Integration by Parts

Part 2: LIATE

J. Gonzalez-Zugasti, University of Massachusetts - Lowell

From Wikipedia – Integration by Parts

A rule of thumb proposed by Herbert Kasube of Bradley University advises that whichever function comes first in the following list should be u:

- **L** - Logarithmic functions: $\ln x$, $\log_b x$, etc.
- **I** - Inverse trigonometric functions: $\tan^{-1} x$, $\sec^{-1} x$, etc.
- **A** - Algebraic functions: x^2, $3x^{50}$, etc.
- **T** - Trigonometric functions: $\sin x$, $\tan x$, etc.
- **E** - Exponential functions: e^x, 19^x, etc.

The function which is to be dv is whichever comes last in the list: functions lower on the list have easier antiderivatives than the functions above them.

From Wikipedia – Integration by Parts

To demonstrate the LIATE rule, consider the integral

$$\int x \cos x \, dx$$

Following the LIATE rule, $u = x$ and $dv = \cos x \, dx$, hence $du = dx$ and $v = \sin x$, which makes the integral become

$$x \sin x - \int \sin x \, dx$$

which equals

$$x \sin x + \cos x + C.$$

From Wikipedia – Integration by Parts

… [I]n some cases, polynomial terms need to be split in non-trivial ways. For example, to integrate

$$\int x^3 e^{x^2}\, dx$$

one would set

$$u = x^2, \qquad dv = xe^{x^2}\, dx$$

so that

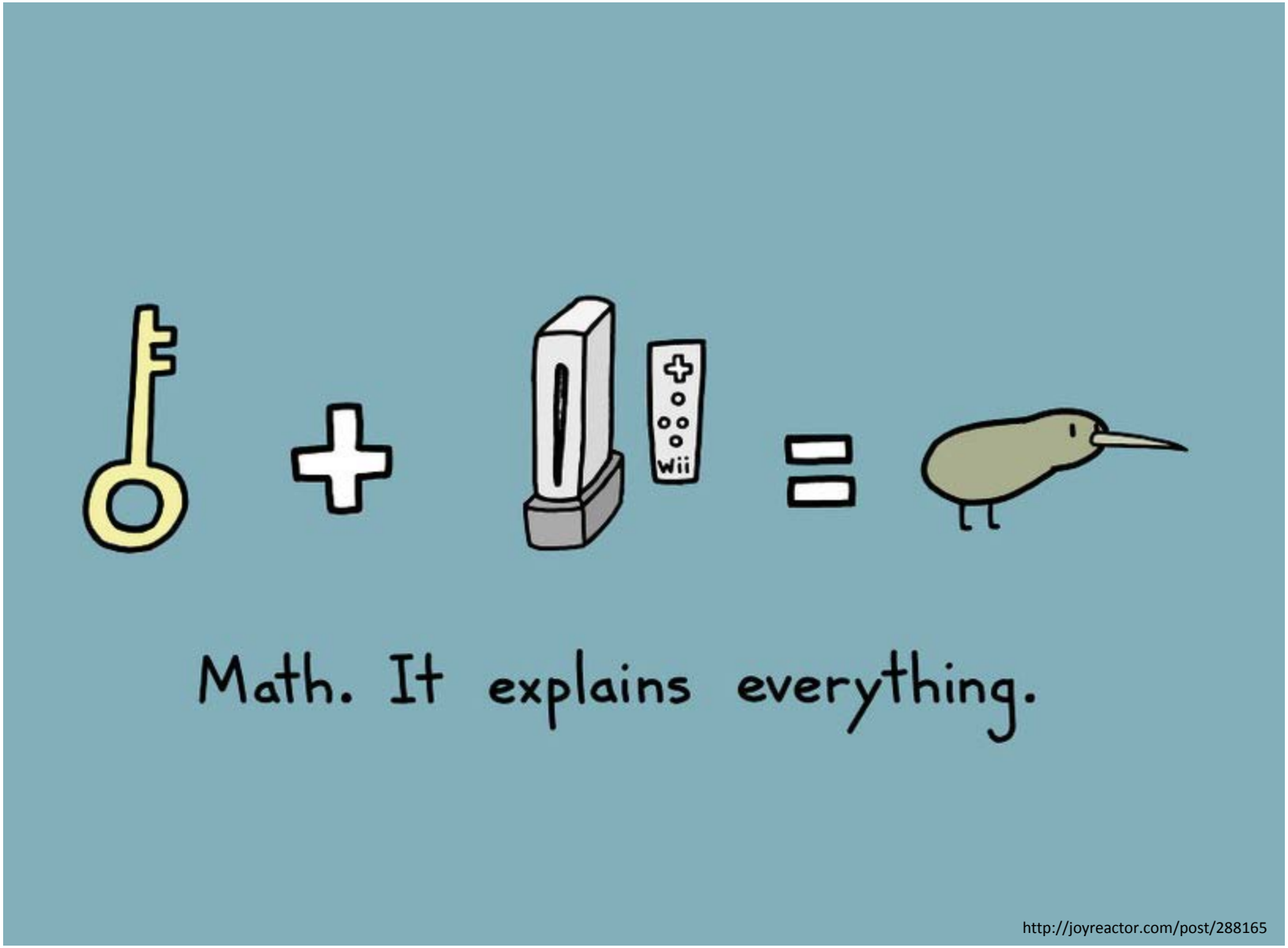
$$du = 2x\, dx, \qquad v = \frac{1}{2} e^{x^2}$$

Then

$$\int x^3 e^{x^2}\, dx = \frac{1}{2} x^2 e^{x^2} - \int xe^{x^2}\, dx$$

Finally, this results in

$$\int x^3 e^{x^2}\, dx = \frac{1}{2} e^{x^2}(x^2 - 1) + C$$



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