Prove that the expression (18.112) yields the nth Laguerre polynomia.

Evaluating the nth derivative in (18.112) using Leibnitz' theorem we find

$$L_n(x) = \frac{e^x}{n!} \sum_{r=0}^{n} {}^nC_r \frac{d^r x^n}{dx^r} \frac{d^{n-r} e^- x}{dx^n - r}$$

$$= \frac{e^x}{n!} \sum_{r=0}^{n} \frac{n!}{r!(n-r)!} \frac{n!}{(n-r)!} x^{n-r} (-1)^{n-r} e^{-x}$$

$$= \sum_{r=0}^{n} (-1)^{n-r} \frac{n!}{r!(n-r)!(n-r)!} x^{n-r}.4$$

Relabeling the summation using the index m = n - r, we obtain

$$L_n(x)$$