Moving to Maple Flow

A Guide for Mathcad® 15 Users

Introduction

This guide is for Mathcad® 13, 14 and 15 users who have decided to move their calculations to Maple Flow. It's not meant to persuade you to switch tools, but will help you move once you have made that decision.

This guide covers these topics:

- The Migration Assistant Toolbox, which partly converts Mathcad 13, 14 & 15 worksheets to Maple Flow worksheets. You'll learn about what the Migration Assistant does and what it doesn't do.
- Tips for implementing non-migrated content in Maple Flow.
- How you can make your calculations more elegant using advanced Maple Flow techniques.
- The differences between Mathcad 15 and Maple Flow.

The goal of using the Migration Assistant with the tips in this guide and Maplesoft's support services is to make the move from Mathcad to Maple Flow as smooth as possible, but transitioning software comes with challenges. Mathcad and Maple Flow, while sharing some design features, have different keystrokes, equation editors, syntax, command libraries, computational models and interface features.

Before starting to translate your Mathcad worksheets, we recommend learning how to use Maple Flow to address any computational issues after migration. Please go through the Maple Flow User Manual to learn more about the following topics:

- Define variables, do math and use units
- Enter and edit text
- Create and customize plots
- Solve equations and use various other functions
- Lay out the worksheet
- The different data structures (such as expressions, lists, vectors and matrices) and how to create them.



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What is the Migration Assistant

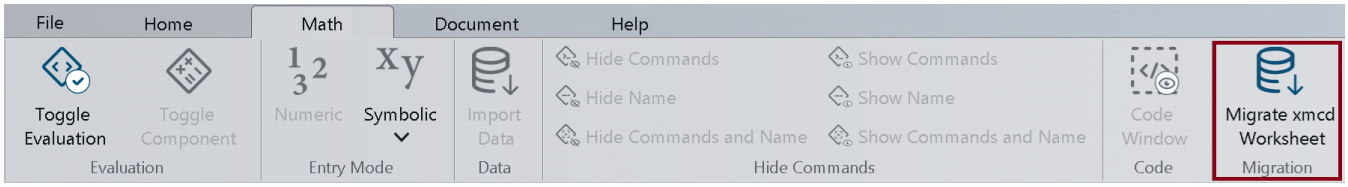
The Migration Assistant creates Maple Flow worksheets based on the content of Mathcad 15 worksheets (it also works with Mathcad 13 and 14 worksheets). The math and documentation in the Mathcad worksheet is moved over to the Maple Flow worksheet, with some translation of syntax and commands during the migration process.

- For simpler Mathcad worksheets, you should get a Maple Flow worksheet that executes as expected, giving the same results and looking roughly similar. Some modification of the layout may be needed.
- For Mathcad worksheets that use features or commands that are unsupported in Maple Flow and/or the Migration Assistant, you will need to modify the converted Maple Flow worksheet for it to execute as expected.

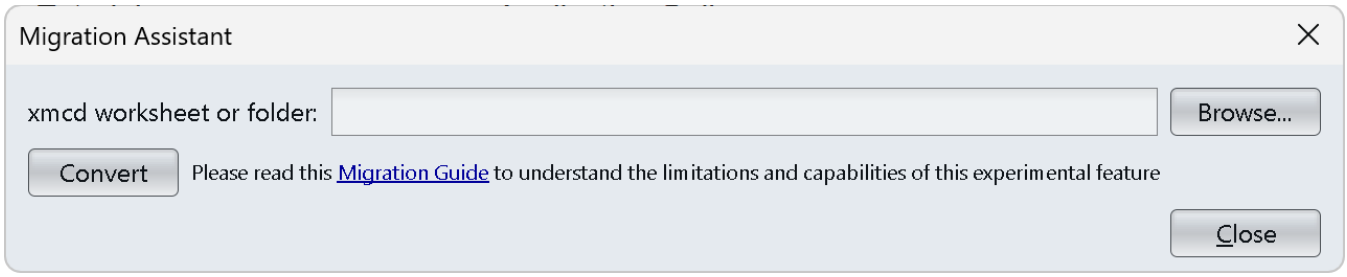
Please read the details below to ensure you understand the capabilities and limitations of the Migration Assistant.

How to use the Migration Assistant

After installation, the Migration Assistant is available from a button in the Math tab in Maple Flow.



Clicking the button will show this window:



Click **Browse** to open a file browser to select either

- A single Mathcad 13, 14 or 15 worksheet with an xmcd extension
- Or a folder of Mathcad 13, 14 or 15 worksheets with xmcd extensions

Then click on **Convert** to migrate the Mathcad worksheet(s) to Maple Flow files. For each Mathcad worksheet, a Maple Flow worksheet is generated in the same folder, with the same file name but with a .flow extension.

What is Automatically Migrated by the Migration Assistant

Documentation

During migration, as much of the formatting and layout of text and the worksheet is preserved as possible. This includes

- Relative positioning of math, text and images
- Font, point size, color, bold, italics
- Line breaking
- Justification

- Numbered lists, bullets
- Images
- Page breaks
- Background color for text and math
- Sections

However, some manual repositioning may be needed. Bear in mind that Mathcad and Maple Flow have different grid spacing (i.e. the grid to which math and text snaps), so the Migration Assistant Toolbox may not preserve the exact relative positioning of math and text.

Example of text in Mathcad 15	Migrated text in Maple Flow
This is Arial 10 pt (the default) **This is Arial 10 pt bold** This is Times New Roman 18pt with page break below **This is Calibri 12pt underlined** This is red Multiline text that is broken onto two lines with Greek letters: αΔ	This is Arial 10 pt (the default) **This is Arial 10 pt bold** This is Times New Roman 18pt with page break below **This is Calibri 12pt underlined** This is red Multiline text that is broken onto two lines with Greek letters: αΔ

General Math

The Migration Assistant attempts to preserve the layout, typesetting and execution properties of math (within the boundaries of the math that is supported). This table presents a comparison of how math is migrated, together with relevant notes.

