```
> 
> eq1 := y(n+1) + a·y(n) = 0;
```

$$eq1 := y(n+1) + a\,y(n) = 0 \qquad (1)$$

```
> rsolve(eq1, y(n))
```

$$y(0)\,(-a)^n \qquad (2)$$

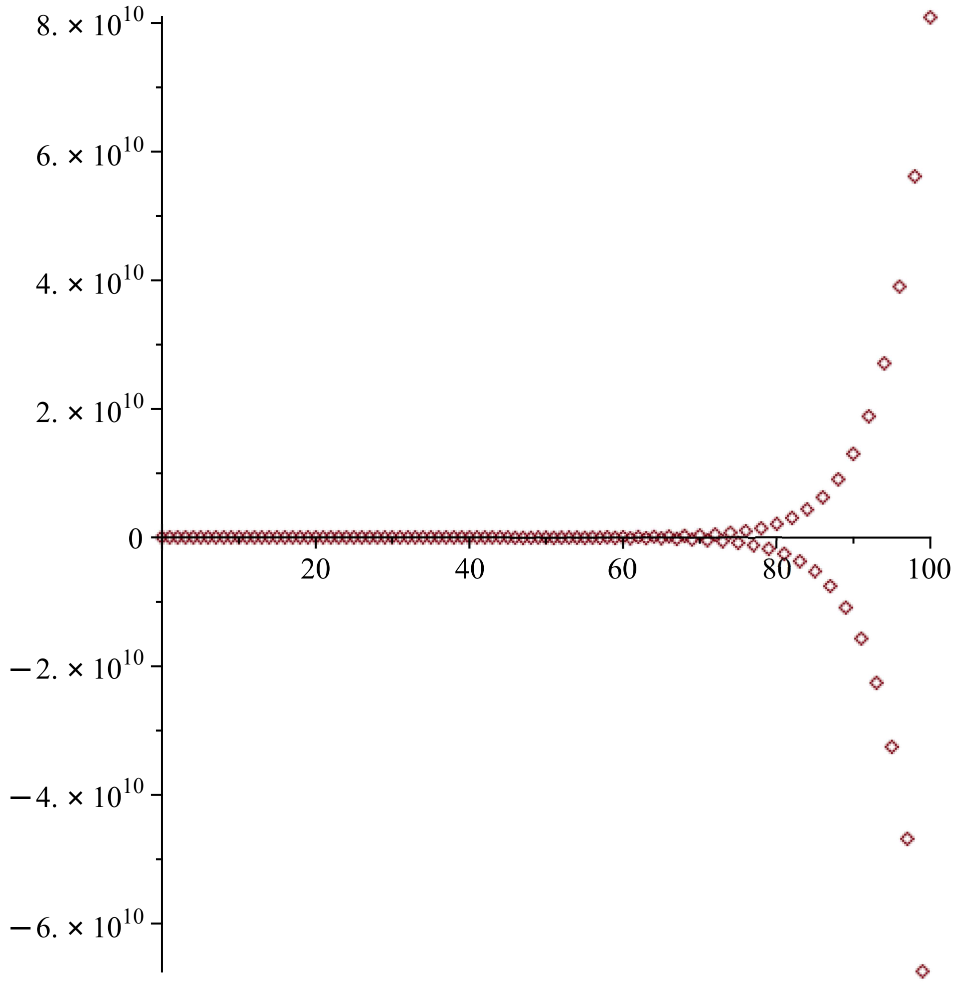
```
> rsolve({eq1, y(0) = alpha}, y(n))
```

$$\alpha\,(-a)^n \qquad (3)$$

```
> # problem 1
> 
> generate_seq := proc(p, q, a0, n)
    local i;
    local a;
    a[0] := a0;
    for i from 1 to n do
      a[i] := p·a[i − 1] + q;
    end do;
    return a; #seq(a(i), i=0..n);
    end proc;
```

```
generate_seq := proc(p, q, a0, n)                                        (4)
    local i, a;
    a[0] := a0; for i to n do a[i] := p*a[i − 1] + q end do; return a
end proc
```

```
> # a.
> N := 100 :
> a := generate_seq(−1.2, 50, 1000, N) :
> plot([[n, a[n]]$n = 0..N], style = point)
```



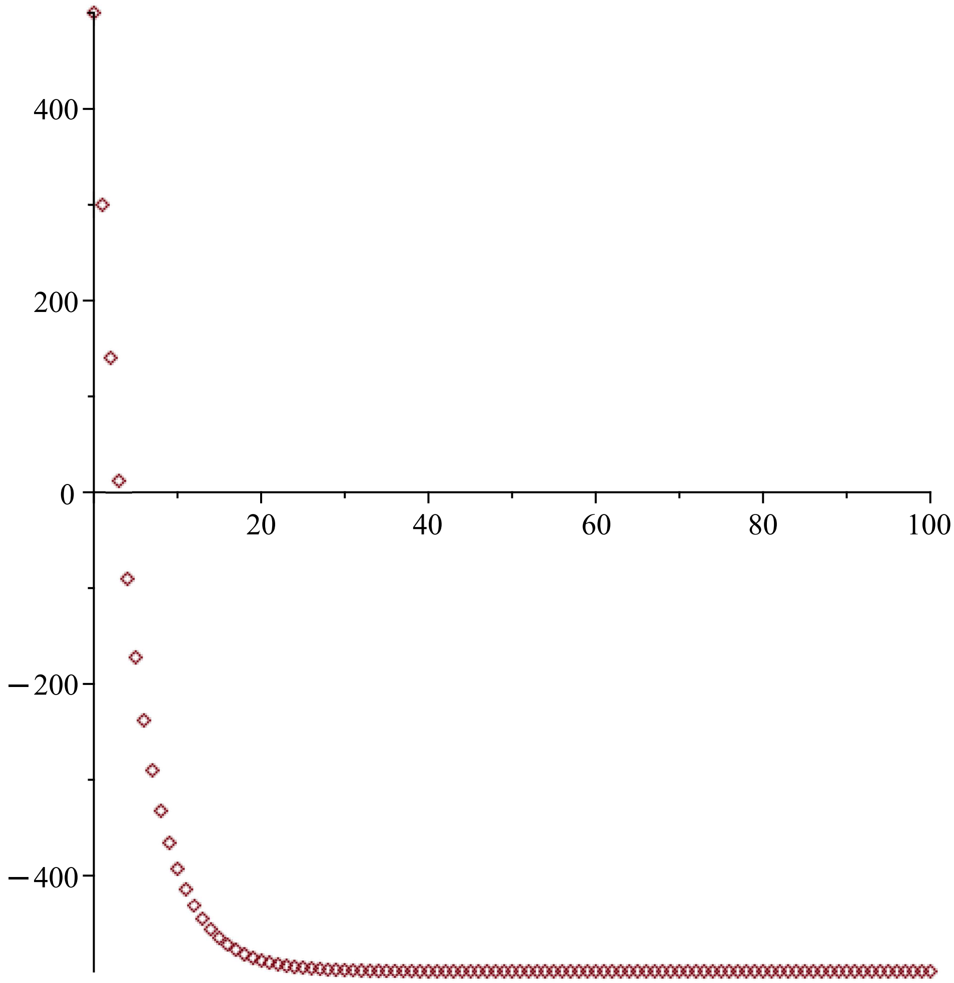
> *#equilibrium point unstable*

>

> *# b*

> $b := generate\_seq(0.8, -100, 500, N)$:

