1. It has been previously established that the egf for the class of derangements is 
\[ \hat{d}(z) = \frac{e^{-z}}{1-z} \]. 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 \( n \geq 1 \):

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

(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 descendents) directly by applying the respective ogf-constructions and Lagrange’s inversion formula.