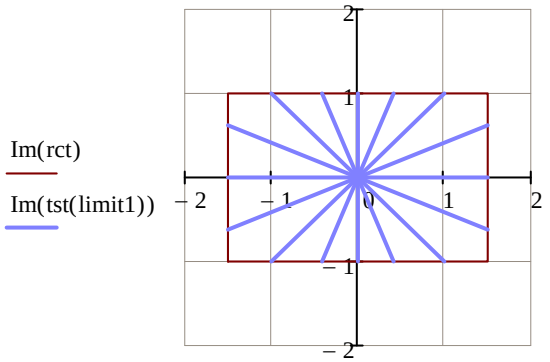
slopefield

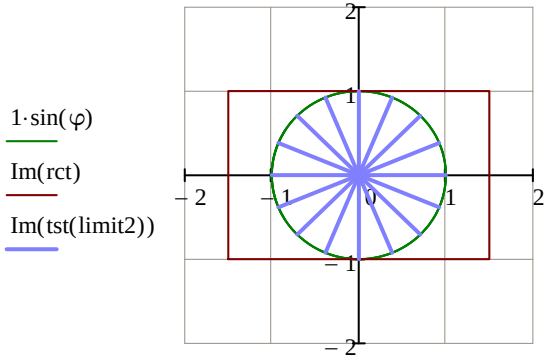
$$rct := stack(-1.5 - j, 1.5 - j, 1.5 + j, -1.5 + j, -1.5 - j)$$

$$tst(limit) := \left| \begin{array}{l} \text{for } i \in 0..7 \\ \quad sl(x,y) \leftarrow \tan\left(i \cdot \frac{\pi}{8}\right) \\ \quad v_{3\cdot i} \leftarrow limit(sl,0,0,3,2) \\ \quad v_{3\cdot i+1} \leftarrow -limit(sl,0,0,3,2) \\ \quad v_{3\cdot i+2} \leftarrow NaN \\ \text{return } v \end{array} \right.$$

$$limit1(slope,x,y,\Delta x,\Delta y) := \left| \begin{array}{l} k \leftarrow NaN \quad \text{on error } slope(x,y) \\ \text{return } NaN \quad \text{if } Im(k) \neq 0 \\ \text{return } j \cdot \frac{\Delta y}{2} \quad \text{if } IsNaN(k) \\ \text{return } \frac{\Delta x}{2} \quad \text{if } k = 0 \\ dx \leftarrow \min\left(\frac{\Delta y}{2 \cdot |k|}, \frac{\Delta x}{2}\right) \\ \text{return } dx + j \cdot dx \cdot k \end{array} \right.$$

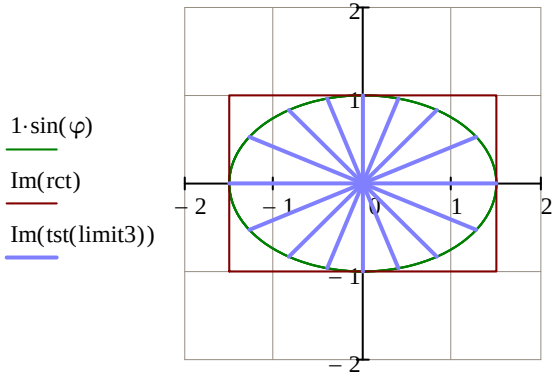


$$\text{limit2}(\text{slope}, x, y, \Delta x, \Delta y) := \left| \begin{array}{l} k \leftarrow \text{NaN} \quad \text{on error slope}(x, y) \\ \text{return NaN if } \text{Im}(k) \neq 0 \\ \text{return } j \cdot \min\left(\frac{\Delta x}{2}, \frac{\Delta y}{2}\right) \text{ if IsNaN}(k) \\ \text{tmp} \leftarrow 1 + j \cdot k \\ \text{return } \frac{\text{tmp}}{|\text{tmp}|} \cdot \min\left(\frac{\Delta x}{2}, \frac{\Delta y}{2}\right) \end{array} \right.$$



