Листинг 2

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

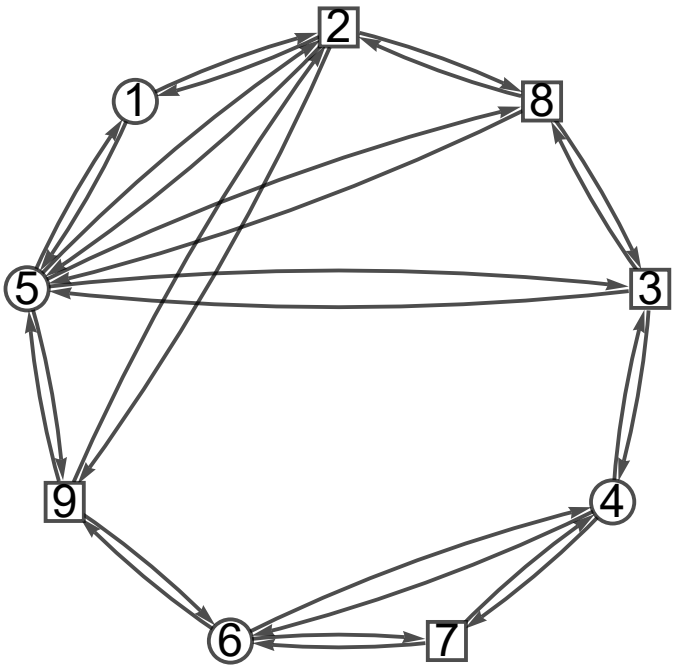
In[ ]:=
```
readGraph2[file_, dir_] := Module[{
    fn = FileNameJoin[{dir, file}],
    stream, imod, umod, u, b
    },
    stream = OpenRead[fn];
    imod = Read[stream, {Word, Number}][[2]];
    umod = Read[stream, {Word, Number}][[2]];

  u = ({#[[1]] ↔ #[[2]], #[[2]] ↔ #[[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 → Placed["Name", Center],
    VertexStyle → Directive[White],
    VertexShapeFunction → {xx_ :> If[SameQ[b[[xx]], x], "Square", "Circle"]},
    VertexLabelStyle -> Directive[Black, 24], GraphLayout -> "CircularEmbedding"], b}]
```

In[ ]:=
```
forma[ff_] := ((ff /. {ξ_u_↔v_ → ξu,v}) // TableForm)
```

In[ ]:=
```
{g, b} = readGraph2["grDET0.txt", NotebookDirectory[]];
GraphPlot[g, EdgeStyle → Directive[Black, Thick],
 VertexStyle → Directive[EdgeForm[Thick], White], MultiedgeStyle → .05]
```

Out[ ]=



In[ ]:=
```
balanceEqs = ((Total[x_# & /@ EdgeList[g, _ ↔ #]] - Total[x_# & /@ EdgeList[g, # ↔ _]])) ==
      MapIndexed[#1 /. x → x_#2[[1]] &, b][[#]] & /@ VertexList[g];
balanceEqs //
 forma
```

Out[ ]//TableForm=

$$-x_{1,2} - x_{1,5} + x_{2,1} + x_{5,1} == 0$$
$$x_{1,2} - x_{2,1} - x_{2,5} - x_{2,8} - x_{2,9} + x_{5,2} + x_{8,2} + x_{9,2} == x_2$$
$$x_{1,5} + x_{2,5} + x_{3,5} - x_{5,1} - x_{5,2} - x_{5,3} - x_{5,8} - x_{5,9} + x_{8,5} + x_{9,5} == 0$$
$$x_{2,8} + x_{3,8} + x_{5,8} - x_{8,2} - x_{8,3} - x_{8,5} == x_8$$
$$-x_{3,4} - x_{3,5} - x_{3,8} + x_{4,3} + x_{5,3} + x_{8,3} == x_3$$
$$x_{3,4} - x_{4,3} - x_{4,6} - x_{4,7} + x_{6,4} + x_{7,4} == 0$$
$$x_{4,7} + x_{6,7} - x_{7,4} - x_{7,6} == x_7$$
$$x_{4,6} - x_{6,4} - x_{6,7} - x_{6,9} + x_{7,6} + x_{9,6} == 0$$
$$x_{2,9} + x_{5,9} + x_{6,9} - x_{9,2} - x_{9,5} - x_{9,6} == x_9$$

In[ ]:=
```
M = {8, 9};
Print["M = ", M];
```

M = {8, 9}

In[ ]:=
```
(*Do[inclist=EdgeList[g,u↔_];
 Do[p_v=1/Length[inclist];,{v,inclist}];,{u,VertexList[g]}]*)
```

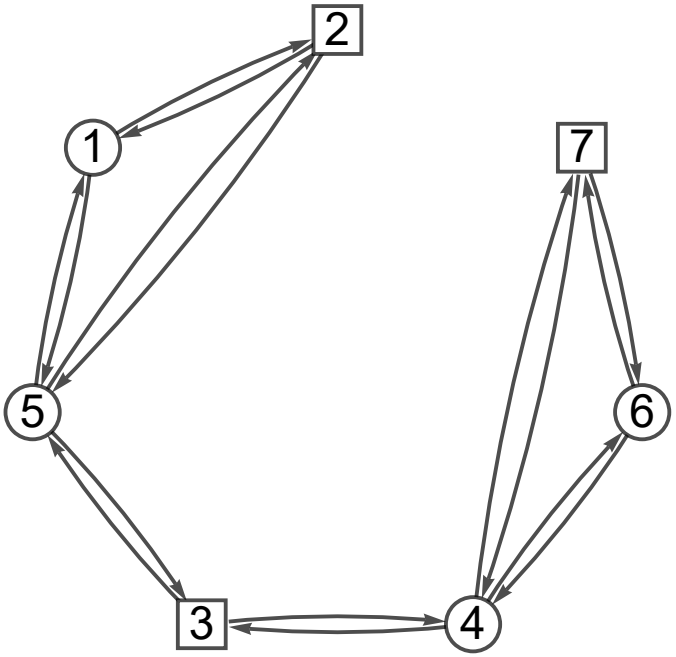
In[ ]:=
```
(*p_#&/@EdgeList[g]*)
```

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

Out[ ]= {2 ↔ 8, 8 ↔ 2, 3 ↔ 8, 8 ↔ 3, 8 ↔ 5, 5 ↔ 8, 9 ↔ 6, 6 ↔ 9, 9 ↔ 5, 5 ↔ 9, 9 ↔ 2, 2 ↔ 9}

In[ ]:=
```
(*Do[If[MemberQ[M,j[[1]]],b[[j[[2]]]]+=f_j,b[[j[[1]]]]-=f_j],{j,incL}]*)
b̄ = Fold[If[MemberQ[M, #2[[1]]], ReplacePart[#, #2[[2]] → #[[#2[[2]]]] - f_#2],
      ReplacePart[#, #2[[1]] → #[[#2[[1]]]] + f_#2]] &, b, incL];
b̄ = b̄[[Range[g // VertexCount] ~Complement~ M]];
n̄ḡ = VertexDelete[g, M];
GraphPlot[n̄ḡ, EdgeStyle → Directive[Black, Thick],
 VertexStyle → Directive[EdgeForm[Thick], White], MultiedgeStyle → .05]
b̄
```

Out[ ]=



Out[ ]= $\{0,\ x + f_{2\leftrightarrow 8} + f_{2\leftrightarrow 9} - f_{8\leftrightarrow 2} - f_{9\leftrightarrow 2},\ x + f_{3\leftrightarrow 8} - f_{8\leftrightarrow 3},\ 0,\ f_{5\leftrightarrow 8} + f_{5\leftrightarrow 9} - f_{8\leftrightarrow 5} - f_{9\leftrightarrow 5},\ f_{6\leftrightarrow 9} - f_{9\leftrightarrow 6},\ x\}$

