**CPP Problem Design Example**

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| **Subject: Polynomial operation** |
| **Contributor: 鍾賢廣** |
| **Main testing concept: structure/class**   |  |  | | --- | --- | | **Basics** | **Functions** | | ■ C++ BASICS  ■ FLOW OF CONTROL  ■ FUNCTION BASICS  □ PARAMETERS AND OVERLOADING  □ ARRAYS  □ STRUCTURES AND CLASSES  □ CONSTRUCTORS AND OTHER TOOLS  □ OPERATOR OVERLOADING, FRIENDS,AND REFERENCES  □ STRINGS  □ POINTERS AND DYNAMIC ARRAYS | □ SEPARATE COMPILATION AND NAMESPACES  □ STREAMS AND FILE I/O  □ RECURSION  □ INHERITANCE  □ POLYMORPHISM AND VIRTUAL FUNCTIONS  □ TEMPLATES  □ LINKED DATA STRUCTURES  □ EXCEPTION HANDLING  □ STANDARD TEMPLATE LIBRARY  □ PATTERNS AND UML | |
| **Description:**  Using dynamic arrays, implement a polynomial class with polynomial addition, subtraction, and multiplication.  Remarks: A variable in a polynomial does nothing but acts as a placeholder for the coefficients. Hence, the only interesting thing about polynomial is the array of coefficients and the corresponding exponent. Think about the polynomial.  x\*x\*x + x + 1  Where is the term in x\*x? One simple way to implement the polynomial class is to use an array of doubles to store the coefficients. The index of the array is the exponent of the corresponding term. If a term is missing, then it simply has a zero coefficient.  Please:  1.Provide a default constructor, a copy constructor, and a parameterized constructor that enable an arbitrary polynomial to be constructed.  2.Supply an overloaded operator = and a destructor.  3.Provide these operations:  polynomial + polynomial, constant + polynomial, polynomial + constant,  polynomial - polynomial, constant - polynomial, polynomial - constant.  polynomial \* polynomial, constant \* polynomial, polynomial \* constant,  4.Supply functions to assign and extract coefficients, indexed by exponent.  5.Supply a function to evaluate the polynomial at a value of type double.  You should decide whether to implement these functions as members, friends, or standalone functions.  **Input:**  The tester will replace the \*.cpp file that contained the main function.  Please make sure you have done the flowing requirement   1. implement your class in another file. 2. The class type should be Polynomial 3. The class's header file should be named Polynomial.h   **Output:**  please refer to the sample input/output below.  **Sample Input / Output：**   |  |  | | --- | --- | | Sample Input | Sample Output | | Please refer to the attachment example.cpp | Polynomial q  term with degree 0 has coefficient 3  term with degree 1 has coefficient 2  term with degree 2 has coefficient 1  Polynomial c  term with degree 0 has coefficient 1  term with degree 1 has coefficient 2  term with degree 2 has coefficient 0  term with degree 3 has coefficient 3  value of q(2) is 11  value of p(2) is 11  value of r(2) is 29  value of c(2) is 29  value of (q + c)(2) is 40  value of (q - c)(2) is -18  size of q\*c is 6  Polynomial r (= q\*c)  term with degree 0 has coefficient 3  term with degree 1 has coefficient 8  term with degree 2 has coefficient 5  term with degree 3 has coefficient 11  term with degree 4 has coefficient 6  term with degree 5 has coefficient 3  value of (q \* c)(2) is 319 | |
| **□ Easy,Only basic programming syntax and structure are required.**  **□ Medium,Multiple programming grammars and structures are required.**  **■ Hard,Need to use multiple program structures or complex data types.** |
| **Expected solving time:**  50 minutes |
| **Other notes:**  The default constructor creates an empty polynomial. A zero polynomial has degree 0, since it has only the zero degree coefficient.  In the coefficient array, the index is the value of the exponent of term having this coefficient. For example, the index 0 entry is the constant coefficient, the index 1 entry is coefficient of the linear term, the index 2 entry is the coefficient of the quadratic term (term in x2), etc.  The size of the coefficient array include a degree 0 entry, so the size is the degree of the polynomial + 1. |