IS12 - Introduction to Programming

Lecture 2: Simple Programs

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More on Logistics (I)

- Final grade

$$\frac{\text{(attendance + hw\_points + quiz\_points + extra\_credit\_points + exam\_points)}}{\text{(max\_attendance +max\_ hw \_points + max\_quiz\_points+ max\_exam\_points}}$$

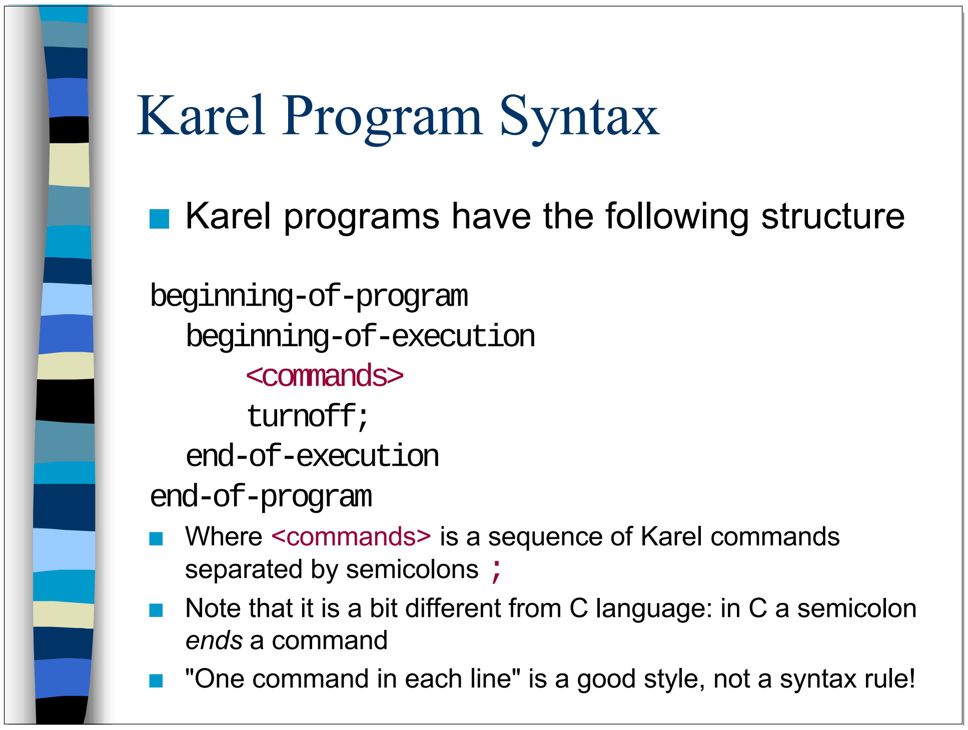
  - Using this formula you can always check where you are standing. 50% corresponds to F, 50-62.5 is D range, 62.5-75 is C range, 75-87.5 is B range, and 87.5-100 is A range.
- Homeworks and Late submissions
  - To get full credit submit homework before or on the due date!
  - 20% of the grade is lost each late day
- Quizzes
  - One lowest score will be dropped

More on Logistics (II)

- Extra credit
  - Be active in forums, answer questions, report errors and problems
  - Take part in extra credit studies
- Catch up early:
  - Get books, ask questions, seek help
  - Run examples, experiment, write your code
- Integrity

Outline

- Karel program syntax
- Programming errors
- Edit-Compile-Run-Test loop
- Karel built-in commands
- Defining new commands for Karel
- Naming Karel commands

