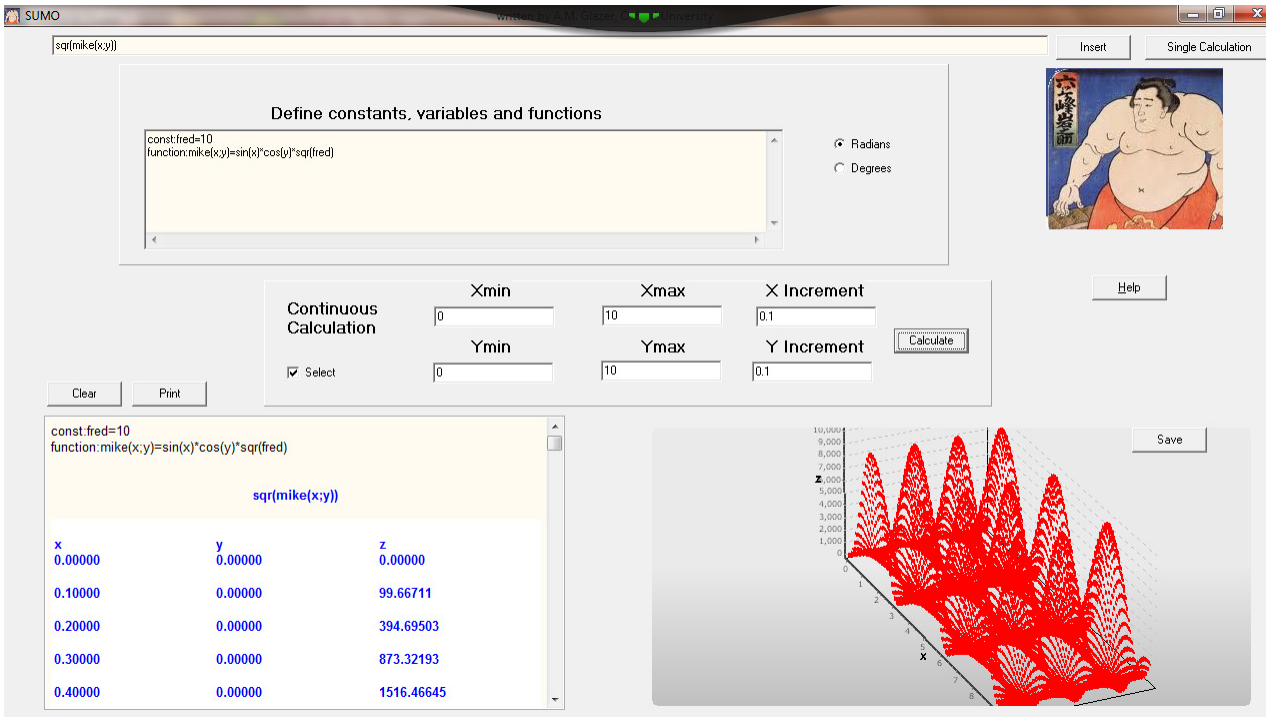
SUMO

Introduction (Version 1.0)

SUMO (**Simple User-defined Mathematical Operations**) is a program that enables calculation of a user-defined function. The program makes use of the mathematics parser at
http://www.mhgsoft.de/software/prfinder.php?category=3&lang=en

Below is shown a typical screen view.



