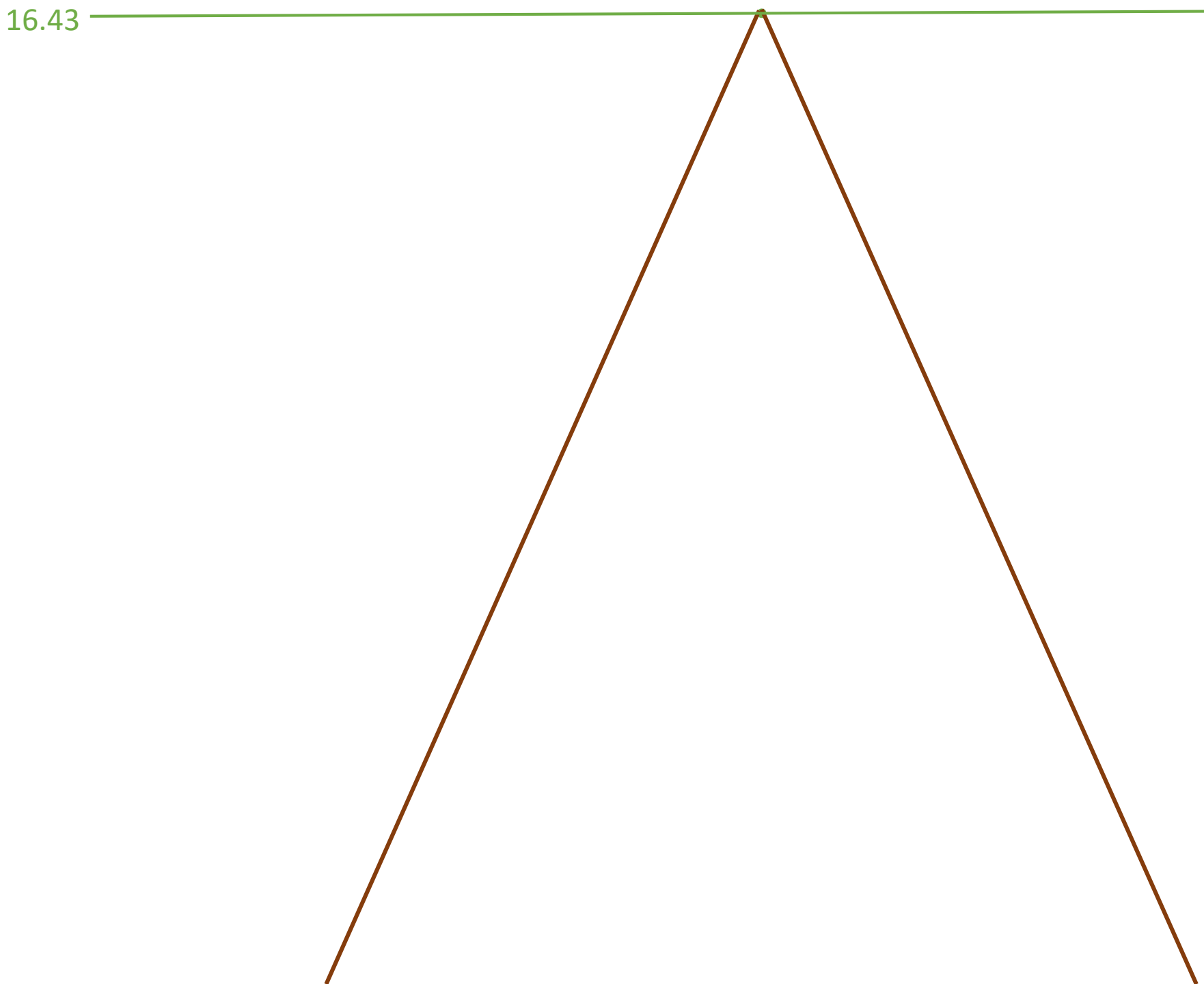
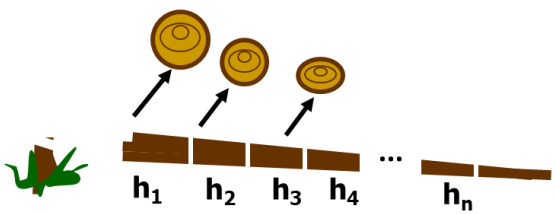
Suppose we have a tree with a total height of 16.43 m



