$f := (x, y) \rightarrow 2 \cdot x - x^2 - x \cdot y;$

$$(x, y) \rightarrow 2\, x - x^2 - x\, y \tag{1}$$

$f1 := (x, y) \rightarrow 2 \cdot x - x^2 - x \cdot y;$

$$(x, y) \rightarrow 2\, x - x^2 - x\, y \tag{2}$$

$f2 := -y + x \cdot y;$

$$x\, y - y \tag{3}$$

$Jm := Jacobian([f1(x, y), f2(x, y)], [x, y]);$

$$Jacobian([-x^2 - x\, y + 2\, x, x(x, y)\, y(x, y) - y(x, y)], [x, y]) \tag{4}$$

$with(linalg) : with(VectorCalculus)$

[&x, `*`, `+`, `-`, `.`, <,>, <|>, About, AddCoordinates, ArcLength, BasisFormat, Binormal, Compatibility, ConvertVector, CrossProduct, Curl, Curvature, D, Del, DirectionalDiff, Divergence, DotProduct, Flux, GetCoordinateParameters, GetCoordinates, GetNames, GetPVDescription, GetRootPoint, GetSpace, Gradient, Hessian, IsPositionVector, IsRootedVector, IsVectorField, Jacobian, Laplacian, LineInt, MapToBasis, Nabla, Norm, Normalize, PathInt, PlotPositionVector, PlotVector, PositionVector, PrincipalNormal, RadiusOfCurvature, RootedVector, ScalarPotential, SetCoordinateParameters, SetCoordinates, SpaceCurve, SurfaceInt, TNBFrame, Tangent, TangentLine, TangentPlane, TangentVector, Torsion, Vector, VectorField, VectorPotential, VectorSpace, Wronskian, diff, eval, evalVF, int, limit, series] **(5)**

$Jm := Jacobian([f1(x, y), f2(x, y)], [x, y]);$

$$\left[\left[-2\, x - y + 2,\ -x\right], \left[\left(\frac{\partial}{\partial x} x(x, y)\right) y(x, y) + x(x, y) \left(\frac{\partial}{\partial x} y(x, y)\right) - \left(\frac{\partial}{\partial x} y(x, y)\right), \left(\frac{\partial}{\partial y} x(x, y)\right) y(x, y) + x(x, y) \left(\frac{\partial}{\partial y} y(x, y)\right) - \left(\frac{\partial}{\partial y} y(x, y)\right)\right]\right] \tag{6}$$

$A := subs([x = p1, y = p2], Jm);$

$$\left[\left[-2\, p1 - p2 + 2,\ -p1\right], \left[\left(\frac{\partial}{\partial p1} p1(p1, p2)\right) p2(p1, p2) + p1(p1, p2) \left(\frac{\partial}{\partial p1} p2(p1, p2)\right) - \left(\frac{\partial}{\partial p1} p2(p1, p2)\right), \left(\frac{\partial}{\partial p2} p1(p1, p2)\right) p2(p1, p2) + p1(p1, p2) \left(\frac{\partial}{\partial p2} p2(p1, p2)\right) - \left(\frac{\partial}{\partial p2} p2(p1, p2)\right)\right]\right] \tag{7}$$

$eigenvalues(A);$

$$\frac{1}{2} \left(\frac{\partial}{\partial p2} p1(p1, p2)\right) p2(p1, p2) + \frac{1}{2}\, p1(p1, p2) \left(\frac{\partial}{\partial p2} p2(p1, p2)\right) - \frac{1}{2} \frac{\partial}{\partial p2} p2(p1, p2) - p1 - \frac{1}{2}\, p2 + 1 \tag{8}$$

$$+ \frac{1}{2} \, ((\frac{\partial}{\partial p2} \, p1(p1, p2))^2 \, p2(p1, p2)^2 + 2 \, (\frac{\partial}{\partial p2} \, p1(p1, p2)) \, p2(p1,$$

$$p2) \, p1(p1, p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) + p1(p1, p2)^2 \, (\frac{\partial}{\partial p2} \, p2(p1, p2))^2 - 2 \, (\frac{\partial}{\partial p2} \, p1(p1,$$

