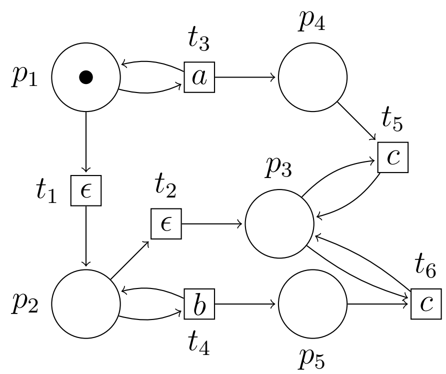
ComS 331 Spring 2024 Name: Aren Ashlock

1. We know that NPDA can sum: $L = \{a^i b^j c^{i+j} : i, j \in \mathbb{N}\}$ is a CFL. Petri nets can perform the same operation: show a T-type Petri net for the same language.



2. Consider the language $L = \{w \in \{a, b, c\}^* : |w|_a = |w|_b = |w|_c\}$.

   (a) Prove that L is not a context-free language.

   Let L be a CFL. Then, $\exists m, \forall |w| \geq m, \exists uvxyz = w, |vy| > 0, |vxy| \leq m, \exists k, uv^kxy^kz \in L$. Let's have w where $|w|_a = |w|_b = |w|_c = m$. We can break it down into 2 cases...

   Case 1: v and y only consist of 1 type of letter (a, b, c). Choosing to pump with $k = 0$, we get any of these 3 results: (1) $|w|_a = m-i-j$, (2) $|w|_b = m-i-j$, (3) $|w|_c = m-i-j$. In all 3 results, the number of a's, b'c, and c's are not equal. Thus, $w \notin L$.

   Case 2: v and y consist of 2 types of letters ((1) a and b, (2) b and c, or (3) a and c). Choosing to pump with $k = 0$, we get these 3 results: (1) $|w|_a = m-i$ AND $|w|_b = m-j$, (2) $|w|_b = m-i$ AND $|w|_c = m-j$, (3) $|w|_a = m-i$ AND $|w|_c = m-j$. In all 3 results, the number of a's, b'c, and c's are not equal since at least $i > 1$ or $j > 1$. Thus, $w \notin L$.

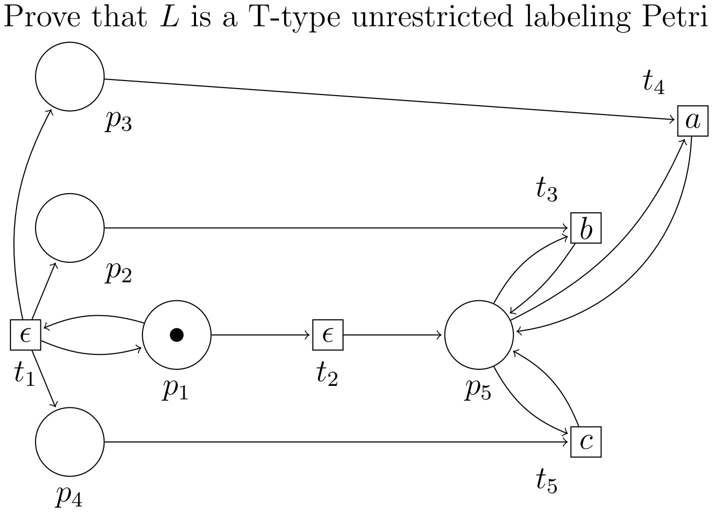
   Since $|vxy| \leq m$, it is **impossible** for v and y **to consist of all 3 types of letters**.

   It's evident that there are no cases where w can be pumped, therefore, L **is not context-free**.

   (b) Prove that L is an L-type non-ϵ labeling Petri net language.

   I have no clue and spent too much time trying to figure this out. At least I don't loose any points...

   (c) Prove that L is a T-type unrestricted labeling Petri net language.



   Here is a T-type unrestricted labeling Petri net that accepts L. This **proves** that L is a T-type unrestricted labeling Petri net language.