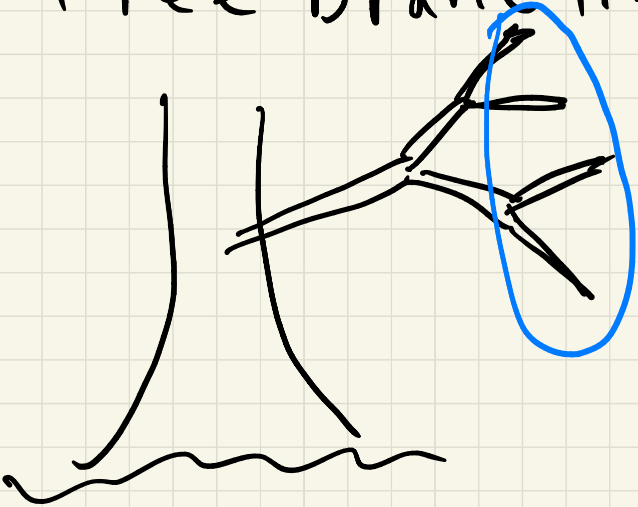
Tree branching

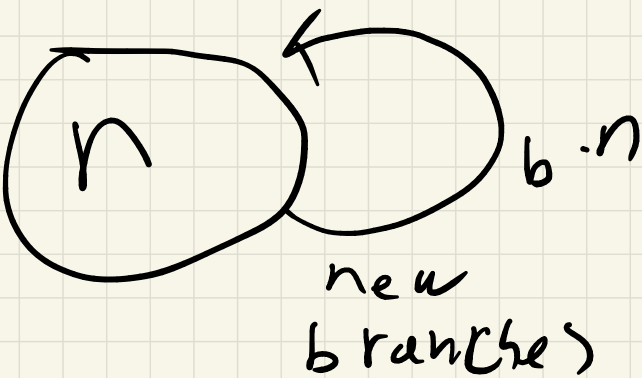


$n_t \equiv$ # of branches

$t \equiv$ time

$b \equiv$ chance that branch splits

Flow Diagram

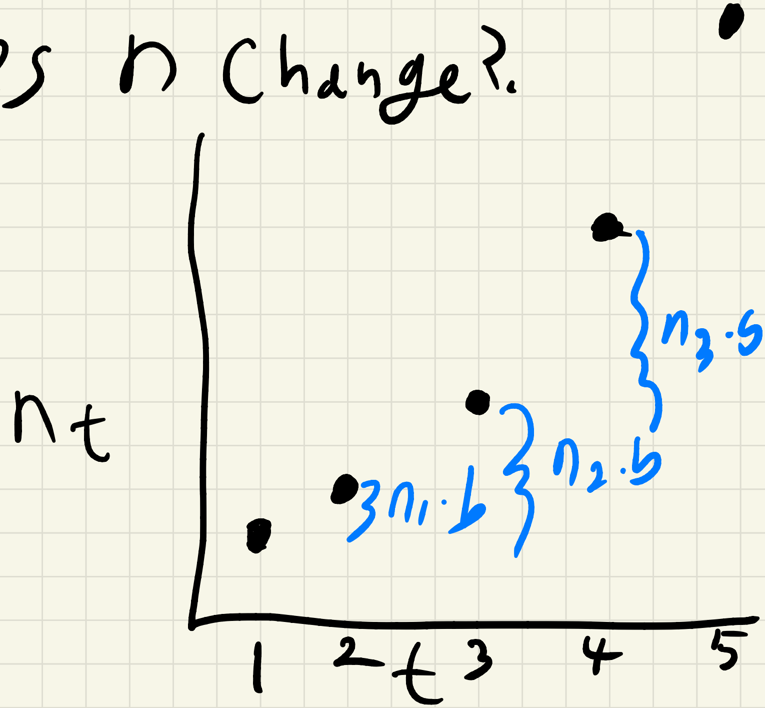


Assumptions:
All branches act the same

so

$$n_{t+1} = n_t + n_t \cdot b$$

How does n change?



