IS12 - Introduction to Programming

Lecture 1: Introduction

Peter Brusilovsky
http://www2.sis.pitt.edu/~peterb/0012-072/

January 8, 2007

Introduction (outline)

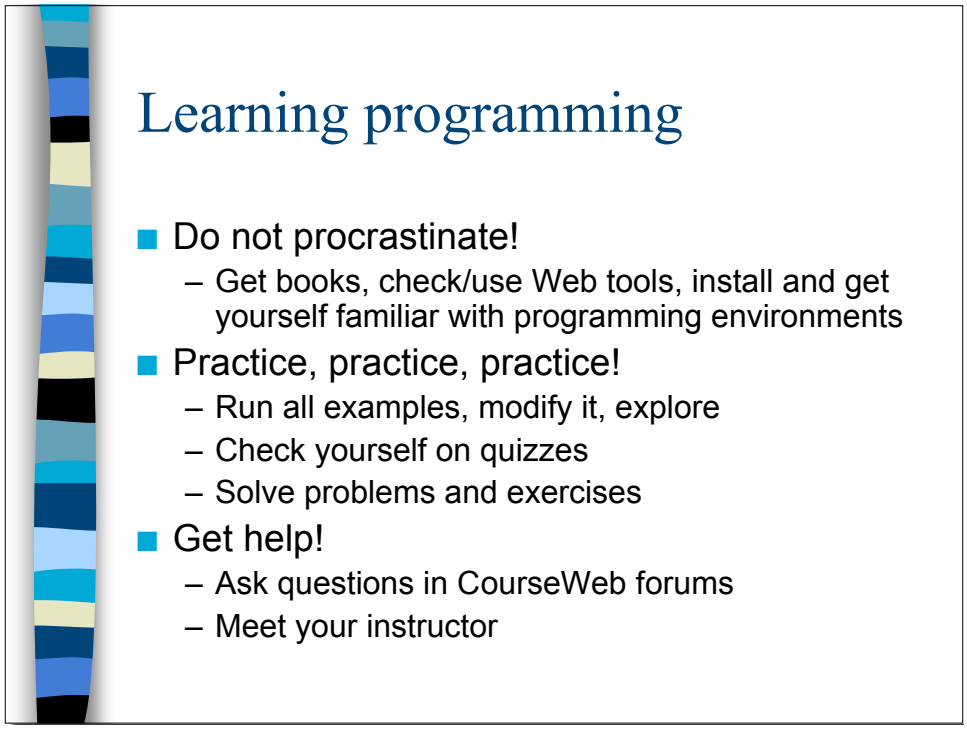
- Introduction to course goals and content
- Web site
  - Books
  - Tools
  - Syllabus
  - Materials
- What is programming?
- Introduction to Karel the Robot