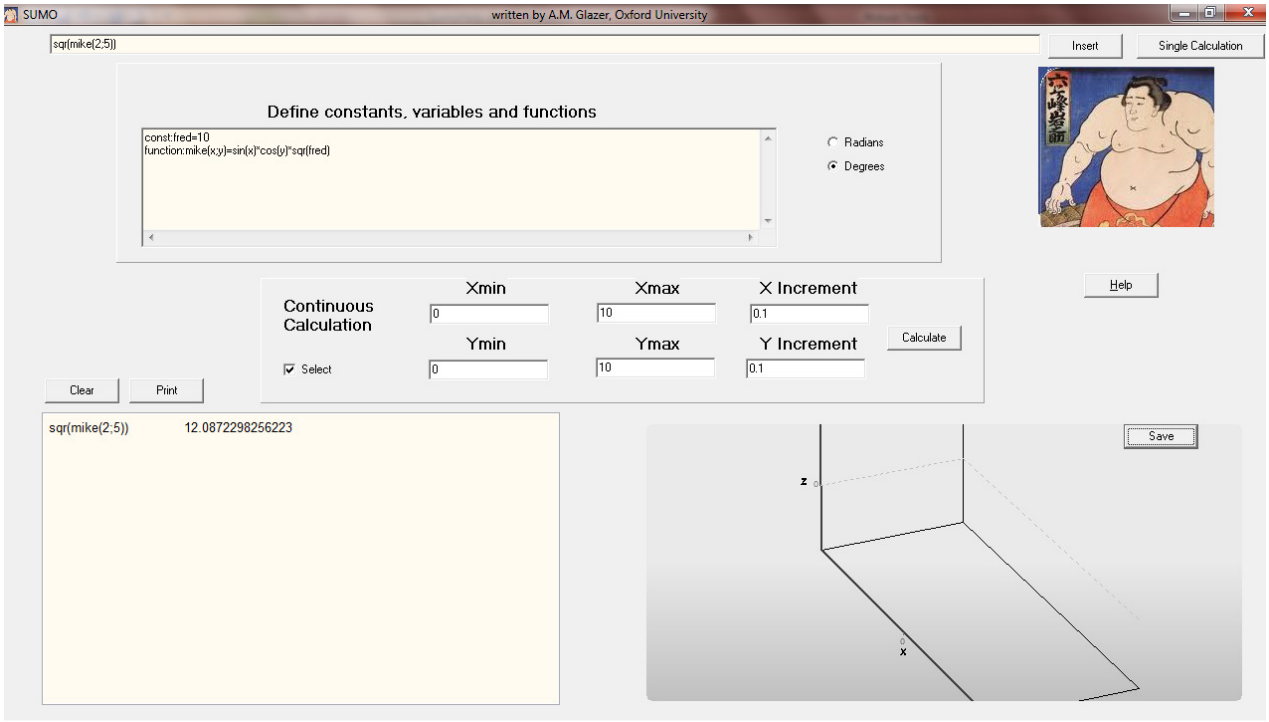
In the top box the function to be refined is entered. The left-hand panel at bottom shows the results of the calculation and the chart shows a plot of the results.

How to use SUMO

Operation of the program is very simple.

1. The mathematical function is entered into the function box (in-built functions and constants can be included). Press the button marked Single Calculation to obtain answer in the Results Area.
2. You can choose between a single calculation in which x and y can be substituted by values.
3. Or you can calculate a continuous variation of x or of x and y, in which case a graph will be plotted.

