Using the Pumping Lemma for Regular Languages

**Theory of Computation**

**CSCI 3434, Spring 2010**

**Statement of the Pumping Lemma (P.L.) for regular languages:**

For every regular language $L$, $\exists k \in \mathbb{N}$ such that

$\forall x \in L$, $\forall x_1, x_2, x_3$ with $x_1 x_2 x_3 = x$, $|x_2| = k$, $\exists u, v, w$ with $x_2 = u v w$, $|v| \geq 1$ such that $x_1 u v^* w x_3 \subseteq L$.

(Note that $x_1 u v w x_3 = x$.)

**Using the Pumping Lemma**

To prove a language $L$ is not regular

1. Assume $L$ is regular
2. Let $k$ be the constant from PL
3. Choose a string $x \in L$
   - Definition based on $k$
4. Choose a substring of $x$ of length $k$ to be $x_2$
5. Consider all possible substrings $v$ of $x_2$ with $|v| \geq 1$. Show that some string of the form $x_1 u v^* w x_3 \notin L$ for all possibilities for $v$.
   - Usually $x_1 u w x_3$ or $x_1 u v v w x_3$
6. State that this is a contradiction to the PL, so conclude that assumption was false, so $L$ is not regular.