右辺の単位を書き換える

$$L:=1\cdot10^{-5}\ H=10\ \mu H \qquad \frac{4\ V}{2\ s}=2\ \frac{V}{s}$$

$$RPM:=\frac{Hz}{60}$$

$y:=12$

$N_{rpm}:=750\ RPM$

$D:=1\ in$

$S:=0.5\ in$

$A:=\frac{\pi}{4}\cdot D^2=0.785\ in^2$

$V_D:=y\cdot A\cdot S=4.712\ in^3$

$Q_T:=V_D\cdot N_{rpm}=15.3\ gpm$

$f:=60 \qquad \omega:=2\cdot\pi\cdot f$

$rpm:=1\ rpm=0.10472\ \frac{1}{s}$

$RPM:=\frac{Hz}{60}=0.01667\ \frac{1}{s}$

$3600\ RPM=60\ \frac{1}{s}$

$3600\ rpm=376.991\ \frac{1}{s}$

Shift+F1でリボンをたためる。

テキストに数式を加え下付き・上付きを加える。式は Ctrl+Shift+M、下付きはCtrl+-、上付きは^

tokoro $V_A+V_B+V^A$

式のまとめ

$$B:=\frac{\sqrt{a}\cdot\sqrt{b}}{\sqrt{c}}\ \xrightarrow[\ ]{assume,ALL>0 \atop combine}\ \sqrt{\frac{a\cdot b}{c}}$$

$$S_1\ \xrightarrow{factor}\ \frac{P\cdot a^2\cdot b\cdot(3\cdot b+4)}{16\cdot E\cdot I\cdot(b+2)\cdot(3\cdot b+2)}$$

$$S_1\ \xrightarrow{factor \atop collect,\frac{P\cdot a^2}{E\cdot I}}\ \frac{b\cdot(3\cdot b+4)}{16\cdot(b+2)\cdot(3\cdot b+2)}\cdot\frac{P\cdot a^2}{E\cdot I}$$

値と単位の分離抽出

$B:=1\ k\Omega$

$\mu_0=(1.257\cdot10^{-6})\ \dfrac{kg\cdot m}{s^2\cdot A^2}$

$\dfrac{\mu_0}{\mathrm{SIUnitsOf}(\mu_0)}=1.257\cdot10^{-6}$

$\dfrac{\mu_0}{\mathrm{SIUnitsOf}(\mu_0)}=1.257\cdot10^{-6}$

$\dfrac{\varepsilon_0}{\mathrm{SIUnitsOf}(\varepsilon_0)}=8.854\cdot10^{-12}$

$\mathrm{UnitsOf}(L)=1\ H$

$\mathrm{UnitsOf}(B)=1\ \Omega$

$\mathrm{SIUnitsOf}(B)=1\ \Omega$ $\qquad \dfrac{B}{\mathrm{SIUnitsOf}(B)}=1\cdot10^{3}$

分母と分子の分離抽出

$a:=\dfrac{45}{82}$ $\qquad \mathrm{denom}(a)\rightarrow 82$ $\qquad \mathrm{numer}(a)\rightarrow 45$

$b:=\mathrm{trunc}(a)\rightarrow 0$ $\qquad c:=\mathrm{floor}(a)\rightarrow 0$ $\qquad bb:=\mathrm{trunc}\left(\dfrac{1}{a}\right)\rightarrow 1$ $\qquad cc:=\mathrm{floor}\left(\dfrac{1}{a}\right)\rightarrow 1$

$$\frac{45}{82}\xrightarrow{confrac,fraction}\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{4+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{2}}}}}}}$$

虚数単位の表示の簡略化

$f:=60$ $\qquad \omega:=2\cdot\pi\cdot f$ $\qquad j\omega:=1\mathrm{i}\cdot\omega$

$CN:=1+i$

$i:=\sqrt{-1}=1\mathrm{i}$

$CN:=1+i$

$R:=1$ $\qquad L:=1$ $\qquad C:=1$ $\qquad jX:=j\omega\cdot L=376.991\mathrm{i}$

$jX:=\dfrac{1}{j\omega\cdot C}=-0.003\mathrm{i}$

$i:=1\mathrm{i}$

$Z:=1+i$ $\qquad |Z|=1.414$ $\qquad \arg(Z)=45\ deg$

$\sqrt{-1}=1\mathrm{i}$

$\dfrac{1+i}{1-i}=1\mathrm{i}$ $\qquad \dfrac{1\cdot i}{1+i}\rightarrow\dfrac{1}{2}+\dfrac{1}{2}\cdot1\mathrm{i}$

$Z:=1+\sqrt{3}\cdot i$ $\qquad |Z|=2$ $\qquad \arg(Z)=60\ deg$

$f := 60\ Hza \qquad f = 3600\ rpm$

$1\ Hz = 1\ \frac{1}{s} \qquad 1\ Hz = 9.549\ rpm \qquad \frac{1}{9.549} = 0.105$

行列要素の和

$$array := \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \\ 10 & 11 & 12 \end{bmatrix}$$

```
SumArray(M) := | sum ← 0.0
               | for i ∈ ORIGIN .. last(M^⟨ORIGIN⟩)
               |   | for j ∈ ORIGIN .. last((M^⟨ORIGIN⟩)^T)
               |   |   | sum ← sum + M[i,j]
               | return sum
```

$SumArray(array) = 78$

連立方程式の解き方

$$[V_p\ \ V_n] := \begin{bmatrix} V_n = \left(\frac{V_p}{Z_L} - I_n\right) \cdot \left(\frac{Z_n \cdot Z_L}{Z_n + Z_L}\right) \\ V_p = \left(\frac{V_{DD}}{Z_p} + I_p + \frac{V_n}{Z_L}\right) \cdot \left(\frac{Z_p \cdot Z_L}{Z_p + Z_L}\right) \end{bmatrix} \xrightarrow[\text{simplify}]{\text{solve}, V_p, V_n} \left[\frac{Z_L \cdot V_{DD} + Z_n \cdot V_{DD} + I_{\ldots}}{Z \ldots} \right.$$

$$V_p - V_n \xrightarrow{\text{simplify}} \frac{Z_L \cdot (V_{DD} + I_p \cdot Z_p + I_n \cdot Z_n)}{Z_p + Z_L + Z_n}$$

$$diff(V_{DD}, Z_p, Z_n, I_n, I_p, Z_L) := V_p - V_n \xrightarrow{\text{simplify}} \frac{Z_L \cdot (V_{DD} + I_p \cdot Z_p + I_n \cdot Z_n)}{Z_p + Z_L + Z_n}$$

正の要素と負の要素の分離抽出

$M := \text{stack}(\text{runif}(10, -90, 90))$ $\quad M_5 := 0$

$POS := \text{trim}(M, \text{Match}(0, M, \text{"lt"}))$ $\quad NEG := \text{trim}(M, \text{Match}(0, M, \text{"geq"}))$

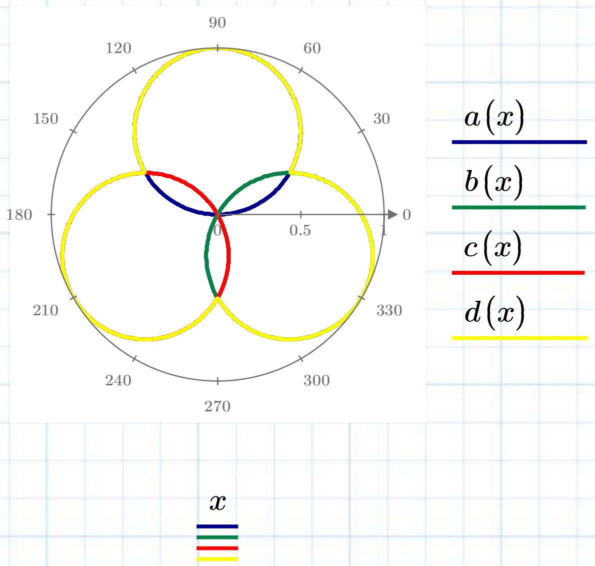
$$M = \begin{bmatrix} -89.772 \\ -55.202 \\ 15.301 \\ -26.945 \\ 58.111 \\ 0 \\ 37.889 \\ -35.283 \\ -73.546 \\ -63.484 \end{bmatrix} \quad POS = \begin{bmatrix} 15.301 \\ 58.111 \\ 0 \\ 37.889 \end{bmatrix} \quad NEG = \begin{bmatrix} -89.772 \\ -55.202 \\ -26.945 \\ -35.283 \\ -73.546 \\ -63.484 \end{bmatrix}$$

$$\text{Match}(0, M, \text{"geq"}) = \begin{bmatrix} 2 \\ 4 \\ 5 \\ 6 \end{bmatrix} \quad \text{Match}(0, M, \text{"lt"}) = \begin{bmatrix} 0 \\ 1 \\ 3 \\ 7 \\ 8 \\ 9 \end{bmatrix}$$

