Листинг 2

In[1]:=
```
ClearAll["Global`*"]
SetDirectory[NotebookDirectory[]];
Needs["FlowSolver`"]
```

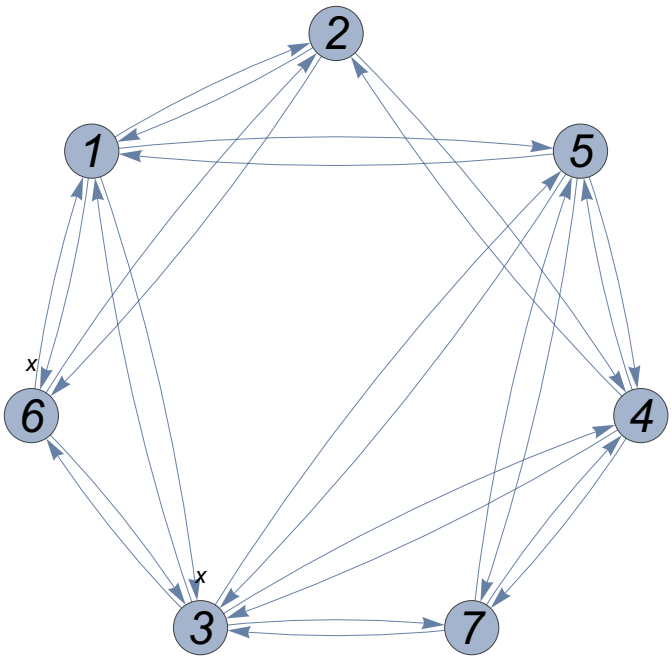
In[4]:=
```
readGraph2[file_, dir_] := Module[{
    fn = FileNameJoin[{dir, file}],
    stream, imod, umod, u, b
    },
    stream = OpenRead[fn];
    imod = Read[stream, {Word, Number}][[2]];
    umod = Read[stream, {Word, Number}][[2]];

  u = ({#[[1]] \[Rule] #[[2]], #[[2]] \[Rule] #[[1]]} & /@ ReadList[stream, Expression, umod]) // Flatten;
  b = ConstantArray[0, imod];
    (b[[Read[StringToStream[StringTake[#1, {5, -3}]], Number]]] = #2) &@@@
   ReadList[stream, {Word, Expression}, imod];
  {Graph[u, VertexSize -> Medium, VertexLabels -> {xx_ :> Placed[{xx, Style[{{
 {x, SameQ[b[[xx]], x]}, {{
  {-b[[xx]]},
  {"↑"}
 }, b[[xx]] < 0},
 {{
  {b[[xx]]},
  {"↓"}
 }, b[[xx]] > 0},
 {"", True}
} // TableForm, Medium]}, {Center, Above}]}, VertexLabelStyle ->
     Directive[Black, Italic, 24], GraphLayout -> "CircularEmbedding"], b}

 ]
```

In[5]:=
```
{g, b} = readGraph2["gr.txt", NotebookDirectory[]];
GraphPlot[g, MultiedgeStyle → .05]
```

Out[6]=



In[7]:=
```
M = {7};
Print["M = ", M];
```

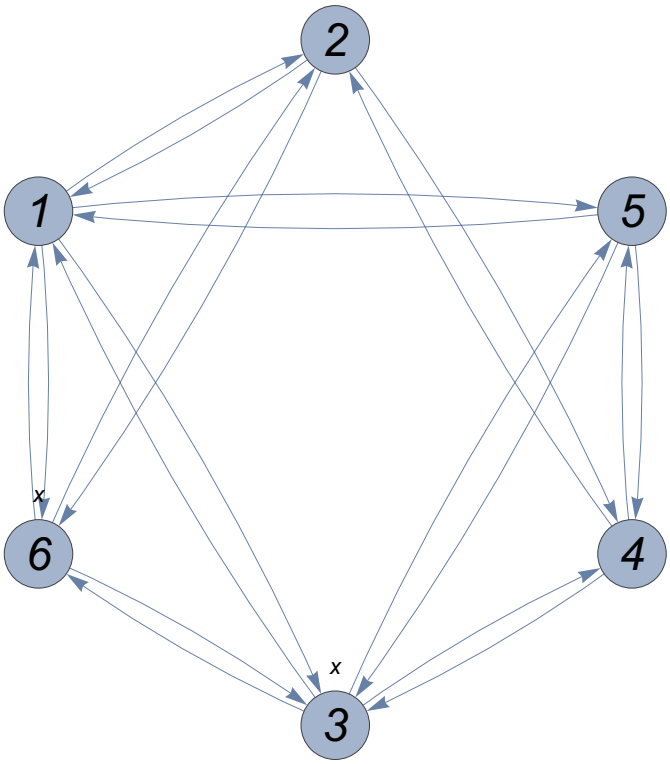
```
M = {7}
```

In[9]:=
```
(*incL=
 DeleteCases[DeleteDuplicates[Cases[IncidenceList[g,#],i_↔j_:>{i,j}]//Flatten],
    v_/;v==#]&/@M*)
incL = (IncidenceList[g, #] & /@ M) // Flatten
```

