

# Notes on Synthetic Division:

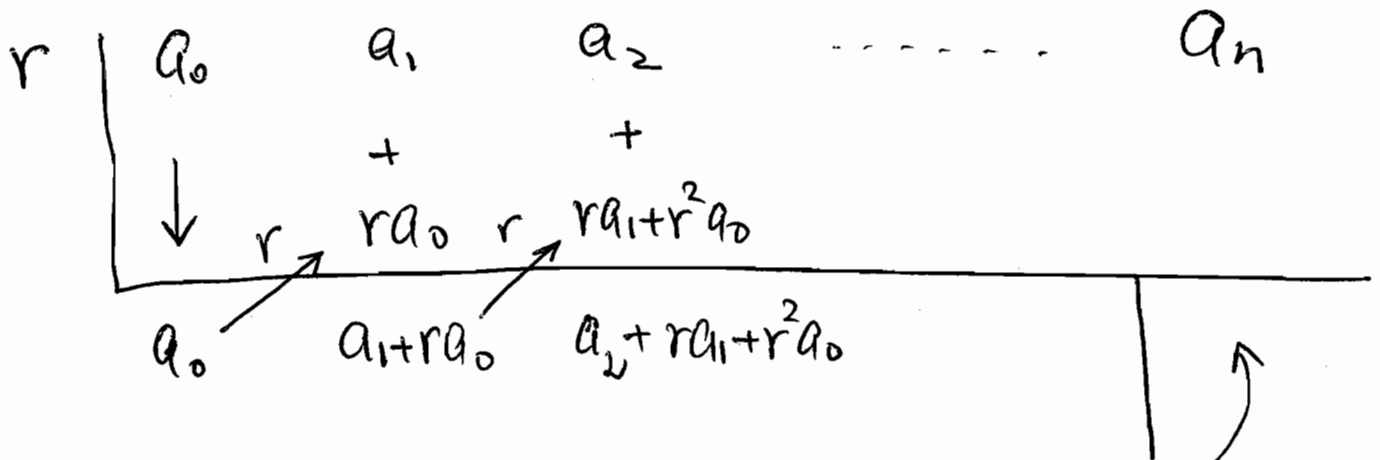
①

How to factor polynomials  
(with integer coefficients)

Let  $p(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \dots + a_{n-1}x + a_n$

where  $a_i$ 's are integers.

Try  $\frac{\pm \text{factors of } a_n}{\pm \text{factors of } a_0}$  (usually  $a_0 = 1$ )



remainder.

If  $r$  is a root, then remainder is zero

①  $f(x) = x^3 - 2x^2 - 5x + 6$

②

Try  $-1 \mid 1 \quad -2 \quad -5 \quad +6$

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$1 \quad -3 \quad -2 \quad \mid 8$

remainder  $\neq 0$   
(not good).

in fact:

$$x^3 - 2x^2 - 5x + 6 = (x+1)(x^2 - 3x - 2) + 8$$

Try again

$1 \mid 1 \quad -2 \quad -5 \quad 6$

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$-2 \mid 1 \quad -1 \quad -6 \quad \mid 0$

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$3 \mid 1 \quad -3 \quad \mid 0$

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$1 \mid 3$

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$1 \mid 0$

$x^3 - 2x^2 - 5x + 6$

$\parallel$

$(x-1)(x^2 - x - 6)$

$\parallel$

$(x-1)(x+2)(x-3)$

(2)

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

(3)

Try  $\downarrow$

1	1	-3	0	4
		1	-2	-2
1	-2	-2	2	

remainder  $\neq 0$   
(not good)

(in fact

$$x^3 - 3x^2 + 4 = (x-1)(x^2 - 2x - 2) + 2$$

Try again:

2	1	-3	0	4
		2	-2	-4
2	1	-1	-2	0
		2	2	
-1	1	1	0	
		-1		
1	0			

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

||

$$(x-2)(x^2 - x - 2)$$

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