最大値の抽出

$a(x) := \sin(x)$ $\quad b(x) := \sin\left(x + \frac{2 \cdot \pi}{3}\right)$ $\quad c(x) := \sin\left(x + \frac{4 \cdot \pi}{3}\right)$

$d(x) := \max(a(x), b(x), c(x))$



再帰計算　Prime 5

$\textbf{clear}(f, i, n)$

$f(n) := \textbf{if}(n \le 0, 0, n + f(n-1))$ $\quad f(3) = 6$ $\quad f(4) = 10$ $\quad f(100) = 5050$ $\quad \sum_{i=1}^{100} i = 5050$

$g(n) := \textbf{if}(n \le 1, 1, n \cdot g(n-1))$ $\quad g(3) = 6$ $\quad g(4) = 24$ $\quad \prod_{i=1}^{4} i = 24$

$$g(6)=720 \qquad \prod_{i=1}^{6} i=720$$

定積分

$$\int_0^{\pi} \sin(x)\,dx=2 \quad A:=\int_0^{2\cdot\pi} \sin(x)\,dx \rightarrow 0 \quad A:=\int_0^{2\cdot\pi} (\sin(x))^2\,dx \rightarrow \pi \quad A:=\int_0^{2\cdot\pi} (\sin(x))^4\,dx \rightarrow \frac{3\cdot\pi}{4}$$

連立方程式をソルバーで解く

推定値

$x:=0 \quad y:=0 \quad z:=0$

制約条件

$x+y-z=4$

$x-2\,y+3\,z=-6$

$2\,x+3\,y+z=7$

ソルバー

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}:=\text{find}(x,y,z)$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}=\begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$$

$x=1$

$y=2$

$z=-1$

連立方程式を行列で解く

$X:=0 \quad Y:=0 \quad Z:=0$

$$A:=\begin{bmatrix} 1 & 1 & -1 \\ 1 & -2 & 3 \\ 2 & 3 & 1 \end{bmatrix} \quad B:=\begin{bmatrix} 4 \\ -6 \\ 7 \end{bmatrix} \quad A\cdot\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}=B \quad \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}:=A^{-1}\cdot B \quad \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}=\begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$$

$X=1 \quad Y=2 \quad Z=-1$

２軸グラフの書式設定(P5)

$x:=0\ deg, 0.1\ deg .. 360\ deg$

$\mathrm{X}:=x \quad \mathrm{Y}_1:=\sin(x) \quad \mathrm{Y}_2:=\cos(x) \quad \mathrm{Y}_3:=\sin(x^2)$

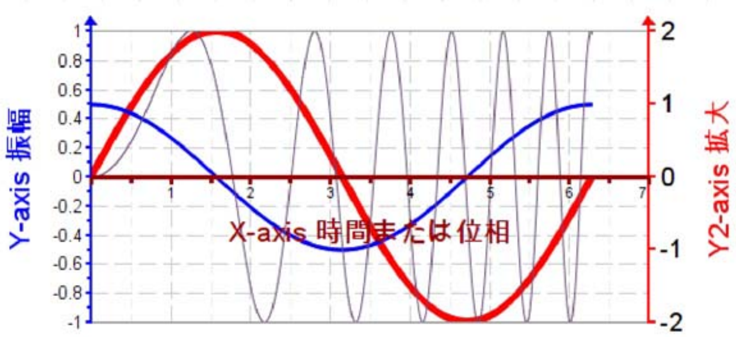


Chart グラフのタイトル

クラーメルの定理をシンボリックに解く

$$E := \begin{bmatrix} E_1 \\ E_2 \end{bmatrix}$$

$$R := \begin{bmatrix} R_1+R_3 & R_3 \\ R_3 & R_2+R_3 \end{bmatrix} \qquad I_{M1} := \begin{bmatrix} E_1 & R_3 \\ E_2 & R_2+R_3 \end{bmatrix} \qquad I_{M2} := \begin{bmatrix} R_1+R_3 & E_1 \\ R_3 & E_2 \end{bmatrix}$$

クラーメルで解くと

$$\det\left(\begin{bmatrix} R_1+R_3 & R_3 \\ R_3 & R_2+R_3 \end{bmatrix}\right) \rightarrow R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3$$

$$\det(R) \rightarrow R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3$$

$$\det(I_{M1}) \xrightarrow{collect, E_1} (R_2+R_3) \cdot E_1 - R_3 \cdot E_2$$

$$\det(I_{M2}) \rightarrow R_1 \cdot E_2 - E_1 \cdot R_3 + R_3 \cdot E_2$$

$$I_1 := \frac{\det(I_{M1})}{\det(R)} \rightarrow \frac{E_1 \cdot R_2 + E_1 \cdot R_3 - R_3 \cdot E_2}{R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3}$$

$$I_2 := \frac{\det(I_{M2})}{\det(R)} \rightarrow \frac{R_1 \cdot E_2 - E_1 \cdot R_3 + R_3 \cdot E_2}{R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3}$$

$$I := \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} \rightarrow \begin{bmatrix} \dfrac{E_1 \cdot R_2 + E_1 \cdot R_3 - R_3 \cdot E_2}{R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3} \\ \dfrac{R_1 \cdot E_2 - E_1 \cdot R_3 + R_3 \cdot E_2}{R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3} \end{bmatrix}$$

$$I_3 := I_1 + I_2 \xrightarrow{simplify} \frac{E_1 \cdot R_2 + E_1 \cdot R_3 + R_1 \cdot E_2 - E_1 \cdot R_3}{R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3}$$

なぜか $E_1 \cdot R_3 - E_1 \cdot R_3$ が消えない

$[I_1 \ I_2] :=$

$I_1 + I_2 \xrightarrow{sim}$

クラーメルの定理をシンボリックに解く２（これがベスト解）

$$I := \text{lsolve}(R, E) \xrightarrow{simplify} \begin{bmatrix} \dfrac{R_2 \cdot E_1 + E_1 \cdot R_3 - R_3 \cdot E_2}{R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3} \\ \dfrac{R_1 \cdot E_2 - E_1 \cdot R_3 + R_3 \cdot E_2}{R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3} \end{bmatrix}$$

$$I_3 := I_0 + I_1 \xrightarrow{simplify} \frac{R_1 \cdot E_2 + R_2 \cdot E_1}{R_1 \cdot R_2 + R_1 \cdot R_3 + R_2 \cdot R_3}$$

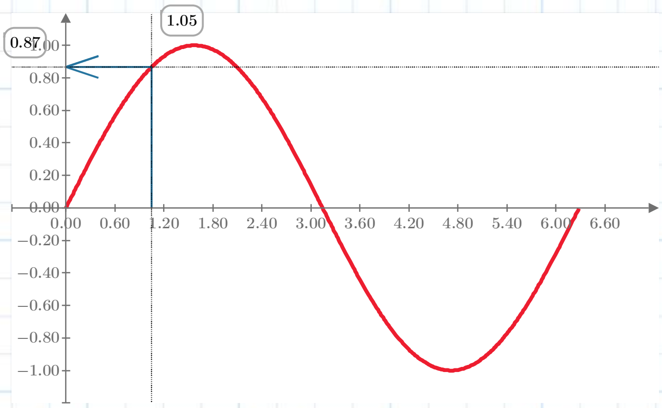
矢印の追加

$f(x) := \sin(x)$ $x := 60\ deg$ $y := f(x) = 0.866$

$\Delta := 0.2$ $X := \begin{bmatrix} x \\ x \\ 0 \\ 0+2\cdot\Delta \\ 0 \\ 0+2\cdot\Delta \end{bmatrix}$ $Y := \begin{bmatrix} 0 \\ y \\ y \\ y+\frac{\Delta}{3} \\ y \\ y-\frac{\Delta}{3} \end{bmatrix}$

