

## BIL 214 – System Programming

### Homework #6

Assigned on 01.11.2022 – Due on 08.11.2022

- Submit one C source file per question.
- If a source file fails to compile with the gcc compiler, you get zero credits for that question.
- Make sure your submission file names are formatted as:

FirstName\_LastName\_StudentID\_HW#\_Q#.c

**For example:**      **Toygar\_Akgun\_123456789\_HW6\_Q1.c**  
                          **Toygar\_Akgun\_123456789\_HW6\_Q2.c ...**

1. [25 points] The left-shift operator can be used to pack four character values into a four-byte unsigned int variable. Write a program that inputs four characters from the keyboard and passes them to function packCharacters. To pack four characters into an unsigned int variable, assign the first character to the unsigned int variable, shift the unsigned int variable left by 8 bit positions and combine the unsigned variable with the second character using the bitwise inclusive OR operator. Repeat this process for the third and fourth characters. The program should output the characters in their bit format before and after they're packed into the unsigned int to prove that the characters are in fact packed correctly in the unsigned int variable.
2. [25 points] Using the right-shift operator, the bitwise AND operator and a mask, write function unpackCharacters that takes the unsigned int from Question-1 and unpacks it into four characters. To unpack characters from a four-byte unsigned int, combine the unsigned int with the mask 4278190080 (11111111 00000000 00000000 00000000) and right shift the result 8 bits. Assign the resulting value to a char variable. Then combine the unsigned int with the mask 16711680 (00000000 11111111 00000000 00000000). Assign the result to another char variable. Continue this process with the masks 65280 and 255. The program should print the unsigned int in bits before it's unpacked, then print the characters in bits to confirm that they were unpacked correctly.
3. [50 points] Write a C program to calculate the matrix product of two **integer** matrices. Use **pointers** for your implementation. Assume that the input matrices are 512 x 512. Your code should randomly generate (all elements should be integers between -127 and +127) the input matrices and write them to two separate files called A.dat and B.dat (columns separated with space, rows separated with newline), compute matrix product of the inputs and write the result to a file called C.dat. Your code will be checked for numerical correctness.
4. [0 points] Observe how quickly the execution time grows with increasing matrix dimensions. Try 1024 x 1024, 2048 x 2048 and 4096 x 4096. Depending on your implementation and your CPU, you should start hitting hours somewhere in range 2048 – 4096.