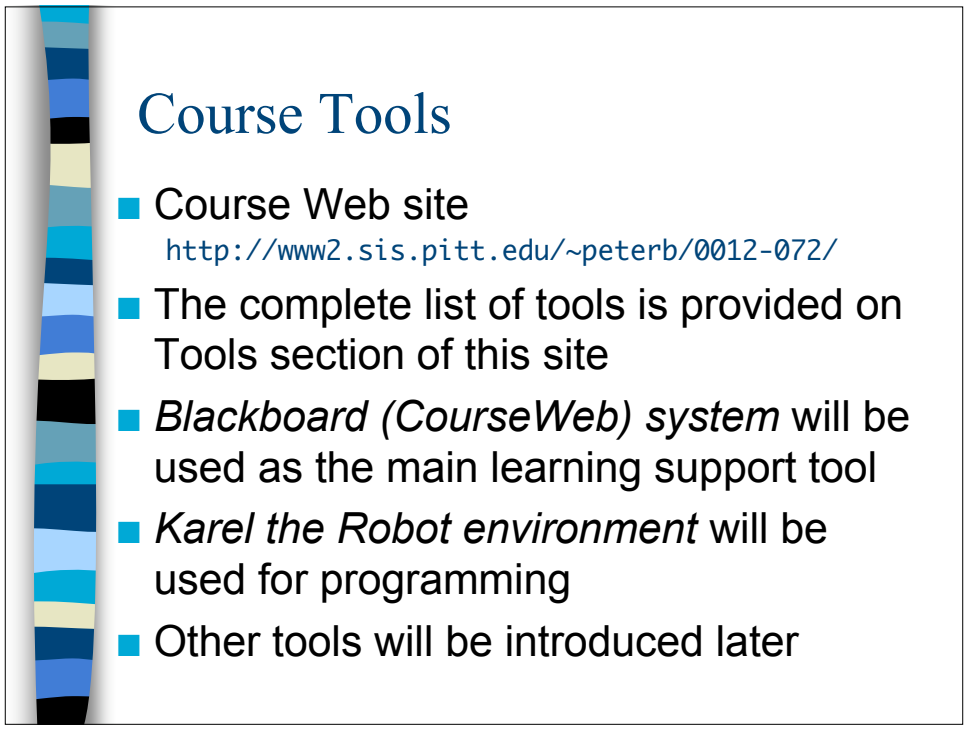
IS12 and BSIS

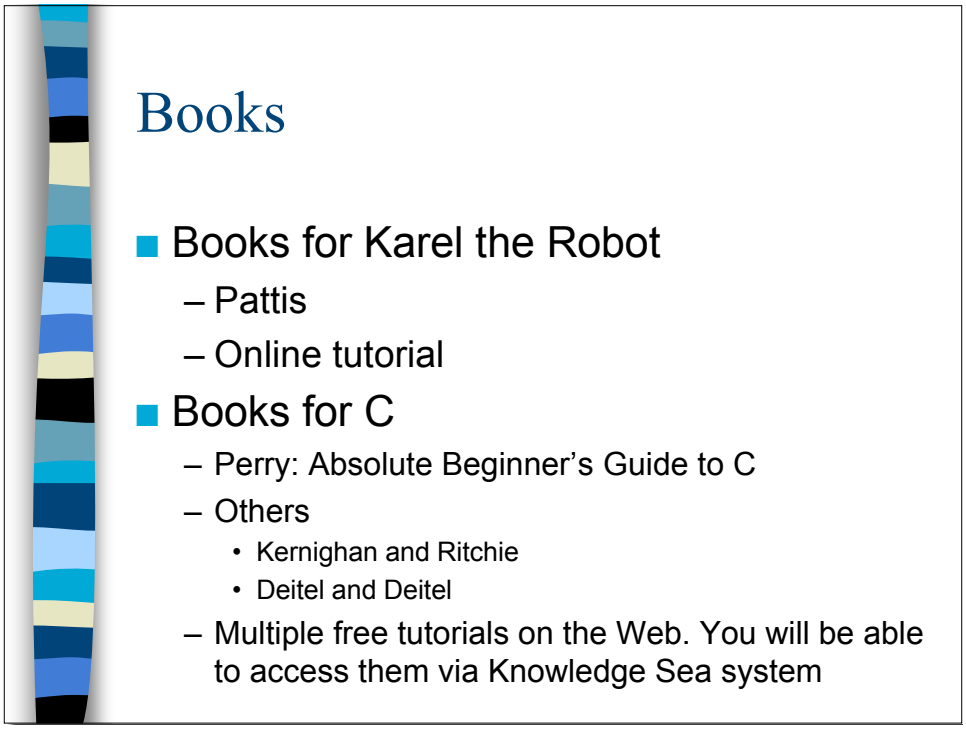
- Information Science and programming
- So, do we need to learn a programming language?
  - To understand it, you have to do it!
  - No magic in programming!
- BSIS: need 2 programming courses
  - (IS12) ⇨ IS17 ⇨ (IS19)
- DLIM: Intro Programming requirement

What is special for IS12?

- Most courses offer a steep introduction
- Gentle introduction for the beginners
- Prepares for IS17and IS19
- Languages:
  - Karel the Robot (1/4 of the course)
  - Introduction to C (3/4 of the course)
- Is it the right course for you?
  - You can go directly to IS17

