

# Note 6.1 - Integration by Parts

## 1 Introduction

Integration by parts is essentially the inverse of product rule. It turns an integration into another hopefully easier one.

## 2 The Formula

Start with the product rule for differentiation

$$\frac{d}{dx}uv = u\frac{dv}{dx} + v\frac{du}{dx},$$

## 3 Instruction Manual and Principles

The instructions are obvious. When we see an expression  $f(x)dx$  that can not be integrated right away, name some part of  $f$  to be  $u$  and the rest  $dv$ . Apply the formula above and see if we get an easier integral. Here is a quick example:

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However, there are often more than one way to name  $u$  and  $dv$ . Some of them are not helpful:

So we usually prefer to set  $u$  to be something that becomes nicer after differentiation (e.g. polynomials).

## 4 Examples

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