Homework #5
(CSE587 Students Only)
(Due: Dec 6)

Task 1. [30 Points] Construct PDAs

Construct PDAs for the following languages assuming $\Sigma = \{a, b, c\}$. Do not use nondeterminism.

(*a*) **[15 Points]** $L = \{w |\ w \in \Sigma^*$ **and** $n_a(w) = 2n_b(w)\}$

(*b*) **[15 Points]** $L = \{a^i b^j c^k |\ j = i + k\}$

Task 2. [40 Points] Unrestricted Grammar

Write down an unrestricted grammar for each of the following languages.

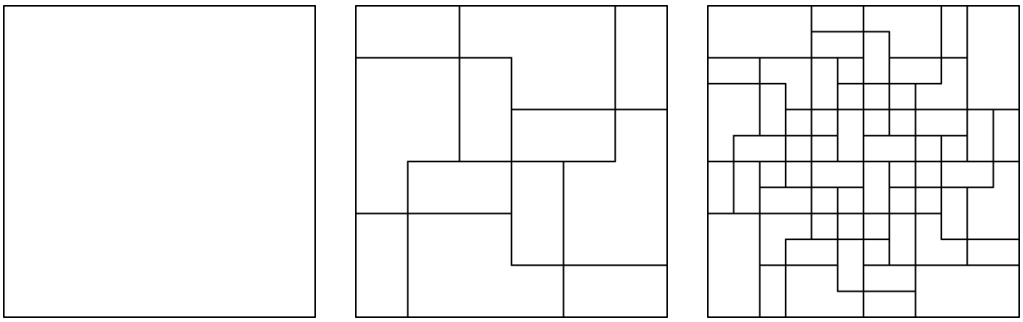
(*a*) **[20 Points]** $L = \{ww^R w |\ w \in \{a, b\}^*$ and w^R is the reverse of $w\}$

(*b*) **[20 Points]** $L = \{a^n b^{n^2} |\ n \geq 0\}$

Task 3. [30 Points] Fun with L-systems

Use the pumping lemma to show that the following languages are not regular.

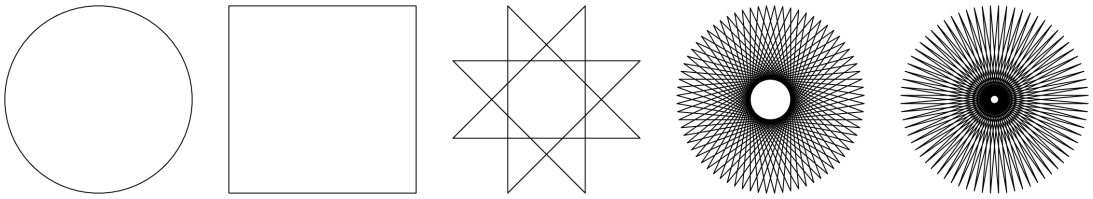
(*a*) **[15 Points]** Design an L-system that generates the following patterns in its first three iterations.



Iteration 1 Iteration 2 Iteration 3

What will the pattern look like after iteration 5?

(*b*) [**15 Points**] Design an L-system that can generate the following patterns as the angle of rotation is varied.



What pattern does it generate for each angle in $(0°, 180°)$ that is a multiple of $15°$?