>

Cobweb (diagramme en toile d'arraignée)

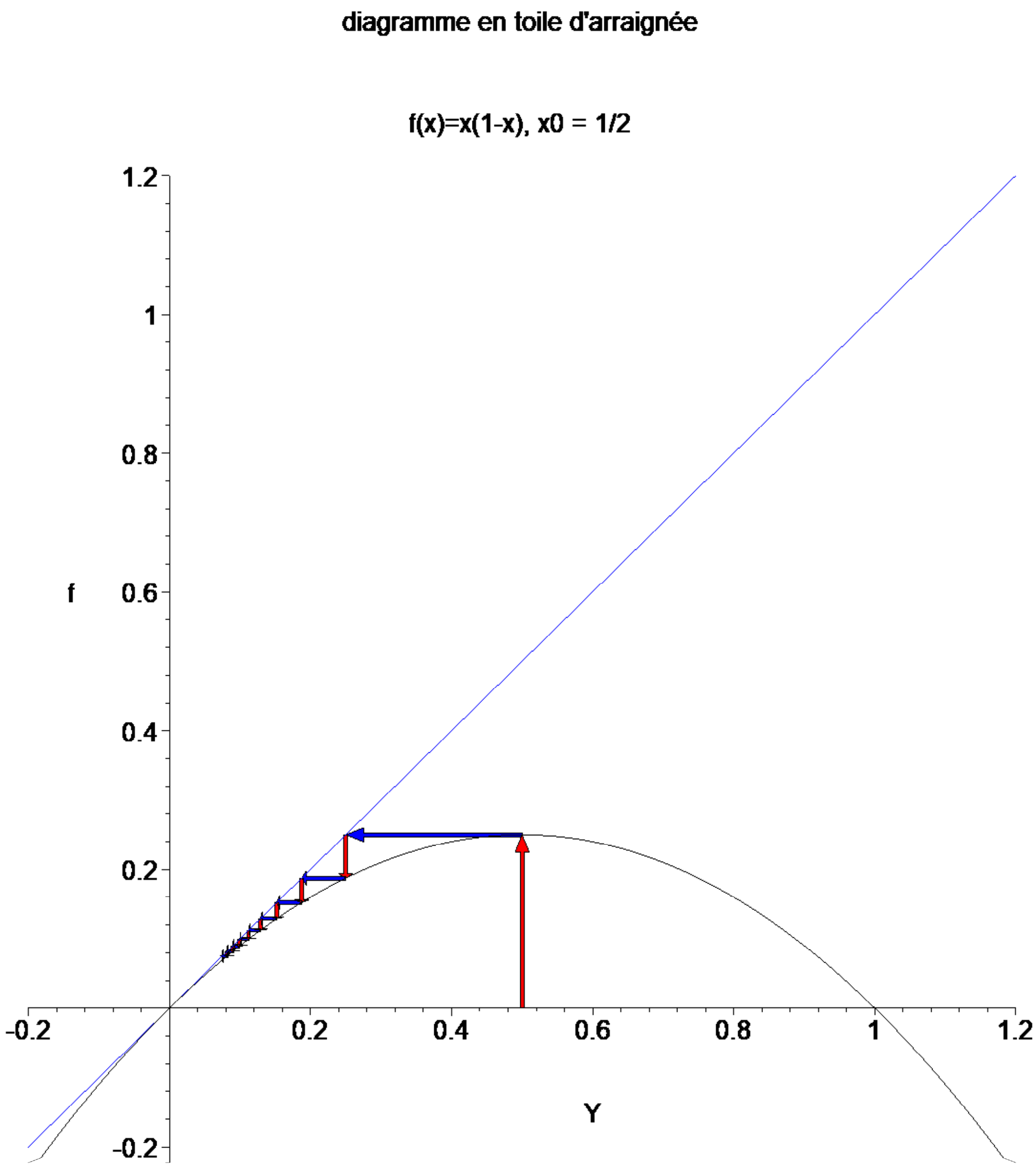
Toile d’araignée de dynamique logistique avec r =1

```
> ####################################
  Conditions initiales f,x0
  restart: N:=10:t0:=0:x0:=0.5:
  Digits:=4:t1:=3: h:=(t1-t0)/N:
  #####################
  f:=Y*(1-Y):G:=f-Y:
  ###############################################
  ########
  x := array(1..N+1):
  nn := array(1..N+1):
  t := array(1..N+1):
  Y(1):=x0: T(1):=t0:
  nn[1]:=0:
  t[1]:=T(1):
  x[1]:=Y(1):
  fn:=eval(G, [T=T[1],Y=T(1)]):
  for n from 1 to N do
  T(n+1):= T(n)+h; fn:=eval(G,
  [Y=Y(n),T=T(n)]);
  Y(n+1):=eval(f, [Y=Y(n),T=T(n)]);
  t[n+1]:=T(n+1);
  x[n+1]:=Y(n+1);
  nn[n+1]:=n;
  end do:
```

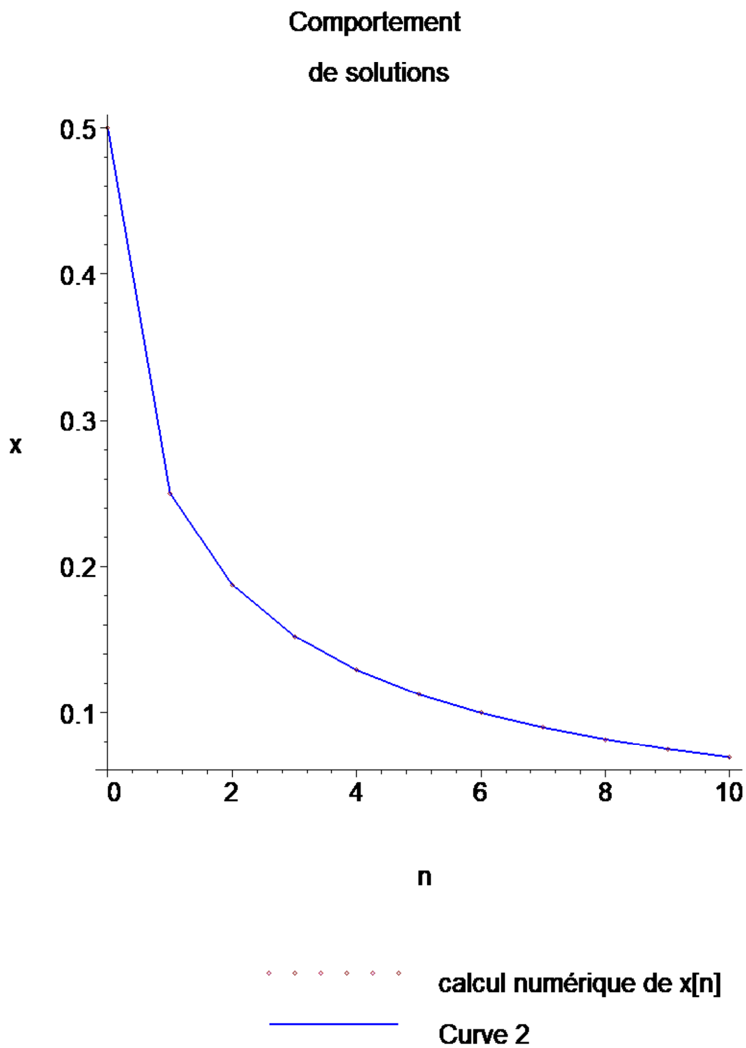
```
#############################################
########
with(plots):
pointsx:=[seq([nn[n],x[n]],n=1..N+1)]:
R1:=plot(pointsx, style=point,
labels=["n", "x"],
legend="calcul numérique de x[n]"):
R2:=plot(pointsx, color=blue,
labels=["n", "x"],
 style=line,thickness=2,
title="Comportement
de solutions", scaling=unconstrained):
########################################
with(plottools):
F:=plot([f,Y], Y=-.2..1.2,
title="diagramme en toile d'arraignée

f(x)=x(1-x), x0 = 1/2",
 style=[line],color=[black, blue, red,
magenta,green],
labels=[Y,"f"]):
#############################################
##########
A1 := arrow([Y(1),0], vector([0,Y(2)]),
.005, .02, .1,
color=red):
A2:=arrow([Y(1),Y(2)],
vector([Y(2)-Y(1),0]), .005, .02, .1,
color=blue):
```

```
A3 := arrow([Y(2),Y(2)],
vector([0,Y(3)-Y(2)]), .005, .02, .1,
color=red):
#A4:=arrow([Y(2),Y(3)],
vector([Y(3)-Y(2),0]), .005, .02,
.1,color=blue):
########################
A5:=seq(PLOT(arrow([Y(i),Y(i)],
vector([0,Y(i+1)-Y(i)]),
.005, .02, .1, color=red)),i=2..N-1):
A6:=seq(PLOT(arrow([Y(i),Y(i+1)],
vector([Y(i+1)-Y(i),0]),
.005, .02, .1, color=blue)),i=2..N-1):
plots[display](F,
A1,A2,A3, A5,A6);
print("Les valeurs de [n, x_n]=",
pointsx,"points fixes=",solve(f=Y));
display(R1,R2);
> #####################################
```



