Dunaev Viktor, 3 kurs, 6 group, 23 variant

Pre - Task

In[36]:=
```
fname = NotebookDirectory[] <> "input.txt"
```
Out[36]=
```
C:\6_Cemestr\DS_Laguto\input.txt
```

In[37]:=
```
stream = OpenRead[fname];
```

In[38]:=
```
vertexNum = Read[stream, {Word, Number}][[2]]
```
Out[38]=
```
6
```

In[39]:=
```
edgesNum = Read[stream, {Word, Number}][[2]]
```
Out[39]=
```
12
```

In[40]:=
```
edges = Table[#[[1]] ⧟ #[[2]] &[ToExpression[Read[stream]]], edgesNum]
```
Out[40]=
```
{1 ⧟ 5, 2 ⧟ 5, 3 ⧟ 1, 3 ⧟ 4, 3 ⧟ 5, 4 ⧟ 1, 4 ⧟ 2, 4 ⧟ 6, 5 ⧟ 4, 6 ⧟ 2, 6 ⧟ 3, 6 ⧟ 5}
```

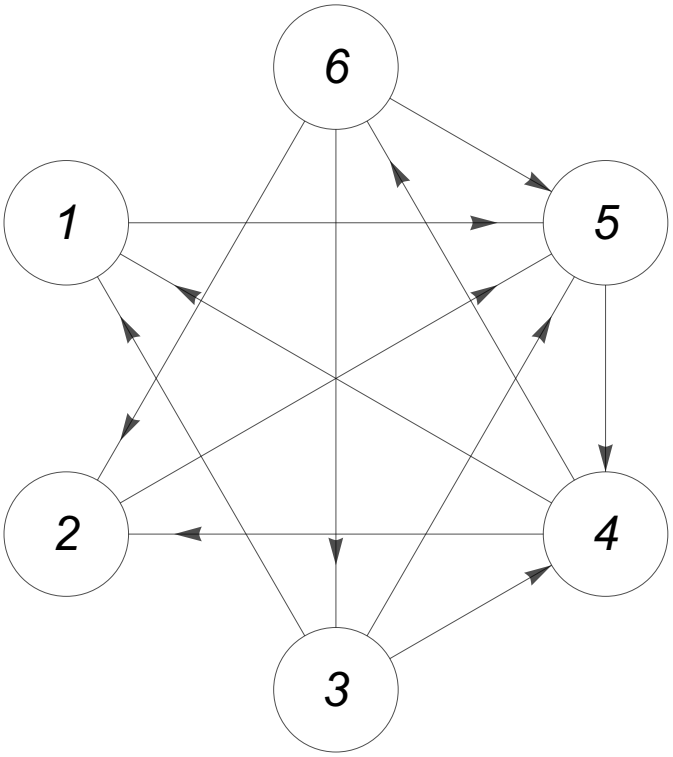
In[41]:=
```
vertex = Table[i, {i, 1, vertexNum}]
```
Out[41]=
```
{1, 2, 3, 4, 5, 6}
```

In[42]:=
```
weight = Range[vertexNum]
```
Out[42]=
```
{1, 2, 3, 4, 5, 6}
```

In[43]:=
```
Table[(pos = ToExpression[Characters[#[[1]]][[5]]];
    val = #[[2]];
    weight[[pos]] = val) &[Read[stream, {Word, Number}]], vertexNum]
```
Out[43]=
```
{7, 4, -1, -7, -2, -1}
```

In[44]:=
```
g = Graph[vertex, edges, VertexSize -> Large,
  VertexStyle -> White, VertexLabels -> Placed["Name", Center],
  VertexLabelStyle -> Directive[Black, Italic, 25], GraphLayout ->
   {"CircularEmbedding"}, EdgeShapeFunction -> "Arrow", EdgeStyle -> Black]
```

Out[44]=



Task 1

In[45]:=
```
(* 1) реализовать алгоритм построения частного решения системы уравнений баланса;
   2) найти и вывести частное решение для своей системы уравнений,
проверить правильность найденного решения путём подставки решения в систему. *)
```