In[ ]:=
```
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[ ]:=
```
M^+ = CC[g, M]
```

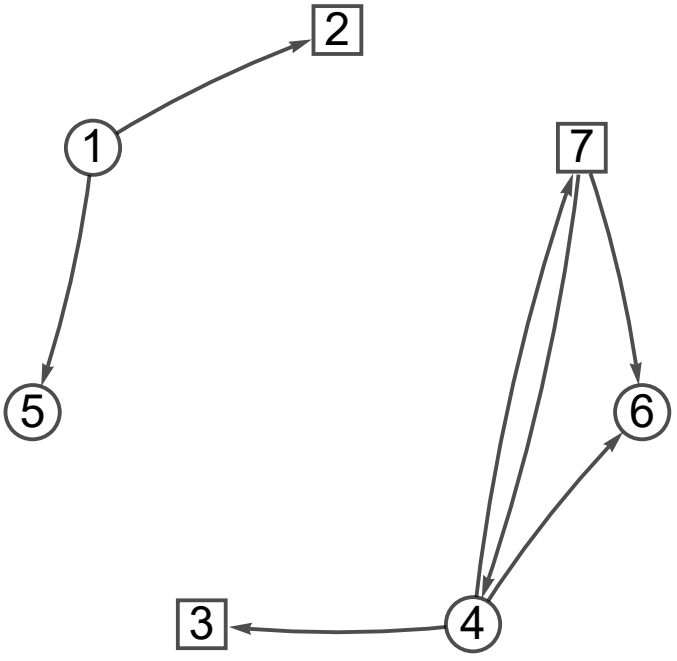
Out[ ]= $\{2 \leftrightarrow 8,\ 3 \leftrightarrow 8,\ 5 \leftrightarrow 8,\ 6 \leftrightarrow 9,\ 5 \leftrightarrow 9,\ 2 \leftrightarrow 9\}$

In[•]:=
```
b1 = Fold[
  Module[{bb = #1, i = #2[[1]], k = #2[[2]]}, (Fold[Module[{bbb = #1, jj = #2}, ReplacePart[
      bbb, ((({jj → bbb[[jj]] - (p[i↔jj]/p[i↔k]) f[i↔k], i → bbb[[i]] + (p[i↔jj]/p[i↔k]) f[i↔k]})))] //
     Flatten] &, bb, ii[ng]])] &, b, M^+]
```

Out[•]=
$$\left\{-\frac{f_{2\bullet\to 8}\,p_{2\bullet\to 1}}{p_{2\bullet\to 8}}-\frac{f_{2\bullet\to 9}\,p_{2\bullet\to 1}}{p_{2\bullet\to 9}}-\frac{f_{5\bullet\to 8}\,p_{5\bullet\to 1}}{p_{5\bullet\to 8}}-\frac{f_{5\bullet\to 9}\,p_{5\bullet\to 1}}{p_{5\bullet\to 9}},\ x+f_{2\bullet\leftrightarrow 8}+f_{2\bullet\leftrightarrow 9}-f_{8\bullet\leftrightarrow 2}-\right.$$
$$f_{9\bullet\leftrightarrow 2}+\frac{f_{2\bullet\to 8}\,p_{2\bullet\to 1}}{p_{2\bullet\leftrightarrow 8}}+\frac{f_{2\bullet\to 8}\,p_{2\bullet\to 5}}{p_{2\bullet\leftrightarrow 8}}+\frac{f_{2\bullet\to 9}\,p_{2\bullet\to 1}}{p_{2\bullet\leftrightarrow 9}}+\frac{f_{2\bullet\to 9}\,p_{2\bullet\to 5}}{p_{2\bullet\leftrightarrow 9}}-\frac{f_{5\bullet\to 8}\,p_{5\bullet\to 2}}{p_{5\bullet\leftrightarrow 8}}-\frac{f_{5\bullet\to 9}\,p_{5\bullet\to 2}}{p_{5\bullet\leftrightarrow 9}},$$
$$x+f_{3\bullet\to 8}-f_{8\bullet\leftrightarrow 3}+\frac{f_{3\bullet\to 8}\,p_{3\bullet\to 4}}{p_{3\bullet\leftrightarrow 8}}+\frac{f_{3\bullet\to 8}\,p_{3\bullet\to 5}}{p_{3\bullet\leftrightarrow 8}}-\frac{f_{5\bullet\to 8}\,p_{5\bullet\to 3}}{p_{5\bullet\leftrightarrow 8}}-\frac{f_{5\bullet\to 9}\,p_{5\bullet\to 3}}{p_{5\bullet\leftrightarrow 9}},\ -\frac{f_{3\bullet\to 8}\,p_{3\bullet\to 4}}{p_{3\bullet\leftrightarrow 8}}-\frac{f_{6\bullet\to 9}\,p_{6\bullet\to 4}}{p_{6\bullet\leftrightarrow 9}},$$
$$f_{5\bullet\leftrightarrow 8}+f_{5\bullet\leftrightarrow 9}-f_{8\bullet\leftrightarrow 5}-f_{9\bullet\leftrightarrow 5}-\frac{f_{2\bullet\to 8}\,p_{2\bullet\to 5}}{p_{2\bullet\leftrightarrow 8}}-\frac{f_{2\bullet\to 9}\,p_{2\bullet\to 5}}{p_{2\bullet\leftrightarrow 9}}-\frac{f_{3\bullet\to 8}\,p_{3\bullet\to 5}}{p_{3\bullet\leftrightarrow 8}}+$$
$$\frac{f_{5\bullet\to 8}\,p_{5\bullet\to 1}}{p_{5\bullet\leftrightarrow 8}}+\frac{f_{5\bullet\to 8}\,p_{5\bullet\to 2}}{p_{5\bullet\leftrightarrow 8}}+\frac{f_{5\bullet\to 8}\,p_{5\bullet\to 3}}{p_{5\bullet\leftrightarrow 8}}+\frac{f_{5\bullet\to 9}\,p_{5\bullet\to 1}}{p_{5\bullet\leftrightarrow 9}}+\frac{f_{5\bullet\to 9}\,p_{5\bullet\to 2}}{p_{5\bullet\leftrightarrow 9}}+\frac{f_{5\bullet\to 9}\,p_{5\bullet\to 3}}{p_{5\bullet\leftrightarrow 9}},$$
$$\left.f_{6\bullet\leftrightarrow 9}-f_{9\bullet\leftrightarrow 6}+\frac{f_{6\bullet\to 9}\,p_{6\bullet\to 4}}{p_{6\bullet\leftrightarrow 9}}+\frac{f_{6\bullet\to 9}\,p_{6\bullet\to 7}}{p_{6\bullet\leftrightarrow 9}},\ x-\frac{f_{6\bullet\to 9}\,p_{6\bullet\to 7}}{p_{6\bullet\leftrightarrow 9}}\right\}$$

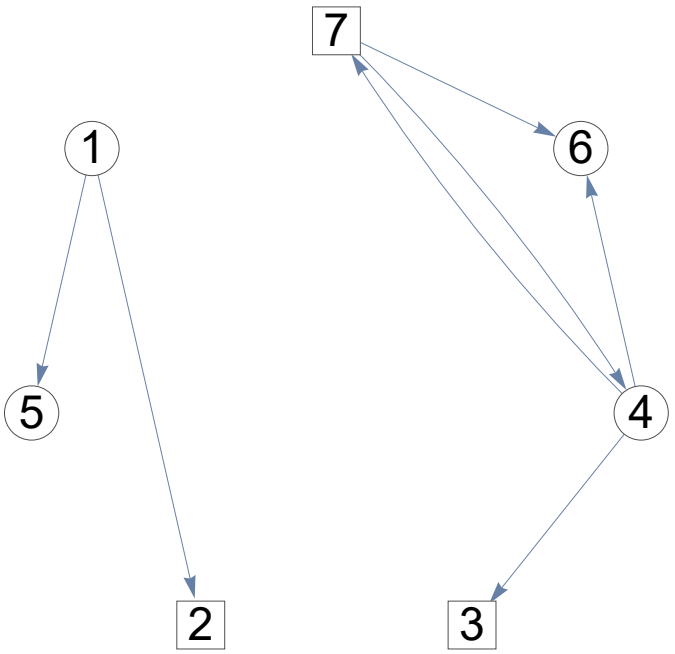
In[•]:=
```
GraphPlot[Fold[HighlightGraph[#1, u_ ↔ v_ /; u == #2, GraphHighlightStyle → "White"] &,
  ng, #[[1]] & /@ M^+], EdgeStyle → Directive[Black, Thick],
 VertexStyle → Directive[EdgeForm[Thick], White], MultiedgeStyle → .05]
```

Out[•]=



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

Out[ ]=



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

Out[ ]=
```
{1, 4, 7}
```

In[ ]:=
```
λ = SparseArray[
  Replace[(EdgeList[g1] /. # & /@ Flatten[Module[{i = #, jf, Icur},
      (Icur = ii[g1];
       jf = First[Icur];
