AMALGAM OF BIOTECHNOLOGY & COMPUTER PROGRAMMING

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Abstract: Many times it has been seen that the students of Biotechnology field resist in learning the computer programming. But with the growing needs, it is required to combine Biotechnology and Computer Programming field for smooth working of Biotechnology field in future. The purpose of this paper is to explore how Computer Programming can be used in Biotechnology field and why it is important for Biotechnology student to study Computer Programming. This is recommended for all Universities to include Computer Programming in Biotechnology field and most importantly to aware them why Computer Science Programming has been included in their curriculum.
Keywords: Biotechnology, Computer Programming, Python, Computation Time, Statistics, Multiplicity of Infection, Bacteriophage

I. INTRODUCTION

Now a day's any field is incomplete without computer programming, so how a Biotechnology field can stay behind. But it has been noticed that, Biotechnology students have a mindset that they have opt this field for getting their career in respective field and not learning or being a computer programmer. But if they look from future point of view, in every field we have different applications and equipments which are working using a Computer Programming & just a computer programmer cannot make that efficient application which you can make with your understanding in your subject, or if you don't want to make, you can at least guide the programmer and this is possible if you have good understanding in programming to communicate easily with programmer. So, it is seriously required to amalgam the Biotechnology field with Computer Programming, so that we can have smooth Biotech innovations in future.

II. LIMITATIONS

This paper is not discussing very advanced problems/topics on Biotechnology but trying to solve some basic problems of Biotechnology just to show use of programming concept in Biotechnology.

III. METHODOLOGIES

a. An observation was done in department of Biotechnology of an Engineering College where students were not clear why they are studying Computer Programming & was upset that why Computer Engineering field students are not taught Biology subjects, when they are learning Computer Subjects. They felt it unfair, without evaluating the benefits of learning Computer Programming.

b. Discussion was held with Programming Specialist, where the response was – "everything in today's generation is programmed; even the medical equipments like X-Ray Machines, Ultrasound Machines, and Weather Forecasting

& in fact with your programming predictions, lifecycle of different microbes can be calculated. Computer Programming is in fact playing a crucial role in Data Science and Artificial Intelligence."[3]

c. Discussion was also done with Biotechnology field specialist where it was stated that "now IT companies have also started taking Life Science Projects and hence need Biotechnology Engineers also" & to work in IT Company you should have Programming knowledge [2]. It was also stated that "Biological data is vaster in comparison to other fields & needs knowledge of Computer Science Engineering for its effective processing and proper analysis."

d. In this research paper I am solving some Biotechnology problems using Python Programming & will also calculate the time to solve the problem.

IV. APPLYING COMPUTER PROGRAMMING IN BIOTECHNOLOGY

Below is an example of solving biotechnology problem using Computer Programming & calculating the time to solve problem using Computer Program.

A. Problem on Multiplicity of Infection(moi):

A 0.1mL aliquot of a bacteriophage stock having a concentration of 4 X 109 phage/mL is added to 0.5mL of E. coli cells having a concentration of 2 X 108 cells/mL. What is the moi? (An example from [1])

If you solve above problem manually it will take 2-3 minutes to solve, but using Computer Program can reduce the time.
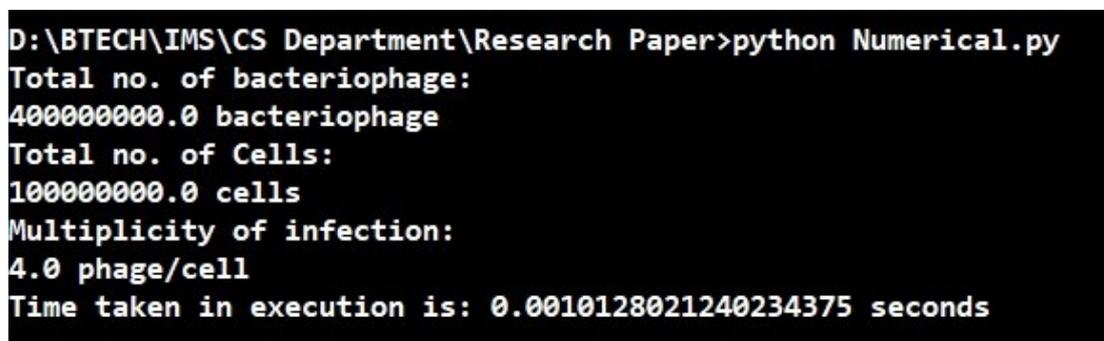
B. Solving the above problem by using Static Code

Static code is a code which uses fixed values in a program for calculation & works only for specific set of data.

```python
# Code in Python to calculate moi
import time
start_time = time.time()
print("Total no. of bacteriophage:")
bacteriophage=0.1 * 4 * 10**9
print(bacteriophage, "bacteriophage")
print("Total no. of Cells:")
cells=0.5 * 2 * 10**8
print(cells,"cells")
print("Multiplicity of infection:")
moi=bacteriophage/cells
print(moi, "phage/cell")
end_time = time.time()
s=end_time-start_time
print("Time taken in execution is:", s, "seconds")
```