$f(xx)$

Y



xx

X

等間隔ベクトルの作成

$i := 0, 1..47$ $k_i := 0.01 \cdot i$ $k = \begin{bmatrix} 0 \\ 0.01 \\ 0.02 \\ 0.03 \\ 0.04 \\ \vdots \end{bmatrix}$ $k \cdot 100 = \begin{bmatrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \\ \vdots \end{bmatrix}$

$k := \text{matrix}(47+1, 1, \max) \cdot 0.01$ $k = \begin{bmatrix} \vdots \\ 0.36 \\ 0.37 \\ 0.38 \\ \vdots \end{bmatrix}$ $k \cdot [100] = \begin{bmatrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \\ \vdots \end{bmatrix}$

$k := 0, 0.01..0.47 = \begin{bmatrix} 0 \\ 0.01 \\ 0.02 \\ 0.03 \\ \vdots \end{bmatrix}$ $k_1 = 0.01$

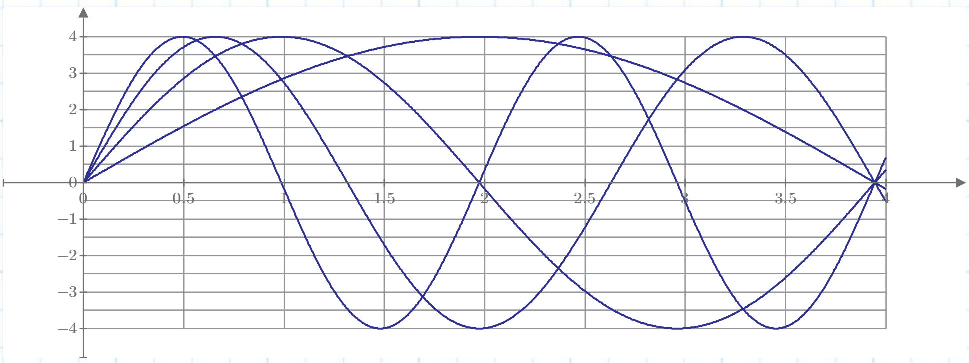
グラフの補助線の表示

$$we\_Grid(axis, x1, x2, step, y1, y2) := \left\| \begin{array}{l} G \leftarrow [NaN \;\; NaN] \\ n \leftarrow \dfrac{x2 - x1}{step} \\ \text{for } i \in 0..n \\ \quad \left\| \begin{array}{l} x \leftarrow x1 + i \cdot step \\ G \leftarrow \text{stack}\left(G, \begin{bmatrix} x & y1 \\ x & y2 \\ NaN & NaN \end{bmatrix}\right) \end{array} \right. \\ \text{if } axis = \text{“y”} \\ \quad \left\| G \leftarrow \text{augment}\left(G^{\langle ORIGIN+1 \rangle}, G^{\langle ORIGIN \rangle}\right) \right. \\ G \end{array} \right.$$

$$v(\kappa) := \left\| \begin{array}{l} \text{for } f \in 1, 2..1000 \\ \quad \left\| R^{\widehat{rows(R)}} \leftarrow \left[\dfrac{f}{250} \;\; 4 \cdot \sin\left(\dfrac{f \cdot \kappa}{314}\right) \right] \right. \\ \text{stack}(R, [NaN \;\; NaN]) \end{array} \right.$$

$$All := \text{stack}(v(1), v(2), v(3), v(4))$$

$$G := \text{stack}(we\_Grid(\text{“x”}, 0, 5, 0.5, -4, 4), we\_Grid(\text{“y”}, -4, 4, 0.5, 0, 4))$$



$G^{\langle 1 \rangle}$

$All^{\langle 1 \rangle}$

$G^{\langle 0 \rangle}$

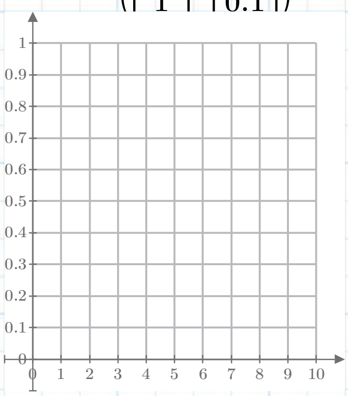
$All^{\langle 0 \rangle}$

グラフの補助線の表示

$$we\_logGrid(axis, x1, x2, step, y1, y2) :=$$

```
G ← [NaN NaN]
x1 ← floor(log(x1))
x2 ← ceil(log(x2))
for i ∈ x1 .. x2
    for j ∈ 1, 1+step .. 10
        x ← j·10^i
        G ← stack(G, [x y1; x y2; NaN NaN])
if axis = "y"
    G ← augment(G^⟨ORIGIN+1⟩, G^⟨ORIGIN⟩)
G
```

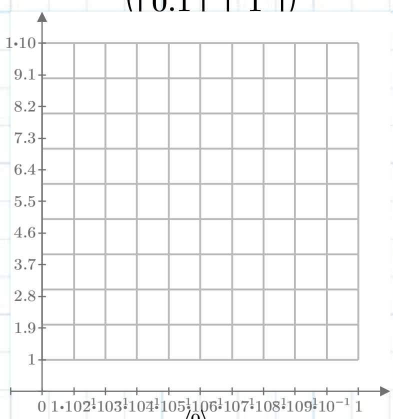
$$G7 := Grid\left(\begin{bmatrix}0\\10\\1\end{bmatrix}, \begin{bmatrix}0\\1\\0.1\end{bmatrix}\right)$$



$G7^{\langle 1\rangle}$

$G7^{\langle 0\rangle}$

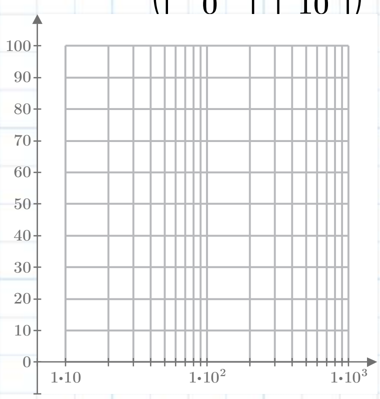
$$G8 := Grid\left(\begin{bmatrix}0\\1\\0.1\end{bmatrix}, \begin{bmatrix}1\\10\\1\end{bmatrix}\right)$$



$G8^{\langle 1\rangle}$

$G8^{\langle 0\rangle}$

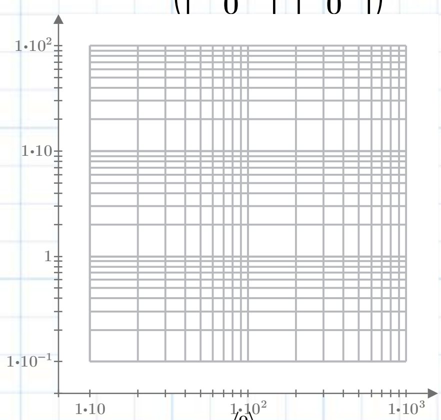
$$G3 := Grid\left(\begin{bmatrix}10\\1000\\0\end{bmatrix}, \begin{bmatrix}0\\100\\10\end{bmatrix}\right)$$



$G3^{\langle 1\rangle}$

$G3^{\langle 0\rangle}$

$$G4 := Grid\left(\begin{bmatrix}10\\1000\\0\end{bmatrix}, \begin{bmatrix}0.1\\100\\0\end{bmatrix}\right)$$