"Les valeurs de [n, x_n]=", [[0, 0.5], [1, 0.25], [2, 0.1875], [3, 0.1523], [4, 0.1291], [5, 0.1124], [6, 0.09977], [7, 0.08981], [8, 0.08175], [9, 0.07506], [10, 0.06942]], "points fixes=", 0, 0

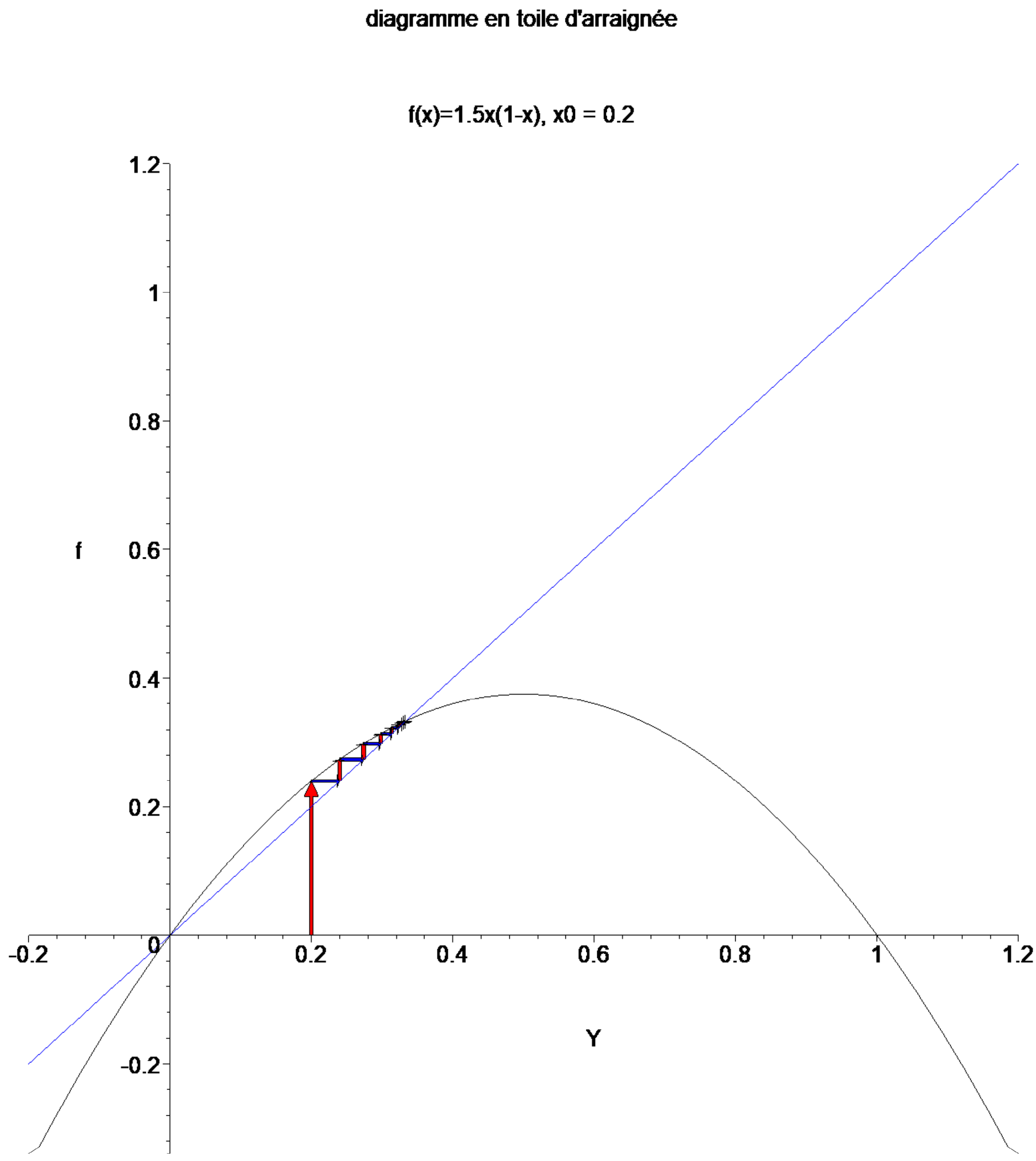


Cobweb (diagramme en toile d'arraignée)

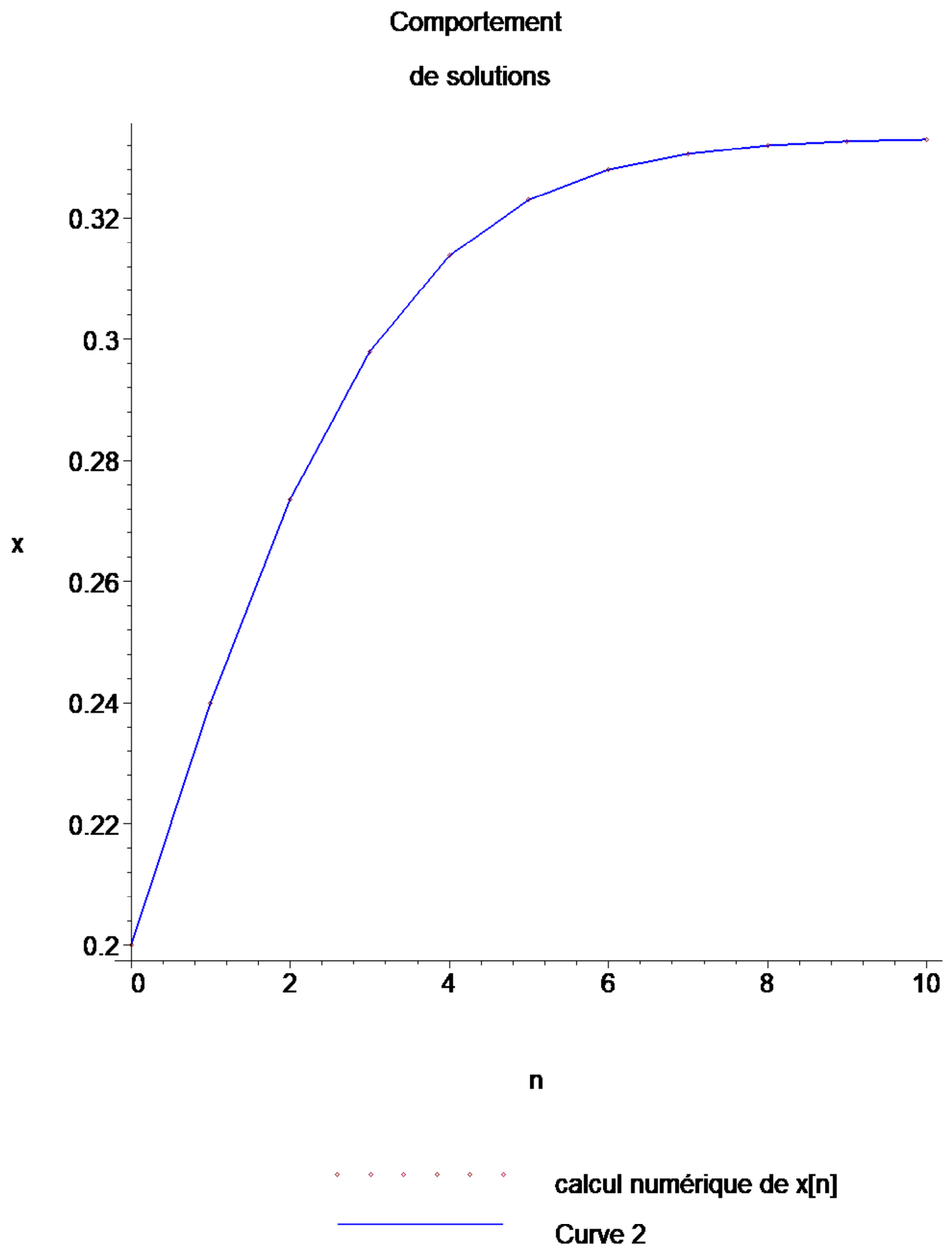
Toile d'araignée de dynamique logistique avec r =3/2

```
> ####################################
  Conditions initiales f,x0
  restart: N:=10:t0:=0:x0:=0.2:
  Digits:=4:t1:=3: h:=(t1-t0)/N:
  #####################
  f:=(3/2)*Y*(1-Y):G:=f-Y:
```

```
vector([Y(i+1)-Y(i),0]),
.005, .02, .1, color=blue)),i=2..N-1):
plots[display](F,
A1,A2,A3, A5,A6);
print("Les valeurs de [n, x_n]=",
pointsx,"points fixes=",solve(f=Y));
display(R1,R2);
```