Out[9]= $\{3 \leftrightarrow 7, 7 \leftrightarrow 3, 7 \leftrightarrow 5, 5 \leftrightarrow 7, 7 \leftrightarrow 4, 4 \leftrightarrow 7\}$

In[10]:=
```
(*Do[If[MemberQ[M,j[[1]]],b[[j[[2]]]]+=f_j,b[[j[[1]]]]-=f_j],{j,incL}]*)
b = Fold[If[MemberQ[M, #2[[1]]], ReplacePart[#, #2[[2]] → #[[#2[[2]]]] + f_#2],
      ReplacePart[#, #2[[1]] → #[[#2[[1]]]] - f_#2]] &, b, incL];
Delete[b, #] & @@ M;
g = VertexDelete[g, M];
GraphPlot[g, MultiedgeStyle → .05]
b
```

Out[13]=



Out[14]= $\{0, 0, x - f_{3\leftrightarrow 7} + f_{7\leftrightarrow 3}, -f_{4\leftrightarrow 7} + f_{7\leftrightarrow 4}, -f_{5\leftrightarrow 7} + f_{7\leftrightarrow 5}, x, 0\}$

In[15]:=
```
CC[g_, M_] :=
  (DeleteDuplicates[Cases[IncidenceList[g, #], i_ ↔ j_ /; j == #]] & /@ M) // Flatten

ii_i_[g_] := Cases[IncidenceList[g, i], u_ ↔ v_ /; u == i :> v]
```

In[17]:=
```
M⁺ = CC[g, M]
```

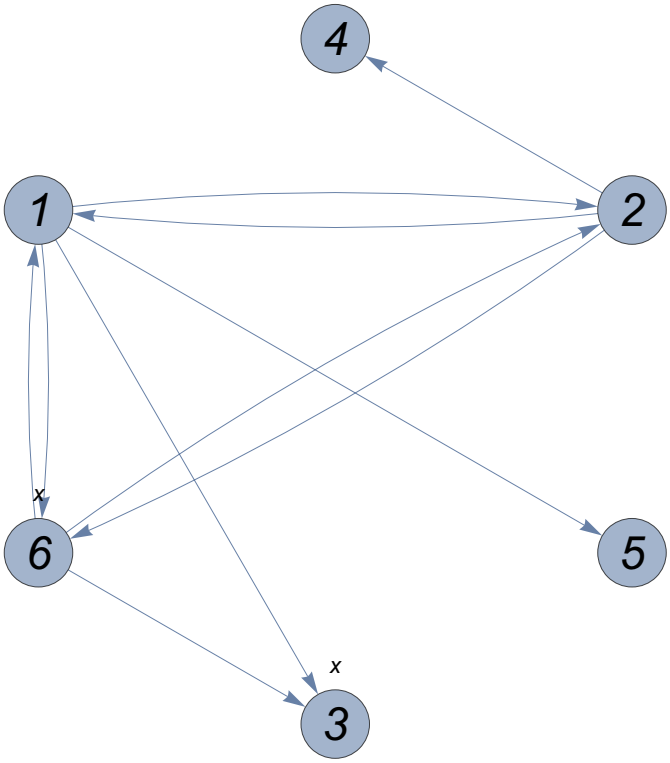
Out[17]= $\{3 \leftrightarrow 7, 5 \leftrightarrow 7, 4 \leftrightarrow 7\}$

In[18]:=
```
b1 = Fold[Module[{bb = #1, i = #2[[1]], k = #2[[2]]},
    (ReplacePart[bb, (({# → bb[[#]] + p_{i↔#}/p_{i↔k} f_{i↔k}, i → bb[[i]] - p_{i↔#}/p_{i↔k} f_{i↔k}}) & ) /@ ii_i^‡[g]] //
     Flatten])] &, b, M^+]
```

