1. It has been previously established that the egf for the class of derangements is 
\( \hat{d}(z) = e^{-z} /(1 - z) \). Derive from this a simple recurrence equation for the number 
of derangements of \( n \) elements. Can you think of a combinatorial interpretation 
for this formula?

2. Let \( h(z) = \sum_{n \geq m} h_n z^n \), where \( h_m \neq 0 \), be a formal Laurent series. Prove the 
following results:
   (a) \( \text{Res}(h'(z)) = 0 \);
   (b) \( \text{Res}(h'(z)/h(z)) = m \).

3. Derive from Lagrange’s inversion formula for formal power series (Theorem 5.2 
in the lecture notes) its following reformulation (useful e.g. in the analysis of tree 
structures): Let \( f(z) \) and \( \phi(u) \) be formal power series satisfying \( \phi(0) = \phi_0 \neq 0 \) 
and \( f(z) = z\phi(f(z)) \). Then for all \( n \geq 1 \):

\[
[z^n] f(z) = \frac{1}{n} [u^{n-1}] \phi(u)^n.
\]

(\text{Hint: Consider the power series } \psi(u) = \frac{u}{\phi(u)}.)

4. Derive formulas for the number of \( n \)-node rooted ordered trees and \( n \)-node binary 
trees (rooted ordered trees where each node has 0, 1 or 2 descendants) directly 
by applying the respective ogf-constructions and Lagrange’s inversion formula.