Single Calculation



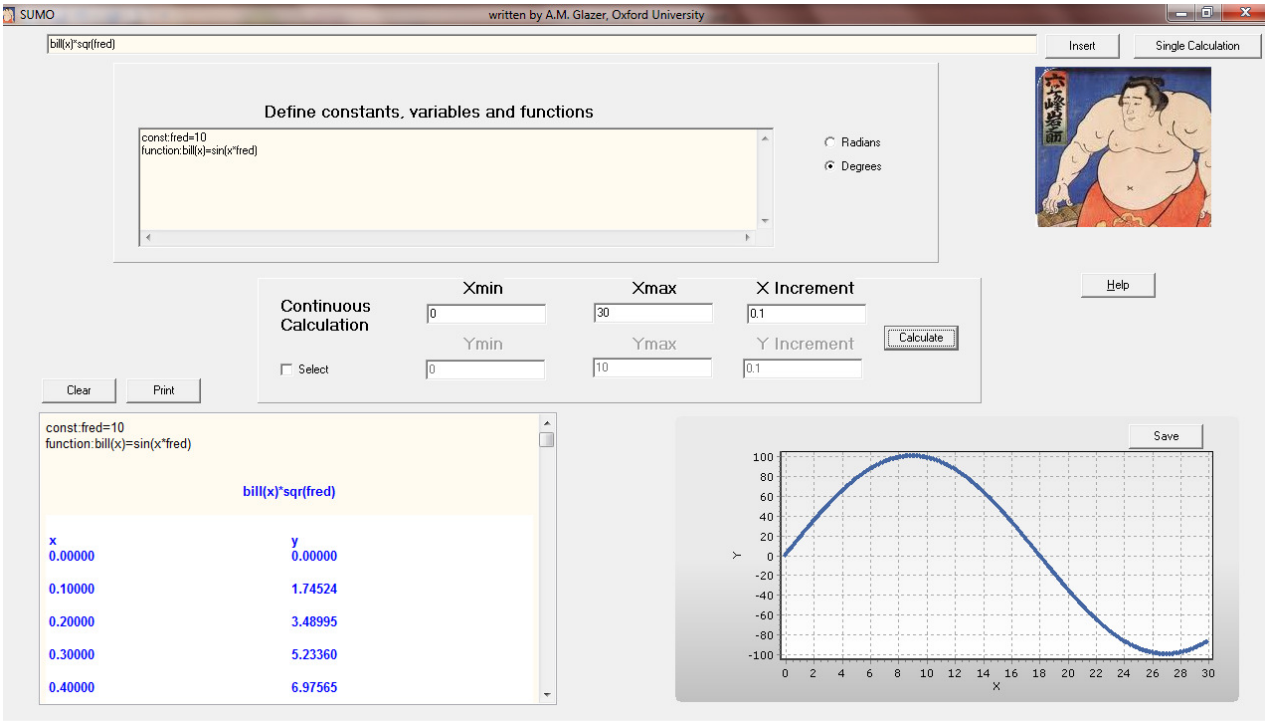
Write a function in the function box at top with actual values. Press Single Calculation button (or simply tab out of the function box) to see answer in Result area. In this example the constant *fred = 10* has been defined and the function mike*(x;y)=sin(x)*cos(y)*sqr(fred)*. The angles are in degrees as indicated in the checked radio button to the right. In the function box at the top we are evaluating *sqr(mike(2;5))* (note the semi-colon between the function arguments). The result is shown in the Results area.

Insert

Inserts the last calculated result into the function box.

