Tutorial 1

1. The computation of the expression

$$f(x) = \frac{\sqrt{1 + 8x^2} - 1}{2}$$

involves the difference of small numbers when $x << 1$. Obtain the value of *f(x)* for $x = 0.002$, and also the relative error (True Value is $0.7999936001023980 \times 10^{-5}$), performing operations by rounding all mantissas to six decimals: (a) using the expression above, (b) employing a Taylor's series expansion and using the first three terms, and (c) using the equivalent expression $f(x) = \frac{4x^2}{\sqrt{1+8x^2}+1}$. For the case (a), perform a backward error analysis to find the relative error in *x* required to make the computed result *exact*.

2. On a plot of land, which is in the shape of a right-angled triangle, the two perpendicular sides were measured as $a = 300.0 \pm 0.1$ m and $b = 400.0 \pm 0.1$ m. How accurately is it possible to estimate the hypotenuse *c*?

3. The following set of equations is to be solved to get the value of *x* for a given δ. For what values of δ will this problem be well-conditioned?

$$x + y = 2$$
$$x + (1 - \delta)y = 1$$