LOADING BALANCE PROBLEM

Solve by Linear Program

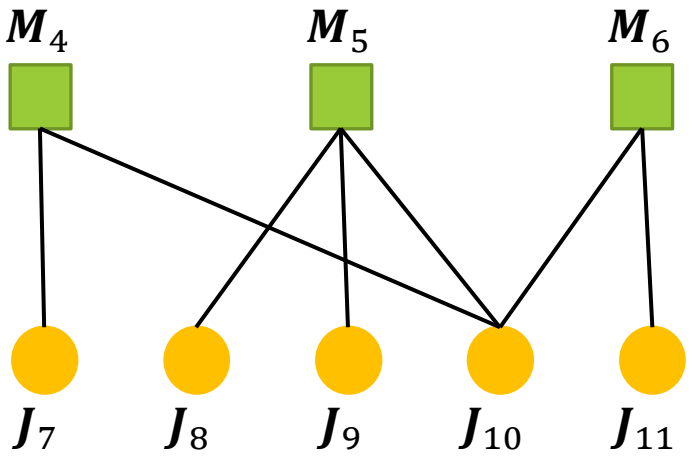
Zhiyuan Wang 12032878
Supervisor: Ke Tang

SUSTech Southern University of Science and Technology

CONTENT

1. Generate tree Structures and discuss how to choice tree and child machine node
2. Generate a graph with no cycle from a graph with cycles
3. LP-based Algorithm has best result