Mathcad concept	**Comment**	**Example in Mathcad 15**	**Maple Flow translation**
Typesetting of math	The typesetting of math is preserved as much as possible. However, in specific circumstances, typesetting may be altered because of differing syntax.	$\sqrt{\frac{(2^2+3-4)\cdot 9}{4\cdot 5}} = 1.162$	$\sqrt{\frac{(2^2+3-4)\cdot 9}{4\cdot 5}} = 1.162$
Variable definitions	For variable names • Mathcad allows periods in literal subscripts. These are converted to underscores in Maple Flow • Mathcad allows D, γ, π, Re, and length to be used	$\Delta_x := 3 \qquad y := 4$ $\Delta_x^2 + y = 13$	$\Delta_x := 3 \qquad y := 4$ $\Delta_x^2 + y = 13$

	as variable names; these are, however, protected names in Maple Flow and cannot be overwritten. During migration, these are converted to D1, g1, Re1 and length1 in Maple Flow (or sequentially numbered if D1, g1 and Re1 already exist)		
Units	Mathcad assumes that units and variables exist in the same name space. Maple Flow distinguishes between name spaces for units (which are entered in a units placeholder) and variables. During migration, Mathcad units are placed in a units placeholder in Maple Flow. Given the context, this may not always be correct; you may need to correct the migrated worksheet.	$W_G := 2kg \cdot s^{-1}$ $\mu_L := 0.005 \cdot Pa \cdot s$	$W_G := 2 \cdot kg \cdot s^{-1}$ $\mu_L := 0.005 \cdot Pa \cdot s$
Function definition and evaluation	Maple Flow uses the arrow mapping operator when defining functions. This is entered with a hyphen, followed by a greater-than symbol	$f(x) := \sin(x)$ $f(4) = -0.757$	$f := x \mapsto \sin(x)$ $f(4) = -0.757$
% to represent 0.01	% is converted to a multiplication factor of 1/100	$93\% = 0.93$	$93 \cdot \frac{1}{100} = 0.930$
if/otherwise in its own programming block with no other programming constructs such as for/while etc.	These are converted to multi-row piecewise statements in Maple Flow.	$y := 6$ $x := \begin{cases} 2 & \text{if } y < 6 \\ 4 & \text{if } y \geq 6 \wedge y < 10 \\ 0 & \text{otherwise} \end{cases}$ $x = 4$	$y := 6$ $x := \begin{cases} 2 & y < 6 \\ 4 & y \geq 6 \wedge y < 10 \\ 0 & \text{otherwise} \end{cases}$ $x = 4$
Iterated addition and multiplication		$v := \begin{pmatrix} 1 \\ 2 \\ 4 \end{pmatrix}$ $\sum_{i=0}^{2} v_i = 7 \qquad \prod_{i=0}^{2} v_i = 8$	$v := \begin{bmatrix} 1 \\ 2 \\ 4 \end{bmatrix}$ $\text{add}(v[i+1], i=0..2) = 7$ $\text{mul}(v[i+1], i=0..2) = 8$

Complex numbers, including conjugate and argument		$x := 1 + 2i$ $x^2 = -3 + 4i$ $\overline{(1 + 2i)} = 1 - 2i$ $x := 2 + 6i$ $\arg(x) = 1.249$	$x := 1 + 2\,i$ $x^2 = -3 + 4\,i$ $\overline{(1 + 2\,i)} = 1 + -2\,i$ $x := 2 + 6\,i$ $\text{argument}(x) = 1.249$
Matrices and Vectors		$M := \begin{pmatrix} 4 & 5 \\ 6 & 4 \end{pmatrix}$	$M := \begin{bmatrix} 4 & 5 \\ 6 & 4 \end{bmatrix}$
Matrix/vector indexing and redefinition of ORIGIN	In Mathcad, • matrices/vectors are indexed with a subscript entered with a left square bracket ([]). • the default origin is a row index of 0 and column index of 0. • the origin can be manually altered by defining the variable ORIGIN In Maple Flow, • matrices/vectors are indexed with square brackets. • the origin is a row index of 1 and column index of 1, and cannot be manually changed by the user. • During conversion, if needed, ORIGIN is defined and used in the index to shift the origin back to 1,1.	indexing starts at 0 by default (the default value of ORIGIN) $M := \begin{pmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 7 & 8 & 9 \end{pmatrix}$ $M_{2,2} = 9$ Redefine ORIGIN $ORIGIN := 2$ $M_{2,3} = 2$	indexing starts at 0 by default (the default value of ORIGIN) $M := \begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 7 & 8 & 9 \end{bmatrix}$ $M[3, 3] = 9$ Redefine ORIGIN $ORIGIN := 2$ $M[3 - ORIGIN, 4 - ORIGIN] = 2$

Matrix column		$M := \begin{pmatrix} 7 & 76 & 6 \\ 56 & 56 & 7 \\ 8 & 76 & 5 \end{pmatrix}$ $M^{\langle 0 \rangle} = \begin{pmatrix} 7 \\ 56 \\ 8 \end{pmatrix}$	$M := \begin{bmatrix} 7 & 76 & 6 \\ 56 & 56 & 7 \\ 8 & 76 & 5 \end{bmatrix}$ $M[\ ..,\ 1] = \begin{bmatrix} 7 \\ 56 \\ 8 \end{bmatrix}$
Matrix/vect or transpose		$v = \begin{pmatrix} 13 \\ -3 \\ 50 \end{pmatrix}$ $v^{T} = (13 \quad -3 \quad 50)$	$v = \begin{bmatrix} 13 \\ -3 \\ 50 \end{bmatrix}$ $v^{\%T} = \begin{bmatrix} 13 & -3 & 50 \end{bmatrix}$
Vector cross product		$v := \begin{pmatrix} 13 \\ -3 \\ 60 \end{pmatrix} \quad w := 2 \cdot v + \begin{pmatrix} 7 \\ 2i \\ -18 \end{pmatrix}$ $v \times w = \begin{pmatrix} 54 - 120i \\ 654 \\ 21 + 26i \end{pmatrix}$	$v := \begin{bmatrix} 13 \\ -3 \\ 60 \end{bmatrix} \quad w := 2 \cdot v + \begin{bmatrix} 7 \\ 2i \\ -18 \end{bmatrix}$ $v \times w = \begin{bmatrix} 54 - 120i \\ 654 \\ 21 + 26i \end{bmatrix}$
Vector dot product	Mathcad overloads a normal multiplication to mean a dot product when used between two vectors. Maple Flow distinguishes between a normal multiplication (entered with *) and a dot product (entered with a period). Given the context, the Migration Assistant attempts to determine the correct multiplication to use.	$x := \begin{pmatrix} 6 \\ 5 \\ 4 \end{pmatrix} \quad y := \begin{pmatrix} 7 \\ 4 \\ 9 \end{pmatrix}$ $x \cdot y = 98$	$x := \begin{bmatrix} 6 \\ 5 \\ 4 \end{bmatrix} \quad y := \begin{bmatrix} 7 \\ 4 \\ 9 \end{bmatrix}$ $x \cdot y = 98$
nthroot	Both Mathcad and Maple Flow have typeset nthroot operators, Mathcad's nthroot operator preferentially returns a real root (if one exists). However, Maple Flow's nthroot operator preferentially returns the principal root (which may be complex).Therefore the most accurate translation of Mathcad's nthroot operator is Maple Flow's surd() function.	$\sqrt[3]{2} = 1.26$	$\mathrm{surd}(2, 3) = 1.260$