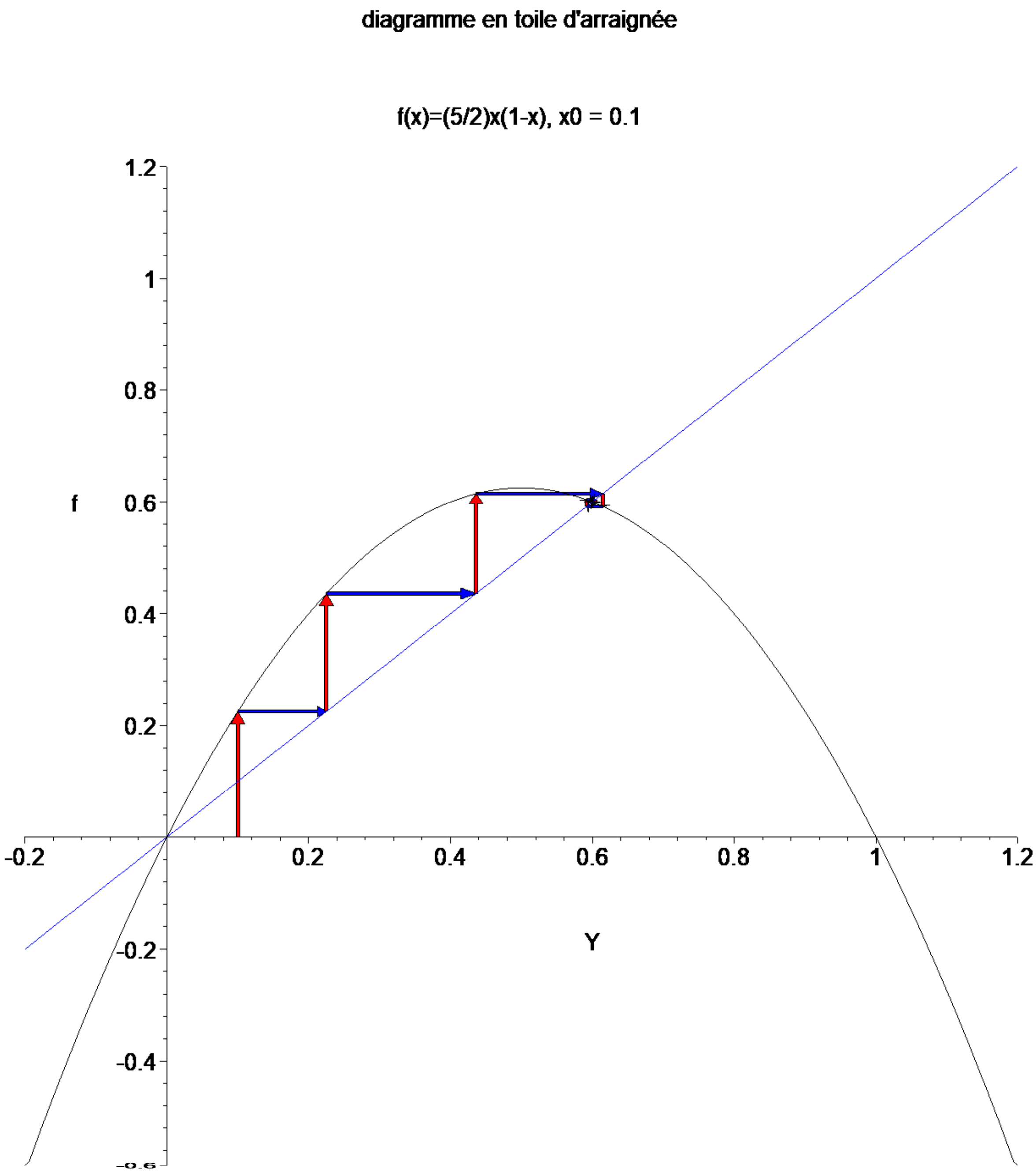


"Les valeurs de [n, x_n]=", [[0, 0.2], [1, 0.2400], [2, 0.2736], [3, 0.2980], [4, 0.3138], [5, 0.3230], [6, 0.3280], [7, 0.3306], [8, 0.3320], [9, 0.3327], [10, 0.3330]], "points fixes=", 0, $\frac{1}{3}$

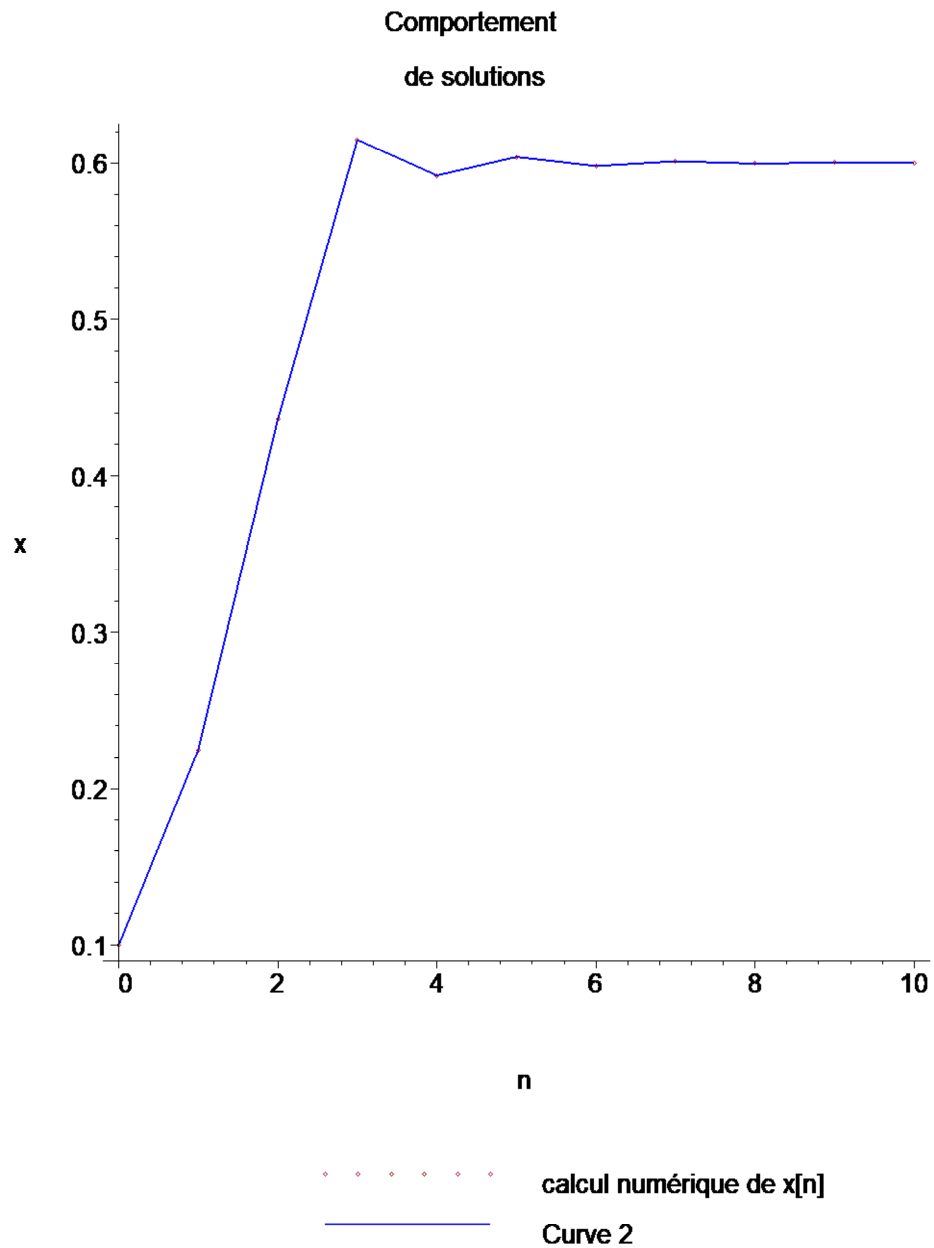


\> ##

Cobweb (diagramme en toile d'arraignée)



