**7.** (*expires 2/18*) Fit the points $(-1.9,-4.7),(-0.8,1.2),(0.1,2.8),(1.4,-1.2),(1.8,-3.5)$ by means of a quadratic function $f(x)=ax^2+bx+c$, using the least square method. First, do this step by step, as we did in class; then, use the built-in `Maple` command, described in the notes. Check that the two solutions agree.

**8.** (*expires 2/18*) Fit the set of points

$$(1.02,-4.30),(1.00,-2.12),(0.99,0.52),(1.03,2.51),(1.00,3.34),(1.02,5.30)$$

with a line, using the least square method we used in class. You will see that this is not a good fit. Think of a better way to do the fit and use `Maple` to do it. Explain in your solution why you think your better way is better.

**9.** (*expires 2/18*) In this problem we will estimate the charge of the electron: If an electron of energy $E$ is thrown into a magnetic field $B$, perpendicular to its velocity, its trajectory will be deflected into a circular trajectory of radius $r$. The relation between these three quantities is:

$$B\,r\,e=\frac{E^2}{m^2c^4}\sqrt{E^2-m^2c^4}, \tag{1}$$

where $e$ and $m$ are, respectively, the charge and the mass of the electron, and $c$ is the speed of light. The rest mass of the electron is defined as $E_0=mc^2$, and is about equal to $8.817\,10^{-14}$ Joules. In our experimental set-up the energy of the emitted electrons is set to be $E=2.511E_0$.
Use `read` to make `Maple` load and execute the commands in the file `electron_data.txt`, which is located in the `Worksheets` directory of the `mat331` account. This defines a list called `electron`. Each element of the list is a pair of the form $[B_i,r_i]$, and these quantities are expressed in Teslas and meters. Use least square fitting to determine the best value for $e$. [*Hint: Notice that the right hand side of (1) is just a constant—calculate it once and for all and give it a name. Then (1) is a very easy equation, which is linear in the unknown parameter $e$. To verify your solution:* $e\approx 1.602\,10^{-19}$ Coulomb].
Physical constants courtesy of N.I.S.T.

**10.** (*expires 2/18*) Prove relation (1), knowing the following physical facts: In relativistic dynamics Newton's law is replaced by

$$F=m\,\frac{d}{dt}\left(\frac{v}{\sqrt{1-\frac{v^2}{c^2}}}\right), \tag{2}$$

where $F$ is the force acting on a particle, $m$ its mass and $v$, a function of time, its velocity. In the case at hand, the force exerted by a magnetic field $B$ on an electron is $F=e\,v\,B/c$. Recall that in a circular motion the acceleration $a=dv/dt=v^2/r$, $r$ being the radius of the circle. Since (1) is expressed in terms of the energy, rather than the velocity, you also need Einstein's formula,

$$E=\frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}, \tag{3}$$

which can be solved in terms of $v$.