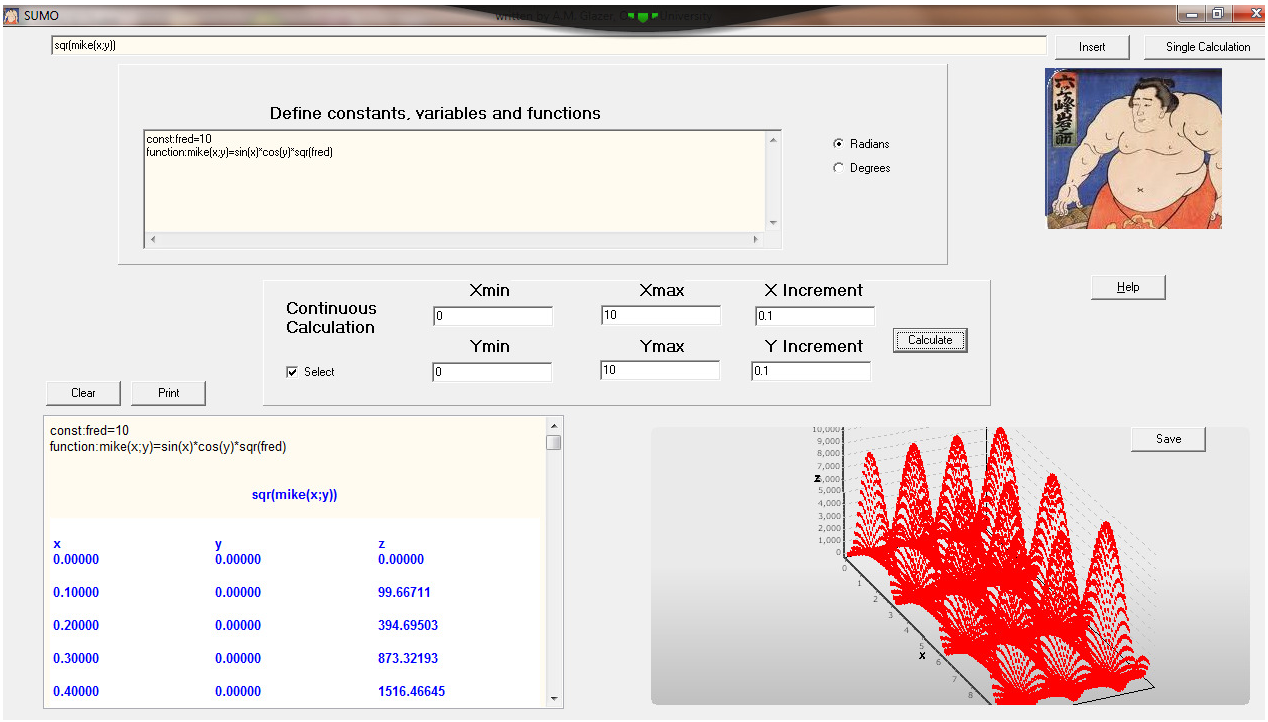
Continuous Calculations

y = f(x)



Enter function of x and minimum, maximum limits of x with an increment value. The Calculate button calculates y = f(x). The chart shows the plot. In this example the constant *fred = 10* has been defined and the function *bill(x)=sin(x*fred)*. The angles are in degrees as indicated in the checked radio button to the right. In the function box at the top we are evaluating *bill(x)*sqr(fred)*. The result is shown in the Results area.

z= f(x,y)



Type into the Function box a function of two variables x and y. Check the Select box and enter the minimum and maximum values of x and y and the relevant increments. Click on the Calculate button to obtain a continuous calculation as a function of two variables, x and y. The chart shows the resulting plot. . In this example the constant *fred =10* has been defined and the function *mike(x;y)=sin(x)*cos(y)*sqr(fred)*. The angles are in degrees as indicated in the checked radio button to the right. In the function box at the top we are evaluating *sqr(mike(x;y))* (note the semi-colon between the function arguments). The result is shown in the Results area.

Define Constants

You can define an arbitrary number of constants using the notation e.g. 'A1=1.5e-3'. It is even possible to define constants like 'A2=sin(pi/4)' or 'A3=A2-A1'.

Warning: The call of variable names (e.g. 'A4=exp(y)') will lead to wrong results. You must not call constants recursively (e.g. 'A5=sqr(A5+1)') or crosswise (e.g. 'A6=A7', 'A7=A6').

The constant identifiers must be unique. Otherwise the first one in the list is taken.

Reserved abbreviations for identifiers are e, pi, C, TRUE and FALSE.
The sequence of the definition of the constants doesn't matter. Lines must be separated by CR LF (0xD,0xA).
The constants list is automatically initialized with a list of physical constants.

Functions

In this list you can define functions (macros) that are based on the intrinsic functions. For example:

'F(X;Y)=EXP(X)*COS(Y)'.

You must specify the arguments in brackets and separated by semicolons on the left side. There must be at least one argument.
User-defined functions may depend on other user-defined funclions, such as 'G(X)=SQR(F(X;PI)). Recursive or crosswise calls are not allowed.
Warning: If you use identifiers of predefined functions (e.g. SIN(X)) the latter ones are overwritten. Lines must be separated by CR LF (0xD,0xA). .

Clear

This clears the Results area.

Print

Sends results output to printer

Charts

(x) case

The chart can be zoomed using the left mouse button. To return to unzoomed view rapidly move left mouse button up towards the left. Right mouse button allows plot to be translated across the screen. The Save button sends the chart to the Results area.

