```
> restart
> ec:=diff(y(x),x)-y(x)/x-m*x
```

$$ec := \frac{d}{dx} y(x) - \frac{y(x)}{x} - m\,x \tag{1}$$

```
> sol:=dsolve(ec,y(x))
```

$$sol := y(x) = \left(m\,x + c_1\right) x \tag{2}$$

```
> f:=unapply(rhs(sol),x,m,c__1)
```

$$f := \left(x, m, c_1\right) \mapsto \left(m \cdot x + c_1\right) \cdot x \tag{3}$$

```
> solve(f(1,m,c__1)=1,m)
```

$$1 - c_1 \tag{4}$$

```
> solve(f(2,1-c__1,c__1)=0)
```

$$2 \tag{5}$$

```
> f(x,-1,2)
```

$$\left(-x + 2\right) x \tag{6}$$

```
> restart
> with(plots)
```

[*animate*, *animate3d*, *animatecurve*, *arrow*, *changecoords*, *complexplot*, *complexplot3d*, *conformal*, *conformal3d*, *contourplot*, *contourplot3d*, *coordplot*, *coordplot3d*, *densityplot*, *display*, *dualaxisplot*, *fieldplot*, *fieldplot3d*, *gradplot*, *gradplot3d*, *implicitplot*, *implicitplot3d*, *inequal*, *interactive*, *interactiveparams*, *intersectplot*, *listcontplot*, *listcontplot3d*, *listdensityplot*, *listplot*, *listplot3d*, *loglogplot*, *logplot*, *matrixplot*, *multiple*, *odeplot*, *pareto*, *plotcompare*, *pointplot*, *pointplot3d*, *polarplot*, *polygonplot*, *polygonplot3d*, *polyhedra_supported*, *polyhedraplot*, *rootlocus*, *semilogplot*, *setcolors*, *setoptions*, *setoptions3d*, *shadebetween*, *spacecurve*, *sparsematrixplot*, *surfdata*, *textplot*, *textplot3d*, *tubeplot*] (7)

```
> ec:=x^2*diff(y(x),x$2)+3*x*diff(y(x),x)+y(x)=0
```

$$ec := x^2 \left(\frac{d^2}{dx^2} y(x)\right) + 3\,x \left(\frac{d}{dx} y(x)\right) + y(x) = 0 \tag{8}$$

```
> sol:=dsolve(ec,y(x))
```

$$y(x) = \frac{c_1}{x} + \frac{c_2 \ln(x)}{x} \tag{9}$$

```
> cond:=y(1)=1,D(y)(1)=1
```

$$cond := y(1) = 1, \mathrm{D}(y)(1) = 1 \tag{10}$$

```
> sol2:=dsolve({ec,cond},y(x))
```

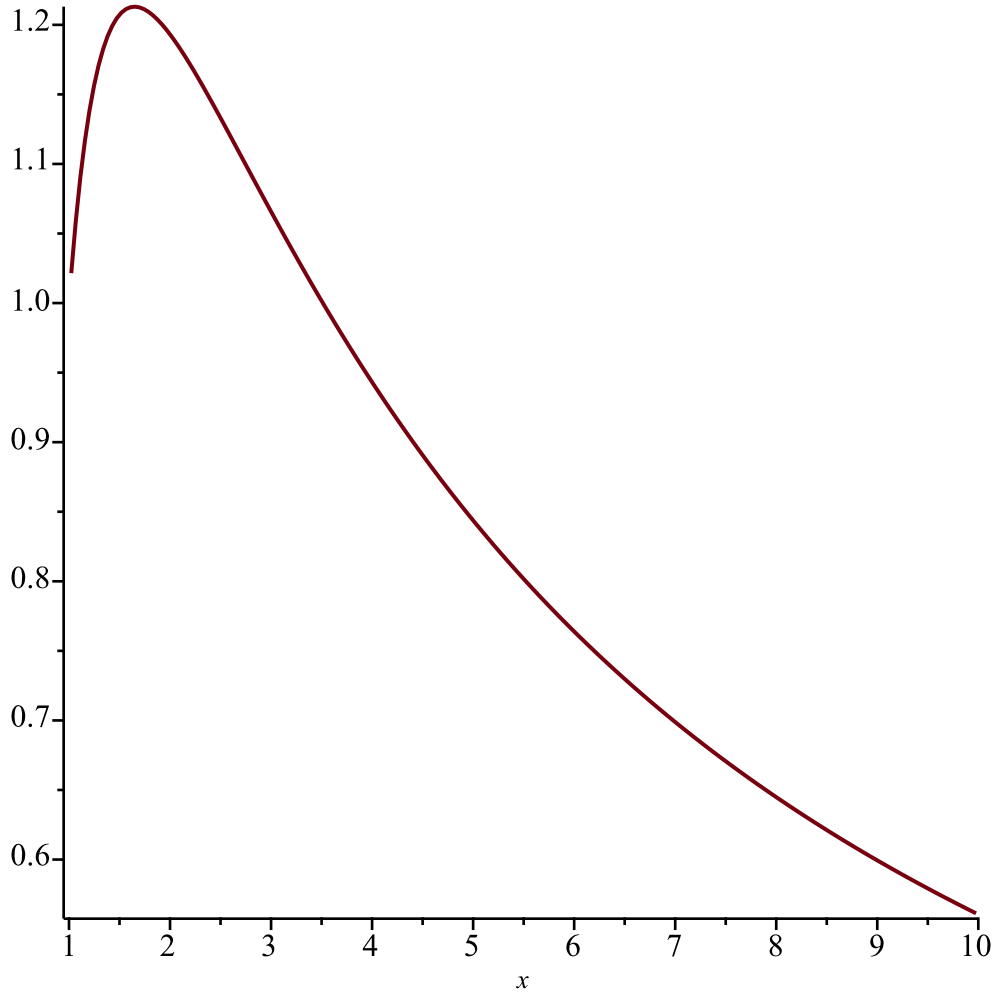
(11)

