1. **LaTeX typesetting system.** Write a template project report using LaTeX typesetting system. The project report should include the following parts:
   - Titlepage with the following information
     - Exercise project name and number
     - Your name, degree programme and starting year
     - Your e-mail address
     - Date returned
   - Short description of the project and how it was done
   - Source code listings with comments
   - Program execution output

2. **Formulas and equations in LaTeX.** Write the following formulas into a new LaTeX file.

$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{1}$$

$$\int\limits_a^b f'(x)\, dx = f(b) - f(a) \tag{2}$$

$$S_n = \sum_{k=1}^{n} \frac{1}{k^2} \tag{3}$$

$$e^{i\theta} = \cos\theta + i \sin\theta \tag{4}$$

   Also try referencing to them in your document.

3. **Recurrance relations.** Many functions are numerically evaluated using recurrance relations. The task here is to compute the values of the Bessel $J_n(x)$ function at $x = 1$ using the recurrance formula

$$J_{n+1}(x) = \frac{2n}{x} J_n(x) - J_{n-1}(x), \tag{5}$$

   for $n = 1, \ldots, 20$. The finite precision of computer arithmetic is here an issue.

   (a) Apply Eq. (5) as it is using initial values $J_0(1) \approx 0.7651976$ and $J_1(1) \approx 0.4400506$. Do you think the result is correct?

   (b) Now reverse the recurrance relation and use initial values $J_{20}(1) \approx 3.8735030 \cdot 10^{-25}$ and $J_{21}(1) \approx 9.2276220 \cdot 10^{-27}$. Compare the results to the previous ones.

4. **Cosine power series expansion.** Evaluate the cosine function at an arbitrary point x using a truncated power series expansion

$$\cos x \approx \cos^{(N)} x = \sum_{k=0}^{N} \frac{(-1)^k}{(2k)!} x^{2k}. \tag{6}$$

For large x the series will converge too slowly. Still, you must somehow make the code applicable even in that case. Compare the values of your approximation to the correct values at $x = 0, \pi/5, \ldots, 100\pi$.

Implement the code as a separate subroutine that takes as its arguments the value of x and the order of the expansion, n.