"Les valeurs de [n, x_n]=", [[0, 0.1], [1, 0.2250], [2, 0.4360], [3, 0.6148], [4, 0.5920], [5, 0.6038], [6, 0.5980], [7, 0.6010], [8, 0.5995], [9, 0.6002], [10, 0.6000]], "points fixes=", 0, $\frac{3}{5}$

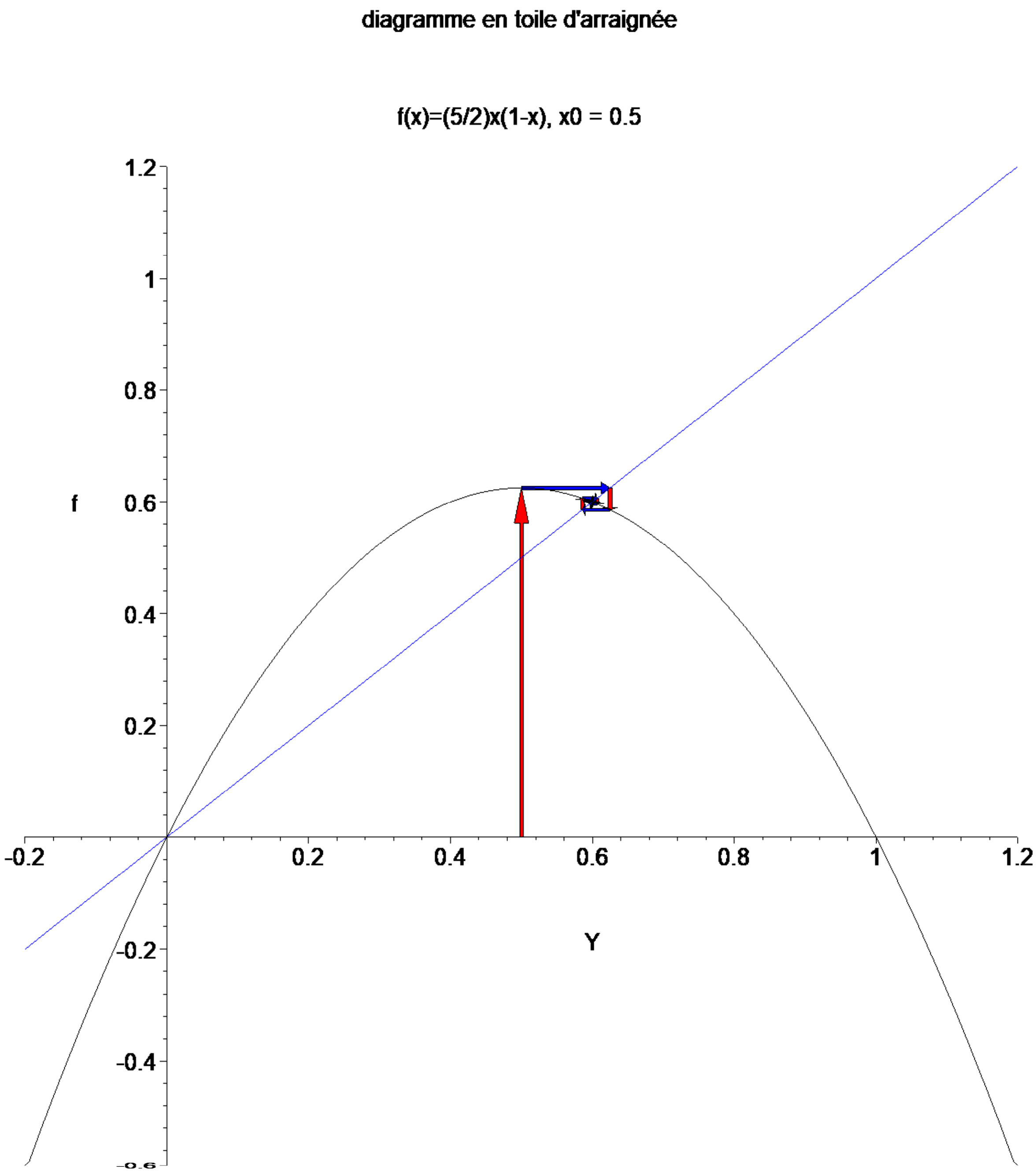



```
> ######################################
```

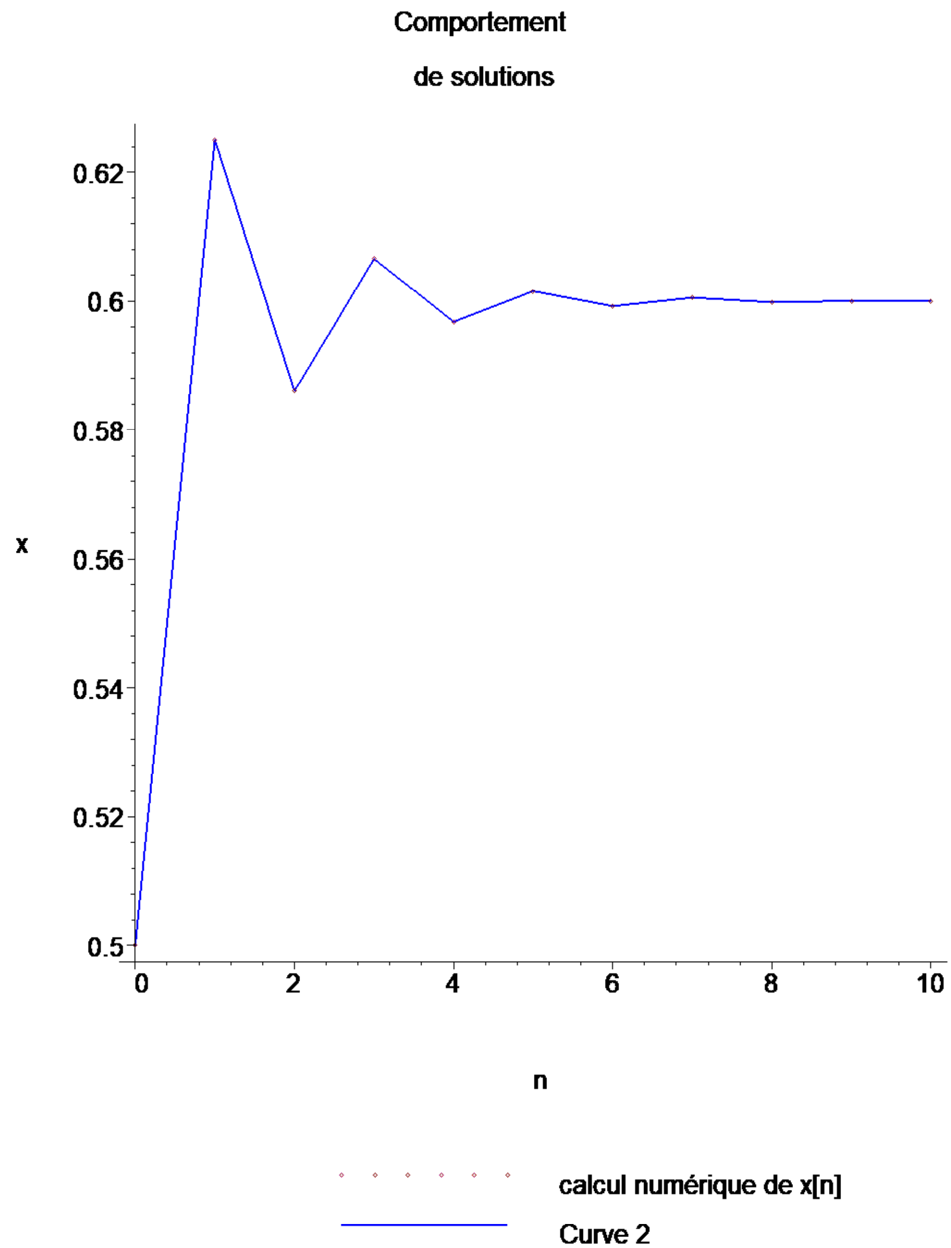
Cobweb (diagramme en toile d'arraignée)

Toile d'araign´ee de dynamique logistique avec r =5/2

```
> ####################################
  Conditions initiales f,x0
  restart: N:=10:t0:=0:x0:=0.5:
```



"Les valeurs de [n, x_n]=", [[0, 0.5], [1, 0.6250], [2, 0.5860], [3, 0.6065], [4, 0.5968], [5, 0.6015], [6, 0.5992], [7, 0.6005], [8, 0.5998], [9, 0.6000], [10, 0.6000]], "points fixes=", 0, $\frac{3}{5}$



