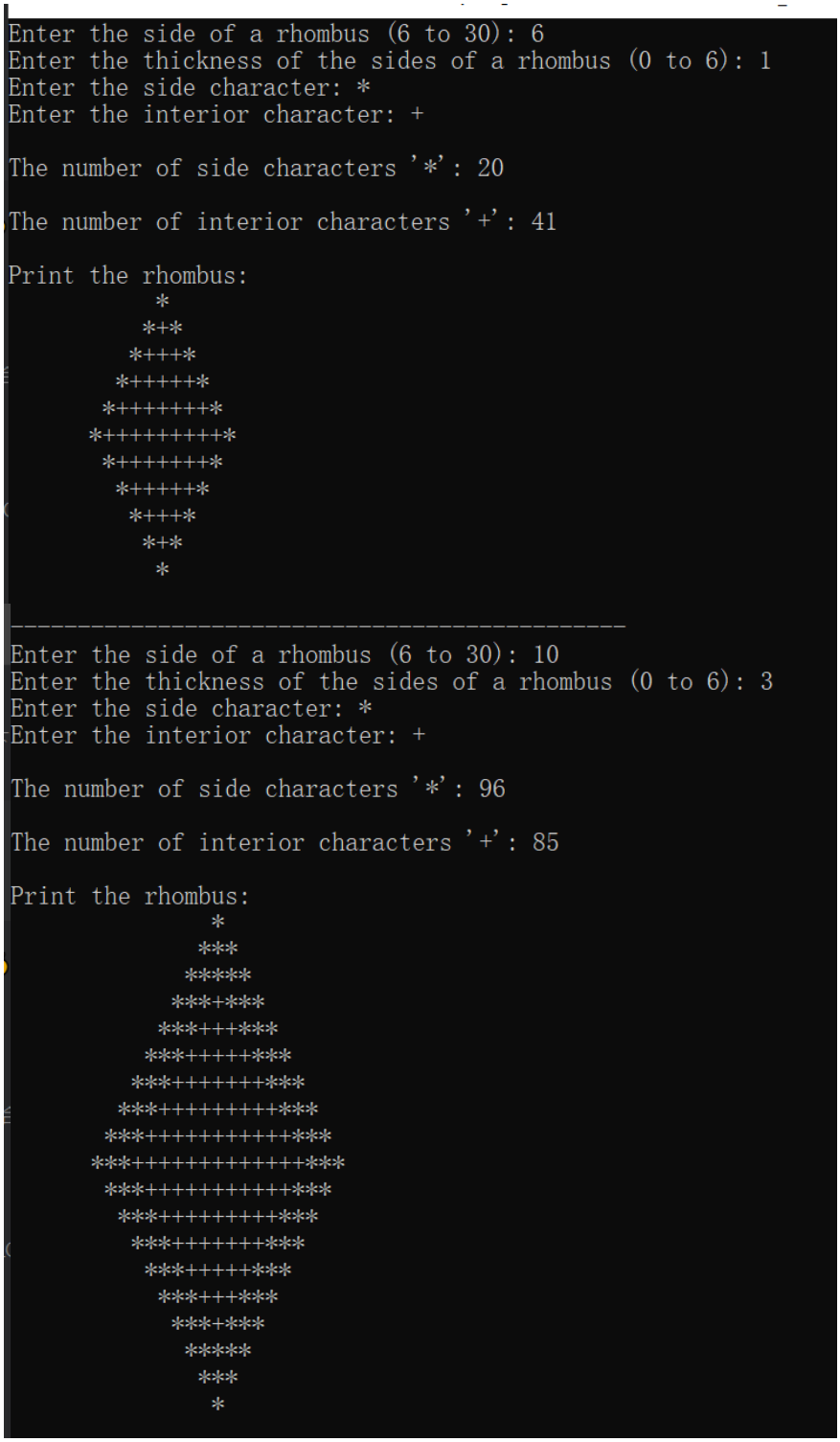
Spring 2024, ISTM, FCU-Purdue 2+2 ECE Program
ISTM 2731, Advanced C Programming, Final Exam

Two questions. Use the designated file names as specified in each question. In the file/directory names, change skeleton to DXXXXXXX, where DXXXXXXX is your student ID. When you finish the exam, submit all files/directory to the instructor's computer.