> $plot([[n, b[n]]\$n = 0..N], style = point)$



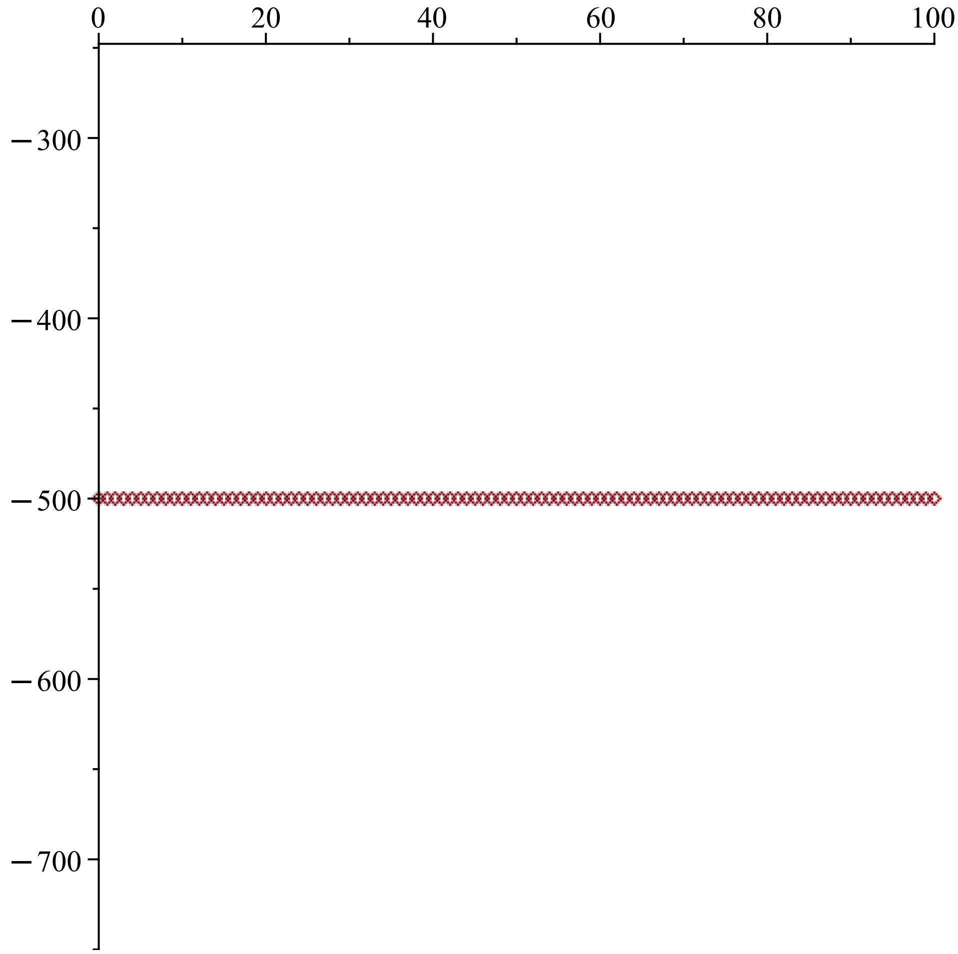
> # one equilibrium point; stable

>

> #c

> $c := generate\_seq(0.8, -100, -500, N)$:

> $plot([[n, c[n]]\$n = 0..N], style = point)$



> # *equilibrium point -500 stable*

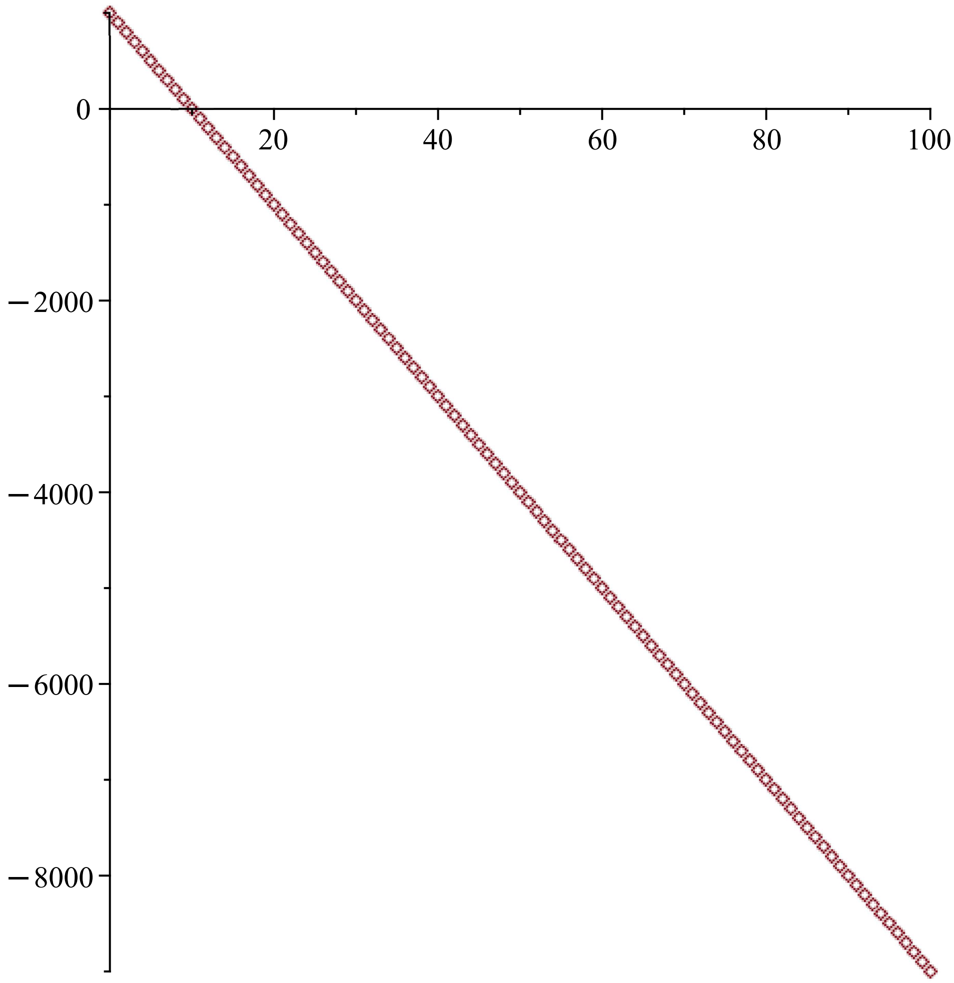
>

> # *d*

>

> $d := generate\_seq(1, -100, 1000, N)$:

> $plot([[n, d[n]]\$n = 0..N], style = point)$

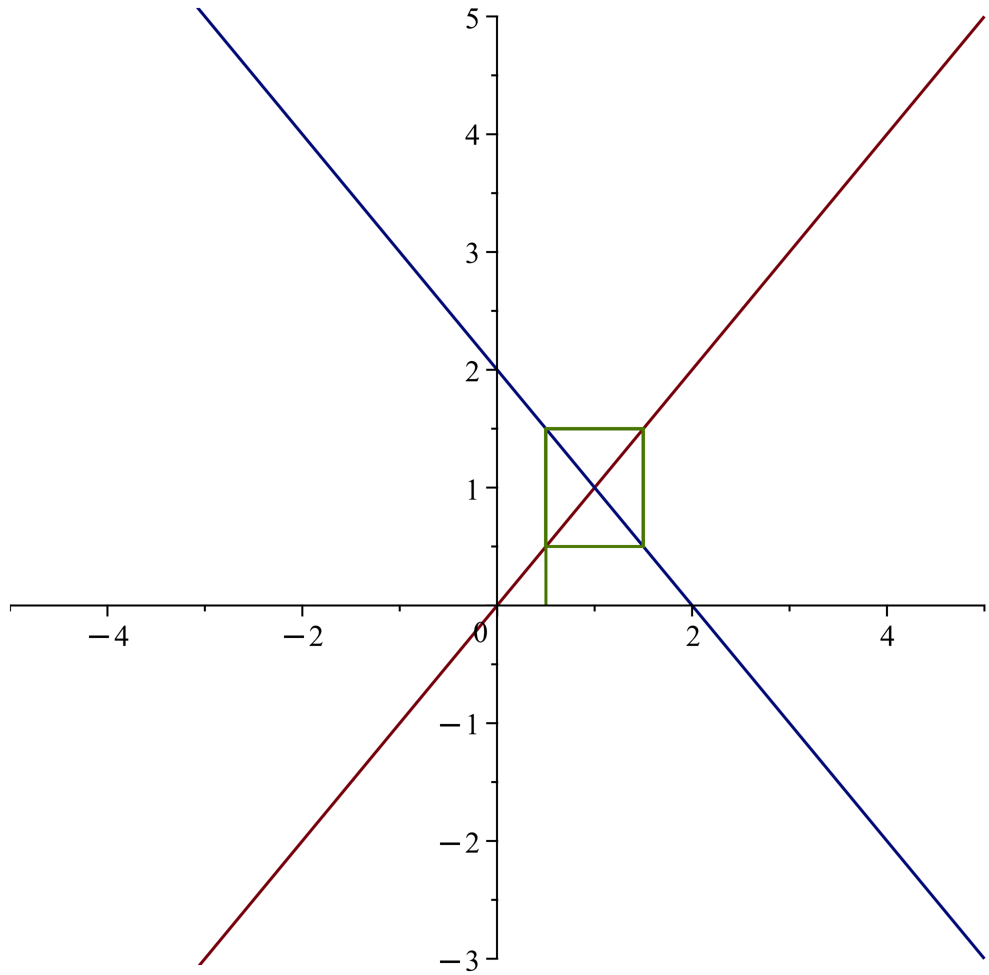



```
> # no equilibrium
>
> # 2
> restart;
> cobweb := proc(f,x0,n)
     local x; local y;local i;
     x[0] := x0; y[0] := 0;
    for i from 1 to n do:
      x[2·i − 1] := x[2·i − 2]; y[2·i − 1] := f(x[2·i − 2]);
     x[2·i] := y[2·i − 1]; y[2·i] := y[2·i − 1];
    end do;
    return x, y :
  end proc:
> solve_2 := proc(eq, s, f, point0, q, view0)
     local sol, x, y, k;
     sol := rsolve(eq, s) ;
    print(sol);
     x, y := cobweb(f, point0, q);
    plot([x→x, f, [[x[k], y[k]]$k = 0 ..2·q]], style = line, view = view0)
```

end proc:

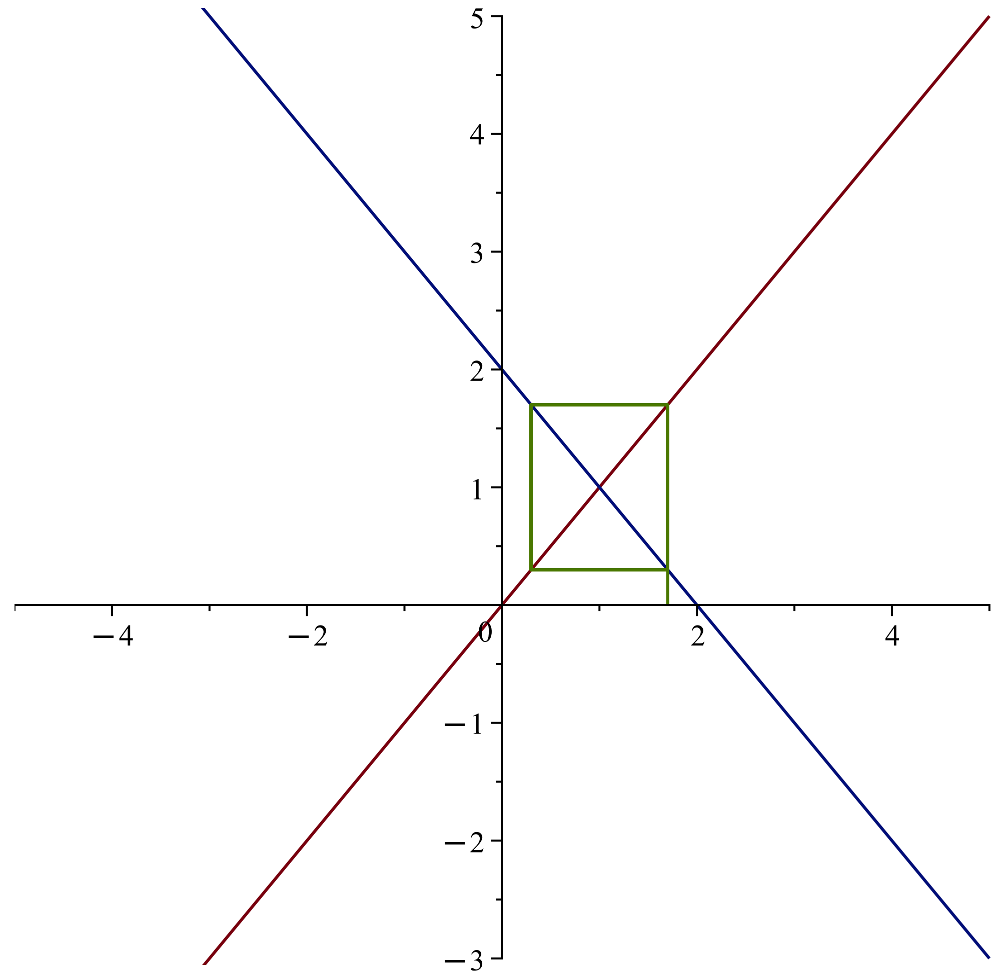
> $solve\_2\big(a(n+1) = -a(n) + 2, a(n), x \to -x + 2, 0.5, 100, [-5..5, -3..5]\big)$

