CISC 320 Multiple choice questions on arithmetic – with solutions

No Date, 2000

Name: ______________________________

The first 40 questions count 2 points each. The remaining three questions count 9, 3, and 8 points for a total of 100 points.
Multiple Choice: write the letter of the best choice in the blank.

____ Consider the classical method of multiplication of many-digit numbers that we learned in school. For multiplication of two n digit numbers (positive integers) it requires how many single digit operations in the worst case?

(a) $\Theta(n)$.
(b) $\Theta(n \lg(n))$.
(c) $\Theta(n^{\lg(3)})$.
(d) $\Theta(n^2)$.

Answer is (d).

1. ____ Consider the divide and conquer "Karatsuba" method of multiplication of many-digit numbers, using three multiplications of n/2 digit numbers. For multiplication of two n digit numbers (positive integers) it requires how many single digit operations in the worst case?

   (a) $\Theta(n)$.
   (b) $\Theta(n \lg(n))$.
   (c) $\Theta(n^{\lg(3)})$.
   (d) $\Theta(n^2)$.

   Answer is (c).

2. ____ Consider the FFT (fast Fourier transform) method of multiplication of polynomials. For multiplication of two polynomials of degree bounded above by n, this method requires how many arithmetic operations on coefficients in the worst case?

   (a) $\Theta(n)$.
   (b) $\Theta(n \lg(n))$.
   (c) $\Theta(n^{\lg(3)})$.
   (d) $\Theta(n^2)$.

   Answer is (b).

3. ____ Consider the addition of polynomials. For addition of two polynomials of degree bounded above by n, this method requires how many arithmetic operations on coefficients in the worst case?

   (a) $\Theta(n)$.
   (b) $\Theta(n \lg(n))$.
   (c) $\Theta(n^{\lg(3)})$.
   (d) $\Theta(n^2)$.

   Answer is (a).

4. ____ Consider the addition of many-digit numbers, For addition of two n digit numbers (positive integers) it requires how many single digit operations in the worst case?

(a) $\Theta(n)$.
(b) $\Theta(n \lg(n))$.
(c) $\Theta(n^{\lg(3)})$.
(d) $\Theta(n^2)$.

Answer is (a).

5. ____ Consider the evaluation of a polynomial function at a specified value a. Evaluation of $f(a)$, for a given polynomial $f(x) = f_{n-1}x^{n-1} + f_{n-2}x^{n-2} + \ldots + f_1 x + f_0$ of degree bounded by n, may be done most efficiently by a method known as

(a) Horner's rule.
(b) Discrete Fourier Transform.
(c) Karatsuba's method.
(d) Fermat's formula.

Answer is (a).

6. ____ Consider the evaluation of a polynomial function at specified values a_i. For n values $a_1, a_2, \ldots, a_n$, evaluation of $f(a_1), f(a_2), \ldots, f(a_n)$, for a given polynomial $f(x) = f_{n-1}x^{n-1} + f_{n-2}x^{n-2} + \ldots + f_1 x + f_0$ of degree bounded by n, may be done in a number of coefficient operations which is

(a) $O(n^2)$.
(b) $O(n \lg(n))$, but only if the a_i's are specially chosen values such as the n-th roots of unity.
(c) Both (a) and (b) are true.
(d) None of the above.

Answer is (c).

7. ____ Consider the evaluation of a polynomial function at a specified value a. Evaluation of f(a), for a given polynomial $f(x) = f_{n-1}x^{n-1} + f_{n-2}x^{n-2} + \ldots + f_1 x + f_0$ of degree bounded by n, may be done in how many arithmetic operations on coefficients in the worst case? (choose sharpest correct answer)

(a) $O(n)$.
(b) $O(n \lg(n))$.
(c) $O(n^{1.59})$.
(d) $O(n^2)$.

Answer is (a).