Out[18]=
$$\left\{\frac{f_{3\bullet\to 7}\, p_{3\bullet\to 1}}{p_{3\bullet\to 7}}+\frac{f_{5\bullet\to 7}\, p_{5\bullet\to 1}}{p_{5\bullet\to 7}},\ \frac{f_{4\bullet\to 7}\, p_{4\bullet\to 2}}{p_{4\bullet\to 7}},\ x-f_{3\bullet\to 7}+f_{7\bullet\to 3}-\frac{f_{3\bullet\to 7}\, p_{3\bullet\to 1}}{p_{3\bullet\to 7}}+\frac{f_{4\bullet\to 7}\, p_{4\bullet\to 3}}{p_{4\bullet\to 7}}+\frac{f_{5\bullet\to 7}\, p_{5\bullet\to 3}}{p_{5\bullet\to 7}},\right.$$
$$-f_{4\bullet\to 7}+f_{7\bullet\to 4}+\frac{f_{3\bullet\to 7}\, p_{3\bullet\to 4}}{p_{3\bullet\to 7}}-\frac{f_{4\bullet\to 7}\, p_{4\bullet\to 2}}{p_{4\bullet\to 7}}+\frac{f_{5\bullet\to 7}\, p_{5\bullet\to 4}}{p_{5\bullet\to 7}},$$
$$\left.-f_{5\bullet\to 7}+f_{7\bullet\to 5}+\frac{f_{3\bullet\to 7}\, p_{3\bullet\to 5}}{p_{3\bullet\to 7}}+\frac{f_{4\bullet\to 7}\, p_{4\bullet\to 5}}{p_{4\bullet\to 7}}-\frac{f_{5\bullet\to 7}\, p_{5\bullet\to 1}}{p_{5\bullet\to 7}},\ x+\frac{f_{3\bullet\to 7}\, p_{3\bullet\to 6}}{p_{3\bullet\to 7}},\ 0\right\}$$

In[19]:=
```
g1 = Fold[EdgeDelete[#1, u_ ↔ v_ /; u == #2] &, g, #[[1]] & /@ M^+];
GraphPlot[g1, MultiedgeStyle → .05]
```

Out[20]=



In[21]:=
```
II_rem = VertexList[g1] ~Complement~ (M^+[[All, 1]])
```

Out[21]=
```
{1, 2, 6}
```

In[145]:=
```
λ = SparseArray[
  Replace[(EdgeList[g1] /. # & /@ Flatten[Module[{i = #, f, Icur},
      (Icur = ii_i^+[g1];
       jf = First[Icur];
       ({(i ↔ jf) → 1, (i ↔ #) → -p_{i↔#}/p_{i↔jf}} & /@ Icur[[2 ;;]])] & /@ II_rem, 1]]),
   _ ↔ _ → 0, 2]]
```

Out[145]=
```
SparseArray[ <image> ]
```
Specified elements: 14
Dimensions: {7, 10}

In[23]:=
```
g = g1;
b = b1;
```

In[25]:=
```
II* = Cases[MapIndexed[{#1, #2} &, b], {el_, i_} /; MemberQ[el, x] :> i] // Flatten
```

Out[25]=
```
{3, 6}
```

In[26]:=
```
buildt = Timing[{t, g} = buildTree[g, II*];][[1]]
TableForm[t[[1 ;; 4]],
 TableHeadings → {{"pred", "dir", "depth", "d"}, t // pred // Length // Range}]
```

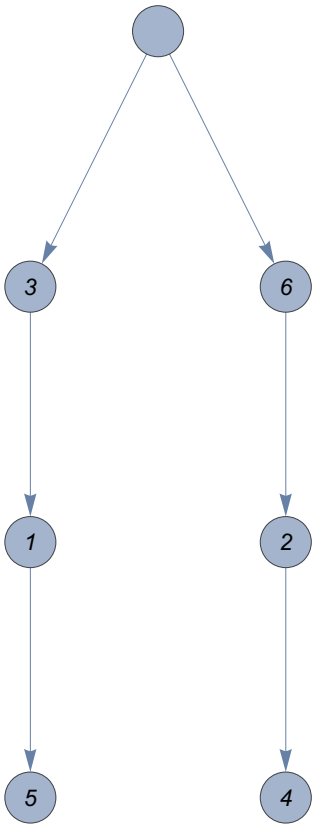
Out[26]=
```
0.
```

Out[27]//TableForm=

	1	2	3	4	5	6	7
pred	3	6	7	2	1	7	0
dir	-1	1	1	1	1	1	0
depth	2	2	1	3	3	1	0
d	5	4	1	7	6	2	3