$G4^{\langle 1\rangle}$

$G4^{\langle 0\rangle}$

右辺の単位を書き換える

$r := 0.07\ \frac{\Omega}{km}$ $\quad r = \left(7 \cdot 10^{-5}\right) \frac{kg \cdot m}{s^3 \cdot A^2}$ $\quad r \rightarrow \frac{0.07 \cdot \Omega}{km}$ $\quad r \cdot km \rightarrow 0.07 \cdot \Omega$

$\text{UnitsOf}(r) = 1\ \frac{kg \cdot m}{s^3 \cdot A^2}$ $\quad \frac{r}{\text{UnitsOf}(r)} = 7 \cdot 10^{-5}$

$\text{SIUnitsOf}(r) = 1\ \frac{kg \cdot m}{s^3 \cdot A^2}$ $\quad \frac{r}{\text{SIUnitsOf}(r)} = 7 \cdot 10^{-5}$

$r \cdot 1\ km = 0.07\ \Omega$ $\quad r \cdot 1\ km \rightarrow 0.07 \cdot \Omega$

$r \cdot 1\ m = \left(7 \cdot 10^{-5}\right)\ \Omega$

$r \cdot 1\ m \rightarrow \frac{0.07 \cdot \Omega \cdot m}{km}$ $\quad \frac{1\ m}{0.001\ km} = 1$ $\quad \frac{1\ m}{0.001\ km} \rightarrow \frac{1000.0 \cdot m}{km}$

有効数値の桁数に注意すること

$\cos\left(\frac{\pi}{2}\right) = 0$ $\quad \cos\left(\frac{\pi}{2}\right) \cdot 10^{17} = 6.123$ $\quad \cos\left(\frac{\pi}{2}\right) \cdot 10^{17} \rightarrow 0$

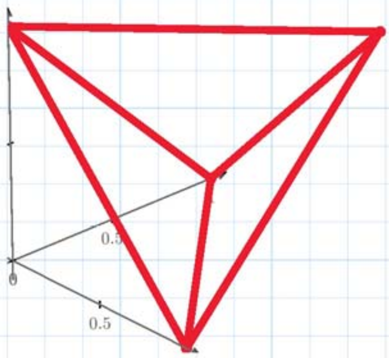
$\sin(0) = 0$ $\quad \sin(0) \cdot 10^{17} = 0$

点と点をつなぐ データを　NaN　とすると分離できる。

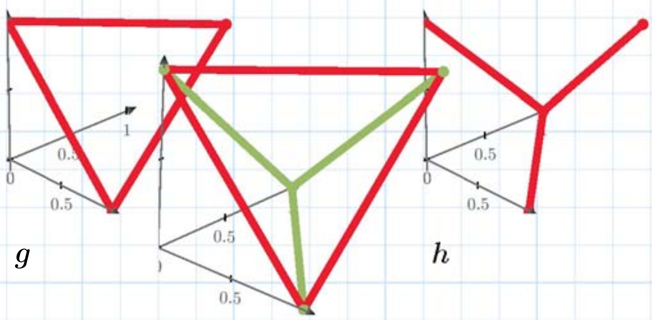
$a := [0\ \ 0\ \ 1]$ $\quad b := [1\ \ 1\ \ 1]$ $\quad c := [0\ \ 1\ \ 0]$ $\quad d := [1\ \ 0\ \ 0]$ $\quad f := \text{stack}(a, b, c, d, a, c, d, b)$

$g := \text{stack}(a, d, b, a)$

$h := \text{stack}(a, c, b, c, d)$



f



g $\quad h$

g

h

補間ベクトルの作成

$x := 0, 1 .. 13$

$y_x := \sin(x) = \begin{bmatrix} 0 \\ 0.841 \\ 0.909 \\ 0.141 \\ \vdots \end{bmatrix}$

$x = \begin{bmatrix} 0 \\ 1 \\ \vdots \end{bmatrix}$ $y = \begin{bmatrix} 0 \\ 0.841 \\ \vdots \end{bmatrix}$ $x := 0, 1 .. 13 = \begin{bmatrix} 0 \\ 1 \\ \vdots \end{bmatrix}$

$x_1 = 1$ $y_1 = 0.841$

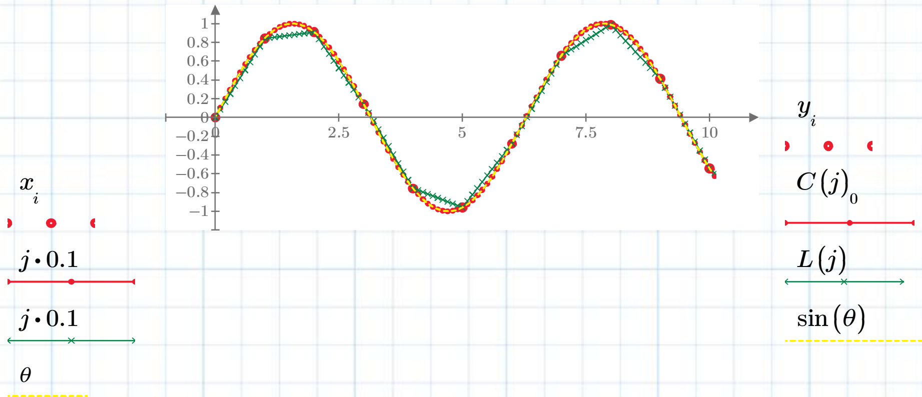
$i := 0, 1 .. 13$

$n := 0, 0.1 .. 13 = \begin{bmatrix} 0 \\ 0.1 \\ \vdots \end{bmatrix}$ $n_1 = 0.1$ $j := 0, 1 .. 130$

低次数つまり点の数が少ない場合

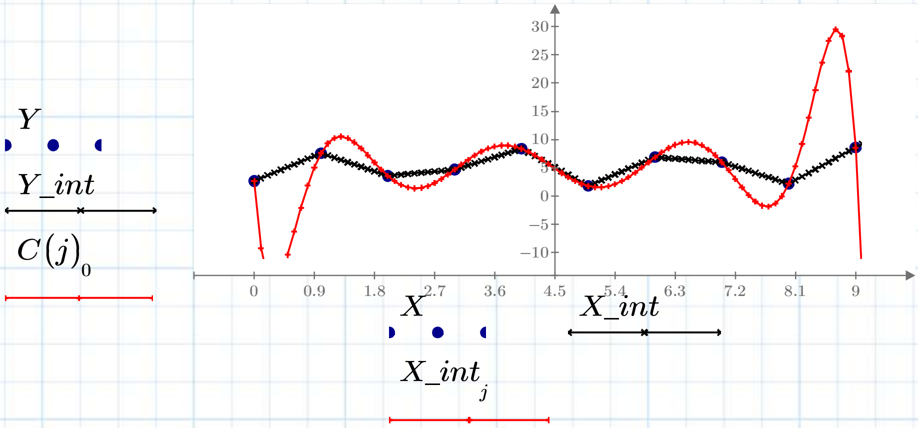
$C(j) := \text{polyint}(x, y, j \cdot 0.1)$ $C(5)_0 = 0.48$ $\theta := 0, 0.05 .. 4 \cdot \pi$

$L(j) := \text{linterp}(x, y, j \cdot 0.1)$ $L(5) = 0.421$



$Y := \begin{bmatrix} 2.7 \\ 7.6 \\ \vdots \end{bmatrix}$ $i := 0 .. \text{rows}(Y) - 1$ $X_i := i$ $X = \begin{bmatrix} 0 \\ 1 \\ \vdots \end{bmatrix}$ $j := 0 .. 95$ $X\_int_j := 0.1 \cdot j$

$Y\_int_j := \text{linterp}(X, Y, X\_int_j)$ $C(j) := \text{polyint}(X, Y, X\_int_j)$



ステップ補間

time	y
0.1	1.2
0.2	1.1
0.5	0.9
1	0.5

```
stepfun1(x,X,Y):= || if x < X_ORIGIN
                  ||    || return NaN
                  || for i ∈ ORIGIN+1 .. last(X)
                  ||    || if x < X_i
                  ||    ||    || return Y_{i−1}
                  || Y_last(Y)
```