$$a(0)\,(-1)^n + 1 - (-1)^n$$



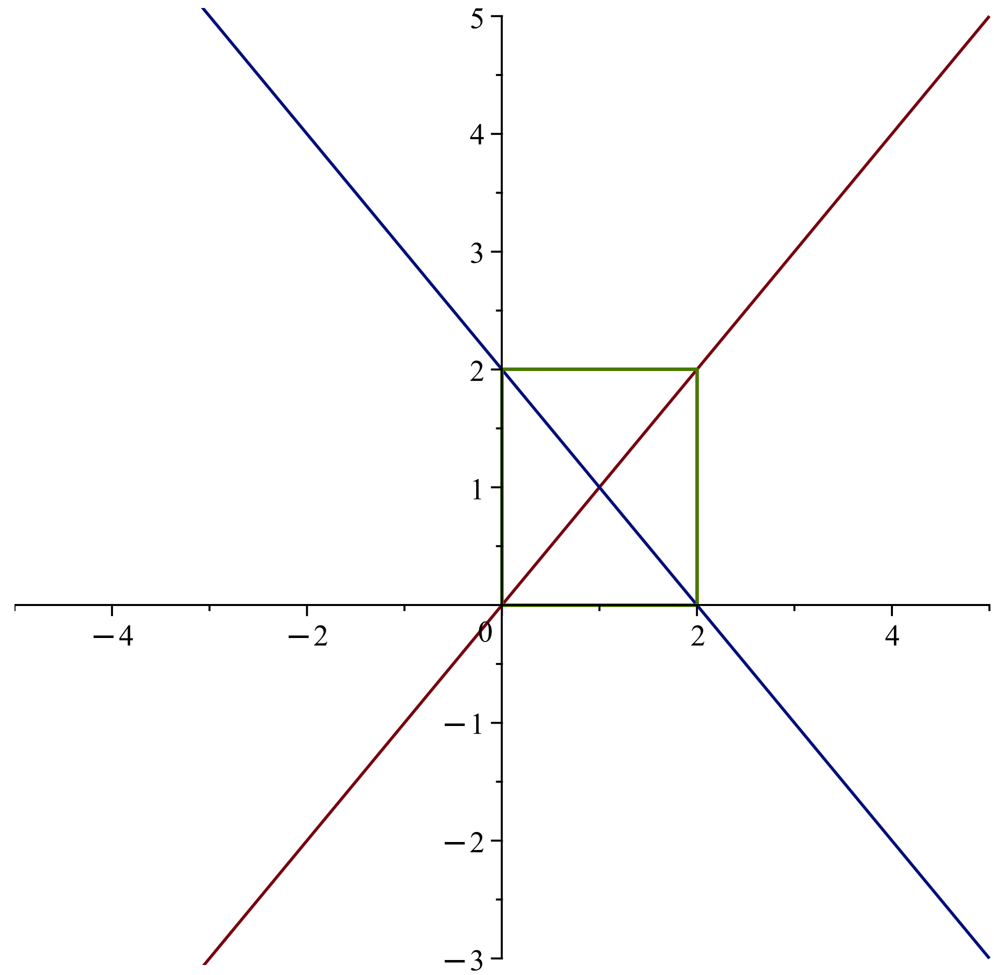
> $solve\_2\big(a(n+1) = -a(n) + 2, a(n), x \to -x + 2, 1.7, 100, [-5..5, -3..5]\big)$

$$a(0)\,(-1)^n + 1 - (-1)^n$$



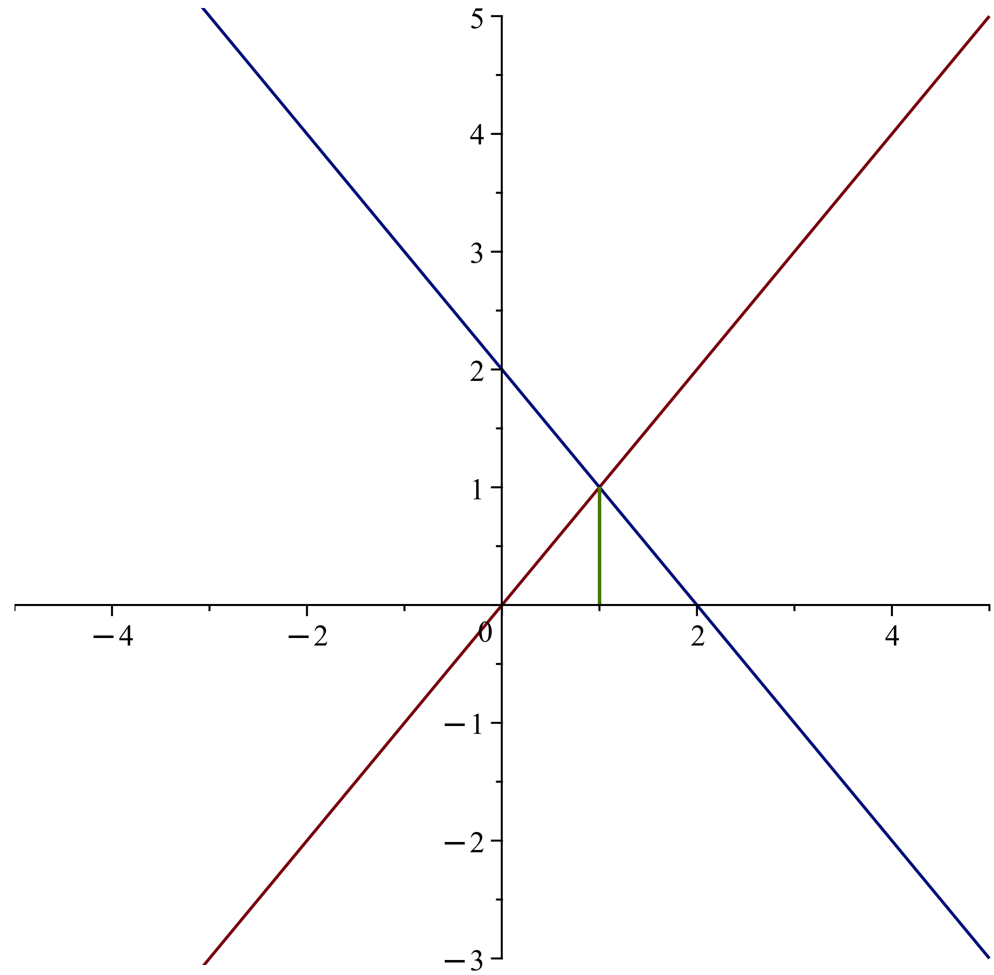
> $solve\_2\left(a(n+1) = -a(n) + 2, a(n), x \rightarrow -x + 2, 0, 100, [-5..5, -3..5]\right)$

$$a(0)\,(-1)^{n} + 1 - (-1)^{n}$$



> $solve\_2\left(a(n+1) = -a(n) + 2, a(n), x \rightarrow -x + 2, 1, 100, [-5..5, -3..5]\right)$