       ({(i ↔ jf) → 1, (i ↔ #) → -pi↔#/pi↔jf}) & /@ Icur[[2 ;;]])] & /@ IIrem, 1]),
   _ ↔ _ → 0, 2]]
```

Out[ ]=
```
SparseArray[ ]
```
Specified elements: 8
Dimensions: {4, 7}

In[ ]:=
```
Grid[λ]
```

Out[ ]=

$$\begin{array}{ccccccc} 1 & -\frac{p_{1\leftrightarrow 5}}{p_{1\leftrightarrow 2}} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & -\frac{p_{4\leftrightarrow 7}}{p_{4\leftrightarrow 3}} & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & -\frac{p_{4\leftrightarrow 6}}{p_{4\leftrightarrow 3}} \\ 0 & 0 & 0 & 0 & 1 & -\frac{p_{7\leftrightarrow 6}}{p_{7\leftrightarrow 4}} & 0 \end{array}$$

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

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

Out[ ]=
```
{2, 3, 7}
```

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

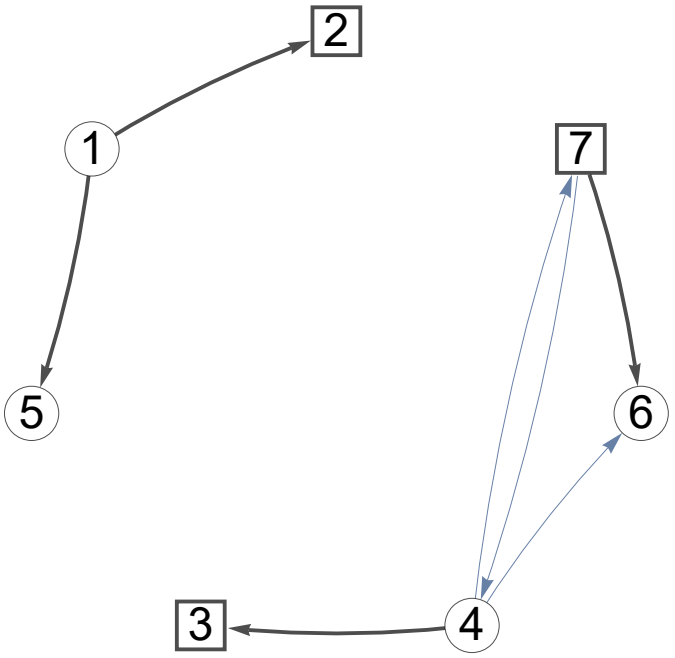
Out[ ]=
```
0.
```

Out[ ]//TableForm=

	1	2	3	4	5	6	7	8
pred	2	8	8	3	1	7	8	0
dir	−1	1	1	−1	1	1	1	0
depth	2	1	1	2	3	2	1	0
d	5	1	4	7	3	8	6	2

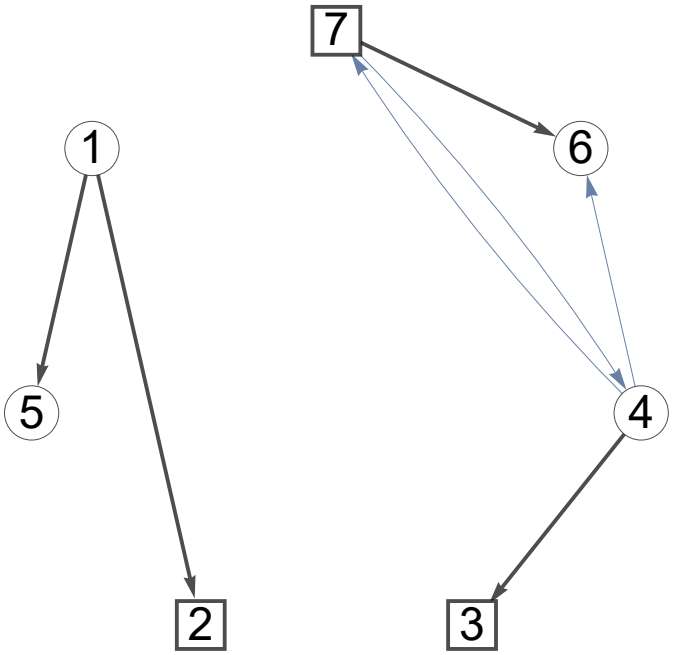
In[ ]:=
```
GraphPlot[HighlightGraph[
  Fold[HighlightGraph[#1, Style[u_ ↔ v_ /; u == #2, White]] &, ng, #[[1]] & /@ M+],
  {Style[u_ /; VertexQ[g, u] && pred[t][[u]] == root[t], EdgeForm[Thick]],
   Style[u_ ↔ v_ /; (pred[t][[u]] == v && dir[t][[u]] == -1) ||
       (pred[t][[v]] == u && dir[t][[v]] == 1), Directive[Black, Thick]]},
  GraphHighlightStyle → None], MultiedgeStyle → .05]
```

Out[ ]=



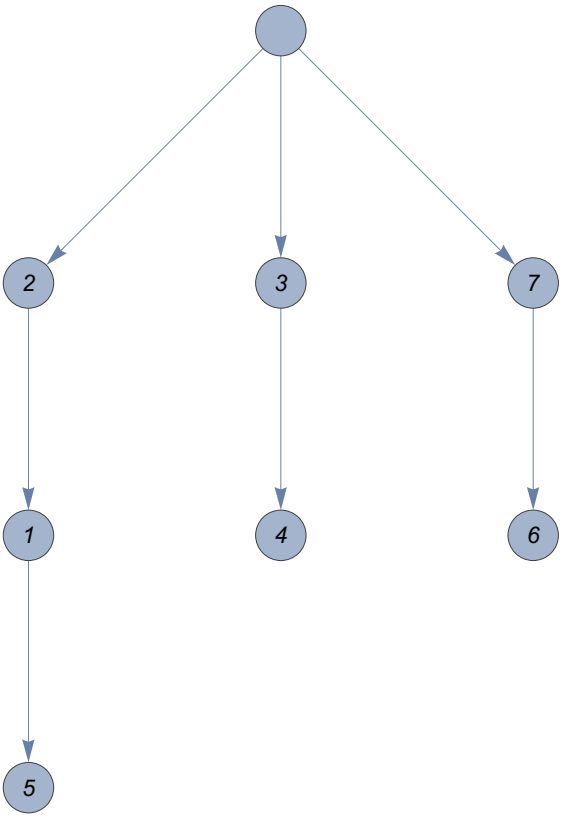
In[ ]:=
```
GraphPlot[HighlightGraph[g1,
  {Style[u_ /; VertexQ[g, u] && pred[t][[u]] == root[t], EdgeForm[Thick]],
   Style[u_ ↔ v_ /; (pred[t][[u]] == v && dir[t][[u]] == -1) ||
       (pred[t][[v]] == u && dir[t][[v]] == 1), Directive[Black, Thick]]},
  GraphHighlightStyle → None], MultiedgeStyle → .05]
```

Out[ ]=



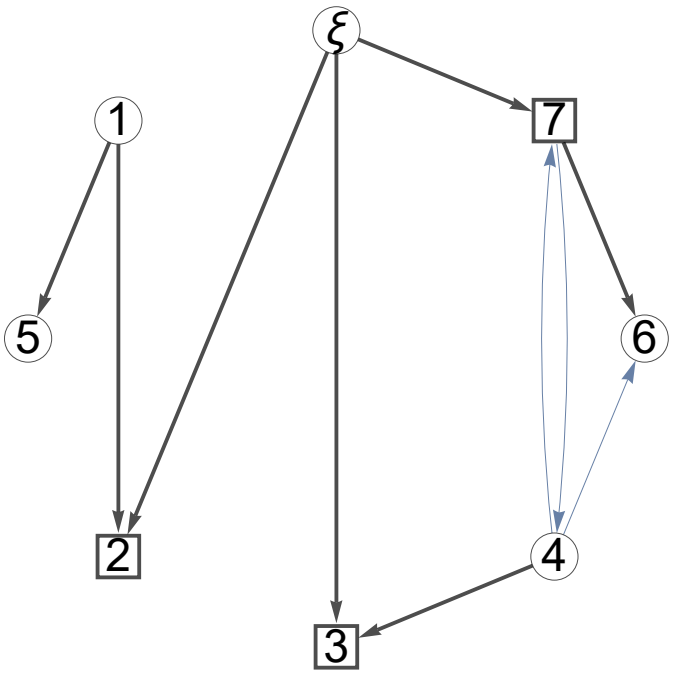
In[ ]:=
```
t[[7]](*пометить на графе*)
```

Out[ ]=



In[ ]:=
```
(*GraphPlot[g,MultiedgeStyle→.05]*)
GraphPlot[HighlightGraph[g,
  {Style[u_ /; VertexQ[g, u] && pred[t][[u]] == root[t], EdgeForm[Thick]],
   Style[u_ ↔ v_ /; (pred[t][[u]] == v && dir[t][[u]] == -1) ||
       (pred[t][[v]] == u && dir[t][[v]] == 1), Directive[Black, Thick]]},
  GraphHighlightStyle → None], MultiedgeStyle → .05]
```

Out[ ]=



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

Out[ ]=

$$\left\{-\frac{f_{2\bullet\to 8}\,p_{2\bullet\leftrightarrow 1}}{p_{2\bullet\to 8}}-\frac{f_{2\bullet\to 9}\,p_{2\bullet\leftrightarrow 1}}{p_{2\bullet\to 9}}+p_{5\bullet\to 1}\left(-\frac{f_{5\bullet\to 8}}{p_{5\bullet\to 8}}-\frac{f_{5\bullet\to 9}}{p_{5\bullet\to 9}}\right),\right.$$

$$-f_{8\bullet\to 2}-f_{9\bullet\to 2}+\frac{f_{2\bullet\to 8}\,(p_{2\bullet\to 1}+p_{2\bullet\to 5}+p_{2\bullet\to 8})}{p_{2\bullet\to 8}}+\frac{f_{2\bullet\to 9}\,(p_{2\bullet\to 1}+p_{2\bullet\to 5}+p_{2\bullet\to 9})}{p_{2\bullet\to 9}}-\frac{f_{5\bullet\to 8}\,p_{5\bullet\to 2}}{p_{5\bullet\to 8}}-\frac{f_{5\bullet\to 9}\,p_{5\bullet\to 2}}{p_{5\bullet\to 9}},$$

$$-f_{8\bullet\to 3}+\frac{f_{3\bullet\to 8}\,(p_{3\bullet\to 4}+p_{3\bullet\to 5}+p_{3\bullet\to 8})}{p_{3\bullet\to 8}}+p_{5\bullet\to 3}\left(-\frac{f_{5\bullet\to 8}}{p_{5\bullet\to 8}}-\frac{f_{5\bullet\to 9}}{p_{5\bullet\to 9}}\right),-\frac{f_{3\bullet\to 8}\,p_{3\bullet\to 4}}{p_{3\bullet\to 8}}-\frac{f_{6\bullet\to 9}\,p_{6\bullet\to 4}}{p_{6\bullet\to 9}},$$

$$-f_{8\bullet\to 5}-f_{9\bullet\to 5}-\frac{f_{2\bullet\to 8}\,p_{2\bullet\to 5}}{p_{2\bullet\to 8}}-\frac{f_{2\bullet\to 9}\,p_{2\bullet\to 5}}{p_{2\bullet\to 9}}-\frac{f_{3\bullet\to 8}\,p_{3\bullet\to 5}}{p_{3\bullet\to 8}}+\frac{f_{5\bullet\to 8}\,(p_{5\bullet\to 1}+p_{5\bullet\to 2}+p_{5\bullet\to 3}+p_{5\bullet\to 8})}{p_{5\bullet\to 8}}+$$

