Programming Languages and Compilers

Midterm Exam

Name:_____

Question 1

Give a regular expression for each of the following languages over $\Sigma = \{a, b, c\}$.

1. Strings that begin with a and end with c.
2. Strings that are lexicographically sorted. For example, a, ab and $abbc$ are valid.
3. Strings that do not end with the substring abc.

Question 2

Give a DFA for each of the languages in Question 1.

Question 3

Based on the DFA for "strings that do not end with the substring *abc*", write a function in a programming language of your choice, which takes a string and checks if the string is valid.

Question 4

Give a context-free grammar for each of the following languages over $\Sigma = \{a, b, c\}$.

1. $\{a^n b^{2n} : n \geq 0\}$.

2. $\{a^i b^j c^k : i + j = k\}$.

3. Strings in which the number of a's is double the number of b's.

Question 5

Consider the following CFG:

```
E  -> E or T | T
T  -> T and NF | NF
NF -> not NF | F
F  -> ( E ) | t | f
```

where the terminal `t` denotes true, and `f` denotes false.

1. Construct a parse tree for the sentence: `(not not t or f) and t`.
2. Explain the precedence of the operators: `or`, `and`, `not`.
3. Explain the associativity (left-associative or right-associative) of the operators: `or`, `and`, `not`.
4. (extra 10 points) Write a recursive-descent parser for the grammar in pseudo-code.