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Quiz – April 13, 2004

What familiar function is equal to

$$f(x) = x - x^2 + x^3 - x^4 + x^5 - \ldots?$$

Justify your answer.

Answer: Recall that

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + x^4 + x^5 + \ldots$$

for $-1 < x < 1$. Replace x by $-x$ to see that

$$\frac{1}{1+x} = 1 - x + x^2 - x^3 + x^4 - x^5 + \ldots$$

for $-1 < -x < 1$. (Of course $-1 < -x < 1$ if and only if $-1 < x < 1$.) Multiply by x to see that

$$\boxed{\frac{x}{1+x} = x - x^2 + x^3 - x^4 + x^5 - x^6 + \ldots \ .}$$