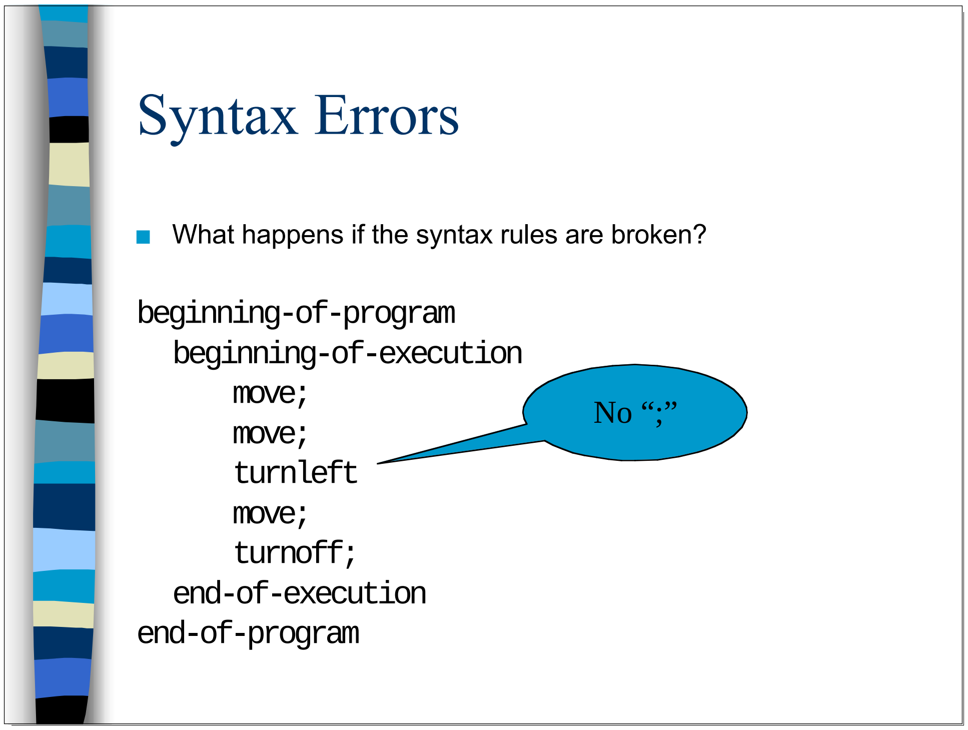


Karel Program Syntax

- Karel programs have the following structure

```
beginning-of-program
  beginning-of-execution
      <commands>
      turnoff;
  end-of-execution
end-of-program
```

- Where <commands> is a sequence of Karel commands separated by semicolons ;
- Note that it is a bit different from C language: in C a semicolon *ends* a command
- "One command in each line" is a good style, not a syntax rule!

