CSci 435: Formal Languages and Automata

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**Home Assignment 6: 90 points + 20 points (optional)**

In any (N/D)PDA, assume that a start stack symbol z is already in the stack; so, you don’t have to insert z into the stack at the beginning of transition.

Q1.[30] Prove if the following languages are CFL or not.

If L is a CFL, give its CFG. Otherwise, prove it by Pumping Lemma.

If any closure property of CFL is applicable, apply them to simplify it before its proof.

1. [10] L = {*wwRw* | *w* ∈ {*a, b*}\*}
2. [10] L = { *anwwRbn* | *n* ≥ 0, *w* ∈ {*a, b*}\*}
3. [10] L = {*anbjajbn* | *n* ≥ 0, *j* ≥ 0}
4. [10, optional] L = { *an*| *n* is a prime number }

Q2. [20] Prove that the following languages are linear or not.

If L is linear, give the linear-CFG for L. Otherwise, prove it by Pumping Lemma for a Linear-CFL.

1. [10] L = { *w* | *na*(*w*) + *nb*(*w*) = *nc*(*w*) } is not linear.
2. [10] L = { *anbmcn* | *n, m* ≥ 0 } ∪ { *anbncm* | *n, m* ≥ 0 } is linear or not.

Q3. [30] Prove the following properties clearly.

1. [10] The family of CFLs is closed under reversal.
2. [10] The family of DCFL is closed under regular difference:

i.e. for a DCFL L1 and a RL L2, L1 − L2 ∈ DCFL.

1. [10] The family of CFLs is not closed under complement. Give an example for it.
2. [10] If L1 is linear and L2 is regular, L1⋅L2 is a linear language.
3. [10, optional] The family of DCFLs is **not** closed under reversal. Give an example.