

$$f(n, k) = 1 + \sum_{j=1}^k \frac{1}{1 + \sum_{i=1}^j 2^{i-1} \frac{(j+i)!}{(j-i)! (2i)!} n^i}$$

$$\sqrt{3} = \lim_{k \rightarrow \infty} f(1, k)$$

$$\sqrt{2} = \lim_{k \rightarrow \infty} f(2, k)$$

$$\sqrt{n(n+2)} = n \lim_{k \rightarrow \infty} f(n, k)$$