$$\frac{f_{5\bullet\to 9}\,(p_{5\bullet\to 1}+p_{5\bullet\to 2}+p_{5\bullet\to 3}+p_{5\bullet\to 9})}{p_{5\bullet\to 9}},-f_{9\bullet\to 6}+\frac{f_{6\bullet\to 9}\,(p_{6\bullet\to 4}+p_{6\bullet\to 7}+p_{6\bullet\to 9})}{p_{6\bullet\to 9}},-\frac{f_{6\bullet\to 9}\,p_{6\bullet\to 7}}{p_{6\bullet\to 9}},$$

$$\left.-f_{2\bullet\to 8}-f_{2\bullet\to 9}-f_{3\bullet\to 8}-f_{5\bullet\to 8}-f_{5\bullet\to 9}-f_{6\bullet\to 9}+f_{8\bullet\to 2}+f_{8\bullet\to 3}+f_{8\bullet\to 5}+f_{9\bullet\to 2}+f_{9\bullet\to 5}+f_{9\bullet\to 6}\right\}$$

In[]:=
```
balanceEqs = ((Total[x_# & /@ EdgeList[g, _ ↔ #]] - Total[x_# & /@ EdgeList[g, # ↔ _]]) /.
        root[t] → ξ) == b[[#]] & /@ VertexList[g];
balanceEqs //
 forma
```

Out[]//TableForm=

$$-x_{1,2}-x_{1,5}==-\frac{f_{2,8}\,p_{2,1}}{p_{2,8}}-\frac{f_{2,9}\,p_{2,1}}{p_{2,9}}+p_{5,1}\left(-\frac{f_{5,8}}{p_{5,8}}-\frac{f_{5,9}}{p_{5,9}}\right)$$

$$x_{1,2}+x_{\xi,2}==-f_{8,2}-f_{9,2}+\frac{f_{2,8}\,(p_{2,1}+p_{2,5}+p_{2,8})}{p_{2,8}}+\frac{f_{2,9}\,(p_{2,1}+p_{2,5}+p_{2,9})}{p_{2,9}}-\frac{f_{5,8}\,p_{5,2}}{p_{5,8}}-\frac{f_{5,9}\,p_{5,2}}{p_{5,9}}$$

$$x_{1,5}==-f_{8,5}-f_{9,5}-\frac{f_{2,8}\,p_{2,5}}{p_{2,8}}-\frac{f_{2,9}\,p_{2,5}}{p_{2,9}}-\frac{f_{3,8}\,p_{3,5}}{p_{3,8}}+\frac{f_{5,8}\,(p_{5,1}+p_{5,2}+p_{5,3}+p_{5,8})}{p_{5,8}}+\frac{f_{5,9}\,(p_{5,1}+p_{5,2}+p_{5,3}+p_{5,9})}{p_{5,9}}$$

$$x_{4,3}+x_{\xi,3}==-f_{8,3}+\frac{f_{3,8}\,(p_{3,4}+p_{3,5}+p_{3,8})}{p_{3,8}}+p_{5,3}\left(-\frac{f_{5,8}}{p_{5,8}}-\frac{f_{5,9}}{p_{5,9}}\right)$$

$$-x_{4,3}-x_{4,6}-x_{4,7}+x_{7,4}==-\frac{f_{3,8}\,p_{3,4}}{p_{3,8}}-\frac{f_{6,9}\,p_{6,4}}{p_{6,9}}$$

$$x_{4,7}-x_{7,4}-x_{7,6}+x_{\xi,7}==-\frac{f_{6,9}\,p_{6,7}}{p_{6,9}}$$

$$x_{4,6}+x_{7,6}==-f_{9,6}+\frac{f_{6,9}\,(p_{6,4}+p_{6,7}+p_{6,9})}{p_{6,9}}$$

$$-x_{\xi,2}-x_{\xi,3}-x_{\xi,7}==-f_{2,8}-f_{2,9}-f_{3,8}-f_{5,8}-f_{5,9}-f_{6,9}+f_{8,2}+f_{8,3}+f_{8,5}+f_{9,2}+f_{9,5}+f_{9,6}$$

In[]:=
```
ps = partSolve[g, -b, t, x̃];
ps // forma
```

Out[]//TableForm=

$$\tilde{x}_{1,2}\to f_{8,5}+f_{9,5}+\frac{f_{2,8}\,p_{2,1}}{p_{2,8}}+\frac{f_{2,8}\,p_{2,5}}{p_{2,8}}+\frac{f_{2,9}\,p_{2,1}}{p_{2,9}}+\frac{f_{2,9}\,p_{2,5}}{p_{2,9}}+\frac{f_{3,8}\,p_{3,5}}{p_{3,8}}-\frac{f_{5,8}\,(p_{5,1}+p_{5,2}+p_{5,3}+p_{5,8})}{p_{5,8}}-p_{5,1}\left(-\frac{f_{5,8}}{p_{5,8}}-\frac{f_{5,9}}{p_{5,9}}\right)-$$

$$\tilde{x}_{1,5}\to -f_{8,5}-f_{9,5}-\frac{f_{2,8}\,p_{2,5}}{p_{2,8}}-\frac{f_{2,9}\,p_{2,5}}{p_{2,9}}-\frac{f_{3,8}\,p_{3,5}}{p_{3,8}}+\frac{f_{5,8}\,(p_{5,1}+p_{5,2}+p_{5,3}+p_{5,8})}{p_{5,8}}+\frac{f_{5,9}\,(p_{5,1}+p_{5,2}+p_{5,3}+p_{5,9})}{p_{5,9}}$$

$$\tilde{x}_{4,3}\to \frac{f_{3,8}\,p_{3,4}}{p_{3,8}}+\frac{f_{6,9}\,p_{6,4}}{p_{6,9}}$$

$$\tilde{x}_{4,6}\to 0$$

$$\tilde{x}_{4,7}\to 0$$

$$\tilde{x}_{7,4}\to 0$$

$$\tilde{x}_{7,6}\to -f_{9,6}+\frac{f_{6,9}\,(p_{6,4}+p_{6,7}+p_{6,9})}{p_{6,9}}$$

$$\tilde{x}_{8,2}\to -f_{8,2}-f_{8,5}-f_{9,2}-f_{9,5}-\frac{f_{2,8}\,p_{2,1}}{p_{2,8}}-\frac{f_{2,8}\,p_{2,5}}{p_{2,8}}+\frac{f_{2,8}\,(p_{2,1}+p_{2,5}+p_{2,8})}{p_{2,8}}-\frac{f_{2,9}\,p_{2,1}}{p_{2,9}}-\frac{f_{2,9}\,p_{2,5}}{p_{2,9}}+\frac{f_{2,9}\,(p_{2,1}+p_{2,5}+p_{2,9})}{p_{2,9}}-$$

$$\tilde{x}_{8,3}\to -f_{8,3}-\frac{f_{3,8}\,p_{3,4}}{p_{3,8}}+\frac{f_{3,8}\,(p_{3,4}+p_{3,5}+p_{3,8})}{p_{3,8}}+p_{5,3}\left(-\frac{f_{5,8}}{p_{5,8}}-\frac{f_{5,9}}{p_{5,9}}\right)-\frac{f_{6,9}\,p_{6,4}}{p_{6,9}}$$

$$\tilde{x}_{8,7}\to -f_{9,6}-\frac{f_{6,9}\,p_{6,7}}{p_{6,9}}+\frac{f_{6,9}\,(p_{6,4}+p_{6,7}+p_{6,9})}{p_{6,9}}$$

In[]:=
```
Simplify[(balanceEqs /. {x → x̃, ξ → root[t]}) /. ps]
```

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