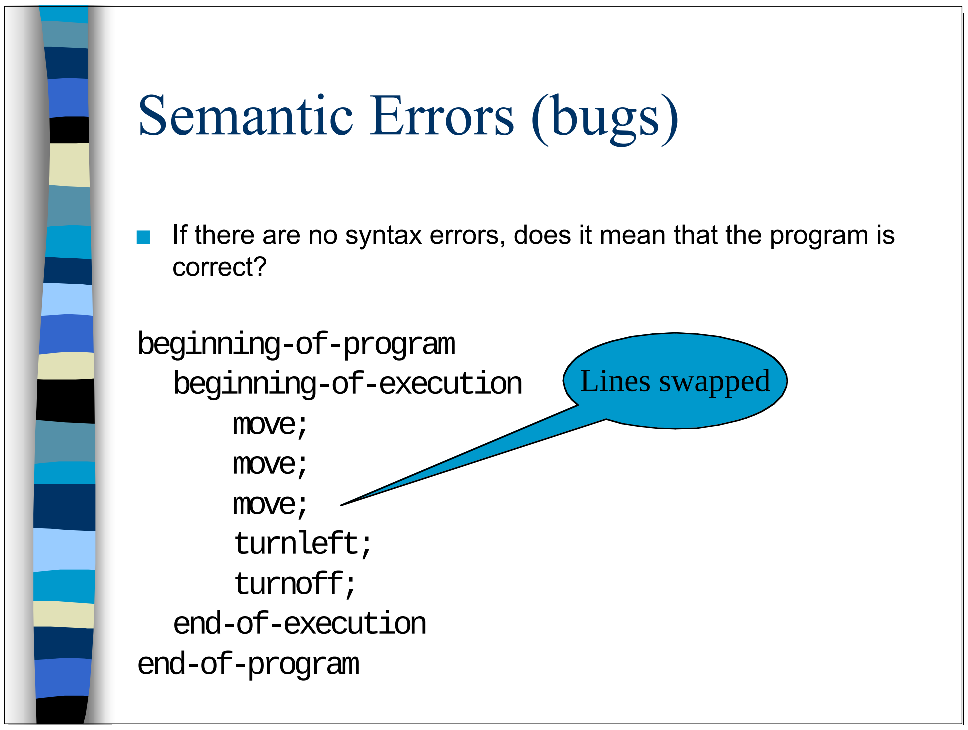


Syntax Errors

- What happens if the syntax rules are broken?

```
beginning-of-program
  beginning-of-execution
      move;
      move;
      turnleft
      move;
      turnoff;
  end-of-execution
end-of-program
```

No “;”

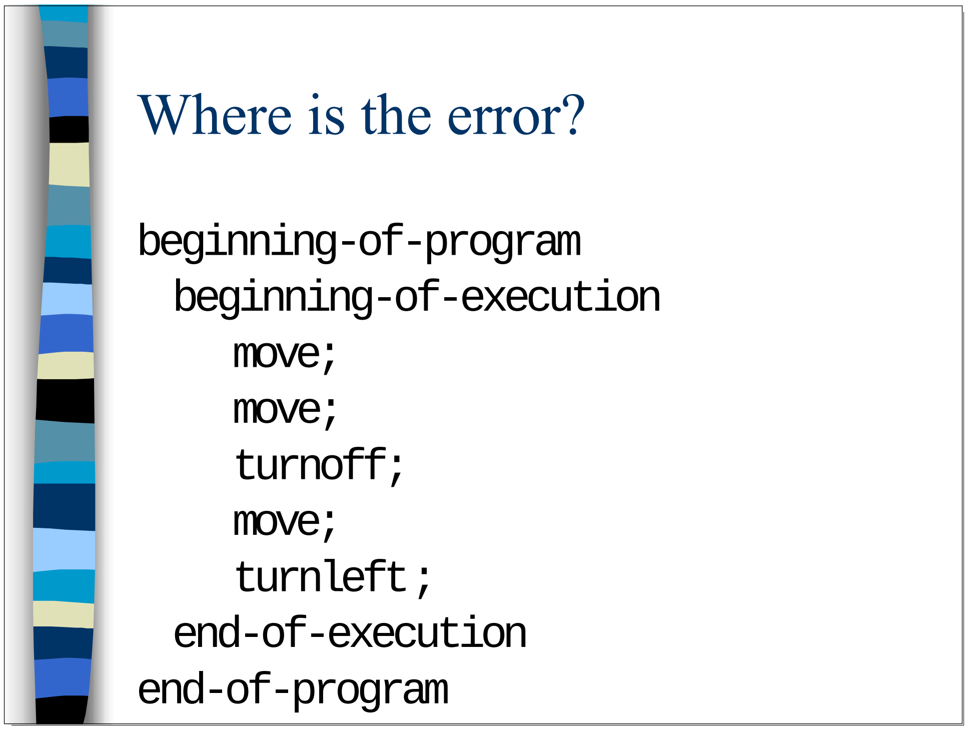


Semantic Errors (bugs)

- If there are no syntax errors, does it mean that the program is correct?

```
beginning-of-program
  beginning-of-execution
      move;
      move;
      move;
      turnleft;
      turnoff;
  end-of-execution
end-of-program
```

Lines swapped



Where is the error?

