Technische Universität Berlin **Winter Semester 2012/2013**
Fakultät II – Mathematik und Naturwissenschaften
Institut für Mathematik
Dr. Agnieszka Miedlar Stand: October 17, 2012

Wissenschaftliches Rechnen / Scientific Computing
1. Assignment (Due date 25.10.2012)

1. **Calculation of machine precision** `eps`

   Write a Matlab/Octave program which determines the value of the machine precision `eps`. Compare it with the Matlab/Octave value `eps`, i.e.,

```
>> eps
ans = 2.2204e-16
```

```
octave:1> eps
ans = 2.2204e-16
```

   Hint: Machine epsilon `eps` is the smallest number such that $1 + \texttt{eps} > 1$.

2. **Solving quadratic equation** $ax^2 + bx + c = 0$

   Write Matlab/Octave function `solve2Eq(a,b,c)`,e.g.,

```
function [x1,x2] = solve2Eq(a,b,c)
```

   which solves the quadratic equation $ax^2 + bx + c = 0$. Use two different formulas for the solutions x_1 and x_2, i.e.,

   (a) $x_1 = \frac{-b+\sqrt{b^2-4ac}}{2a}$ and $x_1 = \frac{2c}{-b-\sqrt{b^2-4ac}}$,

   (b) $x_2 = \frac{-b-\sqrt{b^2-4ac}}{2a}$ and $x_2 = \frac{2c}{-b+\sqrt{b^2-4ac}}$.

   Test your program for $x^2 - (10^{10} + 10^{-10})x + 1 = 0$.

   What problems do you observe? Which formulas behave better depending on the value of b?

3. **Exponential function** e^x

   It is known that the series

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots \tag{1}$$

   converges for any finite x.

   Write the Matlab/Octave function `myexp(x,n)`, e.g.,

```
function e_x = myexp(x,n)
```

   to calculate the value of e^x by using the Taylor expansion (1) truncated after the $n+1$-th term.

   (a) Test your program for $(x, n) = (1, 5), (10, 50), (20, 500), (-20, 500)$. Compare your results with Matlab/Octave function `exp`. Try to explain what has happened for $(x, n) = (-20, 500)$.

   (b) Check if for $x < 0$ using the formula $e^{-x} = 1/e^x$ gives better results?