Overview.

- If/then
- Karel’s conditions
- if/then/else
- Examples
- else/if
- Checking several conditions
Case 1: Cleaner Stairs

- Move Karel up the stairs picking beepers - but now a step may not have a beeper!

![Stairs Diagram]

Start:

![Stairs Diagram]

Target:

Conditional instruction if/then

- Can Karel do something only in a special case?

```plaintext
if <condition> then
    <instruction>;
```

- Example:
  ```plaintext
  if front-is-clear
    move;
  ```

- Note indentation!
Semantics of if/then instruction

if <condition> then
  <instruction-1>;
  <next-instruction>;

Semantics of execution
- If condition is true - instruction-1; after that - next-instruction
- If condition is false - next-instruction

Flowchart of if/then
if/then instruction with a block

if <condition> then begin
    <instruction-1>;
    <instruction-2>;
    ...
    <instruction-k>;
end;
<next-instruction>;

Semantics of execution:
– If condition is true - instruction-1 ... instruction-k after that - next-instruction
– If condition is false - next-instruction

Karel’s conditions

- Walls
  – front-is-clear, left-is-clear, right-is-clear
  – front-is-blocked, left-is-blocked, right-is-blocked

- Direction
  – facing-north, facing-south, facing-east, facing-west
  – not-facing-north, not-facing-south, not-facing-east, not-facing-west

- Beepers
  – next-to-a-beeper, any-beepers-in-beeper-bag
  – not-next-to-a-beeper, no-beepers-in-beeper-bag
Solution 1: Cleaner Stairs

beginning-of-program
define-new-instruction
  turnright as begin
    turnleft;
    turnleft;
    turnleft;
  end;
define-new-instruction
  climb-step as begin
    turnleft;
    move;
    turnright;
    move;
  end;
define-new-instruction
  pickbeeper-if-present as
    begin
      if next-to-a-beeper then
        pickbeeper
      end;
beginning-of-execution
  climb-step;
  pickbeeper-if-present;
  climb-step;
  pickbeeper-if-present;
  climb-step;
  pickbeeper-if-present;
  turnoff;
end-of-execution
end-of-program

Case 2: The Bad Year Harvest

define-new-instruction
  pickbeeper-if-present as
    begin
      if next-to-a-beeper then
        pickbeeper;
    end;
define-new-instruction
  harvest-1-row as
    begin
      pickbeeper-if-present;
      move;
      pickbeeper-if-present;
      move;
      pickbeeper-if-present;
      move;
      pickbeeper-if-present;
      end;
Conditional instruction if-else

- Can Karel do different things in different situations?
  if <condition> then
    <instruction-1>
  else <instruction-2>;
- Example:
  if front-is-clear then
    move;
  else
    turnright;

Semantics of if-else instruction

if <condition> then
  <instruction-1>
else
  <instruction-2>;
<next-instruction>;
- Semantics of execution
  - If condition is true - instruction-1; after that - next-instruction
  - If condition is false - instruction-2; after that - next-instruction
Flowchart of if-else

Case 3: Hurdle Jumping Race

- Move Karel through a row of “hurdles”
- Each pair of Avenues may or may not have a hurdle between them
Solution 3: Hurdle Jumping Race

Main program:
beginning-of-execution
race-stride;
race-stride;
race-stride;
race-stride;
race-stride;
race-stride;
race-stride;
race-stride;
turnoff;
end-of-execution

Main subtask:
define-new-instruction race-stride as begin
if front-is-clear then
move
else
jump-hurdle
end;

Decomposing jump-hurdle:
define-new-instruction
jump-hurdle as begin
jump-up;
move;
jump-down;
end;
define-new-instruction
jump-up as begin
turnleft;
move;
turnright;
end;
define-new-instruction
jump-down as begin
turnright;
move;
turnleft;
end;
Stepwise refinement tree for Hurdle

- hurdle problem
  - race-stride
    - jump-hurdle
      - jump-up
      - jump-down
    - move

Flowchart of `else-if`

1. **Condition1 ?**
   - true → **Instruction1**
   - false → **Condition2 ?**
2. **Condition2 ?**
   - true → **Instruction2**
   - false → **Condition3 ?**
3. **Condition3 ?**
   - true → **Instruction3**
   - false → **Instruction4**
4. **NextInstruction**
Example of else-if

define-new-instruction inverse as begin
  if next-to-a-beeper then
    pickbeeper
  else if any-beepers-in-beeper-bag then
    putbeeper;
  else
    turnoff;
end

What will happen if in bad year harvest we replace pick-beeper-if-present into inverse?

Checking Several Conditions

How we can check that Karel is in a dead end of a maze?

if front-is-blocked then
  if left-is-blocked then
    if right-is-blocked then begin
      turnleft;
      turnleft;
      move;
    end;
end;
Formatting, boxing and transformations

if facing-north then
   begin
      move;
      turnleft;
   end
else
begin
   move;
   if not-facing-north then 
      turnright;
   end;

1. Format
2. Box
3. Analyze and transform, repeat if necessary

Before next lecture:

- Reading assignment
  - Pattis: Chapter 4.
  - Tutorial: lessons 6, 7, 9
  - Perry, Chapter 2 (starting from "Kinds of Data"); Chapter 4; Chapter 9 (first reading)

- Run Classroom Examples

- Get ready to the first quiz:
  - Karel: Check yourself by answering questions #1-#5 (at least) from Section 4.10.
  - C: Use WADEIn and QuizPack

- HW3 (dual) - due 2/5/07