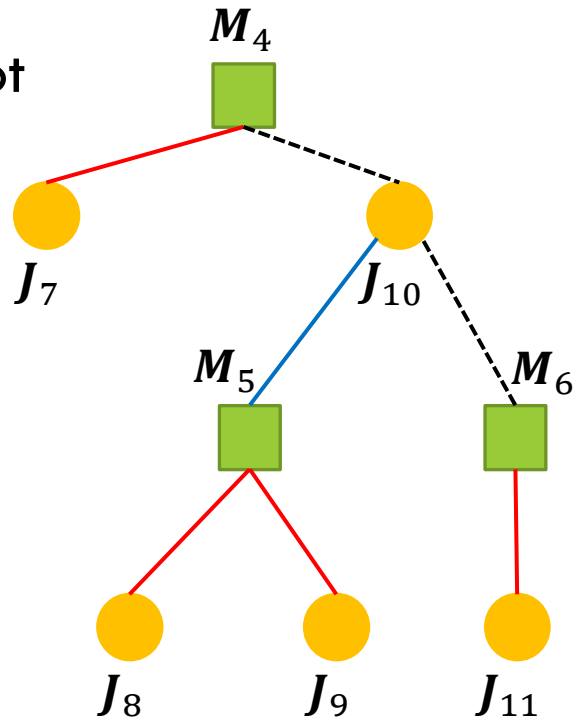
GENERATE TREE STRUCTURES AND DISCUSS HOW TO CHOICE TREE AND CHILD MACHINE NODE

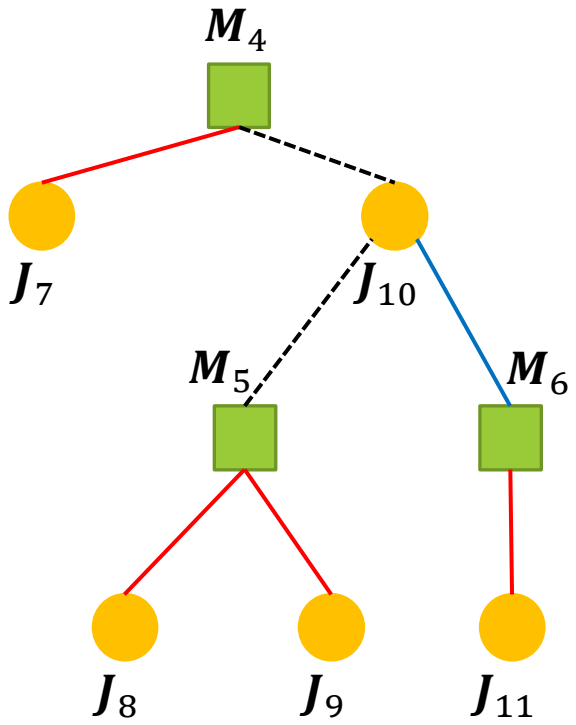


The source graph

GENERATE TREE STRUCTURES AND DISCUSS HOW TO CHOICE TREE AND CHILD MACHINE NODE

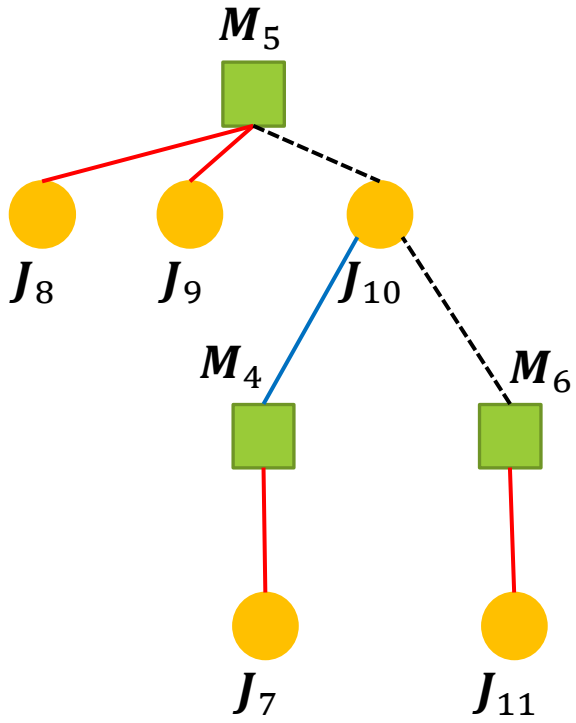
M_4 is the root

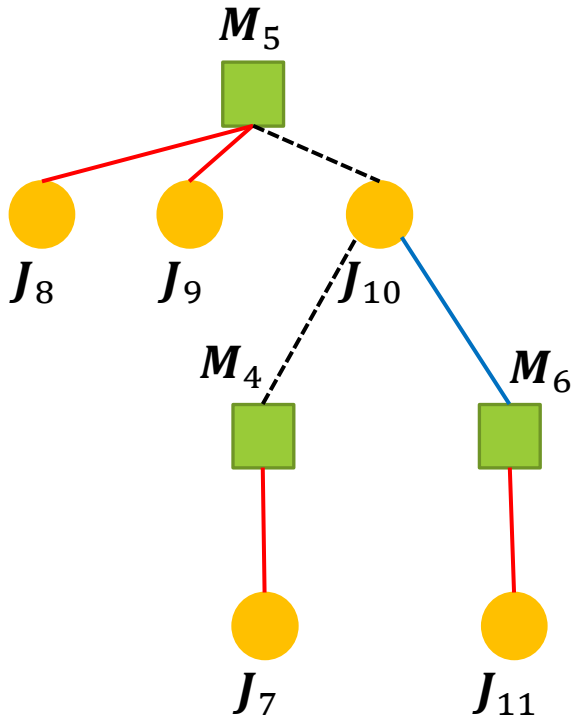