$$sol2 := y(x) = \frac{1 + 2\ln(x)}{x} \tag{11}$$

```
> f:=unapply(rhs(sol2),x)
```

$$f := x \mapsto \frac{1 + 2\cdot\ln(x)}{x} \tag{12}$$

```
> plot([f(x)],x=1..10)
```




```
> restart
> with(DEtools)
```

[*AreSimilar*, *Closure*, *DEnormal*, *DEplot*, *DEplot3d*, *DEplot_polygon*, *DFactor*, *DFactorLCLM*, *DFactorsols*, *Dchangevar*, *Desingularize*, *FindODE*, *FunctionDecomposition*, *GCRD*, *Gosper*, *Heunsols*, *Homomorphisms*, *IVPsol*, *IsHyperexponential*, *LCLM*, *MeijerGsols*, *MultiplicativeDecomposition*, *ODEInvariants*, *PDEchangecoords*, *PolynomialNormalForm*, *RationalCanonicalForm*, *ReduceHyperexp*, *RiemannPsols*, *Xchange*, *Xcommutator*, *Xgauge*, *Zeilberger*, *abelsol*, *adjoint*, *autonomous*, *bernoullisol*, *buildsol*, *buildsym*, *canoni*, *caseplot*, *casesplit*, *checkrank*, *chinisol*, *clairautsol*, *constcoeffsols*, *convertAlg*, *convertsys*, *dalembertsol*, *dcoeffs*, *de2diffop*, *dfieldplot*, *diff_table*, *diffop2de*, *dperiodic_sols*, *dpolyform*, (13)

dsubs, eigenring, endomorphism_charpoly, equinv, eta_k, eulersols, exactsol, expsols, exterior_power, firint, firtest, formal_sol, gen_exp, generate_ic, genhomosol, gensys, hamilton_eqs, hypergeometricsols, hypergeomsols, hyperode, indicialeq, infgen, initialdata, integrate_sols, intfactor, invariants, kovacicsols, leftdivision, liesol, line_int, linearsol, matrixDE, matrix_riccati, maxdimsystems, moser_reduce, muchange, mult, mutest, newton_polygon, normalG2, ode_int_y, ode_y1, odeadvisor, odepde, parametricsol, particularsol, phaseportrait, poincare, polysols, power_equivalent, rational_equivalent, ratsols, redode, reduceOrder, reduce_order, regular_parts, regularsp, remove_RootOf, riccati_system, riccatisol, rifread, rifsimp, rightdivision, rtaylor, separablesol, singularities, solve_group, super_reduce, symgen, symmetric_power, symmetric_product, symtest, transinv, translate, untranslate, varparam, zoom]

```
> f:=x->x*(x+1)*(2-x)
```

$$f := x \mapsto x \cdot (x+1) \cdot (2-x) \tag{14}$$

```
> ec:=diff(x(t),t)=f(x(t))
```

