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proof of Vieta's formula

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Proof: We can write $P(x)$ as

$$P(x) = a_n(x-r_1)(x-r_2)\ldots(x-r_n) = a_n(x^n - S_1 x^{n-1} + S_2 x^{n-2} - \ldots + (-1)^n S_n).$$

Since we also have that

$$P(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots a_1 x + a_0,$$

setting the coefficients equal yields

$$a_n(-1)^i S_i = a_{n-i}$$

which is what the theorem stated.