$$a(0)\,(-1)^n + 1 - (-1)^n$$



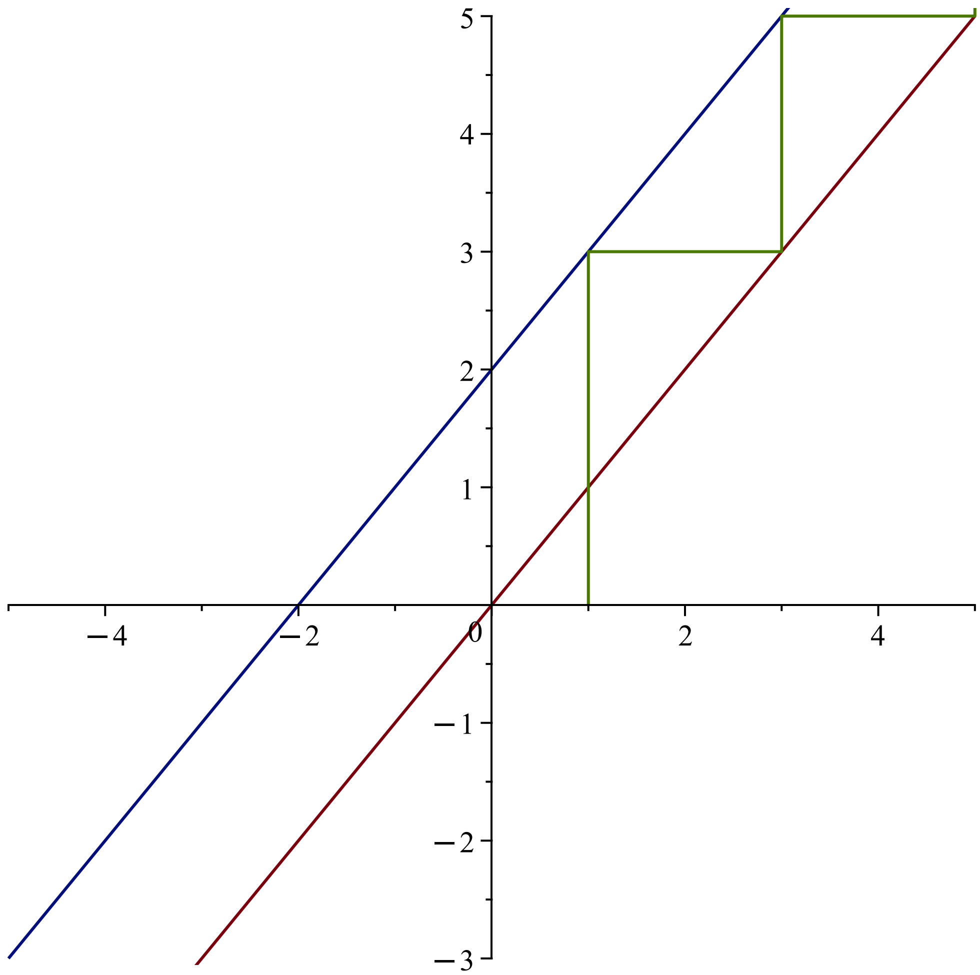
> # if a(0)!=1 => no equilibrium (alternate limit); if a(0)==1 => 1 equilibrium point a=1

>

> # b (same for c)

> $solve\_2\big(a(n+1) = a(n) + 2, a(n), x \rightarrow x + 2, 1, 100, [-5..5, -3..5]\big)$

$$a(0) + \frac{16\,n}{5}$$



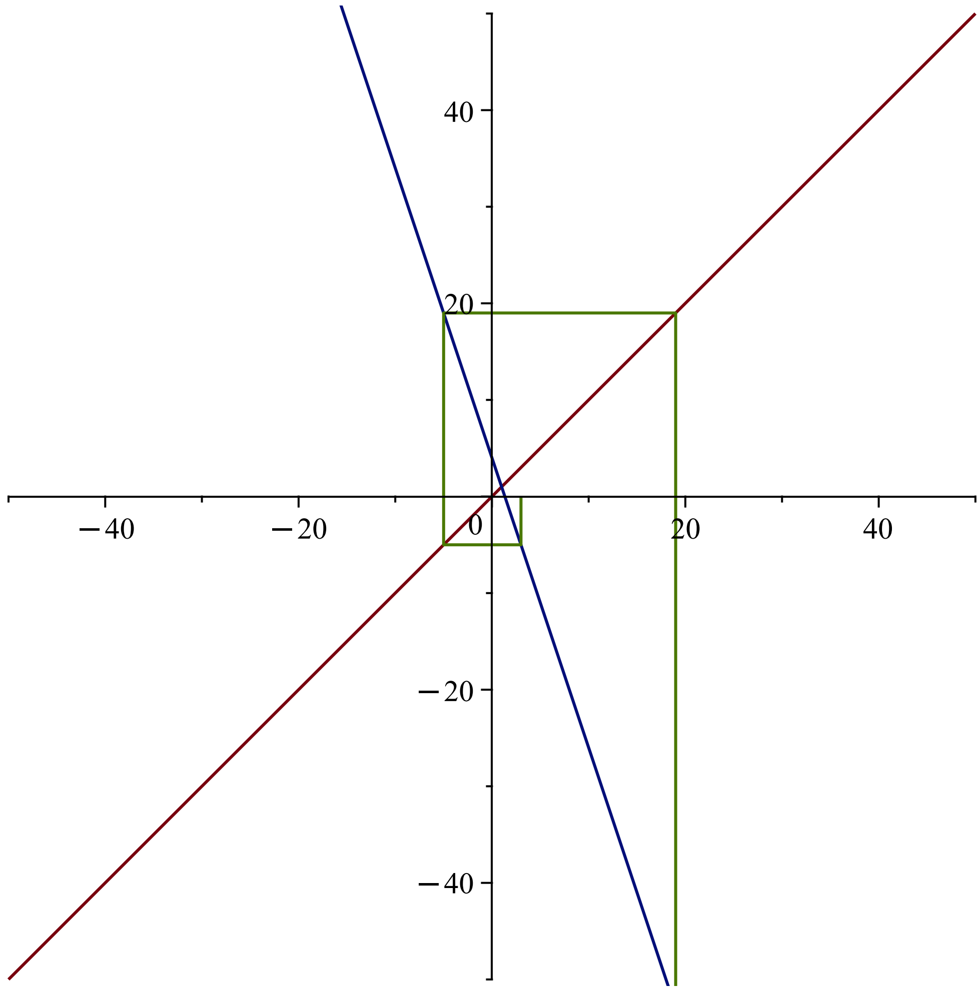
> *# unstable equilibrium, no matter the starting value*

>

> *# d*

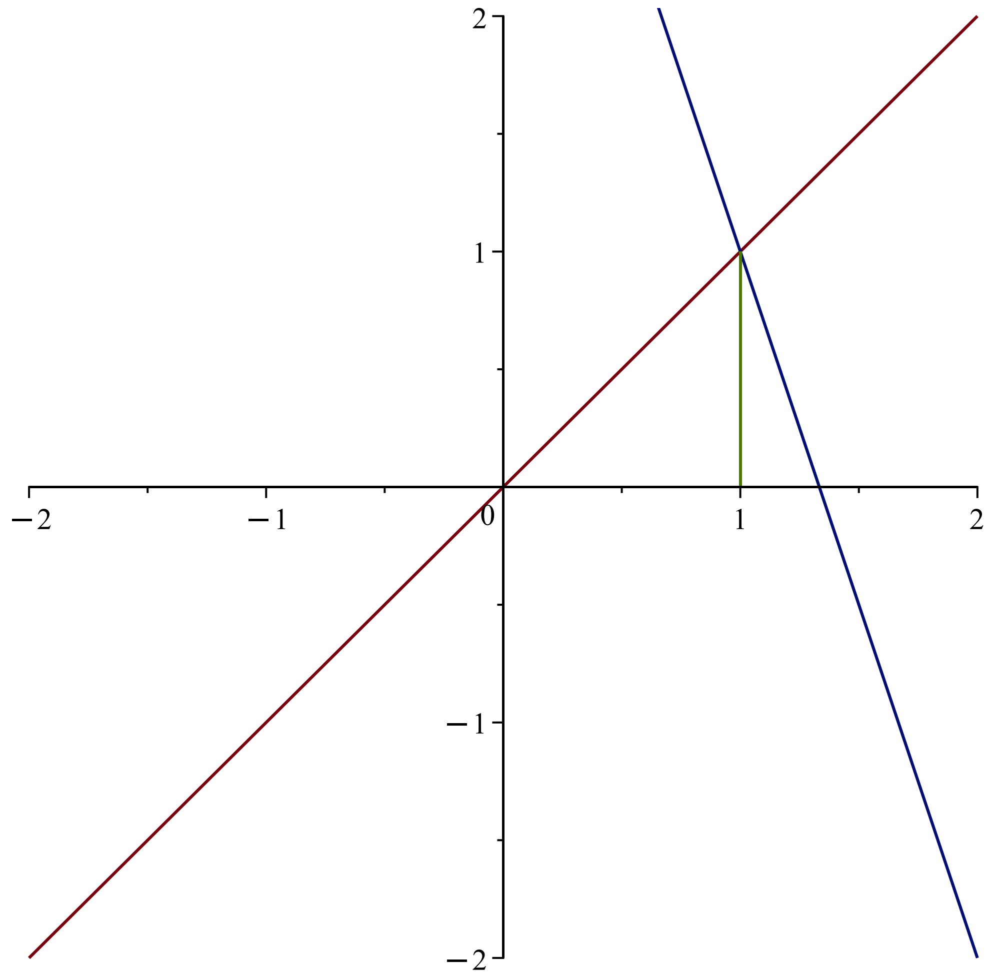
> $solve\_2\left(a(n+1) = -3\,a(n) + 4, a(n), x \rightarrow -3\,x + 4, 3, 20, [-50..50, -50..50]\right)$

