So, $\boxed{\int u\,dv = uv - \int v\,du}$ ← This is the integration by parts

**Example 4**: Evaluate $\int \underbrace{x}_{u}\,\underbrace{e^x dx}_{dv}$

$u = x \qquad dv = e^x dx$

$du = dx \qquad v = e^x$

$\int x e^x dx = x e^x - \int e^x dx$

$= \boxed{x e^x - e^x + C}$

Another Way: **Warning**: the following way works only for some functions such as polynomials, exponential functions, and sin(x)/cos(x) functions.

| Derivatives Part | Integration Part |
|---|---|
| | $e^x$ |
| $x$ | |
| | $e^x$ ⊕ |
| $1$ | |
| | $e^x$ ⊖ |
| $0$ | |

$\int x e^x dx = \boxed{x e^x - e^x + C}$

Example 5: Evaluate $\int \underbrace{x^2}_{u} \underbrace{\cos(x)\,dx}_{dv}$.

$u = x^2 \qquad dv = \cos(x)\,dx$

$du = 2x\,dx \qquad v = \sin(x)$

$$\int x^2\cos(x)\,dx = x^2\sin(x) - \int 2x\sin(x)\,dx$$

$$= x^2\sin(x) - 2\int \underbrace{x}_{u}\,\underbrace{\sin(x)\,dx}_{dv}$$

$u = x \qquad dv = \sin(x)\,dx$

$du = dx \qquad v = -\cos(x)$

$$\int x\sin(x)\,dx = -x\cos(x) + \int \cos(x)\,dx$$

$$= \boxed{-x\cos(x) + \sin(x)}$$

So, $\boxed{\int x^2\cos(x)\,dx = x^2\sin(x) + 2x\cos(x) - 2\sin(x) + C}$

Another Way: Table Method

| Derivative Part | Integration Part |
|---|---|
| $x^2$ | $\cos(x)$ |
| $2x$ | $\sin(x)$ ⊕ |
| $2$ | $-\cos(x)$ ⊖ |
| $0$ | $-\sin(x)$ ⊕ |

$$\int x^2\cos(x)\,dx = \boxed{x^2\sin(x) + 2x\cos(x) - 2\sin(x) + C}$$

☑