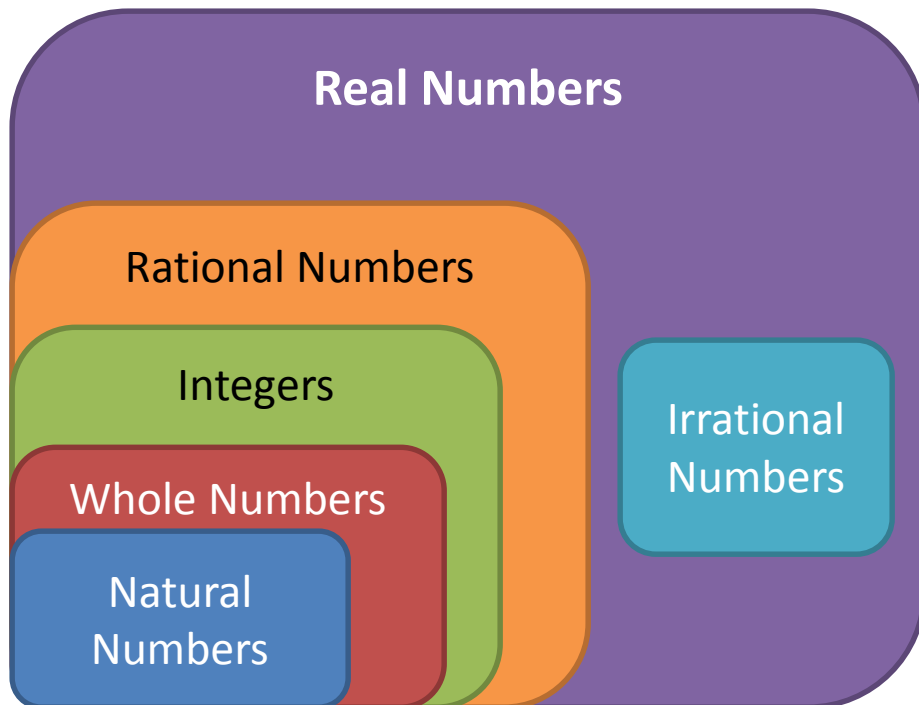


# Complex Numbers

## Section 2.4



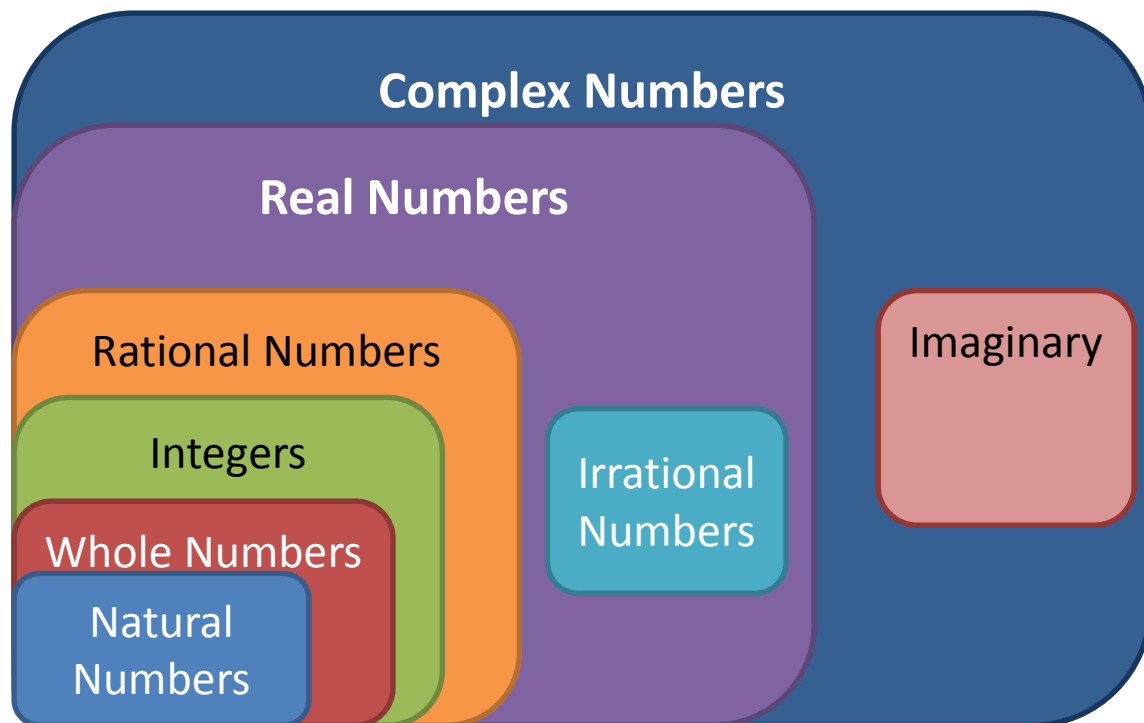
$$x^2 + 4 = 0$$

$$\sqrt{x^2} = \sqrt{-4}$$

$$x = \pm \sqrt{4} \sqrt{-1}$$
$$= \pm 2i$$

$$0 + 2i \quad 0 - 2i$$

- $i = \sqrt{-1}$
- Standard form of a complex number is  $a + bi$  where  $a$  is real, and  $bi$  is the imaginary part.



- $i$  allows us to solve equations like  $x^2 + 4 = 0$ .

- $i = \sqrt{-1}$

- $i^2 = (\sqrt{-1})^2 = -1$

- $i^3 = -i$

- $i^4 = 1$

$$\begin{array}{l} \cdot 5 \\ | = | \\ \cdot 6 \\ | = | \\ \cdot 7 \\ | = | \\ \cdot 8 \\ | = | \end{array}$$

$$\begin{array}{l} \cdot 16 \\ | = | \\ \cdot 25 \\ | = | \\ \cdot 53 \\ | = | \\ 13 R 1 \end{array}$$

# Operations with Complex Numbers

Add and Subtract

a.  $(6 - 3i) + (1 + 2i)$       b.  $(5 - i) - (2 - 4i)$

$$7 - i$$

$$5 - 1 - 2 + 4i = 3 + 3i$$

$-3i^2$

Multiply the following

a.  $2(14 - 3i)$

$$28 - 6i$$

b.  $(2 - i)(4 + 3i)$

$$8 + 6i - 4i + 3$$

$$11 + 2i$$

c.  $(2 + 5i)^2$

$(x+2)^2$   
 $x^2 + 4$