We cut this tree and sample discs at different height from the soil (m) and count the number of rings in each disc

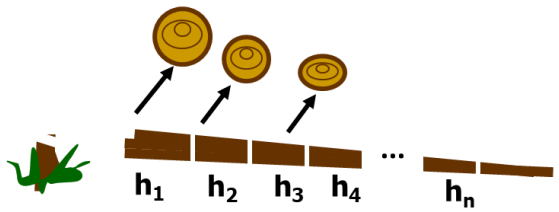


29 Rings

=

29 years

We cut this tree and sample discs at different height from the soil (m) and count the number of rings in each disc



29 Rings
=
29 years

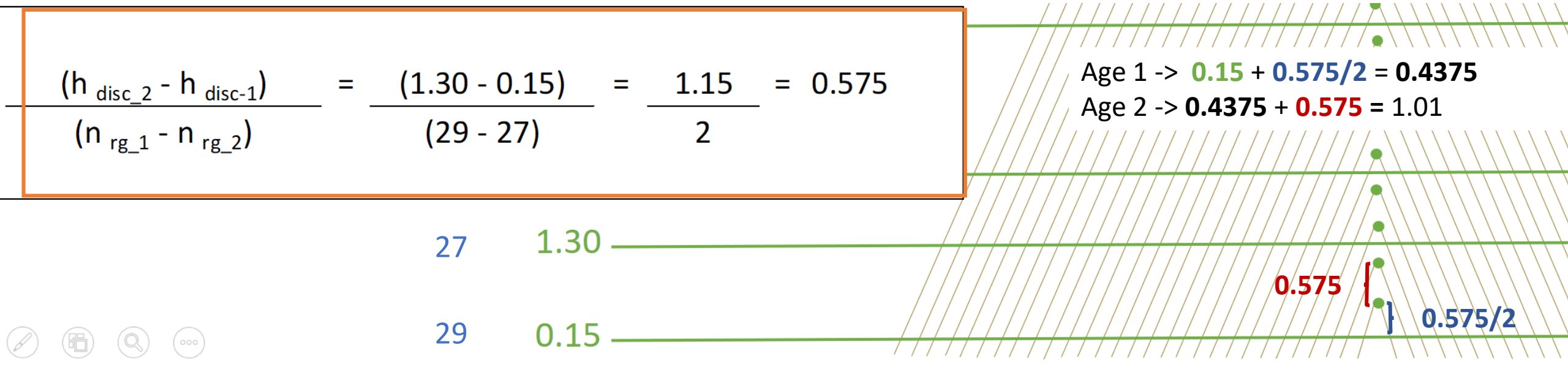
Number of rings	height from the soil (m)
	16.43
5	14.50
6	14.00
8	13.30
11	11.30
15	9.30
18	7.30
21	5.30
25	3.30
27	1.30
29	0.15

With this information we want to determine the evolution of tree height over time, however a bias in height determination for given ages results because the cut will seldom occur at the tip of a terminal leader (whorl) requiring a correction method to be applied.

Carmen's method is based on two assumptions:

1. Constant annual increment in height between two discs
2. Each disc occurs at the mid-point between two whorls

$$\frac{(h_{disc\_2} - h_{disc\text{-}1})}{(n_{rg\_1} - n_{rg\_2})} = \frac{(1.30 - 0.15)}{(29 - 27)} = \frac{1.15}{2} = 0.575$$



Carmen's method is based on two assumptions:

