CompSci 334 **Project 1** **Spring 2026**

Project Due: Thursday, Feb. 12, 11:59pm
30 points

The company METASOFT has hired you to write an interpretor for a simple programming language called ROBOTGO for programming their robots. This language allows the programmer to specify the location of obstacles and the starting position and movements of robots. For valid ROBOTGO programs, you will visualize the motion of the robot in order to determine if it is going to crash into any obstacles.

The ROBOTGO programming language has a program definition (shown first) and six types of statements:

Statement	Meaning
begin i j *stmts* halt	program definition - defines height i and width j of the room.
obstacle a b ;	draw an obstacle at position (a, b)
robot v a b ;	draw a robot with name v at position (a, b)
add a to v ;	add statement
move v d a ;	move the robot v, a spaces in direction d
$v = a$;	an assignment statement
do *stmts* until $a > b$;	Execute *stmts*, if $a \leq b$ then repeat

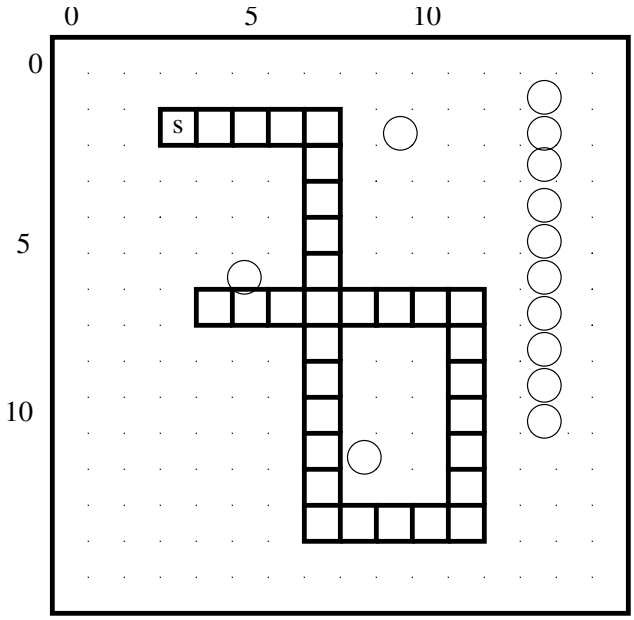
where v is a variable, a and b are either variables or integers, i and j are integers, d is a direction (north, south, east or west) and *stmts* represents 1 or more valid statements.

Here is a sample ROBOTGO program that draws a few obstacles and then moves the robot through the room. We will assume that all rooms are a grid of points (x,y) with width w and height h with x from 0 to width and y positions from 0 to height. The upper left point is point (0,0). **A comment starts with $*-$ and continues to the end of a line, so the end of line marker is the end of a comment.**

```
begin 80 100                    *- room has height 80 and width 100 -*
    obstacle 8 11 ;             *- an obstacle at (8,11) -*
    obstacle 9 2 ;              *- an obstacle at (9,2) -*
    obstacle 5 6 ;              *- an obstacle at (5,6) -*
    robot rob 3 2 ;             *- robot rob starts at (3,2) -*
    wall = 13 ;                 *- a wall of obstacles -*
    j = 1 ;
    do
        obstacle wall j ;
        add 1 to j ;
    until j > 10 ;
    run = 4 ;                   *- move robot -*
```

```
        move rob east run ;
        move rob south 11 ;
        move rob east run ;
        move rob north 6 ;
        move rob west 7 ;
halt
```

A picture showing the robot rob and obstacles from this program would look like:



In the picture, single obstacles (denoted as circles) are drawn in positions (8,11), (9,2), (5,6), and a wall of obstacles from (13,1) to (13,10). The robot rob starts in position (3,2) (denoted by the s in the square) and the robots movements are indicated by the squares. In this example, the robot safely avoided all the obstacles.

