

```
SetDirectory["C:\\drorbn\\AcademicPensieve\\Classes\\12-267"]
```

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C:\\drorbn\\AcademicPensieve\\Classes\\12-267
```

```
RandomQuadratic[] :=
```

```
(a x^2 +  $\sqrt{2}$  b x y + c y^2) /. a | b | c  $\Rightarrow$  RandomVariate[NormalDistribution[]];
```

```
RandomQuadratic[n_] := Table[RandomQuadratic[], {n}]
```

```
RandomQuadratic[2]
```

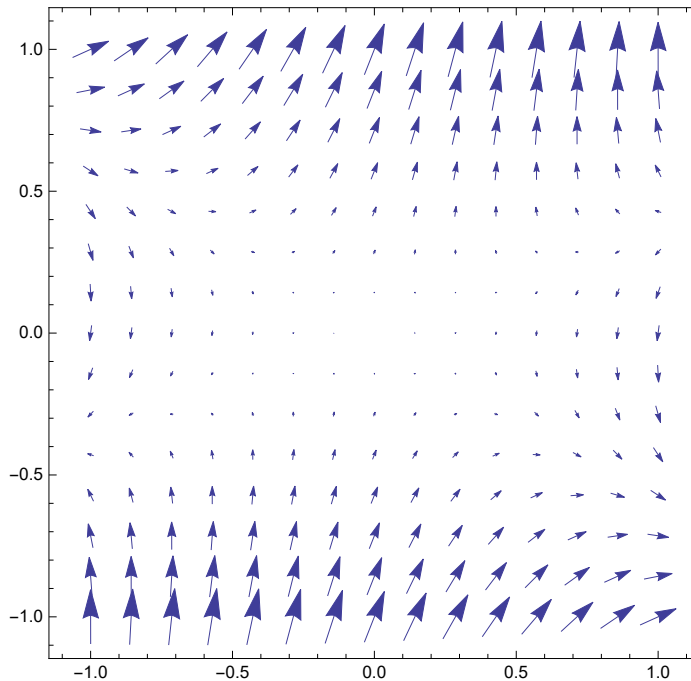
```
{-0.089427 x^2 - 0.0548483 x y + 0.93843 y^2, -0.27239 x^2 - 0.755967 x y - 0.235646 y^2}
```

```
quad = RandomQuadratic[2];
```

```
Print[quad];
```

```
VectorPlot[quad, {x, -1, 1}, {y, -1, 1}]
```

```
{-0.0698726 x^2 - 0.628976 x y + 0.69531 y^2, -0.537876 x^2 + 0.659672 x y + 1.7648 y^2}
```



```
eqns = Join[
```

```
Thread[{x'[t], y'[t]} == (quad /. {x  $\rightarrow$  x[t], y  $\rightarrow$  y[t]})],
```

```
{x[0] == RandomReal[{-1, 1}], y[0] == RandomReal[{-1, 1}]}
```

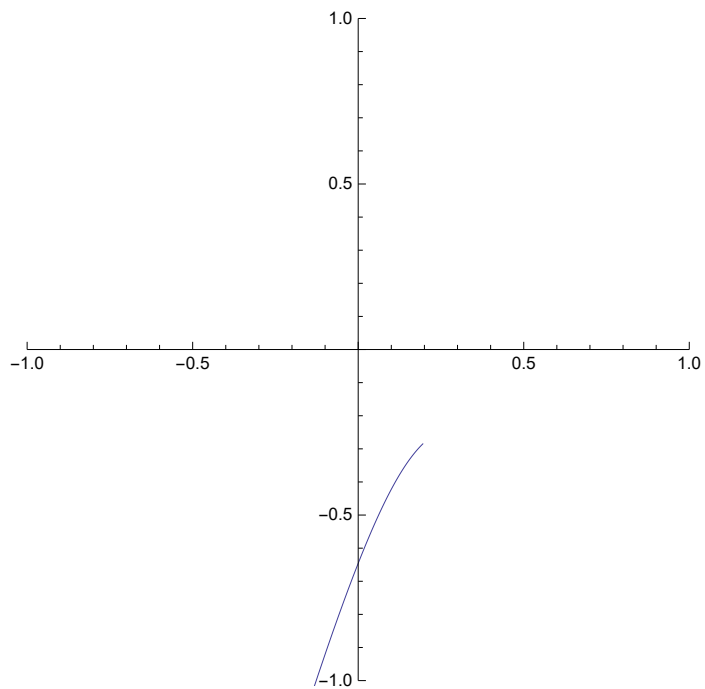
```
];
```

