```
> restart;
> yp:=y(xn-h)+2*h*f(xn,y(xn));
```

$$yp := y(xn-h) + 2\,h\,f(xn, y(xn)) \tag{1}$$

```
> ynp1:=y(xn)+h/2*(f(xn,y(xn))+f(xn+h,yp));
```

$$ynp1 := y(xn) + \frac{h\,(f(xn, y(xn)) + f(xn+h, y(xn-h) + 2\,h\,f(xn, y(xn))))}{2} \tag{2}$$

```
> f:=(xi,eta)->A*eta;
```

$$f := (\xi, \eta) \mapsto A\,\eta \tag{3}$$

```
> method:=y(xn+h)=ynp1;
```

$$method := y(xn+h) = y(xn) + \frac{h\,(A\,y(xn) + A\,(y(xn-h) + 2\,h\,A\,y(xn)))}{2} \tag{4}$$

```
> ceq:=eval(subs(y=(s->rho^s),method));
```

$$ceq := \rho^{xn+h} = \rho^{xn} + \frac{h\,(A\,\rho^{xn} + A\,(\rho^{xn-h} + 2\,h\,A\,\rho^{xn}))}{2} \tag{5}$$

```
> ceq2:=subs({xn=0,h=1},ceq);
```

$$ceq2 := \rho = 1 + \frac{A}{2} + \frac{A\left(\frac{1}{\rho} + 2\,A\right)}{2} \tag{6}$$

```
> S:=solve(ceq2,rho);
```

$$S := \frac{A^2}{2} + \frac{A}{4} + \frac{1}{2} + \frac{\sqrt{4\,A^4 + 4\,A^3 + 9\,A^2 + 12\,A + 4}}{4},\ \frac{A^2}{2} + \frac{A}{4} + \frac{1}{2} - \frac{\sqrt{4\,A^4 + 4\,A^3 + 9\,A^2 + 12\,A + 4}}{4} \tag{7}$$

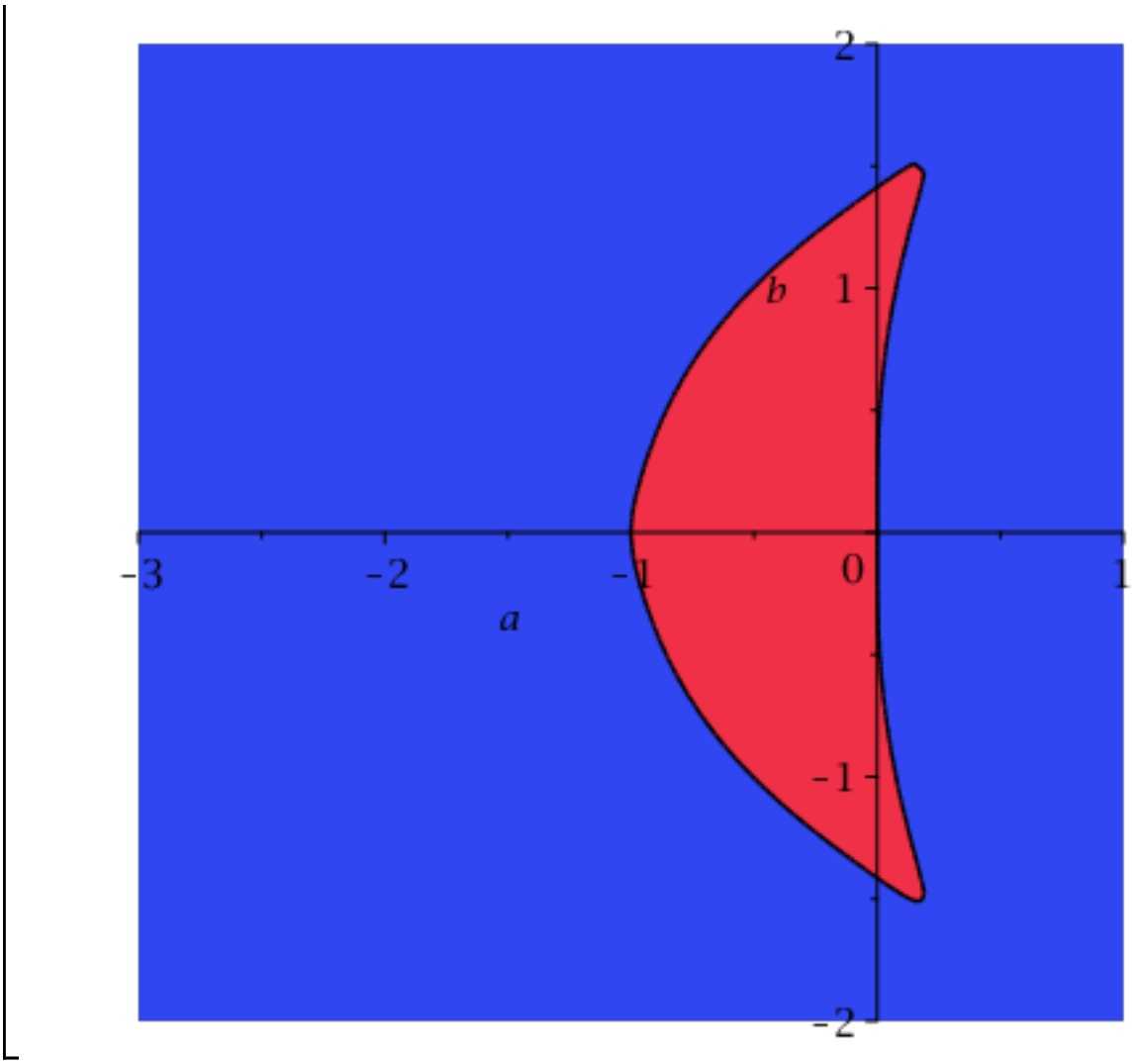
```
> # the linear stability region is all values of A such that
  |rho|<1
> Z1:=subs(A=a+I*b,abs(S[1]));
```

$$Z1 := \left|\frac{1}{2}(a + \mathrm{I}\,b)^2 + \frac{a}{2} + \frac{\mathrm{I}\,b}{2} + 1 + \frac{\sqrt{4\,(a+\mathrm{I}\,b)^4 + 4\,(a+\mathrm{I}\,b)^3 + 9\,(a+\mathrm{I}\,b)^2 + 12\,a + 12\,\mathrm{I}\,b + 4}}{2}\right| \tag{8}$$

```
> Z2:=subs(A=a+I*b,abs(S[2]));
```

$$Z2 := \left|\frac{1}{2}(a + \mathrm{I}\,b)^2 + \frac{a}{2} + \frac{\mathrm{I}\,b}{2} + 1 - \frac{\sqrt{4\,(a+\mathrm{I}\,b)^4 + 4\,(a+\mathrm{I}\,b)^3 + 9\,(a+\mathrm{I}\,b)^2 + 12\,a + 12\,\mathrm{I}\,b + 4}}{2}\right| \tag{9}$$

```
> with(plots):
> contourplot(max(Z1,Z2),a=-3..1,b=-2..2,contours=[1],grid=[100,
  100],filled=true);
```


2
b
1
-3
-2
-1
0
1
a
-1
-2