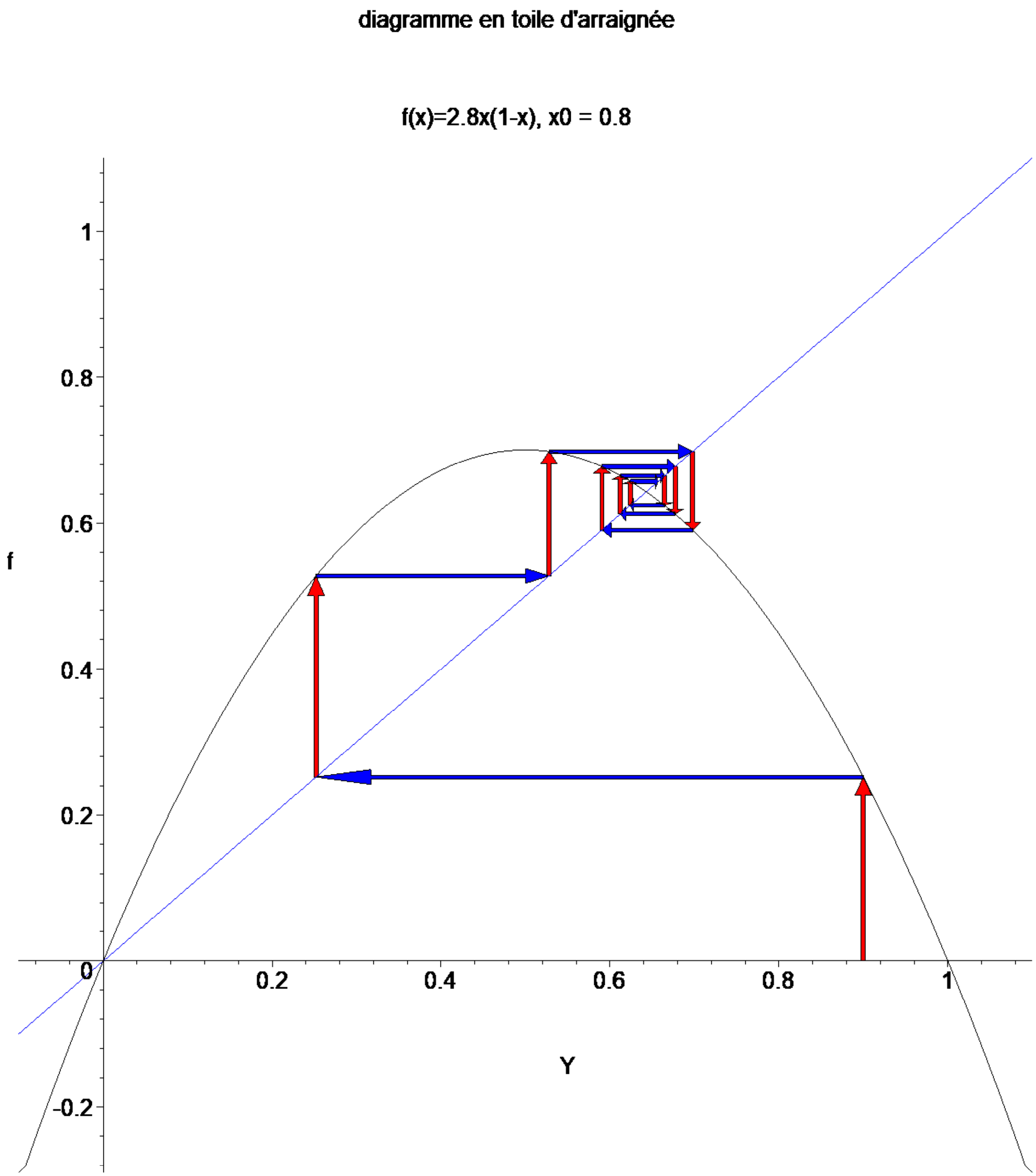
> ######################################

> ######################################

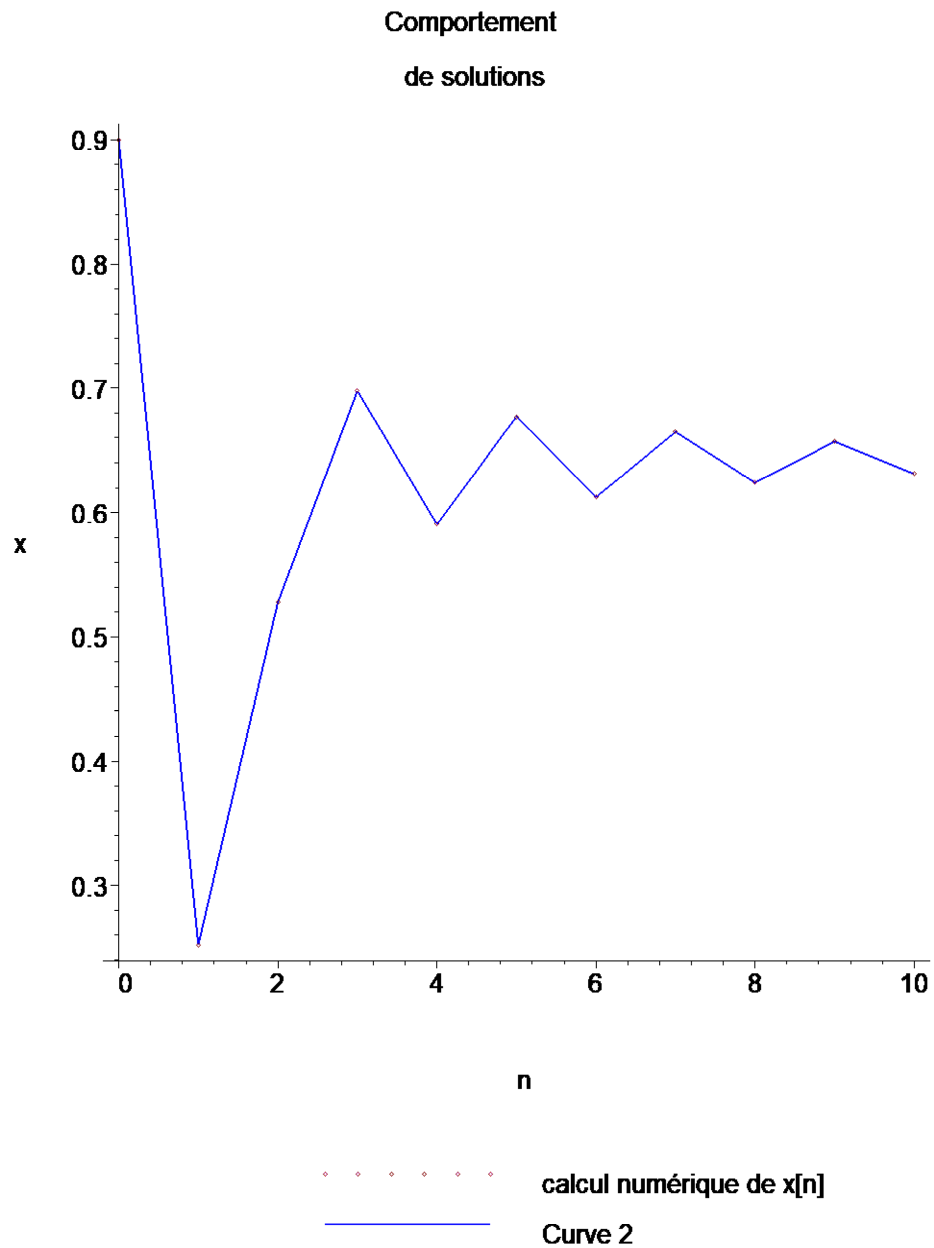
Cobweb (diagramme en toile d'arraignée)

Toile d'araign´ee de dynamique logistique avec r =2.8

> ####################################
Conditions initiales f,x0



"Les valeurs de [n, x_n]=", [[0, 0.9], [1, 0.252], [2, 0.5278], [3, 0.6978], [4, 0.5905], [5, 0.6770], [6, 0.6124], [7, 0.6647], [8, 0.6241], [9, 0.6569], [10, 0.6311]], "points fixes=", 0., 0.6429

