Листинг 2

In[202]:=
```
ClearAll["Global`*"]
SetDirectory[NotebookDirectory[]];
Needs["FlowSolver`"]
```

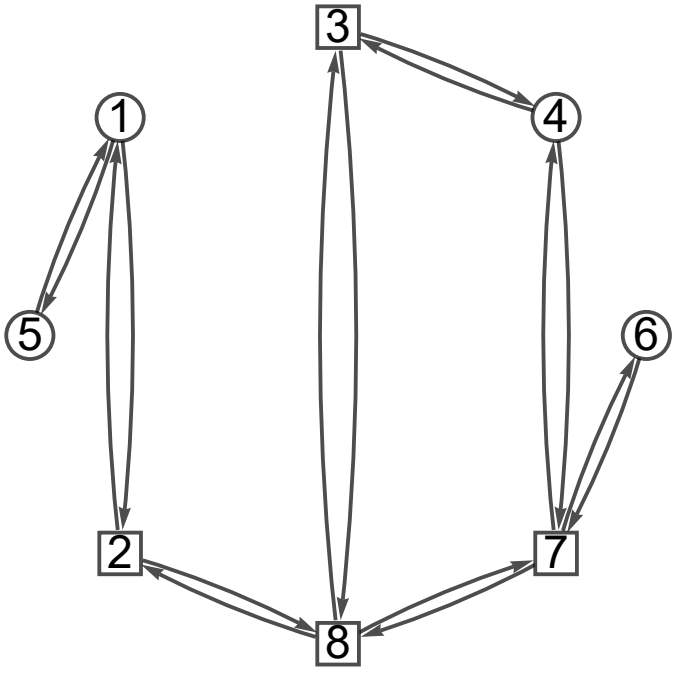
In[205]:=
```
readGraph2[file_, dir_] := Module[{
    fn = FileNameJoin[{dir, file}],
    stream, imod, umod, u, b
    },
    stream = OpenRead[fn];
    imod = Read[stream, {Word, Number}][[2]];
    umod = Read[stream, {Word, Number}][[2]];

  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[206]:=
```
forma[ff_] := ((ff /. {ξ_u_↔v_ → ξu,v}) // TableForm)
```

In[312]:=
```
{g, b} = readGraph2["gr.txt", NotebookDirectory[]];
GraphPlot[g, EdgeStyle → Directive[Black, Thick],
 VertexStyle → Directive[EdgeForm[Thick], White], MultiedgeStyle → .05]
```

Out[313]=



In[314]:=
```
balanceEqs = ((Total[x_# & /@ EdgeList[g, _ ↔ #]] - Total[x_# & /@ EdgeList[g, # ↔ _]])) ==
      MapIndexed[#1 /. x → x_#2[[1]] &, b][[#]] & /@ VertexList[g];
balanceEqs //
 forma
```

Out[315]//TableForm=

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

In[316]:=
```
M = {8};
Print["M = ", M];
```

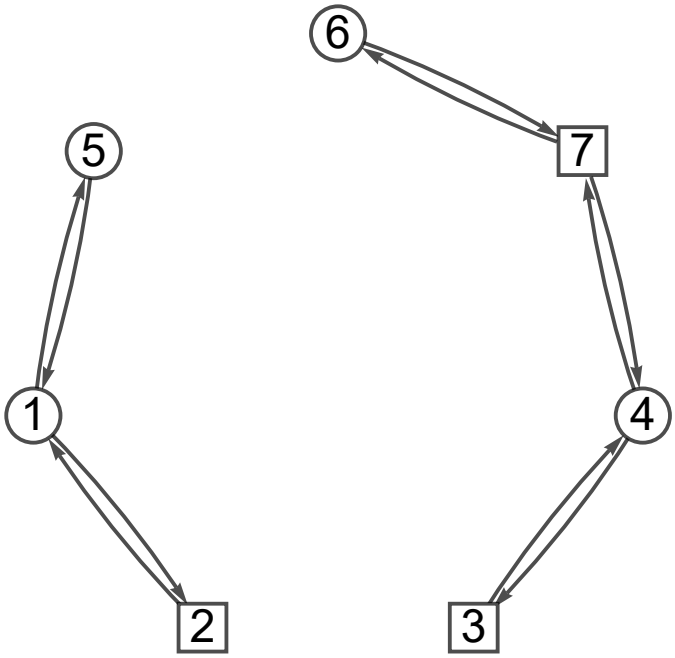
M = {8}

In[318]:=
```
(*incL=
 DeleteCases[DeleteDuplicates[Cases[IncidenceList[g,#],i_↔j_:>{i,j}]//Flatten],
    v_/;v==#]&/@M*)
incL = (IncidenceList[g, #] & /@ M) // Flatten
```

Out[318]= {2 ↔ 8, 8 ↔ 2, 3 ↔ 8, 8 ↔ 3, 8 ↔ 7, 7 ↔ 8}

In[319]:=
```
(*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 = Delete[b̄, #] & @@ M;
n̄ḡ = VertexDelete[g, M];
GraphPlot[n̄ḡ, EdgeStyle → Directive[Black, Thick],
 VertexStyle → Directive[EdgeForm[Thick], White], MultiedgeStyle → .05]
b̄
```

Out[322]=



Out[323]= $\{0, x - f_{2\leftrightarrow 8} + f_{8\leftrightarrow 2}, x - f_{3\leftrightarrow 8} + f_{8\leftrightarrow 3}, 0, 0, 0, x - f_{7\leftrightarrow 8} + f_{8\leftrightarrow 7}\}$

In[324]:=
```
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[326]:=
```
M⁺ = CC[g, M]
```

