Xi'an Jiaotong-Liverpool University 西交利物浦大学

PAPER CODE	EXAMINER	DEPARTMENT	TEL
INT102		Intelligent Science	

2nd SEMESTER 2020/21 EXAMINATIONS (FINAL)

BACHELOR DEGREE – Year 2

ALGORITHMIC FOUNDATIONS AND PROBLEM SOLVING

TIME ALLOWED: 2 Hours

INSTRUCTIONS TO CANDIDATES

READ THE FOLLOWING CAREFULLY:

1. The paper consists of Part A and Part B. Answer all questions in both parts. Total marks available are 100. Marks for this examination account for 80% of the total credit for INT102.

2. In Part A, each of the questions comprises 5 statements, for which you should select the one most appropriate answer. Answer all questions in Part A using the Multiple Choice Answer Sheet. Please read the instructions on the Multiple Choice Answer Sheet carefully and use a HB pencil to mark the Multiple Choice Answer Sheet. If you change your mind, be sure to erase the mark you have made. You may then mark the alternative answer.

3. Answers to questions in Part B should be written in the answer booklet provided.

4. This is an OPEN BOOK examination. You can reference textbooks and notes but discuss with other students in any way is not allowed.

5. Answer all questions using the Multiple Choice Answer Sheet at the end of the paper. Please read the instructions on the Multiple Choice Answer Sheet carefully.

6. The time of the exam is strictly limited to 2 hours.

7. For students who take the exam online, at the end of the examination, be absolutely sure to submit your answer via Learning Mall. The time for submission of your answer via Learning Mall is strictly limited to 15 minutes. Once the time is over, the submission link will be closed.

8. All answers must be in English.

PART A

MCAs

PART B

Question 1 (20 marks)

1. Change-making problem: give change for amount n using the minimum number of coins of values $d_1 < d_2 < \cdots < d_m$. Assume that there are unlimited quantities of coins for each of the m values $d_1 < d_2 < \cdots < d_m$ where $d_1 = 1$, making change for n cents using the fewest number of coins.

   a) Describe a greedy algorithm to make change consisting of quarters (25 cents), dimes (10 cents), nickels (5 cents), and pennies (1 cent). 4

   b) Give a set of coin denominations for which the greedy algorithm does not yield an optimal solution. Your set should include a penny so that there is a solution for every value of n. 4

   c) Let $F(n)$ be the minimum number of coins whose values add up to n. For convenience, define $F(0)=0$. Set up a recurrence relation for $F(n)$ (n > 0) that can be used by a dynamic programming algorithm. 6

   d) Write pseudocode of the dynamic programming algorithm for solving this problem and determine its time complexity. 6

END OF THE PAPER

(a). We first use $\lfloor \frac{n}{25} \rfloor$ quarters, then there are $m = n \% 25$ left, then we use $\lfloor \frac{m}{10} \rfloor$ dimes, then there are $k = m \% 10$ left, then we use $\lfloor \frac{k}{5} \rfloor$ nickels, then there are $i = k \% 5$ left, finally we use i pennies.

(b). 5, 4, 3, 1

amount = 7 — 5+1+1 — total 3

4+3 — total 2

(c). $F(n) = \begin{cases} \min_{1 \le i \le m, d_i \le n} (F(n-d_i)+1) & n > 0 \\ 0 & n = 0 \end{cases}$

(d).

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for i ← 0 to n do
    F(n) = n
end
F(d1) = 1   F(d2) = 1  --  F(dm) = 1
for i ← 1 to n do
    for j ← 1 to m do
        if n ≥ dj then
            F(n) = min( F(n-dj)+1, F(n) )
        end
    end
end
return F(n).
```