Select the first job *i*, from the list for scheduling.
   - For each machine *k* **do**
     Compute *EST(i,k)* value using insertion-based scheduling policy
   - Assign job *i* to the machine *j* that minimized EFT of job *i*.

End while