

$$\begin{aligned}
 (1+x)^n &= (1+x)^{n-1} (1+x) \\
 \binom{n}{k} & \quad \downarrow \qquad \qquad \downarrow \\
 & \left(\sum_{j=0}^{n-1} \binom{n-1}{j} x^j \right) (1+x) \\
 & \quad \quad \quad \downarrow \\
 & \sum_{k=0}^n \left(\binom{n-1}{k} + \binom{n-1}{k-1} \right) x^k
 \end{aligned}$$

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$$\binom{n}{k} = \binom{n-1}{k} + \binom{n-1}{k-1}$$