GENERATE TREE STRUCTURES AND DISCUSS HOW TO CHOICE TREE AND CHILD MACHINE NODE

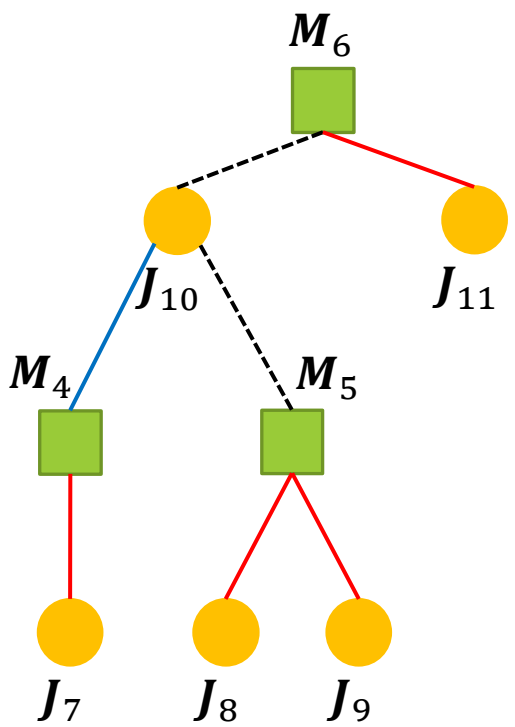
M_5 is the root

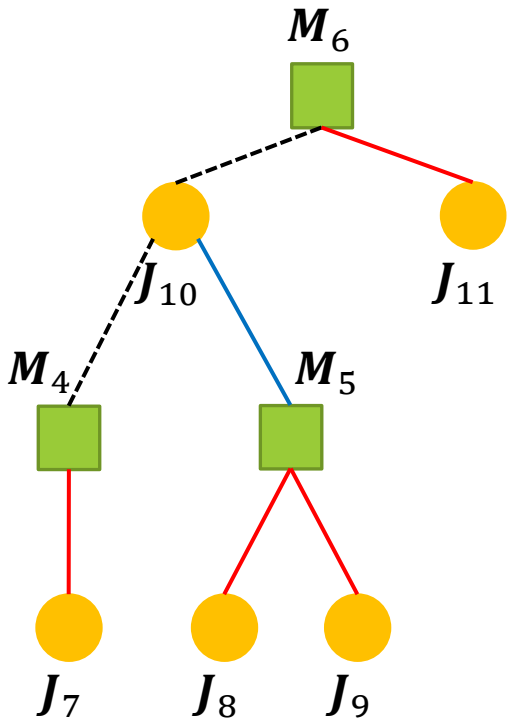




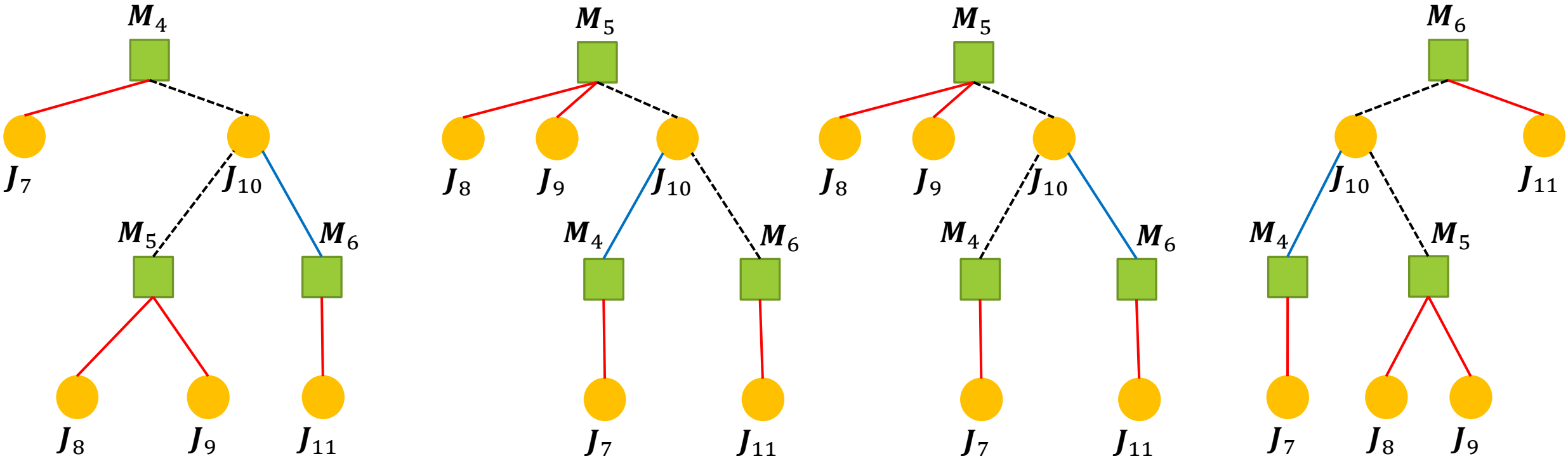
GENERATE TREE STRUCTURES AND DISCUSS HOW TO CHOICE TREE AND CHILD MACHINE NODE

M_6 is the root



