

### Assignment 5

Due: Thursday, July 20, 2017, upload before 11:30pm

1) (20 pts.): How many times is function  $F$  called in each code segment given below? Clearly explain your answer and express the bounds in terms of  $n$  in big-O notation. Assume  $n = 2^k$ .

#### Code Segment 1

```
for  $i = 1$  to  $n^2$  do
    for  $j = 1$  to  $n$  by  $k$  do
        for  $l = 1$  to  $j$  do
             $F(i, j)$ 
```

#### Code Segment 2

```
while  $n > 10$  do
     $i = 1$ 
    while  $i < n$  do
         $F(i, k)$ 
         $i = i * k$ 
     $n = n/2$ 
```

2) (20 pts.): Find a phrase-structure grammar and construct the corresponding DFA for each of these languages.

1. the set of bitstrings consisting of an odd number of 0s followed by a final 1.
2. the set of bitstrings that have neither two consecutive 0s nor two consecutive 1s.

3) (Answer the following questions and explain your answer ):

1. (5 pts) The name of a variable in the C programming language is a string that can contain uppercase letters, lowercase letters, digits, or underscores. Further, the first character in the string must be a letter, either uppercase or lowercase, or an underscore. If the name of a variable is determined by its first eight characters, how many different variables can be named in C? (Note that the name of a variable may contain fewer than eight characters.)
2. (5 pts) How many positive integers less than  $n = pq$ , where  $p$  and  $q$  are prime, are relatively prime to  $n$ ?
3. (5 pts) Assume that no one has more than 200,000 hairs on their head. In 2013, the population of Indianapolis was 852,866. Show that at least 5 people in Indianapolis in 2013 must have had the exact same number of hairs on their heads.
4. (5 pts) How many permutations of the letters  $ABCDEFGH$  contain
  - (a) the string  $ED$ ?
  - (b) the string  $CDE$ ?
  - (c) the strings  $BA$  and  $FGH$ ?
  - (d) the strings  $AB$ ,  $DE$ , and  $GH$ ?
  - (e) the strings  $CAB$  and  $BED$ ?

5. (5 pts) What is the coefficient of  $x^4y^8$  in  $(x + y)^{12}$ .
6. (5 pts) How many strings with 6 letters are there?
7. (5 pts) There are six different candidates for governor of a state, but only three spots on the ballot. In how many ways can the names of three candidates be printed on a ballot?
8. (5 pts) How many solutions does  $x_1 + x_2 + x_3 + x_4 + x_5 = 19$  have when  $x_i \geq 1$ ?
9. (5 pts) How many different bit strings contain exactly six 0s and fifteen 1s if every 0 must be immediately followed by two 1s?
10. (5 pts) How many different strings can be made from the letters in *ENGINEERING*?
11. (5 pts) How many different ways are there to deal 13-card hands to 4 players from a 52-card deck?
12. (5 pts) How many ways are there to place 5 balls (Red, Orange, Yellow, Green, Blue) into 3 indistinguishable urns.

**Note:** As you will have read on the course website, you need to submit your answers typed and as one PDF file named LastName.FirstName.5.PDF before the due date stated above. Follow the the template given at <https://www.cs.purdue.edu/homes/amahmoo/cs182summer2017/homeworksolutiontemplate.pdf>.