DSC 40B - Discussion 02

Problem 1.

a) Let $f(n) = 12log_2(3^{n^2-2n} + 2^{logn} - 10n^2 - log_3n)$. Which of the following asymptotic bounds on f is true?

b) What is the best case time complexity of the following function?

```python
def foo(arr):
''' arr is a sorted array of size n'''
        i = 0
        j = len(arr) - 1

        while i < j:
                current_sum = arr[i] + arr[j]

                if current_sum == 5:
                        return sum(arr)
                elif current_sum < 5:
                        i += 1
                else:
                        j -= 1

        return False
```

Problem 2.

State the growth of the function below using Θ notation in the simplest terms possible, and prove your answer by finding constants that satisfy the definition of Θ notation.

$$f(n) = \frac{n^2 + 2n - 5}{n - 10}$$

Problem 3.

Consider the algorithm below.

```python
def bogosearch(numbers, target):
    """search by randomly guessing. `numbers` is an array of n numbers"""
    n = len(numbers)

    while True:
        # randomly choose a number between 0 and n-1 in constant time
        guess = np.random.randint(n)
        if numbers[guess] == target:
            return guess
```

We will set up the analysis of the expected time complexity of this algorithm.

a) What are the cases? How many are there?

b) What is the probability of case α?

c) What is the running time in case α?

Problem 4.

Provide a tight theoretical lower bound for the problems given below. Provide justification for your answer.

a) Given an array of n numbers, find the sum of the numbers in the array.

b) Given a sorted array of $n \geq 2$ numbers, find the second largest number in the array.