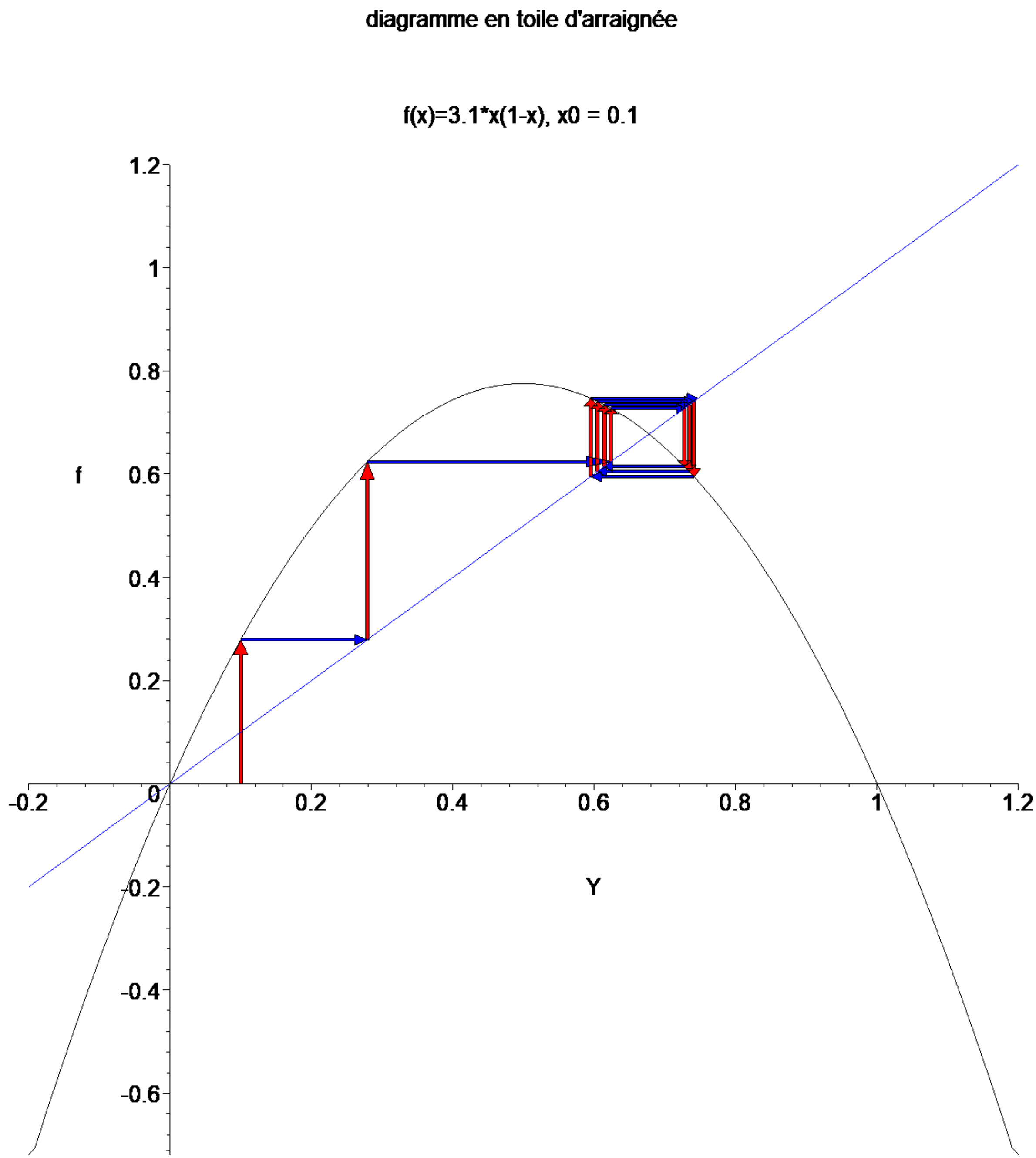


>

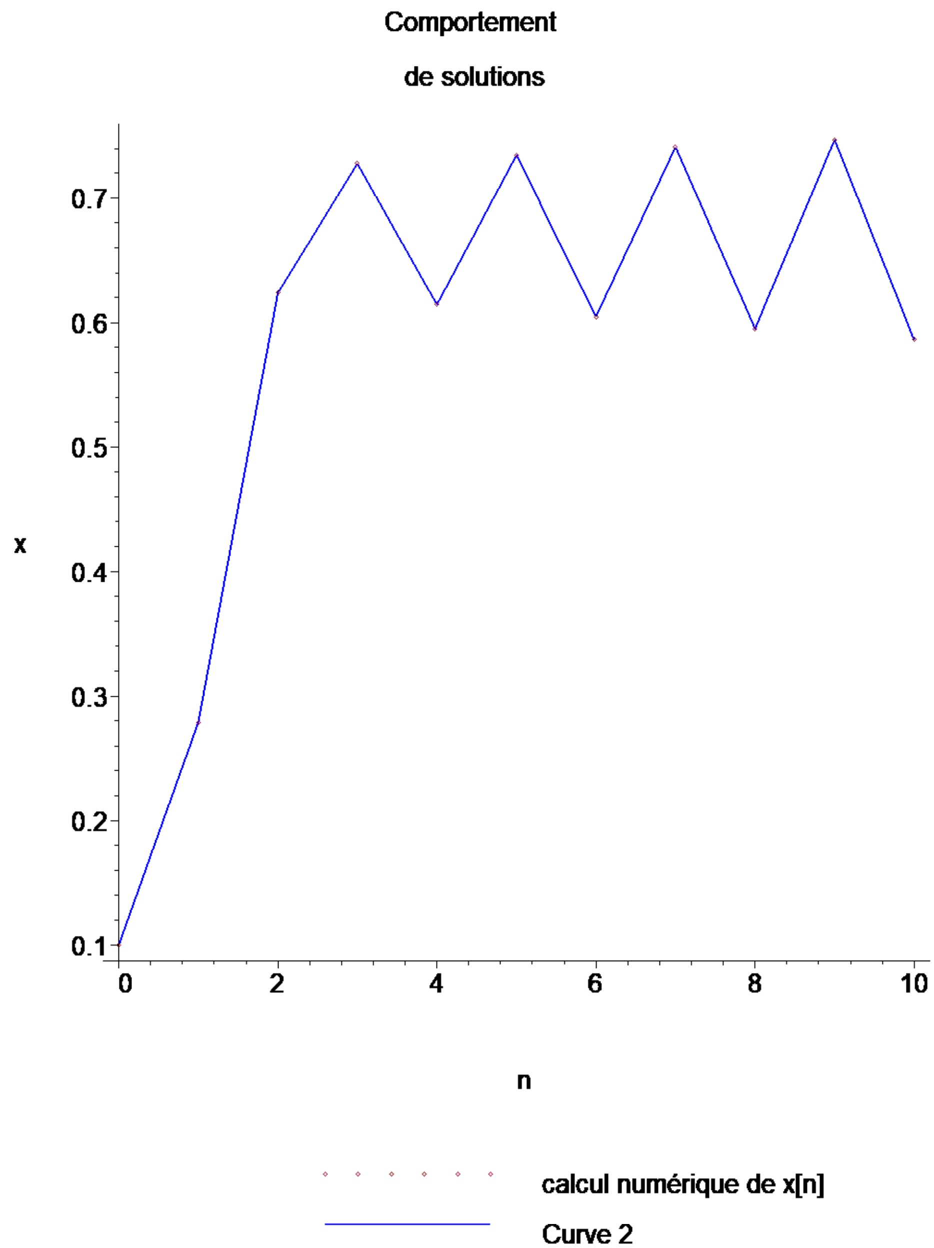
Cobweb (diagramme en toile d'arraignée)

Toile d'araignée de dynamique logistique avec r =3,1
la suite oscille, pour n assez grand, entre deux valeurs

```
> ####################################
  Conditions initiales f,x0
```



"Les valeurs de [n, x_n]=", [[0, 0.1], [1, 0.279], [2, 0.6237], [3, 0.7276], [4, 0.6144], [5, 0.7344], [6, 0.6048], [7, 0.7409], [8, 0.5952], [9, 0.7468], [10, 0.5862]], "points fixes=", 0., 0.6774