In[]:=
```
matrt = Timing[δMatr = δ1[g, t]];
rootT = VertexCount[g];
TableForm[δMatr, TableHeadings → {uNb[g, t], δ⎡⎢⎣#⟦2⟧ #⟦1⟧==rootT & /@ EdgeList[g]⎤⎥⎦ // forma
```

Out[]//TableForm=

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

In[]:=
```
λ = SparseArray[λ, {Length[λ], Length[λ[[1]]] + Length[II*]}];
(*λ=λ[[;;-2]]*)
```

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

Out[ ]//TableForm=

$$x_{1,2} - \frac{p_{1,5}\, x_{1,5}}{p_{1,2}} == 0$$
$$x_{4,3} - \frac{p_{4,7}\, x_{4,7}}{p_{4,3}} == 0$$
$$x_{4,3} - \frac{p_{4,6}\, x_{4,6}}{p_{4,3}} == 0$$
$$x_{7,4} - \frac{p_{7,6}\, x_{7,6}}{p_{7,4}} == 0$$

In[ ]:=
```
Λ = λ.(δMatr)^T;
"cicle det's:"
Λ // forma
```

Out[ ]= cicle det's:

Out[ ]//TableForm=

$$\begin{array}{lll} 0 & 0 & 0 \\ -1 - \frac{p_{4\to 7}}{p_{4\to 3}} & 1 & -1 \\ -1 & 1 & -1 - \frac{p_{4\to 6}}{p_{4\to 3}} \\ 0 & 1 & \frac{p_{7\to 6}}{p_{7\to 4}} \end{array}$$

In[ ]:=
```
MatrixRank[Λ]
```

Out[ ]= 3

In[ ]:=
```
"U_c="
U_c = {1, 2, 3}
"U_nc="
U_nc = {}
```

Out[ ]= $U_c =$

Out[ ]= {1, 2, 3}

Out[ ]= $U_{nc} =$

Out[ ]= { }

In[ ]:=
```
Λc = Λ[[2 ;;, U_c]];
Λnc = Λ[[All, U_nc]];
"Λ_c="
Λc // MatrixForm
```

Out[ ]= $\Lambda_c =$

Out[ ]//MatrixForm=

$$\begin{pmatrix} -1 - \frac{p_{4\to 7}}{p_{4\to 3}} & 1 & -1 \\ -1 & 1 & -1 - \frac{p_{4\to 6}}{p_{4\to 3}} \\ 0 & 1 & \frac{p_{7\to 6}}{p_{7\to 4}} \end{pmatrix}$$

In[ ]:=
```
"det(Λ_c)="
Simplify[det = Det[Λc]] // forma
```

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

Out[ ]//TableForm=

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

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

Out[•]= $U_T=$

Out[•]= $\{1 \bullet\!\!\to 2,\ 8 \bullet\!\!\to 2,\ 8 \bullet\!\!\to 3,\ 4 \bullet\!\!\to 3,\ 1 \bullet\!\!\to 5,\ 7 \bullet\!\!\to 6,\ 8 \bullet\!\!\to 7\}$

In[•]:=
```
"U_Nb="
U_Nb = uNb[g, t]
```

Out[•]= $U_{Nb}=$

Out[•]= $\{4 \bullet\!\!\to 7,\ 7 \bullet\!\!\to 4,\ 4 \bullet\!\!\to 6\}$

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

Out[•]= $A=$

Out[•]//MatrixForm=

$$\left(\begin{array}{c} -f_{8\bullet\to 5} - f_{9\bullet\to 5} - \frac{f_{2\bullet\to 8}\, p_{2\bullet\to 1}}{p_{2\bullet\to 8}} - \frac{f_{2\bullet\to 8}\, p_{2\bullet\to 5}}{p_{2\bullet\to 8}} - \frac{f_{2\bullet\to 9}\, p_{2\bullet\to 1}}{p_{2\bullet\to 9}} - \frac{f_{2\bullet\to 9}\, p_{2\bullet\to 5}}{p_{2\bullet\to 9}} - \frac{f_{3\bullet\to 8}\, p_{3\bullet\to 5}}{p_{3\bullet\to 8}} + \frac{f_{5\bullet\to 8}\,(p_{5\bullet\to 1}+p_{5\bullet\to 2}+p_{5\bullet\to 3}+p_{5\bullet\to 8})}{p_{5\bullet\to 8}} + p_{5\bullet\to 1}\left(-\frac{f_{5\bullet\to 8}}{p_{5\bullet\to 8}} - \right. \\ \left. - \frac{f_{3\bullet\to 8}\, p_{3\bullet\to 4}}{p_{3\bullet\to 8}} \right. \\ \left. - \frac{f_{3\bullet\to 8}\, p_{3\bullet\to 4}}{p_{3\bullet\to 8}} \right. \\ \left. \frac{\left(-f_{9\bullet\to 6} + \frac{f_{6\bullet\to 9}\,(p_{6\bullet\to 4}}{p_{} \right.}{p_{7\bullet}} \end{array}\right.$$

In[•]:=
```
β = A(*-Λnc.{x_#&/@U_Nb[[U_nc]]}^T*);
"β="
β // forma
```

Out[•]= $\beta=$

Out[•]//TableForm=

$$-f_{8,5} - f_{9,5} - \frac{f_{2,8}\, p_{2,1}}{p_{2,8}} - \frac{f_{2,8}\, p_{2,5}}{p_{2,8}} - \frac{f_{2,9}\, p_{2,1}}{p_{2,9}} - \frac{f_{2,9}\, p_{2,5}}{p_{2,9}} - \frac{f_{3,8}\, p_{3,5}}{p_{3,8}} + \frac{f_{5,8}\,(p_{5,1}+p_{5,2}+p_{5,3}+p_{5,8})}{p_{5,8}} + p_{5,1}\left(-\frac{f_{5,8}}{p_{5,8}} - \frac{f_{5,9}}{p_{5,9}}\right) + \frac{f_{5,9}\,(}{}$$

$$- \frac{f_{3,8}\, p_{3,4}}{p_{3,8}} - \frac{f_{6,9}\, p_{6,4}}{p_{6,9}}$$

$$- \frac{f_{3,8}\, p_{3,4}}{p_{3,8}} - \frac{f_{6,9}\, p_{6,4}}{p_{6,9}}$$

$$\frac{\left(-f_{9,6} + \frac{f_{6,9}\,(p_{6,4}+p_{6,7}+p_{6,9})}{p_{6,9}}\right) p_{7,6}}{p_{7,4}}$$