Strings		str1 := "hello" str2 := " world" str3 := concat(str1, str2) = "hello world"	str1 := "hello" str2 := " world" str3 := cat(str1, str2) = "hello world"
Symbolic Math	A few symbolic math functions are converted	$ax^2 + b \cdot x + c = 0 \text{ solve}, x \rightarrow \left(\begin{array}{c} -\frac{\frac{b}{2} + \frac{\sqrt{b^2 - 4 \cdot a \cdot c}}{2}}{a} \\ -\frac{\frac{b}{2} - \frac{\sqrt{b^2 - 4 \cdot a \cdot c}}{2}}{a} \end{array} \right)$ $x^2 + 2x + 1 \text{ factor} \rightarrow (x + 1)^2$	$(\text{solve}(a \cdot x^2 + b \cdot x + c = 0, x)) = \left[\begin{array}{c} \frac{-b + \sqrt{-4 \cdot a \cdot c + b^2}}{2 \cdot a} \\ -\frac{b + \sqrt{-4 \cdot a \cdot c + b^2}}{2 \cdot a} \end{array} \right]$ $\text{factor}(x^2 + 2 \cdot x + 1) = (x + 1)^2$

Function Conversion Table

During migration, many Mathcad functions are converted to their equivalent in Maple Flow. A conversion table is given below.

Mathcad Function	Maple Flow Function
Ai(z)	AiryAi(z)
augment(M1,M2,...)	ArrayTools:-Concatenate(2, M1,M2,...)
Bi(z)	AiryBi(z)
ceil(x)	ceil(x)
Ceil(z,y)	Ceil(z,y)
cholesky(M)	LinearAlgebra:- LUDecomposition(M, method=cholesky)
cols(M)	upperbound(M,2)
cond1(M)	LinearAlgebra:- ConditionNumber(M,1)
cond2(M)	LinearAlgebra:- ConditionNumber(M,2)
conde(M)	LinearAlgebra:- ConditionNumber(M, Euclidean)

Mathcad Function	Maple Flow Function
condi(M)	LinearAlgebra:- ConditionNumber(M,infinity)
csort(M,n)	ArrayTools:-SortBy(M, column,n+1)
DAi(z)	AiryAi(1, z)
DBi(z)	AiryBi(1, z)
dbeta(x,nu,omega)	Statistics:-PDF (BetaDistribution(nu,omega), x)
dbinom(x,n,q)	Statistics:-PDF(Binomial(n,q), x)
dcauchy(x,l,s)	Statistics:-PDF(Cauchy(l,s), x)
dchisq(x,d)	Statistics:-PDF(ChiSquare(d),x)
dexp(x,r)	Statistics:-PDF(Exponential(r), x)
dF(x,d1,d2)	Statistics:-PDF(FRatio(d1,d2), x)
dgamma(x,s)	Statistics:-PDF(Gamma(1,s), x)
dgeom(x,q)	Statistics:-PDF(Geometric(q), x)
diag(V)	LinearAlgebra:-DiagonalMatrix(V)
dlnorm(x,mu,sigma)	Statistics:-PDF(LogNormal(xu, sigma), x)
dlogis(x,l,s)	Statistics:-PDF(Logistic(l,s), x)
dnorm(x,mu,sigma)	Statistics:-PDF(Normal(xu, sigma), x)
dnbinom(x,n,q)	Statistics:-PDF(NegativeBinomial(n,q), x)
dpois(x,lambda)	Statistics:-PDF(Poisson(lambda), x)
dt(x,nu)	Statistics:-PDF(StudentT(nu), x)
dunif(x,a,b)	Statistics:-PDF(Uniform(a,b), x)
dweibull(x,s)	Statistics:-PDF(Weibull(1,s), x)
eigenvals(M)	LinearAlgebra:-Eigenvalues(M)
eigenvecs(M)	LinearAlgebra:-Eigenvectors(M)[2]
fft(data)	SignalProcessing:-FFT(data)[1..upperbound(data)/2+1]
floor(x)	floor(x)
Floor(z,y)	Floor(z,y)
genvals(M,N)	LinearAlgebra:-Eigenvalues(M, N)
genvecs(M,N)	LinearAlgebra:-Eigenvectors(M, N)[2]
gmean(data)	Statistics:-GeometricMean([data])
H1(m, z)	HankelH1(m, z)

H2(m, z)	HankelH2(m, z)
hmean(data)	Statistics:-HarmonicMean([data])
hlookup(z,A,r)	ArrayTools:-Lookup(z,A,row,1,r+1)
I0(z)	BesselI(0,z)
I1(z)	BesselI(1,z)
identity(x)	LinearAlgebra:-IdentityMatrix(x)
ifft(data)	SignalProcessing:-InverseFFT(ArrayTools:-Concatenate(1, data, conjugate(ArrayTools:-Reverse(data[2 .. -2]))))
In(m,z)	BesselI(z)
intercept(X,Y)	coeff(CurveFitting:-LeastSquares(X,Y,x),x,0)
IsArray(t)	type(t,rtable)
IsFunction(t)	type(t,procedure)
IsNaN(t)	type(t,undefined)
IsScalar(t)	type(t,constant)
IsString(t)	type(t,string)
J0(z)	BesselJ(0,z)
J1(z)	BesselJ(1,z)
Jn(m,z)	BesselJ(z)
K0(z)	BesselK(0,z)
K1(z)	BesselK(1,z)
Kn(m,z)	BesselK(z)
kurt(data)	Statistics:-Kurtosis([data])
last(data)	data[-1]
length(data)	numelems(data)
lsolve(M,v)	LinearAlgebra:-LinearSolve(M,v)
var(data)	Statistics:-Variance(data) * (1-1/numelems(data))
lu(M)	ArrayTools:-Concatenate(2,LinearAlgebra:-LUDecomposition(M,method=GaussianElimination))
matrix(i,j,p)	Matrix(i,j,(i,j)->p(i-1,j-1))
mean(data)	Statistics:-Mean([data])
median(data)	Statistics:-Median([data])
mode(data)	Statistics:-Mode([data])
norm1(M)	LinearAlgebra:-Norm(M,1)
norm2(M)	LinearAlgebra:-Norm(M,2)

