Problem 0 - Assignment 4

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1 Part A

If L is an undecidable language, and S is any string, then $L \cup \{S\}$ is also undecidable. This is because any algorithm that computes $L \cup \{S\}$ includes the algorithm that computes the language L. As the algorithm for L does not exist (as the language is undecidable), this means the algorithm that computes $L \cup \{S\}$ also doesn't exist, and hence the language is undecidable.

2 Part B

For a base case, we will use $k = 0$.
$L^{(0)} = L \cup \{\}$
$L^{(0)} = L$

As L is undecidable, this means that $L^{(0)}$ is also undecidable.

For the induction step, we use $k = k + 1$
$L^{(k+1)} = L \cup s_1, s_2, s_3, ..., s_k \cup s_k + 1$
As we have shown in Part A, any language that includes a undecidable language in it's definition will also be undecidable. As $L^{(k+1)}$ includes L, $L^{(k+1)}$ is also undecidable for all K.

3 Part C

The language L is undecidable because there is no algorithm for generating it. There is however an algorithm for generating the set of all strings. The fact that L is a subset of the set of all strings has nothing to do with the algorithm used for generating it.