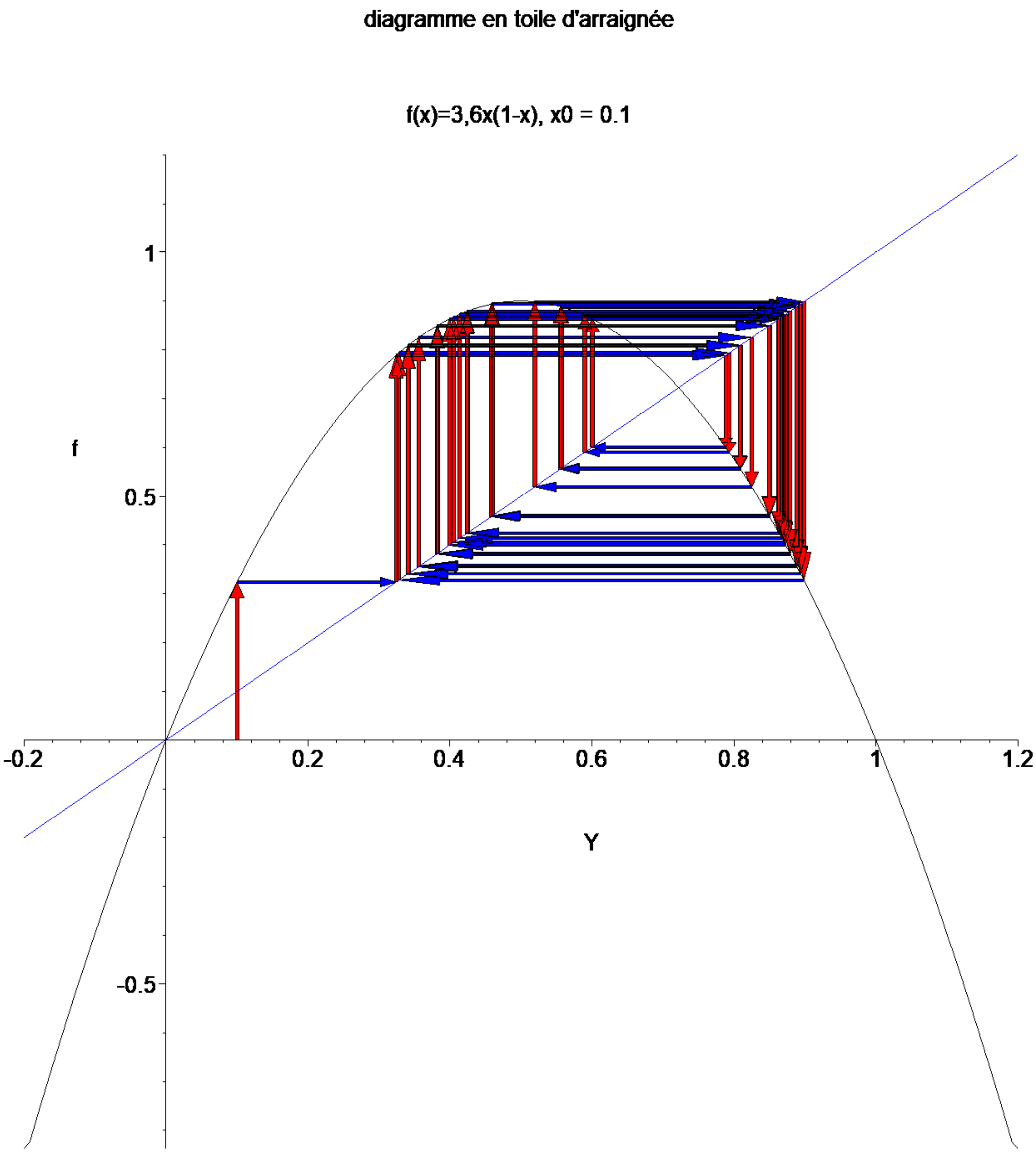


> ######################################

Cobweb (diagramme en toile d'arraignée)

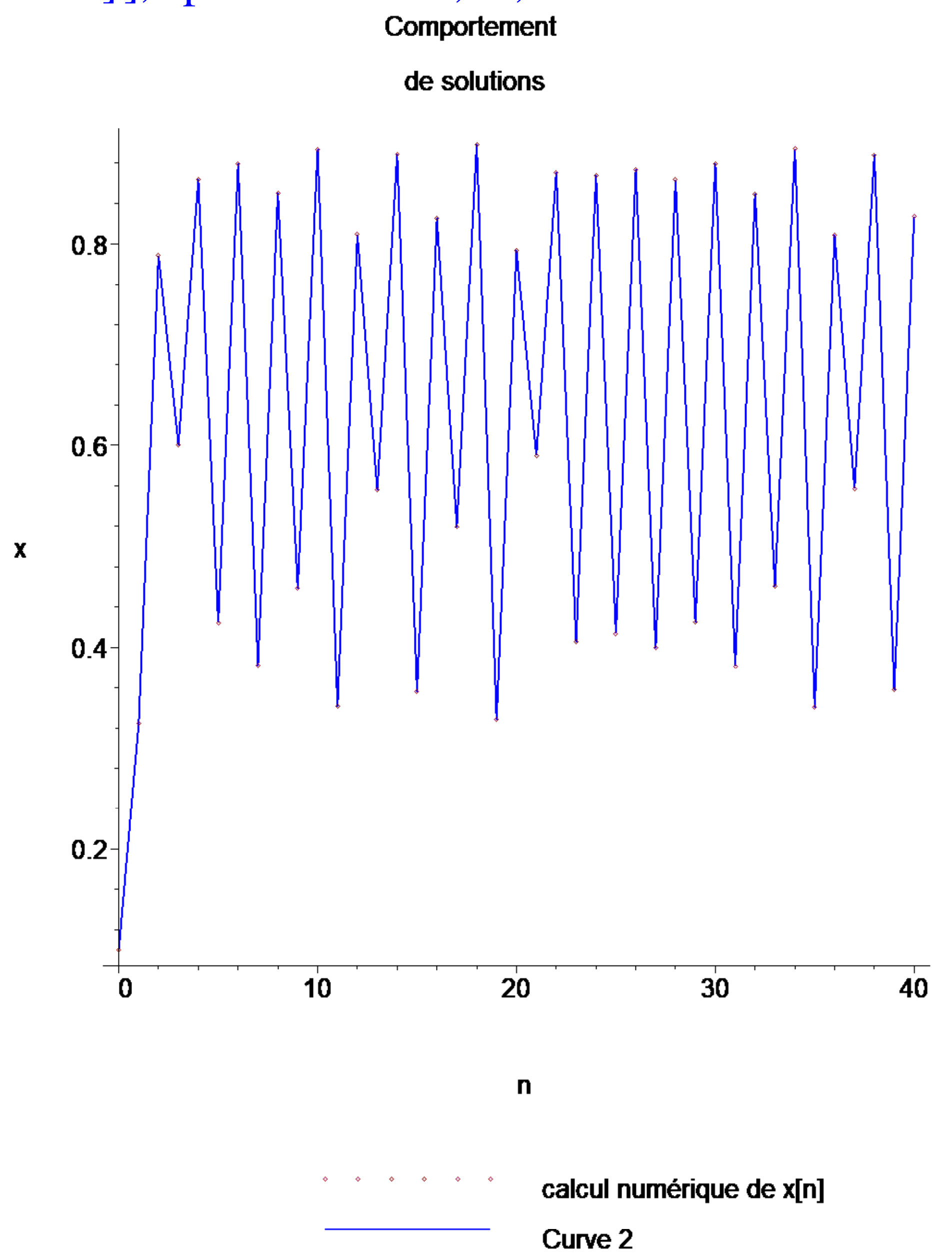
Toile d'araignée de dynamique logistique avec r =3,6 :
la suite oscille, pour n assez grand, entre quatre
valeurs

> ####################################



"Les valeurs de [n, x_n]=", [[0, 0.1], [1, 0.324], [2, 0.7884], [3, 0.6005], [4, 0.8636], [5, 0.4241], [6, 0.8791], [7, 0.3827], [8, 0.8503], [9, 0.4583], [10, 0.8939], [11, 0.3414], [12, 0.8093], [13, 0.5555], [14, 0.8888], [15, 0.3558], [16, 0.8251], [17, 0.5195], [18, 0.8986], [19, 0.3280], [20, 0.7934], [21, 0.5900], [22, 0.8708], [23, 0.4050],

[24, 0.8676], [25, 0.4136], [26, 0.8730], [27, 0.3992],
[28, 0.8633], [29, 0.4248], [30, 0.8795], [31, 0.3816],
[32, 0.8496], [33, 0.4601], [34, 0.8942], [35, 0.3406],
[36, 0.8086], [37, 0.5573], [38, 0.8881], [39, 0.3578],
[40, 0.8273]], "points fixes=", 0., 0.7222

