```
> #Hrudai Battini hw 14
  read "/Users/hb334/Documents/M14.txt";
  Help14();
```

RevOp(n,k), RevOpTr(n,k) **(1)**

```
> #4
  RevOpTr(234, 3);
  RevOpTr(699, 3);
  RevOpTr(911, 3);
  RevOpTr(483, 3);
  RevOpTr(714, 3);
  RevOpTr(333, 3);
```

#The period orbit of any number 3 digits is [495,495], except values whos digits are all the same or 0. The period then is 0. .

[234, 198, 792, 693, 594, 495, 495]

[699, 297, 693, 594, 495, 495]

[911, 792, 693, 594, 495, 495]

[483, 495, 495]

[714, 594, 495, 495]

[333, 0, 0] **(2)**

```
> #4 pt 2
  RevOpTr(1234, 4);
  RevOpTr(4921, 4);
  RevOpTr(6942, 4);
  #The Period of Orbit of any number 4 digits is [6174,
     6174] except values whos digits are all the same  or 0, the period then is 0.
```

[1234, 3087, 8352, 6174, 6174]

[4921, 8172, 7443, 3996, 6264, 4176, 6174, 6174]

[6942, 7173, 6354, 3087, 8352, 6174, 6174]

[0, 0] **(3)**

```
> #5
  traj := proc(n)
  local out;
  out := n;
  if (type(n, even)) then
  out := n/2; end if;

  if (type(n, odd)) then
  out := (3·n + 1)/2;
  end if;
```

```
RETURN(out);
end proc:

rtraj := proc(n)
local L, n1;


L := [ ];
n1 := n;

while not member(n1, L) do L := [op(L), n1]; n1 := traj(n1) end do;
[op(L), n1]
end proc:

rtraj(3);
rtraj(12);
rtraj(0);
rtraj(-5);
rtraj(-18);
#The trajectories for 5 random integers.
```

$$[3, 5, 8, 4, 2, 1, 2]$$

$$[12, 6, 3, 5, 8, 4, 2, 1, 2]$$

$$[0, 0]$$

$$[-5, -7, -10, -5]$$

$$[-18, -9, -13, -19, -28, -14, -7, -10, -5, -7] \quad \textbf{(4)}$$

```
> #6(Bonus).
rtraj(1234);
rtraj(0);
rtraj(-5);
rtraj(-6);

rtraj(-17);

rtraj(-11);

 #The periodic orbit for the any positive integer is  (2,1,2).
#The periodic orbit for 0 is (0, 0).
#The periodic orbit for negative integers varies. It can be  [-5, -7, -10, -5], [-1, -1],  or [-17,
    -25, -37, -55, -82, -41, -61, -91, -136, -68, -34, -17].
```

$$[1234, 617, 926, 463, 695, 1043, 1565, 2348, 1174, 587, 881, 1322, 661, 992, 496, 248, 124, 62, 31, 47, 71, 107, 161, 242, 121, 182, 91, 137, 206, 103, 155, 233, 350, 175, 263, 395, 593, 890, 445, 668, 334, 167, 251, 377, 566, 283, 425, 638, 319, 479, 719, 1079, 1619, 2429, 3644, 1822, 911, 1367, 2051, 3077, 4616, 2308, 1154, 577, 866, 433, 650, 325, 488, 244, 122, 61, 92, 46, 23, 35, 53, 80, 40, 20, 10, 5, 8, 4, 2, 1, 2]$$

$$[0, 0]$$

$$[-5, -7, -10, -5]$$

$$[-6, -3, -4, -2, -1, -1]$$

$$[-17, -25, -37, -55, -82, -41, -61, -91, -136, -68, -34, -17]$$

$$[-11, -16, -8, -4, -2, -1, -1] \quad \textbf{(5)}$$

>

>

Haodai B HW 14

1) $x(n) = x(n-1) + y(n-1)^2 - \frac{1}{16}$ (f) $\quad y(n) = x(n-1)^2 + y(n-1) - \frac{1}{9}$ (g)

$(x,y) = (x+y^4 - \frac{1}{16},\ x^2+y-\frac{1}{9})$ $\quad x = x+y^4-\frac{1}{16}$ $\quad y = x^2+y-\frac{1}{9}$ $\quad x = \pm\frac{1}{3}$ $\quad y = \frac{\pm 1}{2}$

$(-\frac{1}{3}, -\frac{1}{2})$ $(-\frac{1}{3}, \frac{1}{2})$ $(\frac{1}{3}, -\frac{1}{2})$ $(\frac{1}{3}, \frac{1}{2})$