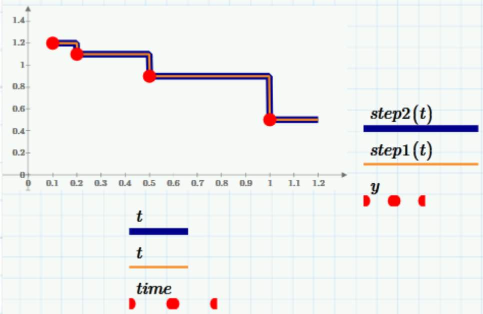
```
stepfun2(x,X,Y):= || v ← lookup(x,X,Y,"leq")
                  || v_last(v)
```

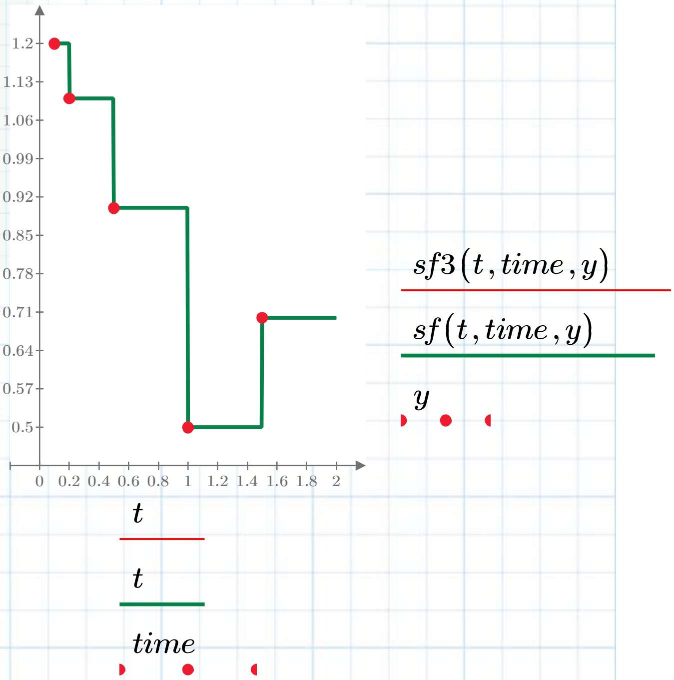
$$time := \begin{bmatrix} 0.1 \\ 0.2 \\ .5 \\ 1 \\ 1.5 \end{bmatrix} \qquad y := \begin{bmatrix} 1.2 \\ 1.1 \\ 0.9 \\ 0.5 \\ 0.7 \end{bmatrix}$$

```
sf(x,X,Y):= || v ← lookup(x,X,Y,"leq")
            || v_last(v)
```

$$sf3(x,X,Y) := \text{reverse}(\text{lookup}(x,X,Y,\text{"leq"}))_{\text{ORIGIN}}$$

$step1(t) := stepfun1(t, time, y)$ $step2(t) := stepfun2(t, time, y)$





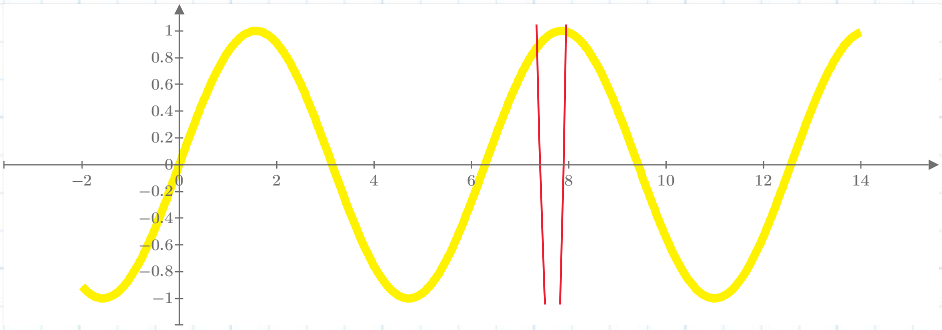
グラフ範囲の外部指定

$\mathbf{clear}(x)$ $f(x):=\sin(x)$

$$[x1\ \ x2\ \ y1\ \ y2]:=[-2\ \ 14\ \ -1\ \ 1]$$

$f(x)$

$C(j)_0$



x

$j \cdot 0.1$

最大電力伝達定理

p.8　例題4.3

$$\mathbf{clear}(L_1, L_2, R, I, E, Z, \omega, P)$$

$$Z:=1\mathrm{i}\cdot\omega\cdot L_1+\frac{R\cdot 1\mathrm{i}\cdot\omega\cdot L_2}{R+1\mathrm{i}\cdot\omega\cdot L_2}$$

$$I:=\frac{E}{Z}\cdot\frac{1\mathrm{i}\cdot\omega\cdot L_2}{R+1\mathrm{i}\cdot\omega\cdot L_2}$$

$$P(R):=|I|^2\cdot R \xrightarrow{simplify} \frac{R\cdot|L_2|^2\cdot|E|^2}{|L_1\cdot R+L_2\cdot R+\omega\cdot L_1\cdot L_2\cdot 1\mathrm{i}|^2}$$

$$P(R):=\frac{R\cdot|L_2|^2\cdot|E|^2}{(L_1\cdot R+L_2\cdot R)^2+((\omega\cdot L_1\cdot L_2)^2)}$$

$$\frac{\mathrm{d}}{\mathrm{d}R}P(R)=0 \xrightarrow[]{\substack{assume, ALL>0\\ solve, R}} \frac{\omega\cdot L_1\cdot L_2}{L_1+L_2}$$

解の求め方

$p_1 := 0.6947368\ atm$ $p_1' := 0.248684211\ atm$

$t := 2705\ s$ $L := 56\ m$

$D := 1\ \frac{m^2}{s}$

$$\frac{p_1 - p_1'}{p_1 + p_1'} = \frac{8}{\pi}\left(e^{-\pi^2 \frac{D \cdot t}{4 L^2}} + \frac{1}{9} e^{-9 \pi^2 \frac{D \cdot t}{4 L^2}}\right)$$

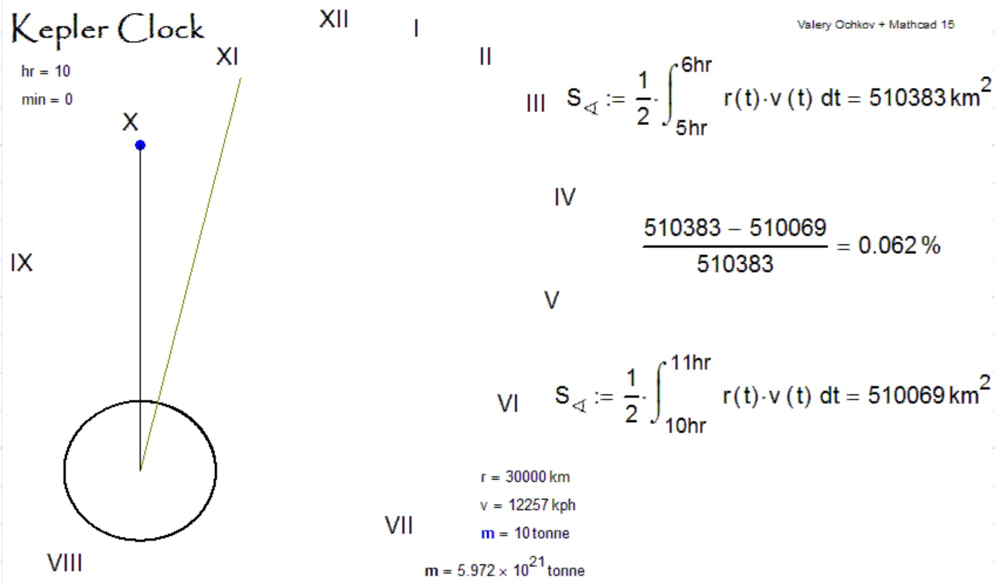
$D := \text{Find}(D) = 0.791\ \frac{m^2}{s}$

