```
> #OK to post
> #Anusha Nagar, 9.20.2021, Homework 5
>
> #Problem 0
> #Canonical form: Replace n by n-3
> #6a(n-4)+a(n)+5a(n-2) = 0
> #Canonical form: a(n) = 0·a(n-1)-5·a(n-2)+0·a(n-3) - 6·a(n-4)
> read "C:/Users/an646/Downloads/M5.txt":
> Help5()
                RecToSeq(INI,REC,N), GrowthC(INI,REC,K) , GrowthCe(REC)
                   LeslieMod(SUR,FER): e.g. LeslieMod([9/10,9/10],[0,1,1]);
                   LeslieMat(SUR,FER); e.g. LeslieMat([9/10,9/10],[0,1,1]);          (1)
> L := RecToSeq([1, 2, 4, 11], [0, -5, 0, -6], 1000):
> L[1000]
181801458979349684211926335397716595590116925130008115201730179162903000957 91\    (2)
    94774209925134910767767993350034005595962441714858161276739646642515466061\
    81311762839416505521709454841943997493283513047867597347184546959401904109\
    745684403540309
> #a(1000) = L[1000] (directly above)
>
> #Problem 1
> # a(n) = a(n-1) + a(n-2) + a(n-3)+ a(n-4) + a(n-5) + a(n-6) + a(n-7) + a(n-8) + a(n-9) + a
    (n-10)
> # Let's let INI =  a random list?
> GrowthCe([1, 1, 1, 1, 1, 1, 1, 1, 1, 1])
                                   1.999018633                                      (3)
> #Second way: Use GrowthC
> ra := rand(1..10):
> INI := [seq(ra(), i=1..10)];
                          INI := [8, 10, 9, 1, 6, 7, 7, 3, 3, 5]                    (4)
> REC := [1, 1, 1, 1, 1, 1, 1, 1, 1, 1];
                          REC := [1, 1, 1, 1, 1, 1, 1, 1, 1, 1]                     (5)
> GrowthC(INI, REC, 100);
                                   1.999018633                                      (6)
> #They match!
>
> #Problem 2
> #Information: SUR is 0.99, FER is 0.5 from 16 to 30 and 0.25 from 31 to 45
> SUR := [.99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99,
    .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99,
    .99, .99, .99]:
> FER := [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5,
    0.5, 0.5, 0.5, 0.5, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25,
    0.25, 0.25]:
> LeslieMod([.99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99,
    .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99,
    .99, .99, .99, .99], [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5,
    0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25,
    0.25, 0.25, 0.25, 0.25]);
[0, 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.4300291774, 0.4257288856, 0.4214715968,        (7)
   0.4172568808, 0.4130843120, 0.4089534689, 0.4048639342, 0.4008152948,
   0.3968071419, 0.3928390705, 0.3889106798, 0.3850215730, 0.3811713572,
   0.3773596437, 0.3735860472, 0.1849250934, 0.1830758425, 0.1812450840,
   0.1794326332, 0.1776383069, 0.1758619238, 0.1741033046, 0.1723622715,
   0.1706386488, 0.1689322623, 0.1672429396, 0.1655705102, 0.1639148052,
   0.1622756571, 0.1606529005]
> GrowthCe(%);
                                   1.090394687                                                        (8)
> A := LeslieMat([.99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99,
    .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99, .99,
    .99, .99, .99, .99, .99], [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5,
    0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25,
    0.25, 0.25, 0.25, 0.25, 0.25]) :
> #I'm not fully sure what to do from here for this problem.
>
> #Problem 3
> #Equation: S(t) = 0.16·S(t-4) +0.41 ·S(t-5)
> GrowthCe([0, 0, 0, 0.16, 0.41]);
                                   0.8879729192                                                       (9)
>
> #Problem 4
> #Want: function PlantGseq(alpha, beta, gamma, sigma, INI, K)
>
> #Get to canonical form: replace n by n-1
```

> #$p(n) - a \cdot p(n-1) - b \cdot p(n-2) = 0 \dashrightarrow p(n) = a \cdot p(n-1) + b \cdot p(n-2)$, *where* $a = \text{alpha} \cdot \text{sigma} \cdot \text{gamma}$ **and** $b = \text{beta} \cdot \sigma^2 \cdot (\text{gamma}) \cdot (1 - \text{alpha})$. $p(0) = 100$ **and** $p(1) = 80$

```
Error, unable to parse
PlantGSeq :=proc(α, β, γ, σ, INI, K) local i, k, L, newguy : REC := [α·σ·γ, β·γ·(1 − α)·σ·σ]if not (type(INI, li
```

```
> PlantGSeq :=proc(alpha, beta, gamma, sigma, INI, K) local i, k, L, newguy :
  REC := [alpha·sigma·gamma, beta·gamma·(1 − alpha)·sigma·sigma];
  if not (type(INI, list) and type(REC, list) and nops(INI) = nops(REC) and type(K, integer)
       and K ≥ nops(INI)) then
   print(`bad innput`) :
   RETURN(FAIL) :
  fi: k := nops(INI) :

   L := INI:

  while nops(L) < K do
   newguy := add(REC[i]*L[-i], i=1..k) :
   L := [op(L), newguy] :
  od:
  L :
  end:

Warning, (in PlantGSeq) `REC` is implicitly declared local
```

```
> PlantGSeq(0.5, 0.25, 2.0, 0.8, [100 , 80], 20)
[100, 80, 80.000000, 76.80000000, 74.24000000, 71.68000000, 69.22240000, 66.84672000,        (10)
    64.55296000, 62.33784320, 60.19874816, 58.13305344, 56.13824246, 54.21188252,
    52.35162481, 50.55520105, 48.82042081, 47.14516882, 45.52740239, 43.96514892]
> #seems to work for the number of plants column
>
> #Problem 5
> #Want PlanGseqgrow(alpha, beta, gamma, sigma) with growth constants
> PlanGseqgrow :=proc(alpha, beta, gamma, sigma) local x, i :
  REC := [alpha·sigma·gamma, beta·gamma·(1 − alpha)·sigma·sigma];
  evalf([solve(1-add(REC[i]/x^i, i=1..nops(REC)))])[1] :

  end:


Warning, (in PlanGseqgrow) `REC` is implicitly declared local
```

```
> PlanGseqgrow(0.5, 0.25, 2.0, 0.8)
                                 0.9656854250                                         (11)
> #Here we get extinction eventually
> PlanGseqgrow(0.99, 0.99, 2.0, 0.9)
                                  1.790954999                                         (12)
> #Here we have explosion
```