> #Deven Singh
> #Assignment 24
> # Do not post

> #Q1

> # For Question 1, I incorrectly read "the rate of change of the acceleration" as the acceleration and solved the problem with Calculus 1 methods.

> #For Question 2, I made an algebra error when solving for the constant in the position equation

> #Q2

> # x''''''(t) = 120

> #x(0) = 0, x'(0) = 0,x''(0)=0,x'''(0)=0,x''''(0)=0,x'''''(0)=0

> #Integrating x''''''(t)=120 -> x'''''(t) = 120·t +c

> # x'''''(0) = 0 +c -> c=0

> #Integrating x'''''(t) = 120·t

> $\#x''''(t) = 60 \cdot t^2 + c \rightarrow c = 0$ *after plugging* **in** *initial value*

> $\#x'''(t) = 20 \cdot t^3 + c \rightarrow c = 0$ *after plugging* **in** *initial value*

> $\#x''(t) = 5 \cdot t^4 + c \rightarrow c = 0$ *after plugging* **in** *initial value*

> $\#x'(t) = t^5 + c \rightarrow c = 0$ *after plugging* **in** *initial value*

> $\#\frac{x(t) = (t^6 \cdot 1}{6}\Big) \rightarrow c = 0$ *after plugging* **in** *initial value*

> #x(2) = 10.7 meters

> #Q3

> #Part i

> # x(0) = 100

> #x'(t) = -10

> # x(t) = -10·t+c

> # x(0) = -10·0+c

> #100 = c

> #x(t) = -10·t+100

> # 0 = -10·t + 100

> # It will take 10 seconds for the ball to hit the ground

> # Part ii

> # Assuming the ball's mass is 1 kg -> k = 1

> # x''(t) = -g +k·x'(t)

> help(dsolve);

> ode := diff(y(x), x, x) =-10 + diff(y(x), x)

$$ode := \frac{d^2}{dx^2}\, y(x) = -10 + \frac{d}{dx}\, y(x) \qquad \textbf{(1)}$$

> ics := y(0) = 100, D(y)(0) = 0

$$ics := y(0) = 100, D(y)(0) = 0 \qquad \textbf{(2)}$$

> dsolve({ics, ode});

$$y(x) = -10\, e^x + 10\, x + 110 \qquad \textbf{(3)}$$

> $evalf\left(solve\left(-10\, e^{x} + 10\, x + 110 = 0, x\right)\right);$

$$-10.99998330, 2.61086864 \quad (4)$$

> #The ball will hit the ground 2.61 seconds after being dropped

> #Q4

> # (a) A difference or recurrence equation with one variable, e.g., x(n) = x(n-1) ·(1-x(n-1))

> # (b) The output of the recurrence equation up to the kth iteration with an initial value of x0

> # (c) An input value of the recurrence equation that outputs the same value

> # (d) An equilibrium point at which all initial values in its neighborhood converge toward in the long-run

> #Q5

> # (a) Use Orb to input a first-order dynamical system and its initial value to calculate the orbit up until the kth term to numerically find the fixed point

> # (b) Convert the first-order dynamical system into a function of x. Set the function to equal x and solve to find the fixed points

> # (c) Find the value of the derivative when the function is at the fixed point. If its absolute value is less than 1, it is a stable fixed point

> # (d)

> # (i)

> **read** `/Users/Deven/Desktop/Fall 2021/Dynamic Models of Biology/DMB.txt`

First Written: Nov. 2021

This is DMB.txt, A Maple package to explore Dynamical models in Biology (both discrete and continuous)
accompanying the class Dynamical Models in Biology, Rutgers University. Taught by Dr. Z. (Doron Zeilbeger)

The most current version is available on WWW at:
http://sites.math.rutgers.edu/~zeilberg/tokhniot/DMB.txt .
Please report all bugs to: DoronZeil at gmail dot com .

For general help, and a list of the MAIN functions,
type "Help();". For specific help type "Help(procedure_name);"

For a list of the supporting functions type: Help1();
For help with any of them type: Help(ProcedureName);

For a list of the functions that give examples of Discrete-time dynamical systems (some famous), type: HelpDDM();

For help with any of them type: Help(ProcedureName);

For a list of the functions continuous-time dynamical systems (some famous) type: HelpCDM();

For help with any of them type: Help(ProcedureName);

------------------------------ **(5)**

> $Help(Orb)$;

Orb(F,x,x0,K1,K2): Inputs a transformation F in the list of variables x with initial point pt, outputs the trajectory of

of the discrete dynamical system (i.e. solutions of the difference equation): x(n)=F(x(n-1)) with x(0)= x0 from n=K1 to n=K2.

For the full trajectory (from n=0 to n=K2), use K1=0. Try:

*Orb(5/2*x*(1-x),[x], [0.5], 1000,1010);*

*Orb([(1+x+y)/(2+x+y),(6+x+y)/(2+4*x+5*y)],[x,y], [2.,3.], 1000,1010);* **(6)**

>

> $Orb\left(\frac{(1+x)}{(2+x)}, x, 0.5, 1000, 1010\right)$;

bad input

FAIL **(7)**

> $Orb(5/2*x*(1-x), [x], [0.5], 1000, 1010)$;

bad input

FAIL **(8)**

> $Orb(7/2*x*(1-x), [x], [0.5], 1000, 1010)$;

bad input

FAIL **(9)**

> $evalf\left(FP\left(\left[\frac{(1+x)}{(2+x)}\right], [x]\right)\right)$;

$\{[-1.618033988], [0.6180339880]\}$ **(10)**

> $evalf\left(FP\left(\left[\frac{5}{2}\cdot x\cdot(1-x)\right], [x]\right)\right)$;

$\{[0.], [0.6000000000]\}$ **(11)**

> $evalf\left(FP\left(\left[\frac{7}{2}\cdot x\cdot(1-x)\right], [x]\right)\right)$;

$\{[0.], [0.7142857143]\}$ **(12)**

> $SFP\left(\left[\frac{(1+x)}{(2+x)}\right], [x]\right)$;

$\{[0.6180339880]\}$ **(13)**

> $SFP\left(\left[\frac{5}{2}\cdot x\cdot(1-x)\right],[x]\right);$

$$\{[0.6000000000]\} \quad \textbf{(14)}$$

> $SFP\left(\left[\frac{7}{2}\cdot x\cdot(1-x)\right],[x]\right);$

$$\varnothing \quad \textbf{(15)}$$

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