sheet8

October 17, 2017

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In [1]: using PyPlot
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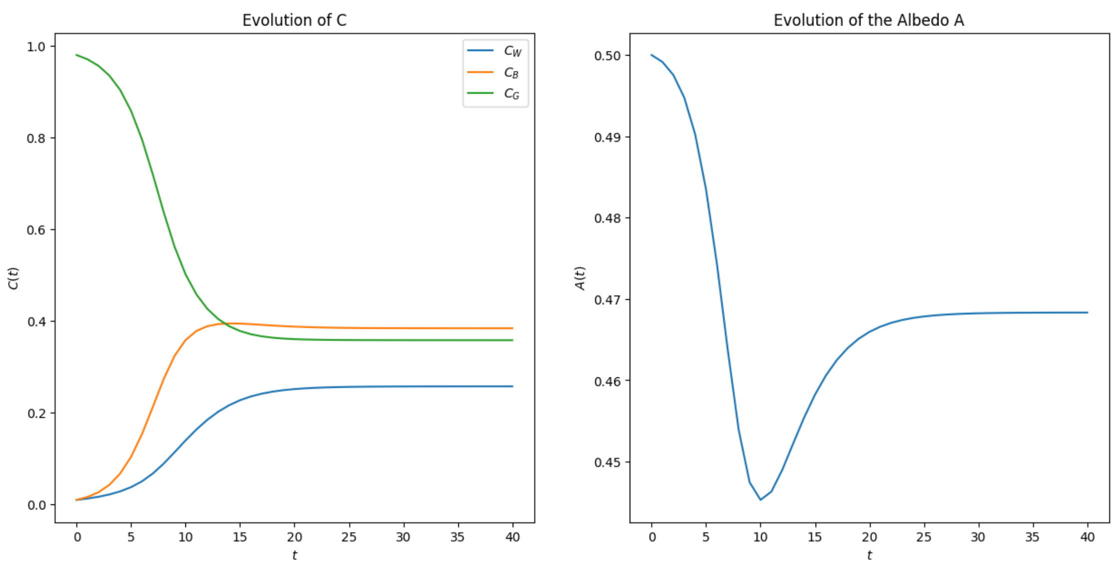
0.1 11. The daisy world system

```
In [32]: #free parameters
         s0=1380.
         aw=0.75
         ab=0.25
         ag=0.5
         d=0.3
         delta=5.67e-8
         t0=295.7
         b=0.003265
         k=0.6
         cb=Float64[]
         push!(cb,0.01)
         cw=Float64[]
         push!(cw,0.01)
         cg=Float64[]
         a=Float64[]

         print("L: "); l = parse(Float64,readline(STDIN))
         dt=1
         tmax=40

         #circle of life: cb,cw,cg->albedo->blackbodytemp->surfacetemp->daisytemp->birthrates-
         for i in 1:dt:tmax
             push!(cg,1.-cb[i]-cw[i])
             push!(a,ag*cg[i]+ab*cb[i]+aw*cw[i])
             te=l*s0/(4.*delta)*(1.-a[i])
             ts=2.*te
             tw=(1.-k)*l*s0/(4.*delta)*(a[i]-aw)+ts
             tb=(1.-k)*l*s0/(4.*delta)*(a[i]-ab)+ts
             bw=1.-b*(t0-tw^0.25)^2.
             bb=1.-b*(t0-tb^0.25)^2.
             push!(cw,dt*cw[i]*(bw*cg[i]-d+1./dt))
             push!(cb,dt*cb[i]*(bb*cg[i]-d+1./dt))
         end
```

```julia
#to add tmax value
push!(cg,1.-cb[length(cb)]-cw[length(cw)])
push!(a,ag*cg[length(cg)]+ab*cb[length(cb)]+aw*cw[length(cw)])

#ploting commands
figure(1,figsize=(15,7))
#2figs in line, linenumber=1, rownumber=2,number of figure=1
subplot(121)
x=0:dt:tmax
title("Evolution of C")
plot(x,cw[x+1],label=L"$C_W$")
plot(x,cb[x+1],label=L"$C_B$")
plot(x,cg[x+1],label=L"$C_G$")
ylabel(L"$C(t)$")
xlabel(L"$t$")
legend()
subplot(122)
title("Evolution of the Albedo A")
plot(x,a)
ylabel(L"$A(t)$")
xlabel(L"$t$")
```

```
L: STDIN> 1.2
```




```
Out[32]: PyObject <matplotlib.text.Text object at 0x7f9e2e8bbad0>
```