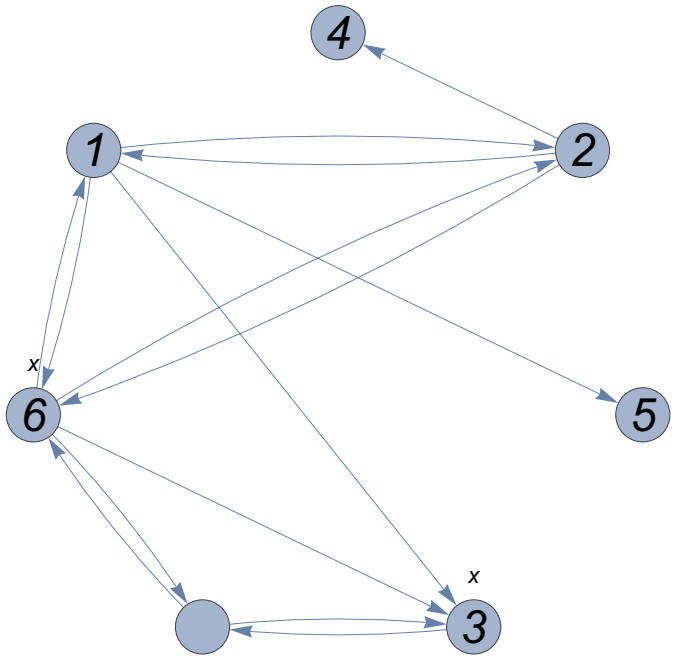
In[28]:=
```
t[[7]]
```

Out[28]=



In[29]:=
```
GraphPlot[g, MultiedgeStyle → .05]
```

Out[29]=



In[30]:=
```
AppendTo[b, -Total[b]];
b = b /. x → 0
```

Out[31]=

$$\left\{\frac{f_{3\to 7}\,p_{3\to 1}}{p_{3\to 7}}+\frac{f_{5\to 7}\,p_{5\to 1}}{p_{5\to 7}},\ \frac{f_{4\to 7}\,p_{4\to 2}}{p_{4\to 7}},\ -f_{3\to 7}+f_{7\to 3}-\frac{f_{3\to 7}\,p_{3\to 1}}{p_{3\to 7}}+\frac{f_{4\to 7}\,p_{4\to 3}}{p_{4\to 7}}+\frac{f_{5\to 7}\,p_{5\to 3}}{p_{5\to 7}},\right.$$
$$-f_{4\to 7}+f_{7\to 4}+\frac{f_{3\to 7}\,p_{3\to 4}}{p_{3\to 7}}-\frac{f_{4\to 7}\,p_{4\to 2}}{p_{4\to 7}}+\frac{f_{5\to 7}\,p_{5\to 4}}{p_{5\to 7}},$$
$$-f_{5\to 7}+f_{7\to 5}+\frac{f_{3\to 7}\,p_{3\to 5}}{p_{3\to 7}}+\frac{f_{4\to 7}\,p_{4\to 5}}{p_{4\to 7}}-\frac{f_{5\to 7}\,p_{5\to 1}}{p_{5\to 7}},\ \frac{f_{3\to 7}\,p_{3\to 6}}{p_{3\to 7}},\ 0,\ f_{3\to 7}+f_{4\to 7}+f_{5\to 7}-f_{7\to 3}-f_{7\to 4}-$$
$$\left.f_{7\to 5}-\frac{f_{3\to 7}\,p_{3\to 4}}{p_{3\to 7}}-\frac{f_{3\to 7}\,p_{3\to 5}}{p_{3\to 7}}-\frac{f_{3\to 7}\,p_{3\to 6}}{p_{3\to 7}}-\frac{f_{4\to 7}\,p_{4\to 3}}{p_{4\to 7}}-\frac{f_{4\to 7}\,p_{4\to 5}}{p_{4\to 7}}-\frac{f_{5\to 7}\,p_{5\to 3}}{p_{5\to 7}}-\frac{f_{5\to 7}\,p_{5\to 4}}{p_{5\to 7}}\right\}$$

In[32]:=
```
ps = partSolve[g, b, t, x̃]
```

Out[32]=

$$\left\{\tilde{x}_{1\to 2}\to 0,\ \tilde{x}_{1\to 3}\to 0,\ \tilde{x}_{1\to 5}\to 0,\ \tilde{x}_{1\to 6}\to 0,\ \tilde{x}_{2\to 1}\to 0,\right.$$
$$\tilde{x}_{2\to 4}\to f_{4\to 7}-f_{7\to 4}-\frac{f_{3\to 7}\,p_{3\to 4}}{p_{3\to 7}}+\frac{f_{4\to 7}\,p_{4\to 2}}{p_{4\to 7}}-\frac{f_{5\to 7}\,p_{5\to 4}}{p_{5\to 7}},\ \tilde{x}_{2\to 6}\to 0,$$
$$\tilde{x}_{3\to 7}\to 0,\ \tilde{x}_{6\to 1}\to 0,\ \tilde{x}_{6\to 2}\to f_{4\to 7}-f_{7\to 4}-\frac{f_{3\to 7}\,p_{3\to 4}}{p_{3\to 7}}-\frac{f_{5\to 7}\,p_{5\to 4}}{p_{5\to 7}},\ \tilde{x}_{6\to 3}\to 0,$$
$$\left.\tilde{x}_{6\to 7}\to 0,\ \tilde{x}_{7\to 3}\to 0,\ \tilde{x}_{7\to 6}\to f_{4\to 7}-f_{7\to 4}-\frac{f_{3\to 7}\,p_{3\to 4}}{p_{3\to 7}}-\frac{f_{3\to 7}\,p_{3\to 6}}{p_{3\to 7}}-\frac{f_{5\to 7}\,p_{5\to 4}}{p_{5\to 7}}\right\}$$

In[33]:=
```
matrt = Timing[δMatr = δ1[g, t]];
root = VertexCount[g];
TableForm[δMatr, TableHeadings → {uNb[g, t], δ[#[[2]] #[[1]] == root & /@ EdgeList[g]}]
```

