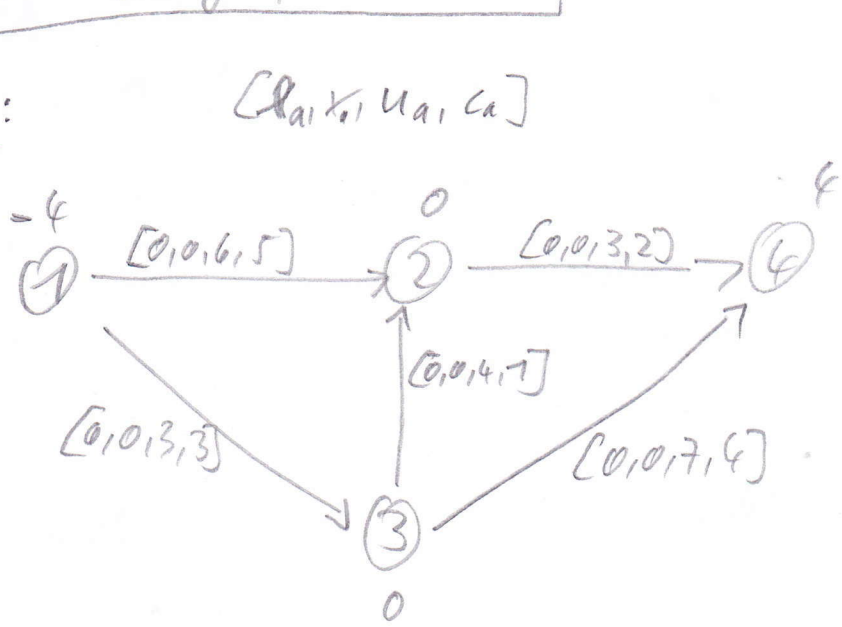
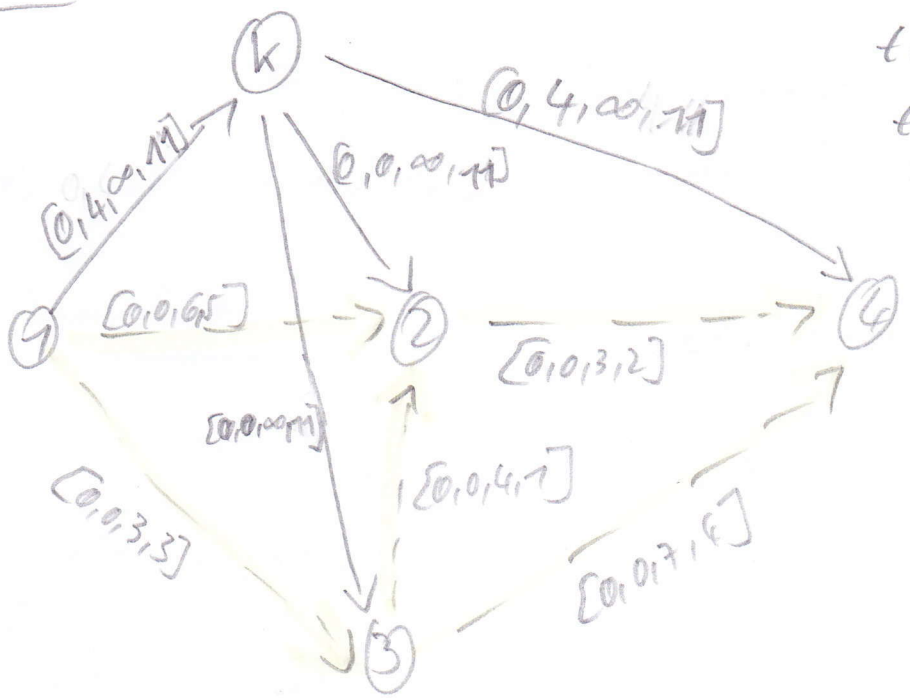
Beispiel testgraph2.txt

Netzwerk: [a, x, u, c]



Inhaltbaum:



t[k] = 1 d(v) = 0
t[1] = 2 d(i) = 1
t[2] = 3 i ∈ {1,...,4}
t[3] = 4
t[4] = k

p(k) = -1
p(1) = k
p(2) = k
p(3) = k
p(4) = k

Fairbrief:

$y(k) = 0$

$y(1) = y(k) + c_{1k} = 0 + 11 = 11$, da $(1,k) \in T$

$y(2) = y(k) - c_{k2} = 0 - 11 = -11$, da $(k,2) \in T$

$y(3) = y(4) = -11$

reduced Costs: $\bar{c}_{ij} = c_{ij} - y(i) + y(j) \quad \forall (i,j) \in T$

T: $\bar{c}_{1k} = c_{1k} - y(1) + y(k) = 11 - 11 + 0 = 0$

$\bar{c}_{k2} = 11 - 0 + (-11) = 0$

$\bar{c}_{k3} = 11 - 0 + (-11) = 0$ $\bar{c}_{k4} = 0$

P1

$\bar{c}_{13} = 3 - 11 + (-11) = -19$, $\bar{c}_{12} = 5 - 11 + (-11) = -17$

$\bar{c}_{32} = 1 - (-11) + (-11) = 1$, $\bar{c}_{24} = 2 - (-11) + (-11) = 2$

$\bar{c}_{34} = 4 - (-11) + (-11) = 4$

$\Rightarrow$ "$\max_{i,j}$" $= \bar{c}_{13} = -19 \Rightarrow$ entering arc $= (1,3)$

$\Rightarrow$ Circle: $(k, 1, 3, 2, k)$ Schritt $= k$

$\varepsilon = \min (x_{1k} - l_{1k} ; u_{13} - x_{13} ; x_{k3} - l_{k3})$

$= \min (4 - 0 = 4 ; 3 - 0 = 3 ; 0 - 0 = 0)$

$= 0 \Rightarrow$ letzter blockierender Bogen: $(k,3)$

leaving arc: $(k,3)$

$\Rightarrow$ keine Flussveränderung

Neue Baumschalter:

$p(k) = -1$

$p(1) = k$ $p(2) = k$ $p(4) = k$

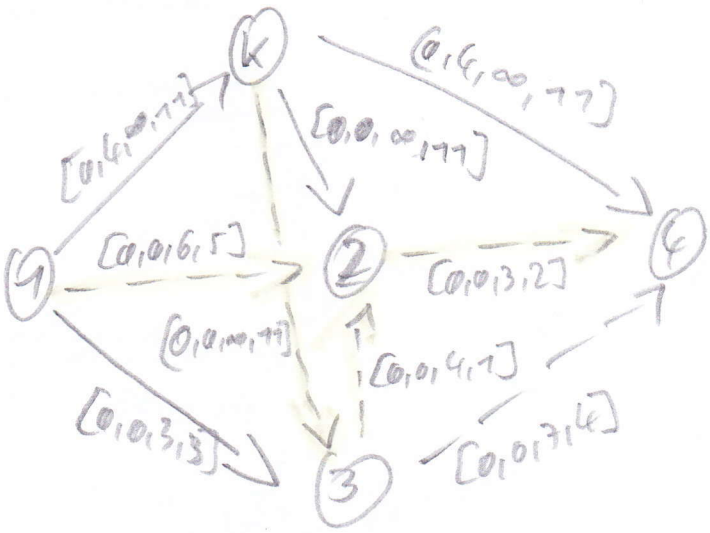
$p(3) = 1$

$t(k) = 1$ $t(1) = 3$ $t(2) = 4$

$t(3) = 2$ $t(4) = k$

$d(k) = 0$ $d(1) = 1$

$d(2) = 1$ $d(3) = 2$ $d(4) = 1$



Tree Potentials Update: change $= -\bar{c}_{13} = +19$

$\rightarrow y(3) := y(3) + \text{change} = y(3) + 19 = 8$

fertig, da $d(t(3)) \leq d(3)$

T1:

T2:

reduced Costs Update:

T: $\bar{c}_{1k} = 0$, $\underline{\bar{c}_{13}} = 3 - 11 + 8 = 0$

$\bar{c}_{k2} = 0$, $\bar{c}_{k4} = 0$

L: $\underline{\bar{c}_{k3}} = 11 - 0 + 8 = 19$

$\bar{c}_{12} = -17$, $\underline{\bar{c}_{32}} = 1 - 8 + (-11) = -18$

$\bar{c}_{24} = 2$, $\underline{\bar{c}_{34}} = 4 - 8 + (-11) = -15$

$\Rightarrow$ "max" $= \bar{c}_{32} = -18$ $\Rightarrow$ entering arc = $(3,2)$

$\Rightarrow$ Circle = $(k,1,3,2,k)$ Schritt = k

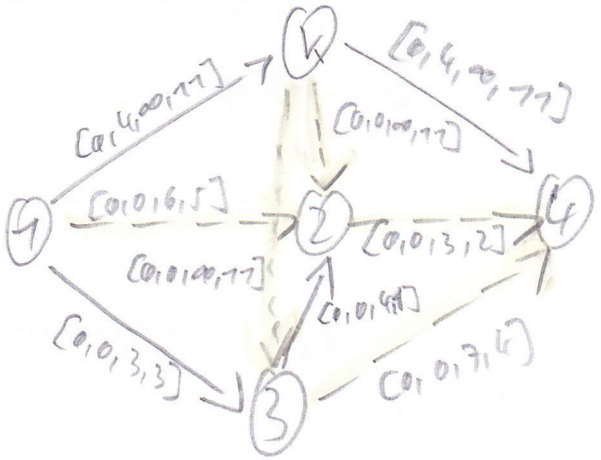
$\varepsilon = \min(x_{1k} - l_{1k}; u_{13} - x_{13}; u_{32} - x_{32}; x_{k2} - l_{k2})$

$= \min(4-0=4; 3-0=3; 4-0=4; 0-0=0)$

$= 0$ $\Rightarrow$ leaving arc = $(k,2)$ (letzter blockierender Bogen)

$\Rightarrow$ keine Flussänderung!

keine Baumänderung:



$p(k) = -1$, $p(1) = k$, $p(2) = 3$

$p(3) = 1$, $p(4) = k$

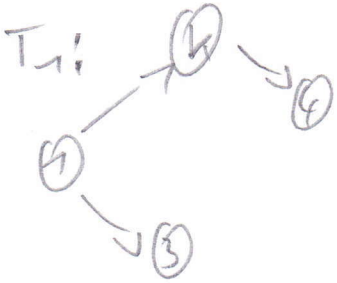
$t(k) = 1$, $t(1) = 3$, $t(2) = 4$, $t(3) = 2$

$\epsilon(4) = k$

$d(k) = 0$, $d(1) = d(4) = 1$

$d(2) = 3$, $d(3) = 2$

T_1:



T_2:

Tree Price Update:

change $= -\bar{c}_{32} = 18 \rightarrow y(2) = y(2) + \text{change}$
$= -11 + 18 = 7$

fertig, da $d(t(2)) \leq d(2)$

Reduced Costs Update:

T:/ $\bar{c}_{1k} = 0$, $\bar{c}_{k4} = 0$, $\bar{c}_{13} = 0$

$\bar{c}_{32} = 1 - 8 + 7 = 0$

L:/ $\bar{c}_{k3} = 19$, $\bar{c}_{34} = -15$

$\bar{c}_{12} = 5 - 11 + 7 = 1$

$\bar{c}_{k2} = 11 - 0 + 7 = 18$

$\bar{c}_{24} = 2 - 7 + (-11) = -16$

$\Rightarrow$ "min" $= \bar{c}_{24} = -16 \Rightarrow$ entering arc $= (2,4)$
$L,4$

$\Rightarrow$ circle $= (k, 1, 3, 2, 4, k)$ Schritt $= k$

$\varepsilon = \min (x_{1k} - l_{1k} ; u_{13} - x_{13} , u_{32} - x_{32} ; u_{24} - x_{24} ; x_{k4} - l_{k4})$
$= \min (4 - 0 = 4 ; 3 - 0 = 3 ; 4 - 0 = 4 ; 3 - 0 = 3 ; 4 - 0 = 4)$

$\Rightarrow \varepsilon = 3 \Rightarrow$ letzter blockierender Bogen $= (2,4)$
$=$ leaving arc