$1 \cos(\varphi), \text{Re}(\text{rct}), \text{Re}(\text{tst}(\text{limit2}))$

$$\text{limit3}(\text{slope}, x, y, \Delta x, \Delta y) := \left| \begin{array}{l} k \leftarrow \text{NaN} \quad \text{on error slope}(x, y) \\ \text{return NaN if } \text{Im}(k) \neq 0 \\ \text{ret} \leftarrow j \cdot \frac{\Delta y}{2} \text{ if IsNaN}(k) \\ \text{tmp} \leftarrow 1 + j \cdot k \cdot \frac{\Delta x}{\Delta y} \\ \text{tmp} \leftarrow \frac{\text{tmp}}{|\text{tmp}|} \cdot \frac{\Delta x}{2} \\ \text{return } \text{Re}(\text{tmp}) + j \cdot \frac{\Delta y}{\Delta x} \cdot \text{Im}(\text{tmp}) \end{array} \right.$$



$\frac{3}{2} \cos(\varphi), \text{Re}(\text{rct}), \text{Re}(\text{tst}(\text{limit3}))$

```
mk_slopeField(slope, x1, x2, nx, y1, y2, ny, limit, scale) :=
    (Δx  Δy) ← (x2 − x1)/nx   (y2 − y1)/ny
    for ix ∈ 0 .. nx
        x ← x1 + ix·Δx
        for iy ∈ 0 .. ny
            y ← y1 + iy·Δy
            P_ORIGIN+rows(P) ← x + j·y
            S_ORIGIN+rows(S) ← x + j·y − scale·limit(slope, x, y, Δx, Δy)
            S_ORIGIN+rows(S) ← x + j·y + scale·limit(slope, x, y, Δx, Δy)
            S_ORIGIN+rows(S) ← NaN
    return (S  P)^T
```

slopefield

$a := \frac{1}{6}$ $t_{end} := 6$

Given

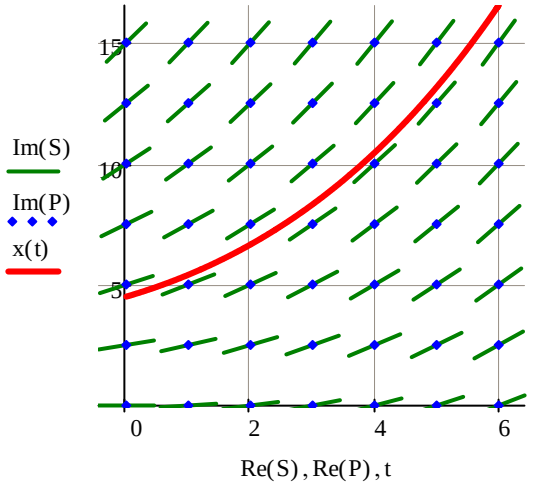
$\frac{d}{dt}x(t) = a\cdot(x(t) + t)$ $x(0) = x0$

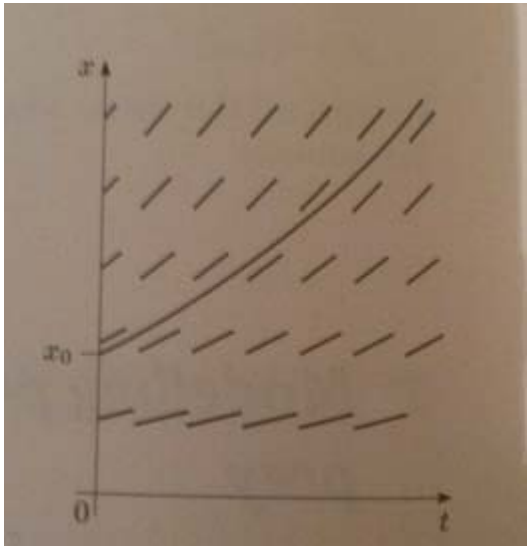
$X(x0) := \text{Odesolve}(t, t_{end})$

$D1(x, t) := a\cdot(x + t)$

$\begin{pmatrix} S \\ P \end{pmatrix} := \text{mk\_slopeField}(D1, 0, 6, 6, 0, 15, 6, \text{limit3}, 0.9)$

$x_0 := 4.5$ $x := X(x_0)$





You may of course omit the plotting of the points P.