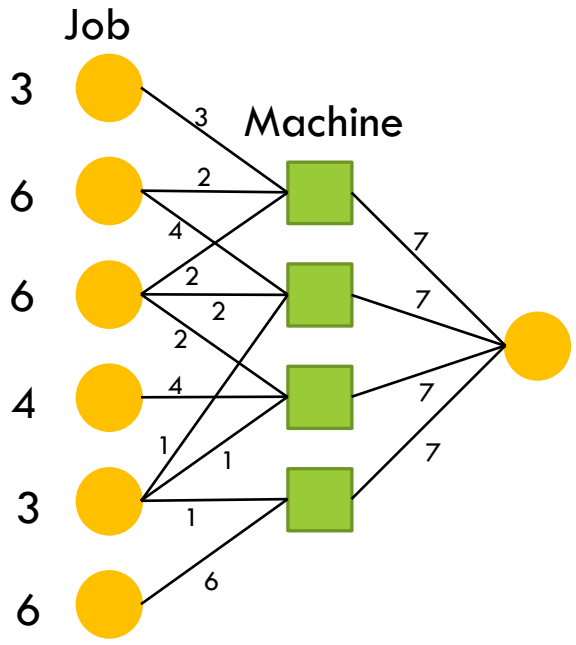


GENERATE TREE STRUCTURES AND DISCUSS HOW TO CHOICE TREE AND CHILD MACHINE NODE

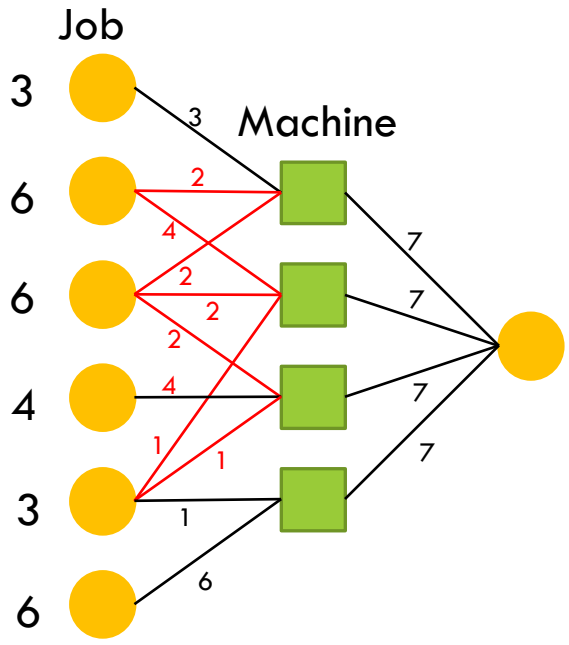


These are better case, the max number of jobs need to process in one machine is 2.

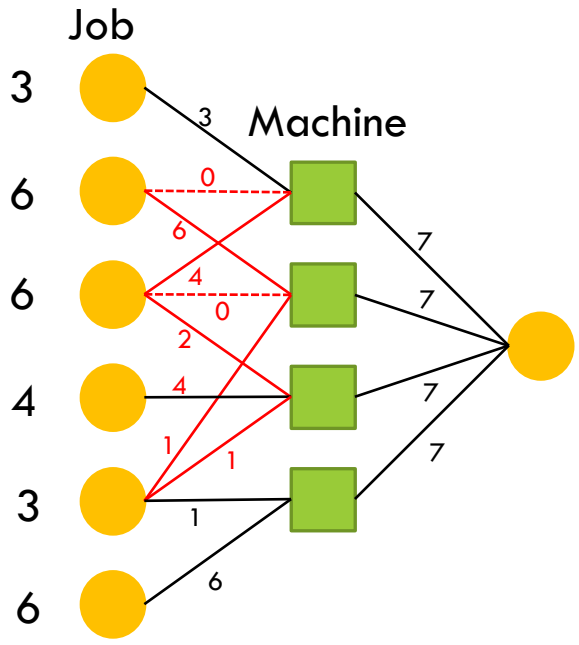
GENERATE A GRAPH WITH NO CYCLE FROM A GRAPH WITH CYCLES