$$ec := \frac{\mathrm{d}}{\mathrm{d}t} x(t) = x(t)\ (x(t)+1)\ (2-x(t)) \tag{15}$$

```
> sol:=solve(f(x)=0)
```

$$sol := -1, 0, 2 \tag{16}$$

```
> D(f)(sol[1])
```

$$-3 \tag{17}$$

```
> D(f)(sol[2])
```

$$2 \tag{18}$$

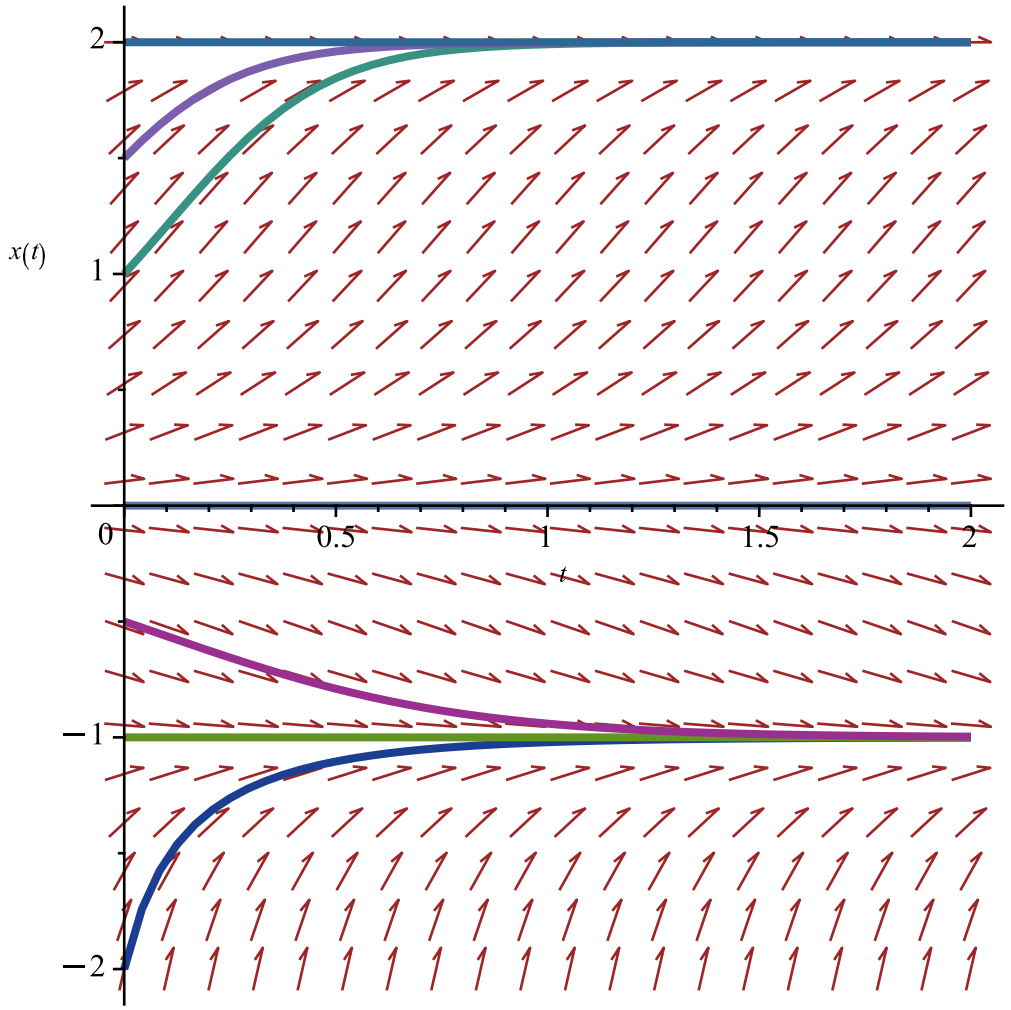
```
> D(f)(sol[3])
```

$$-6 \tag{19}$$

```
> cond:=x(0)=-2,x(0)=-1,x(0)=0,x(0)=-1/2,x(0)=1,x(0)=3/2,x(0)=2
```

$$cond := x(0) = -2, x(0) = -1, x(0) = 0, x(0) = -\frac{1}{2}, x(0) = 1, x(0) = \frac{3}{2}, x(0) = 2 \tag{20}$$

```
> DEplot(ec,x(t),t=0..2,[cond])
```




```
> restart
> with(linalg); with(DEtools)
```