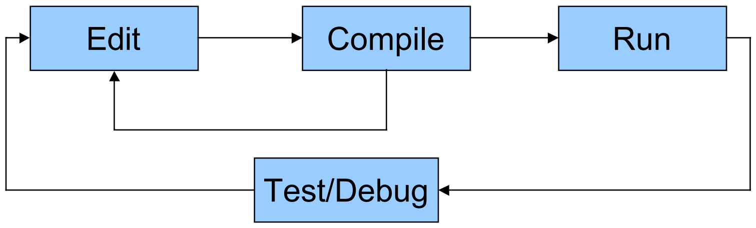
```
beginning-of-program
  beginning-of-execution
      move;
      move;
      turnoff;
      move;
      turnleft;
  end-of-execution
end-of-program
```

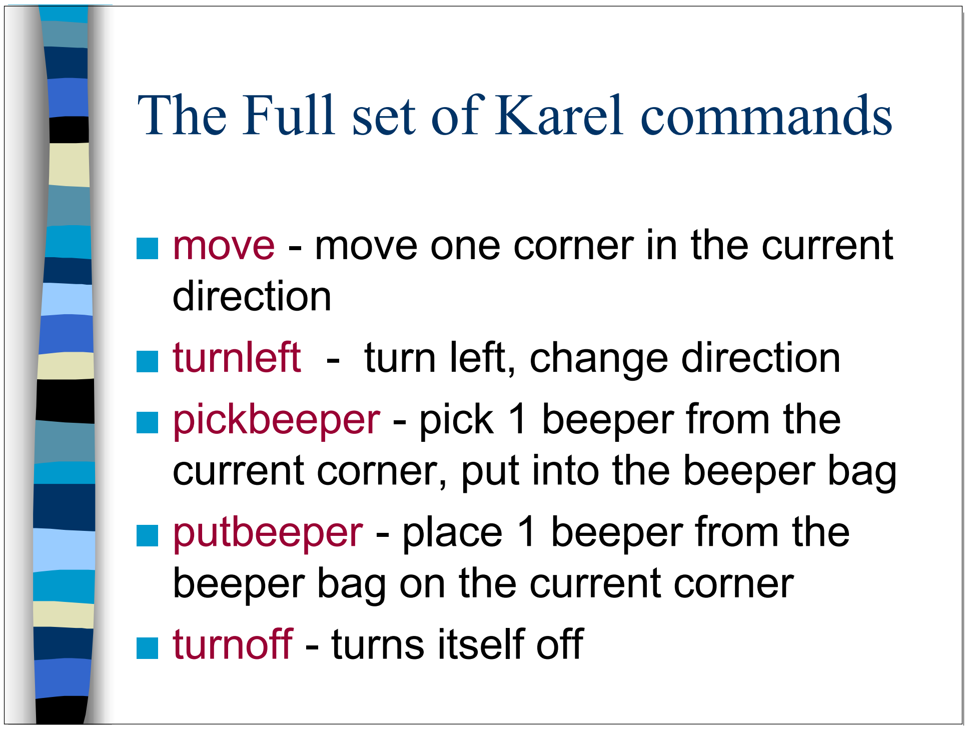
The edit-compile-run loop

1. Edit program
2. Compile program
3. If there are errors, fix and go back to 1
   - you have got syntax error
   - fix and go back to 1
4. Run it
5. If it produce wrong results
   - you have got semantic error
   - find the source of the error (debug)
   - fix and go back to 1

