

So we are given an expression:

$$(x + 1) \cdot (x + 2) \cdot (x + 2) \cdot (x + 1)$$

Let's differentiate it!

$$((1 + 0) \cdot (x + 2) + (1 + 0) \cdot (x + 1)) \cdot (x + 2) \cdot (x + 1) + ((1 + 0) \cdot (x + 1) + (1 + 0) \cdot (x + 2)) \cdot (x + 1) \cdot (x + 2)$$

Uhhh, let's simplify it a bit...

Some evaluations leave us with

$$(1 \cdot (x + 2) + 1 \cdot (x + 1)) \cdot (x + 2) \cdot (x + 1) + (1 \cdot (x + 1) + 1 \cdot (x + 2)) \cdot (x + 1) \cdot (x + 2)$$

No big brains are needed to get

$$(x + 2 + x + 1) \cdot (x + 2) \cdot (x + 1) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(2 + x + x + 1) \cdot (x + 2) \cdot (x + 1) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(2 + x + 1 + x) \cdot (x + 2) \cdot (x + 1) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(2 + 1 + x + x) \cdot (x + 2) \cdot (x + 1) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Some evaluations leave us with

$$(2 + 1 + 2 \cdot x) \cdot (x + 2) \cdot (x + 1) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(1 + 2 + 2 \cdot x) \cdot (x + 2) \cdot (x + 1) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Caboom, we can fold in half of the expression:

$$(3 + 2 \cdot x) \cdot (x + 2) \cdot (x + 1) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(3 + 2 \cdot x) \cdot (2 + x) \cdot (x + 1) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(3 + 2 \cdot x) \cdot (2 + x) \cdot (1 + x) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(3 + 2 \cdot x) \cdot (1 + x) \cdot (2 + x) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(1 + x) \cdot (3 + 2 \cdot x) \cdot (2 + x) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (x + 1 + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (1 + x + x + 2) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (1 + x + 2 + x) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (1 + 2 + x + x) \cdot (x + 1) \cdot (x + 2)$$

Some evaluations leave us with

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (1 + 2 + 2 \cdot x) \cdot (x + 1) \cdot (x + 2)$$

Caboom, we can fold in half of the expression:

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (3 + 2 \cdot x) \cdot (x + 1) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (3 + 2 \cdot x) \cdot (1 + x) \cdot (x + 2)$$

Let's reshuffle operands a bit

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (3 + 2 \cdot x) \cdot (1 + x) \cdot (2 + x)$$

Let's reshuffle operands a bit

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (1 + x) \cdot (3 + 2 \cdot x) \cdot (2 + x)$$

Let's reshuffle operands a bit

$$(1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x) + (1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x)$$

Some evaluations leave us with

$$2 \cdot (1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x)$$

So finally:

$$2 \cdot (1 + x) \cdot (2 + x) \cdot (3 + 2 \cdot x)$$