$$p2)) \, p2(p1, p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) + 4 \, (\frac{\partial}{\partial p2} \, p1(p1, p2)) \, p2(p1, p2) \, p1$$

$$+ 2 \, (\frac{\partial}{\partial p2} \, p1(p1, p2)) \, p2(p1, p2) \, p2 - 4 \, p2(p1, p2) \, (\frac{\partial}{\partial p1} \, p1(p1, p2)) \, p1 - 2 \, p1(p1,$$

$$p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2))^2 + 4 \, p1(p1, p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) \, p1 + 2 \, p1(p1,$$

$$p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) \, p2 - 4 \, p1(p1, p2) \, (\frac{\partial}{\partial p1} \, p2(p1, p2)) \, p1 - 4 \, (\frac{\partial}{\partial p2} \, p1(p1,$$

$$p2)) \, p2(p1, p2) - 4 \, p1(p1, p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) + (\frac{\partial}{\partial p2} \, p2(p1, p2))^2$$

$$- 4 \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) \, p1 - 2 \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) \, p2 + 4 \, (\frac{\partial}{\partial p1} \, p2(p1, p2)) \, p1 + 4 \, p1^2$$

$$+ 4 \, p1 \, p2 + p2^2 + 4 \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) - 8 \, p1 - 4 \, p2 + 4)^{1/2}, \; \frac{1}{2} \, (\frac{\partial}{\partial p2} \, p1(p1,$$

$$p2)) \, p2(p1, p2) + \frac{1}{2} \, p1(p1, p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) - \frac{1}{2} \, \frac{\partial}{\partial p2} \, p2(p1, p2) - p1 - \frac{1}{2} \, p2$$

$$+ 1$$

$$- \frac{1}{2} \, ((\frac{\partial}{\partial p2} \, p1(p1, p2))^2 \, p2(p1, p2)^2 + 2 \, (\frac{\partial}{\partial p2} \, p1(p1, p2)) \, p2(p1,$$

$$p2) \, p1(p1, p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) + p1(p1, p2)^2 \, (\frac{\partial}{\partial p2} \, p2(p1, p2))^2 - 2 \, (\frac{\partial}{\partial p2} \, p1(p1,$$

$$p2)) \, p2(p1, p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) + 4 \, (\frac{\partial}{\partial p2} \, p1(p1, p2)) \, p2(p1, p2) \, p1$$

$$+ 2 \, (\frac{\partial}{\partial p2} \, p1(p1, p2)) \, p2(p1, p2) \, p2 - 4 \, p2(p1, p2) \, (\frac{\partial}{\partial p1} \, p1(p1, p2)) \, p1 - 2 \, p1(p1,$$

$$p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2))^2 + 4 \, p1(p1, p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) \, p1 + 2 \, p1(p1,$$

$$p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) \, p2 - 4 \, p1(p1, p2) \, (\frac{\partial}{\partial p1} \, p2(p1, p2)) \, p1 - 4 \, (\frac{\partial}{\partial p2} \, p1(p1,$$

$$p2)) \, p2(p1, p2) - 4 \, p1(p1, p2) \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) + (\frac{\partial}{\partial p2} \, p2(p1, p2))^2$$

$$- 4 \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) \, p1 - 2 \, (\frac{\partial}{\partial p2} \, p2(p1, p2)) \, p2 + 4 \, (\frac{\partial}{\partial p1} \, p2(p1, p2)) \, p1 + 4 \, p1^2$$

$$+ 4\, p1\, p2 + p2^2 + 4 \left(\frac{\partial}{\partial p2}\, p2(p1, p2) \right) - 8\, p1 - 4\, p2 + 4 \Big)^{1/2}$$

