Homework 1

Programming Language Concepts

Due September 29th, 2020

Name: _____

1. (points) Describe, in English, the language defined by the following grammar:

```
<S> =: <A> <B> <C>
<A> =: a <A> | a
<B> =: b <B> | b
<C> =: c <C> | c
```

2. (points) Consider the following grammar:

```
<S> =: <A> a <B> b
<A> =: <A> b | b
<B> =: a <B> | a
```

   Which of the following sentences are in the language generated by this grammar?

   a. baab

   b. bbbab

   c. bbaaaaa

   d. bbaab

3. (points) Explain the four criteria for proving the correctness of a logical pretest loop construct of the form "while B do S end". And prove the correctness of the following:

```
power = 1;
i = 1;
while( i <= n ){
   power = power * x;
   i = i + 1;
}
{ power = x ^ n }
```

4. (points) Give an operational semantic definition of the following:

   a. Java do-while

   b. C++ if-then-else

5. (points) Write a denotational semantics mapping function for the following statements:

   a. Java for

   b. Java do-while

   c. C switch

6. (points) Design a state diagram to recognize one floating point literals in C.

```
3.14159       /* Legal */
314159E-5L    /* Legal */
510E          /* Illegal: incomplete exponent */
210f          /* Illegal: no decimal or exponent */
.e55          /* Illegal: missing integer or fraction */
```

7. (points) Design a state diagram to recognize one floating point literals in Go-Lang.

```
0.
72.40
072.40       // == 72.40
2.71828
1.e+0
6.67428e-11
1E6
.25
.12345E+5
1_5.         // == 15.0
0.15e+0_2    // == 15.0

0x1p-2       // == 0.25
0x2.p10      // == 2048.0
0x1.Fp+0     // == 1.9375
0X.8p-0      // == 0.5
0X_1FFFP-16  // == 0.1249847412109375
0x15e-2      // == 0x15e - 2 (integer subtraction)

0x.p1        // invalid: mantissa has no digits
1p-2         // invalid: p exponent requires hexadecimal mantissa
0x1.5e-2     // invalid: hexadecimal mantissa requires p exponent
1_.5         // invalid: _ must separate successive digits
1._5         // invalid: _ must separate successive digits
1.5_e1       // invalid: _ must separate successive digits
1.5e_1       // invalid: _ must separate successive digits
1.5e1_       // invalid: _ must separate successive digits
```

8. (points)) How many lexemes does the following Java code contain?

```
public class CountDigits {
    public static void main(String[] args) {
        SimpleIO.prompt("Enter an integer: ");
        String userInput = SimpleIO.readLine();
        int number = Integer.parseInt(userInput);
        int numDigits = 0;
        while (number > 0) {
            number /= 10;
            numDigits++;
        }
        System.out.println("The number " + userInput + " has " +
        numDigits + " digits");
    }
}
```


_____ 0 points

9. (points) The following class contains several errors that violate the rules of Java. Describe each error and specify whether it is (a) lexical, (b) syntactic, or (c)semantic. Identify the line on which each error occurs. The class may also contain programming errors that do not violate the rules of Java and will not be detected by a Java compiler. You should ignore these errors.

```
class Thermometer {
    private int temperature

    public Thermometer(int degrees) {
        temperature = degrees;
    }

    public Thermometer() {
        temperature = 0.0;
    }

    public void makeWarmer(int degrees) {
        temperature =+ degrees;
    }

    public void makeCooler(int degrees) {
        temperature -= degrees;
    }

    public getTemperature() {
        return temperature;
    }

    public string tostring() {
        return temperature +  degrees;
    }
}
```

10. (points) Write code in a language of your choice that checks a source file (input file in plain text format) that separates lexemes by white space and special characters. This lexical analyzer will only have tokens for special characters and alphanumeric strings.

```
Ie: 2345 6tgbsauhd9sa67*I{OPKDSl;jaklhl
Would be
2345
6tgbsauhd9sa67
*
I
{
OPKDSl
;
jaklhl
```


_____ 0 points