CS319 **SAMPLE** test (Feb 2025) ANS with solutions

Instructions:

- This is just a *sample* of the type and range of questions you can expect for the class test on Friday 21 Feb.
- The real test will also have 4 questions and you'll be expected to answer all of them.
- The solution of each question should be in the form of a C++ program. For the test, you'll upload thse "Assignments... Class Test" on Canvas. You can upload a single file, or one file per question (as you prefer). Each of your files should include comments with your name, ID number, and email address.
- The test will be "open book": you can use your lecture notes, and any other resource at `https://www.niallmadden.ie/2425-CS319`
- You may not communicate with anyone during the test, use a search engine, or generative AI.
- Solutions to this sample test will be posted on Wednesday (19 Feb)

Q1 Here is a simple "Hello World" C++ programme.

```
#include <iostream>

int main(void)
{
  std::cout << "Hello, world!" << std::endl;
  return(0);
}
```

You can also download it from `niallmadden.ie/2425-CS319/ClassTest/HelloWorld.cpp`.

Compile and run this program. Modify it so that

(a) a variable of type **`string`** is declared;

(b) The user is prompted to enter their name;

(c) The user's input is read and stored in the **`string`** declared in (a).

(d) A message is displayed using that name. For example, if the user enters "Catherine" as their name, it should output "**`Hello Catherine`**".

The goal of Q1 is to test if you can compile and run a C++ program, define a **`string`** *variable, and do basic input and output. Pay special attention to ensuring that your code compiles without error or warning.*

Answer:

```
// Solution to Q1 from 2424-CS319 Sample Class Test
#include <iostream>

int main(void)
{
  string name; // (a)
  std::cout << "Please enter your name: "; // (b)
  std::cin >> name;  // (c)
  std::cout << "Hello " << name << std::endl; //(d)

  return(0);
}
```

Q2 For this question, it helps to know that

- **`int a[10];`**
  creates an array (list) of 10 integers called $a[0]$, $a[1]$, ..., $a[9]$.
- **`x=rand()%n`**;
  sets **`x`** to be a random int between 0 and $n-1$.

Write a program that works as follows.

(a) the program has a function with header **`int CountOccurences(int list[], int len, int k);`** which returns the number of times that **`k`** occurs in the array **`list[]`**, which is of length **`len`**.

(b) In the **`main()`** function, an integer array of length 10 is defined. Then a **`for`** loop to used to sets the entries of this array to be a random number between 0 and 10 (inclusive). These should also be displayed.

(c) Then, in the **`main()`** function the **`CountOccurences()`** function to report which entries in the list are unique (that is, occur exactly once).

The goal of Q2 is to verify that you are competent writing **`for`***-loops and functions.*

Answer:

```
// Solution to Q2 on sample test
#include <iostream>
#include <cstdlib> //needed for the rand() function

int CountOccurences(int list[], int len, int k);

int main(void)
{
  // Part (b) START
  int a[10];
  for (int i=0; i<10; i++)
  {
    a[i] = rand()%11;
    std::cout << "a["<<i<<"]=" << a[i] << std::endl;
  }

  std::cout << "The following entries are unique:";
  for (int i=0; i<10; i++)
    if (CountOccurences(a, 10, i) == 1)
      std::cout << i << " ";
  std::cout << std::endl;
  return(0);
}

// Function for Part (a)
int CountOccurences(int list[], int n, int k)
{
  int c=0;
  for (int i=0; i<n; i++)
    if (list[i]==k)
      c++;
  return(c);
}
```

Q3 Write a recursive function with header **`int MyNchooseK(int n, int k);`**

that takes a two integer arguments, **n** and **k**, and returns $\binom{n}{k}$, using the following algorithm.

- If $n < k$, or either n or k are negative, then $\binom{n}{k} = 0$.
- Otherwise, if $k = 0$ or $k = n$, then $\binom{n}{k} = 1$.
- Otherwise $\binom{n}{k} = \binom{n-1}{k-1} + \binom{n-1}{k}$

In your **main()** function, verify that **MyNchooseK()** works by

- Prompting the user to enter values of n and k;
- reading in those values, using **std::cin**
- Outputting $\binom{n}{k}$ for these values.

Note: for example, $\binom{6}{-1}$=0, $\binom{6}{1}$=6, and $\binom{6}{3}$=20.

The purpose of Q3 is to verify that you can read input, write functions, and use **if** *statements.*

Answer:

```
// Solution to Q3 on sample test
#include <iostream>

int MyNchooseK(int n, int k);

int main(void)
{
  int n, k, c;

  std::cout << "Enter n and k" <<std::endl;
  std::cin >> n >> k;

  c = MyNchooseK(n,k);

  std::cout << n << " choose " << k << " = "
            << c << std::endl;
  return(0);
}


int MyNchooseK(int n, int k)
{
  if ( (n < k) || (n<0) || (k<0) )
    return(0);
  else if ( (k==0) || (k==n))
    return(1);
  else
    return( MyNchooseK(n-1,k-1) +
            MyNchooseK(n-1,k));
}
```