$$a(0)\,(-3)^n - (-3)^n + 1$$



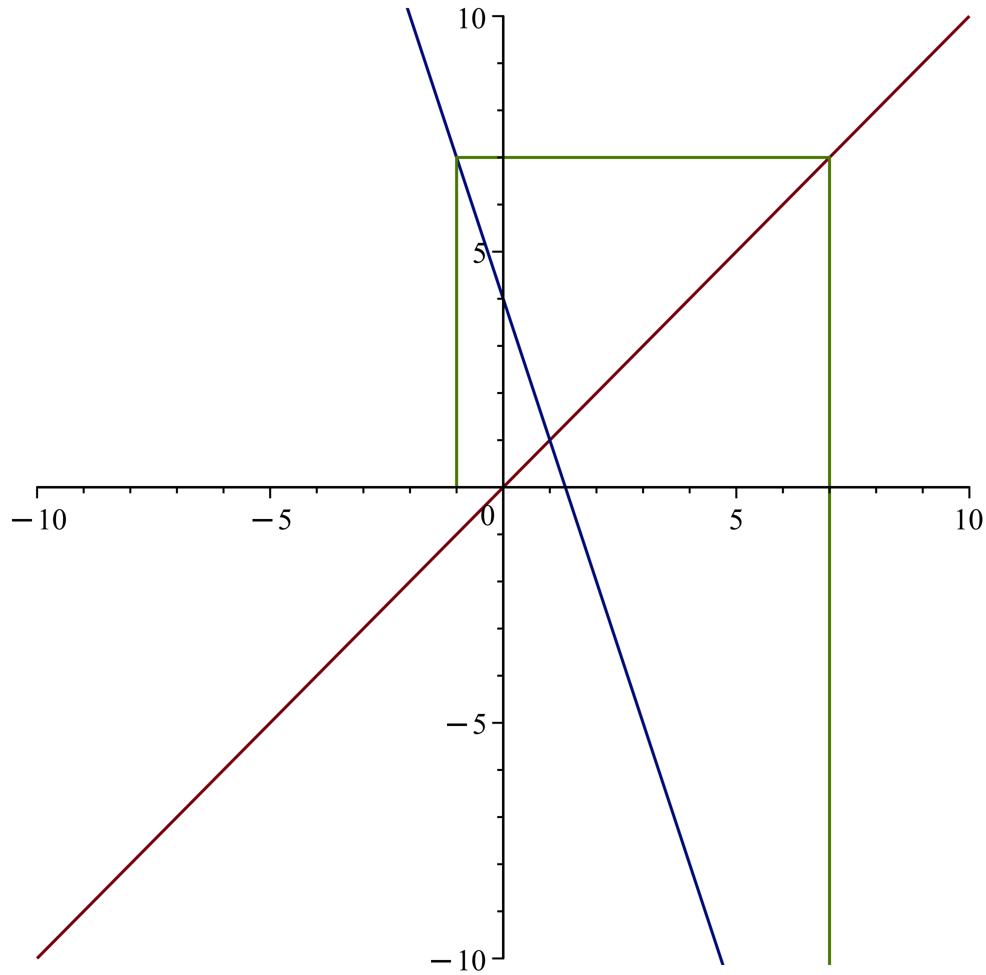
> $solve\_2\left(a(n+1) = -3\,a(n) + 4, a(n), x \rightarrow -3\,x + 4, 1, 20, [-2..2, -2..2]\right)$

$$a(0)\,(-3)^n - (-3)^n + 1$$



> $solve\_2\left(a(n+1)=-3\,a(n)+4, a(n), x \to -3\,x+4, -1, 20, [-10..10, -10..10]\right)$

$$a(0)\,(-3)^n-(-3)^n+1$$



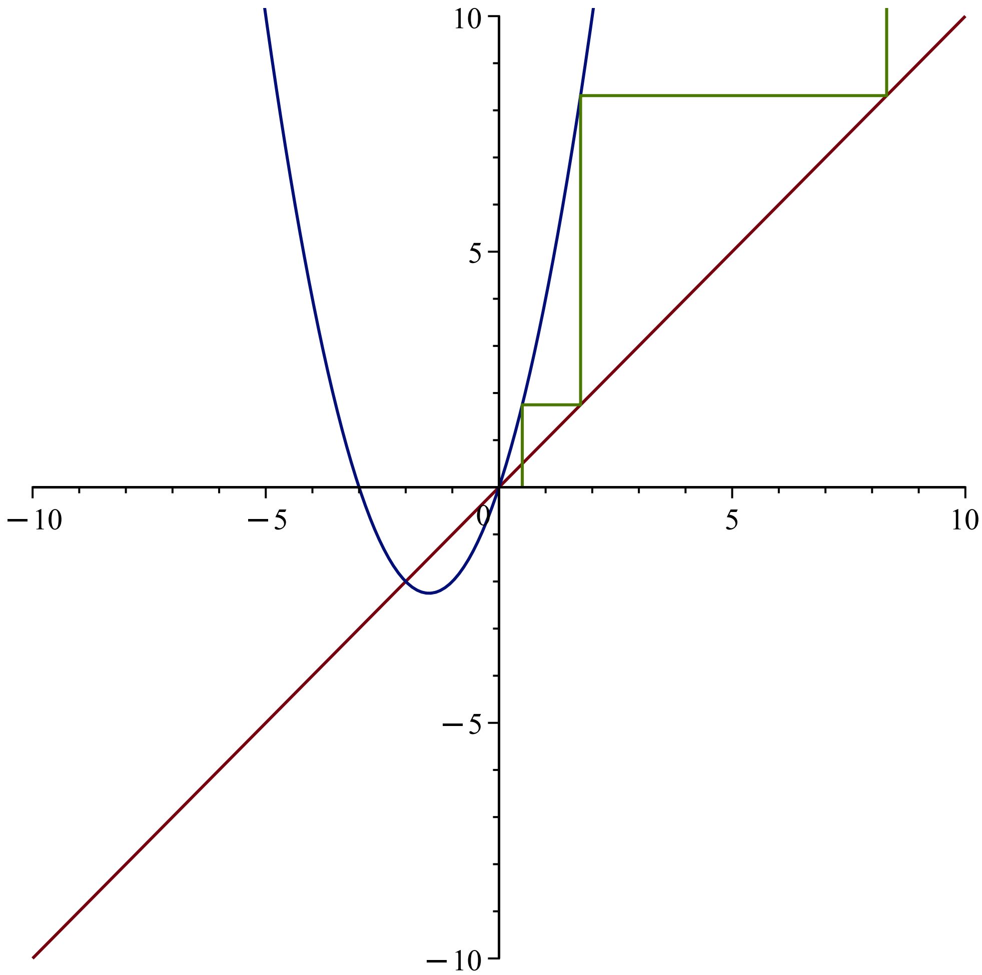
> # if a(0)-1!=0 => unstable equilibrium, if a(0)=1 => equilibrium a=1