$with(linalg) : with(VectorCalculus) :$

$Jm := Jacobian([f1(x, y), f2(x, y)], [x, y]);$

$$\left[\left[-2\, x - y + 2,\ -x \right], \left[\left(\frac{\partial}{\partial x}\, x(x, y) \right) y(x, y) + x(x, y) \left(\frac{\partial}{\partial x}\, y(x, y) \right) - \left(\frac{\partial}{\partial x}\, y(x, y) \right), \left(\frac{\partial}{\partial y}\, x(x, y) \right) y(x, y) + x(x, y) \left(\frac{\partial}{\partial y}\, y(x, y) \right) - \left(\frac{\partial}{\partial y}\, y(x, y) \right) \right] \right] \tag{9}$$

$Jm1 := Jacobian([2 \cdot x - x^2 - x \cdot y, -y + x \cdot y], [x, y]);$

$$\begin{bmatrix} -2\, x - y + 2 & -x \\ y & x - 1 \end{bmatrix} \tag{10}$$

$A := subs([x = p1, y = p2],\ Jm1);$

$$\begin{bmatrix} -2\, p1 - p2 + 2 & -p1 \\ p2 & p1 - 1 \end{bmatrix} \tag{11}$$

$eigenvalues(A);$

$$-\frac{1}{2}\, p1 - \frac{1}{2}\, p2 + \frac{1}{2} + \frac{1}{2} \sqrt{9\, p1^2 + 2\, p1\, p2 + p2^2 - 18\, p1 - 6\, p2 + 9},\ -\frac{1}{2}\, p1 - \frac{1}{2}\, p2 + \frac{1}{2} - \frac{1}{2} \sqrt{9\, p1^2 + 2\, p1\, p2 + p2^2 - 18\, p1 - 6\, p2 + 9} \tag{12}$$

$with(DEtools);$

[*AreSimilar*, *Closure*, *DEnormal*, *DEplot*, *DEplot3d*, *DEplot_polygon*, *DFactor*, *DFactorLCLM*, *DFactorsols*, *Dchangevar*, *Desingularize*, *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*, *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*, **(13)** *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*]

$eq1 := 2\cdot x(t) - x(t)^2 - x(t)\cdot y(t) = 0;$

$$2\,x(t) - x(t)^2 - x(t)\,y(t) = 0 \tag{14}$$

$eq2 := -y(t) + x(t)\cdot y(t) = 0;$

$$-y(t) + x(t)\,y(t) = 0 \tag{15}$$

$dfieldplot([eq1, eq2], [x(t), y(t)], t = -3\,..3, x = -1\,..-1, y = 2.2\,..1.2]);$

```
Error, unable to match delimiters
  dfieldplot([eq1, eq2], [x(t), y(t)], t=-3..3, x=-1..-1, y=2.2..1.2]);
```

$dfieldplot([eq1, eq2], [x(t), y(t)], t = -3\,..3, x = -1\,..-1, y = 2.2\,..1.2);$

```
Error, (in DEtools/dfieldplot) Invalid range for x
```

$dfieldplot([eq1, eq2], [x(t), y(t)], t = -3\,..3, x = -1\,..2.2, y = -1\,..1.2);$

```
Error, (in DEtools/dfieldplot) cannot produce plot, non-autonomous DE
(s) require initial conditions.
```

$dfieldplot([eq1, eq2], [x(t), y(t)], t = -3\,..3, x = -1\,..2.2, y = -1\,..1.2);$

```
Error, (in DEtools/dfieldplot) cannot produce plot, non-autonomous DE
(s) require initial conditions.
```

