Mathematical and Statistical Foundations for Data Science (CMPINF 2105)
"Pen and Paper" Homework 3: Derivatives & Integrals (Modules 5 & 6)

1. Find the second derivative of
$$f(x) = e^{2x}$$

2. Find the derivative of
$$f(x) = \cos(x)$$
Here are some useful hints:
   - $\cos(x + y) = \cos(x)\cos(y) - \sin(x)\sin(y)$
   - $\lim_{h \to 0} \frac{\cos(h) - 1}{h} = 0$
   - $\lim_{h \to 0} \frac{\sin(h)}{h} = 1$

   The last two hints can be confirmed by plotting the functions.

3. For $f(x, y) = x^2 + y^2 = 25$, find $\frac{dy}{dx}$. That is, given the constraints of the equation, how must y change as a function of x?

4. Evaluate the definite integral
$$\int_0^1 x^3 - 2x + 1 \, dx$$

5. Evaluate the integral
$$\int xe^x \, dx$$

6. Evaluate the integral
$$\int 2x\sqrt{1 + x^2} \, dx$$