[*BlockDiagonal*, *GramSchmidt*, *JordanBlock*, *LUdecomp*, *QRdecomp*, *Wronskian*, *addcol*, *addrow*, *adj*, *adjoint*, *angle*, *augment*, *backsub*, *band*, *basis*, *bezout*, *blockmatrix*, *charmat*, *charpoly*, *cholesky*, *col*, *coldim*, *colspace*, *colspan*, *companion*, *concat*, *cond*, *copyinto*, *crossprod*, *curl*, *definite*, *delcols*, *delrows*, *det*, *diag*, *diverge*, *dotprod*, *eigenvals*, *eigenvalues*, *eigenvectors*, *eigenvects*, *entermatrix*, *equal*, *exponential*, *extend*, *ffgausselim*, *fibonacci*, *forwardsub*, *frobenius*, *gausselim*, *gaussjord*, *geneqns*, *genmatrix*, *grad*, *hadamard*, *hermite*, *hessian*, *hilbert*, *htranspose*, *ihermite*, *indexfunc*, *innerprod*, *intbasis*, *inverse*, *ismith*, *issimilar*, *iszero*, *jacobian*, *jordan*, *kernel*, *laplacian*, *leastsqrs*, *linsolve*, *matadd*, *matrix*, *minor*, *minpoly*, *mulcol*, *mulrow*, *multiply*, *norm*, *normalize*, *nullspace*, *orthog*, *permanent*, *pivot*, *potential*, *randmatrix*, *randvector*, *rank*, *ratform*, *row*, *rowdim*, *rowspace*, *rowspan*, *rref*, *scalarmul*, *singularvals*, *smith*, *stackmatrix*, *submatrix*, *subvector*, *sumbasis*, *swapcol*, *swaprow*, *sylvester*, *toeplitz*, *trace*, *transpose*, *vandermonde*, *vecpotent*, *vectdim*, *vector*, *wronskian*]

[*AreSimilar*, *Closure*, *DEnormal*, *DEplot*, *DEplot3d*, *DEplot_polygon*, *DFactor*, *DFactorLCLM*, **(21)**

DFactorsols, *Dchangevar*, *Desingularize*, *FindODE*, *FunctionDecomposition*, *GCRD*, *Gosper*, *Heunsols*, *Homomorphisms*, *IVPsol*, *IsHyperexponential*, *LCLM*, *MeijerGsols*, *MultiplicativeDecomposition*, *ODEInvariants*, *PDEchangecoords*, *PolynomialNormalForm*, *RationalCanonicalForm*, *ReduceHyperexp*, *RiemannPsols*, *Xchange*, *Xcommutator*, *Xgauge*, *Zeilberger*, *abelsol*, *adjoint*, *autonomous*, *bernoullisol*, *buildsol*, *buildsym*, *canoni*, *caseplot*, *casesplit*, *checkrank*, *chinisol*, *clairautsol*, *constcoeffsols*, *convertAlg*, *convertsys*, *dalembertsol*, *dcoeffs*, *de2diffop*, *dfieldplot*, *diff_table*, *diffop2de*, *dperiodic_sols*, *dpolyform*, *dsubs*, *eigenring*, *endomorphism_charpoly*, *equinv*, *eta_k*, *eulersols*, *exactsol*, *expsols*, *exterior_power*, *firint*, *firtest*, *formal_sol*, *gen_exp*, *generate_ic*, *genhomosol*, *gensys*, *hamilton_eqs*, *hypergeometricsols*, *hypergeomsols*, *hyperode*, *indicialeq*, *infgen*, *initialdata*, *integrate_sols*, *intfactor*, *invariants*, *kovacicsols*, *leftdivision*, *liesol*, *line_int*, *linearsol*, *matrixDE*, *matrix_riccati*, *maxdimsystems*, *moser_reduce*, *muchange*, *mult*, *mutest*, *newton_polygon*, *normalG2*, *ode_int_y*, *ode_y1*, *odeadvisor*, *odepde*, *parametricsol*, *particularsol*, *phaseportrait*, *poincare*, *polysols*, *power_equivalent*, *rational_equivalent*, *ratsols*, *redode*, *reduceOrder*, *reduce_order*, *regular_parts*, *regularsp*, *remove_RootOf*, *riccati_system*, *riccatisol*, *rifread*, *rifsimp*, *rightdivision*, *rtaylor*, *separablesol*, *singularities*, *solve_group*, *super_reduce*, *symgen*, *symmetric_power*, *symmetric_product*, *symtest*, *transinv*, *translate*, *untranslate*, *varparam*, *zoom*]

```
> f1:=(x,y)->y^2-8*x
```