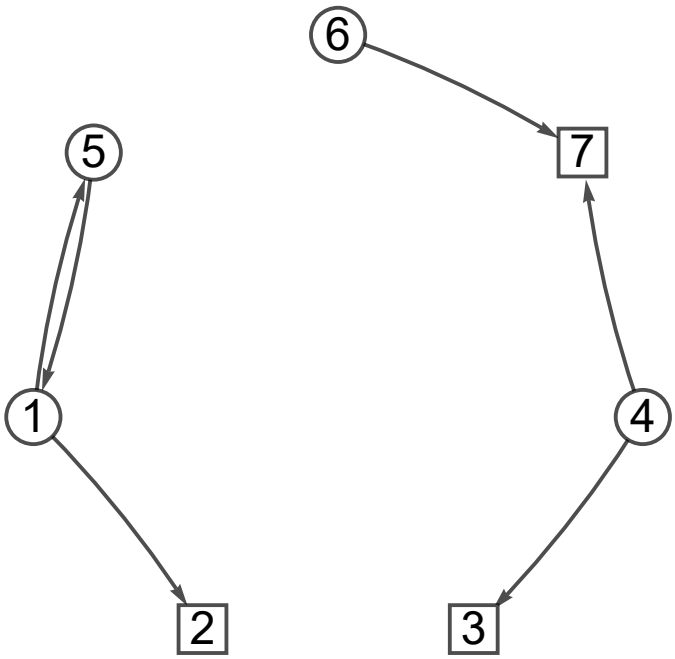
Out[326]=
$$\{2 \leftrightarrow 8,\ 3 \leftrightarrow 8,\ 7 \leftrightarrow 8\}$$

In[327]:=
```
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^†[ng])] //
     Flatten)] &, b, M⁺]
```

Out[327]=
$$\left\{\frac{f_{2\leftrightarrow 8}\, p_{2\leftrightarrow 1}}{p_{2\leftrightarrow 8}},\ x - f_{2\leftrightarrow 8} + f_{8\leftrightarrow 2} - \frac{f_{2\leftrightarrow 8}\, p_{2\leftrightarrow 1}}{p_{2\leftrightarrow 8}},\ x - f_{3\leftrightarrow 8} + f_{8\leftrightarrow 3} - \frac{f_{3\leftrightarrow 8}\, p_{3\leftrightarrow 4}}{p_{3\leftrightarrow 8}},\right.$$
$$\left.\frac{f_{3\leftrightarrow 8}\, p_{3\leftrightarrow 4}}{p_{3\leftrightarrow 8}} + \frac{f_{7\leftrightarrow 8}\, p_{7\leftrightarrow 4}}{p_{7\leftrightarrow 8}},\ 0,\ \frac{f_{7\leftrightarrow 8}\, p_{7\leftrightarrow 6}}{p_{7\leftrightarrow 8}},\ x - f_{7\leftrightarrow 8} + f_{8\leftrightarrow 7} - \frac{f_{7\leftrightarrow 8}\, p_{7\leftrightarrow 4}}{p_{7\leftrightarrow 8}}\right\}$$