```
sol = NDSolve[eqns, {x, y}, {t, -1, 1}]
```

```
{x  $\rightarrow$  InterpolatingFunction[{{-1., 1.}}, <>],
```

```
y  $\rightarrow$  InterpolatingFunction[{{-1., 1.}}, <>]}
```

```
ParametricPlot[  
  Evaluate[{x[t], y[t]} /. sol],  
  {t, -1, 1},  
  PlotRange -> {{-1, 1}, {-1, 1}}  
]
```



```

MakeImage["QuadraticPortraits",
GraphicsGrid[Table[
quad = RandomQuadratic[2];
Print[quad];
Show[Join[
{VectorPlot[quad, {x, -1, 1}, {y, -1, 1}, Frame -> None]},
Table[
eqns = Join[
Thread[{x'[t], y'[t]} == (quad /. {x -> x[t], y -> y[t]}),
{x[0] == RandomReal[{-1, 1}], y[0] == RandomReal[{-1, 1]}]
];
sol = NDSolve[eqns, {x, y}, {t, -1, 1}];
ParametricPlot[
Evaluate[{x[t], y[t]} /. sol],
{t, -1, 1},
PlotRange -> {{-1, 1}, {-1, 1}}, ColorFunction -> (Red &
),
{100}
],
]],
{8}, {8}
]]
]

```

$\{1.0228 x^2 + 0.789659 x y - 1.22091 y^2, -0.309186 x^2 + 1.13814 x y + 0.921496 y^2\}$

$\{2.58059 x^2 - 0.939251 x y - 0.700025 y^2, -1.51503 x^2 - 1.58389 x y + 0.41058 y^2\}$

NDSolve::npsz: At t == -0.501799, step size is effectively zero; singularity or stiff system suspected. >>

InterpolatingFunction::dmval:

Input value {-0.999959} lies outside the range of data in the interpolating function. Extrapolation will be used. >>

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Input value {-0.999959} lies outside the range of data in the interpolating function. Extrapolation will be used. >>

NDSolve::npsz: At t == -0.904087, step size is effectively zero; singularity or stiff system suspected. >>

InterpolatingFunction::dmval:

Input value {-0.999959} lies outside the range of data in the interpolating function. Extrapolation will be used. >>

General::stop: Further output of InterpolatingFunction::dmval will be suppressed during this calculation. >>

NDSolve::npsz: At t == 0.37493350083564153, step size is effectively zero; singularity or stiff system suspected. >>

General::stop: Further output of NDSolve::npsz will be suppressed during this calculation. >>

$\{-0.836618 x^2 - 0.911066 x y - 2.61177 y^2, -0.861744 x^2 + 2.16747 x y - 1.55119 y^2\}$

$\{-1.67325 x^2 - 0.34082 x y + 0.00557681 y^2, -0.0520714 x^2 + 1.83711 x y + 0.941212 y^2\}$

$\{0.696075 x^2 - 0.255238 x y + 0.207944 y^2, -2.5172 x^2 + 0.509597 x y + 0.749891 y^2\}$

$\{1.9241 x^2 - 0.657943 x y - 0.910184 y^2, -0.736976 x^2 + 0.570367 x y + 1.02628 y^2\}$

$\{-1.09425 x^2 - 0.285686 x y - 0.0966392 y^2, 2.56747 x^2 + 2.16508 x y - 0.45504 y^2\}$
 $\{-0.486531 x^2 + 0.0396628 x y - 0.744937 y^2, 0.502634 x^2 - 2.28039 x y + 0.0862318 y^2\}$