norme(M)	LinearAlgebra:-Norm(M,Euclidean)
normi(M)	LinearAlgebra:-Norm(M,infinity)
pbeta(x,nu,omega)	Statistics:-CDF(BetaDistribution(nu,omega),x)
pbinom(x,n,q)	Statistics:-CDF(Binomial(n,q), x)
pcauchy(x,l,s)	Statistics:-CDF(Cauchy(l,s), x)
pchisq(x,d)	Statistics:-CDF(ChiSquare(d), x)
pexp(x,r)	Statistics:-CDF(Exponential(r), x)
pF(x,d1,d2)	Statistics:-CDF(FRatio(d1,d2), x)
pgamma(x,s)	Statistics:-CDF(Gamma(1,s), x)
pgeom(x,q)	Statistics:-CDF(Geometric(q), x)
plnorm(x,mu,sigma)	Statistics:-CDF(LogNormal(xu, sigma), x)
plogis(x,l,s)	Statistics:-CDF(Logistic(l,s), x)
pnorm(x,mu,sigma)	Statistics:-CDF(Normal(xu, sigma), x)
pnbinom(x,n,q)	Statistics:-CDF(NegativeBinomial(n,q), x)
ppois(x,lambda)	Statistics:-CDF(Poisson(lambda), x)
pt(x,nu)	Statistics:-CDF(StudentT(nu), x)
punif(x,a,b)	Statistics:-CDF(Uniform(a,b), x)
pweibull(x,s)	Statistics:-CDF(Weibull(1,s), x)
qbeta(x,nu,omega)	Statistics:-Quantile(BetaDistribution(nu,omega),x)
qbinom(x,n,q)	Statistics:-Quantile(Binomial(n,q), x)
qcauchy(x,l,s)	Statistics:-Quantile(Cauchy(l,s), x)
qchisq(x,d)	Statistics:-Quantile(ChiSquare(d), x)
qexp(x,r)	Statistics:-Quantile(Exponential(r), x)
qF(x,d1,d2)	Statistics:-Quantile(FRatio(d1,d2), x)
qgamma(x,s)	Statistics:-Quantile(Gamma(1,s), x)
qgeom(x,q)	Statistics:-Quantile(Geometric(q), x)
qlnorm(x,mu,sigma)	Statistics:-Quantile(LogNormal(xu, sigma), x)
qlogis(x,l,s)	Statistics:-Quantile(Logistic(l,s), x)
qnbinom(x,n,q)	Statistics:-Quantile(NegativeBinomial(n,q), x)
qnorm(x,mu,sigma)	Statistics:-Quantile(Normal(xu, sigma), x)
qpois(x,lambda)	Statistics:-Quantile(Poisson(lambda), x)
qr(M)	ArrayTools:-Concatenate(2,LinearAlgebra:-QRDecomposition(M)

qt(x,nu)	Statistics:-Quantile(StudentT(nu), x)
qunif(x,a,b)	Statistics:-Quantile(Uniform(a,b), x)
qweibull(x,s)	Statistics:-Quantile(Weibull(1,s), x)
rank(M)	LinearAlgebra:-Rank(M)
rbeta(N,nu,omega)	Statistics:-Sample(BetaDistribution(nu,omega), N)
rbinom(m,n,q)	Statistics:-Sample(Binomial(n,q), m)
rcauchy(N,l,s)	Statistics:-Sample(Cauchy(l,s), N)
rchisq(m,d)	Statistics:-Sample(ChiSquare(d), m)
READEXCEL("file", "range", [emptyfill])	ExcelTools:-Import("file","sheet","range")
READPRN(file)	ImportMatrix(file)
reverse(M)	ArrayTools:-Reverse(M)
rexp(m,r)	Statistics:-Sample(Exponential(r), m)
rF(m,d1,d2)	Statistics:-Sample(FRatio(d1,d2), m)
rgamma(N,s)	Statistics:-Sample(Gamma(1,s), N)
rgeom(m,q)	Statistics:-Sample(Geometric(q), m)
rhypergeom(m,a,b,n)	Statistics:-Sample(HyperGeometric(a,b,n), m)
rlnorm(m,mu,sigma)	Statistics:-Sample(LogNormal(mu, sigma), m)
rlogis(m,l,s)	Statistics:-Sample(Logistic(l,s), m)
rnbinom(m,n,q)	Statistics:-Sample(NegativeBinomial(n,q), m)
rnorm(N,mu,sigma)	Statistics:-Sample(Normal(mu, sigma), N)
root(expression_in_x, x)	fsolve(x -> expression_in_x, x)
round(x)	round(x)
Round(z,y)	Round(z,y)
rows(M)	upperbound(M,1)
rpois(m,lambda)	Statistics:-Sample(Poisson(lambda), m)
rsort(M,n)	ArrayTools:-SortBy(M,row,n+1)
rt(m,nu)	Statistics:-Sample(StudentT(nu), m)
runif(m,a,b)	Statistics:-Sample(Uniform(a,b), m)
rweibull(m,s)	Statistics:-Sample(Weibull(1,s), m)
skew(data)	Statistics:-Skewness([data])
slope(X,Y)	coeff(CurveFitting:-LeastSquares(X,Y,x),x)
sort(V)	sort(V)
stack(M1,M2,...)	ArrayTools:-Concatenate(1,M1,M2,...)

stdev(data)	Statistics:-StandardDeviation(data) * sqrt(1-1/numelems(data))
Stdev(data)	Statistics:-StandardDeviation(data)
submatrix(M,r1,r2,c1,c2)	M[r1+1..r2+1,c1+1..c2+1]
tr(M)	LinearAlgebra:-Trace(M)
trunc(x)	trunc(x)
Trunc(z,y)	Trunc(z,y)
var(data)	Statistics:-Variance(data) * (1-1/numelems(data))
Var(data)	Statistics:-Variance(data)
vlookup(z,A,c)	ArrayTools:-Lookup(z,A,column,1,c+1)
WRITEPRN(file,data)	ExportMatrix(file,data)
Y0(z)	BesselY(0,z)
Y1(z)	BesselY(1,z)
Yn(m,z)	BesselY(z)
acos(x)	arccos(x)
arg(x)	argument(x)
asin(x)	arcsin(x)
atan(x)	arctan(x)
concat(x)	cat(x)
cos(x)	cos(x)
cosh(x)	cosh(x)
cot(x)	cot(x)
csc(x)	csc(x)
FresnelC(x)	FresnelC(x)
FresnelS(x)	FresnelS(x)
if(arg1,arg2,arg3)	ifelse(arg1,arg2,arg3)
log(x)	log10(x)
erf(x)	erf(x)
erfc(x)	erfc(x)
exp(x)	exp(x)
sec(x)	sec(x)
sin(x)	sin(x)
sinh(x)	sinh(x)

tan(x)	tan(x)
tanh(x)	tanh(x)

Translation Tips for Mathcad Content Not Supported by the Migration Assistant or Maple Flow

These language or documentation concepts are either partially migrated or ignored. Given the application, alternatives may be available.

Range Variables

These have no direct representation in Maple Flow. They are converted to Vectors, which may or may not be appropriate, given the context.

Creating and Filling Vectors/Matrices - if the nth element is calculated independently of any prior elements

Some uses of range variables in Mathcad involve the creation and filling of matrices and vectors. You can use Maple Flow's Vector() and Matrix() constructors for the same application.