Figure 1. is showing the output of above program

Figure1. Solving moi problem using static code, taking just 0.00101280 seconds
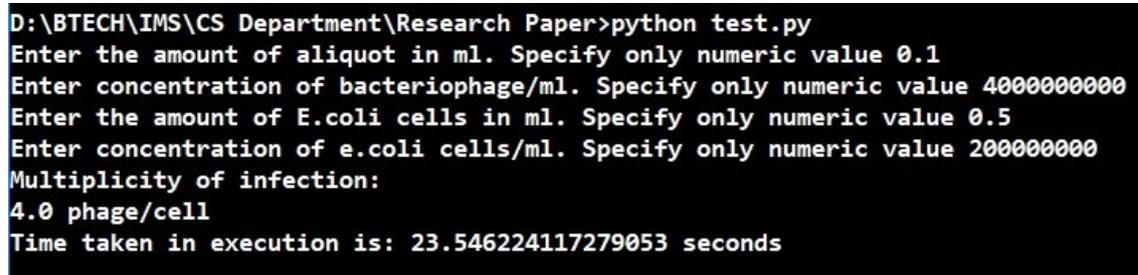
When compared to manual method of solving moi problem, static code is taking less than a second while manual method of calculation takes 2-3 minutes. So, if more complex problem is taken, it can quickly be solved using Computer Programs. As Biotech data is vast, this time reducing computer programming is essential for solving biotechnology field.

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C. Solving the above problem by using Dynamic Code

Dynamic code is a code which works on different set of data, i.e. data which is not fixed & values are randomly entered by user.

```python
# Code in Python to calculate moi
import time
start_time = time.time()
aliquot=float(input("Enter the amount of aliquot in ml. Specify only numeric value "))
concentration=float(input("Enter concentration of bacteriophage/ml. Specify only numeric value "))
bacteriophage=aliquot*concentration
ecoli=float(input("Enter the amount of E.coli cells in ml. Specify only numeric value "))
concentration=float(input("Enter concentration of e.coli cells/ml. Specify only numeric value "))
cells=ecoli * concentration
print("Multiplicity of infection:")
moi=bacteriophage/cells
print(moi, "phage/cell")
end_time = time.time()
s=end_time-start_time
print("Time taken in execution is:", s, "seconds")
```

Figure 2. is showing the output of above program


```
D:\BTECH\IMS\CS Department\Research Paper>python test.py
Enter the amount of aliquot in ml. Specify only numeric value 0.1
Enter concentration of bacteriophage/ml. Specify only numeric value 4000000000
Enter the amount of E.coli cells in ml. Specify only numeric value 0.5
Enter concentration of e.coli cells/ml. Specify only numeric value 200000000
Multiplicity of infection:
4.0 phage/cell
Time taken in execution is: 23.546224117279053 seconds
```

Figure 2. Solving moi problem using dynamic code, taking 24 seconds (approx)

When compared to manual method of solving moi problem, dynamic code is taking just 24 seconds while manual method of calculation takes 2-3 minutes, which again shows that programming method for solving Biotech problem is much better than manual method. Although dynamic code takes more time than static method, as this time of dynamic code also includes time taken by user to enter the data, but still dynamic code is preferred, as in real world, we need to work on different data sets rather than specific data set. Below Figure 3, is the comparison of above results is terms of Graph plotting, which is actually depicting the vast difference between execution time in manual and computer programming method, that cannot be visualize just talking theoretically.
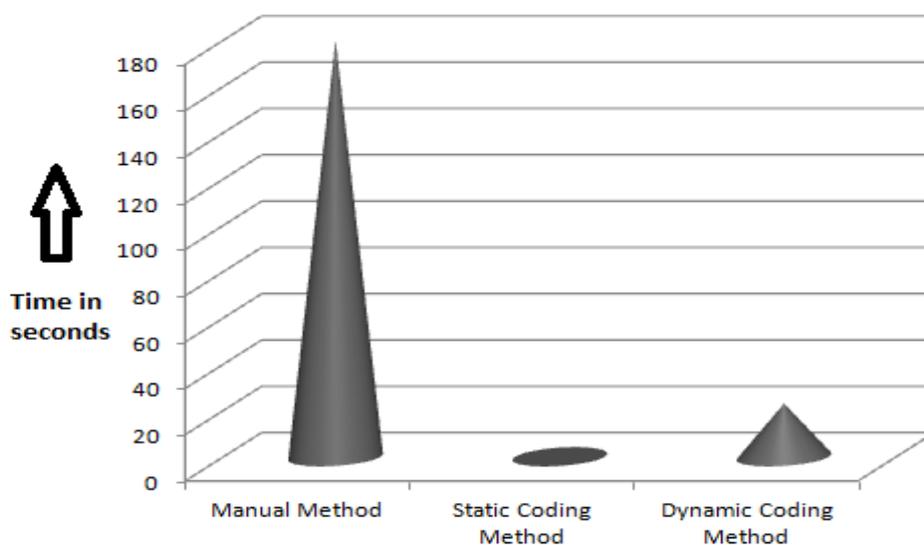
Figure 3. Graph plot on X-Y axis depicting the time taken by manual method, static coding method and dynamic Coding method

V. CONCLUSION

Computer Programming is not just for Computer Science people, it is for all those who want to work smartly and progressively. It has wide scope in Biotechnology field, as it will decrease the computation and time required for computation. It can help to solve problems quickly and can give quicker statistics, and hence in turn can give wide scope in research.

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