?*dfieldplot*

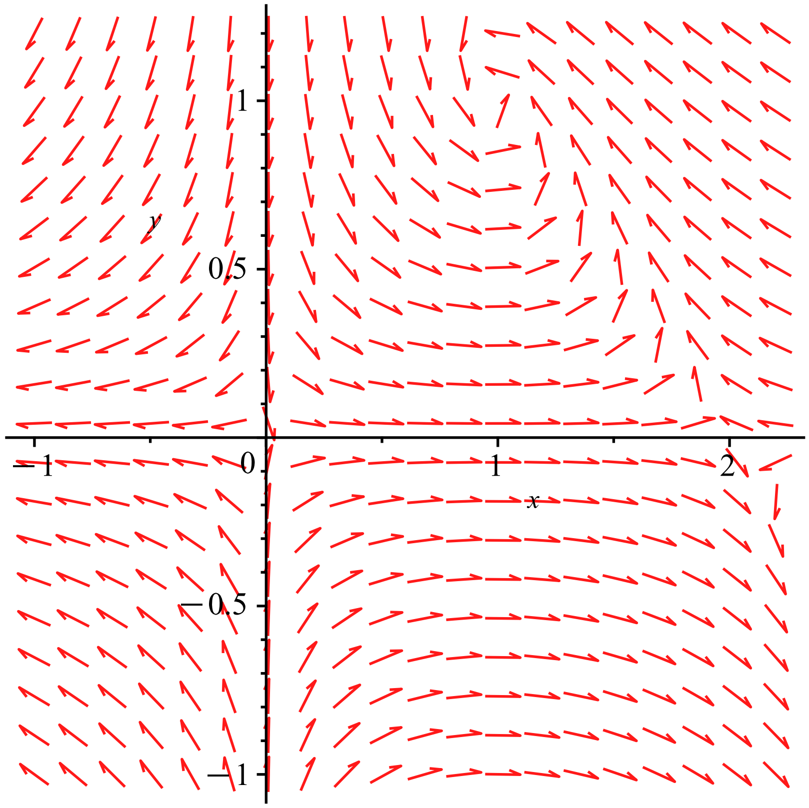
$eq1 := diff(x(t), t) = 2\cdot x(t) - x(t)^2 - x(t)\cdot y(t);$

$$\frac{d}{dt}\,x(t) = 2\,x(t) - x(t)^2 - x(t)\,y(t) \tag{16}$$

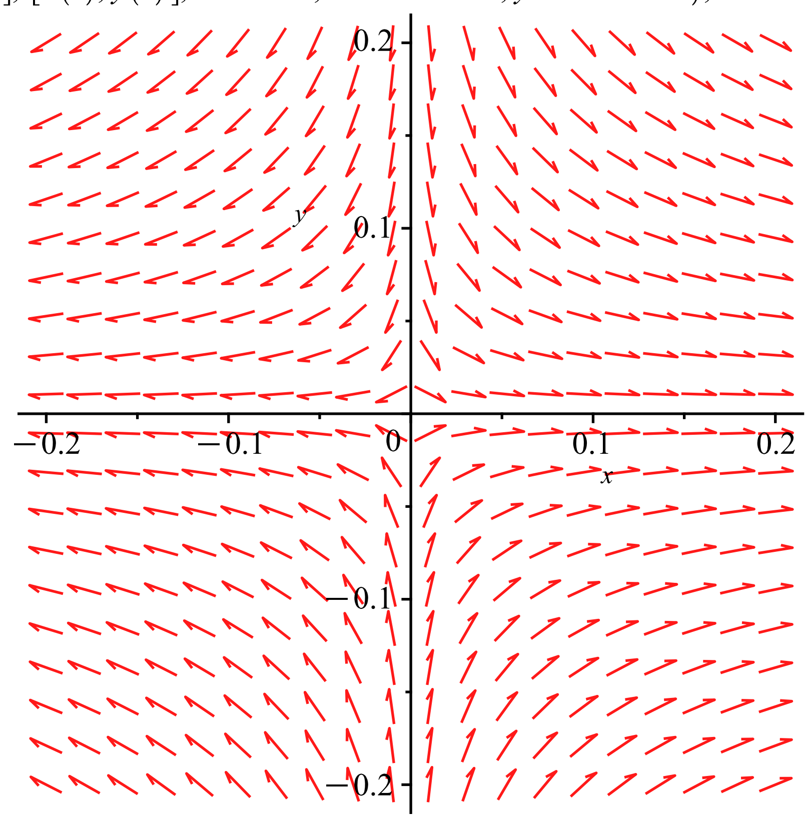
$eq2 := diff(y(t), t) = -y(t) + x(t)\cdot y(t);$