Origin Graph

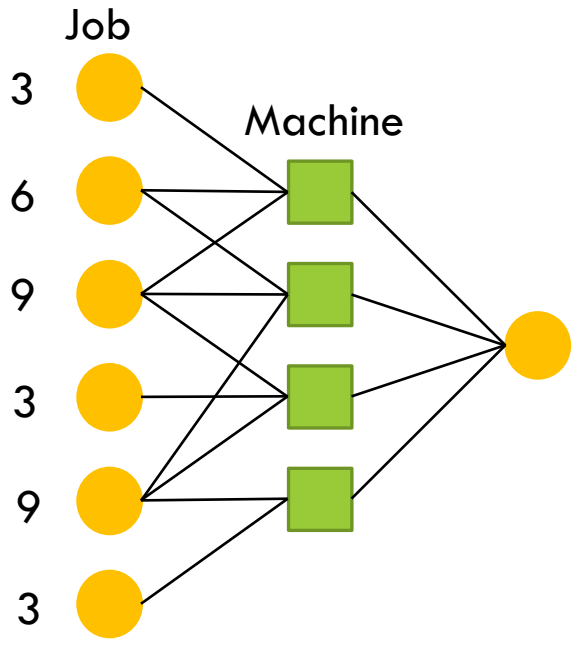


Find the Cycle



Remove the Cycle

GENERATE A GRAPH WITH NO CYCLE FROM A GRAPH WITH CYCLES



Origin Graph

```
NMinimize[
数值最小化
 {L,
  t11 + t21 + t31 ≤ L && t22 + t32 + t52 ≤ L
   && t33 + t43 + t53 ≤ L && t54 + t64 ≤ L &&
   t11 == 3 && t21 + t22 == 6 && t31 + t32 + t33 == 9 &&
   t43 == 3 && t52 + t53 + t54 == 9 && t64 == 3 &&
   t11 ≥ 0 && t21 ≥ 0 && t22 ≥ 0 && t31 ≥ 0 && t32 ≥ 0 &&
   t33 ≥ 0 && t43 ≥ 0 && t52 ≥ 0 && t53 ≥ 0 && t54 ≥ 0 && t64 ≥ 0
 },
 {t11, t21, t22, t31, t32, t33, t43, t52, t53, t54, t64, L
 }]

Out[40]= {8.25, {t11 → 3., t21 → 0., t22 → 6., t31 → 5.25, t32 → 2.25, t33 → 1.5,
   t43 → 3., t52 → 0., t53 → 3.75, t54 → 5.25, t64 → 3., L → 8.25}}
```

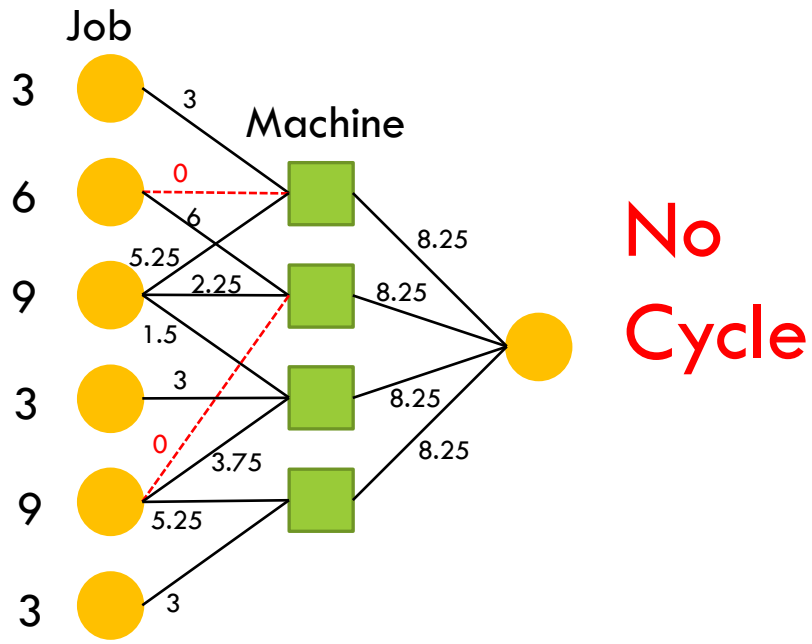
Calculate Process

GENERATE A GRAPH WITH NO CYCLE FROM A GRAPH WITH CYCLES

```
NMinimize[
数值最小化
 {L,
  t11 + t21 + t31 ≤ L && t22 + t32 + t52 ≤ L
   && t33 + t43 + t53 ≤ L && t54 + t64 ≤ L &&
   t11 == 3 && t21 + t22 == 6 && t31 + t32 + t33 == 9 &&
   t43 == 3 && t52 + t53 + t54 == 9 && t64 == 3 &&
   t11 ≥ 0 && t21 ≥ 0 && t22 ≥ 0 && t31 ≥ 0 && t32 ≥ 0 &&
   t33 ≥ 0 && t43 ≥ 0 && t52 ≥ 0 && t53 ≥ 0 && t54 ≥ 0 && t64 ≥ 0
 },
 {t11, t21, t22, t31, t32, t33, t43, t52, t53, t54, t64, L
 }]

Out[40]= {8.25, {t11 → 3., t21 → 0., t22 → 6., t31 → 5.25, t32 → 2.25, t33 → 1.5,
   t43 → 3., t52 → 0., t53 → 3.75, t54 → 5.25, t64 → 3., L → 8.25}}
```