 $\{0.686823 x^2 + 0.587299 x y - 1.26683 y^2, 0.0975242 x^2 - 1.83035 x y - 0.580246 y^2\}$
 $\{0.0988637 x^2 + 0.976749 x y + 0.372051 y^2, 0.0136202 x^2 - 0.782185 x y + 0.353595 y^2\}$
 $\{-1.01438 x^2 + 1.17698 x y + 0.361699 y^2, 0.648978 x^2 + 1.00191 x y - 0.682662 y^2\}$
 $\{-0.111836 x^2 + 0.0818017 x y + 0.817066 y^2, 0.591276 x^2 + 1.30955 x y + 0.348274 y^2\}$
 $\{-1.03073 x^2 - 0.806311 x y - 0.412033 y^2, -1.70864 x^2 - 0.830448 x y + 0.515908 y^2\}$
 $\{-0.297404 x^2 + 0.956188 x y + 0.992852 y^2, 0.137919 x^2 - 0.467129 x y - 0.74381 y^2\}$
 $\{-3.66549 x^2 - 0.238593 x y + 1.73158 y^2, 0.668457 x^2 + 2.00869 x y + 0.0625317 y^2\}$
 $\{1.20711 x^2 + 0.59034 x y + 0.773817 y^2, 0.30938 x^2 - 1.69706 x y - 1.76899 y^2\}$
 $\{-0.197552 x^2 - 0.837164 x y - 0.223825 y^2, 0.785441 x^2 + 0.872804 x y - 0.498702 y^2\}$
 $\{0.204911 x^2 + 0.419563 x y + 1.22114 y^2, -0.589999 x^2 - 0.463917 x y - 1.14371 y^2\}$
 $\{-1.19932 x^2 + 2.90977 x y - 0.443704 y^2, -0.101433 x^2 - 0.696032 x y + 0.949485 y^2\}$
 $\{-2.67918 x^2 - 0.365193 x y + 0.162765 y^2, 0.289944 x^2 + 1.27831 x y + 0.570327 y^2\}$
 $\{0.591113 x^2 + 2.09528 x y + 0.99726 y^2, -1.72994 x^2 + 1.2175 x y + 0.312129 y^2\}$
 $\{1.82416 x^2 - 1.32004 x y + 0.837975 y^2, 0.375354 x^2 - 1.63805 x y + 0.399832 y^2\}$
 $\{-2.099 x^2 + 0.0257186 x y + 1.01361 y^2, -0.0432465 x^2 - 0.053244 x y - 1.15084 y^2\}$
 $\{0.825905 x^2 - 0.640722 x y + 0.87192 y^2, 0.00806567 x^2 - 0.826791 x y - 1.3351 y^2\}$
 $\{0.594247 x^2 - 1.39872 x y + 1.13331 y^2, 0.15444 x^2 + 1.68988 x y - 0.230607 y^2\}$
 $\{-0.596506 x^2 + 2.30956 x y - 1.23901 y^2, 1.11804 x^2 + 1.30699 x y - 0.165464 y^2\}$
 $\{0.384317 x^2 + 1.03065 x y - 1.12338 y^2, 0.475324 x^2 - 0.0306425 x y + 0.212388 y^2\}$
 $\{-0.0920056 x^2 + 0.315632 x y - 0.937359 y^2, -0.602766 x^2 - 1.69305 x y + 1.46134 y^2\}$
 $\{-0.714642 x^2 + 1.26051 x y + 0.322233 y^2, 0.449618 x^2 + 1.88764 x y + 0.845105 y^2\}$
 $\{0.020298 x^2 + 1.10615 x y + 0.885894 y^2, 0.671048 x^2 - 1.71747 x y + 0.499032 y^2\}$
 $\{-1.13535 x^2 - 1.66809 x y - 0.166239 y^2, -2.24865 x^2 + 0.864368 x y + 0.413573 y^2\}$
 $\{-1.68067 x^2 + 0.520533 x y - 0.135879 y^2, 1.30258 x^2 - 1.10871 x y - 1.55459 y^2\}$
 $\{-0.113497 x^2 - 0.40565 x y - 0.935389 y^2, 1.14722 x^2 + 1.55313 x y + 0.0201975 y^2\}$
 $\{2.46954 x^2 + 0.11047 x y - 0.0676903 y^2, -0.136948 x^2 + 2.69602 x y - 1.10219 y^2\}$
 $\{-0.726858 x^2 - 0.701147 x y - 0.130949 y^2, -0.378486 x^2 + 2.37724 x y - 0.825959 y^2\}$
 $\{-0.18489 x^2 + 0.240645 x y + 1.11236 y^2, -0.583718 x^2 + 0.544724 x y + 0.651541 y^2\}$