$$\frac{d}{dt}\,y(t) = -y(t) + x(t)\,y(t) \tag{17}$$

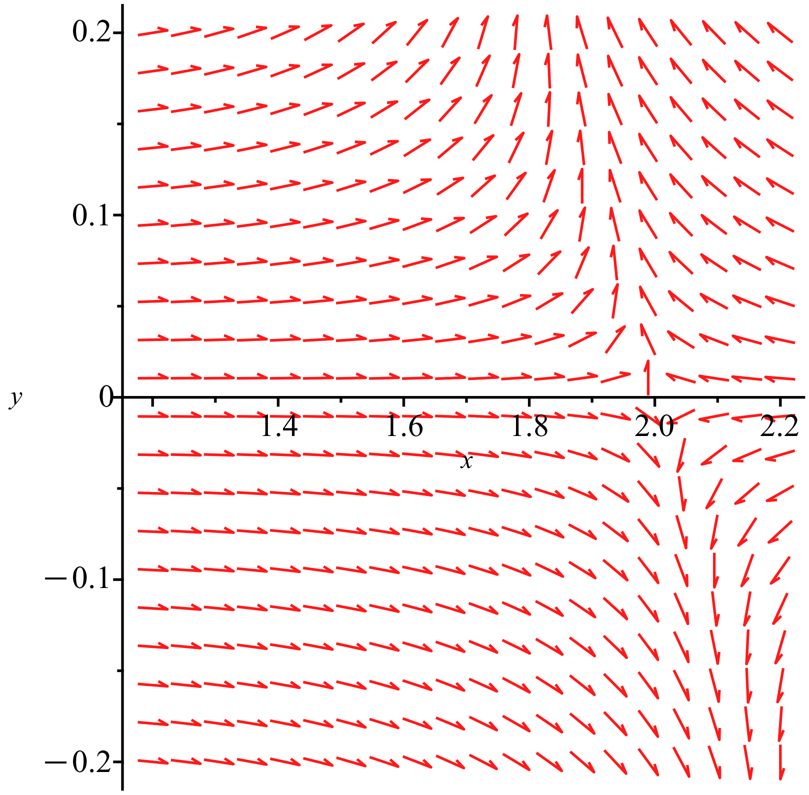
$dfieldplot([eq1, eq2], [x(t), y(t)], t = -3\,..3, x = -1\,..2.2, y = -1\,..1.2);$



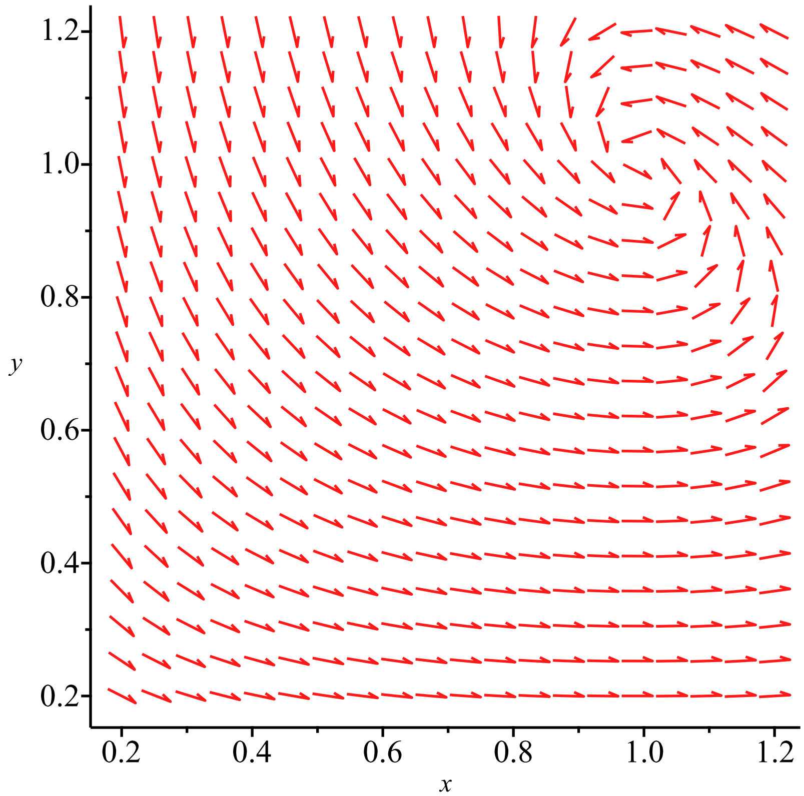
dfieldplot([*eq1*, *eq2*], [*x*(*t*), *y*(*t*)], *t* =− 3 ..3, *x* =− 0.2 ..0.2, *y* =− 0.2 ..0.2);