In[46]:=
```
startNode = RandomChoice[vertex]
```

Out[46]= 5

In[47]:=
```
dirs = Table[0, Length[vertex]]
```

Out[47]= {0, 0, 0, 0, 0, 0}

In[48]:=
```
pred = Table[0, Length[vertex]]
```

Out[48]= {0, 0, 0, 0, 0, 0}

In[49]:=
```
depth = Table[0 , Length[vertex]]
```

Out[49]= {0, 0, 0, 0, 0, 0}

In[50]:=
```
dinast = {}
```

Out[50]= {}

In[51]:=
```
tree = {}
```
Out[51]= {}

In[52]:=
```
graphTree = {}
```
Out[52]= {}

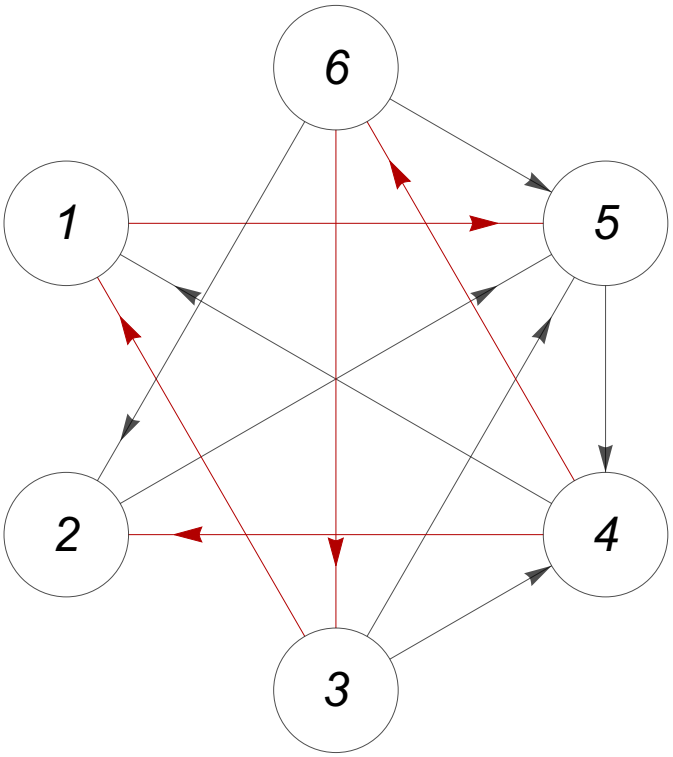
In[53]:=
```
DepthFirstScan[UndirectedGraph@g, startNode,
  {"FrontierEdge" → ((edge = # /. (x_ ⟷ y_) → (x ⟷ y); AppendTo[tree, edge];
            If[MemberQ[edges, edge], dirs[[#[[2]]]] = 1;
              AppendTo[graphTree, edge], dirs[[#[[2]]]] = -1;
              AppendTo[graphTree, #[[2]] ⟷ #[[1]]];
            pred[[#[[2]]]] = #[[1]];
            depth[[#[[2]]]] = depth[[#[[1]]]] + 1) &)}]
```
Out[53]= {5, 4, 1, 6, 5, 3}

In[54]:=
```
DepthFirstScan[tree, startNode, {"PrevisitVertex" → ((AppendTo[dinast, #]) &)}];
```

In[55]:=
```
tree
```
Out[55]= {5 ⟷ 1, 1 ⟷ 3, 3 ⟷ 6, 6 ⟷ 4, 4 ⟷ 2}

In[56]:=
```
HighlightGraph[g, graphTree]
```

Out[56]=



In[57]:=
```
dirs
```
Out[57]= {-1, 1, -1, -1, 0, -1}

In[58]:=
```
pred
```
Out[58]= {5, 4, 1, 6, 0, 3}

In[59]:= **dinast**

Out[59]= {5, 1, 3, 6, 4, 2}

In[60]:= **depth**

Out[60]= {1, 5, 2, 4, 0, 3}

In[61]:=
```
Graph[tree, VertexSize -> Large, VertexStyle -> White,
  VertexLabels -> Placed["Name", Center], VertexLabelStyle -> Directive[Black, Italic, 25],
  GraphLayout -> {"RadialEmbedding"}, EdgeShapeFunction -> "Arrow", EdgeStyle -> Black]
```

Out[61]=

In[62]:=
```
TableForm[{vertex, pred, depth, dirs},
  TableHeadings → {{"Вершины", "Список предков", "Список глубин", "Список направлений"}}]
```

Out[62]//TableForm=

Вершины	1	2	3	4	5	6
Список предков	5	4	1	6	0	3
Список глубин	1	5	2	4	0	3
Список направлений	−1	1	−1	−1	0	−1

In[63]:= `(* Строим частное решение *)`

In[64]:= $(z_{\#[[1]],\#[[2]]} = 0)$ & /@ edges

Out[64]= {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}

In[65]:= **xp = Table[0, Length[vertex]];**

In[66]:=
```
For[n = Length[vertex], n > 1, n--,
  i = dinast[[n]];
  xp[[i]] += -dirs[[i]] * weight[[i]];
  xp[[pred[[i]]]] += dirs[[i]] * dirs[[pred[[i]]]] * xp[[i]];
]
```

In[67]:= **xp**

Out[67]= {2, −4, −5, −3, 0, −4}

In[68]:= If[dirs[[#]] == 1, $z_{\text{pred}[[\#]],\#}$ = xp[[#]]] & /@ Range[vertexNum];

In[69]:= If[dirs[[#]] == −1, $z_{\#,\text{pred}[[\#]]}$ = xp[[#]]] & /@ Range[vertexNum];

In[70]:= pSol = $(x_{\#[[1]],\#[[2]]} \to z_{\#[[1]],\#[[2]]})$ & /@ edges

Out[70]= $\{x_{1,5} \to 2,\ x_{2,5} \to 0,\ x_{3,1} \to -5,\ x_{3,4} \to 0,\ x_{3,5} \to 0,\ x_{4,1} \to 0,\ x_{4,2} \to -4,\ x_{4,6} \to -3,\ x_{5,4} \to 0,\ x_{6,2} \to 0,\ x_{6,3} \to -4,\ x_{6,5} \to 0\}$

In[71]:=
```
sys =
  ((Total[Join[Select[edges, MatchQ[# ↔ _]], -Select[edges, MatchQ[_ ↔ #]]]] & /@ vertex /. (a_ ↔ b_) →
        x_{a,b})[[#]] == weight[[#]]) & /@ vertex
```

Out[71]= $\{x_{1,5} - x_{3,1} - x_{4,1} == 7,\ x_{2,5} - x_{4,2} - x_{6,2} == 4,\ x_{3,1} + x_{3,4} + x_{3,5} - x_{6,3} == -1,$
$-x_{3,4} + x_{4,1} + x_{4,2} + x_{4,6} - x_{5,4} == -7,\ -x_{1,5} - x_{2,5} - x_{3,5} + x_{5,4} - x_{6,5} == -2,\ -x_{4,6} + x_{6,2} + x_{6,3} + x_{6,5} == -1\}$

In[72]:= `(* проверка *)`

In[73]:= **sys /. pSol**

Out[73]= {True, True, True, True, True, True}