

$$x(n,m) = \begin{cases} 1 & \text{if } n=256 \\ 0 & \text{otherwise} \end{cases}$$

$$X(k,l) = \sum_{n=0}^{N-1} \sum_{m=0}^{M-1} x(n,m) e^{-j2\pi \left( \frac{kn}{N} + \frac{lm}{M} \right)}$$

$$= \sum_{n=0}^{511} \sum_{m=0}^{511} x(n,m) e^{-j2\pi \left( \frac{kn}{512} + \frac{lm}{512} \right)}$$

$$= \sum_{m=0}^{511} 1 \cdot e^{-j2\pi \left( \frac{k}{2} + \frac{lm}{512} \right)}$$

$$= (-1)^k \sum_{m=0}^{511} e^{-2\pi j \left( \frac{lm}{512} \right)}$$

$$X(k,l) = (-1)^k \left[ \frac{1(e^{-2\pi j l} - 1)}{e^{-\frac{2\pi j l}{512}} - 1} \right] \Rightarrow \text{Sum of GP with } a=1, \\ r = e^{-\frac{2\pi j l}{512}} = \frac{a(r^n - 1)}{r - 1} \\ \text{and } n=512$$

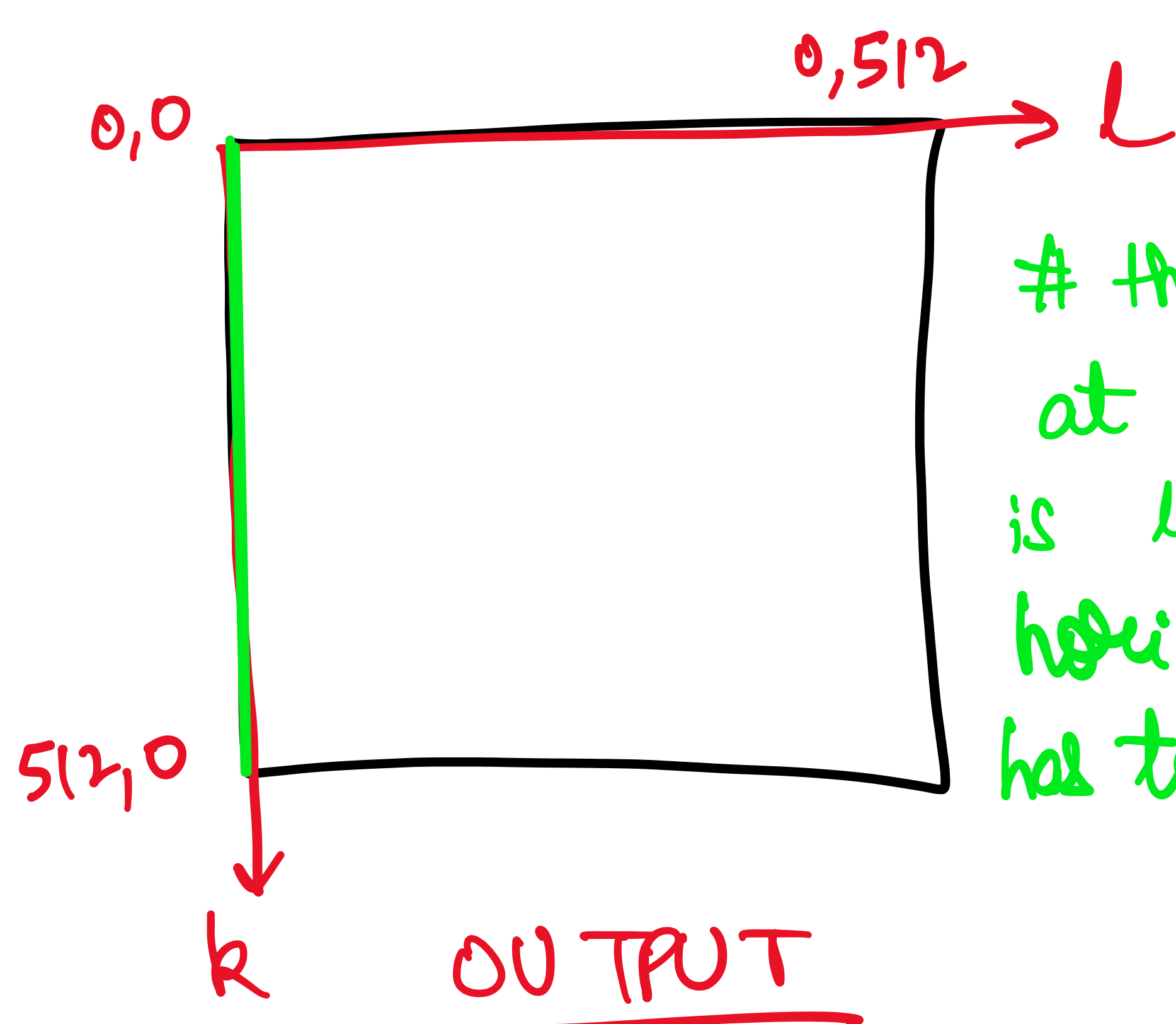
at  $l=0$ ,  $X(k,l) = X(k,0) = (-1)^k$ . (limit)

note that  $\forall l \neq 0, X(k,l) = 0$

$\therefore$ , only place where DFT  $\neq 0$  is  $l=0$  and  $0 \leq k \leq 511$ ,

$X(k,l)$  at  $l=0$  and  $0 \leq k \leq 511 = \boxed{1 \text{ intensity}}$

output (2D DFT of given image)



# the green vertical line at  $l=0$  is the DFT. This is because input is a horizontal line,  $\therefore$ , output has to be a vertical line

Final ans :  $X(k,l) = \begin{cases} 1 & l=0 \\ 0 & \text{otherwise} \end{cases}$