Mathcad example of creating and filling matrices with range variables (nth element independent on any prior elements)	Maple Flow manual translation
$i := 0 .. 2^8 - 1 \qquad j := 0 .. 2^5 - 1$ $v_i := \sin\left(\frac{i}{100}\right)$ $M_{i,j} := \sin\left(\frac{i}{100}\right) + \tan\left(\frac{j}{100}\right)$	$v := \mathrm{Vector}\left(2^8, i \to \sin\left(\frac{i}{100}\right)\right)$ $M := \mathrm{Matrix}\left(2^8, 2^5, (i, j) \to \sin\left(\frac{i}{100}\right) + \tan\left(\frac{j}{100}\right)\right)$

Creating and Filling Vectors/Matrices - if the nth element is dependent on the value of prior elements

You will need to use a Maple procedure, defined in the Math > Code window.

Mathcad example of creating and filling a vector with range variables (nth element dependent on prior elements)	Maple Flow manual translation

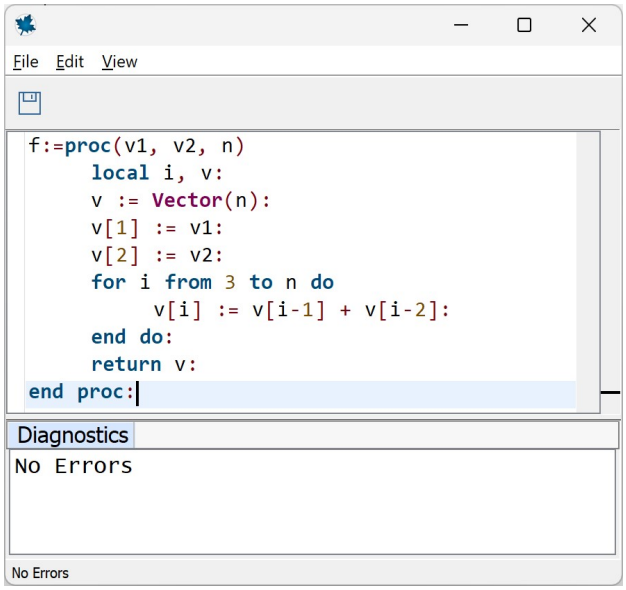
$i := 2..5$

$v_0 := 2 \qquad v_1 := 7$

$v_i := v_{i-1} + v_{i-2}$

$$v = \begin{pmatrix} 2 \\ 7 \\ 9 \\ 16 \\ 25 \\ 41 \end{pmatrix}$$

Procedure defi ned in Edit > Code:



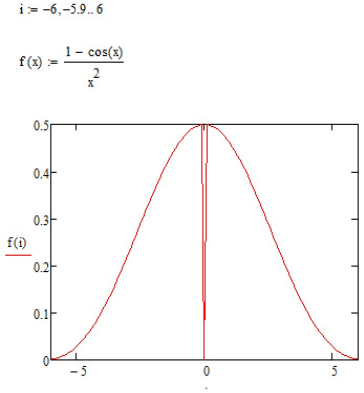
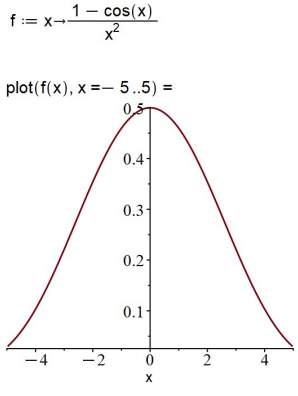
Procedure called on worksheet

$v := f(2, 7, 6)$

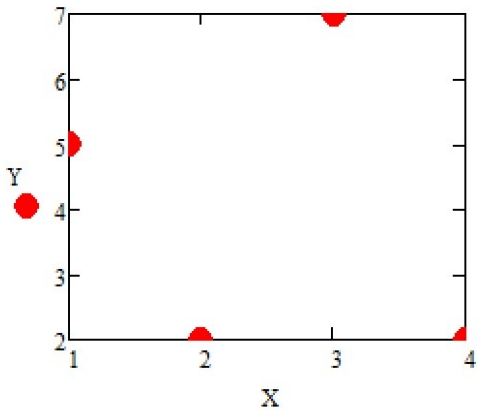
$$v = \begin{bmatrix} 2 \\ 7 \\ 9 \\ 16 \\ 25 \\ 41 \end{bmatrix}$$

Discretizing Functions for Plotting

Other uses of range variables in Mathcad involve discretizing functions before plotting. This does not necessarily need to be done in Maple Flow because the plot command intelligently discretizes a function to produce a smooth plot or identify singularities.

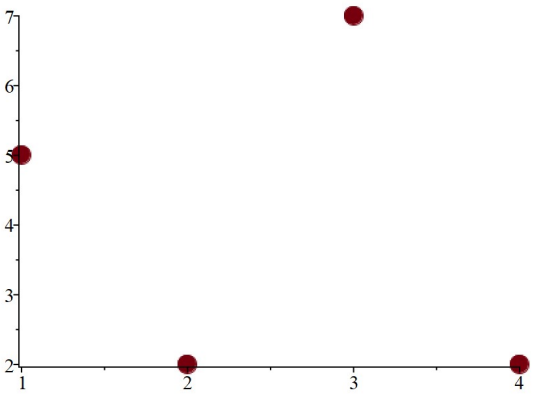
Discretization of a function before plotting in Mathcad	Corresponding Maple Flow implementation
	

$$X := \begin{pmatrix} 1 \\ 2 \\ 3 \\ 4 \end{pmatrix} \qquad Y := \begin{pmatrix} 5 \\ 2 \\ 7 \\ 2 \end{pmatrix}$$



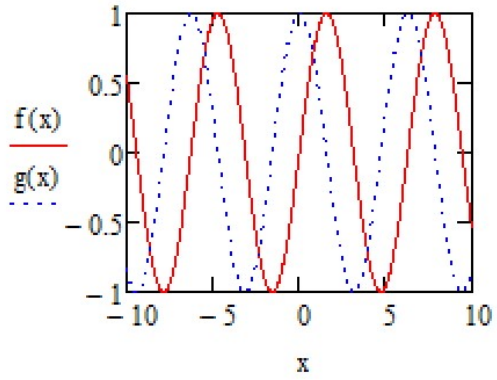
$$X := \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix} \qquad Y := \begin{bmatrix} 5 \\ 2 \\ 7 \\ 2 \end{bmatrix}$$

plot(X, Y, style = point, symbol = solidcircle, symbolsize = 30) =



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

$g(x) := \cos(x)$



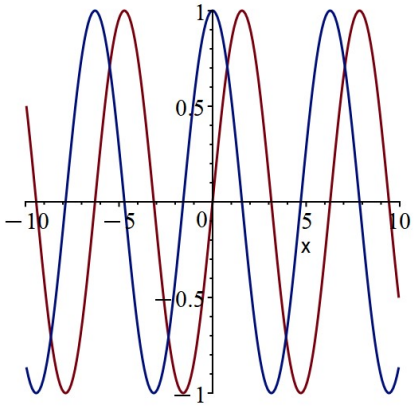
f := x→sin(x)