Out[35]//TableForm=

	$\delta_{1\leftrightarrow 2}$	$\delta_{2\leftrightarrow 1}$	$\delta_{1\leftrightarrow 5}$	$\delta_{2\leftrightarrow 4}$	$\delta_{1\leftrightarrow 3}$	$\delta_{6\leftrightarrow 3}$	$\delta_{6\leftrightarrow 1}$	$\delta_{1\leftrightarrow 6}$	$\delta_{6\leftrightarrow 2}$	$\delta_{2\leftrightarrow 6}$	
$1 \leftrightarrow 2$	1	0	0	0	−1	0	0	0	−1	0	1
$2 \leftrightarrow 1$	0	1	0	0	1	0	0	0	1	0	-
$6 \leftrightarrow 3$	0	0	0	0	0	1	0	0	0	0	-
$6 \leftrightarrow 1$	0	0	0	0	1	0	1	0	0	0	-
$1 \leftrightarrow 6$	0	0	0	0	−1	0	0	1	0	0	1
$2 \leftrightarrow 6$	0	0	0	0	0	0	0	0	1	1	0
$3 \leftrightarrow 7$	0	0	0	0	0	0	0	0	0	0	1
$6 \leftrightarrow 7$	0	0	0	0	0	0	0	0	0	0	0

In[146]:=
```
λ = SparseArray[λ, {Length[λ], Length[λ[[1]]] + 4}];
λ = λ[[ ;; -2]]
```

Out[147]=
```
SparseArray[  Specified elements: 12
Dimensions: {6, 14} ]
```

In[148]:=
```
dopEq = # == 0 & /@ Flatten[λ.{x_# & /@ EdgeList[g]}^T];
dopEq // TableForm
```

Out[149]//TableForm=

$$x_{1\leftrightarrow 2} - \frac{p_{1\leftrightarrow 5}\, x_{1\leftrightarrow 5}}{p_{1\leftrightarrow 2}} == 0$$
$$x_{1\leftrightarrow 2} - \frac{p_{1\leftrightarrow 3}\, x_{1\leftrightarrow 3}}{p_{1\leftrightarrow 2}} == 0$$
$$x_{1\leftrightarrow 2} - \frac{p_{1\leftrightarrow 6}\, x_{1\leftrightarrow 6}}{p_{1\leftrightarrow 2}} == 0$$
$$x_{2\leftrightarrow 1} - \frac{p_{2\leftrightarrow 4}\, x_{2\leftrightarrow 4}}{p_{2\leftrightarrow 1}} == 0$$
$$x_{2\leftrightarrow 1} - \frac{p_{2\leftrightarrow 6}\, x_{2\leftrightarrow 6}}{p_{2\leftrightarrow 1}} == 0$$
$$-\frac{p_{6\leftrightarrow 1}\, x_{6\leftrightarrow 1}}{p_{6\leftrightarrow 3}} + x_{6\leftrightarrow 3} == 0$$

In[150]:=
```
Λ = λ.(δMatr)^T;
"cicle det's:"
Grid[Λ, Frame → All]
```

Out[151]=
```
cicle det's:
```

Out[152]=

1	0	0	0	0	0	0	0
$1 + \frac{p_{1\leftrightarrow 3}}{p_{1\leftrightarrow 2}}$	$-\frac{p_{1\leftrightarrow 3}}{p_{1\leftrightarrow 2}}$	0	$-\frac{p_{1\leftrightarrow 3}}{p_{1\leftrightarrow 2}}$	$\frac{p_{1\leftrightarrow 3}}{p_{1\leftrightarrow 2}}$	0	0	0
1	0	0	0	$-\frac{p_{1\leftrightarrow 6}}{p_{1\leftrightarrow 2}}$	0	0	0
0	1	0	0	0	0	0	0
0	1	0	0	0	$-\frac{p_{2\leftrightarrow 6}}{p_{2\leftrightarrow 1}}$	0	0
0	0	1	$-\frac{p_{6\leftrightarrow 1}}{p_{6\leftrightarrow 3}}$	0	0	0	0

In[153]:=
```
"Uc="
Uc = {1, 2, 3, 4, 5 , 6}
"Unc="
Unc = {7, 8}
```

Out[153]= $U_c =$

Out[154]= $\{1, 2, 3, 4, 5, 6\}$

Out[155]= $U_{nc} =$

Out[156]= $\{7, 8\}$

In[157]:=
```
Λc = Λ[[{1, 2, 3, 4, 5, 6}, Uc]];
Λnc = Λ[[All, Unc]];
"Λc="
Λc // MatrixForm
```

