MCT 4C
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Class Notes
Unit 2, Lesson 9

Review – Factoring Part 2

When a trinomial has a leading coefficient that is not 1, and it cannot be (fully) common factored, then our factoring approach changes. This is called **factoring by decomposition**, and our process changes a little bit.

In ax^2+bx+c...

- Multiplies to *ac*.
- Adds to *b*.
- Numbers are ...
- Split the *b* term into the numbers, found above.
- Factor by grouping.

Example 1:

$$\begin{aligned} &2x^2+5x+3 \\ &=2x^2+\mathbf{2}x+\mathbf{3}x+3 \\ &=2x(x+1)+3(x+1) \\ &=(x+1)(2x+3) \end{aligned}$$

M: 2·3 = 6
A: 5
N: 2,3

$$\begin{aligned} &4x^2+5x-6 \\ &=4x^2+\mathbf{8}x-\mathbf{3}x-6 \\ &=4x(x+2)-3(x+2) \\ &=(x+2)(4x-3) \end{aligned}$$

M: 4·(-6) = -24
A: 5
N: 8,-3

Factoring by grouping can be extended into higher degree polynomials, especially when there are an even number of terms.

Example 2:

$$\begin{aligned} &x^3-3x^2-4x+12 \\ &=x^2(x-3)-4(x-3) \\ &=(x-3)(x^2-4) \end{aligned}$$

$$\begin{aligned} &18x^3+9x^2+8x+4 \\ &=9x^2(2x+1)+4(2x+1) \\ &=(2x+1)(9x^2+4) \end{aligned}$$

$$\begin{aligned} &2ab+4ac+6bd+12cd \\ &=2a(b+2c)+6d(b+2c) \\ &=(b+2c)(2a+6d) \end{aligned}$$

$$\begin{aligned} &2x^3-3x^2+4x+6 \\ &=x^2(2x-3)+2(2x+3) \end{aligned}$$

Doesn't work! This can't be factored this way.

Some polynomials have a similar form to factoring quadratic trinomials. So long as the exponents are appropriate (the higher exponent is double the lower), we can trinomial factor.

Example 3:

$$x^4 - 10x^2 + 9$$

Let $a = x^2$

then $a^2 = (x^2)^2 = x^4$

$a^2 - 10a + 9$ M: 9 A: -10 N: -1, -9

$= (a-1)(a-9)$

$= (x^2-1)(x^2-9)$

$= (x-1)(x+1)(x-3)(x-3)$

$$8x^6 - 65x^3 + 8$$

Let $a = x^3$; $a^2 = x^6$

$8a^2 - 65a + 8$ M: 64 A: -65 N: -64, -1

$= 8a^2 - 64a - a + 8$

$= 8a(a-8) - 1(a-8)$

$= (a-8)(8a-1)$

$= (x^3-8)(8x^3-1)$

As in previous courses, you should always common factor first if possible.

Example 4:

$$2x^4 + 8x^3 - 2x^2 - 8x$$

$= 2x(x^3 + 4x^2 - x - 4)$

$= 2x[x^2(x+4) - 1(x+4)]$

$= 2x(x+4)(x^2-1)$

$= 2x(x+4)(x-1)(x+1)$