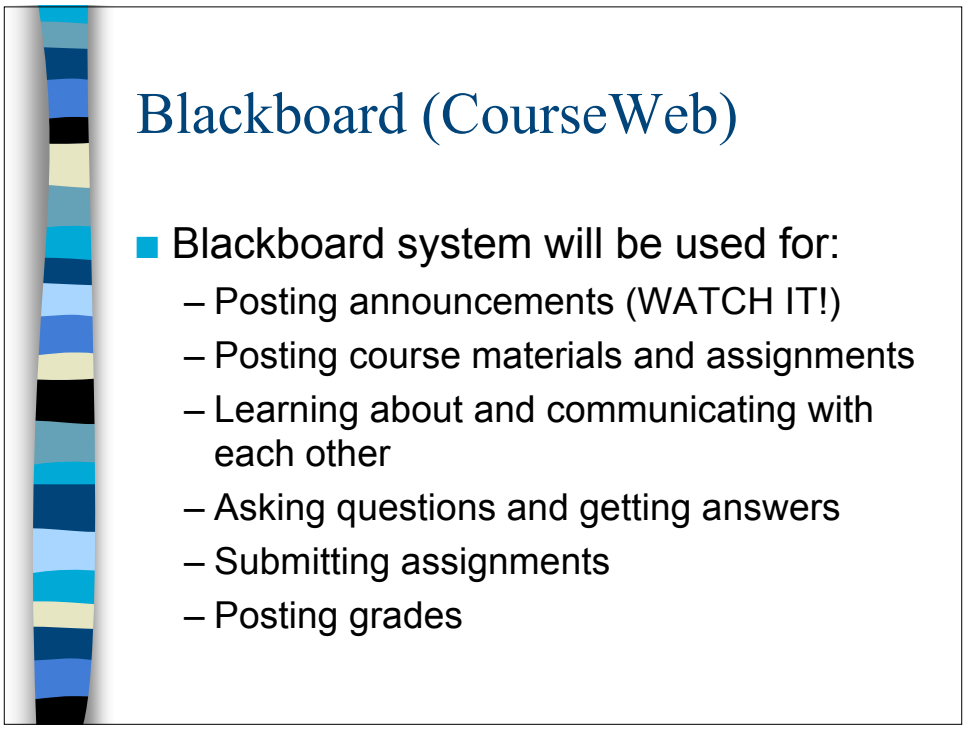

Learning programming
Do not procrastinate!
– Get books, check/use Web tools, install and get yourself familiar with programming environments
Practice, practice, practice!
– Run all examples, modify it, explore
– Check yourself on quizzes
– Solve problems and exercises
Get help!
– Ask questions in CourseWeb forums
– Meet your instructor


Course Tools
Course Web site
http://www2.sis.pitt.edu/~peterb/0012-072/
The complete list of tools is provided on Tools section of this site
Blackboard (CourseWeb) system will be used as the main learning support tool
Karel the Robot environment will be used for programming
Other tools will be introduced later



Books

- Books for Karel the Robot
  - Pattis
  - Online tutorial
- Books for C
  - Perry: Absolute Beginner's Guide to C
  - Others
    - Kernighan and Ritchie
    - Deitel and Deitel
  - Multiple free tutorials on the Web. You will be able to access them via Knowledge Sea system



Blackboard (CourseWeb)

- Blackboard system will be used for:
  - Posting announcements (WATCH IT!)
  - Posting course materials and assignments
  - Learning about and communicating with each other
  - Asking questions and getting answers
  - Submitting assignments
  - Posting grades

Read Syllabus Carefully (I)

- Final Grade

  (attendance + hw_points + quiz_points + extra_credit_points + exam_points) / (max_attendance_points + max_homework_points + max_quiz_point s+ max_exam_points) * 100%

  - <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.
- Homework and Late submissions

  Due date: after lecture - for paper version, 11:59 pm for electronic version.

  Within 3 days after due date: 80%, before next class: 50%.
- Quizzes

  One lowest score will be dropped

Read Syllabus Carefully (II)

- Attendance

  Each lecture worth 1 point, usually 2 lectures per class, up to max_attendance_points=20
- Extra credit
  - Be active in forums, answer questions, report errors and problems
  - Take part in extra credit studies
- Integrity

Communication

- To you
  - Watch closely the CourseWeb site for announcements.
  - Check your Pitt mail (xyz@pitt.edu) connected to CourseWeb regularly - most important and urgent information will be distributed by e-mail
- From you
  - If a question is not personal (an answer could be useful for others) - *ask via forum*
  - If it is a personal question - ask me via e-mail
- Office Hours

CourseWeb Assignment (HW0)

- Due Friday 1/12/2007
- Try visible features, ask questions, answer questions
- Home page (picture!) (2pts)
- Complete a Pre-test - results are not counted towards your grade (1pt)
- Search the Web, find a programming course that uses Karel or a similar language, post URL and a message to the test forum (1pt)

What are computers (robots)?

