Learning Catalytics exercise: Here's some space for you to make a calculation.

Integration Techniques

Section 7.1 of our textbook discusses a few basic approaches to the problem of computing antiderivatives. These approaches include a review of the method of substitution as well as algebraic techniques such as splitting up fractions into manageable pieces and completing the square. We will touch upon these techniques either in the homework exercises or as we discuss more involved techniques over the course of the next two weeks.

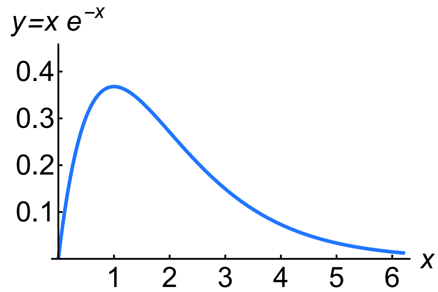
Integration by Parts

Integration by parts is an integration technique based on the Product Rule for differentiation. Given two differentiable functions $u(x)$ and $v(x)$, we know that

$$\begin{aligned} \frac{d}{dx} u\, v &= u \left(\frac{dv}{dx}\right) + \left(\frac{du}{dx}\right) v \\ &= u \left(\frac{dv}{dx}\right) + v \left(\frac{du}{dx}\right). \end{aligned}$$

Example. $\int x \sin x \, dx$

The technique works on definite integrals as well.



Example. $\int_0^6 xe^{-x}\,dx$

How do we go about picking u and dv?

Example. $\int x\,\ln x\,dx$

Example. $\int x^3(\cos x^2)\,dx$

Now I would like to derive one of the most important mathematical results of the seventeenth century, and I will do so using integration by parts.

Example. $\displaystyle\int \frac{1}{x\ln x}\,dx$