dfieldplot([*eq1*, *eq2*], [*x*(*t*), *y*(*t*)], *t* =− 3 ..3, *x* = 1.2 ..2.2, *y* =− 0.2 ..0.2);



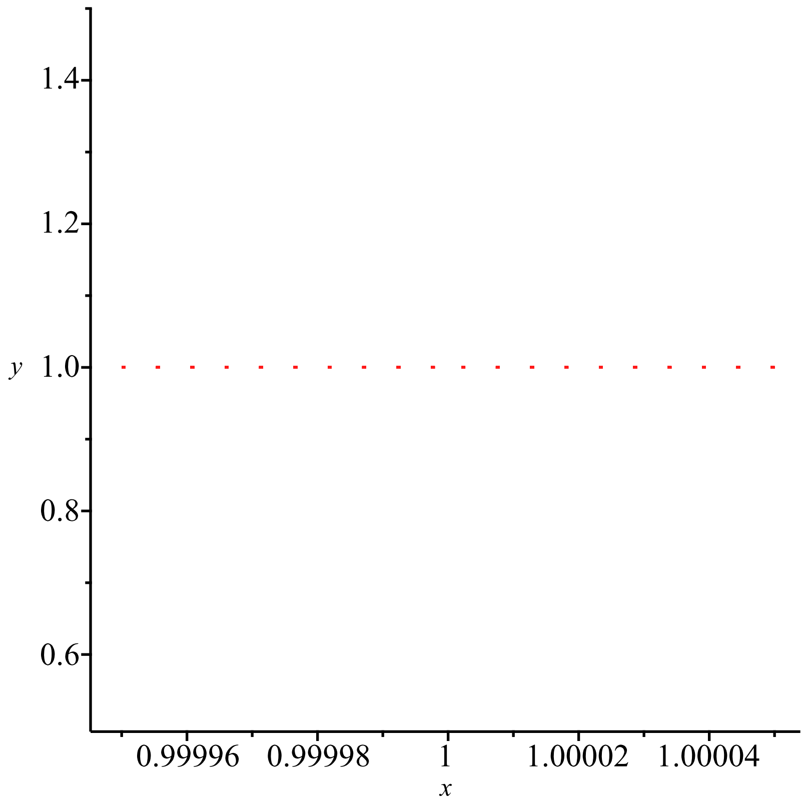
dfieldplot([*eq1*, *eq2*], [$x(t)$, $y(t)$], $t=-3..3$, $x=0.2..1.2$, $y=0.2..1.2$);



ic1 := $x(0)=1, y(0)=1$;

