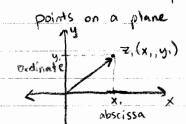
## Number Systems

- . natural numbers: m=0,1,2,... (positive integers)
  - Cannot be used to solve x+m=n where x:unknown;m,n:natural
- 2. integers: m = 0,1,2, -- -1,-2, -regotive integers
  - -cannot solve mx=n. x may not be an integer.
- 3. rational numbers: m; m, n: integers
  - -cannot solve x2=m (mipositive integer)
- 4 real numbers; as points of a line
  - cannot solve x2+1=0
- 5. complex numbers: 2=x+iy x, y real i: i2=-1 inaginary unit



Complex numbers can be thought of as vectors.

"length" of vector: | = 1 x + y 2 > 0 non-negative

Z, = X, + 14.

## Algebra of Complex Numbers

· addition: == x + iy, == x = x + iy2

Z=Z,+Z2 = (x, +iy, ) + (x2+ iy2) = X + iY = (x,+x2) + i(y,+y2)

· multiplication:

$$Z,Z_2 = (x, \pm iy,)(x_2 \pm iy_2) = x_1x_2 + i(x_1x_2) \pm i(y_1x_2) - y_1y_2$$
  
=  $(x_1x_2 - y_1y_2) + i(x_1y_2 + x_2y_1)$ 

· division:

$$\frac{z_1}{z_2} = \frac{z_1 \overline{z}_2}{z_1 \overline{z}_2} = \frac{z_1 \overline{z}_2}{z_2} = \frac{x_2 x_1 + y_1 y_2 + y_1 x_2 + y_2 x_1}{x_2^2 + y_2^2}$$

$$\frac{z_1}{z_2} = \frac{z_1 \overline{z}_2}{|z_2|^2} = \frac{x_2 x_1 + y_1 y_2 + y_2 x_1}{x_2^2 + y_2^2}$$

Triangle inequality: |12,1-1221 6 12,+221 6 12,1+1221

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	^	$z = r(\omega_0 \theta + i \sin \theta)$ , $r = 0$ , $r =  z $	
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