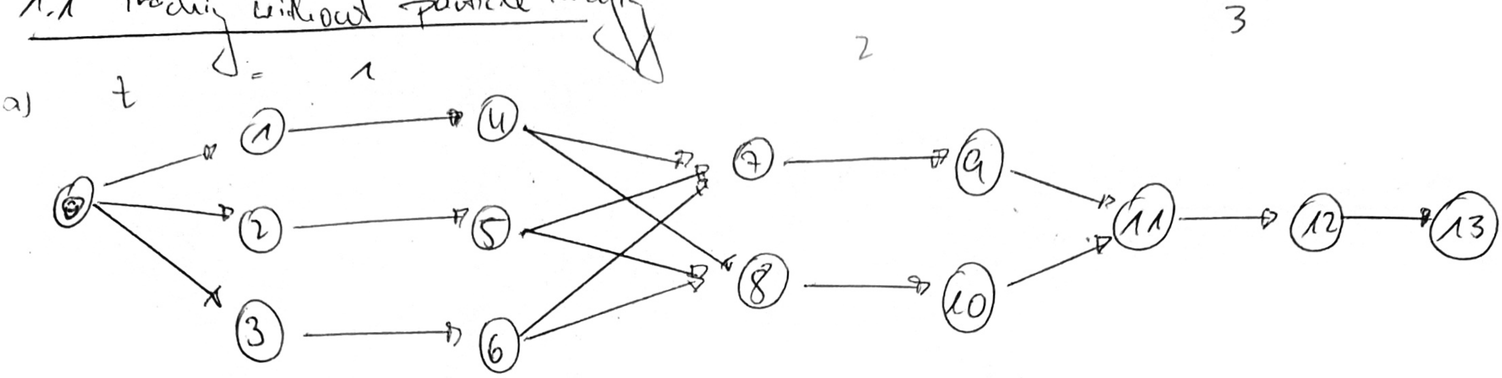
1.1 Tracking without particle merging

a)



Consider 0 to be start- and 13 target-node.

<u>Costs</u>: • $c_{01} = c_{02} = c_{03} = c_{12,13} = 0$ (No cost for (dis)appearing)

• $c_{14} = -10 \quad c_{7,9} = -13$

$c_{25} = -20 \quad c_{8,10} = -8$

$c_{36} = -18 \quad c_{11,12} = -9$

• $c_{47} = (2-0)^2 + (1-0)^2 = 5$

$c_{48} = (2-1)^2 + (1-6)^2 = 26$

$c_{57} = (0-0)^2 + (4-0)^2 = 16$

$c_{58} = (0-1)^2 + (4-6)^2 = 5$

$c_{67} = (5-0)^2 + (4-0)^2 = 41$

$c_{68} = (5-1)^2 + (4-6)^2 = 20$

$c_{9,11} = (0-4)^2 + (0-1)^2 = 17$

$c_{10,11} = (1-4)^2 + (6-1)^2 = 34$

<u>capacity</u>: $\mu_e = 1 \quad \forall e \in E$

b) $$\min_X \sum_{e \in E} x_e c_e$$

$$\text{s.t.} \sum_{u:(u,v)\in E} x_{(u,v)} - \sum_{w:(v,w)\in E} x_{(v,w)} = 0 \quad \forall v \in V$$

$$x_e \le \mu_e$$

$$x_e \in \{0,1\}$$

for $G = (V, E)$ as sketched in a).

c) current assumptions: $N_{tot} = 1$, because there is only one observation for $t=3$

⊕

appearance at $t>0$: $N_{tot} = 1$, same reason. Disappearance not allowed yet.

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dissappearance after $t=2$: $N_{tot} = 3$, the two obs. at $t=2$ have to originate from $t=1$ because none are allowed to dissappear. After that both obs. 4,5 now considered particles could dissappear and obs. 6 could appear

or

disappearance after $t=1$: $N_{tot} = 6$ All obs. represent particles appearing / dissappearing at given frame.

d) In general if $N_{tot} = 1$ holds, otherwise the second shortest path might reuse edges from the shortest path, which contradicts the capacity condition.

e) Yes, if flow over all edges is set to zero, otherwise conservation of mass will prevent $N_{tot} = 0$.

f) choose: Aeq ⟶ Node-arc incidence Matrix ~~w/~~ without start/target

beq ⟶ 0

Aeeq ⟶ 𝟙

beeq ⟶ 1

For more details see notebook.

g) +h) see notebook