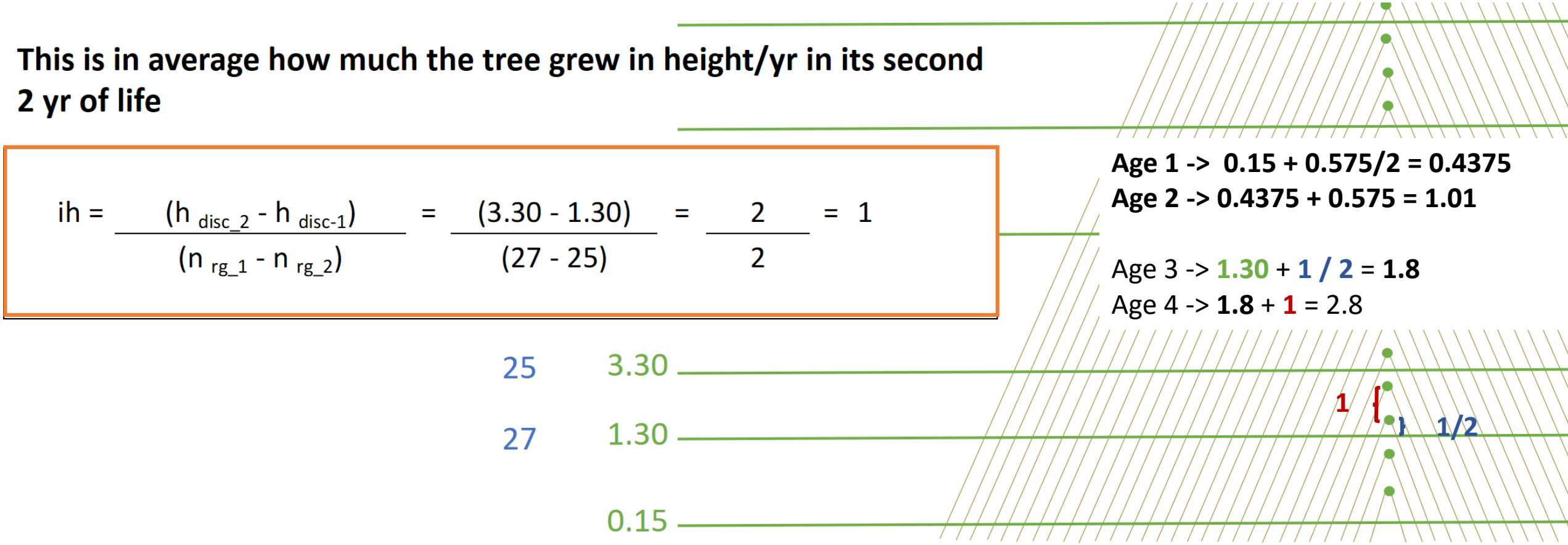
1. Constant annual increment in height between two discs
2. Each disc occurs at the mid-point between two whorls

This is in average how much the tree grew in height/yr in its second 2 yr of life

$$ih = \frac{(h_{disc\_2} - h_{disc\text{-}1})}{(n_{rg\_1} - n_{rg\_2})} = \frac{(3.30 - 1.30)}{(27 - 25)} = \frac{2}{2} = 1$$

Age 1 -> 0.15 + 0.575/2 = 0.4375
Age 2 -> 0.4375 + 0.575 = 1.01

Age 3 -> **1.30** + **1 / 2** = **1.8**
Age 4 -> **1.8** + **1** = 2.8



Carmen's method is based on two assumptions:

1. Constant annual increment in height between two discs
2. Each disc occurs at the mid-point between two whorls

$$\frac{(h_{disc\_2} - h_{disc\text{-}1})}{(n_{rg\_1} - n_{rg\_2})} = \frac{(5.30 - 3.30)}{(25 - 21)} = \frac{2}{4} = 0.5$$