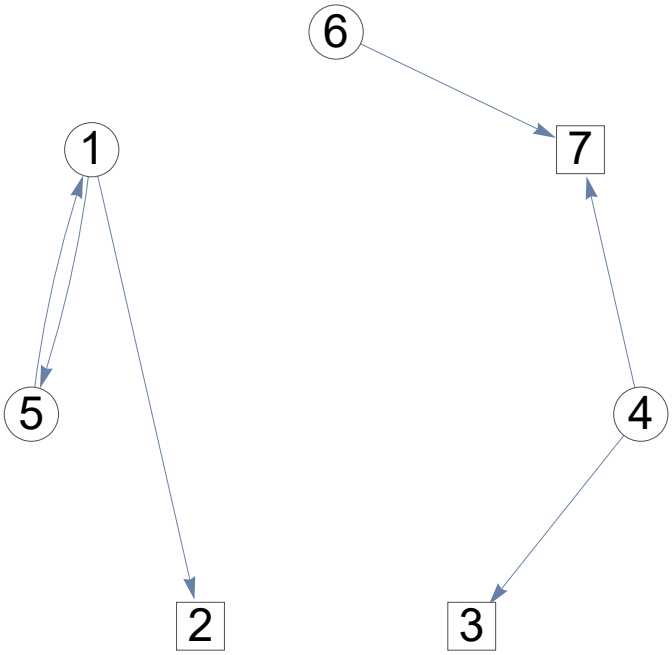
In[328]:=
```
GraphPlot[Fold[HighlightGraph[#1, u_ ↔ v_ /; u == #2, GraphHighlightStyle → "White"] &,
   ng, #[[1]] & /@ M⁺], EdgeStyle → Directive[Black, Thick],
  VertexStyle → Directive[EdgeForm[Thick], White], MultiedgeStyle → .05]
```

Out[328]=



In[329]:=
```
g1 = Fold[EdgeDelete[#1, u_ ↔ v_ /; u == #2] &, ng, #[[1]] & /@ M⁺];
GraphPlot[g1, MultiedgeStyle → .05]
```

Out[330]=



In[331]:=
```
IIrem = VertexList[g1] ~Complement~ (M⁺[[All, 1]])
```

Out[331]=
```
{1, 4, 5, 6}
```

In[332]:=
```
λ = SparseArray[
  Replace[(EdgeList[g1] /. # & /@ Flatten[Module[{i = #, jf, Icur},
      (Icur = ii[g1];
       jf = First[Icur];
       ({(i ↔ jf) → 1, (i ↔ #) → -p(i↔#)/p(i↔jf)}) & /@ Icur[[2 ;;]])] & /@ IIrem, 1]),
   _ ↔ _ → 0, 2]]
```

Out[332]=
```
SparseArray[ ]
```
Specified elements: 4
Dimensions: {2, 6}

In[333]:=
```
Grid[λ]
```

Out[333]=
$$\begin{matrix} 1 & -\frac{p_{1\leftrightarrow 5}}{p_{1\leftrightarrow 2}} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & -\frac{p_{4\leftrightarrow 7}}{p_{4\leftrightarrow 3}} & 0 \end{matrix}$$

In[334]:=
```
g = g1;
b = b1;
```

In[336]:=
```
II* = Cases[MapIndexed[{#1, #2} &, b], {el_, i_} /; MemberQ[el, x] :> i] // Flatten
```

Out[336]=
```
{2, 3, 7}
```

In[337]:=
```
buildt = Timing[{t, g} = buildTree[g, II*];][[1]]
TableForm[t[[1 ;; 4]],
 TableHeadings → {{"pred", "dir", "depth", "d"}, t // pred // Length // Range}]
```