(x,y) case

The chart can be zoomed using the left mouse button. To return to unzoomed view rapidly move left mouse button up towards the left. Right mouse button rotates the plot. The Save button sends the chart to the Results area.

Function List

Clicking with the right mouse button on the Function Box brings up a list of functions. Click with left mouse button to select. The following are the functions available.

Adding:	x + y	adds x and y
Subtracting:	x - y	subtracts y from x
Multiplying:	x * y	multiplies x and y
	fac(n)	factorial of n, n!
Dividing:	x / y	divides x through y
	n div m n \ m	integer division
	rez(x)	reciprocal value of x
	n mod m n % m	integer modulo
	modulo(x;y)	rest of division x/y
Powers:	x ^ y	x to the power of y
	sqr(x)	square of x
	exp(x)	exponential of x
Roots:	sqrt(x)	Square root of x
	cbrt(x)	cubic root of x
	root(n;x)	n-th root of x
Logarithms:	ln(x)	log. with base e of x
	lg(x)	log. with base 10 of x
	lb(x)	log. with base 2 of x
	log(b;x)	common log. with base b of x
Trigonometric Functions:	sin(x)	sine of x
	cos(x)	cosine of x
	tan(x)	tangent of x
	cot(x)	cotangent of x
	sec(x)	secant of x
	cosec(x)	cosecant of x
Arc Functions:	arcsin(x)	arc sine of x
	arccos(x)	arc cosine of x
	arctan(x)	arc tangent of x
	atan2(y;x)	arc tangent of y/x
	arccot(x)	arc cotangent of x
Hyperbolic Functions:	sinh(x)	hyperbolic sine of x
	cosh(x)	hyperbolic cosine of x
	tanh(x)	hyperbolic tangent of x
	coth(x)	hyperbolic cotangent of x
Area Functions:	arsinh(x)	inverse hyperbolic sine of x
	arcosh(x)	inverse hyperbolic cosine of x
	artanh(x)	inverse hyperbolic tangent of x
	arcoth(x)	inverse hyperbolic cotangent of x
Statistical Function:	gauss(x)	normal distribution of x
	erf(x)	error function of x
	inverf(x)	inverse of error function of x
	n over k bino(n;k)	binomial coefficient n over k
	poisson(mu;n)	Poisson distribution of n with average mu
	poicum(mu;n)	cumulated Poisson distribution up to n with average mu

Random Numbers:	rnd(x)	random number in [0,x[
	rand(a;b)	random number in [a,b[
	poirand(mu)	Poisson distributed random numbers with average mu
Bessel Functions:	J0(x)	0th order of x
	J1(x)	1st order of x
	J2(x)	2nd order of x
	J3(x)	3rd order of x
	J4(x)	4th order of x
	J5(x)	5th order of x
	J(n;x)	n-th order of x
Integral Functions:	Si(x)	sine integral of x
	Ci(x)	cosine integral of x
	Ei(x)	exponential integral of x
	li(x)	logarithm integral of x
Gammafunction:	gamma(x)	gamma function of x
Stepfunctions:	theta(x)	=1 if x >0, else =0
	sgn(x)	Sign function of x
	int(x)	integer part of x
	round(x)	x rounded to next integer value
	ceil(x)	x rounded to higher integer value
	floor(x)	x rounded to lower integer value
Periodical Functions:	triangle(x)	triangle waveform (period 2π)
	sawtooth(x)	sawtooth waveform (period 2π)
	square(x)	square waveform (period 2π)
Absolute Values:	abs(x)	absolute |x|
	cabs(x;y)	absolute |x+iy|
Miscellaneous:	frac(x)	non-integer part of x
	max(x;y)	maximum value of x and y
	min(x;y)	minimum value of x and y
	odd(n)	=1 if n is odd, =0 if n is even
	gcd(n;m)	greatest common divisor of n and m
	lcm(n;m)	least common multiple of n and m
	ramp(x;a;b)	=0 if x<a, =1 if x>b, else continuation between a and b
Bitwise and Logical Functions:	a and ba & b	bitwise logic AND
	a or b a | b	bitwise logic OR
	(a) xor (b)	bitwise logic XOR
	bnot(a)	bitwise NOT
	not(a) !a	logical NOT
	a shl b a >> b	shifts a b bit positions to the left
	a shr b a >> b	shifts a b bit positions to the right
Relational Operators:	x = y	=1 if x is equal to y, else =0
	x < > y x != y	=1 if x is not equal to y, else =0
	x < = y	=1 if x is less or equal to y, else =0
	x < y	=1 if x is less than y, else =0
	x > = y	=1 if x is greater or equal to y, else =0
	x > y	=1 if x is greater than y, else =0
IF- Function:	if(c;x;y)	if condition c=1 then x, else if c=0 then y
Properties of complex numbers:	abs(z)	absolute |z|
	arg(z)	argument (phase) of z
	re(z)	real part of z
	im(z)	imaginary part of z
	CC(z) ~z	complex conjugate of z

