Arnold problems for homework 1

1. Let (a) be the statement

$$\frac{|\bar{x} - x|}{|x|} \leq \mu \qquad \text{(a)},$$

and (b) be the statement

$$\bar{x} = x(1 + \delta),\ |\delta| \leq \mu \qquad \text{(b)}.$$

Show that for nonzero $x \in \mathbb{R}$, (a) is true if and only if (b) is true.

2. Let $x = [4.0091, 0.12319, 1.2341]^T$ and $y = [-1.1021, .35449, 3.5449]^T$. Using 3 decimal-digit arithmetic compute $\bar{x} = \text{fl}(x)$, $\bar{y} = \text{fl}(y)$, $c = \text{fl}(\bar{x}^T\bar{x})$ and $d = \text{fl}(\bar{x}^T\bar{y})$.

Now compute the actual values of x^Tx and x^Ty (to 5 or 6 significant digits) and find the relative errors

$$\frac{|x^Tx - c|}{|x^Tx|}$$

and

$$\frac{|x^Ty - d|}{|x^Ty|}.$$

Note: $s = \text{fl}(u^Tv)$ for $u, v \in \mathbb{R}^n$ is to be computed in the standard way (the same way as the textbook problem in this homework assignment):

s=0; for j=1:n, $s = fl(s + fl(u_j * v_j))$; end