(S1-19_DSECLZG519)
(Data Structures and Algorithms Design)
Academic Year 2019-2020

Assignment 2 – PS2 - [Integer Multiplication] - [Weightage 13%]

1. Problem Statement

Multiplication of two n digit numbers using common grade-school algorithm takes n^2 multiplication operations. **Design a sub quadratic-time algorithm for multiplying two n digit integers.** For 2 integers A and B, use the following approach:

$$A * B = (A1 * B1)10^n + (A1 * B2 + A2 * B1) \ 10^{n/2} + A2 * B2$$

Requirements:

1. Identify which design strategy is employed here and give a brief explanation about the same.

2. Use recurrence relations to find the number of multiplication operations required using this approach. Briefly explain the steps involved.

3. ***"Multiplying big integers has applications to data security, where big integers are used in encryption schemes."*** - Substantiate the above statement with one example.

4. Implement the above problem statement using Python 3.7.

Sample Input:

Input of two numbers A and B should be taken in as user input from **inputPS2.txt**.

223245
123456

Note that the input data shown here is only for understanding and testing, the actual file used for evaluation will be different.

Sample Output:

Display intermediate values of A1, A2, B1 and B2. Also display the product of the two integers.

1st number, A: 223245
2nd number, B:123456

Intermediate Values of A1, B1 after partition:

A:223245 A1: 223 A2: 245

B:123456 B1: 123 B2: 456

Intermediate Values of A1, B1 after partition:

A:223 A1: 2 A2: 23

B:123 B1: 1 B2: 23

Intermediate Values of A1, B1 after partition:

A:23 A1: 2 A2: 3

B:23 B1: 2 B2: 3

Intermediate Values of A1, B1 after partition:

A:223 A1: 2 A2: 23

B:456 B1: 4 B2: 56

Intermediate Values of A1, B1 after partition:

A:23 A1: 2 A2: 3

B:56 B1: 5 B2: 6

Intermediate Values of A1, B1 after partition:

A:245 A1: 2 A2: 45

B:123 B1: 1 B2: 23

Intermediate Values of A1, B1 after partition:

A:45 A1: 4 A2: 5

B:23 B1: 2 B2: 3

Intermediate Values of A1, B1 after partition:

A:245 A1: 2 A2: 45

B:456 B1: 4 B2: 56

Display the output in **outputPS2.txt**.

2. Deliverables

- Word document **designPS2_<group id>.docx** detailing your answers to requirements 1,2 and 3.
- **Zipped AS2_PS2_IM_[Group id].py package folder** containing all the modules classes and functions and the main body of the program.
- **inputPS2.txt** file used for testing
- **outputPS2.txt** file generated while testing

3. Instructions

a. It is compulsory to make use of the data structures or algorithm mentioned in the problem statement.

b. It is compulsory to use Python 3.7 for implementation.

c. Ensure that all data structures and functions throw appropriate messages when their capacity is empty or full.

d. For the purposes of testing, you may implement some functions to print the data structures or other test data. But all such functions must be commented before submission.

e. Make sure that your read, understand, and follow all the instructions

f. Ensure that the input, prompt and output file guidelines are adhered to. Deviations from the mentioned formats will not be entertained.

g. The input, prompt and output samples shown here are only a representation of the syntax to be used. Actual files used to test the submissions will be different. Hence, do not hard code any values into the code.

h. Run time analysis is provided in asymptotic notations and not timestamp based runtimes in sec or milliseconds.

4. Deadline

a. The strict deadline for submission of the assignment is 16th Feb, 2020.

b. The deadline is set for a month from the date of rollout to accommodate for the semester exams. No further extension of the deadline will be entertained.

c. Late submissions will not be evaluated.

5. How to submit

a. This is a group assignment.

b. Each group has to make one submission (only one, no resubmission) of solutions.

c. Each group should zip the deliverables and name the zipped file as below

"ASSIGNMENT2_[BLR/HYD/DLH/PUN/CHE]_[G1/G2/…].zip"
and upload in CANVAS in respective location under ASSIGNMENT Tab.

d. Assignment submitted via means other than through CANVAS will not be graded.

6. Evaluation

a. The assignment carries 13 Marks.

b. Grading will depend on

    a. Fully executable code with all functionality

    b. Well-structured and commented code

    c. Accuracy of the run time analysis and design document.

c. Every bug in the functionality will have negative marking.

d. Source code files which contain compilation errors will get at most 25% of the value of that question.

7. Readings

Text book: Algorithms Design: Foundations, Analysis and Internet Examples Michael T. Goodrich, Roberto Tamassia, 2006, Wiley (Students Edition). Chapters: 5.2