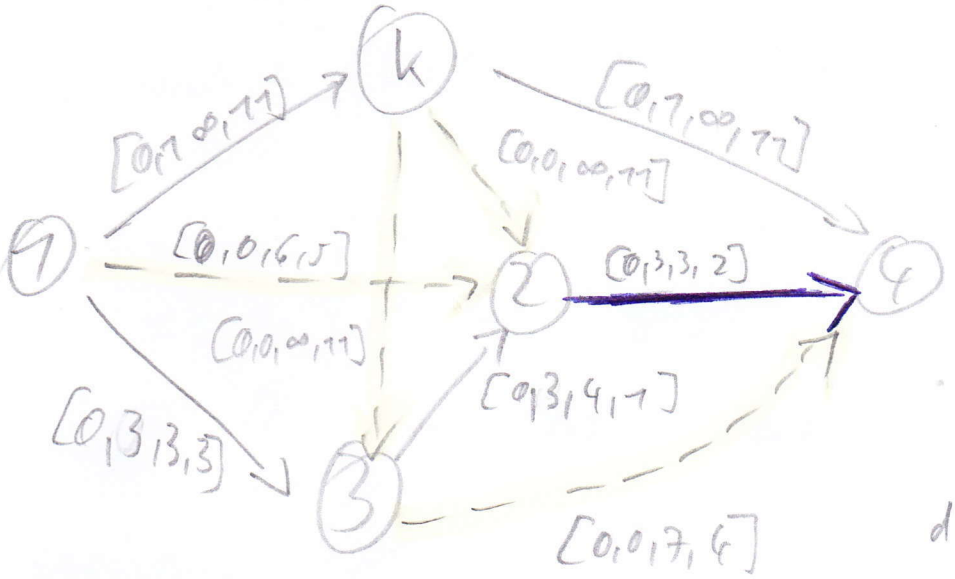
Flussänderung: $x_{24} := x_{24} + \varepsilon = 3$, $x_{k4} := x_{k4} - \varepsilon = 1$

$x_{1k} := x_{1k} - \varepsilon = 1$, $x_{13} := x_{13} + \varepsilon = 3$

$x_{32} := x_{32} + \varepsilon = 3$

$\Rightarrow$ $(2,4)$ in U

Keine Baumstruktur!



$p(k) = -1$

$p(1) = k = p(4)$

$p(2) = 3$, $p(3) = 1$

$t(k) = 1$, $t(1) = 3$

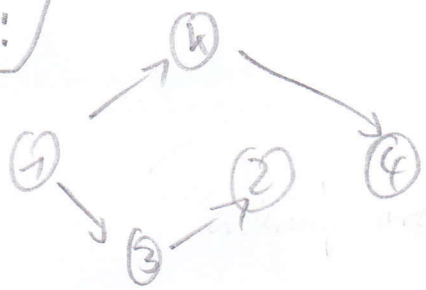
$t(3) = 2$, $t(2) = 4$

$t(4) = k$

$d(k) = 0$, $d(1) = d(4) = 1$

$d(2) = 3$, $d(3) = 2$

T1:



T2:

Fair Price Update:

reduced Costs: (no update needed)

T: $\bar{c}_{1k} = 0$; $\bar{c}_{k4} = 0$; $\bar{c}_{13} = 0$

$\bar{c}_{32} = 0$

L: $\bar{c}_{k3} = 19$, $\bar{c}_{34} = -15$; $\bar{c}_{12} = 1$

$\bar{c}_{k2} = 18$

U: $\bar{c}_{24} = -16$

$\Rightarrow$ "$\max_{i,u}$" $= \bar{c}_{34} = -15$ $\Rightarrow$ entering arc $= (3,4)$