The iterative nature of programming

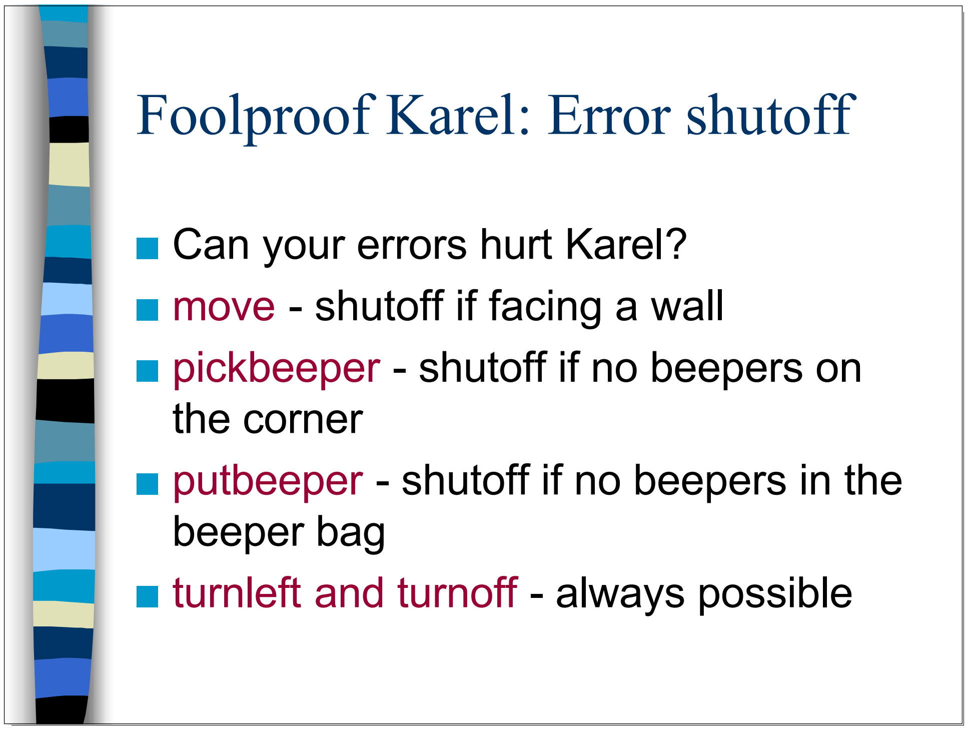
The "programming in small" loop





The Full set of Karel commands

- move - move one corner in the current direction
- turnleft - turn left, change direction
- pickbeeper - pick 1 beeper from the current corner, put into the beeper bag
- putbeeper - place 1 beeper from the beeper bag on the current corner
- turnoff - turns itself off



Foolproof Karel: Error shutoff

- Can your errors hurt Karel?
- move - shutoff if facing a wall
- pickbeeper - shutoff if no beepers on the corner
- putbeeper - shutoff if no beepers in the beeper bag
- turnleft and turnoff - always possible

Problem: Move beeper

- Move a beeper from 1:4 to 3:5

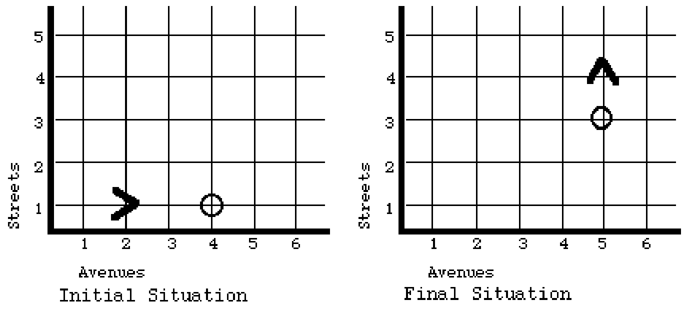
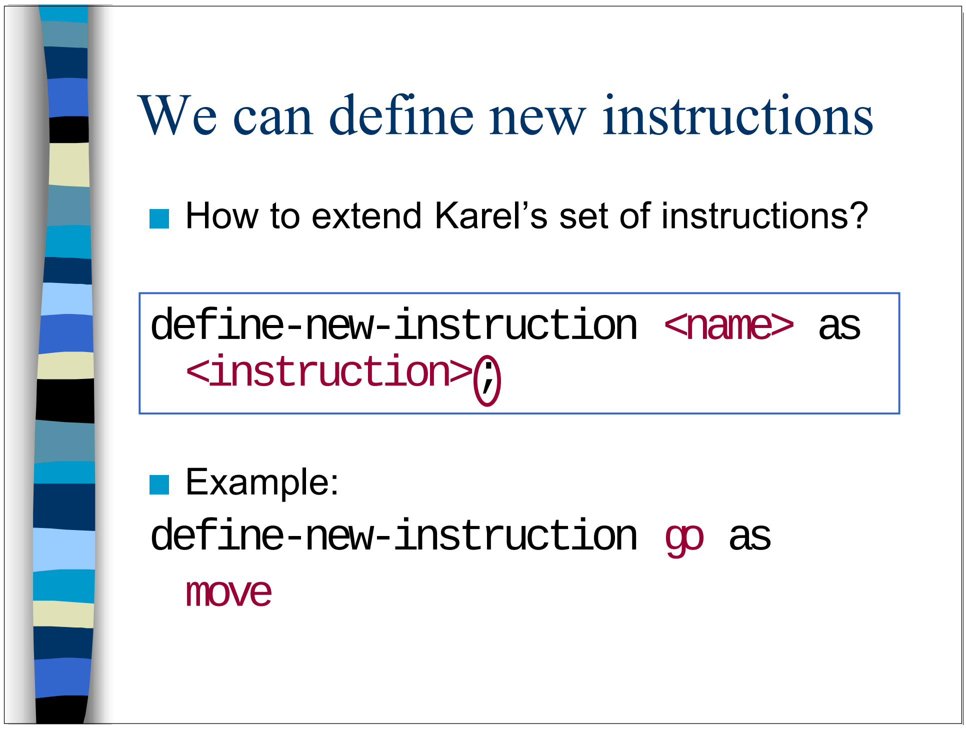