The interpretor for ROBOTGO will be built in three parts, the first part is this project. For this part, you will write a scanner that will identify the elementary parts (tokens) of a ROBOTGO program and store these parts for later use. In project 2, you will write a parser that will identify syntactically correct ROBOTGO programs. Project 3 will further extend the parser into an interpretor that will execute a ROBOTGO program and generate an animation of obstacles and a moving robot.

DESCRIPTION OF THE SCANNER

Given a sample ROBOTGO program, your first task is to write a scanner to identify all its *parts* (or *tokens*).

The purpose of the scanner is to find the next token in your program, enter its value into a data structure (called a symbol table) that handles searches and insertions, and return 1) a reference to the tokens location in the symbol table, and 2) a unique symbol, called the *token type*, which indicates the type of the token. Not every token is entered into the symbol table, but for those that are, make sure that there is only one copy of each. Thus, upon encountering a token, search

the symbol table first to see if it is already there. If so, return a reference to its location. If it is not in the symbol table, insert it, and then return the reference to its location.

Your program will repeatedly compute the next token type and the reference to its location in the symbol table. For this project, you will print the token type and its values in the symbol table, and then request the next token (thus losing the information about the previous token). Although we are throwing away this information now, we will use it in projects 2 and 3.

Be sure to keep track of the program line number for reporting where errors occur.

TOKENS

The tokens of a ROBOTGO program consist of keywords, variable names, integer constants, and punctuation symbols. Tokens are separated by blanks, end-of-line, and end-of-file.

Not all tokens are entered into the symbol table. If they are to be entered, then a character value and an integer value are inserted for each token.

The tokens of the ROBOTGO programming language and their associated types are:

Keywords: Keywords are **not** entered into the symbol table. They have no value. For each keyword found, return its type and NULL for its value. Keywords are only formed using lowercase letters. The uppercase and lowercase of the same letter should be treated as the same, so beGIN is the same as begin.

KEYWORD	TYPE
begin	b
halt	h
obstacle	o
add	a
to	t
move	m
north	n
south	s
east	e
west	w
robot	r
do	d
until	u

Variables: Variables are entered into the symbol table. Valid variable names may contain 1-8 lowercase letters. The uppercase and lowercase of the same letter should be treated as the same, so SUm is the same variable as sum. The type of a variable is *v*. The character value associated with a variable is the name of the variable. with all uppercase letters converted to lowercase. Its integer value is set to 0 for now (it is not needed until project 3). (Exceptions: Keywords are not variables. So, *east* is a keyword, not a variable!)

Integers: Integers are entered into the symbol table. Valid integers may contain 1-8 digits (0-9). If it starts with 0 then it must be of length 1. The type of an integer is *i*. Integers are read in as character strings. Store the character value and convert the character string to an integer, and also store the integer value (it will not be used until project 3).

Punctuation Symbols: These are not entered into the symbol table. They do not have values. For each symbol found, return its type and NULL for its value.

SYMBOL	TYPE
=	=
;	;
>	>

Comments are not tokens! In addition to tokens, your program may contain comments. A comment begins with $*-$ and extends to the end of the line. All comments are to be ignored. When a comment is encountered, ignore everything to the end of the line. Since comments are not tokens, there is no type associated with a comment.

INPUT

A data file consists of one ROBOTGO program. A ROBOTGO program should end with the **.rbt** extension. For example, a file might be named **p1.rbt**. Sample data files will be available soon. These are not necessarily the data files that your program will be tested on. To ensure your program runs correctly, you should also create your own data files for testing. A sample data file is:

```
*- program 1
begin 60 80
      obstacle 7 11 ;
      robot biff 6 8 ;
      skip = 6 ;
      move biff east skip ;
halt
```

OUTPUT

For each ROBOTGO program print out the following information for each token in three columns: the type of token, the character value, and the integer value. If the token is not entered into the symbol table, then the character and integer values are left blank.