Calculate Process



No Cycle

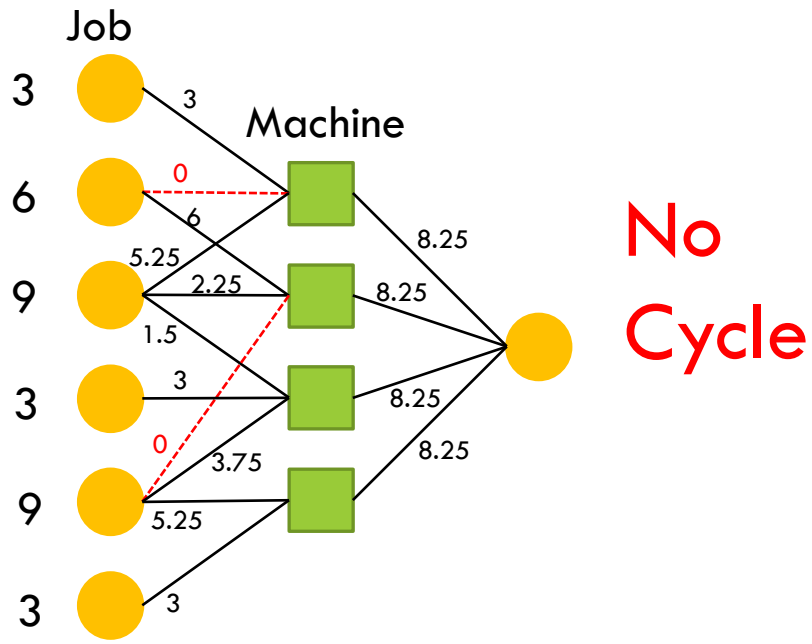
Generate Result

GENERATE A GRAPH WITH NO CYCLE FROM A GRAPH WITH CYCLES

```
NMinimize[
数值最小化
 {L,
  t11 + t21 + t31 ≤ L && t22 + t32 + t52 ≤ L
   && t33 + t43 + t53 ≤ L && t54 + t64 ≤ L &&
   t11 == 3 && t21 + t22 == 6 && t31 + t32 + t33 == 9 &&
   t43 == 3 && t52 + t53 + t54 == 9 && t64 == 3 &&
   t11 ≥ 0 && t21 ≥ 0 && t22 ≥ 0 && t31 ≥ 0 && t32 ≥ 0 &&
   t33 ≥ 0 && t43 ≥ 0 && t52 ≥ 0 && t53 ≥ 0 && t54 ≥ 0 && t64 ≥ 0
 },
 {t11, t21, t22, t31, t32, t33, t43, t52, t53, t54, t64, L
 }]

Out[40]= {8.25, {t11 → 3., t21 → 0., t22 → 6., t31 → 5.25, t32 → 2.25, t33 → 1.5,
   t43 → 3., t52 → 0., t53 → 3.75, t54 → 5.25, t64 → 3., L → 8.25}}
```

Calculate Process



No Cycle

Generate Result

GENERATE A GRAPH WITH NO CYCLE FROM A GRAPH WITH CYCLES

- I can't find an example that the graph drawn by my LP software has a cycle.
- I try to construct many examples that can get the optimal value with a cycle, but my LP program prefers to set one edge of the cycle to 0.

```
In[92]:= FindMinimum[
         求极小值和其坐标
          {L,
           t11 ≥ 0 && t12 ≥ 0 && t13 ≥ 0 && t14 ≥ 0 && t21 ≥ 0 && t22 ≥ 0 &&
            t23 ≥ 0 && t24 ≥ 0 && t31 ≥ 0 && t32 ≥ 0 && t33 ≥ 0 && t34 ≥ 0 &&
            t11 + t12 + t13 + t14 == 72 && t21 + t22 + t23 + t24 == 32 &&
            t31 + t32 + t33 + t34 == 36 &&
            t11 + t21 + t31 ≤ L && t12 + t22 + t32 ≤ L &&
            t13 + t23 + t33 ≤ L && t14 + t24 + t34 ≤ L
          },
          {t11, t12, t13, t14, t21, t22, t23, t24, t31, t32, t33, t34, L},
          Method → "InteriorPoint"]
         方法

Out[92]= {35., {t11 → 0., t12 → 2., t13 → 35., t14 → 35., t21 → 0., t22 → 32.,
           t23 → 0., t24 → 0., t31 → 35., t32 → 1., t33 → 0., t34 → 0., L → 35.}}
```

THANK YOU !

Q&A

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