OR:

$D := 1\ \frac{m^2}{s}$

$$D := \text{root}\left(\frac{8}{\pi}\left(e^{-\pi^2 \frac{D \cdot t}{4 L^2}} + \frac{1}{9} e^{-9 \pi^2 \frac{D \cdot t}{4 L^2}}\right) - \frac{p_1 - p_1'}{p_1 + p_1'}, D\right) = 0.791\ \frac{m^2}{s}$$

アニメーション



最大値と最小値

例:最適化関数

$f(x) := 1.0 \cdot e^{-0.1 \cdot x} \cdot \sin(2 \cdot x)$

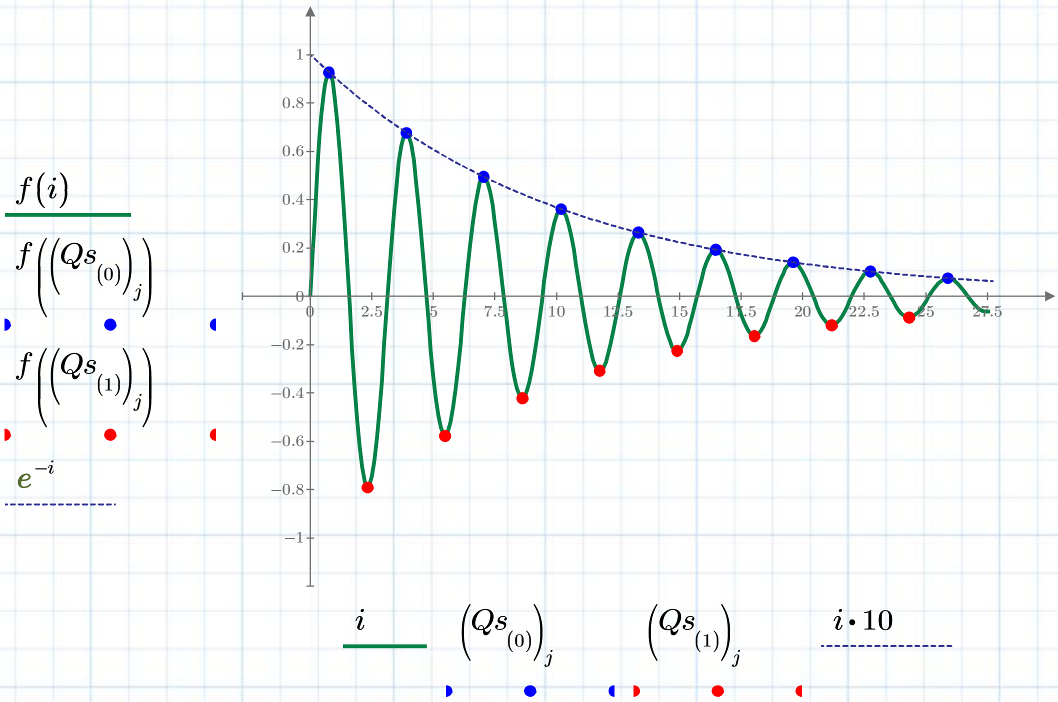
$Vec := 0 \cdot \pi, \pi .. 8 \cdot \pi = \begin{bmatrix} 0 \\ \vdots \end{bmatrix}$

$F(x) := \mathbf{Maximize}(f, x)$ $G(x) := \mathbf{Minimize}(f, x)$ $j := 0, 1 .. 4$

$Qs := \overrightarrow{\begin{bmatrix} F(Vec) \\ G(Vec) \end{bmatrix}}$ $i := 0, 0.1 .. 10 \cdot \pi$

$x_j := \left(Qs_{(0)}\right)_j = \begin{bmatrix} 0.76 \\ 3.902 \\ 7.044 \\ 10.185 \\ 13.327 \end{bmatrix}$ $y_j := f\left(\left(Qs_{(0)}\right)_j\right) = \begin{bmatrix} 0.926 \\ 0.676 \\ 0.494 \\ 0.361 \\ 0.263 \end{bmatrix}$ $j := 0, 1 .. 300$

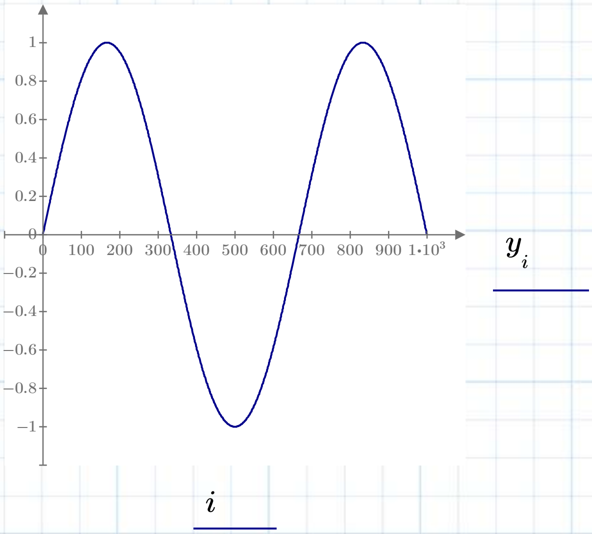
$C(j) := \text{polyint}(x, y, j \cdot 0.1)$



$y(x) := \sin(x)$ $x := 0, \frac{3 \cdot \pi}{10} .. 3 \cdot \pi$ $mean(y) = ?$

$i := 0, 1 .. 1000$ これが正しい

$y_i := \sin\left(\frac{i}{1000} \cdot 3 \cdot \pi\right)$ $\text{mean}(y) = 0.212$ $\max(y) = 1$ $\frac{2}{3 \cdot \pi} = 0.212$



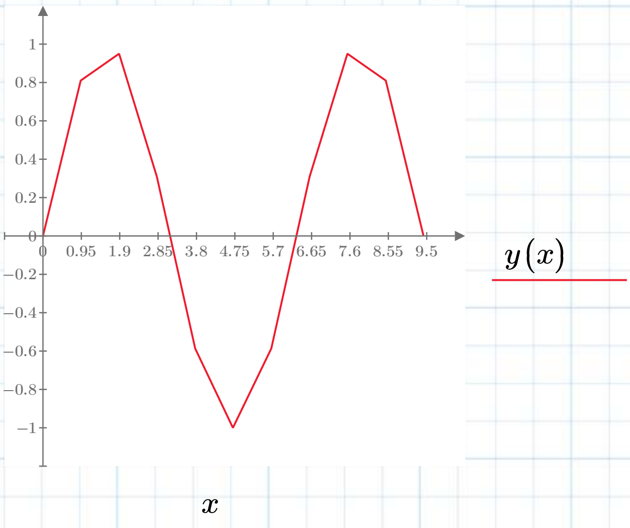
これはだめ

$y(x) := \sin(x)$

$y(x) = \begin{bmatrix} 0 \\ 0.809 \\ 0.951 \\ \vdots \end{bmatrix}$

$\mathrm{mean}(y(x)) = \begin{bmatrix} 0 \\ 0.809 \\ \vdots \end{bmatrix}$

$\max(y(x)) = \begin{bmatrix} 0 \\ 0.809 \\ \vdots \end{bmatrix}$



$f(j,k) := k \cdot \sin(j)$

$j := 0, 0.1 .. 1 = \begin{bmatrix} 0 \\ 0.1 \\ 0.2 \\ 0.3 \\ 0.4 \\ 0.5 \\ 0.6 \\ 0.7 \\ 0.8 \\ 0.9 \\ 1 \end{bmatrix} \qquad k := \begin{bmatrix} 25 \\ 15 \\ 77 \\ 33 \\ 4 \\ 80 \\ 90 \\ 20 \end{bmatrix}$