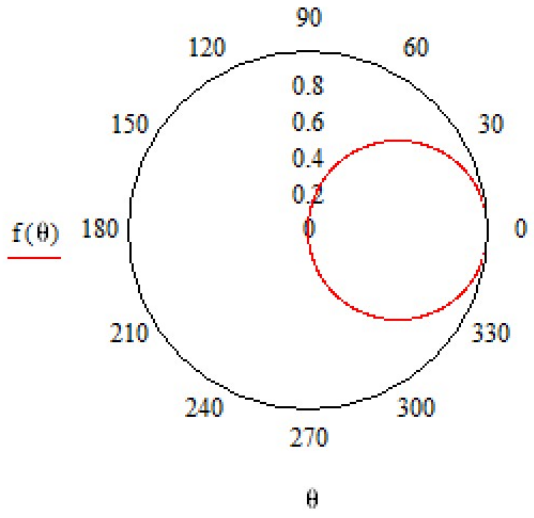
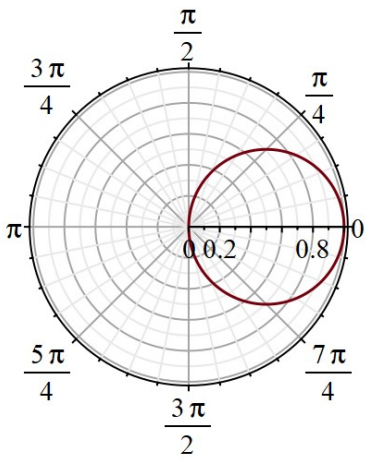
g := x→cos(x)

p1 := plot(f(x), x =– 10..10)

p2 := plot(g(x), x =– 10..10)

plots:-display(p1, p2) =

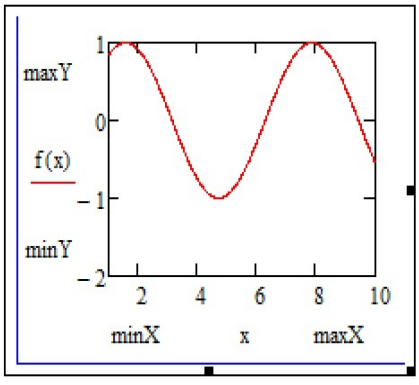
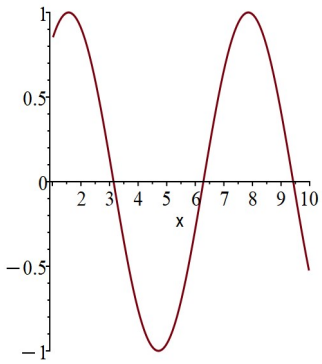


$f(x) := \cos(x)$ 	$f := x \to \cos(x)$ $\text{plots:-polarplot}(f(\theta), \theta = 0..2\cdot\pi) =$ 

Plots

The Migration Assistant converts Mathcad plots to static images. You can use Maple Flow plotting commands to recreate your live plots.

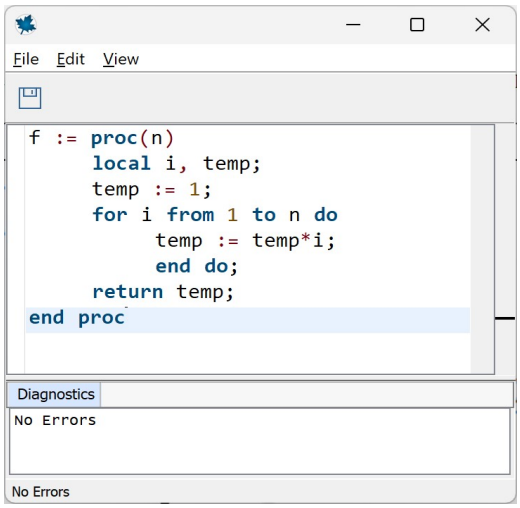
Maple Flow has a flexible plotting language, and plots can be extensively customized - please refer to the documentation for more assistance. These are a few sample Mathcad plots and their Maple Flow equivalents.

Mathcad 15 plot	Maple Flow equivalent
$f(x) := \sin(x)$ $\text{minX} := 1 \quad \text{maxX} := 10$ $\text{minY} := -2 \quad \text{maxY} := 1$ 	$\text{minX} := 1 \quad \text{maxX} := 10$ $\text{minY} := -2 \quad \text{maxY} := 1$ $f := x \to \sin(x)$ $\text{plot}(f(x), x = \text{minX}..\text{maxX}) =$ 

Programming Blocks

The only Mathcad programming blocks supported by the Migration Assistant and Maple Flow (for in-worksheet conversion) are those that contain multi-line if/otherwise statements with no other programming statements.

More complex Mathcad programs (as long as they are implemented as functions with parameters) can be converted to Maple-language based procedures in the Math > Code window in Maple Flow. These procedures can then be called on the worksheet.

Mathcad 15 program	Procedure manually implemented in a Maple Flow code window
$f(n) := \left\| \begin{array}{l} temp \leftarrow 1 \\ \text{for } i \in 1..n \\ \quad temp \leftarrow temp \cdot i \\ temp \end{array} \right.$	

Global Definitions

Global definitions are converted to local definitions. You will need to move the local definitions to the appropriate point or modify your worksheet for it to execute as expected.

Embedded Excel Spreadsheets

Maple Flow does not support embedded Excel spreadsheets. Given the goal, these alternatives are available.