$$n_{t+1} = n_t + b \cdot n_t = (1+b)\, n_t$$

if at $t=0$ $n = n_0$

$$n_1 = n_0(1+b)$$

n_2? $\Rightarrow$ $n_2 = n_1 \cdot (1+b)$

$$n_2 = n_0(1+b)(1+b)$$

$$n_2 = n_0(1+b)^2$$

if at $t=0$ $n=n_0$

$$n_1 = n_0(1+b)$$

$$n_2 ? \Rightarrow n_2 = n_1 \cdot (1+b)$$

$$n_2 = n_0(1+b)(1+b)$$

$$n_2 = n_0(1+b)^2$$

$$n_3 = n_2(1+b) \Rightarrow n_3 = n_0(1+b)^3$$

so

$$\boxed{n_t = n_0(1+b)^t}$$

$$\parallel$$

Geometric Growth

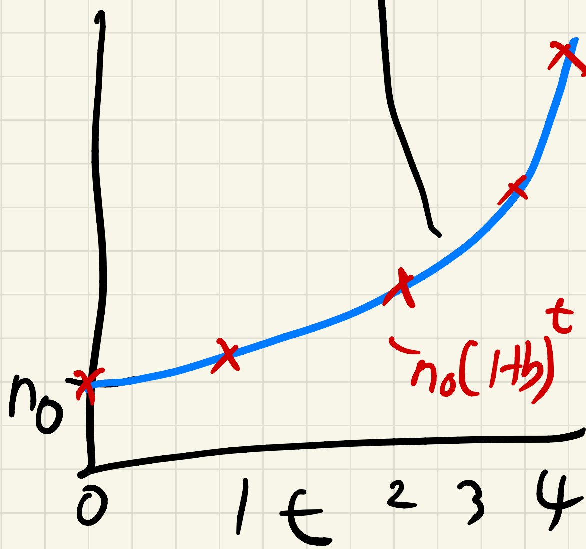
Also

$$\Delta n = b \cdot n_t$$

Continuous time and n
(for comparison)

$$\frac{dn}{dt} = n \cdot B \Rightarrow n(t) = n_0 e^{Bt}$$

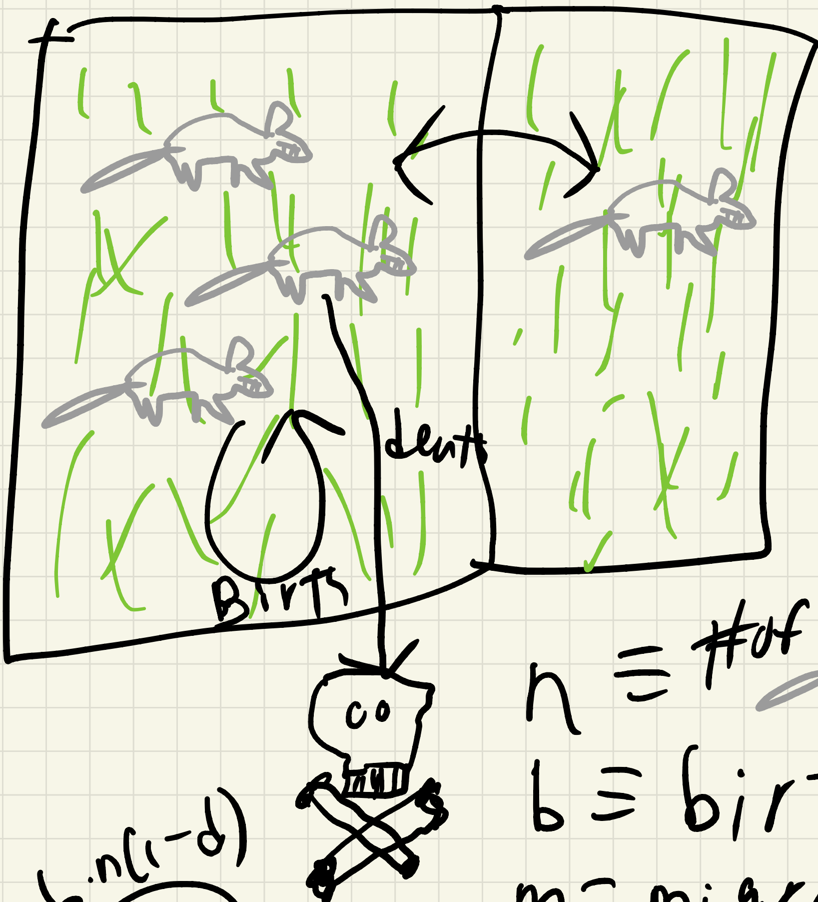
$$B = \log(1+b)_n$$



So $B > 0$ or

$b > 0 \Rightarrow$ n grows over time!

Backyard Mice

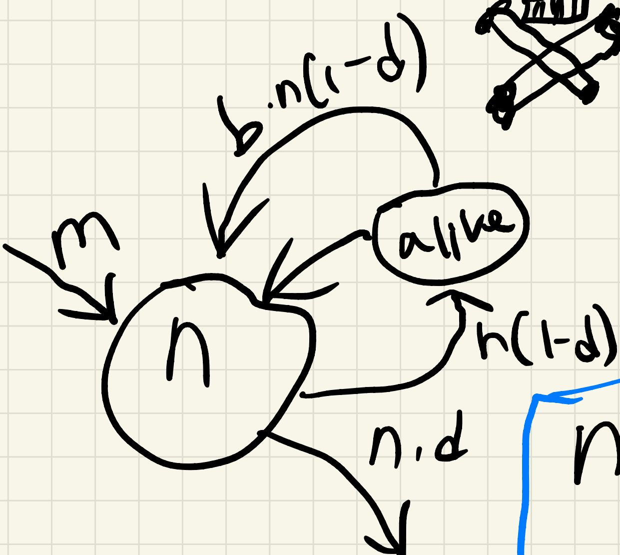


$n \equiv$ # of 

$b \equiv$ birth

$m \equiv$ migration

$d \equiv$ deaths



$$\boxed{n_{t+1} = n_t(1-d)(1+b) + m}$$

$$n_{t+1} = n_t(1-d)(1+b) + m$$

if $m = 0$

$$n_t = n_0\left[(1-d)(1+b)\right]^t$$