Ember+ Formulas

Syntax Description

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Date: 2012-06-26

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# Introduction

This document describes the syntax of formulas used in the Glow schema, which is part of the Ember+ protocol standard. An Ember+ provider may define a formula for any parameter of numerical type. This formula can be used by consumers to translate the transmitted value of the parameter into the required unit.

A Glow formula is a tuple of two mathematical expressions, each of which applies a projection to one input value (referred to as $ in the syntax).

The two expressions must have the following mathematical relationship:   
expr2(expr1($)) = $ = expr1(expr2($))

This means, expr2 must inverse the projection applied by expr1 and vice versa, like in these examples:

* expr1 = $ / 2  
  expr2 = $ \* 2
* expr1 = exp($)  
  expr2 = log($)

In the case of read-only parameters, the second expression may be omitted.

Technically, Glow formulas support the following data types:

* 64 bit integer, referred to as INTEGER
* 64 bit floating-point, referred to as DOUBLE

When evaluating a formula expression, the data type of the result may be different from the input value’s data type.

## Examples

1. expr1 = 1 + log($, 2)  
   expr2 = 2^($ - 1)
2. expr1 = sin($ / 7.43) where $ is of type INTEGER  
   expr2 = int(7.43 \* asin($))
3. expr1 = $ - log($ / (e^(-$) \* $^sin(1 / $)), 10)  
   expr2 = *exercise left to the reader*

# Operators

In ascending order of precedence

* **Addition:***Operand1* **+** *Operand2*

Example:

* + 100 + 12.1

= 112.1 (DOUBLE)

Result:

* + DOUBLE if at least one of the two operands is of type DOUBLE
  + INTEGER if both operands are of type INTEGER
* **Subtraction:***Operand1* **-** *Operand2*

Example:

* + 75 – 5

= 70 (INTEGER)

Result:

* + DOUBLE if at least one of the two operands is of type DOUBLE
  + INTEGER if both operands are of type INTEGER
* **Multiplication:***Operand1* **\*** *Operand2*

Example:

* + 12.4 \* 2

= 24.8 (DOUBLE)

Result:

* + DOUBLE if at least one of the two operands is of type DOUBLE
  + INTEGER if both operands are of type INTEGER
* **Division:***Operand1* **/** *Operand2*

Example:

* + 1 / 2

= 0.5 (DOUBLE)

Result:

* + DOUBLE
* **Integer Division:***Operand1* **\** *Operand2*

Example:

* + 12.4 \ 5

= 12 \ 5 = 2 (INTEGER)

Result:

* + INTEGER
* **Modulo:***Operand1* **%** *Operand2*

Example:

* + 15 % 4.5

= 15 % 4 = 3 (INTEGER)

Result:

* + INTEGER
* **Negation:  
  -** *Operand*

Example:

* + -11.3

= -11.3 (DOUBLE)

Result:

* + DOUBLE if operand is DOUBLE
  + INTEGER if operand is INTEGER
* **Power:***Operand1* **^** *Operand2*

Example:

* + 2^10

= 1024 (INTEGER)

Result:

* + INTEGER if both operands are of type INTEGER and Operand2 is positive or zero.
  + DOUBLE otherwise.
* **Parenthesis:  
  (***Expression***)**

Example:

* + 2^(9 + 1)

= 2^10 = 1024 (INTEGER)

Result:

* + DOUBLE if expression is of type DOUBLE
  + INTEGER if expression is of type INTEGER

# Built-in Constants

* **$**The formula’s input value.

Type:

* + Either DOUBLE or INTEGER
* **PI**Mathematical constant π.

Type:

* + DOUBLE
* **E**Mathematical constant e of type DOUBLE.

Type:

* + DOUBLE

# Built-in Functions

* **Sine  
  sin(***Expression***)**Expression is in radians

Type:

* + DOUBLE
* **Cosine  
  cos(***Expression***)**Expression is in radians

Result:

* + DOUBLE
* **Tangent  
  tan(***Expression***)**Expression is in radians

Result:

* + DOUBLE
* **Hyperbolic Sine  
  sinh(***Expression***)**Expression is in radians

Type:

* + DOUBLE
* **Hyperbolic Cosine  
  cosh(***Expression***)**Expression is in radians

Result:

* + DOUBLE
* **Hyperbolic Tangent  
  tanh(***Expression***)**Expression is in radians

Result:

* + DOUBLE
* **Arc Sine  
  asin(***Expression***)**Expression is in radians

Type:

* + DOUBLE
* **Arc Cosine  
  acos(***Expression***)**Expression is in radians

Result:

* + DOUBLE
* **Arc Tangent  
  atan(***Expression***)  
  atan(***Expression1***,** *Expression2***)** “atan2” function in C  
  Expression is in radians

Result:

* + DOUBLE
* **Square Root  
  sqrt(***Expression***)**

Result:

* + DOUBLE
* **Natural Logarithm (base E)  
  log(***Expression***)**

Type:

* + DOUBLE
* **Logarithm  
  log(***Expression***,** *BaseExpression***)**

Result:

* + DOUBLE
* **Exponential  
  exp(***Expression***)** equivalent to e^(Expression)  
  Result:
  + DOUBLE
* **Round to closest integer  
  round(***Expression***)**

Type:

* + INTEGER
* **Round to next bigger integer  
  ceil(***Expression***)**

Result:

* + INTEGER
* **Convert to integer, truncating fractional part  
  int(***Expression***)**  
  Result:
  + INTEGER
* **Convert to floating-point  
  float(***Expression***)**  
  Result:
  + DOUBLE