Mlab Curve fitting features

MLAB is a very powerful curve fitting program. The example below shows most of the features of MLAB that apply to curve fitting. These features are:

1. fitting in the $L_p$-norm.
2. fitting of several functions simultaneously.
3. weighted and re-weighted fitting with functional weights and/or numerical weights.
4. fitting ordinary differential equation models, involving ode-defined functions, derivatives, and auxiliary functions, together with algebraic functions.
5. delay terms may appear in functions that define a model.
6. implicit functions may be used in defining the functions of a model.
7. fitting initial conditions to solve boundary-value problems can be handled via shooting.
8. automatic Jacobian computation, either symbolic or numeric, is provided.
9. overflow handling is provided.
10. linear constraints may be imposed.

Here is an example which shows off each of the above features. Can you spot where each feature is exhibited? [The operator root(z,a,b,E(z)) return a value \( v \) for the dummy variable \( z \) lying in \([a,b]\) which satisfies \( E(v) = 0 \), with suitable caveats. The notation \( g'(t) \) denotes the function of \( t \) which is the derivative of \( g \) with respect to \( t \). The function ewt computes estimated reciprocal variance weights for the data given in its matrix arguments.]

\[
\text{func } g'(t) = a*g(t-d) + h*\text{root}(z,-b,b, \cos(z/b)-1/(t+1)) \\
\text{func } h'(t)=\cos(t-a)*g \\
\text{initial } g(0)=c \\
\text{initial } h(0)=1 \\
a=.1; b=1; c=.5; d=.1; \\
m1= \text{read}(gdata,100,2) \\
m2= \text{read}(gdata,100,2)
\]
\texttt{fct \ wg(m,j) = abs(m[j,2] - sqrt(g))}

\texttt{constraints \ q = \{a > 0, b > 1, 0.1 < c, c < 1\}}
\texttt{wr = ewt(m2)}

\texttt{fitnorm = 1}
\texttt{fit(a, b, c, d), g to m1 with weight \ wg, g'\ to m2 with weight \ wr, constraints \ q}

\texttt{final parameter values}

\begin{tabular}{cccc}
\textit{value} & \textit{error} & \textit{dependency} & \textit{parameter} \\
8.326672685e-17 & 0.3825860609 & 0.983098032 & A \\
1.009375311 & 0.8904044698 & 0.9920220641 & B \\
1 & 7.341169978 & 0.9966718057 & C \\
0.5318706953 & 1.797693135e+308 & 1 & D \\
\end{tabular}

\texttt{2 iterations}
\texttt{CONVERGED}
\texttt{best weighted sum of squares = 9.072228e+04}
\texttt{weighted root mean square error = 5.593169e+01}
\texttt{weighted deviation fraction = 8.740915e-01}
\texttt{lagrange multiplier[1] = -8986.559879}
\texttt{lagrange multiplier[4] = 250.7190973}

\texttt{draw m1 pt circle lt none}
\texttt{draw points(g,0:12!160) color red}
\texttt{top title "fit of g"}
\texttt{frame 0 to 1, 0 to .5}
\texttt{w1=w}

\texttt{draw m2 pt "+" lt none}
\texttt{draw points(g't,0:12!160) color green}
\texttt{top title "fit of g'\''t"}
\texttt{frame 0 to 1, .5 to 1}
\texttt{view}