Mathematical Constants:	pi	circumference/diameter of circle
	e	base of natural logarithms
	C	Euler's constant
	i	imaginary unit, sqrt(-1)
	TRUE	logical value 1.0
	FALSE	logical value 0.0
	INFINITY	symbolical value for ∞
	NEGINFINITY	symbolical value for -∞
	NaN	Not a Number (aborts evaluation)
Number Formats:	N	integer numbers
	X	floating point numbers
	Z	complex numbers
	$n	hexadecimal numbers

Constants

Vacuum speed of light [m/s]	C0 = 2.99792458e8
Planck's constant [J s]	H = 6.626176e-34
Electrical charge of electron [C]	EE = 1.6021892e-19
Boltzmann's constant [J/K]	K = 1.380662e-23
Gravitational constant [m^3 / kg / s^2]	GAMMA = 6.672e-11
Earth acceleration due to gravity [m / s^2]	G = 9.80665e0
General gas constant [J / mol / K]	R = 8.31441e0
Molar norm volume of an ideal gas [m^3 / mol]	VM = 22.41383e-3
Avogadro's constant [mol^(-1)]	NA = 6.022045e23
Loschmidt's constant [m^(-3)]	NL = 2.686754e25
Stefan-Boltzmann's constant [W / m^2 / K^4]	SIGMA = 5.67032e-8
Vacuum permittivity [F / m]	EPSILON0 = 8.85418782e-12
Magnetic permeability of vacuum [H / m]	MY0 = pi*4e-7
Faraday's constant [C / mol]	F = 9.648456e4
Quantum of angular momentum [J s]	HQUER = 1.0545887e-34
Atomic mass unit [kg]	U = 1.6605655e-37
Rydberg's constant for hydrogen [m^(-1)]	RH = 1.096776e7
Rydberg's constant for large nuclei [m^(-1)]	RINF = 1.0973731e7
Ionisation energy of hydrogen [eV]	EH = 1.36058e1
Absolute zero [°C]	T0 = -273.15e0
Square of sine of Weinberg's angle	SIN2THETAW = 0.2259e0
Sommerfeld's fine structure constant	ALPHA = 7.29735e-3
Mass of electron [MeV]	ME = 0.511004e0
Classical radius of electron [m]	RE = 2.81794e-15
Compton wavelength for electrons [m]	LAMBDACE = 2.42611e-12
Mass of neutron [MeV]	MN = 9.39553e2
Mass of proton [MeV]	MP = 9.38259e2
Mass of Z-boson [MeV]	MZ = 91.161e3
Mass of W-boson [MeV]	MW = 80.6e3
Bohr magneton [A m^2]	MYB = 9.27408e-24
Nuclear magneton [A m^2]	MYK = 5.0508e-27
Bohr radius [m]	A0 = 5.29177e-11