1. (50 points) You may start with program skeleton **fexam_skeleton_1.cpp** and change the file name to **fexam_DXXXXXXX_1.cpp**. Write a C++ program to perform the following steps: (1) inputs two integers length from 6 to 30 and thick from 0 to 6 such that length is the side of a rhombus (diamond) and thick is the thickness of the sides of the rhombus that thick≤length/2. (2) Input two characters sChar and iChar for the side characters and interior characters of the rhombus. Suppose there are 6 blanks on the left-hand-side of the rhombus. (3) Output the number of side characters and the number of interior characters. (4) Print the rhombus to output every row using functions cout <<, setw(), and setfill(), not to use any loop to print characters of a row. Note that for the first and the last thick rows, all points are side characters and no interior characters are printed. Repeat steps (1) to (4) until thick is of value 0. Example of program execution:

(continue in the next page)



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2. (50 points) A polynomial $P(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x + a_0$, where $-10<a_i<10$ and $a_n \neq 0$, is represented using an ordered single link linear list. Suppose the highest term and coefficients are generated using random numbers; and there is only 50% chance that the coefficients are not 0 except for the coefficient of the highest degree term. Let $P(x) = a_m x^m + a_{m-1} x^{m-1} + \ldots + a_1 x + a_0$ and $Q(x) = b_n x^n + b_{n-1} x^{n-1} + \ldots + b_1 x + b_0$ be two polynomials of degree m and n, respectively. Product of two polynomials, i.e., polynomial multiplication, P*Q(X) is defined as $\sum_{i=0}^{m} \sum_{j=0}^{n} a_i b_j x^{i+j}$.

   Rename "skeleton" to "DXXXXXXX" in directory/files fexam_skeleton_2, polynomial_product_list_skeleton.h, polynomial_product_list_skeleton.c, and polynomial_product_main_skeleton.c to fexam_DXXXXXXX_2. In directory fexam_DXXXXXXX_2, **create** a C project, fexam_DXXXXXXX_2.dev and **add** three files polynomial_product_list_skeleton.h, polynomial_product_list_skeleton.c, and polynomial_product_main_skeleton.c to the project. Source programs polynomial_product_list_skeleton.c, and polynomial_product_main_skeleton.c are not fully implemented and you will complete their implementation as indicated in the corresponding program code. Complete functions **replaceTerm()** and **productPolynomial()** in program polynomial_product_list_skeleton.c and functions **genePolynomial()**, **evalPolynomial()**, and **main()** in polynomial_product_main_skeleton.c. Upload directory to **submit directory** fexam_DXXXXXXX_2. Example of program execution:

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Enter degree of polynomial P (between 0 and 20): 9
Enter degree of polynomial Q (between 0 and 20): 7
Enter value of a (between -1.0 and 1.0): 0.23

>>>> Polynomial P(X) has 4 non-zero coefficient terms.
    -0.080 X^9-7.900 X^6-3.340 X^2-6.390

>>>> Polynomial Q(X) has 4 non-zero coefficient terms.
    -1.220 X^7+2.990 X^4+1.290 X-6.550

>>>> Evaluation of Polynomial P(a): -6.5679E+000
>>>> Evaluation of Polynomial Q(a): -6.2450E+000

>>>> Polynomial product P*Q(X) has 11 non-zero coefficient terms.
    0.098 X^16+9.399 X^13-23.724 X^10+4.599 X^9-2.395 X^7+41.758 X^6-19.106 X^4-4.309 X^3+21.877 X^2-8.243 X+41.854
>>>> Evaluation of Polynomial P*Q(a): 4.1016E+001
>>>> |eval_P*eval_Q-eval_PQ| == 0.000000E+000
>>>> Verified, P(a)*Q(a) equals to P*Q(a).
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