- "idiot servants" that can do simple operations incredibly fast if you tell them *every step* to do
- like little children in their need for specific and detailed *instruction*
- computers are not "brains" & are not "smart" - they only as good as the *program* they are running

Adapted from J. Wyatt' s slides

How to give commands?

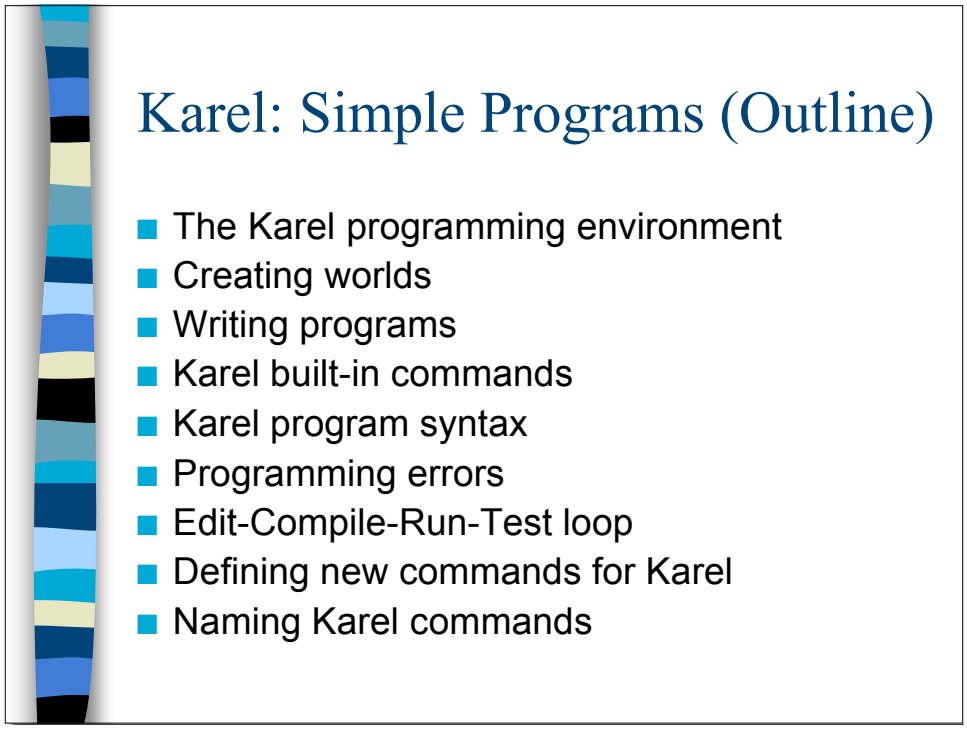
- Dialog mode:
  - Give a command
  - Observe results
  - Give another command
  - Observe results … …
- Programming:
  - Give a set of commands in advance
  - Observe final results

Programs and programming

- What is a program?
  - A set of *instructions* given to a computer to work with *objects (world, data)* in order to accomplish a specific task
- What is programming?
  - The art to control these “robots”, “servants”, “little children” by writing sets of instructions in advance
  - The art and craft of writing *programs*