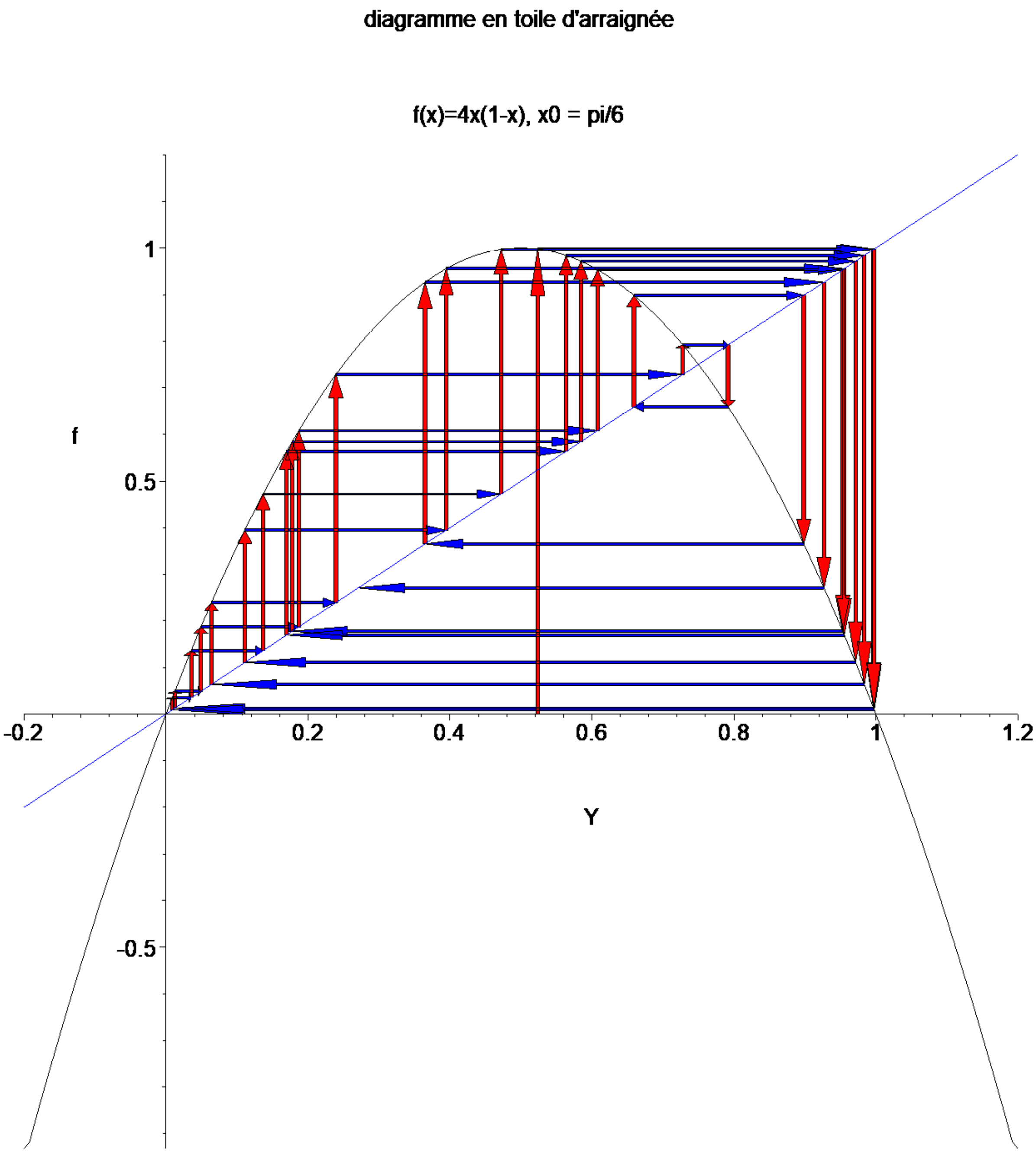


>

Cobweb (diagramme en toile d'arraignée)

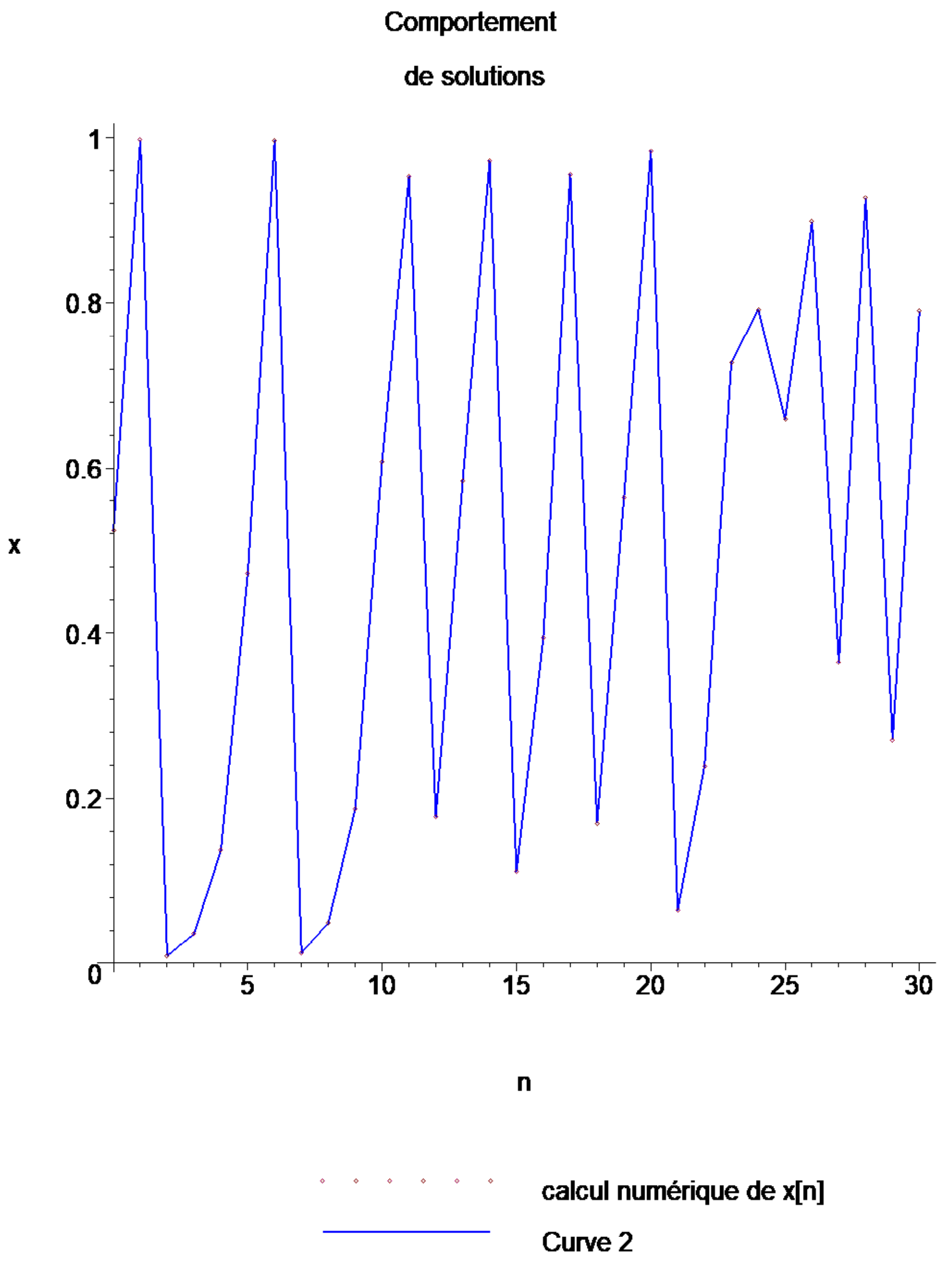
Toile d'araignée de dynamique logistique avec r =4 :
le comportement est chaotique si le coefficient de reproduction est très grand (r > 3, 750)

```
> #####################################
  Conditions initiales f,x0
  restart: N:=30:t0:=0:x0:=Pi/6.:
  Digits:=5:t1:=3: h:=(t1-t0)/N:
  #####################
  f:=4*Y*(1-Y):G:=f-Y:
  ##############################################
  ########
  x := array(1..N+1):
  nn := array(1..N+1):
  t := array(1..N+1):
  Y(1):=x0: T(1):=t0:
  nn[1]:=0:
  t[1]:=T(1):
  x[1]:=Y(1):
  fn:=eval(G, [T=T[1],Y=T(1)]):
  for n from 1 to N do
  T(n+1):= T(n)+h; fn:=eval(G,
  [Y=Y(n),T=T(n)]);
  Y(n+1):=eval(f, [Y=Y(n),T=T(n)]);
  t[n+1]:=T(n+1);
  x[n+1]:=Y(n+1);
  nn[n+1]:=n;
```



"Les valeurs de [n, x_n]=", [[0, 0.5235987758], [1, 0.99776],
[2, 0.0089400], [3, 0.035440], [4, 0.13674], [5, 0.47216],
[6, 0.99688], [7, 0.012441], [8, 0.049144], [9, 0.18692],
[10, 0.60792], [11, 0.95340], [12, 0.17771], [13, 0.58452],
[14, 0.97144], [15, 0.11098], [16, 0.39465], [17, 0.95560],
[18, 0.16972], [19, 0.56368], [20, 0.98376], [21, 0.063904],

[22, 0.23928], [23, 0.72812], [24, 0.79184], [25, 0.65932], [26, 0.89848], [27, 0.36486], [28, 0.92696], [29, 0.27082], [30, 0.78992]], "points fixes=", 0, $\frac{3}{4}$



>