In[ ]:=
```
"решаем уравнение Λc xc=β:"
xc = LinearSolve[Λc, β[[2 ;;]]]
```

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

Out[ ]=
$$\left\{\left\{\left(f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 4}\, p_{7\to 4} + f_{3\to 8}\, p_{3\to 4}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 9}\, p_{7\to 4} + f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 4}\, p_{7\to 6} + f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 7}\, p_{7\to 6} + f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 9}\, p_{7\to 6} - f_{9\to 6}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 9}\, p_{7\to 6}\right) \Big/ \left(p_{3\to 8}\, p_{6\to 9}\left(p_{4\to 3}\, p_{4\to 6}\, p_{7\to 4} + p_{4\to 3}\, p_{4\to 7}\, p_{7\to 4} + p_{4\to 6}\, p_{4\to 7}\, p_{7\to 4} + p_{4\to 3}\, p_{4\to 7}\, p_{7\to 6}\right)\right)\right\},$$
$$\left\{-\left(\left(\left(-f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 4} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 6}\, p_{4\to 7}\, p_{6\to 4} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 7} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 7}\, p_{6\to 7} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 6}\, p_{4\to 7}\, p_{6\to 7} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 9} + f_{9\to 6}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 9} + f_{3\to 8}\, p_{3\to 4}\, p_{4\to 3}\, p_{4\to 7}\, p_{6\to 9} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 7}\, p_{6\to 9} + f_{9\to 6}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 7}\, p_{6\to 9} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 6}\, p_{4\to 7}\, p_{6\to 9} + f_{9\to 6}\, p_{3\to 8}\, p_{4\to 6}\, p_{4\to 7}\, p_{6\to 9}\right) p_{7\to 6}\right) \Big/ \left(p_{3\to 8}\, p_{6\to 9}\left(p_{4\to 3}\, p_{4\to 6}\, p_{7\to 4} + p_{4\to 3}\, p_{4\to 7}\, p_{7\to 4} + p_{4\to 6}\, p_{4\to 7}\, p_{7\to 4} + p_{4\to 3}\, p_{4\to 7}\, p_{7\to 6}\right)\right)\right)\right\},$$
$$\left\{\frac{\frac{f_{3\to 8}\, p_{3\to 4}}{p_{3\to 8}} - \left(-1 - \frac{p_{4\to 7}}{p_{4\to 3}}\right)\left(-\frac{f_{3\to 8}\, p_{3\to 4}}{p_{3\to 8}} - \frac{f_{6\to 9}\, p_{6\to 4}}{p_{6\to 9}}\right) + \frac{f_{6\to 9}\, p_{6\to 4}}{p_{6\to 9}} - \frac{p_{4\to 7}\left(-f_{9\to 6} + \frac{f_{6\to 9}\left(p_{6\to 4}+p_{6\to 7}+p_{6\to 9}\right)}{p_{6\to 9}}\right) p_{7\to 6}}{p_{4\to 3}\, p_{7\to 4}}}{1 - \left(-1 - \frac{p_{4\to 6}}{p_{4\to 3}}\right)\left(-1 - \frac{p_{4\to 7}}{p_{4\to 3}}\right) - \frac{p_{4\to 7}\, p_{7\to 6}}{p_{4\to 3}\, p_{7\to 4}}}\right\}\right\}$$

In[ ]:=
```
xcp = MapThread[x#1 → #2 &, {UNb[[Uc]], Flatten[xc]}];
xcp // TableForm
```

Out[ ]//TableForm=
$$x_{4\to 7} \to \frac{f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 4}\, p_{7\to 4} + f_{3\to 8}\, p_{3\to 4}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 9}\, p_{7\to 4} + f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 4}\, p_{7\to 6} + f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 7}\, p_{7\to 6} + f_{6\to 9}\, p_{3\to 8}}{p_{3\to 8}\, p_{6\to 9}\left(p_{4\to 3}\, p_{4\to 6}\, p_{7\to 4} + p_{4\to 3}\, p_{4\to 7}\, p_{7\to 4} + p_{4\to 6}\, p_{4\to 7}\, p_{7\to 4} + p_{4\to 3}\, p_{4\to 7}\, p_{7\to 6}\right)}$$
$$x_{7\to 4} \to -\frac{\left(-f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 4} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 6}\, p_{4\to 7}\, p_{6\to 4} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 6}\, p_{6\to 7} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 3}\, p_{4\to 7}\, p_{6\to 7} - f_{6\to 9}\, p_{3\to 8}\, p_{4\to 6}\, p_{4\to 7}\, p_{6\to 7}\right.}{p_{3\to 8}\, p_{6\to 9}}$$