$$f1 := (x, y) \mapsto y^2 - 8 \cdot x \tag{22}$$

```
> f2:=(x,y)->x^2-y
```

$$f2 := (x, y) \mapsto x^2 - y \tag{23}$$

```
> ec1:=diff(x(t),t)=f1(x(t),y(t))
```

$$ec1 := \frac{\mathrm{d}}{\mathrm{d}t} x(t) = y(t)^2 - 8\,x(t) \tag{24}$$

```
> ec2:=diff(y(t),t)=f2(x(t),y(t))
```

$$ec2 := \frac{\mathrm{d}}{\mathrm{d}t} y(t) = x(t)^2 - y(t) \tag{25}$$

```
> sist:=ec1,ec2
```

$$sist := \frac{\mathrm{d}}{\mathrm{d}t} x(t) = y(t)^2 - 8\,x(t),\ \frac{\mathrm{d}}{\mathrm{d}t} y(t) = x(t)^2 - y(t) \tag{26}$$

```
> sol:=solve({f1(x,y)=0,f2(x,y)=0},{x,y})
```

$$sol := \{x = 0, y = 0\},\ \{x = 2, y = 4\},\ \{x = -2\,RootOf(\_Z^2 + \_Z + 1) - 2,\ y = 4\,RootOf(\_Z^2 + \_Z + 1)\} \tag{27}$$

```
> evalf(sol[3,1])
```

$$x = -1.000000000 - 1.732050808\,I \tag{28}$$

```
> evalf(sol[3,2])
```

$$y = -2.000000000 + 3.464101615\,I \tag{29}$$

```
> J:=jacobian([f1(x,y),f2(x,y)],[x,y])
```

$$J := \begin{bmatrix} -8 & 2y \\ 2x & -1 \end{bmatrix} \tag{30}$$

```
> A1:=subs(sol[1,1],sol[1,2],eval(J))
```

$$A1 := \begin{bmatrix} -8 & 0 \\ 0 & -1 \end{bmatrix} \tag{31}$$

```
> A2:=subs(sol[2,1],sol[2,2],eval(J))
```

$$A2 := \begin{bmatrix} -8 & 8 \\ 4 & -1 \end{bmatrix} \tag{32}$$

```
> eigenvals(A1)
```

$$-8, -1 \tag{33}$$

```
> eigenvals(A2)
```

$$-\frac{9}{2} + \frac{\sqrt{177}}{2}, -\frac{9}{2} - \frac{\sqrt{177}}{2} \tag{34}$$

```
> cond_in:=[x(0)=0,y(0)=i]$i=1..5,[x(0)=i,y(0)=0]$i=1..5,[x(0)=0,y
  (0)=-i]$i=1..5,[x(0)=-i,y(0)=0]$i=1..5
```

$$cond\_in := [x(0)=0, y(0)=1], [x(0)=0, y(0)=2], [x(0)=0, y(0)=3], [x(0)=0, y(0)=4], [x(0)=0, y(0)=5], [x(0)=1, y(0)=0], [x(0)=2, y(0)=0], [x(0)=3, y(0)=0], [x(0)=4, y(0)=0], [x(0)=5, y(0)=0], [x(0)=0, y(0)=-1], [x(0)=0, y(0)=-2], [x(0)=0, y(0)=-3], [x(0)=0, y(0)=-4], [x(0)=0, y(0)=-5], [x(0)=-1, y(0)=0], [x(0)=-2, y(0)=0], [x(0)=-3, y(0)=0], [x(0)=-4, y(0)=0], [x(0)=-5, y(0)=0] \tag{35}$$

```
> DEplot([sist],[x(t),y(t)],t=-5..5,x=-6..6,y=-6..6,[cond_in])
Warning, plot may be incomplete, the following errors(s) were issued:
   cannot evaluate the solution further left of -.39749706, probably
a singularity
Warning, plot may be incomplete, the following errors(s) were issued:
   cannot evaluate the solution further left of -.58311397, probably
a singularity
Warning, plot may be incomplete, the following errors(s) were issued:
```

```
   cannot evaluate the solution further left of -.36959619, probably
a singularity
Warning, plot may be incomplete, the following errors(s) were issued:
   cannot evaluate the solution further left of -.20654666, probably
a singularity
Warning, plot may be incomplete, the following errors(s) were issued:
   cannot evaluate the solution further left of -.18292932, probably
a singularity
```