Importing Data from Excel

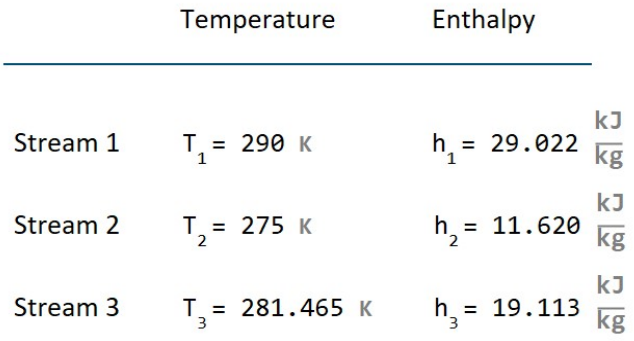
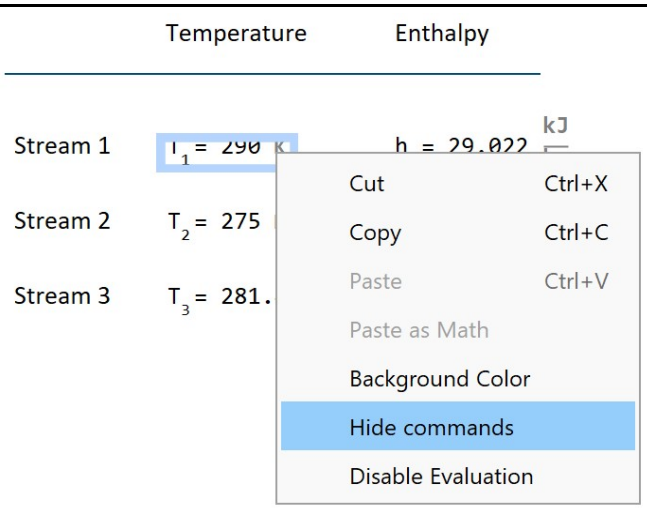
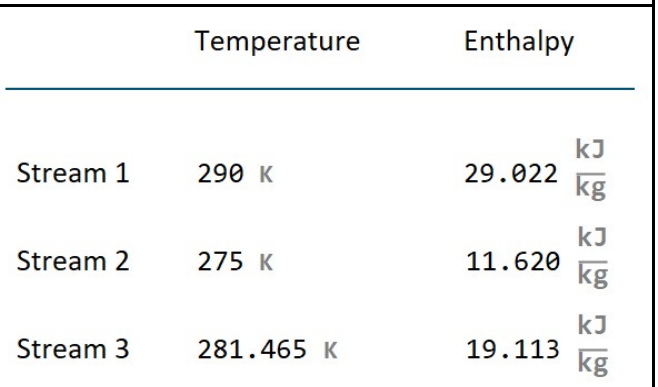
If you want to import numerical data from an Excel spreadsheet, use

- the ExcelTools:-Import command
- or Math > Import Data

Presenting Results in a Tabular Format

If you want to present your results in a tabular format, consider using

- a matrix
- or arrange and evaluate variables in a tabular format, and then hide commands (as described below)

Arrange and evaluate variables in a tabular format	
Right-click on each variable and select "Hide commands" (or drag-select a group of evaluated variables and select "Hide commands")	
Variables are hidden but the evaluations remain. The evaluations are still connected to the upstream analysis, and will update if parameters change.	

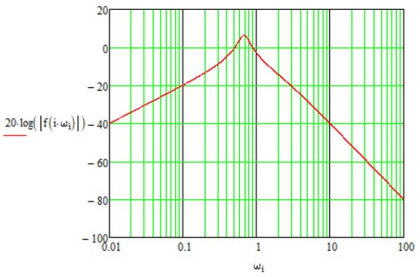
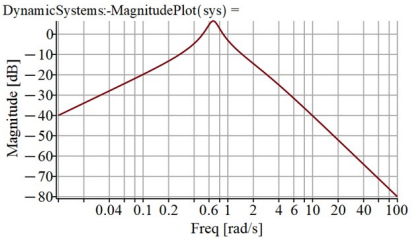
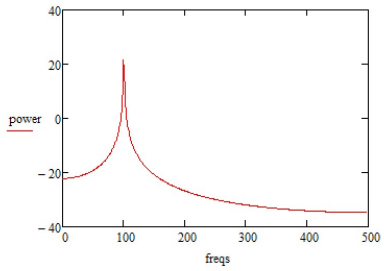
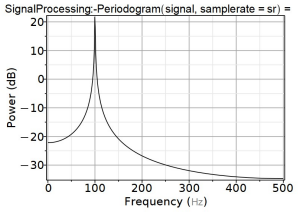
Miscellaneous

- Page size, orientation, margins and headers/footers are not migrated; these will have to be specified manually.
- Live math in text is not supported in Flow and is ignored.
- Mixed alignment in text is not supported in Flow and is ignored.
- Mathcad UI components such as buttons, sliders and combo boxes are converted into images (these are on the roadmap for a future version)

Using Higher Level Maple Functionality to Simplify your Work

A one-to-one conversion from Mathcad to Maple Flow may not always be the optimal approach; you may be able to simplify your work by replacing several Mathcad operations with fewer higher-level Maple Flow function calls. The Migration Assistant cannot see the context of the entire application; and so manual modification is needed.

These are some examples; others certainly exist.

	Mathcad 15 implementation	Maple Flow implementation
Magnitude plot of a transfer function In Mathcad, users manually implement the math and transforms necessary to create a magnitude plot. In Maple Flow, this process can be simplified by using high level functions for visualization and analysis of linear systems. You can create • phase, magnitude, root locus, Nyquist plots and more • compute gain/phase margins, controllability matrices and more For more information, see the DynamicSystems package	$f(s) := \frac{s}{s^3 + 2 \cdot s^2 + 1}$ $i := 1 .. 4000 \qquad \omega_i := 0.01 \cdot 10^{\frac{i}{1000}}$ 	$sys := DynamicSystems:-TransferFunction\left(\frac{s}{s^3 + 2 \cdot s^2 + 1}\right)$ DynamicSystems:-MagnitudePlot(sys) = 
Periodogram of a Signal In Mathcad, you need to perform several mathematical operations to generate periodogram from a signal. In Maple Flow, you can use a call to a single high-level function to generate a periodogram. In addition, there are many other signal processing tools	Number of points $N := 2^{10}$ Sample Rate $sr := 1000$ Frequency $f := 100$ $i := 0 .. N - 1$ Time vector $t_i := \frac{i}{sr}$ Signal vector $v_i := \sin(2 \cdot \pi \cdot t_i \cdot f)$ FFT of signal $fft\_signal := fft(v)$ $j := 0 .. \frac{N}{2} - 1$ Spectral power $power_j := 20 \cdot \log(\|fft\_signal_j\|)$ Frequencies in spectrum $freqs_j := \frac{1}{N} \cdot j \cdot sr$ 	Number of points $N := 2^{10}$ Sample rate $sr := 1000$ Frequency $f := 100$ Time vector $t := Vector\left(N, i \mapsto \frac{i - 1}{sr}\right)$ Signal Vector $signal := Vector(N, i \mapsto \sin(2 \cdot \pi \cdot t[i] \cdot f))$ Periodogram SignalProcessing:-Periodogram(signal, samplerate = sr) = 

Fitting a Linear Equation to Data

In Mathcad, users generally
- first determine the slope and intercept of the line,
- and then form a model function

In Maple Flow, users generally form the model function in one step

$$data := \begin{pmatrix} 1 & 3 \\ 2 & 5 \\ 3 & 8 \\ 4 & 7 \end{pmatrix}$$

$X := data^{\langle 0 \rangle}$ $Y := data^{\langle 1 \rangle}$

$b := intercept(X, Y) = 2$

$m := slope(X, Y) = 1.5$

$line(x) := m \cdot x + b$

$$data := \begin{bmatrix} 1 & 3 \\ 2 & 5 \\ 3 & 8 \\ 4 & 7 \end{bmatrix}$$

$line := CurveFitting:-LeastSquares(data, x) = 2 + 1.500 \cdot x$

Thermophysical Data

In Mathcad, users enter thermophysical data by implementing equations of state or polynomial correlations, or importing tabular data and interpolating.

