

# CSE P505, Winter 2009, Logo Description (for Assignment 2)

Last updated: January 18

The BNF definition of Logo syntax is:

$$\begin{aligned} e &::= \text{home} \mid \text{forward } f \mid \text{turn } f \mid \text{for } i \text{ } lst \\ lst &::= [] \mid e::lst \end{aligned}$$

where  $f$  is a floating-point number and  $i$  is an integer. Note a for-loop executes a fixed number of times and its body is a list of “moves”. A Logo program is a  $lst$ , i.e., a list of moves.

Informally, the semantics of a move list is:

- A program state includes a “current x-coordinate” (call it  $x$ ) a “current y-coordinate” (call it  $y$ ) and a “current direction” (call it  $d$ ). All are floating-point numbers.  $d$  is in radians. So direction 0.0 is “facing East” and  $\pi/2$  is “facing North”.
- The initial program state is 0.0 for each of  $x$ ,  $y$ , and  $d$ .
- A move  $e$  takes a state and a list of “places visited so far” and produces a state and a list of “places visited so far”. A place is an  $x$  and a  $y$  (no direction).
  - home changes the state back to the initial state.
  - forward  $r$  changes the state by “moving in the current direction the distance  $r$ ”. So  $x$  and  $y$  may change, but  $d$  will not.
  - turn  $r$  changes the state by “adding  $r$  radians to the current direction”. (So  $x$  and  $y$  will not change and we do *not* “visit a new place”.)
  - for  $i$   $lst$  executes its move-list  $i$  times.
- A move-list executes each move in order. (The empty list does nothing.)

Notes:

- The trace of places visited could have repeats.
- It is best (but not strictly necessary) to “normalize” the current direction to always be between 0 and  $2\pi$ ; this requires a simple call to `mod_float` in the right place.
- You will notice floating-point rounding errors. Do not worry about them.
- Relevant high-school geometry:
  - A regular polygon with  $n$  sides has angles of  $2\pi/n$  radians.
  - Starting from  $(x, y)$ , the point distance  $r$  away in direction  $d$  is  $(x + r \cos d, y + r \sin d)$ .
  - After turning  $d_1$  radians from direction  $d_2$ , the new direction is  $d_1 + d_2$ .