Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = \dfrac{-4 \pm \sqrt{12}}{2}$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = \dfrac{-4 \pm \sqrt{12}}{2}$

We can make this nicer if we notice: $\sqrt{12} = \sqrt{4 \cdot 3}$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = \dfrac{-4 \pm \sqrt{12}}{2}$

We can make this nicer if we notice: $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3}$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = \frac{-4 \pm \sqrt{12}}{2}$

We can make this nicer if we notice: $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = \dfrac{-4 \pm \sqrt{12}}{2}$

We can make this nicer if we notice: $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$

$$r_{1,2} = \frac{-4 \pm 2\sqrt{3}}{2}$$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = \dfrac{-4 \pm \sqrt{12}}{2}$

We can make this nicer if we notice: $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$

$$r_{1,2} = \frac{-4 \pm 2\sqrt{3}}{2}$$

$$= -2 \pm \sqrt{3}$$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = \frac{-4 \pm \sqrt{12}}{2}$

We can make this nicer if we notice: $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$

$$r_{1,2} = \frac{-4 \pm 2\sqrt{3}}{2}$$

$$= -2 \pm \sqrt{3}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = -2 \pm \sqrt{3}$

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ▸ Quadratic Formula says r_1 and r_2 are ▸ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = \frac{-4 \pm \sqrt{12}}{2}$

We can make this nicer if we notice: $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$

$$r_{1,2} = \frac{-4 \pm 2\sqrt{3}}{2}$$

$$= -2 \pm \sqrt{3}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = -2 \pm \sqrt{3}$

▸ Recall: We were unable to solve this factoring

Solving the quadratic equation: $x^2 + 4x + 1 = 0$:

Recall: The ‣ Quadratic Formula says r_1 and r_2 are ‣ the roots of:

$$ax^2 + bx + c = 0$$

$$r_{1,2} = \frac{-(b) \pm \sqrt{(b)^2 - 4ac}}{2a}$$

$$r_{1,2} = \frac{-(4) \pm \sqrt{(4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{-4 \pm \sqrt{12}}{2}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = \frac{-4 \pm \sqrt{12}}{2}$

We can make this nicer if we notice: $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$

$$r_{1,2} = \frac{-4 \pm 2\sqrt{3}}{2}$$

$$= -2 \pm \sqrt{3}$$

The solutions to $x^2 + 4x + 1 = 0$ are: $x = r_{1,2} = -2 \pm \sqrt{3}$

‣ Recall: We were unable to solve this factoring

‣ Also It took us much longer to solve without the quadratic formula