Programming and Data Structure Lab [CS19003][Section-1]
Assignment-4

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Write a C program for the tasks as described below. Save the file as **A04_[Roll_Number].c**. Build and run to check your program. Upload the .c file for the assignment in MS teams.

Let us play with polynomials again! Here we will multiply two polynomials in coefficient representation and point-value representation to check the equivalence between two methods of multiplication. You should use 1D Array data structure, Loops, Iterations, Conditional statements for this assignment.

1. Generate a random polynomial $f(x)$ of degree $n \leq 4$, read n from the user. Coefficients of the polynomial should be integers less than 10. Print the polynomial in coefficient representation. Input an integer **e** and evaluate the polynomial on **e**. Print $f(e)$. [15]

2. Generate another random polynomial $g(x)$ of degree n. Coefficients of the polynomial should be integers less than 10. Print the polynomial in coefficient representation. Multiply $f(x)$ and $g(x)$ to generate $h(x)$. Print $h(x)$.[25]

3. In this part you have to multiply the polynomials using point value representation. Note that if you multiply two degree n polynomials then you'll get a degree $2n$ polynomial. To represent that you need $2n+1$ points. So, generate $2n+1$ random distinct points $\{\alpha_1, \ldots, \alpha_{2n+1}\}$ less than 15. Print all the points. Evaluate $f(x)$ and $g(x)$ on those $2n+1$ points. Multiply them point wise to generate point value representation of $m(x) = f(x)g(x)$. Print the $f(x)$, $g(x)$ and $m(x)$ point wise.

   Check whether $\{h(\alpha_1), \ldots, h(\alpha_{2n+1})\}$ is same as $\{m(\alpha_1), \ldots, m(\alpha_{2n+1})\}$. If they are same print **h(x) and m(x) are equivalent**, otherwise print an error message. [40]

4. Last part is same as your assignment 1, but here you can use arrays. If degree $n = 1$, then interpolate $m(x)$ from $\{\{\alpha_1, m(\alpha_1)\}, \ldots, \{\alpha_{2n+1}, m(\alpha_{2n+1})\}\}$. Print $m(x)$ in coefficient representation. If that is same with $h(x)$ print any success message, otherwise print an error message. [20]

5. **Bonus:** try to extend the last part for $n > 1$.

Note:

- Include **time.h** and use rand() to generate random numbers. You need to initialize the seed using srand(time(0)).

Sample Output: Here is one sample output:

Please enter Degree of the polynomial: 1

The Degree 1 polynomial is: $f(x) = 8x$

Please enter an evaluation point: 1

$f(1) = 8$

Another Degree 1 polynomial is: $g(x) = 5 + 4x$

The product of $f(x)$ and $g(x)$ is: $h(x) = 40x + 32x^2$

3 distinct points are: 3 4 8

Point value representation of f:

$f(x) := \{(3, 24), (4, 32), (8, 64)\}$

Point value representation of g:

$f(x) := \{(3, 17), (4, 21), (8, 37)\}$

Point value representation of fg:

$m(x) := \{(3, 408), (4, 672), (8, 2368)\}$

Check successful. $h(x)$ and $m(x)$ are equivalent

The result of interpolation is:

$m(x) = 40.000000x + 32.000000x^2$

Yay! Success.