Mathcad 15

Specific heat capacity of hydrogen

$$Cp(t) := \left[33.066178 - 11.363417 \cdot \frac{t}{1000} + 11.432816 \cdot \left(\frac{t}{1000} \right)^2 - 2.772874 \cdot \left(\frac{t}{1000} \right)^3 - \frac{0.158558}{\left(\frac{t}{1000} \right)^2} \right] \cdot \frac{1000}{2.01568}$$

$Cp(525) = 1.452 \times 10^4$

Maple Flow has built-in, units-aware correlations and visualizations for
- transport and thermodynamic properties of pure fluids and fluid mixtures
- humid air properties standard
- atmospheric properties

Maple Flow

Specific heat capacity of hydrogen

$Cp := T \rightarrow ThermophysicalData:-Property(C, H2, temperature = T, pressure = 1\ atm)$

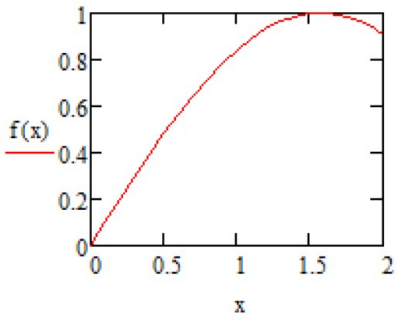
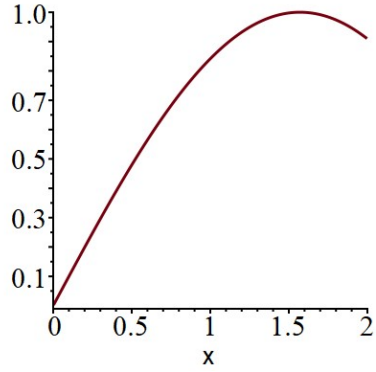
$Cp(525\ K) = 1.452 \times 10^4 \frac{J}{kg \cdot K}$

For more information, see the ThermophysicalData package.

What Mathcad Users Should Know About Maple Flow

	Mathcad 15	Maple Flow
Mathcad is a primarily numeric math environment (symbolic math is available on request, but is essentially an addendum to the main numeric engine). Maple Flow places equal emphasis on numeric and symbolic math.	$x + 1 =$ ▮ This variable is undefined.	$x + 1 = x + 1$

Mathcad uses hardware floating point arithmetic (IEEE 754 double precision) for numeric calculations. Maple Flow uses hardware floating point and software floating point precision for numeric calculations. Software floating point is a more precise representation of numbers.	Internal calculations to 17 decimal places. Sometimes numeric round-off can have suprising effects $\frac{1}{0.3 - 3 \cdot 0.1} = -1.801 \times 10^{16}$	Calculations can be up to thousands of decimal places, if requested and on a case-by-case basis kernelopts(maxdigits) = 38654705646 Numeric round-off is guarded against $\frac{1}{0.3 - 3 \cdot 0.1} = \text{Float}(\infty)$
Apart from the standard Windows shortcuts for cut/copy/paste etc, keystrokes and equation editing are different. For example, square roots are entered differently	Square root symbol is entered with \ or via the Calculator toolbar	Square root symbol is entered with sqrt followed by Command Completion, or via the palette
A small number of commands have the same name and syntax, and give the same result.	sin(0.3) = 0.296 ln(3) = 1.099	sin(0.3) = 0.296 ln(3) = 1.099
Many commands have different names.	asin(3) = 1.571 − 1.763i concat("Hello" ," world") = "Hello world"	arcsin(3) = 1.571 − 1.763 i cat("Hello", " world") = "Hello world"
Some commands behave differently under specific conditions. For example, when given complex numbers, Mathcad max() command constructs a "pseudo max" from the maximum real and maximum imaginary parts. Maple Flow's max command gives an error under the same circumstances	max(1 + 2i,−3 + 5i) = 1 + 5i	max(1 + 2 i, −3 + 5 i) =
In Mathcad, all commands exist at the top-level. In Maple Flow, common commands exist at the top level, but many commands are in packages - for example, the ArrayTools package. Commands in packages are accessed via package_name:-command_name. Flow has a broader, more extensive math library than Mathcad.	$M := \begin{pmatrix} 4 & 2 & 3 \\ 4 & 51 & 6 \\ 7 & 8 & 9 \end{pmatrix}$ $\text{csort}(M, 1) = \begin{pmatrix} 4 & 2 & 3 \\ 7 & 8 & 9 \\ 4 & 51 & 6 \end{pmatrix}$	$M := \begin{bmatrix} 4 & 2 & 3 \\ 4 & 51 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ ArrayTools:-SortBy(M, column, 2) = $\begin{bmatrix} 4 & 2 & 3 \\ 7 & 8 & 9 \\ 4 & 51 & 6 \end{bmatrix}$

The mathematical computing language is different. For example, Mathcad has the concept of range variables, which are not present in Flow. Some (but not all) of the functionality of range variables can be reproduced using other constructs in Maple.	$i := 0..4$ $v_i := \sin(2\cdot\pi\cdot i\cdot 0.1)$ $v = \begin{pmatrix} 0 \\ 0.588 \\ 0.951 \\ 0.951 \\ 0.588 \end{pmatrix}$	$v := \text{Vector}(5, i \to \sin(2\cdot\pi\cdot(i-1)\cdot 0.1))$ $v = \begin{bmatrix} 0. \\ 0.588 \\ 0.951 \\ 0.951 \\ 0.588 \end{bmatrix}$
Text is initiated differently	You start typing, and the math turns into text at the first space	Press space to insert an empty text container, and then type your text
Plots are generated differently • In Mathcad, you use a plot component • In Flow, you use a plotting command	$f(x) := \sin(x)$ $x := 0, 0.1..2$ 	$f := x \to \sin(x)$ $\text{plot}(f(x), x = 0..2) =$ 
Units are entered differently	Units exist as pre-defined variables at the top-level and are typed in like any other variable $L := 3m$	Units entered in a units placeholder (via Ctrl + Space + U) or via the Context Panel, and exist in a separate namespace $L := 3\ m$

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