IS12 - Introduction to Programming

Lecture 4: Conditional Execution

Peter Brusilovsky
http://www2.sis.pitt.edu/~peterb/0012-051/

Conditional instruction `if/then`

- Can Karel do something only in a special case?

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

- Example:

```
if front-is-clear
    move;
```

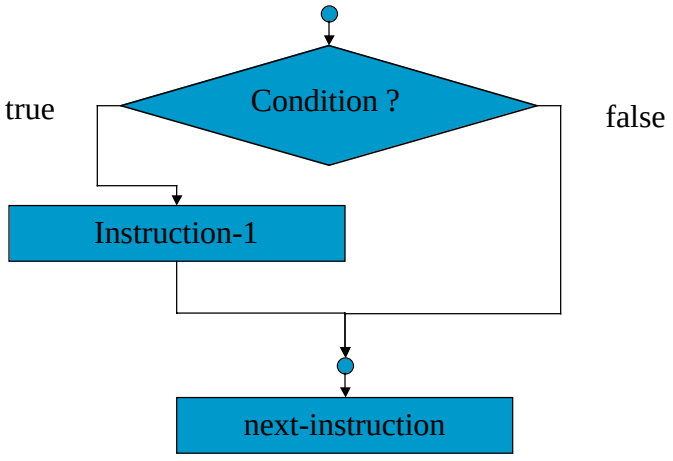
- Note indentation!

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>;
```

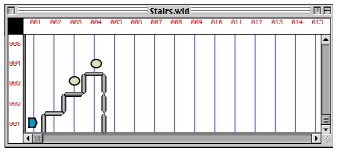
- Semantics of execution:
  - If condition is true - `instruction-1 ... instruction-k` after that - `next-instruction`
  - If condition is false - `next-instruction`

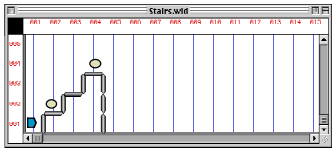
Karel's conditions

- 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

Why? Case 1: Cleaner Stairs

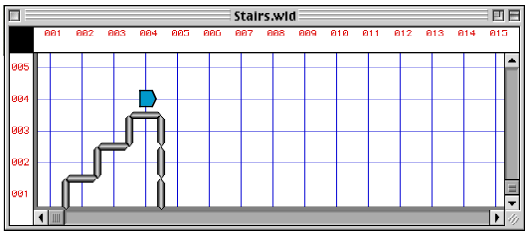
- Move Karel up the stairs picking beepers - but now a stair may not have a beeper!





Start:

Target:



Solution 1: Cleaner Stairs

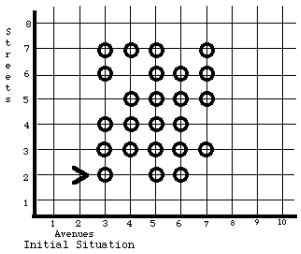
```
beginning-of-program
   define-new-instruction
   turnright as begin
        turnleft;
        turnleft;
        turnleft;
   end;
   define-new-instruction
   climb-stair as begin
        turnleft;
        move;
        turnright;
        move;
   end;
```

```
define-new-instruction pickbeeper -
   if-present as
begin
   if next-to-a-beeper then
        pickbeeper
end;
beginning-of-execution
   climb-stair;
   pickbeeper -if-present;
   climb-stair;
   pickbeeper -if-present;
   climb-stair;
   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;
   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:

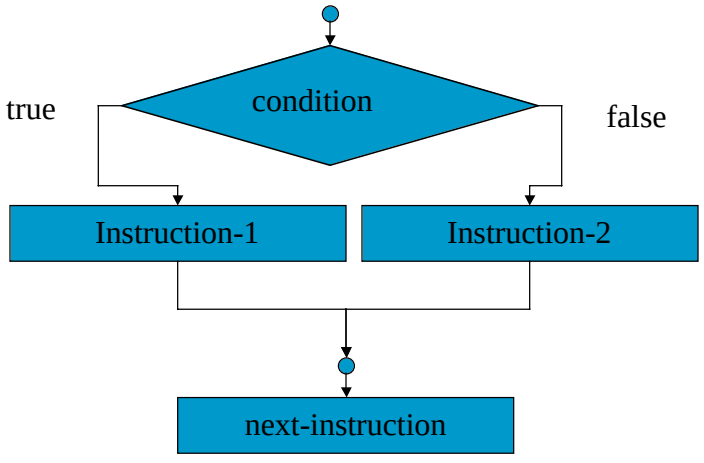
```
if front-is-clear then
     move;
else
     turnright;
```

Semantics of `if-else` instruction

```
if <condition> then
     <instruction-1>
else
     <instruction-2>;
<next-instruction>;
```

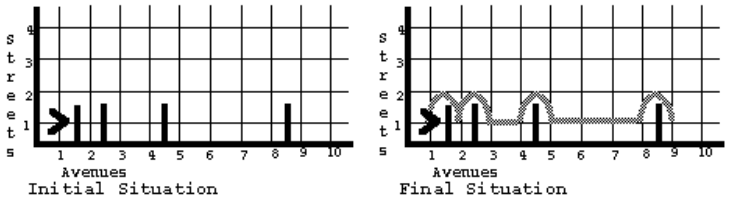
- Semantics of execution
- If condition is true - `instruction-1`; after that - `next-instruction`
- If condition is false - `instruction-2`; after that - `next-instruction`

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;
```

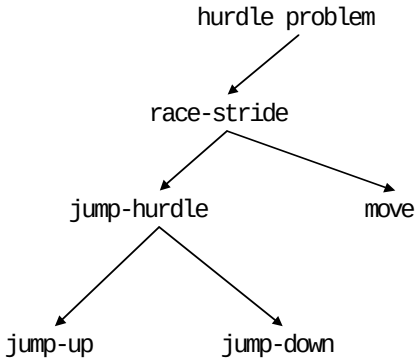
Solution 3: Hurdle Jumping Race

Decomposing `jump-hurdle`:

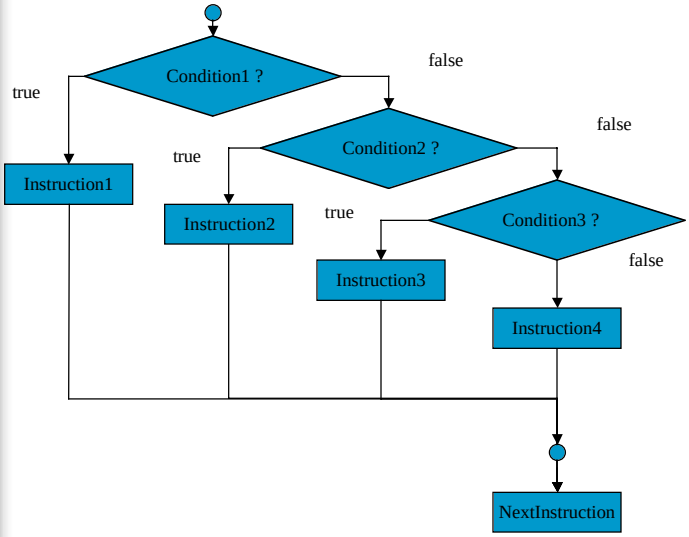
```
define-new-instruction
   jump-hurdle as begin
   jump-up;
   move;
   jump-down;
end;
```

```
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



Flowchart of `else-if`



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;
```

Before next lecture:

- Do reading assignment
  - Pattis: Chapter 4
  - Tutorial: lessons 6, 7, 9
- Run Classroom Examples
- Check yourself by answering 3 questions (#1-#5) and doing 2 exercises (#7-#10) from Section 4.10.