

### Worksheet Jan 13

(1) Determine which of the following functions are linear. If the function is linear, write down its representing matrix.

(a)  $F(x, y) = (5, 2x + 3y)$

(b)  $F(x, y) = (4x, 2x + 3y)$

(c)  $F(x, y) = (xy, 2x + 3y)$

(2) Let

$$T(x, y) = \begin{bmatrix} 2 & 4 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

(a) Find  $T(1, 0)$  and  $T(0, 1)$ . Compare your answer with the matrix entries. What do you notice?

(b) Find and sketch the image of the square  $0 \leq x \leq 1, 0 \leq y \leq 1$ . What is its area?

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(3) Let  $L : \mathbf{R}^2 \rightarrow \mathbf{R}^2$  be the linear transformation satisfying  $L(1, 0) = (4, 1)$  and  $L(0, 1) = (2, 5)$ .

(a) Write down the representing matrix for  $L$ .

(b) Let  $P$  be a parallelogram of area 2. Then  $T$  maps  $P$  to some parallelogram  $Q$ . Find the area of the parallelogram  $Q$ .

(4) Let  $F(x, y) = (2x + 3y, x + 2y)$ . Find the derivative matrix of  $F$ .  
What do you notice?