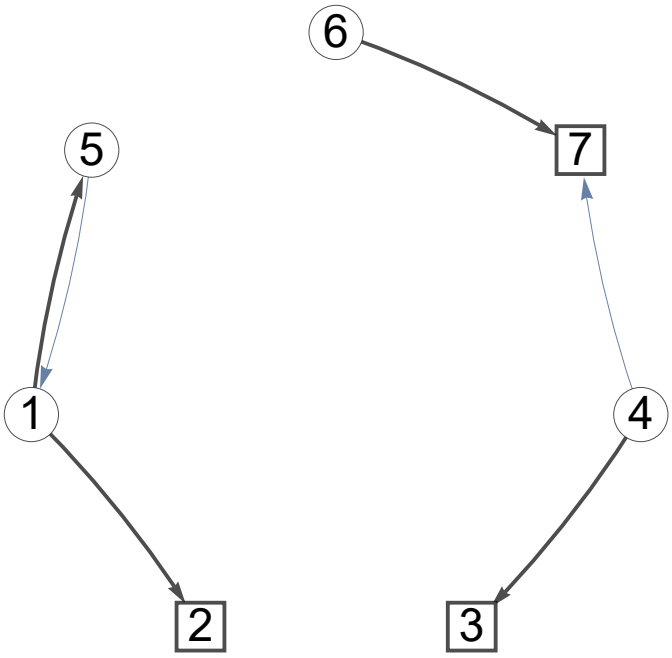
Out[337]= 0.

Out[338]//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

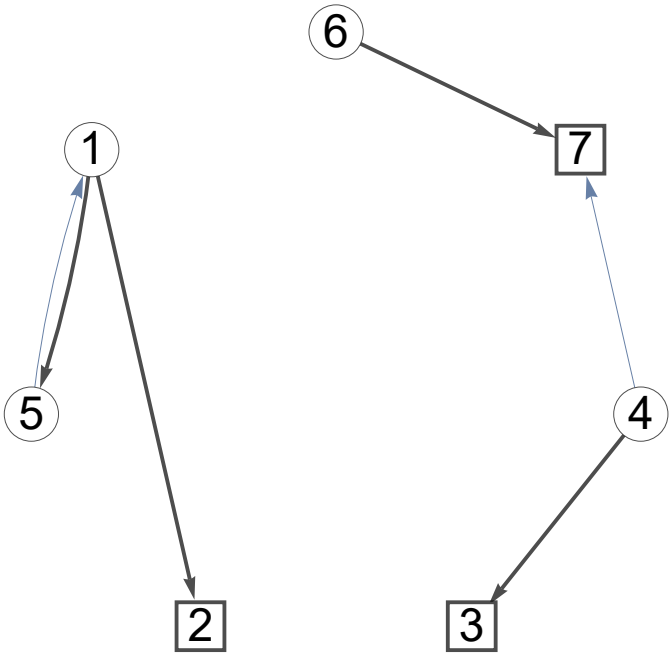
In[339]:=
```
GraphPlot[HighlightGraph[
  Fold[HighlightGraph[#1, Style[u_ ↔ v_ /; u == #2, White]] &, ng, #[[1]] & /@ M+],
  {Style[u_ /; VertexQ[g, u] && pred[t][[u]] == root[t], EdgeForm[Thick]],
   Style[u_ ↔ v_ /; (pred[t][[u]] == v && dir[t][[u]] == -1) ||
       (pred[t][[v]] == u && dir[t][[v]] == 1), Directive[Black, Thick]]},
  GraphHighlightStyle → None], MultiedgeStyle → .05]
```

Out[339]=



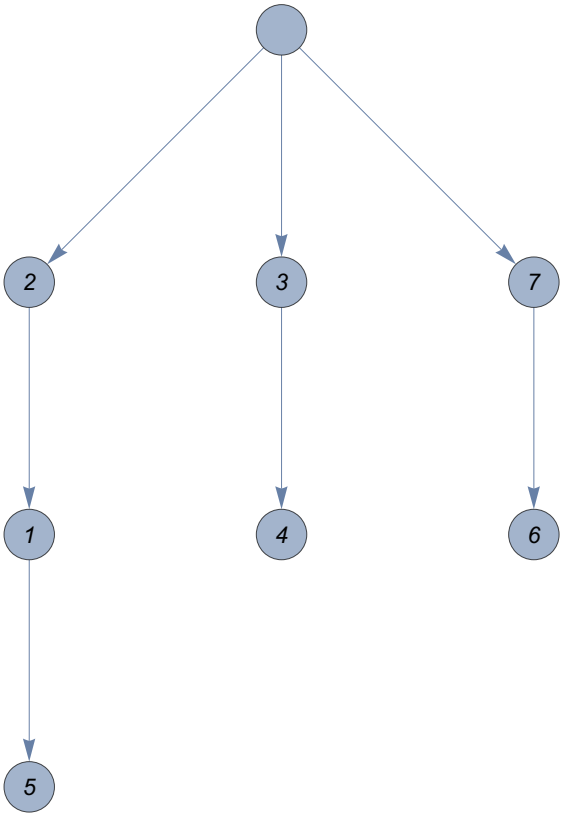
In[340]:=
```
GraphPlot[HighlightGraph[g1,
  {Style[u_ /; VertexQ[g, u] && pred[t][[u]] == root[t], EdgeForm[Thick]],
   Style[u_ ↔ v_ /; (pred[t][[u]] == v && dir[t][[u]] == -1) ||
       (pred[t][[v]] == u && dir[t][[v]] == 1), Directive[Black, Thick]]},
  GraphHighlightStyle → None], MultiedgeStyle → .05]
```