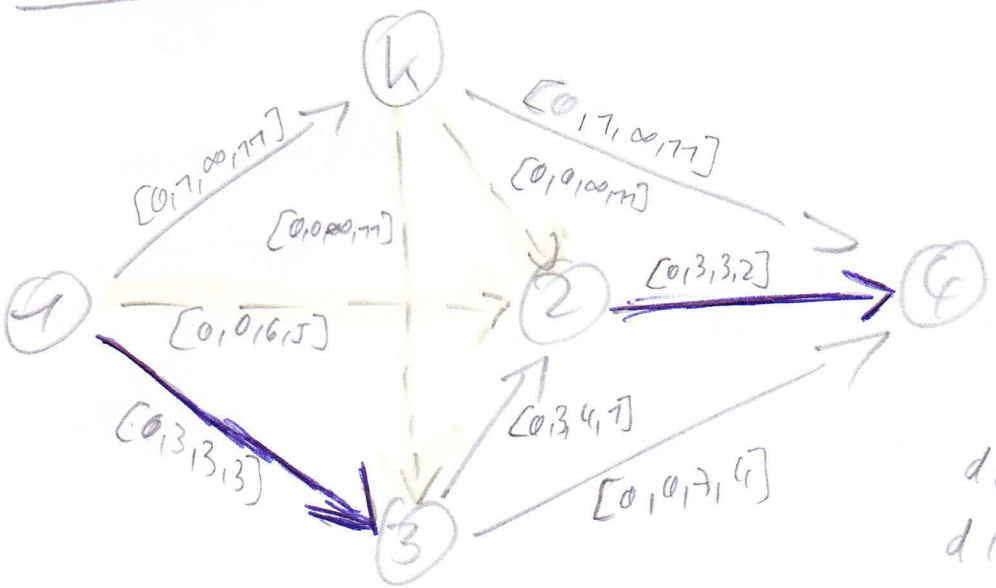
$\Rightarrow$ circle $= (4,1,3,4,4)$ Schritt $= 4$

$\varepsilon = \min(x_{14} - l_{14}; u_{13} - x_{13}; u_{34} - x_{34}; x_{44} - l_{44})$
$= \min(1-0=1; 3-3=0; 7-0=7; 1-0=1)$
$= 0$ $\Rightarrow$ letzter blockierender Bogen $= (1,3)$
$=$ leaving arc

Flussänderung: /

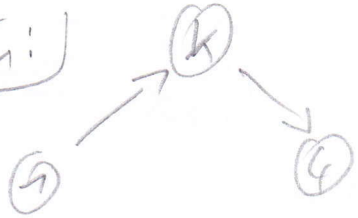
$\Rightarrow (1,3)$ in U

Neue Baumstruktur:



$p(4) = -1$
$p(1) = 4 = p(4)$
$p(2) = 3$, $p(3) = 4$
$t(4) = 1$, $t(1) = 4$
$t(2) = 4$, $t(3) = 2$
$t(4) = 3$
$d(4) = 0$, $d(1) = d(4) = 1$
$d(2) = 3$, $d(3) = 2$

T_1:



T_2:

Fair Price Update: change $= -\bar{c}_{34} = -15$ $(3 \in T_2)$

$y(3) := y(3) + \text{change} = 8 - 15 = -7$
$y(2) := y(2) + \text{change} = 7 - 15 = -8$

Reduced Costs Update:

T:) $\bar{c}_{1k} = 0$, $\bar{c}_{k4} = 0$, $\bar{c}_{32} = 1-(-7)+(-8)) = 0$

$\bar{c}_{34} = 4-(-7)+(-11) = 0$

L:) $\bar{c}_{k2} = 11-0+(-8)=3$, $\bar{c}_{12} = 5-11+(-8) = -14$

$\bar{c}_{k3} = 11-0+(-7) = 4$

U:) $\bar{c}_{13} = 3-11+(-7) = -15$

$\bar{c}_{24} = 2-(-8)+(-11) = -1$

$\Rightarrow$ "most" $_{L,U} = \bar{c}_{12} = -14$ $\Rightarrow$ entering arc $= (1,2)$

$\Rightarrow$ cycle $= (k,1,2,3,4,k)$ Schritt $= k$

$\varepsilon = \min (x_{1k}-l_{1k}; u_{12}-x_{12}; x_{32}-l_{32}; u_{34}-x_{34}; x_{k4}-l_{k4})$

$= \min (1-0=1; 6-0=6; 3-0=3; 7-0=7; 1-0=1)$

$= 1$ $\Rightarrow$ Leaving blocking arc $= (k,4)$

$=$ leaving arc

Flussänderung:

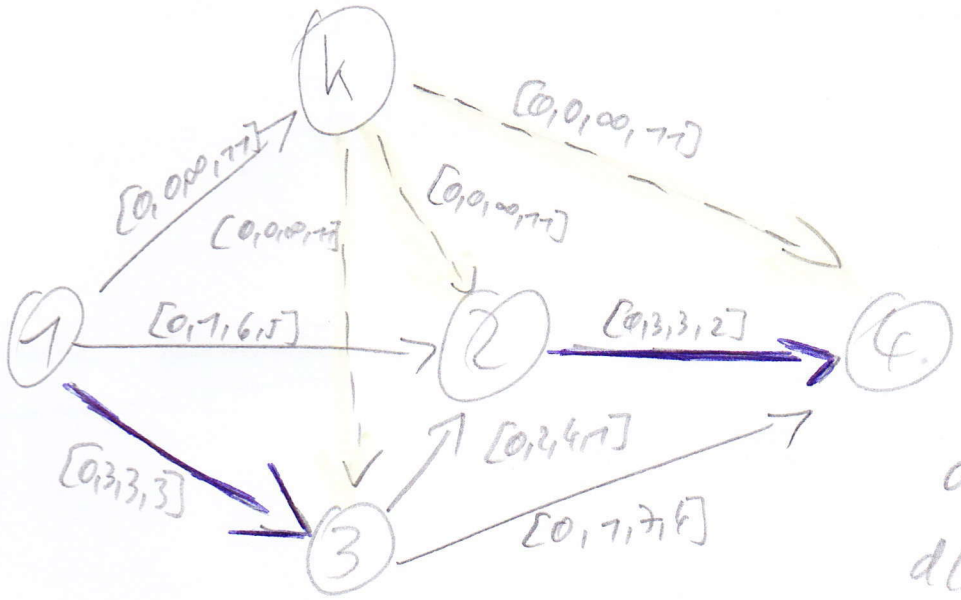
$x_{1k} := x_{1k} - \varepsilon = 0$, $x_{k4} := x_{k4} - \varepsilon = 0$

$x_{12} := x_{12} + \varepsilon = 1$, $x_{32} := x_{32} - 1 = 2$

$x_{34} := x_{34} + \varepsilon = 1$

$\Rightarrow (k,4)$ in L

Neue Baumstruktur:



$p(k) = -1$, $p(1) = k$

$p(2) = 1$, $p(3) = 2$

$p(4) = 3$

$t(k) = 1$, $t(1) = 2$

$t(2) = 3$, $t(3) = 4$

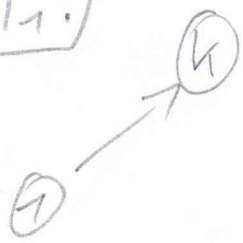
$t(4) = k$

$d(k) = 0$

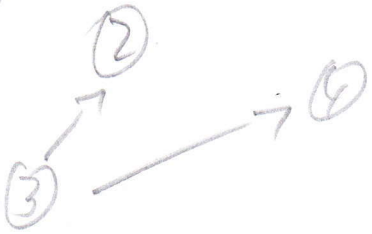
$d(1) = 1$, $d(2) = 2$, $d(3) = 3$

$d(4) = 4$

T1:



T2:



Fast Price Update:

change $= -\bar{c}_{12} = 14$, da $(1 \in T_1)$

$y(1) := y(1) + \text{change} = -11 + 14 = 3$

$y(2) := y(2) + \text{change} = -8 + 14 = 6$

$y(3) := y(3) + \text{change} = -7 + 14 = 7$

reduced Cost Update:

T: $\bar{c}_{1k} = 0$, $\bar{c}_{12} = 5 - 11 + 6 = 0$

$\bar{c}_{32} = 1 - 7 + 6 = 0$

$\bar{c}_{34} = 4 - 7 + 3 = 0$

U: $\bar{c}_{13} = 3 - 11 + 7 = -1$

$\bar{c}_{24} = 2 - 6 + 3 = -1$

L: $\bar{c}_{k4} = 11 - 0 + 3 = 14$, $\bar{c}_{k3} = 11 - 0 + 7 = 18$

$\bar{c}_{k2} = 11 - 0 + 6 = 17$

$\bar{c}_{ij} = 0 \quad \forall (i,j) \in T$

$\bar{c}_{ij} \geq 0 \quad \forall (i,j) \in L$

$\bar{c}_{ij} \leq 0 \quad \forall (i,j) \in U$

$\Rightarrow$ optimale Lösung erreicht, da

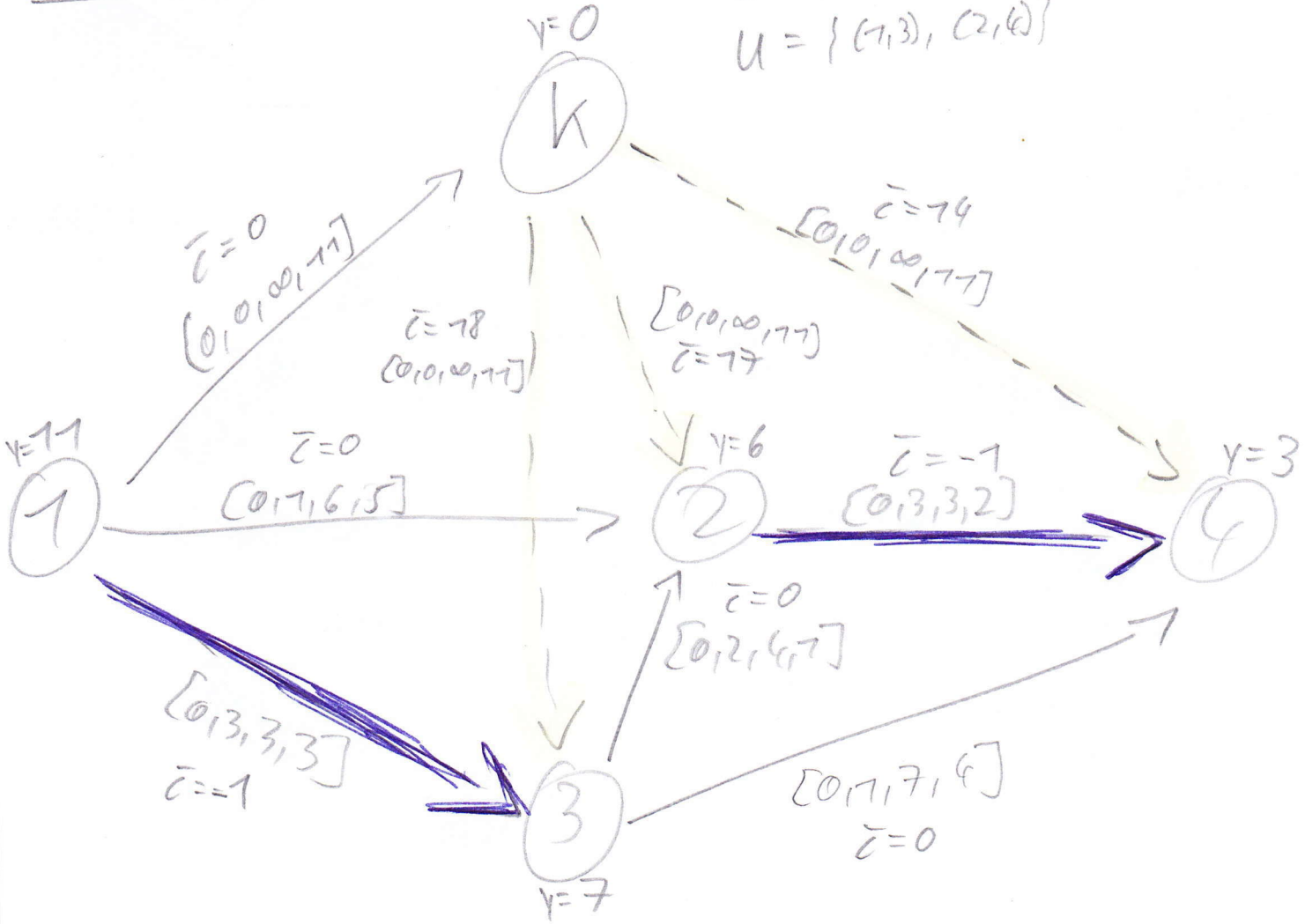
$x_{ij} = 0 \quad \forall (i,j)$ mit $i = k \vee j = k$

Finale Baumstruktur:

$T = \{(1,k), (1,2), (3,2), (3,4)\}$

$L = \{(k,3), (k,2), (k,4)\}$

$U = \{(1,3), (2,4)\}$



Flow: [la, xa, ua, ca]