Possible output for the sample data file above might be:

OUTPUT FOR PROGRAM

TYPE	CH VALUE	INT VALUE
b		
i	60	60
i	80	80
o		
i	7	7
i	11	11
;		
r		
v	biff	0
i	6	6
i	8	8
;		
v	skip	0
=		
i	6	6
;		
m		
v	biff	0
e		
v	skip	0
;		
h		

ERROR HANDLING

Your program should handle files that contain invalid tokens. When an invalid token is found, report it as an error and the line number it occurs on and continue processing.

For example, consider the following ROBOTGO program.

```
one  twentyfive  15 ;
begin  ;  test  end;  ok
paint  *  rob  B  twentysix  ;
move  #B  east  -*  x
```

This program is loaded with syntactic errors, however, for project 1 identify only invalid tokens. The syntactic errors will be caught in project 2.

The invalid tokens above are:

- In line 1: twentyfive (too long)
- In line 2: end; (there is no separator between "end" and ";", so they are treated as one token, which is invalid.)
- In line 3: $*$ is an invalid token and twentysix is too long
- In line 4: #B and $-*$ are invalid tokens.

When an invalid token is encountered in the scanner, print an error message, the token and the line number, then continue scanning for the next token.

THE PROGRAM AND ITS SUBMISSION

- Your program can be written in Java or Python.
- If written in Java, the name of the file with main should be called `Project1.java`. If written in Python, the name of the file with main should be called `Project1.py`.
- Your program should prompt the user for the name of the ROBOTGO program to test. If that file is in the same folder as your code, then your program should run on that file.
- Submit your program as a .zip file under **Project1Files** in Canvas under assignments.
- You must also submit a video that is 15 minutes or less where you explain and show us the modules/methods you wrote and what each one does, and run your program on at least three examples. The video can be submitted one day late with no penalty. Submit the video in Canvas under **Project1Video** OR submit a link to the video (if you submit a link, make sure we have access to view the video).

  You can make the video however you want. One way is to use zoom.
- In addition to submitting your program, you must fill out the REFLECT form on the assignment page.

GRADING

Your program will be graded on style as well as content. Style will count for 15-20% of your grade. Appropriate style for this course includes:

- *Modularity* - Your program should be divided into multiple methods and/or classes. Comments should describe each part of the methods/class(es).
- *Liberal use of comments* - In addition to the comment for each module, each nontrivial section of code should have a comment describing its purpose. Comments should not merely echo the code.
- *Readability* - Your program should use the indentation and spacing appropriately to make it easily readable. Your comments should be clearly distinguishable from the code.
- *Appropriate variable names* - Give variables names that describe their function.

- *Understandable output* - Your program should indicate its input as well as its output in a clear and readable manner. Remember, the output from your program is the only indication that it works!

The remaining part of your grade is based on meeting the specifications of the assignment. If you do not get your program correctly running, for small amount of partial credit you may generate output that identifies which parts of your program are correctly working. This output must also be clearly understandable or no credit will be given!

Late Policy

Programs not submitted by the due date are penalized 10% up to three days late and 20% if four or more days late (Sunday does not count as a late day). You must meet with Prof. Rodger if your program is not turned in one week after the deadline.

EXTRA CREDIT (2 pts)

For extra credit, if a word is not a valid token, assume that it contains tokens that are not separated by whitespace, try to identify the tokens, print a warning message, and then return the tokens one at a time as valid tokens.

For any part that cannot be identified, report an error, discard the invalid token, and check the next token.

Examples:

The word `one15;` is actually three tokens: one, 15, and ;. Return "one" as a token, then return "15", and then return ";". You should either print one warning message for all three tokens, or three separate warning messages.

The word `add6tosum` is three valid tokens: add, 6, and tosum.

The word `twentyfive` should be reported as an error, variable name too long.

The word `begin`$*$ should be reported as the keyword begin and an invalid token $*$.

The words `starmove` and `movestar` are valid variable names. Even though movestar contains the keyword move, this is a valid variable name, so don't assume that an error has been made.

The words `starburstmove` and `starmoveburst` should be reported as errors, variable name too long. These contain the keyword move, but you are not required to detect keywords concatenated with variables.