Figure 2-3 The Initial and Final Situations of Karel's task

Example: Move beeper

```
beginning-of-program
   beginning-of-execution
        move;
        move;
        pickbeeper;
        move;
        turnleft;
        move;
        move;
        putbeeper;
        move;
        turnoff;
   end-of-execution
end-of-program
```



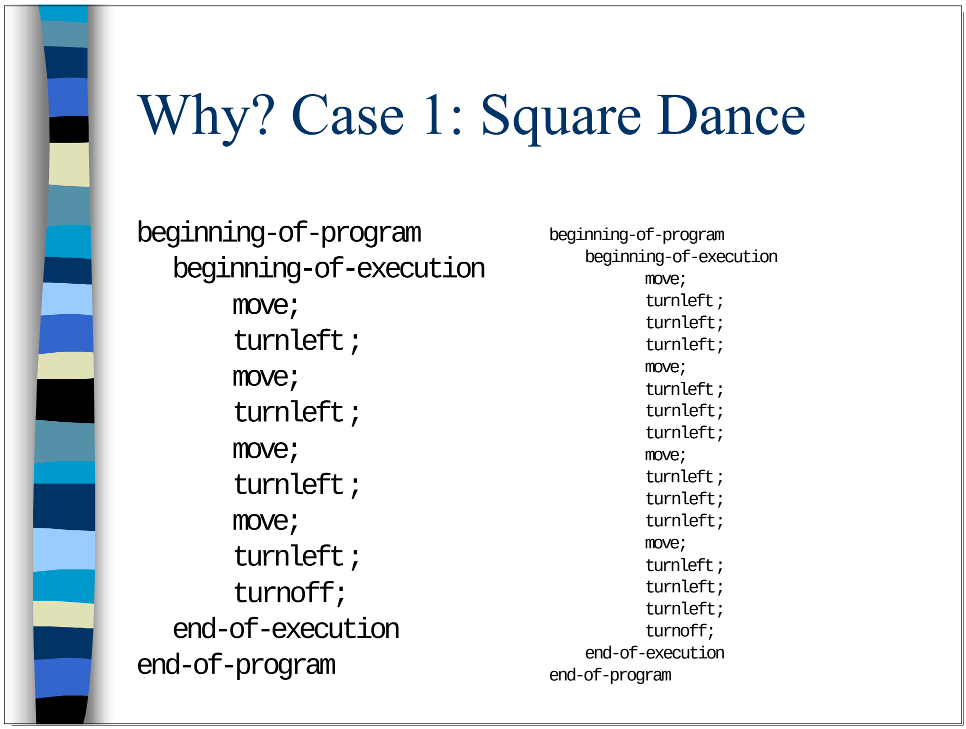
We can define new instructions

- How to extend Karel’s set of instructions?

```
define-new-instruction <name> as
  <instruction>;
```

