APPLICATIONS OF DISCRETE MATHEMATICS

BY:KUNAL JANI

STUDENT ID:201601444

INTRODUCTION

Discrete mathematics is a subject which has a large number of sub sections inside it. It is an important subject to study in various engineering branches. We can observe that the basic concepts of discrete mathematics can be applied in the various fields of the real world.

Many mathematical expressions can be expressed in terms of a recursive function. We will consider the set of non negative integers as the domain. To define the given function, we need two steps:

1)We need to find out the value of the function $f(x)$ at $x = 0$.

2)We will need to figure out a rule to find out the value of a $f(x)$ at a particular value of x where $x \in Z^0 \cup Z^+$ by finding out the value of $f(x)$ at smaller values of x.

We can use this concept to express the Law of Radioactive Decay at a recursive function.

Another useful application of the discrete mathematics in computers. We can convert a binary number into an octal number using the concept of composition of functions.

This procedure can be achieved by first converting a binary number to a decimal number, and then we will convert a decimal number to an octal number.

We will need three function in which one function will be a composition of the other two functions.

EXPRESSING THE LAW OF RADIOACTIVE DECAY IN TERMS OF A RECURSIVE FUNCTION

Let N be the number of nuclides at a given time t.

We can express the law of radioactive decay as:

$\frac{dN}{dt} \alpha N$

$\Rightarrow \frac{dN}{dt} = -\lambda N$

(λ is the decay constant.)

$\Rightarrow \frac{dN}{N} = -\lambda.dt$

Integrating, we get:

$\int \frac{dN}{N} = -\int \lambda.dt$

$\ln N = -\lambda t + lnC$

C is the original number of nuclides.

$N = Ce^{-\lambda t}$

We can express this as a function of time.

$N(t) = Ce^{-\lambda t}$

$N(0) = C$

$N(1) = \frac{C}{e^{-\lambda}} = \frac{N(0)}{e^{-\lambda}}$

$N(2) = \frac{C}{e^{-2\lambda}} = \frac{N(1)}{e^{-\lambda}}$

$N(3) = \frac{C}{e^{-3\lambda}} = \frac{N(2)}{e^{-\lambda}}$

We can define a recursive function of this function as:

$N(t+1) = \frac{N(t)}{e^{-\lambda}}$

CONVERSION OF A BINARY NUMBER TO AN OCTAL NUMBER USING COMPOSITION OF FUNCTIONS

Now we move to the second application of discrete mathematics which would be the conversion of a binary number to an octal number.

Let B be the set of all the binary numbers, D be the set of all the decimal numbers and O be the set of all the octal numbers.

Let $f : B \longrightarrow D$ and $g : B \longrightarrow D$

The three sets can be represented in roster from as:

$B = \{10, 11, 110, 101, ...\}$

$D = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, ...\}$

$O = \{1, 2, 3, 4, 5, 6, 7, 8, 11, 12, ...\}$

We can represent the first function as $y = f(x)$.

Some of the values of this function are:

$f(10) = 2$

$f(11) = 3$

$f(110) = 5$

We can represent the second function as $y = g(x)$.

Some of the values of this function are:

$g(3) = 3$

$g(9) = 11$

$g(10) = 12$

We can represent the third function as $y = f \circ g(x)$ from $B \longrightarrow O$ as

$f \circ g(10) = 2$

$f \circ g(1001) = 11$

$f \circ g(1010) = 12$

The binary to octal conversion in computers is an example of a problem that can be expressed in the from of composition of two functions.

SUMMARY

The applications of discrete mathematics are extremely vast. Even though many people think that discrete mathematics may not be used much, but they are used in even very small but significant things in our daily life.

The law of radioactive decay can easily help us find out the amount of radioactive material present at a given instant so that we can find out the nuclear decay constant for different materials such as uranium, thorium and plutonium.

The different values of the decay constant can help us study the behaviour of different materials as all the materials found in earth are slightly different in nature.

Conversion of binary numbers to octal numbers is a common computer program that students are given to write after they understand the way of conversion to different number systems.

By observation, students can also use the logic that binary numbers can be first converted to decimal numbers, and then decimal numbers are converted to octal numbers, thus involving the concept of composition of functions.

The concept of composition of functions will make it easy to understand different types of number conversions.

This can also be used to convert binary to hexadecimal, hexadecimal to octal, etc.

References:

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5)https://www.mathsisfun.com/sets/functions-composition.html