$J = \begin{pmatrix} f_x & f_y \\ g_x & g_y \end{pmatrix} = \begin{pmatrix} 1 & 4y \\ 2x & 1 \end{pmatrix}$

unstable $(-\frac{1}{3}, -\frac{1}{2}) = \begin{pmatrix} 1-\lambda & -2 \\ -\frac{1}{3} & 1-\lambda \end{pmatrix}$ $1-2\lambda+\lambda^2-\frac{4}{3}$ $\lambda^2-2\lambda-\frac{1}{3}$ $3\lambda^2-6\lambda-1$ $\lambda = \frac{6 \pm \sqrt{b^2-4ac}}{6} > 1$

" $(-\frac{1}{3}, \frac{1}{2}) = \begin{pmatrix} -\lambda & 2 \\ -\frac{2}{3} & 1-\lambda \end{pmatrix}$ $1-2\lambda+\lambda^2+\frac{4}{3}$ $\lambda^2-2\lambda+\frac{7}{3}$ $3\lambda^2-6\lambda+7$ $|\lambda| \approx 1.527$

" $(\frac{1}{3}, -\frac{1}{2}) = \begin{pmatrix} 1-\lambda & -2 \\ \frac{2}{3} & 1-\lambda \end{pmatrix}$ $1-2\lambda+\lambda^2+\frac{4}{3}$ $|\lambda| \approx 1.527$

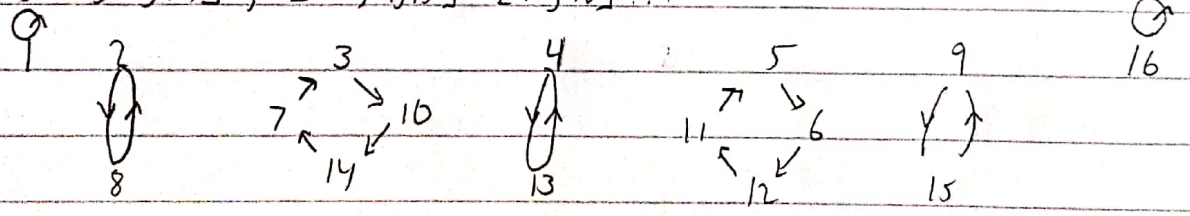
" $(\frac{1}{3}, \frac{1}{2}) = \begin{pmatrix} 1-\lambda & 2 \\ \frac{2}{3} & 1-\lambda \end{pmatrix}$ $1-2\lambda+\lambda^2-\frac{4}{3}$ All value of $|\lambda|$ are not ≤ 1 unstable for all fixed points.

2) $x \to x^3 \bmod 17$ $\quad [0,1]$, $[2,8,7]$, $[3,10,14,7,3]$

$[4,13,4]$, $[5,6,12,11,5]$, $[6,12,11,5,6]$, $[7,3,10,14,7]$, $[8,2,8]$

$[9,15,9]$, $[10,14,7,3,10]$, $[11,5,6,12,11]$, $[12,11,5,6,12]$, $[13,9,13]$

$[14,7,3,10,14]$, $[15,9,15]$ $[16,16]$



3) i) $10 \to [10,(9,81,63,27,45,9)]$ $\quad 28 \to [28,54,(9,81,13,27,45,9)]$

$27 \to ([27,45,9,81,63,27])$ $\quad 15 \to [15,36,(27,45,9,81,63,27)]$

$86 \to [86,18,(63,27,45,9,81,63)]$

$73 \to [73,36,(27,45,9,81,63,27)]$ $\quad [\ \ ] \to$ Trajectory

$14 \to [14,(27,45,9,81,63,27)]$ $\quad ( ) \to$ Ending Cycle

$99 \to [(99,0]$

$51 \to [51,36,(27,45,9,81,63,27)]$

$12 \to [12,(9,81,63,27,45,9)]$

3) ii) 234 -> [234, 198, 792, 693, 594, (495, 495)]

699 -> [699, 297, 693, 594, (495, 495)]

911 -> [792, 693, 594, (495, 495)]

483 -> [483, (495, 495)]

714 -> [714, 594, (495, 495)]

3) iii) 1234 -> [1234, 3087, 8352, (6174, 6174)]

4921 -> [4921, 8172, 7443, 3996, 6264, 4176, (6174, 6174)]

6941 -> [6942, (7173, 6354, 3087, 8343, 5085, 7992, 7173)]