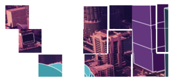

Exercise 5.6: The proof is by induction. We start with $m = 0$. We have

$$\begin{aligned}
-\sum_{i=m+1}^{n} (-1)^i \binom{n}{i} &= -\sum_{i=1}^{n} (-1)^i \binom{n}{i} \\
&= -\sum_{i=0}^{n} \binom{n}{i} (-1)^i \cdot 1^{n-i} + \binom{n}{0} (-1)^0 \\
&= -[(-1)+1]^n + 1 \\
&= 1 \\
&= (-1)^m \binom{n-1}{m}
\end{aligned}$$

Now assume that the stated equality is true when $m = k$, i.e.

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

From this equality we obtain

$$\begin{aligned}
-\sum_{i=k+1}^{n} (-1)^i \binom{n}{i} &= (-1)^{k+1} \binom{n}{k+1} - \sum_{i=k+2}^{n} (-1)^i \binom{n}{i} \\
&= (-1)^k \binom{n-1}{k}
\end{aligned}$$

Let $m = k + 1$. We have

$$\begin{aligned}
-\sum_{i=k+2}^{n} (-1)^i \binom{n}{i} &= (-1)^k \binom{n-1}{k} + (-1)^{k+1} \binom{n}{k+1} \\
&= (-1)^k \left(\binom{n-1}{k} - \binom{n}{k+1} \right) \\
&= (-1)^k \left(\frac{(n-1)!}{(n-1-k)!k!} - \frac{n!}{(n-k-1)!\,(k+1)!} \right) \\
&= (-1)^k \frac{(n-1)!}{(n-1-k)!k!} \left(1 - \frac{n}{k+1} \right) \\
&= (-1)^{k+1} \frac{(n-1)!}{(n-1-k)!k!} \cdot \frac{n-1-k}{k+1} \\
&= (-1)^{k+1} \frac{(n-1)!}{(n-1-k-1)!\,(k+1)!} \\
&= (-1)^{k+1} \binom{n-1}{k+1}
\end{aligned}$$

This concludes our induction.