Out[159]= $\Lambda_c =$

Out[160]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 1+\frac{p_{1\leftrightarrow 3}}{p_{1\bullet\leftrightarrow 2}} & -\frac{p_{1\leftrightarrow 3}}{p_{1\bullet\leftrightarrow 2}} & 0 & -\frac{p_{1\leftrightarrow 3}}{p_{1\bullet\leftrightarrow 2}} & \frac{p_{1\leftrightarrow 3}}{p_{1\bullet\leftrightarrow 2}} & 0 \\ 1 & 0 & 0 & 0 & -\frac{p_{1\leftrightarrow 6}}{p_{1\bullet\leftrightarrow 2}} & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & -\frac{p_{2\leftrightarrow 6}}{p_{2\bullet\leftrightarrow 1}} \\ 0 & 0 & 1 & -\frac{p_{6\leftrightarrow 1}}{p_{6\bullet\leftrightarrow 3}} & 0 & 0 \end{pmatrix}$$

In[161]:=
```
"det(Λc)="
Det[Λc]
```

Out[161]= $\det(\Lambda_c) =$

Out[162]= $$\frac{p_{1\bullet\leftrightarrow 3}\, p_{1\bullet\leftrightarrow 6}\, p_{2\bullet\leftrightarrow 6}}{p_{1\bullet\leftrightarrow 2}^2\, p_{2\bullet\leftrightarrow 1}}$$

In[163]:=
```
"UT="
utind = Cases[t[[6]], ξ_ /; ξ ≠ 0];
UT = EdgeList[g][[utind]]
```

Out[163]= $U_T =$

Out[165]= $\{1 \bullet\leftrightarrow 3,\ 6 \bullet\leftrightarrow 2,\ 7 \bullet\leftrightarrow 3,\ 2 \bullet\leftrightarrow 4,\ 1 \bullet\leftrightarrow 5,\ 7 \bullet\leftrightarrow 6\}$

In[166]:=
```
"UNb="
UNb = uNb[g, t]
```

Out[166]= $U_{Nb} =$

Out[167]= $\{1 \bullet\leftrightarrow 2,\ 2 \bullet\leftrightarrow 1,\ 6 \bullet\leftrightarrow 3,\ 6 \bullet\leftrightarrow 1,\ 1 \bullet\leftrightarrow 6,\ 2 \bullet\leftrightarrow 6,\ 3 \bullet\leftrightarrow 7,\ 6 \bullet\leftrightarrow 7\}$

In[168]:=
```
A = -λ.{x̃# & /@ EdgeList[g]}^T /. ps;
"A="
A // MatrixForm
```

Out[169]= A=

Out[170]//MatrixForm=

$$\begin{pmatrix} 0 \\ 0 \\ 0 \\ \dfrac{p_{2\to 4}\left(f_{4\to 7}-f_{7\to 4}-\dfrac{f_{3\to 7}\,p_{3\to 4}}{p_{3\to 7}}+\dfrac{f_{4\to 7}\,p_{4\to 2}}{p_{4\to 7}}-\dfrac{f_{5\to 7}\,p_{5\to 4}}{p_{5\to 7}}\right)}{p_{2\to 1}} \\ 0 \\ 0 \end{pmatrix}$$

In[171]:=
```
β = A - Λnc.{x# & /@ U_Nb[[U_nc]]}^T;
"β="
β // TableForm
```

Out[172]= β=

Out[173]//TableForm=

$$\begin{array}{l} 0 \\ 0 \\ 0 \\ \dfrac{p_{2\to 4}\left(f_{4\to 7}-f_{7\to 4}-\dfrac{f_{3\to 7}\,p_{3\to 4}}{p_{3\to 7}}+\dfrac{f_{4\to 7}\,p_{4\to 2}}{p_{4\to 7}}-\dfrac{f_{5\to 7}\,p_{5\to 4}}{p_{5\to 7}}\right)}{p_{2\to 1}} \\ 0 \\ 0 \end{array}$$

In[174]:=
```
"решаем уравнение Λc xc=β:"
xc = LinearSolve[Λc, β[[{1, 2, 3, 4, 5, 6}]]]
```

Out[174]= решаем уравнение $\Lambda_c x_c=\beta$:

Out[175]=
$$\left\{\{0\},\ \left\{\frac{1}{p_{2\to 1}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}}p_{2\to 4}\left(-f_{5\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 4}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 2}\,p_{5\to 7}-f_{3\to 7}\,p_{3\to 4}\,p_{4\to 7}\,p_{5\to 7}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}-f_{7\to 4}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}\right)\right\},\right.$$
$$\left\{-\left(\left(p_{2\to 4}\left(-f_{5\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 4}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 2}\,p_{5\to 7}-f_{3\to 7}\,p_{3\to 4}\,p_{4\to 7}\,p_{5\to 7}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}-f_{7\to 4}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}\right)p_{6\to 1}\right)\Big/\left(p_{2\to 1}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}\,p_{6\to 3}\right)\right)\right\},$$
$$\left\{-\frac{1}{p_{2\to 1}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}}p_{2\to 4}\left(-f_{5\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 4}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 2}\,p_{5\to 7}-f_{3\to 7}\,p_{3\to 4}\,p_{4\to 7}\,p_{5\to 7}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}-f_{7\to 4}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}\right)\right\},$$
$$\left.\{0\},\ \left\{\frac{p_{2\to 4}\left(f_{4\to 7}-f_{7\to 4}-\dfrac{f_{3\to 7}\,p_{3\to 4}}{p_{3\to 7}}+\dfrac{f_{4\to 7}\,p_{4\to 2}}{p_{4\to 7}}-\dfrac{f_{5\to 7}\,p_{5\to 4}}{p_{5\to 7}}\right)}{p_{2\to 6}}\right\}\right\}$$

