1. **[10 Points] Proof of KMP’s Linear Running Time!** Recall from class that the KMP algorithm has the following pseudocode:

\[
\text{KMP}(P,T): \\
\text{pi=Compute-Prefix(P)} \\
q=0 \quad // \text{Number of characters we've matched so far} \\
\text{for } i=1 \text{ to } n \\
\quad \text{while } q>0 \quad \&\& \quad P[q+1]!=T[i] \\
\quad \quad q=\text{pi}[q] \\
\quad \quad \text{if } P[q+1]==T[i] \\
\quad \quad \quad ++q \\
\quad \quad \text{if } q==m \\
\quad \quad \quad \text{print "Pattern matched, starting at char " (i-m)}
\]

Given that \text{Compute-Prefix(P)} runs in \(O(m)\) time, show that the rest of \text{KMP(P,T)} runs in \(O(n)\) time and that the whole algorithm is therefore \(O(m+n)\).