$$x_{4\to 6} \to \frac{\frac{f_{3\to 8}\, p_{3\to 4}}{p_{3\to 8}} - \left(-1 - \frac{p_{4\to 7}}{p_{4\to 3}}\right)\left(-\frac{f_{3\to 8}\, p_{3\to 4}}{p_{3\to 8}} - \frac{f_{6\to 9}\, p_{6\to 4}}{p_{6\to 9}}\right) + \frac{f_{6\to 9}\, p_{6\to 4}}{p_{6\to 9}} - \frac{p_{4\to 7}\left(-f_{9\to 6} + \frac{f_{6\to 9}\left(p_{6\to 4}+p_{6\to 7}+p_{6\to 9}\right)}{p_{6\to 9}}\right) p_{7\to 6}}{p_{4\to 3}\, p_{7\to 4}}}{1 - \left(-1 - \frac{p_{4\to 6}}{p_{4\to 3}}\right)\left(-1 - \frac{p_{4\to 7}}{p_{4\to 3}}\right) - \frac{p_{4\to 7}\, p_{7\to 6}}{p_{4\to 3}\, p_{7\to 4}}}$$

In[ ]:=
```
s = solveAll[g, t];
s // TableForm
```

Out[ ]//TableForm=
$$x_{1\to 2} \to f_{8\to 5} + f_{9\to 5} + \frac{f_{2\to 8}\, p_{2\to 1}}{p_{2\to 8}} + \frac{f_{2\to 8}\, p_{2\to 5}}{p_{2\to 8}} + \frac{f_{2\to 9}\, p_{2\to 1}}{p_{2\to 9}} + \frac{f_{2\to 9}\, p_{2\to 5}}{p_{2\to 9}} + \frac{f_{3\to 8}\, p_{3\to 5}}{p_{3\to 8}} - \frac{f_{5\to 8}\left(p_{5\to 1}+p_{5\to 2}+p_{5\to 3}+p_{5\to 8}\right)}{p_{5\to 8}} - p_{5\to 1}\left(-\frac{f_{5}}{p_{5}}\right.$$
$$x_{1\to 5} \to -f_{8\to 5} - f_{9\to 5} - \frac{f_{2\to 8}\, p_{2\to 5}}{p_{2\to 8}} - \frac{f_{2\to 9}\, p_{2\to 5}}{p_{2\to 9}} - \frac{f_{3\to 8}\, p_{3\to 5}}{p_{3\to 8}} + \frac{f_{5\to 8}\left(p_{5\to 1}+p_{5\to 2}+p_{5\to 3}+p_{5\to 8}\right)}{p_{5\to 8}} + \frac{f_{5\to 9}\left(p_{5\to 1}+p_{5\to 2}+p_{5\to 3}+p_{5\to 9}\right)}{p_{5\to 9}}$$
$$x_{4\to 3} \to \frac{f_{3\to 8}\, p_{3\to 4}}{p_{3\to 8}} + \frac{f_{6\to 9}\, p_{6\to 4}}{p_{6\to 9}} - x_{4\to 6} - x_{4\to 7} + x_{7\to 4}$$
$$x_{7\to 6} \to -f_{9\to 6} + \frac{f_{6\to 9}\left(p_{6\to 4}+p_{6\to 7}+p_{6\to 9}\right)}{p_{6\to 9}} - x_{4\to 6}$$
$$x_{8\to 2} \to -f_{8\to 2} - f_{8\to 5} - f_{9\to 2} - f_{9\to 5} - \frac{f_{2\to 8}\, p_{2\to 1}}{p_{2\to 8}} - \frac{f_{2\to 8}\, p_{2\to 5}}{p_{2\to 8}} + \frac{f_{2\to 8}\left(p_{2\to 1}+p_{2\to 5}+p_{2\to 8}\right)}{p_{2\to 8}} - \frac{f_{2\to 9}\, p_{2\to 1}}{p_{2\to 9}} - \frac{f_{2\to 9}\, p_{2\to 5}}{p_{2\to 9}} + \frac{f_{2\to 9}\left(p_{2\to 1}\right.}{p}$$
$$x_{8\to 3} \to -f_{8\to 3} - \frac{f_{3\to 8}\, p_{3\to 4}}{p_{3\to 8}} + \frac{f_{3\to 8}\left(p_{3\to 4}+p_{3\to 5}+p_{3\to 8}\right)}{p_{3\to 8}} + p_{5\to 3}\left(-\frac{f_{5\to 8}}{p_{5\to 8}} - \frac{f_{5\to 9}}{p_{5\to 9}}\right) - \frac{f_{6\to 9}\, p_{6\to 4}}{p_{6\to 9}} + x_{4\to 6} + x_{4\to 7} - x_{7\to 4}$$
$$x_{8\to 7} \to -f_{9\to 6} - \frac{f_{6\to 9}\, p_{6\to 7}}{p_{6\to 9}} + \frac{f_{6\to 9}\left(p_{6\to 4}+p_{6\to 7}+p_{6\to 9}\right)}{p_{6\to 9}} - x_{4\to 6} - x_{4\to 7} + x_{7\to 4}$$

In[ ]:=
```
"общее решение:"
xsol = ((s /. xcp) ~Join~ xcp);
xsol /. {ξ_u_↦v_ → ξu,v} // Simplify // TableForm
```

Out[ ]= общее решение:

Out[ ]//TableForm=

$$x_{1,2} \to f_{8,5} + f_{9,5} + \frac{f_{2,8}\, p_{2,1}}{p_{2,8}} + \frac{f_{2,8}\, p_{2,5}}{p_{2,8}} + \frac{f_{2,9}\, p_{2,1}}{p_{2,9}} + \frac{f_{2,9}\, p_{2,5}}{p_{2,9}} + \frac{f_{3,8}\, p_{3,5}}{p_{3,8}} - \frac{f_{5,8}\,(p_{5,2}+p_{5,3}+p_{5,8})}{p_{5,8}} - \frac{f_{5,9}\,(p_{5,2}+p_{5,3}+p_{5,9})}{p_{5,9}}$$

$$x_{1,5} \to -f_{8,5} - f_{9,5} - \frac{f_{2,8}\, p_{2,5}}{p_{2,8}} - \frac{f_{2,9}\, p_{2,5}}{p_{2,9}} - \frac{f_{3,8}\, p_{3,5}}{p_{3,8}} + \frac{f_{5,8}\,(p_{5,1}+p_{5,2}+p_{5,3}+p_{5,8})}{p_{5,8}} + \frac{f_{5,9}\,(p_{5,1}+p_{5,2}+p_{5,3}+p_{5,9})}{p_{5,9}}$$

$$x_{4,3} \to \frac{p_{4,6}\, p_{4,7}\,(p_{6,9}\,(f_{3,8}\, p_{3,4}\, p_{7,4} - f_{9,6}\, p_{3,8}\, p_{7,6}) + f_{6,9}\, p_{3,8}\,((p_{6,7}+p_{6,9})\, p_{7,6} + p_{6,4}\,(p_{7,4}+p_{7,6})))}{p_{3,8}\, p_{6,9}\,(p_{4,6}\, p_{4,7}\, p_{7,4} + p_{4,3}\,(p_{4,6}\, p_{7,4} + p_{4,7}\,(p_{7,4}+p_{7,6})))}$$