>

> # d

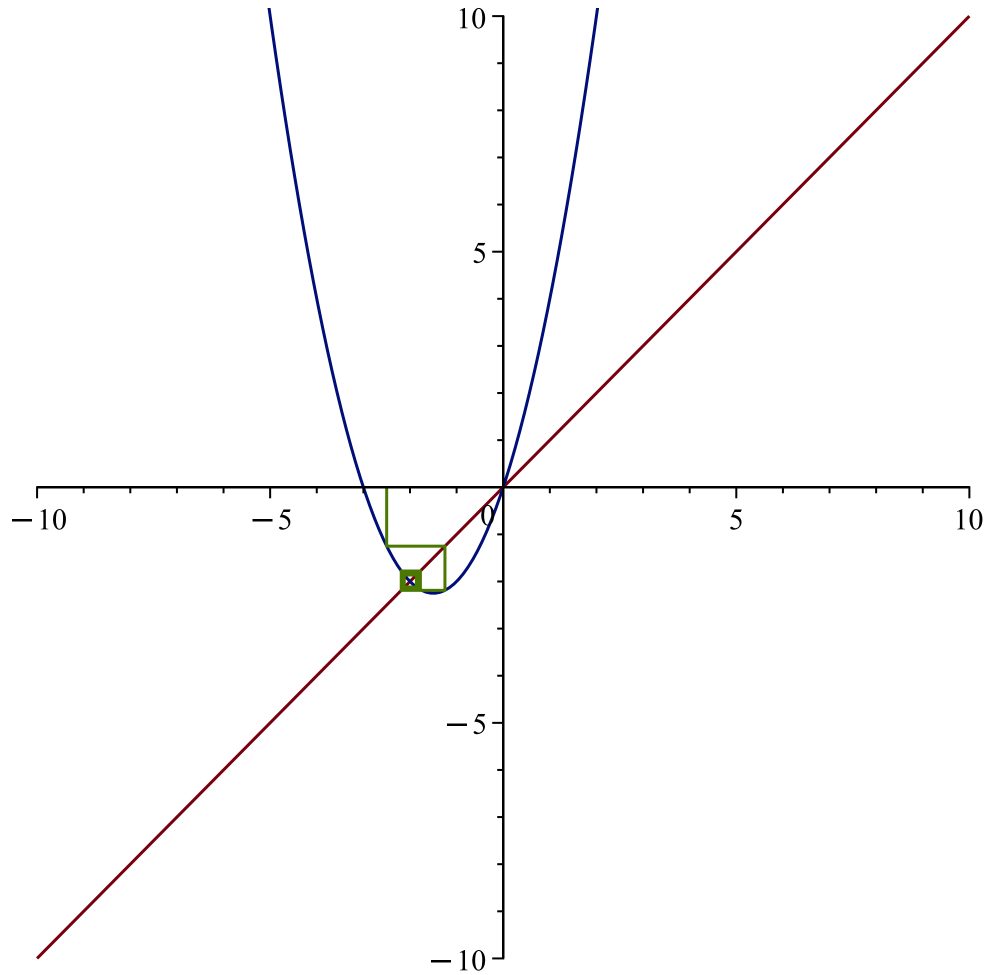
> $solve\_2\left(a(n+1)=a(n)^2+3\,a(n), a(n), x\rightarrow x^2+3\,x, 0.5, 20, [-10\,..10, -10\,..10]\right)$

$$rsolve\left(a(n+1)=a(n)^2+3\,a(n), a(n)\right)$$



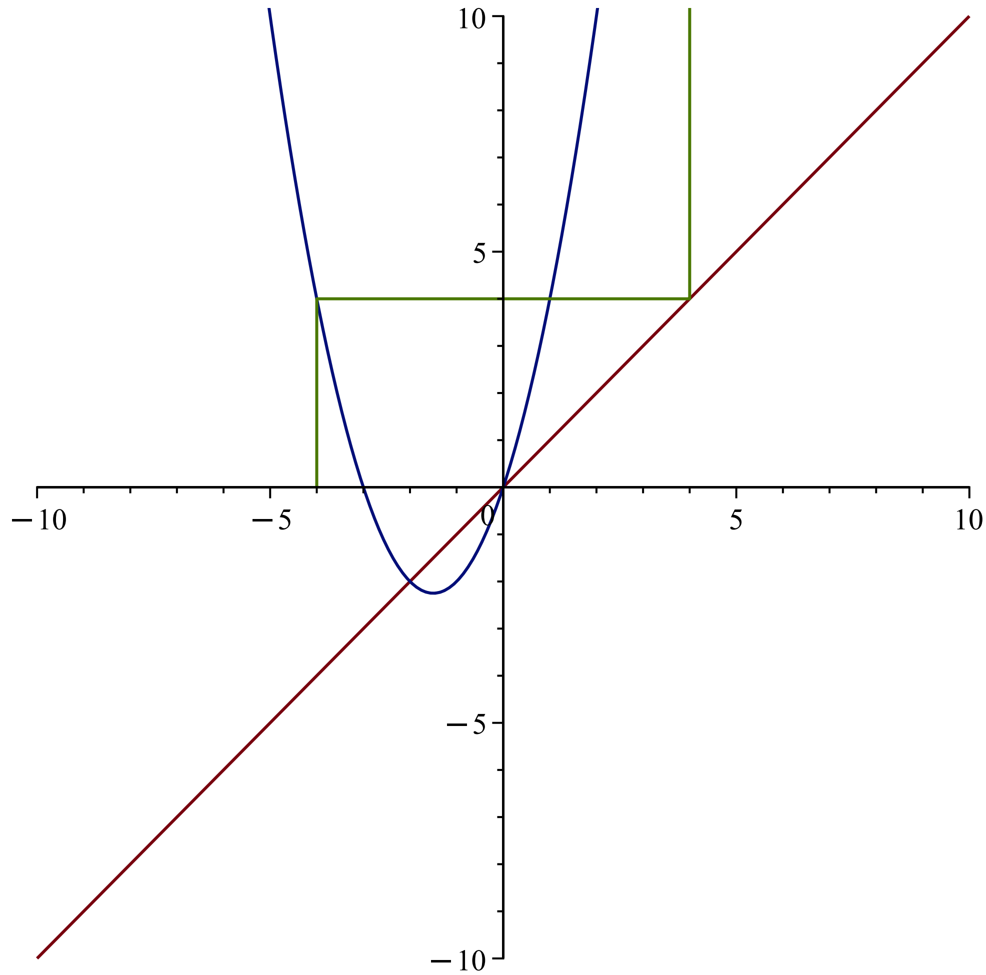
> $solve\_2\left(a(n+1) = a(n)^2 + 3\,a(n), a(n), x \rightarrow x^2 + 3\,x, -2.5, 20, [-10..10, -10..10]\right)$