In[183]:=
```
xcp = MapThread[x_#1 → #2 &, {U_Nb[[U_c]], Flatten[xc]}];
xcp // TableForm
```

Out[184]//TableForm=

$$\begin{array}{l} x_{1\to 2} \to 0 \\ x_{2\to 1} \to \dfrac{p_{2\to 4}\left(-f_{5\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 4}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 2}\,p_{5\to 7}-f_{3\to 7}\,p_{3\to 4}\,p_{4\to 7}\,p_{5\to 7}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}-f_{7\to 4}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}\right)}{p_{2\to 1}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}} \\ x_{6\to 3} \to -\dfrac{p_{2\to 4}\left(-f_{5\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 4}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 2}\,p_{5\to 7}-f_{3\to 7}\,p_{3\to 4}\,p_{4\to 7}\,p_{5\to 7}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}-f_{7\to 4}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}\right)p_{6\to 1}}{p_{2\to 1}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}\,p_{6\to 3}} \\ x_{6\to 1} \to -\dfrac{p_{2\to 4}\left(-f_{5\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 4}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 2}\,p_{5\to 7}-f_{3\to 7}\,p_{3\to 4}\,p_{4\to 7}\,p_{5\to 7}+f_{4\to 7}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}-f_{7\to 4}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}\right)}{p_{2\to 1}\,p_{3\to 7}\,p_{4\to 7}\,p_{5\to 7}} \\ x_{1\to 6} \to 0 \\ x_{2\to 6} \to \dfrac{p_{2\to 4}\left(f_{4\to 7}-f_{7\to 4}-\dfrac{f_{3\to 7}\,p_{3\to 4}}{p_{3\to 7}}+\dfrac{f_{4\to 7}\,p_{4\to 2}}{p_{4\to 7}}-\dfrac{f_{5\to 7}\,p_{5\to 4}}{p_{5\to 7}}\right)}{p_{2\to 6}} \end{array}$$

In[177]:=
```
"общее решение:"
xsol = ((s /. xcp) ~Join~ xcp);
xsol // TableForm
```

Out[177]= общее решение:

Out[179]//TableForm=

$$0 \to 0$$

$$\frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 4}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 2}\,p_{5,\to 7}-f_{3,\to 7}\,p_{3,\to 4}\,p_{4,\to 7}\,p_{5,\to 7}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}-f_{7,\to 4}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7})}{p_{2,\to 1}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}} \to \frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to}}{}$$

$$x_{1,\to 5} \to 0$$

$$x_{2,\to 4} \to f_{4,\to 7} - f_{7,\to 4} - \frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}} + \frac{f_{4,\to 7}\,p_{4,\to 2}}{p_{4,\to 7}} - \frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}}$$

$$x_{1,\to 3} \to 0$$

$$-\frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 4}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 2}\,p_{5,\to 7}-f_{3,\to 7}\,p_{3,\to 4}\,p_{4,\to 7}\,p_{5,\to 7}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}-f_{7,\to 4}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7})\,p_{6,\to 1}}{p_{2,\to 1}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}\,p_{6,\to 3}} \to -\frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}}{}$$

$$-\frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 4}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 2}\,p_{5,\to 7}-f_{3,\to 7}\,p_{3,\to 4}\,p_{4,\to 7}\,p_{5,\to 7}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}-f_{7,\to 4}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7})}{p_{2,\to 1}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}} \to -\frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}}{}$$

$$0 \to 0$$

$$x_{6,\to 2} \to f_{4,\to 7} - f_{7,\to 4} - \frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}} + \frac{p_{2,\to 4}\left(f_{4,\to 7}-f_{7,\to 4}-\frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}}+\frac{f_{4,\to 7}\,p_{4,\to 2}}{p_{4,\to 7}}-\frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}}\right)}{p_{2,\to 6}} - \frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}} + \frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 4}+f_{4,\to 7}\,p_{3,\to}}{}$$

$$\frac{p_{2,\to 4}\left(f_{4,\to 7}-f_{7,\to 4}-\frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}}+\frac{f_{4,\to 7}\,p_{4,\to 2}}{p_{4,\to 7}}-\frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}}\right)}{p_{2,\to 6}} \to \frac{p_{2,\to 4}\left(f_{4,\to 7}-f_{7,\to 4}-\frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}}+\frac{f_{4,\to 7}\,p_{4,\to 2}}{p_{4,\to 7}}-\frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}}\right)}{p_{2,\to 6}}$$