Are you aware that by using the inline evaluation you have changed j from a range to a vector? Thats not bad or a problem, you just should be aware of that.

```
maxval(fun, x, y) := | O ← ORIGIN
                     | [M X Y] ← [fun(x_O, y_O) x_O y_O]
                     | for i ∈ O..last(x)
                     |   for j ∈ O..last(y)
                     |     F ← fun(x_i, y_j)
                     |     if F > M
                     |       [M X Y] ← [F x_i y_j]
                     | [M X Y]
```

$[MAX\ j_{max}\ k_{max}] := maxval(f, j, k)$

$MAX = 75.732$ **The maximum value in the table**

$j_{max} = 1$ **The value in vector j corresponding to the maximum value**

$k_{max} = 90$ **The value in vector k corresponding to the maximum value**

ゲインの求め方

$$\frac{V_i}{C_{75} \cdot R_{96} \cdot s + 1} = \frac{R_{122} \cdot V_o + C_{67} \cdot R_{82} \cdot R_{122} \cdot V_o \cdot s}{R_{82} + R_{122} + C_{67} \cdot R_{82} \cdot R_{122} \cdot s} \left| \begin{array}{l} \text{substitute}, V_o = \lambda \cdot V_i \\ \text{solve}, \lambda \\ \text{simplify}, \max \end{array} \right. \rightarrow \frac{R_{82} + R_{122} + C_{67} \cdot R_{82} \cdot R_{122} \cdot s}{R_{122} \cdot (C_{67} \cdot R_{82} \cdot s + 1) \cdot (C_{75} \cdot R_{96} \cdot s + 1)}$$

$$\frac{V_i}{C_{75} \cdot R_{96} \cdot s + 1} = \frac{R_{122} \cdot V_o + R_{82} \cdot V_{ref} + C_{67} \cdot R_{82} \cdot R_{122} \cdot V_o \cdot s}{R_{82} + R_{122} + C_{67} \cdot R_{82} \cdot R_{122} \cdot s}$$

$$\frac{V_i}{C75 \cdot R96 \cdot s + 1} = \frac{R122 \cdot V_o + C67 \cdot R82 \cdot R122 \cdot V_o \cdot s}{R82 + R122 + C67 \cdot R82 \cdot R122 \cdot s} \xrightarrow{\substack{substitute, V_o = \alpha \cdot V_i \\ solve, \alpha \\ simplify, \max}} \frac{R82 + R122 + s \cdot C67 \cdot R}{R122 \cdot (s \cdot C67 \cdot R82 + 1) \cdot (s \cdot}$$

$N := 3 \qquad M := 3$

```
thetas1 := | for i ∈ 1..N
           |   for j ∈ 1..M
           |     th_{i-1, j-1} ← θ_{i,j}
```

th

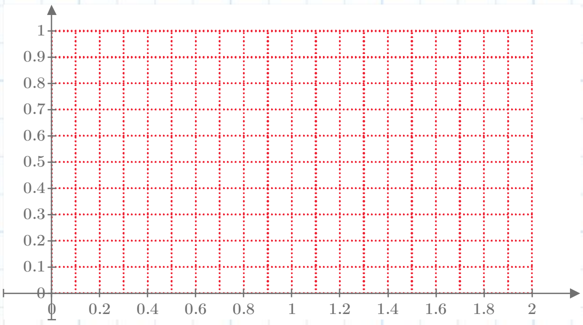
$$thetas1 \rightarrow \begin{bmatrix} \theta_{1,1} & \theta_{1,2} & \theta_{1,3} \\ \theta_{2,1} & \theta_{2,2} & \theta_{2,3} \\ \theta_{3,1} & \theta_{3,2} & \theta_{3,3} \end{bmatrix}$$

Or shorter:

$$thetas2 := \text{matrix}\left(N, M, f(i,j) \leftarrow \theta_{i+1,j+1}\right)$$

$$thetas2 \rightarrow \begin{bmatrix} \theta_{1,1} & \theta_{1,2} & \theta_{1,3} \\ \theta_{2,1} & \theta_{2,2} & \theta_{2,3} \\ \theta_{3,1} & \theta_{3,2} & \theta_{3,3} \end{bmatrix}$$

$$G := Grid\left(\begin{bmatrix} 0 \\ 2 \\ 0.1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0.1 \end{bmatrix}\right)$$



$G^{\langle 1 \rangle}$

$G^{\langle 0 \rangle}$

$\text{clear}(\theta)$ $N := 3$ $M := 3$

$$\Theta := \text{matrix}\left(N, M, f(i,j) \leftarrow \text{concat}\left(\text{“θ”}, \text{num2str}(i+1), \text{num2str}(j+1)\right)\right) = \begin{bmatrix} \text{“θ11”} & \text{“θ12”} & \text{“θ13”} \\ \text{“θ21”} & \text{“θ22”} & \text{“θ23”} \\ \text{“θ31”} & \text{“θ32”} & \text{“θ33”} \end{bmatrix}$$

$$\Theta_{0,0} = \text{“θ11”}$$

$$\Theta := \text{matrix}\left(N, M, f(i,j) \leftarrow \theta_{(i+1)\cdot 10 + (j+1)}\right) \rightarrow \begin{bmatrix} \theta_{11} & \theta_{12} & \theta_{13} \\ \theta_{21} & \theta_{22} & \theta_{23} \\ \theta_{31} & \theta_{32} & \theta_{33} \end{bmatrix}$$

$\Theta_{0,0} \rightarrow \theta_{11}$ $\Theta_{2,2} \rightarrow \theta_{33}$

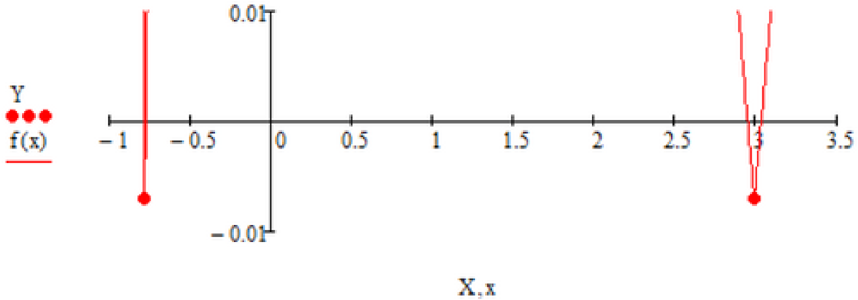
$\Theta_{0,0} := \theta_{11}$

$\Theta_{0,0} \rightarrow \theta_{11}$

$$Y := \textbf{root}\left(x^4 + \left(-\frac{\sqrt{5}}{2} - \frac{3}{2}\right) \cdot x^3 - x^2 - 1, x, -1, 6\right) \rightarrow \begin{bmatrix} 2.98990607210826603 68 \\ -0.77918900060094081705 \end{bmatrix} = \begin{bmatrix} 2.99 \\ -0.779 \end{bmatrix}$$

$$\text{zero(guess)} := \left| \begin{array}{l} x \leftarrow \text{guess} \\ \text{root}\left[x^4 + \left(-\frac{\sqrt{5}}{2} - \frac{3}{2}\right) \cdot x^3 - x^2 - 1, x\right] \end{array} \right.$$

$$X := \overrightarrow{\text{zero}\left(\begin{pmatrix} -1 \\ 3 \end{pmatrix}\right)} = \begin{pmatrix} -0.779189 \\ 2.98990607 \end{pmatrix} \qquad Y := \overrightarrow{f(X)} = \begin{pmatrix} -6.96601124 \times 10^{-3} \\ -6.96601125 \times 10^{-3} \end{pmatrix}$$