$$rsolve\left(a(n+1) = a(n)^2 + 3\,a(n), a(n)\right)$$



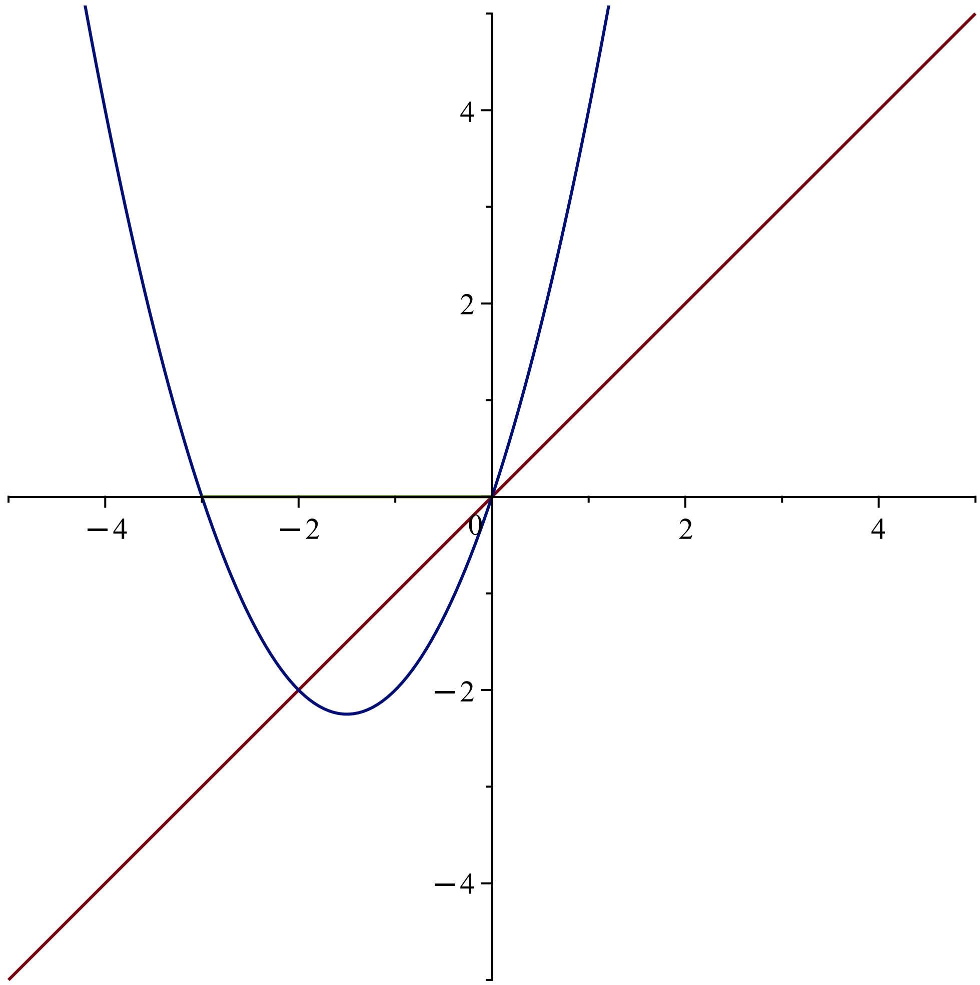
> $solve\_2\left(a(n+1) = a(n)^2 + 3\,a(n), a(n), x \rightarrow x^2 + 3\,x, -4, 20, [-10\,..10, -10\,..10]\right)$

$$rsolve\left(a(n+1) = a(n)^2 + 3\,a(n), a(n)\right)$$



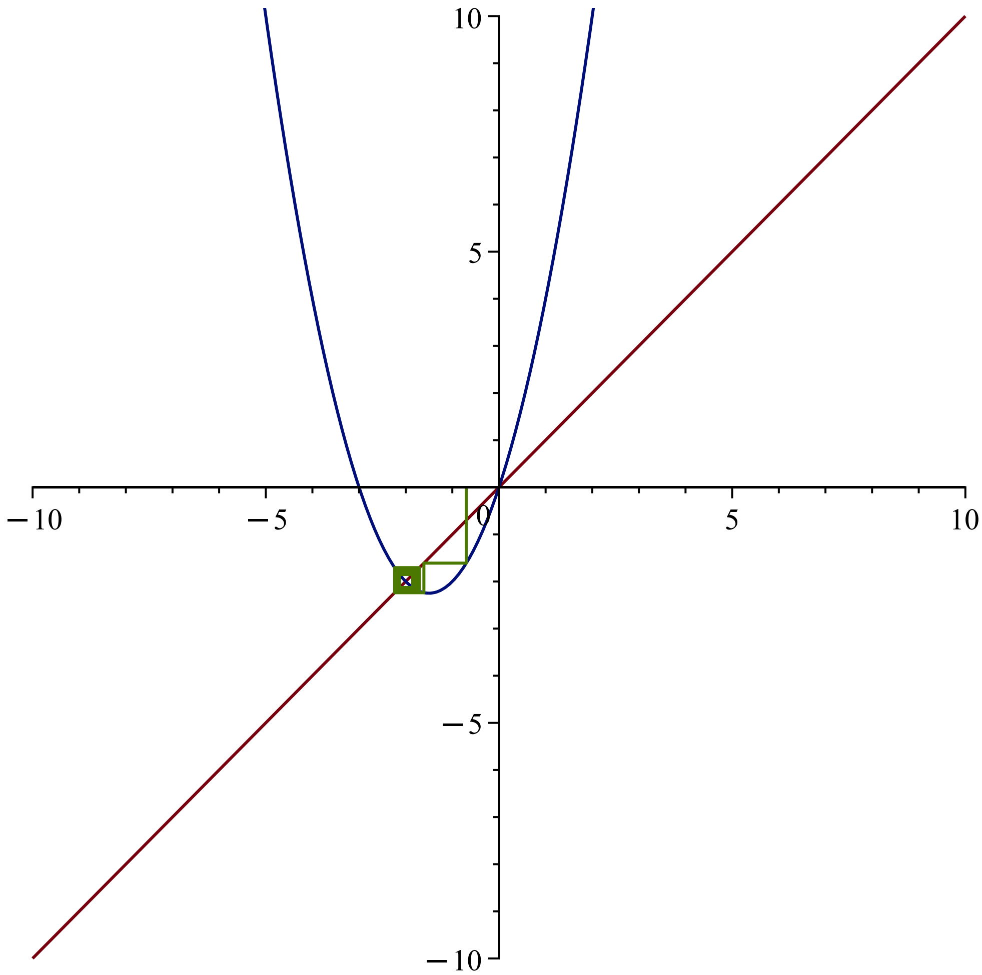
> $solve\_2\left(a(n+1) = a(n)^2 + 3\,a(n), a(n), x \rightarrow x^2 + 3\,x, -3, 20, [-5\,..5, -5\,..5]\right)$

$$rsolve\left(a(n+1) = a(n)^2 + 3\,a(n), a(n)\right)$$



> $solve\_2\left(a(n+1) = a(n)^2 + 3\,a(n), a(n), x \rightarrow x^2 + 3\,x, -0.7, 20, [-10\,..10, -10\,..10]\right)$

$$rsolve\left(a(n+1) = a(n)^2 + 3\,a(n), a(n)\right)$$



> # if -3 <a(0) <0 = > equilibrium point f(a)=a, a!=0

> # if a <-3 or a >0, unstable equilibrium

> # if a=-3 or a=0, a=0 equilibrium

>

>