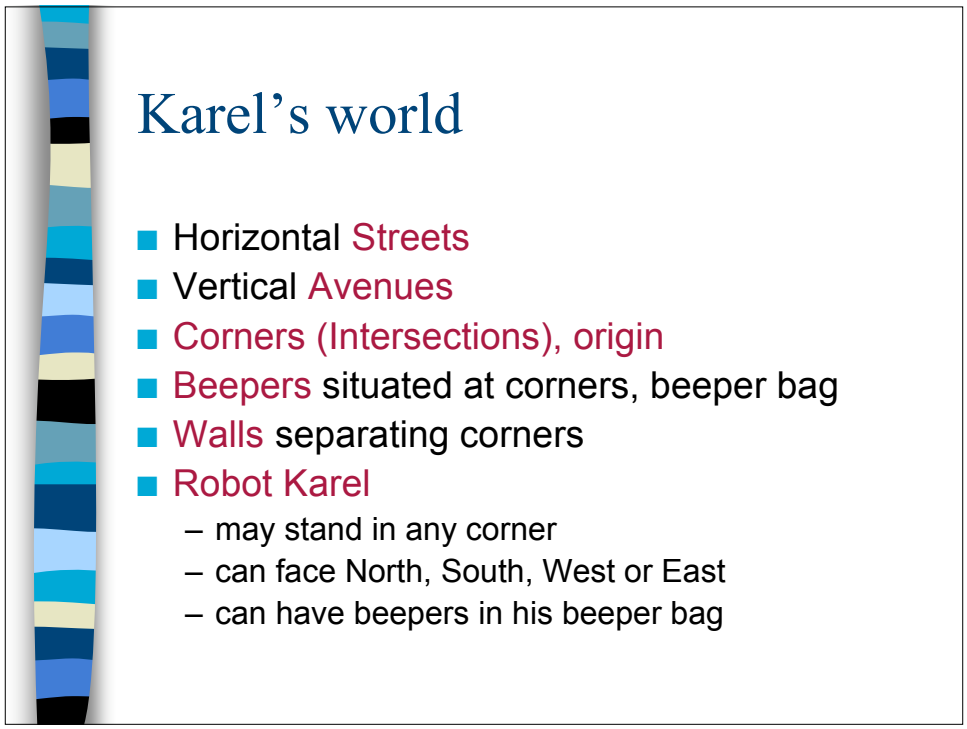
Karel the Robot

- Invented by Richard Pattis in 1981
- A Gentle Introduction into Programming
- Used in top universities and colleges
- Learning to program by learning to control Robot Karel acting in its World
  - Learn basic principles of programming
  - Learn main programming constructs (same in Karel, C, Java, Pascal, Basic, etc)



Karel: Simple Programs (Outline)

- The Karel programming environment
- Creating worlds
- Writing programs
- Karel built-in commands
- Karel program syntax
- Programming errors
- Edit-Compile-Run-Test loop
- Defining new commands for Karel
- Naming Karel commands



Karel's world

- Horizontal Streets
- Vertical Avenues
- Corners (Intersections), origin
- Beepers situated at corners, beeper bag
- Walls separating corners
- Robot Karel
  - may stand in any corner
  - can face North, South, West or East
  - can have beepers in his beeper bag

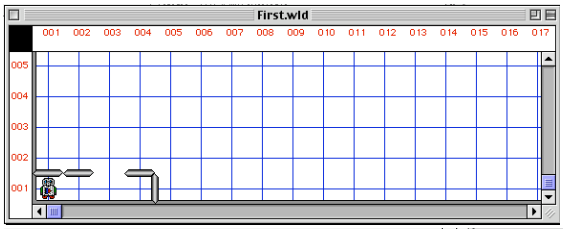
Creating a New World

- Use tab *World* in the environment
- Push *New* to create a new empty world
- Move *cursor* and use world editing tools
  - To place walls
  - To place beepers
  - To position Karel
- Save the world to a file for the future re-use (use .kw extension)

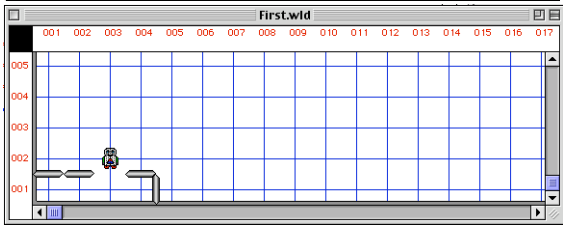
Get out of Jail Problem

- Task: Get Karel out of Jail!

Start, or initial situation:



Target, or final situation:



Commanding Karel

- What *commands* we will give Karel? => What commans would it understand?
- Instructions/commands we'll use to solve this problem:
  - move
  - turnleft
- Let's get Karel out of jail using these commands

Our First Program

- Go to "Program" tab
  - Create new program
  - Write/Edit program
  - Compile program
- Go to "Execute"
  - *Initialize* execution
  - *Run* program
- The robot will execute the current program in the current world

Get out of Jail Program

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

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Lecture 2: Simple Programs

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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", as well as indentation, is a good style, not a syntax rule!

