Problem 1.1. (2 points) Consider the following Black-Derman-Toy tree.

Then, \( r_{ud} \) is the geometric average of \( r_{uu} \) and \( r_{dd} \). True or false?

Problem 1.2. (5 points) It is observed that the bond prices for zero coupon bonds redeemable for $1 are, in our usual notation,

\[
P(0, 1) = 0.9615 \quad \text{and} \quad P(0, 2) = 0.9157.
\]

In the Black-Derman-Toy tree, the base rate parameter is set to equal \( r_d = 0.035 \). What is the interval into which the value of the volatility of effective interest rates in year-2 falls?

(a) [0, 0.1]  
(b) [0.1, 0.15]  
(c) [0.15, 0.25]  
(d) [0.25, 0.35]  
(e) None of the above.
Problem 1.3. (8 points) The following is a Black-Derman-Toy tree containing the prices of one-year, zero-coupon bonds (redeemable for $1) at intervals of length of one year:

Using the fact that this is a Black-Derman-Toy tree, calculate $P_{dd}$. 