21 — 5.30

25 — 3.30

Age 1 -> 0.15 + 0.575/2 = 0.4375

Age 2 -> 0.4375 + 0.575 = 1.01

Age 3 -> 1.30 + 1 / 2 = 1.8

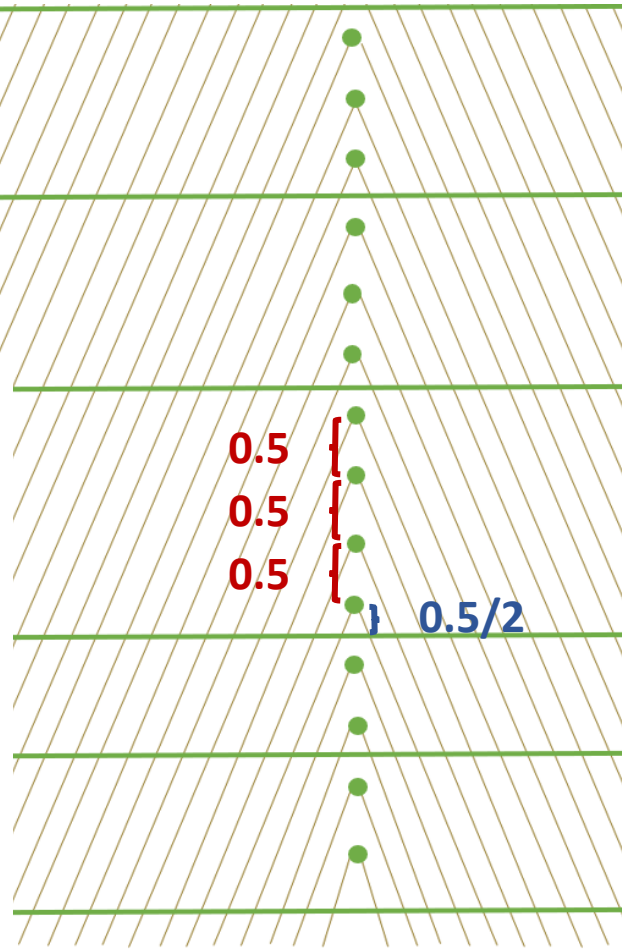
Age 4 -> 1.8 + 1 = 2.8

Age 5 -> **3.30** + **0.5 / 2** = **3.55**

Age 6 -> **3.55** + **0.5** = **4.05**

Age 7 -> **4.05** + **0.5** = **4.55**

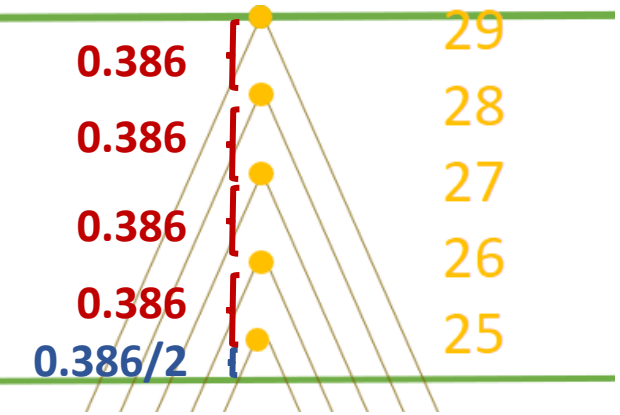
Age 8 -> **4.55** + **0.5** = **5.05**



Nr of rings | height from the soil (m) | Tree age

0 — 16.43

5 — 14.50



$$= \frac{(h_{disc\_2} - h_{disc\text{-}1})}{(n_{rg\_1} - n_{rg\_2})} = \frac{(16\text{-}43 - 14.50)}{(5 - 0)} = \frac{1.93}{5} = 0.386$$

Age 1 -> 0.15 + 0.575/2 = 0.4375
Age 2 -> 0.4375 + 0.575 = 1.01

Age 3 -> 1.30 + 1 / 2 = 1.8
Age 4 -> 1.8 + 1 = 2.8

Age 5 -> **3.30** + **0.5 / 2** = **3.55**
Age 6 -> **3.55** + **0.5** = **4.05**
Age 7 -> **4.05** + **0.5** = **4.55**
Age 8 -> **4.55** + **0.5** = **5.05**
…
Age 25 -> **14.50** + **0.386 /2** = **14.69**
Age 26 -> **14.69** + **0.386** = **15.08**
Age 27 -> **15.08** + **0.386** = **15.47**
Age 28 -> **15.47** + **0.386** = **15.85**
Age 29 -> **15.85** + **0.386** = **16.43**