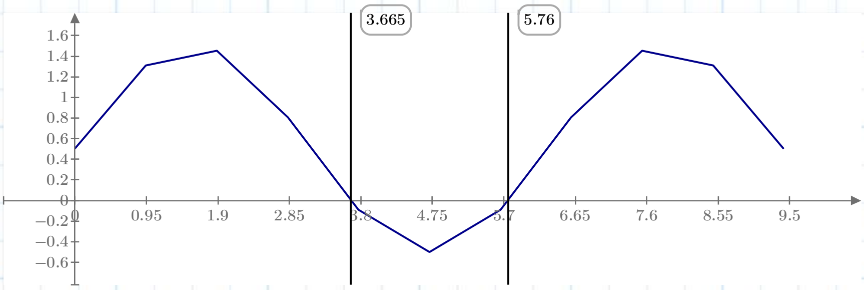


$$Zero(guess) := \left\| \begin{array}{l} x \leftarrow guess \\ \textbf{root}\left(\sin(x) + \frac{1}{2}, x, 0, 6\right) \end{array} \right.$$

$$Y := \textbf{root}\left(\sin(x) + \frac{1}{2}, x, -1, 6\right)$$

$$Y := \textbf{root}\left(\sin(x) + \frac{1}{2}, x, 1, 6\right) \rightarrow \begin{bmatrix} \frac{7 \cdot \pi}{6} \\ \frac{11 \cdot \pi}{6} \end{bmatrix} = \begin{bmatrix} 3.665 \\ 5.76 \end{bmatrix}$$

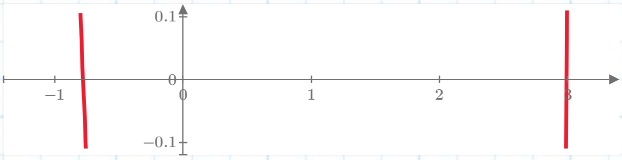
$$X := Zero(0) \rightarrow \begin{bmatrix} \frac{7 \cdot \pi}{6} \\ \frac{11 \cdot \pi}{6} \end{bmatrix} \quad X_0 \rightarrow \frac{7 \cdot \pi}{6} \quad X_1 \rightarrow \frac{11 \cdot \pi}{6}$$



$$\sin(x) + \frac{1}{2}$$

x

$\mathbf{clear}(x)$



$x^4+\left(-\frac{\sqrt{5}}{2}-\frac{3}{2}\right)\cdot x^3-x^2-1$

x

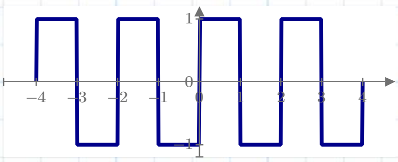
再帰関数

$\mathbf{clear}(y,x)$

$$y(x):=\begin{array}{l}\text{if } (0\le x)\wedge(x\le 1)\\ \quad 1\\ \text{else if } (1\le x)\wedge(x\le 2)\\ \quad -1\\ \text{else if } (x>2)\\ \quad y(x-2)\\ \text{else}\\ \quad y(x+2)\end{array}$$

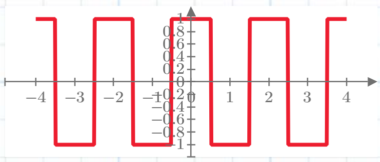
$$y(x):=\begin{array}{l}\text{if } (x>-1)\wedge(x<1)\\ \quad \text{sign}(x)\\ \text{else if } (x<-1)\\ \quad y(x+2)\\ \text{else}\\ \quad y(x-2)\end{array}$$

$$z(x):=\begin{array}{l}\text{if } (x\le -1)\\ \quad z(x)\leftarrow z(x+2)\\ \text{else if } (x\ge 1)\\ \quad z(x)\leftarrow z(x-2)\\ \text{sign}(\cos(\pi\cdot x))\end{array}$$



$y(x)$

x

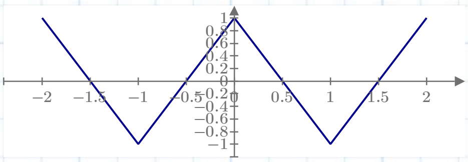


$z(x)$

x

$\tau:=-2,-1..2$

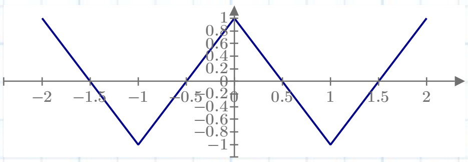
$h(t):=y(t)$ $\qquad \varphi(\tau):=\frac{1}{2}\cdot\int_{-1}^{1} h(t)\cdot h(t+\tau)\,\mathrm{d}t$



$\varphi(\tau)$

τ

$h(t):=z(t)$ $\qquad \varphi(\tau):=\frac{1}{2}\cdot\int_{-1}^{1} h(t)\cdot h(t+\tau)\,\mathrm{d}t$



$\varphi(\tau)$

τ

zeroの活用

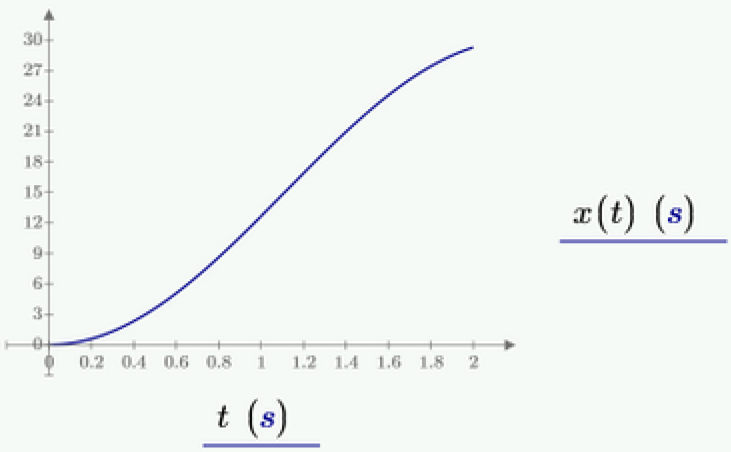
$Zero := zero \qquad Zero = 0$

$$10\ kg \cdot x''(t) + 20\ \frac{N}{m} \cdot x(t) = 300\ N$$

$$x(Zero) = Zero \qquad x'(Zero) = Zero$$

$$x := \text{odesolve}(x(t), 2\ s)$$

$$t := Zero, 0.001\ s..2\ s$$



$\Sigma(n) := \text{if}(n \le 0, 0, n + \Sigma(n-1))$

$\Pi(n) := \text{if}(n \le 0, 1, n \cdot \Pi(n-1))$

$\Sigma(n) := \text{if}(n \le 0, 0, n + \Sigma(n-1)) \qquad \Sigma(6) = 21$

$\Pi(n) := \text{if}(n \le 0, 1, n \cdot \Pi(n-1)) \qquad \Pi(6) = 720$

$\text{clear}_{sym}(\tau)$

$i(\tau) \rightarrow 1 - e^{-\left(\frac{1}{2} \cdot \tau\right)}$ $\qquad \int_0^t \left((i(\tau))^2\right) d\tau \rightarrow t$ wrong! $\qquad \int \left((i(\tau))^2\right) d\tau \rightarrow \tau - e^{-\tau} + 4 \cdot e^{-\frac{\tau}{2}}$

$i(\tau)^2 \rightarrow \left(e^{-\frac{\tau}{2}} - 1\right)^2$ $\qquad \int_0^t \left(e^{-\frac{\tau}{2}} - 1\right)^2 d\tau \rightarrow t$ wrong! $\qquad \int \left(e^{-\frac{\tau}{2}} - 1\right)^2 d\tau \rightarrow \tau - e^{-\tau} + 4 \cdot e^{-\frac{\tau}{2}}$

$i(\tau)^2 \xrightarrow{expand} e^{-\tau} - 2 \cdot e^{-\frac{\tau}{2}} + 1$ $\qquad \int_0^t \left(e^{-\tau} - 2 \cdot e^{-\frac{\tau}{2}} + 1\right) d\tau \rightarrow t - e^{-t} + 4 \cdot e^{-\frac{t}{2}} - 3$ $\qquad \int \left(e^{-\tau} - 2 \cdot e^{-\frac{\tau}{2}} + 1\right) d\tau \rightarrow \tau - e^{-\tau} + 4 \cdot e^{-\frac{\tau}{2}}$

$t_1 := 1 \qquad t_1 := \text{root}\left(W(t_1) - 1, t_1\right) = 3.25174783$

or without a guess $\qquad \text{root}(W(t) - 1, t, 0, 10) = 3.25174783$