

Let  $x$  be the steps in right directions and  $y$  be the steps in left direction and  $x_1$  is the position after  $N$  steps. So  $x+y=N$ . So for  $x_1$ ,  $x$  is

$$x-y=x_1$$

unique and if two drunkmen has same  $x_1$ , so they will have same  $x$ .  $x$  value changes from 0 to  $N$

Probability of drunk men to reach  $x_1$  in  $N$  steps  $= \frac{{}^N C_x}{2^N}$

Probability of two drunk men to reach  $x_1$  in  $N$  steps  $= \left( \frac{{}^N C_x}{2^N} \right)^2$

$$\text{Total probability} = \sum_{x=0}^N \left( \frac{{}^N C_x}{2^N} \right)^2$$

$$= \frac{1}{2^{2N}} ({}^N C_0 + {}^N C_1 + \dots + {}^N C_N)$$

$$= \frac{2^N C_N}{2^{2N}}$$

$$= \frac{2^N C_N}{4^N}$$