- Example:

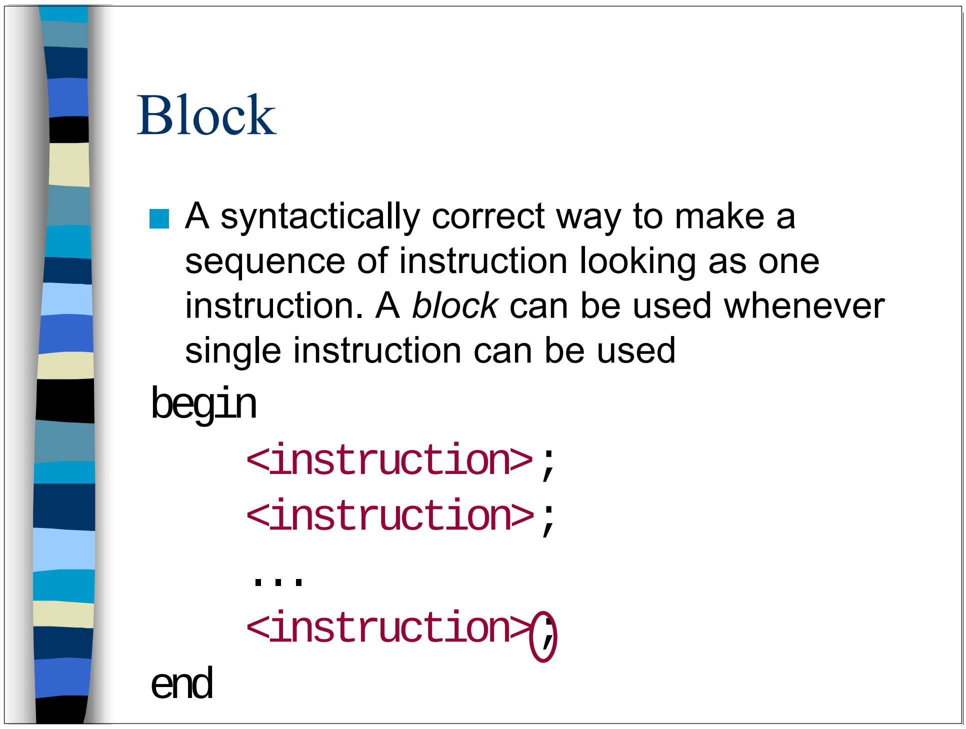
```
define-new-instruction go as
  move
```



Why? Case 1: Square Dance

```
beginning-of-program
  beginning-of-execution
     move;
     turnleft;
     move;
     turnleft;
     move;
     turnleft;
     move;
     turnleft;
     turnoff;
  end-of-execution
end-of-program
```