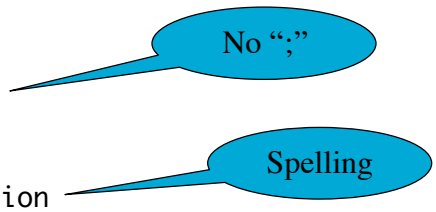
The Full Set of Karel Commands

- 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

Lexical and Syntactic Errors

- Exact spelling and strict rules of syntax:

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



- No execution for programs with lexical or syntax errors.

Semantic Errors

- Where is the error?

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

- Semantic error: Possible misunderstanding how to use a command or a construction

Execution errors

- Situation: Karel at (1,1), facing North

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

- Execution causes error shutoff

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

Intent Errors (bugs)

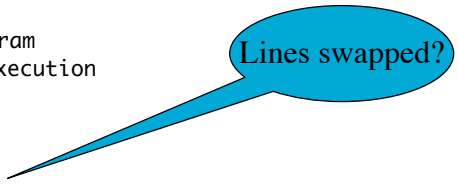
- If there are no syntax errors, does it mean that the program is correct?

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

Intent Errors (bugs)

- It depends on what it suppose to do. What's the task?

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



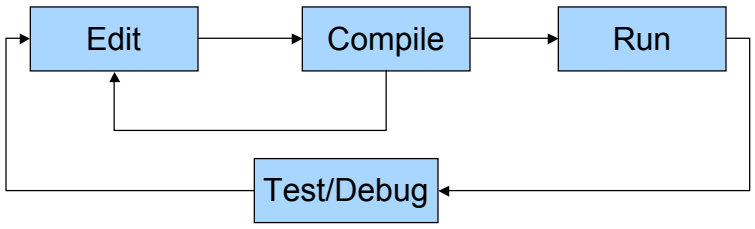
- Let's define the task: ready to go north
- And another task: knight's move

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
   - Think how to fix it and go back to 1
4. Run it
5. If it produce wrong results
   - watch or simulate execution
   - find the source of the error (debug)
   - think how to fix it and go back to 1

The iterative nature of programming

The "programming in small" loop



Problem: Move beeper

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

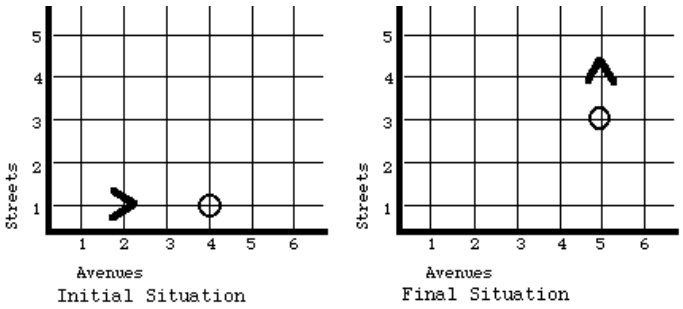


Figure 2-3 The Initial and Final Situations of Karel's task

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
```

Defining New Instructions

- How to extend Karel's set of instructions?

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

- Example:

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

- To be placed between beginning-of-program and beginning-of-execution

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
```

New Instruction with the Block

- 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

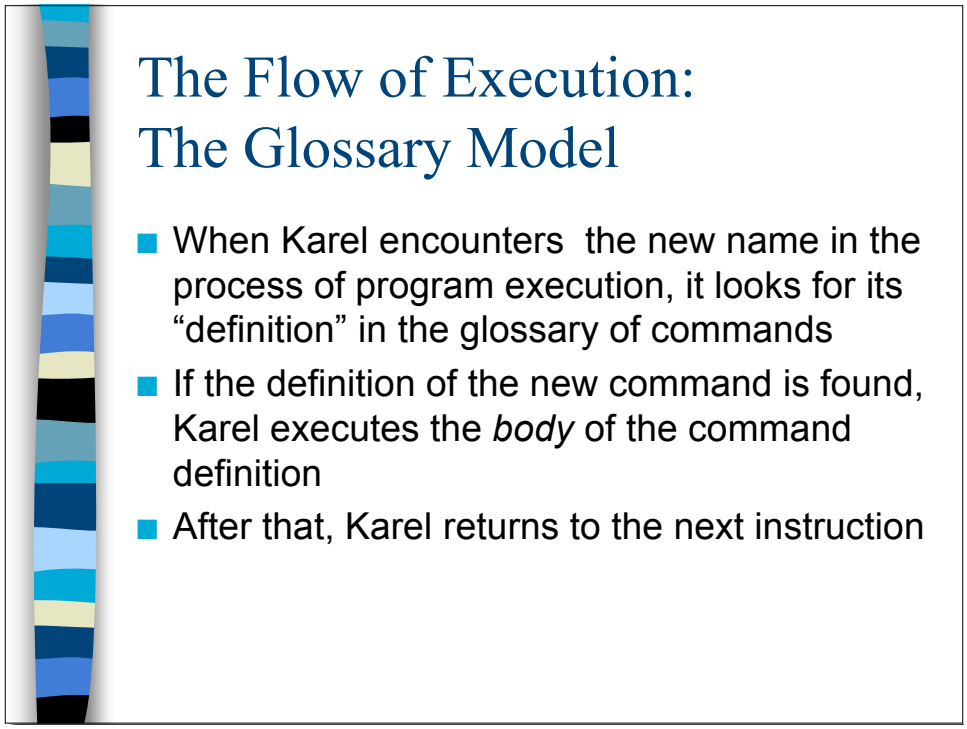
```
define-new-instruction turnright as
  begin
     turnleft;
     turnleft;
     turnleft;
  end;
```

