

## Problem 3

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March 29, 2017

At each stage every node duplicates in a perfect binary tree. Therefore the number of nodes grows by a factor of two.  $1*2*2*2*2...$  where the number of twos is the depth. Therefore it will be  $2^n$ , where  $n$ =depth.

$S(h)$  = Total number of nodes at each stage

$$S(h) = \sum_{i=0}^h 2^i$$

$$S(h) = 1 + 2 + 2^2 + 2^3 \dots + 2^h$$

$$2S(h) = 2 + 2^2 + 2^3 \dots + 2^{h+1}$$

$$S(h) - 2S(h) = 1 - 2^{h+1}$$

$$S(h) = \frac{1 - 2^{h+1}}{1 - 2}$$

$$\therefore S(h) = 2^{h+1} - 1$$