Out[340]=



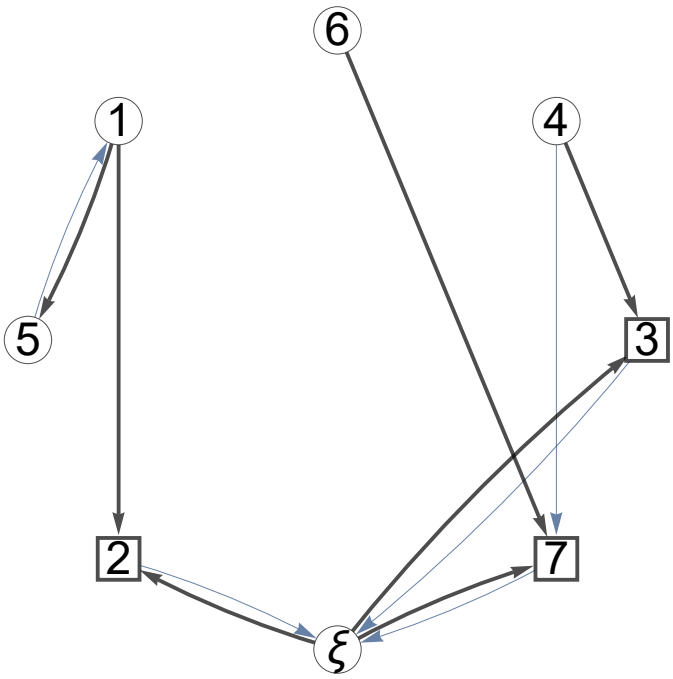
In[394]:=
```
t[[7]](*пометить на графе*)
```