Square Dancing Clockwise

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

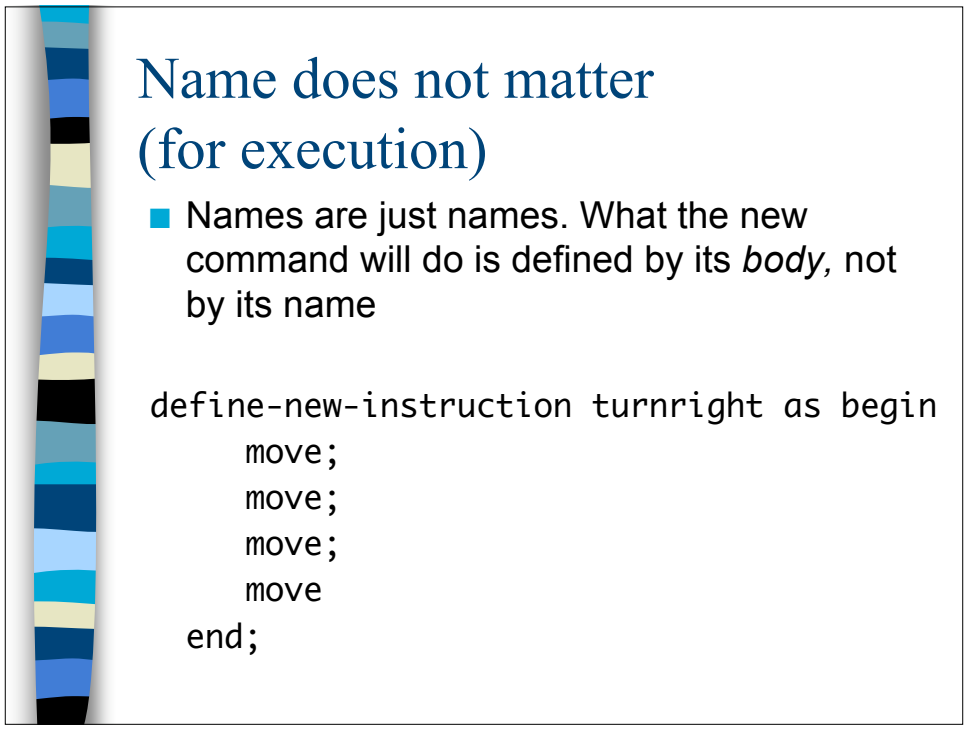
```
beginning-of-program
   define-new-instruction
   turnright as begin
        turnleft;
        turnleft;
        turnleft;
   end;
   beginning-of-execution
        move;
        turnright;
        move;
        turnright;
        move;
        turnright;
        turnoff;
   end-of-execution
end-of-program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

•Another design with defined instruction “step”



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 Meeting

- Explore Web site, read syllabus. Decide if this course is for you.
- Get / check the books
- Install / try Karel Environment
- Reading assignment:
  - Pattis: Chapter 1, Chapter 2, Chapter 3 (3.1-3.7)
  - Tutorial on Karel Environment
- Follow Chapter 2 by writing and running code. Check yourself by doing exercises from Chapter 2
- Homework-1 (5 points) due 1/22/07