```
require 'plot numeric trig'

NB. common utility
mp=: +/ . *

NB. *******sabun*********************
NB. lorenz(1)
dt=: 0.02  NB. or 0.01
NB.'noaxes' plot {@|:  10 50 8r3 lorenz1 0.1 0.2 0.3

lorenz1=: 4 : 0
dt=. 0.01   NB. dt
's r b'=. x  NB. sigma  gamma b
'X0 Y0 Z0'=. y
NB. using only once /next XX,YY,ZZ
XX=.X0 + dt * s *(Y0-X0)
YY=.Y0 + dt * ((r*X0)-(Y0+X0*Z0))
ZZ=.Z0 + dt * ((X0*Y0)-b*Z0)
XX,YY,ZZ
)



  lz=:4 : 0
NB. Lorenz attracta
's r b'=. x    NB. parameter NB. 10 8r3 28
'xx yy zz'=: y NB. initial 5 8 10 or 1 1 1
X=. xx + dt*s*(yy-xx)
Y=. yy + dt*((r*xx)-(yy+xx*zz))
Z=. zz + dt*((xx*yy)-b*zz)
X,Y,Z
)
NB. ----------------------------
NB. Lorenz(2)
NB.maybe C.Reiter
NB. Lorenz2
''`X Y Z'=: (0&{)`(1&{)`(2&{)
's b r'=: 10 8r3 28
```

```
dx=: s * (Y - X)
dy=: (X * r - Z) - Y
dz=: (X*Y) - b*Z

dt2=: 0.005
I=: + (dt * dx, dy, dz)

NB. plot {@|: I^:(i.<le4) 0 1 0  NB. <1e4 is 10000

NB. Usage:  'noaxes' plot <"1|: I^:(i.5000) 0 1 0

NB. ---------------------
NB. Muta


NB. ===========================================
NB. Matrix method of Lorenz

NB. Runge Kutter
NB. by C.Reiter


   rk=:1 : 0
:
h2=. -: x
k1=. u y
k2=. u y + h2*k1
k3=. u y + h2*k2
k4=. u y + x *k3
y+(x%6)*k1+k4++:k2+k3
)


NB. lorenz(3)
NB. x is 0.02
NB. u is 10 8r3 28

lorenz3=: 1 : 0
'S B R'=. m                                          NB. s b r
M=: ((-S),S,0 0 0),(R,_1 0 0 _1),: 0 0 ,(-B),1 0     NB. make matrix
```

```
M&(+/ . *)@[] , ({. * }.))                          NB. 計算部分
)


mk_init=: ] , {. * }.
NB. Usage  'noaxes' plot {@|: 0.002 (10 8r3 28 lz) rk ^:(i.10000) 0.1 0.2 0.3

lorenz31=: 1 : 0
NB. Usage: 'noaxes' plot {@|: 0.02 (10 8r3 28 lorenz31) rk ^:(i.1000) 0.1 0.2 0.3
'S B R'=. m                                    NB. s b r
M=: ((-S),S,0 0 0),(R,_1 0 0 _1),: 0 0 ,(-B),1 0   NB. make matrix
M&mp@mk_init                          NB. 計算部分
NB. same lorenz3
)



NB. lorenz32=: M@mp@mk_init

NB. Usage: lorenz31 10 8r3 28



NB. rossler
rossler=: 1 : 0
'a b c '=. m                                      NB. s b r
M2=. (0 _1 _1 0 0),(1,a,0 0 0),: 0 0 ,(-c),1 ,b   NB. make matrix
M2&mp@mk_init2                          NB. 計算部分
)

mk_init2=: ] , ({. * {:),1:




NB. ************************************
NB. some Muta's sample equation
  Muta0=: 4 : 0
'a b'=: x    NB. parameter
'xx yy'=: y
```

```
X=. xx + dt* (xx* (>:a*b)) - b*xx *yy
Y=. yy+ dt* (yy*(<:b))+ b* ^&2 X
X,Y
)



  Muta1=: 4 : 0
'a b'=: x    NB. parameter
'xx yy'=: y
X=. xx + dt*(yy + a*xx)
Y=. yy + dt* ( b+ ^&2 X)
X,Y
)

init0=: 1.02 0.86
init1=: 0.57 1.55
init2=: 0.806  _0.85
```