Out[394]=



In[395]:=
```
(*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[395]=



In[343]:=
```
AppendTo[b, -Total[b]];
b = Simplify[b /. x → 0]
```

Out[344]=

$$\left\{\frac{f_{2\bullet\to 8}\,p_{2\bullet\to 1}}{p_{2\bullet\to 8}},\ f_{8\bullet\to 2}+f_{2\bullet\to 8}\left(-1-\frac{p_{2\bullet\to 1}}{p_{2\bullet\to 8}}\right),\ f_{8\bullet\to 3}+f_{3\bullet\to 8}\left(-1-\frac{p_{3\bullet\to 4}}{p_{3\bullet\to 8}}\right),\ \frac{f_{3\bullet\to 8}\,p_{3\bullet\to 4}}{p_{3\bullet\to 8}}+\frac{f_{7\bullet\to 8}\,p_{7\bullet\to 4}}{p_{7\bullet\to 8}},\ 0,\right.$$
$$\left.\frac{f_{7\bullet\to 8}\,p_{7\bullet\to 6}}{p_{7\bullet\to 8}},\ f_{8\bullet\to 7}+f_{7\bullet\to 8}\left(-1-\frac{p_{7\bullet\to 4}}{p_{7\bullet\to 8}}\right),\ f_{2\bullet\to 8}+f_{3\bullet\to 8}+f_{7\bullet\to 8}-f_{8\bullet\to 2}-f_{8\bullet\to 3}-f_{8\bullet\to 7}-\frac{f_{7\bullet\to 8}\,p_{7\bullet\to 6}}{p_{7\bullet\to 8}}\right\}$$

In[345]:=
```
balanceEqs = ((Total[x_# & /@ EdgeList[g, _ ↔ #]] - Total[x_# & /@ EdgeList[g, # ↔ _]]) /.
      root[t] → ξ) == b[[#]] & /@ VertexList[g];
balanceEqs //
 forma
```

Out[346]//TableForm=

$$-x_{1,2}-x_{1,5}+x_{5,1}==\frac{f_{2,8}\,p_{2,1}}{p_{2,8}}$$
$$x_{1,2}-x_{2,\xi}+x_{\xi,2}==f_{8,2}+f_{2,8}\left(-1-\frac{p_{2,1}}{p_{2,8}}\right)$$
$$x_{1,5}-x_{5,1}==0$$
$$-x_{3,\xi}+x_{4,3}+x_{\xi,3}==f_{8,3}+f_{3,8}\left(-1-\frac{p_{3,4}}{p_{3,8}}\right)$$
$$-x_{4,3}-x_{4,7}==\frac{f_{3,8}\,p_{3,4}}{p_{3,8}}+\frac{f_{7,8}\,p_{7,4}}{p_{7,8}}$$
$$x_{4,7}+x_{6,7}-x_{7,\xi}+x_{\xi,7}==f_{8,7}+f_{7,8}\left(-1-\frac{p_{7,4}}{p_{7,8}}\right)$$
$$-x_{6,7}==\frac{f_{7,8}\,p_{7,6}}{p_{7,8}}$$
$$x_{2,\xi}+x_{3,\xi}+x_{7,\xi}-x_{\xi,2}-x_{\xi,3}-x_{\xi,7}==f_{2,8}+f_{3,8}+f_{7,8}-f_{8,2}-f_{8,3}-f_{8,7}-\frac{f_{7,8}\,p_{7,6}}{p_{7,8}}$$

In[347]:=
```
ps = partSolve[g, -b, t, x̃];
ps // forma
```

8

Out[348]//TableForm=

$$\tilde{x}_{1,2} \to -\frac{f_{2,8}\, p_{2,1}}{p_{2,8}}$$
$$\tilde{x}_{1,5} \to 0$$
$$\tilde{x}_{2,8} \to 0$$
$$\tilde{x}_{3,8} \to 0$$
$$\tilde{x}_{4,3} \to -\frac{f_{3,8}\, p_{3,4}}{p_{3,8}} - \frac{f_{7,8}\, p_{7,4}}{p_{7,8}}$$
$$\tilde{x}_{4,7} \to 0$$
$$\tilde{x}_{5,1} \to 0$$
$$\tilde{x}_{6,7} \to -\frac{f_{7,8}\, p_{7,6}}{p_{7,8}}$$
$$\tilde{x}_{7,8} \to 0$$
$$\tilde{x}_{8,2} \to f_{8,2} + f_{2,8}\left(-1 - \frac{p_{2,1}}{p_{2,8}}\right) + \frac{f_{2,8}\, p_{2,1}}{p_{2,8}}$$
$$\tilde{x}_{8,3} \to f_{8,3} + f_{3,8}\left(-1 - \frac{p_{3,4}}{p_{3,8}}\right) + \frac{f_{3,8}\, p_{3,4}}{p_{3,8}} + \frac{f_{7,8}\, p_{7,4}}{p_{7,8}}$$
$$\tilde{x}_{8,7} \to f_{8,7} + f_{7,8}\left(-1 - \frac{p_{7,4}}{p_{7,8}}\right) + \frac{f_{7,8}\, p_{7,6}}{p_{7,8}}$$

In[350]:=
```
Simplify[(balanceEqs /. {x → x̃, ξ → root[t]}) /. ps]
```

Out[350]= {True, True, True, True, True, True, True, True}

In[351]:=
```
matrt = Timing[δMatr = δ1[g, t]];
rootr = VertexCount[g];
