Assignment #1

Plotting with analytical thinking

PH1050 - Computational Physics

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Engineering Physics

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Aim:
1) To get List of data of function and it's derivatives and plot the graph
2) To analyse the effects machine precision on sensitive functions

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Defining Constants and expressions

In[233]:=

```
Clear["Global`*"]
(* Constants *)

xt = 2.01 * 10^5;
xp = 3.08 * 10^3;
xl = -1.05 * 10^4;
p0 = N[0.000115000000];
h0 = 5.25 * 10^-5;
k0 = 1.25 * 10^4;
r0 = 1.75;
n0 = 2.75 * 10^2;
x0 = 3.17 * 10^2;
N[{xt, xp, xl, p0, h0, k0, r0, n0, x0} , 300]; (* Setting 300 significant digits*)
```

In[311]:=

```
(* Equations *)
(* Getting 200 digits for precision *)
x1[t_] =
  N[E^(-((xt (1 / (n0 + t) - 1 / x0)) / r0) + (xp (-1 + x0 / (n0 + t) + Log[(n0 + t) / x0])) / r0),
   200];
x2[t_] = N[E^(-((xl (1 / (n0 + t) - 1 / x0)) / r0)), 200];
a[t_] = N[k0 x2[t], 200];
b[t_] = N[1 + x1[t] + a[t] (p0 - h0), 200];
c[t_] = N[-h0 (1 + x1[t]), 200];

(* y1 is now a set delayed function*)
y1[t_] := SetPrecision[
   (-b[t] + SetPrecision[Sqrt[SetPrecision[b[t]^2 - 4 a[t] × c[t], 300]], 300]) /
    (2 a[t]), 300];
```

In[317]:=

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(* test *)
N[y1[80], 50]
```

Out[317]=

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0
```

Computing List of y1

In[268]:=

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(* Getting the list of the data *)
data = Table[{t, N[y1[t], 30]}, {t, -10, 100, 0.25}];


(* Derivative of function y1[t] *)
dy1[t_] = D[y1[t], {t, 1}];
data2 = Table[{t, dy1[t]}, {t, -10, 100, 0.25}];
```

Plotting

In[271]:=

```
(* Plot of the main functions *)
plot1 = ListLinePlot[data,
   PlotStyle → {Green, Thick},
   Frame → True,
   Filling → Bottom,
   PlotLabels → "Function"];

(* Plot of the Derivative *)
plot2 = ListLinePlot[data2,
   PlotStyle → {Red},
   PlotLabels → "Derivative"];

(* Displaying both the graphs once *)
Show[{plot1, plot2}]
```

Out[273]=