0.2 12. The predator-prey problem

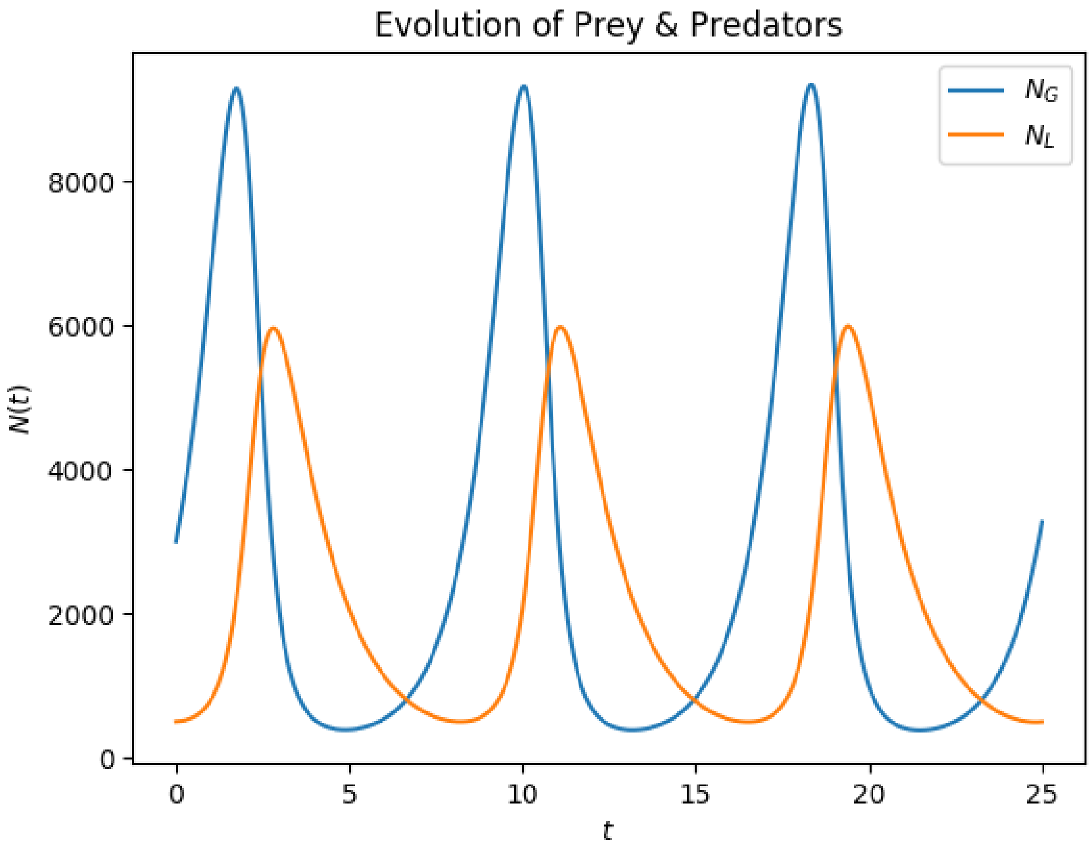
0.3 a)

The growth of the predators depends on the available prey + the birthrate of the predator itself, whereas the mortality rate depends exclusively on the associated deathrate of the predator. Both factors are obviosly connected to the groupsize of the predators.

The growth of the prey on the other hand depends exclusevly on its birthrate, whereas theyr mortality rate is the product of the groupsize of the predator (who is killing the prey) and theyr own deathrate. Obviously both factors have to be conneted to the groupsize of the prey aswell.

0.4 b)

In [92]:
```
dt=0.001
tmax=25.
x=0.:dt:tmax
ng=Array{Float64}(length(x)+1)
nl=Array{Float64}(length(x)+1)
ng[1]=3000
nl[1]=500
bg=1.1
bl=0.00025
dg=0.0005
dl=0.7

for (i,t) in enumerate(x)
    ng[i+1]=ng[i]*(bg-dg*nl[i]+1./dt)*dt
    nl[i+1]=nl[i]*(bl*ng[i]-dl+1./dt)*dt
end

i=1:length(x)
title("Evolution of Prey & Predators")
plot(x[i],ng[i],label=L"$N_G$")
plot(x[i],nl[i],label=L"$N_L$")
ylabel(L"$N(t)$")
xlabel(L"$t$")
legend()
```



Out[92]: PyObject <matplotlib.legend.Legend object at 0x7f9e2c769850>

11.

$$\frac{dC_w}{dt} = C_w(b_w C_G - D)$$

$$\frac{C_w(t+\Delta t) - C_w(t)}{\Delta t} = C_w(t)(b_w C_G(t) - D)$$

$$\boxed{C_w(t+\Delta t) = \Delta t\, C_w(t)\left(b_w C_G(t) - D + \frac{1}{\Delta t}\right)}$$

same for C_B

$$\boxed{C_B(t+\Delta t) = \Delta t\, C_B(t)\left(b_B C_G - D + \frac{1}{\Delta t}\right)}$$

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$$\frac{dN_L}{dt} = b_L N_L N_G - d_L N_L$$

$$\frac{N_L(t+\Delta t) - N_L(t)}{\Delta t} = b_L N_L(t) N_G(t) - d_L N_L(t)$$

$$\boxed{\begin{aligned} N_L(t+\Delta t) &= N_L(t)\left(b_L N_G(t) - d_L + \frac{1}{\Delta t}\right)\Delta t \\ N_G(t+\Delta t) &= N_G(t)\left(b_G - d_G N_L(t) + \frac{1}{\Delta t}\right)\Delta t \end{aligned}}$$