

# BIL105E - Introduction to Scientific and Engineering Computing

## Final Exam 30.5.2008

- Notes and books are closed.
- Exam duration is 2 hours.
- There are 4 questions, each is 25 points.

**Question 1)** Assume that a data file has records of all employees. Each record (line) contains the followings:

- Employee number
  - Hourly salary rate (YTL / hour)
  - Hours worked in a week
- 
- Draw only a **flowchart** which reads records in the data file, calculates and displays the payment amount for each employee.
  - If an employee worked more than 40 hours in a week, then the hourly salary should be raised by %50 for the exceeding part of the hours.
  - Also, you should calculate and display the overall total payment amount of all employees.

**Question 2)** Write a **program** to generate and display Ackermann sequences. The following is the Ackermann sequence definition which generates a sequence of integer numbers that eventually converges on 1.

$$X_{i+1} = \begin{cases} X_i / 2 & \text{when } X_i \text{ is even} \\ 3X_i + 1 & \text{when } X_i \text{ is odd} \end{cases}$$

- Program should get the upper limit N from user.
- For all numbers from 1 to N, program should generate and display the sequences.
- Program should also display which number generates the longest sequence, as well as the length of that sequence.

Sample run:

```
Enter upper limit: 5

Number = 1 , Ackermann Sequence = 1 4 2 1
Number = 2 , Ackermann Sequence = 2 1
Number = 3 , Ackermann Sequence = 3 10 5 16 8 4 2 1
Number = 4 , Ackermann Sequence = 4 2 1
Number = 5 , Ackermann Sequence = 5 16 8 4 2 1

NUMBER HAVING THE LONGEST SEQUENCE= 3 WITH LENGTH= 8
```

**Question 3)** Suppose A, B, and C are sets.  
For example:  $A = \{1, 4, 5, 6, 2\}$   $B = \{6, 3, 4, 7\}$

Set Operations:

Unification:  $C = A \cup B = \{1, 4, 5, 6, 2, 6, 3, 4, 7\}$

Intersection:  $C = A \cap B = \{4, 6\}$

Difference:  $C = A - B = \{1, 5, 2\}$

- Write the **functions** whose prototypes are given below.

```
void Unification (int A[], int B[], int C[], int NA, int NB, int &NC);
```

```
void Intersection (int A[], int B[], int C[], int NA, int NB, int &NC);
```

```
void Difference (int A[], int B[], int C[], int NA, int NB, int &NC);
```

- NA, NB, NC are the number of elements in arrays A, B, C.

**Question 4)** You are given the following unsorted data.

Student Name	Student Age
Brown	20
Rovelli	18
Wong	22
Cramer	18
Gutier	21

Write the **program** whose outline is given below.

- Declare a **struct** definition and an **array** of the structs, initialize the array with the given data.
- Display the unsorted array.
- Sort the array by student name in ascending alphabetical order.
- Display the sorted array.