Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin
Ollscoil Átha Cliath | The University of Dublin

Faculty of Engineering, Mathematics and Science

School of Computer Science and Statistics

Senior Freshman Integrated Computer Science **Michaelmas Term 2022**
Senior Freshman Computer Science Joint Honours

Systems Programming

13th December 2022 **Online Exam** **09.30– 11.30**

Dr David Gregg

Instructions to Candidates:

- □ Answer 1 out of the 2 questions
- □ All questions are marked out of 100
- □ All program code should be commented, indented and use good programming style
- □ Answers to the questions should be completed by completing corresponding assignments that can be found on the CSU22014 Blackboard page.

Materials permitted for this examination:

2. The original ASCII standard defined only 128 characters. Thus, each character could be specified using only 7 bits. The Pascal programming language provides a “packed” string type, which exploits the requirements of only 7 bits per character to pack strings of characters into a smaller space. For example, a string of ten characters (including the NULL terminating character) could fit into 9 bytes (i.e. 70 bits requires 8 bytes and 6 bits, which rounds up to 9 bytes).

   Write two C functions as follows: The first should take a standard NULL-terminated C string, and return a newly created string which contains the packed representation of the original string. The prototype of the function should be as follows:
   unsigned char * string_to_packed(char * string);

   [50 marks]

   The second function should take a packed string as a parameter, and should return a newly created string which contains the corresponding unpacked representation. The prototype for this function should be as follows:
   char * packed_to_string(const unsigned char * packed_string);

   [50 marks]

   Your routines should be implemented in the related files in the assignment for the exam on Blackboard. Note that a string in C is an array of characters terminated by the ‘\0’ character. The packed string should also be terminated by a 7-bit packed ‘\0’ character.
   Note that it is difficult to determine the length of a packed string without first unpacking it. To simplify unpacking, you may assume that the maximum string length is 1024 characters. This will allow you to unpack the packed string into a temporary array of 1024 characters, and then copy the string into a new array of a suitable size to return from the function.