$$x_{7,\to 3} \to \frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 4}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 2}\,p_{5,\to 7}-f_{3,\to 7}\,p_{3,\to 4}\,p_{4,\to 7}\,p_{5,\to 7}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}-f_{7,\to 4}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7})\,p_{6,\to 1}}{p_{2,\to 1}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}\,p_{6,\to 3}} + x_{3,\to 7}$$

$$x_{7,\to 6} \to f_{4,\to 7} - f_{7,\to 4} - \frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}} - \frac{f_{3,\to 7}\,p_{3,\to 6}}{p_{3,\to 7}} - \frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}} - \frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 4}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 2}\,p_{5,\to 7}-f_{3,\to 7}\,p_{3,\to 4}\,p_{4,\to 7}\,p_{5,\to 7}+f_{4,}}{p_{2,\to 1}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}\,p_{6,\to 3}}$$

$$x_{3,\to 7} \to x_{3,\to 7}$$

$$x_{6,\to 7} \to x_{6,\to 7}$$

$$x_{1,\to 2} \to 0$$

$$x_{2,\to 1} \to \frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 4}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 2}\,p_{5,\to 7}-f_{3,\to 7}\,p_{3,\to 4}\,p_{4,\to 7}\,p_{5,\to 7}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}-f_{7,\to 4}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7})}{p_{2,\to 1}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}}$$

$$x_{6,\to 3} \to -\frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 4}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 2}\,p_{5,\to 7}-f_{3,\to 7}\,p_{3,\to 4}\,p_{4,\to 7}\,p_{5,\to 7}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}-f_{7,\to 4}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7})\,p_{6,\to 1}}{p_{2,\to 1}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}\,p_{6,\to 3}}$$

$$x_{6,\to 1} \to -\frac{p_{2,\to 4}\,(-f_{5,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 4}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 2}\,p_{5,\to 7}-f_{3,\to 7}\,p_{3,\to 4}\,p_{4,\to 7}\,p_{5,\to 7}+f_{4,\to 7}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}-f_{7,\to 4}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7})}{p_{2,\to 1}\,p_{3,\to 7}\,p_{4,\to 7}\,p_{5,\to 7}}$$

$$x_{1,\to 6} \to 0$$

$$x_{2,\to 6} \to \frac{p_{2,\to 4}\left(f_{4,\to 7}-f_{7,\to 4}-\frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}}+\frac{f_{4,\to 7}\,p_{4,\to 2}}{p_{4,\to 7}}-\frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}}\right)}{p_{2,\to 6}}$$

In[180]:=
```
s = solveAll[g, t]
```

Out[180]=

$$\left\{x_{1,\to 2} \to x_{1,\to 2},\ x_{2,\to 1} \to x_{2,\to 1},\ x_{1,\to 5} \to 0,\ x_{2,\to 4} \to f_{4,\to 7} - f_{7,\to 4} - \frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}} + \frac{f_{4,\to 7}\,p_{4,\to 2}}{p_{4,\to 7}} - \frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}},\right.$$

$$x_{1,\to 3} \to -x_{1,\to 2} - x_{1,\to 6} + x_{2,\to 1} + x_{6,\to 1},\ x_{6,\to 3} \to x_{6,\to 3},\ x_{6,\to 1} \to x_{6,\to 1},\ x_{1,\to 6} \to x_{1,\to 6},$$

$$x_{6,\to 2} \to f_{4,\to 7} - f_{7,\to 4} - \frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}} - \frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}} - x_{1,\to 2} + x_{2,\to 1} + x_{2,\to 6},$$

$$x_{2,\to 6} \to x_{2,\to 6},\ x_{7,\to 3} \to x_{1,\to 2} + x_{1,\to 6} - x_{2,\to 1} + x_{3,\to 7} - x_{6,\to 1} - x_{6,\to 3},$$

$$x_{7,\to 6} \to f_{4,\to 7} - f_{7,\to 4} - \frac{f_{3,\to 7}\,p_{3,\to 4}}{p_{3,\to 7}} - \frac{f_{3,\to 7}\,p_{3,\to 6}}{p_{3,\to 7}} - \frac{f_{5,\to 7}\,p_{5,\to 4}}{p_{5,\to 7}} - x_{1,\to 2} - x_{1,\to 6} + x_{2,\to 1} + x_{6,\to 1} + x_{6,\to 3} + x_{6,\to 7},$$

$$\left.x_{3,\to 7} \to x_{3,\to 7},\ x_{6,\to 7} \to x_{6,\to 7}\right\}$$

In[181]:=
```
"eq test:"
Simplify[dopEq /. s /. xcp]
```

Out[181]= eq test:

Out[182]= {True, True, True, True, True, True}