TableForm[δMatr, TableHeadings → {uNb[g, t], δ[[#[[2]] &, #[[1]] &, #]] == rootr & /@ EdgeList[g]}] // forma
```

Out[353]//TableForm=

	$\delta_{1,2}$	$\delta_{1,5}$	$\delta_{5,1}$	$\delta_{4,3}$	$\delta_{4,7}$	$\delta_{6,7}$	δ_{2}	δ_{3}	δ_{7}	δ_{2}	δ_{3}	δ_{7}
$5 \leftrightarrow 1$	0	1	1	0	0	0	0	0	0	0	0	0
$4 \leftrightarrow 7$	0	0	0	−1	1	0	0	1	−1	0	0	0
$2 \leftrightarrow 8$	0	0	0	0	0	0	1	0	0	1	0	0
$3 \leftrightarrow 8$	0	0	0	0	0	0	0	1	0	0	1	0
$7 \leftrightarrow 8$	0	0	0	0	0	0	0	0	1	0	0	1

In[354]:=
```
λ = SparseArray[λ, {Length[λ], Length[λ[[1]]] + 6}];
(*λ=λ[[;;-2]]*)
```

In[355]:=
```
dopEq = # == 0 & /@ Flatten[λ.{x_# & /@ EdgeList[g]}^T];
dopEq // forma
```

Out[356]//TableForm=

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

In[357]:=
```
Λ = λ.(δMatr)^T;
"cicle det's:"
Λ // forma
```

Out[358]= cicle det's:

Out[359]//TableForm=

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

In[360]:=
```
"Uc="
Uc = {1, 2}
"Unc="
Unc = {3, 4, 5}
```

Out[360]= $U_c =$

Out[361]= $\{1, 2\}$

Out[362]= $U_{nc} =$

Out[363]= $\{3, 4, 5\}$

In[364]:=
```
Λc = Λ[[All, Uc]];
Λnc = Λ[[All, Unc]];
"Λc="
Λc // MatrixForm
```

Out[366]= $\Lambda_c =$

Out[367]//MatrixForm=

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

In[368]:=
```
"det(Λc)="
Simplify[det = Det[Λc]] // forma
```

Out[368]= $\det(\Lambda_c) =$

Out[369]//TableForm=

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

In[370]:=
```
"UT="
utind = Cases[t[[6]], ξ_ /; ξ ≠ 0];
UT = EdgeList[g][[utind]]
```

Out[370]= $U_T =$

Out[372]= $\{1 \leftrightarrow 2,\ 8 \leftrightarrow 2,\ 8 \leftrightarrow 3,\ 4 \leftrightarrow 3,\ 1 \leftrightarrow 5,\ 6 \leftrightarrow 7,\ 8 \leftrightarrow 7\}$

In[373]:=
```
"UNb="
UNb = uNb[g, t]
```

Out[373]= $U_{Nb} =$

Out[374]= $\{5 \leftrightarrow 1,\ 4 \leftrightarrow 7,\ 2 \leftrightarrow 8,\ 3 \leftrightarrow 8,\ 7 \leftrightarrow 8\}$

In[375]:=
```
A = -λ.{x̃_# & /@ EdgeList[g]}^T /. ps;
"A="
A // MatrixForm
```

Out[376]= $A =$

Out[377]//MatrixForm=

$$\begin{pmatrix} \frac{f_{2\leftrightarrow 8}\,p_{2\leftrightarrow 1}}{p_{2\leftrightarrow 8}} \\ \frac{f_{3\leftrightarrow 8}\,p_{3\leftrightarrow 4}}{p_{3\leftrightarrow 8}}+\frac{f_{7\leftrightarrow 8}\,p_{7\leftrightarrow 4}}{p_{7\leftrightarrow 8}} \end{pmatrix}$$

In[378]:=
```
β = A - Λnc.{x# & /@ U_Nb[[U_nc]]}^T;
"β="
β // forma
```

Out[379]= $\beta=$

Out[380]//TableForm=

$$\frac{f_{2,8}\, p_{2,1}}{p_{2,8}}$$
$$\frac{f_{3,8}\, p_{3,4}}{p_{3,8}} + \frac{f_{7,8}\, p_{7,4}}{p_{7,8}}$$

In[381]:=
```
"решаем уравнение Λ_c x_c=β:"
xc = LinearSolve[Λc, β]
```

Out[381]= решаем уравнение $\Lambda_c x_c=\beta$:

Out[382]= $$\left\{\left\{-\frac{f_{2\bullet\to 8}\, p_{1\bullet\to 2}\, p_{2\bullet\to 1}}{p_{1\bullet\to 5}\, p_{2\bullet\to 8}}\right\}, \left\{\frac{\frac{f_{3\bullet\to 8}\, p_{3\bullet\to 4}}{p_{3\bullet\to 8}} + \frac{f_{7\bullet\to 8}\, p_{7\bullet\to 4}}{p_{7\bullet\to 8}}}{-1-\frac{p_{4\bullet\to 7}}{p_{4\bullet\to 3}}}\right\}\right\}$$

