CS536 Homework 4

Due by 11:00 pm on Feb 22

Homework assignments must be done individually. Collaboration on homework assignments is *not* allowed.

Question 1 - Syntax Directed Translation

For this question you will define a syntax-directed translation for the CFG given below, which defines a very simple programming language.

```
program → MAIN LPAREN RPAREN LCURLY list RCURLY

list → list oneItem
     | epsilon

oneItem → decl
        | stmt

decl → BOOL ID SEMICOLON
     | INT ID SEMICOLON

stmt → ID ASSIGN exp SEMICOLON
     | IF LPAREN exp RPAREN stmt
     | WHILE LPAREN exp RPAREN stmt
     | LCURLY list RCURLY

exp → exp TIMES exp
    | exp DIVIDE exp
    | exp PLUS exp
    | exp LESS exp
    | exp EQUALS exp
    | LPAREN exp RPAREN
    | ID
    | BOOLLITERAL
    | INTLITERAL
```

Write a syntax-directed translation for the CFG given above to extract all the **int literals**. The translations should be sets that contain the intliterals. For example, the statement `int i = 0` will have the translation `{0}`

Your translation rules should use the following notation:

- `{ }` is an empty set
- `{ INTLITERAL.value }` is a set containing the value of the `INTLITERAL` token
- `S1` ∩ `S2` is the intersection of sets `S1` and `S2`
- `S1` ∪ `S2` is the union of sets `S1` and `S2`
- `S1 - S2` is the set of all items that are in `S1` but not in `S2`

Use the notation that was used in class and in the on-line readings; i.e., use `nonterminal.trans` to mean the translation of a nonterminal, and `terminal.value` to mean the value of a terminal. Assume that `ID.value` is a `String` (the name of the identifier). Use subscripts for translation rules that include the same nonterminal or the same terminal more than once. If no translation is necessary for a CFG production, either use `{ }` or say no translation is necessary.

Question 2 - CYK Algorithm

Consider the following grammar

```
S → DA | EB
A → BF | ED
B → EH | DE
F → DD
H → AA
D → a
E → b
```

Use the CYK algorithm to determine if the string `aabaa` can be generated by this grammar. You must use this PDF to answer this question.