$$x(0)=1, y(0)=1 \tag{18}$$

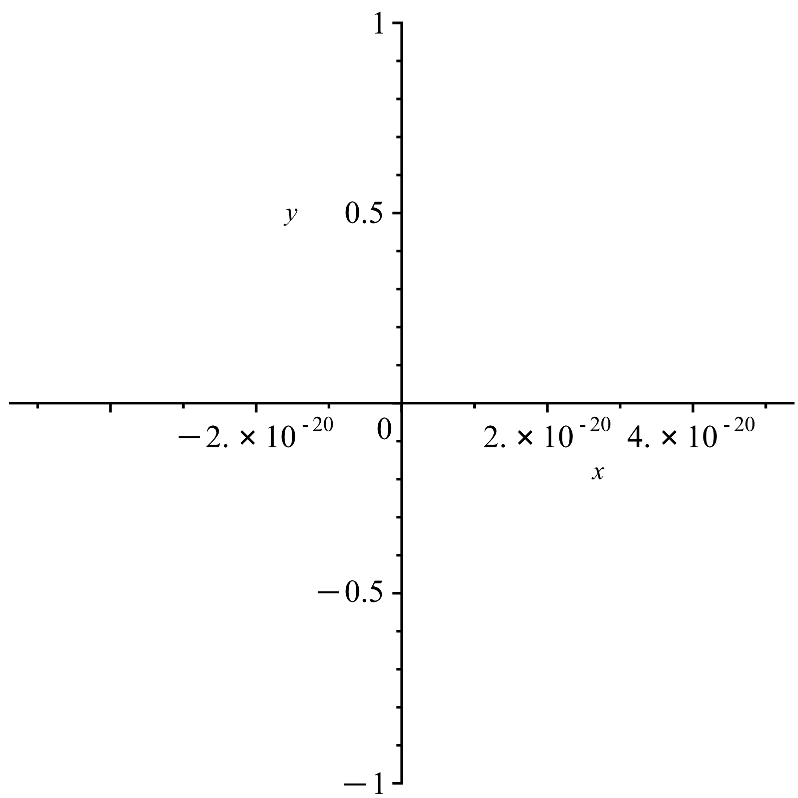
DEplot([*eq1*, *eq2*], [$x(t)$, $y(t)$], $t=0..1$, [[*ic1*]]);



$ic1 := x(0) = 0, y(0) = 0;$

$$x(0) = 0, y(0) = 0 \tag{19}$$

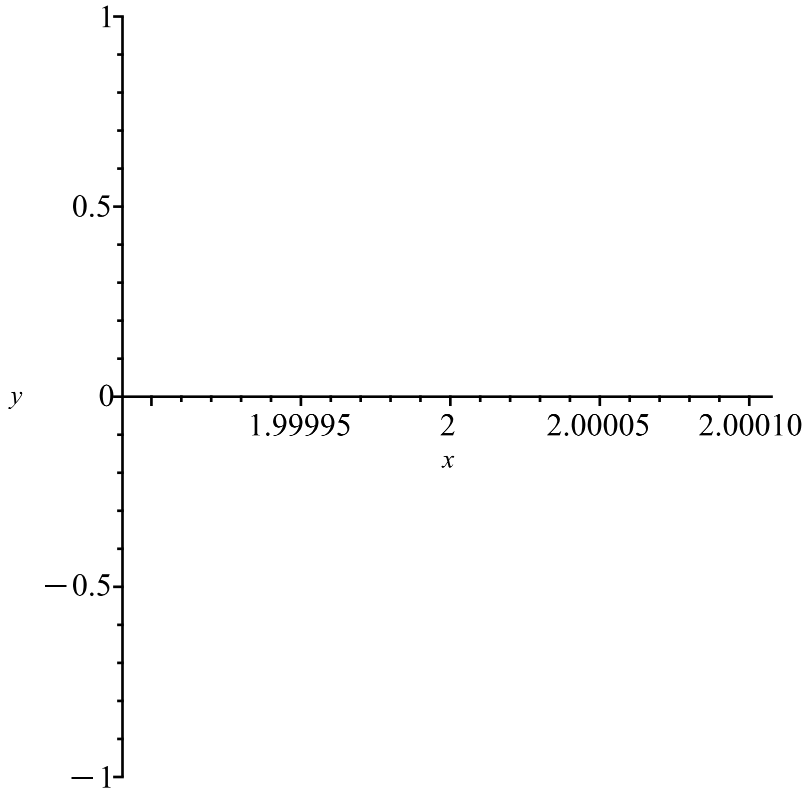
$DEplot([eq1, eq2], [x(t), y(t)], t = 0..1, [[ic1]]);$