$$x_{7,6} \to \frac{(-(f_{3,8}\, p_{3,4}\, p_{4,3}\, p_{4,7} + f_{9,6}\, p_{3,8}\,(p_{4,6}\, p_{4,7} + p_{4,3}\,(p_{4,6}+p_{4,7})))\, p_{6,9} + f_{6,9}\, p_{3,8}\,(p_{4,6}\, p_{4,7}\,(p_{6,4}+p_{6,7}+p_{6,9}) + p_{4,3}\,(p_{4,7}\,(p_{6,7}+p_{6,9}) + p_{4,6}\,(p_{6,4}}{p_{3,8}\, p_{6,9}\,(p_{4,6}\, p_{4,7}\, p_{7,4} + p_{4,3}\,(p_{4,6}\, p_{7,4} + p_{4,7}\,(p_{7,4}+p_{7,6})))}$$

$$x_{8,2} \to f_{2,8} + f_{2,9} + f_{5,8} + f_{5,9} - f_{8,2} - f_{8,5} - f_{9,2} - f_{9,5} - \frac{f_{3,8}\, p_{3,5}}{p_{3,8}} + \frac{f_{5,8}\, p_{5,3}}{p_{5,8}} + \frac{f_{5,9}\, p_{5,3}}{p_{5,9}}$$

$$x_{8,3} \to \frac{-f_{6,9}\, p_{3,8}\, p_{4,6}\, p_{4,7}\, p_{5,8}\, p_{5,9}\,((p_{6,7}+p_{6,9})\, p_{7,6} + p_{6,4}\,(p_{7,4}+p_{7,6})) + p_{6,9}\,(-f_{5,9}\, p_{3,8}\, p_{5,3}\, p_{5,8}\,(p_{4,6}\, p_{4,7}\, p_{7,4} + p_{4,3}\,(p_{4,6}\, p_{7,4} + p_{4,7}\,(p_{7,4}+p_{7,6})}$$

$$x_{8,7} \to \frac{-p_{6,9}\,(f_{3,8}\, p_{3,4}\, p_{4,3}\,(p_{4,6}\, p_{7,4} + p_{4,7}\,(p_{7,4}+p_{7,6})) + f_{6,9}\, p_{3,8}\,(p_{4,6}\, p_{4,7}\,(p_{7,4}+p_{7,6}) + p_{4,3}\,(p_{4,6}\, p_{7,4} + p_{4,7}\,(p_{7,4}+p_{7,6})))) + f_{6,9}\, p_{3,8}\,(p_{4,3}\, p_{4,}}{p_{3,8}\, p_{6,9}\,(p_{4,6}\, p_{4,7}\, p_{7,4} + p_{4,3}\,(p_{4,6}\, p_{7,4} + p_{4,7}\,(p_{7,4}+p}$$

$$x_{4,7} \to \frac{p_{4,3}\, p_{4,6}\,(p_{6,9}\,(f_{3,8}\, p_{3,4}\, p_{7,4} - f_{9,6}\, p_{3,8}\, p_{7,6}) + f_{6,9}\, p_{3,8}\,((p_{6,7}+p_{6,9})\, p_{7,6} + p_{6,4}\,(p_{7,4}+p_{7,6})))}{p_{3,8}\, p_{6,9}\,(p_{4,6}\, p_{4,7}\, p_{7,4} + p_{4,3}\,(p_{4,6}\, p_{7,4} + p_{4,7}\,(p_{7,4}+p_{7,6})))}$$

$$x_{7,4} \to \frac{(-(f_{3,8}\, p_{3,4}\, p_{4,3}\, p_{4,7} + f_{9,6}\, p_{3,8}\,(p_{4,6}\, p_{4,7} + p_{4,3}\,(p_{4,6}+p_{4,7})))\, p_{6,9} + f_{6,9}\, p_{3,8}\,(p_{4,6}\, p_{4,7}\,(p_{6,4}+p_{6,7}+p_{6,9}) + p_{4,3}\,(p_{4,7}\,(p_{6,7}+p_{6,9}) + p_{4,6}\,(p_{6,4}}{p_{3,8}\, p_{6,9}\,(p_{4,6}\, p_{4,7}\, p_{7,4} + p_{4,3}\,(p_{4,6}\, p_{7,4} + p_{4,7}\,(p_{7,4}+p_{7,6})))}$$

$$x_{4,6} \to \frac{p_{4,3}\, p_{4,7}\,(p_{6,9}\,(f_{3,8}\, p_{3,4}\, p_{7,4} - f_{9,6}\, p_{3,8}\, p_{7,6}) + f_{6,9}\, p_{3,8}\,((p_{6,7}+p_{6,9})\, p_{7,6} + p_{6,4}\,(p_{7,4}+p_{7,6})))}{p_{3,8}\, p_{6,9}\,(p_{4,6}\, p_{4,7}\, p_{7,4} + p_{4,3}\,(p_{4,6}\, p_{7,4} + p_{4,7}\,(p_{7,4}+p_{7,6})))}$$

In[ ]:=
```
"eq test:"
Simplify[balanceEqs /. ξ → root[t] /. s /. xcp]
Simplify[(dopEq /. s) /. xcp]
```

Out[ ]= eq test:

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

Out[ ]=
$$\left\{\frac{1}{p_{1,\bullet\to 2}}\left(\left(f_{8,\bullet\to 5} + f_{9,\bullet\to 5}\right)\left(p_{1,\bullet\to 2} + p_{1,\bullet\to 5}\right) + \frac{f_{2,\bullet\to 8}\,(p_{1,\bullet\to 5}\, p_{2,\bullet\to 5} + p_{1,\bullet\to 2}\,(p_{2,\bullet\to 1} + p_{2,\bullet\to 5}))}{p_{2,\bullet\to 8}} + \frac{f_{2,\bullet\to 9}\,(p_{1,\bullet\to 5}\, p_{2,\bullet\to 5} + p_{1,\bullet\to 2}\,(p_{2,\bullet\to 1} + p_{2,\bullet\to 5}))}{p_{2,\bullet\to 9}} + \frac{f_{3,\bullet\to 8}\,(p_{1,\bullet\to 2} + p_{1,\bullet\to 5})\, p_{3,\bullet\to 5}}{p_{3,\bullet\to 8}} - \frac{f_{5,\bullet\to 8}\,(p_{1,\bullet\to 2}\,(p_{5,\bullet\to 2} + p_{5,\bullet\to 3} + p_{5,\bullet\to 8}) + p_{1,\bullet\to 5}\,(p_{5,\bullet\to 1} + p_{5,\bullet\to 2} + p_{5,\bullet\to 3} + p_{5,\bullet\to 8}))}{p_{5,\bullet\to 8}} - \frac{f_{5,\bullet\to 9}\, p_{1,\bullet\to 2}\,(p_{5,\bullet\to 2} + p_{5,\bullet\to 3} + p_{5,\bullet\to 9})}{p_{5,\bullet\to 9}} - \frac{f_{5,\bullet\to 9}\, p_{1,\bullet\to 5}\,(p_{5,\bullet\to 1} + p_{5,\bullet\to 2} + p_{5,\bullet\to 3} + p_{5,\bullet\to 9})}{p_{5,\bullet\to 9}}\right) == 0, \text{True}, \text{True}, \text{True}\right\}$$