 $\{-1.15859 x^2 - 0.390765 x y + 0.89965 y^2, 0.822742 x^2 + 0.179943 x y + 1.47089 y^2\}$
 $\{0.525165 x^2 + 0.128206 x y - 0.87101 y^2, 0.718761 x^2 + 0.277505 x y + 1.27589 y^2\}$
 $\{-0.842979 x^2 - 1.73088 x y + 1.30132 y^2, -0.436404 x^2 - 1.80897 x y + 2.02394 y^2\}$
 $\{-2.57756 x^2 + 0.860421 x y + 0.089472 y^2, 1.42188 x^2 + 0.593009 x y - 0.264238 y^2\}$
 $\{-1.79961 x^2 - 1.54269 x y - 1.41293 y^2, -1.37035 x^2 - 0.192453 x y - 1.17816 y^2\}$
 $\{0.39442 x^2 - 0.277129 x y + 0.302149 y^2, 0.372626 x^2 - 1.61921 x y + 0.999402 y^2\}$

$\{0.671921 x^2 + 0.571534 x y + 0.351046 y^2, -0.161683 x^2 + 0.0117623 x y - 0.0433875 y^2\}$
 $\{0.373293 x^2 + 0.138435 x y + 0.642883 y^2, -1.91312 x^2 + 0.826984 x y - 1.95099 y^2\}$
 $\{1.20883 x^2 + 2.17326 x y - 0.299115 y^2, 0.898122 x^2 - 0.491138 x y + 0.105706 y^2\}$
 $\{-0.711087 x^2 - 0.891951 x y + 2.1371 y^2, 1.38588 x^2 + 0.643549 x y - 0.163834 y^2\}$
 $\{0.922735 x^2 + 1.16316 x y - 0.432434 y^2, 0.412766 x^2 + 0.246508 x y - 1.11008 y^2\}$
 $\{-0.336249 x^2 + 0.398801 x y - 1.24028 y^2, -0.797888 x^2 + 0.822847 x y + 0.239837 y^2\}$
 $\{0.615061 x^2 - 0.304203 x y + 0.917049 y^2, -0.251879 x^2 + 0.413707 x y - 0.646328 y^2\}$
 $\{-0.134099 x^2 + 0.784697 x y + 0.5834 y^2, -0.0611416 x^2 - 1.47756 x y - 0.977987 y^2\}$
 $\{1.00968 x^2 + 0.222405 x y - 1.82301 y^2, -0.611187 x^2 + 0.440929 x y + 0.47554 y^2\}$
 $\{-1.03134 x^2 + 1.22901 x y + 0.751905 y^2, -0.632957 x^2 + 1.79649 x y - 0.352633 y^2\}$
 $\{0.930051 x^2 + 0.882596 x y + 0.473587 y^2, -0.400218 x^2 + 1.21351 x y + 0.952488 y^2\}$
 $\{1.29515 x^2 + 0.246142 x y - 0.493318 y^2, -0.809788 x^2 - 1.38608 x y + 0.738145 y^2\}$
 $\{-0.420014 x^2 - 1.29264 x y - 1.65527 y^2, 1.24488 x^2 - 0.507817 x y - 2.16939 y^2\}$
 $\{-0.131369 x^2 - 2.71081 x y - 0.791676 y^2, -0.330646 x^2 + 0.804113 x y - 0.386319 y^2\}$
 $\{-0.488297 x^2 + 1.4895 x y + 1.5318 y^2, 1.98423 x^2 + 1.58895 x y + 1.49719 y^2\}$
 $\{1.05659 x^2 - 0.717744 x y - 0.610292 y^2, -0.377364 x^2 + 2.72984 x y + 0.0287381 y^2\}$
 $\{1.32377 x^2 + 1.75148 x y - 0.260862 y^2, 0.404669 x^2 - 1.26092 x y + 0.649095 y^2\}$
 $\{1.76429 x^2 + 1.07271 x y - 0.292926 y^2, 0.918873 x^2 - 1.57445 x y + 0.495734 y^2\}$
 $\{1.52011 x^2 + 2.95676 x y - 0.456284 y^2, 1.42443 x^2 + 1.08184 x y + 1.41556 y^2\}$
 $\{0.0668838 x^2 + 2.51877 x y + 1.70555 y^2, -0.168164 x^2 + 0.719186 x y - 0.990698 y^2\}$
 $\{0.354801 x^2 + 1.4709 x y - 0.805227 y^2, 0.323582 x^2 + 0.858467 x y + 1.31966 y^2\}$
 $\{0.326144 x^2 + 0.535488 x y + 0.900761 y^2, 0.973674 x^2 + 0.735356 x y - 0.999747 y^2\}$