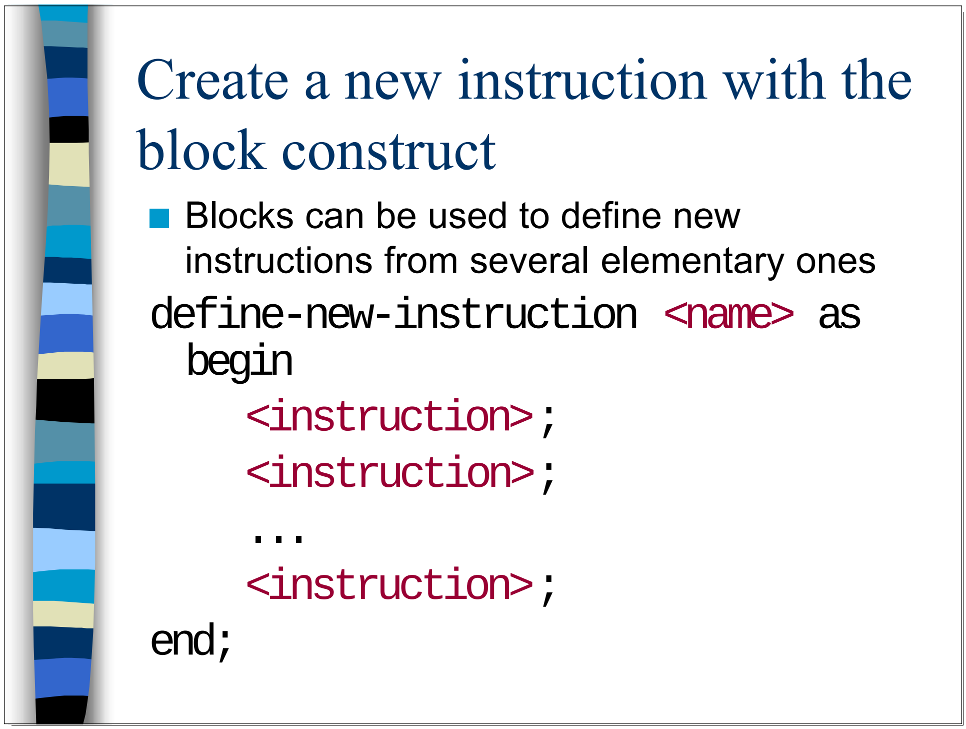
```
beginning-of-program
  beginning-of-execution
     move;
     turnleft;
     turnleft;
     turnleft;
     move;
     turnleft;
     turnleft;
     turnleft;
     move;
     turnleft;
     turnleft;
     turnleft;
     move;
     turnleft;
     turnleft;
     turnleft;
     turnoff;
  end-of-execution
end-of-program
```



Block

- A syntactically correct way to make a sequence of instruction looking as one instruction. A *block* can be used whenever single instruction can be used

```
begin
    <instruction>;
    <instruction>;
    ...
    <instruction>;
end
```



Create a new instruction with the block construct

- Blocks can be used to define new instructions from several elementary ones

```
define-new-instruction <name> as
  begin
    <instruction>;
    <instruction>;
    ...
    <instruction>;
end;
```

Solution 1: The Missing turnright

- Now we can define turnright

```
define-new-instruction turnright as
  begin
     turnleft;
     turnleft;
     turnleft;
  end;
```

Square Dancing Clockwise

The place for defining new instructions is between beginning-of-program and beginning-of-execution

```
beginning-of-program
  define-new-instruction
  turnright as begin
       turnleft;
       turnleft;
       turnleft;
  end;
  beginning-of-execution
       move;
       turnright;
       move;
       turnright;
       move;
       turnright;
       move;
       turnright;
       turnoff;
    end-of-execution
end-of-program
```

The Flow of Execution: The Glossary Model

- When Karel encounters the new name in the process of program execution, it looks for its “definition” in the glossary of commands
- If the definition of the new command is found, Karel executes the *body* of the command definition
- After that, Karel returns to the next instruction

Name does not matter (for execution)

- Names are just names. What the new command will do is defined by its *body,* not by its name

```
define-new-instruction turnright as begin
      move;
      move;
      move;
      move;
  end;
```

Name does matter (for understanding)

- From syntactic prospect, name could be any combination of letters, numbers and hyphens that starts with a letter
- From the understanding prospect, the name should express the function of the new command

```
define-new-instruction i543 as begin
        turnleft;
        turnleft;
        turnleft;
   end;
```

Before next lecture:

- Reading assignment
  - Pattis:
    - Chapter 2
    - Chapter 3, Sections 3.1 - 3.7
  - Tutorial: Lesson 4
- Follow Chapter 2 by writing and running code
- Check yourself by doing exercises from Chapter 2