Proof that $\sum_{i=0}^{n} k^i = \frac{k^{n+1}-1}{k-1} \quad 0 \leq n < \infty$

$$\sum_{i=0}^{n} k^i = \frac{k^{n+1}-1}{k-1}$$

$$(k-1)\sum_{i=0}^{n} k^i = k^{n+1}-1$$

$$\sum_{i=0}^{n}(k-1)k^i = k^{n+1}-1$$

$$\sum_{i=0}^{n}(k^{i+1}-k^i) = k^{n+1}-1$$

$$\sum_{i=0}^{n} k^{i+1} - \sum_{i=0}^{n} k^i = k^{n+1}-1$$

$$\sum_{i=1}^{n+1} k^i - \sum_{i=0}^{n} k^i = k^{n+1}-1$$

$$\sum_{i=n+1}^{n+1} k^i + \sum_{i=1}^{n} k^i - \sum_{i=0}^{0} k^i - \sum_{i=1}^{n} k^i = k^{n+1}-1$$

$$\sum_{i=n+1}^{n+1} k^i - \sum_{i=0}^{0} k^i = k^{n+1}-1$$

$$k^{n+1}-1 = k^{n+1}-1$$