In[383]:=
```
xcp = MapThread[x_#1 → #2 &, {U_Nb[[U_c]], Flatten[xc]}];
xcp // TableForm
```

Out[384]//TableForm=

$$x_{5\bullet\to 1} \to -\frac{f_{2\bullet\to 8}\, p_{1\bullet\to 2}\, p_{2\bullet\to 1}}{p_{1\bullet\to 5}\, p_{2\bullet\to 8}}$$
$$x_{4\bullet\to 7} \to \frac{\frac{f_{3\bullet\to 8}\, p_{3\bullet\to 4}}{p_{3\bullet\to 8}} + \frac{f_{7\bullet\to 8}\, p_{7\bullet\to 4}}{p_{7\bullet\to 8}}}{-1-\frac{p_{4\bullet\to 7}}{p_{4\bullet\to 3}}}$$

In[385]:=
```
s = solveAll[g, t];
s // TableForm
```

Out[386]//TableForm=

$$x_{1\bullet\to 2} \to -\frac{f_{2\bullet\to 8}\, p_{2\bullet\to 1}}{p_{2\bullet\to 8}}$$
$$x_{1\bullet\to 5} \to x_{5\bullet\to 1}$$
$$x_{4\bullet\to 3} \to -\frac{f_{3\bullet\to 8}\, p_{3\bullet\to 4}}{p_{3\bullet\to 8}} - \frac{f_{7\bullet\to 8}\, p_{7\bullet\to 4}}{p_{7\bullet\to 8}} - x_{4\bullet\to 7}$$
$$x_{6\bullet\to 7} \to -\frac{f_{7\bullet\to 8}\, p_{7\bullet\to 6}}{p_{7\bullet\to 8}}$$
$$x_{8\bullet\to 2} \to f_{8\bullet\to 2} + f_{2\bullet\to 8}\left(-1-\frac{p_{2\bullet\to 1}}{p_{2\bullet\to 8}}\right) + \frac{f_{2\bullet\to 8}\, p_{2\bullet\to 1}}{p_{2\bullet\to 8}} + x_{2\bullet\to 8}$$
$$x_{8\bullet\to 3} \to f_{8\bullet\to 3} + f_{3\bullet\to 8}\left(-1-\frac{p_{3\bullet\to 4}}{p_{3\bullet\to 8}}\right) + \frac{f_{3\bullet\to 8}\, p_{3\bullet\to 4}}{p_{3\bullet\to 8}} + \frac{f_{7\bullet\to 8}\, p_{7\bullet\to 4}}{p_{7\bullet\to 8}} + x_{3\bullet\to 8} + x_{4\bullet\to 7}$$
$$x_{8\bullet\to 7} \to f_{8\bullet\to 7} + f_{7\bullet\to 8}\left(-1-\frac{p_{7\bullet\to 4}}{p_{7\bullet\to 8}}\right) + \frac{f_{7\bullet\to 8}\, p_{7\bullet\to 6}}{p_{7\bullet\to 8}} - x_{4\bullet\to 7} + x_{7\bullet\to 8}$$

In[396]:=
```
"общее решение:"
xsol = ((s /. xcp) ~Join~ xcp);
xsol /. {ξ_u_↔v_ → ξu,v} // Simplify // TableForm
```

Out[396]= общее решение:

Out[398]//TableForm=

$$x_{1,2} \to -\frac{f_{2,8}\, p_{2,1}}{p_{2,8}}$$

$$x_{1,5} \to -\frac{f_{2,8}\, p_{1,2}\, p_{2,1}}{p_{1,5}\, p_{2,8}}$$

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

$$x_{6,7} \to -\frac{f_{7,8}\, p_{7,6}}{p_{7,8}}$$

$$x_{8,2} \to -f_{2,8} + f_{8,2} + x_{2,8}$$

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

$$x_{8,7} \to f_{8,7} + \frac{f_{3,8}\, p_{3,4}\, p_{4,3}}{p_{3,8}\,(p_{4,3}+p_{4,7})} + f_{7,8}\left(-1 - \frac{p_{4,7}\, p_{7,4}}{(p_{4,3}+p_{4,7})\, p_{7,8}} + \frac{p_{7,6}}{p_{7,8}}\right) + x_{7,8}$$

$$x_{5,1} \to -\frac{f_{2,8}\, p_{1,2}\, p_{2,1}}{p_{1,5}\, p_{2,8}}$$

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

In[399]:=
```
"eq test:"
Simplify[balanceEqs /. ξ → root[t] /. s /. xcp]
Simplify[(dopEq /. s) /. xcp]
```

Out[399]= eq test:

Out[400]= {True, True, True, True, True, True, True, True}

Out[401]= {True, True}