Second Assignment for MT471S

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Please submit three programs by 16:00 on 2022-10-28 (extended to 2022-11-04) by:

- upload the `.c` files to the MT471S Moodle.

You **only** need to submit the `.c` file for each assignment. Your assignments are:

1. Let A, B, C and D be the first four digits of your student number. Let

$$f(x) = (x + A + C)e^x - (D + B + 1).$$

   Write a program that uses bracketing and bisection to find a root of $f(x) = 0$ to five decimal places. You may *hard code* the digits of student number, so the program does not need to read anything in.

   Hint: You can get e^x by using `exp(x)`. The `exp` functions is declared in `math.h`. Remember to use `-lm`.

2. Alice and Bob play a game. They each start with zero points and begin tossing a coin. If it comes up heads, Alice gets a point. If it comes up tails, Bob gets a point. They keep tossing the coin until one player is l points ahead.

   Write a program that simulates this game. The program should read l, do coin tosses and print out what happens until someone wins. It should print out who won, and how many coin tosses there were.

```
Please enter how much a player must lead by to win: 3
HTHHTTHHH
Alice wins in in 9 coin tosses.
```

   Hint: You can use `rand()` for tossing a coin. Don't forget to seed the random number generator in `main()`.

3. Suppose we have a function on the $\mathbb{Z}^2$ given by the rule

$$C(n,k) = \begin{cases} 0 & \text{if } n < 0 \text{ or } k < 0 \text{ or } k > n, \\ 1 & \text{otherwise if } k = 0, \\ n & \text{otherwise if } k = 1, \\ C(n, k-1) + C(n-1, k) & \text{otherwise.} \end{cases}$$

   Write a C function that calculates the value of $C(n, k)$ using recursion. Use this to write a program that reads in n and k, checks that $k < n$ and prints the value of $C(n, k)$.

   Your final program should contain two functions: `int main(void)`, `int C(int n, int k)`. Check your answer by looking at the Wikipedia page for *Catalan's triangle*. Include a short comment in your program describing what the numbers mean.