$$(2 + 5i)(2 + 5i)$$

$$4 + 25i^2$$

$$4 - 25 = -21$$

$$-21 + 20i$$

d.  $(3 - 2i)(3 + 2i)$

$$9 + 6i - 6i - 4i^2$$

$$13$$

# Complex Conjugates

Two numbers of the form  $a + bi$  and  $a - bi$  are complex conjugates. Their product is a real number.

Write the following quotients in standard form.

a.  $\frac{(6+i)(2+3i)}{(2-3i)(2+3i)}$

$$\frac{12 + 18i + 2i - 3}{4 - 9i^2}$$

$$\boxed{\frac{9 + 20i}{13}}$$

b.  $\frac{2 - i}{4 + 5i}$

$$\frac{2}{\sqrt{3}} \frac{\sqrt{3}}{\sqrt{3}}$$

# Complex Solutions of Quadratic Equations

Solve  $x^2 + 16 = 0$

$$\sqrt{x^2} = \sqrt{-16}$$

$$x = \pm 4i$$

Solve  $x^2 + 6x + 24 = 0$  (by completing the square)

$$\left(x^2 + 6x + \underbrace{9}_{\left(\frac{1}{2} \text{ middle term} \right)^2}\right) + 24 - \underline{9} = 0$$

$$(x+3)^2 + 15 = 0 \quad x = -3 \pm \sqrt{15}$$

$$\sqrt{(x+3)^2} = \sqrt{-15} = -15$$

$$x+3 = \pm i\sqrt{15}$$

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#s 11-56 by 3's, 65-75 odd, 81-84

Quiz 2.1-2.3 Tomorrow

Review (optional)