Question 1 – Assignment 6. Abdoulie Kassama, Harrif Saliu

1. Algebraic Expression: An algebraic expression is a mathematical expression consisting of variables, numbers, and operations. It is an expression that defines a series of arithmetic or algebraic operations consisting of operators and operands, and can be reduced to a single numerical result when numerical values are replaced by the operands and the specified operations are performed [1]. Examples of an algebraic expression are: a + b, x – y, 3x-2y.

A mathematical formula in the other hand is an equation that is used to solve for variables in a normal equation. It normally links two or more quantities with an equal to sign. When you know one quantity's value, you can use the formula to calculate the other's value [2].

The main difference between the two is the equal sign, as mathematical formulas have equal signs with quantities on both sides. Examples: a = b + c, 2x = 3(y-2)

1. Term Rewriting: Term rewriting is a reduction method in which rewrite rules apply to terms. Term rewriting is a process of simplification which begins with one or more rewrite rules and an initial term. This initial term is gradually reduced to a term which cannot be simplified any further: this is the result of the rewriting process and is called the normal form. It is similar to Symbolic Computation which is the evaluation of the mathematical expressions in their exact form, without numbers being added. [4]
2. Symbolic computation is the development of algorithms and software for manipulating mathematical expressions and other mathematical objects [5]. The mathematical expressions are evaluated in their exact form. As for numerical computation, it uses simple arithmetic operations for solving complex mathematical problems. It involves formulation of mathematical models’ physical situations that can be solved with arithmetic operations [6].
3. Evaluation is to calculate the value of an expression. It is a form of assessment which means estimating the value of something. As for Interpretation, refers to giving a value to mathematical expressions. Example: 1 + 1 = 2, the “1 + 1” can be term as an expression, evaluating the expression we have the value of 2.
4. Lazy evaluation is an evaluation technique that delays the evaluation of an expression until its value is required [7]. On the other hand, eager evaluation, is essentially the opposite alternative to lazy evaluation. Most mainstream programming languages use this evaluation strategy. For an eager evaluation an expression is evaluated as soon as it is bound to a variable.
5. Functional programming is related to algebra in the sense that the fundamental concept of functions is derived from that of algebra function. The functions take in an input, process it and produce an output.

It is important to note some of the differences, an example of a math function is *f(x)*, this function is very specific and would always return the same value for x given a specific number.

This is not the case for a programming function, given the same function *f(x)* for a programming function. It may be process in several different ways and may not return the same value for the same input. Say the function returns *x \* rand()*, then it would return arbitrary value for input *x*.

1. No, lambda functions are not a replacement for symbolic computations. As mentioned earlier, symbolic computation processes expressions in their exact form and does not involve numerical values directly, a lambda function takes any number of arguments with only have one expression and returns a value.

Example: This expression c = (exp(x) \*\* 2)/2 processed as symbolic computation would produce something like

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exp(2\*x)/2

This is because the expression is computed as it is and not as computing the values.

Another example why it is not a replacement for lambda function is that, symbolic expressions are useful if you want to do symbolic computation and get your answer in the form of a general expression, and not a number. Whereas lambda function would be useful if you want to solve a numeric problem, i.e that is get a numeric value so their purposes are different.

References:

[1] <https://link.springer.com/referenceworkentry/10.1007%2F1-4020-0613-6_469>

[2] <https://www.splashlearn.com/math-vocabulary/algebra/formula>

[3] <https://homepages.cwi.nl/~daybuild/daily-books/extraction-transformation/term-rewriting/term-rewriting.html>

[4] <https://www.quora.com/What-is-a-symbolic-computation>

[5] <https://en.wikipedia.org/wiki/Computer_algebra>

[6] Dhere P. et al, Introduction to Numerical Computing[7] <https://en.wikipedia.org/wiki/Lazy_evaluation>

[8] <https://en.wikipedia.org/wiki/Eager_evaluation>