$ic1 := x(0) = 2, y(0) = 0;$

$$x(0) = 2, y(0) = 0 \tag{20}$$

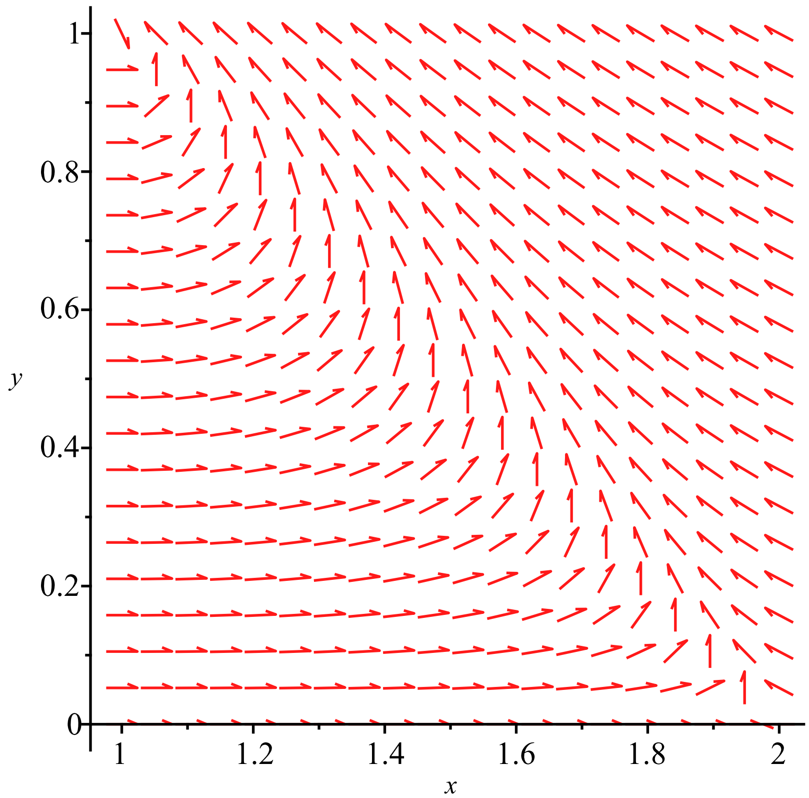
$DEplot([eq1, eq2], [x(t), y(t)], t = 0..10, [[ic1]]);$



$DEplot([eq1, eq2], [x(t), y(t)], t = 0..1, [x(0) = 1, y(0) = 1]);$

```
Error, (in DEtools/DEplot/CheckInitial) too few initial conditions: [x(0) = 1]
```

$DEplot([eq1, eq2], [x(t), y(t)], t = 0..1, [[x(0) = 1, y(0) = 1], [x(0) = 2, y(0) = 0]]);$



$eq1 := 'eq1'$

$$eq1 \tag{21}$$

$eq1 := diff(x(t), t) = x(t) - 2 \cdot x(t) \cdot y(t);$

$$\frac{\mathrm{d}}{\mathrm{d}t} x(t) = x(t) - 2\, x(t)\, y(t) \tag{22}$$

$eq2 := 'eq2'$

$$eq2 \tag{23}$$

$eq2 := diff(y(t), t) = \frac{x(t)^2}{2} - y(t);$

$$\frac{\mathrm{d}}{\mathrm{d}t} y(t) = \frac{1}{2}\, x(t)^2 - y(t) \tag{24}$$

$dsolve(\{eq1, eq2\}, \{x(t), y(t)\});$

$$\left[\{x(t) = 0\}, \{y(t) = \_C1\, \mathrm{e}^{-t}\}\right], \left[\left\{x(t) = \_a \ \&\text{where} \left[\left\{\left(\frac{\mathrm{d}}{\mathrm{d}\_a} \_b(\_a)\right) \_b(\_a) - \frac{-\_a^4 + \_b(\_a)^2 - \_a\, \_b(\_a) + \_a^2}{\_a} = 0\right\}, \left\{\_a = x(t), \_b(\_a) = \frac{\mathrm{d}}{\mathrm{d}t} x(t)\right\}, \left\{t = \int \frac{1}{\_b(\_a)}\, \mathrm{d}\_a + \_C1, x(t) = \_a\right\}\right]\right\}, \left\{y(t) = \frac{1}{2}\, \frac{-\left(\frac{\mathrm{d}}{\mathrm{d}t} x(t)\right) + x(t)}{x(t)}\right\}\right] \tag{25}$$