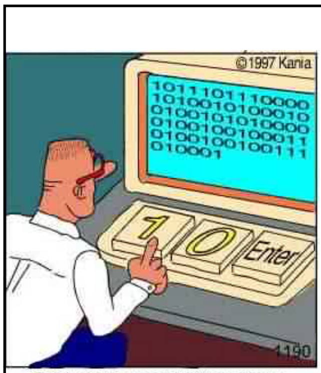


Real programmers code in binary.

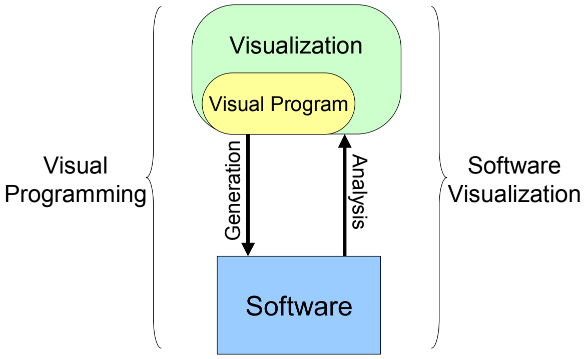
Software Visualization

Visual Programming

Visual Programming

- VP vs. SV
- Examples

VP vs. SV



Syntax of Visual Programs

- Textual programs:
  - Syntax results from the linear order of lexical elements.
- Visual Programs:
  - Syntax results from the graphical and textual elements, their spatial placement and the connection between these elements.

Classification of VP Systems

- Control-Flow based
- Data-Flow based
- Functional
- Object oriented
- Constraint based
- Rule based
- Programming-by-example
- Form based
- Multi-paradigm

Stefan Schiffer, "Visuelle Programmierung“, Addison-Wesley

C^2

Graphical Encapsulation of textual C program code

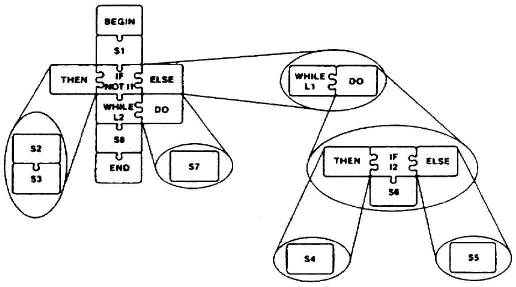
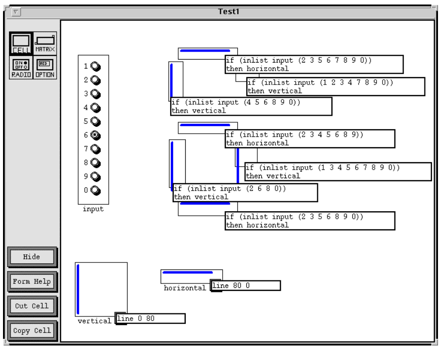


Bild 6-1 Schematische Darstellung eines Programms in der Proc-BLOX-Notation.
Glinert [90-A&I S. 550, Abb. 3]

Form-based VP: Forms/3

- Creation of formulars (GUI) and their semantics
- Widely used subclass: „spreadsheets“
  - Form = table subdivided into cells
  - Each cell contains a value or a calculation rule (formula), i.e. the value of the cell is computed using the values of other
- In Forms/3 no fixed table format
  - Programming = placing and formating of cells + defining the formula for each cell
  - Additional dimension: time
    - Initial Value, Subsequent value
    - Time travel by selecting point of time on time axis
- Spezial Cells:
  - graphical (boxes, circles, lines, glyphs) and interactive (buttons, sliders)

Form-based VP: Forms/3



```
if (inlist input (2 3 5 6 7 8 9 0))
then horizontal
if (inlist input (1 2 3 4 7 8 9 0))
then vertical
if (inlist input (4 5 6 8 9 0))
then vertical
if (inlist input (2 3 4 5 6 8 9))
then horizontal
if (inlist input (1 3 4 5 6 7 8 9 0))
then vertical
if (inlist input (2 6 8 0))
then vertical
if (inlist input (2 3 5 6 8 9 0))
then horizontal
line 80 0
line 0 80
```

Constraints-based VP: ThingLab

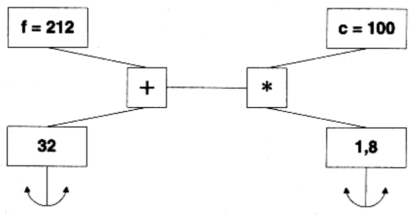
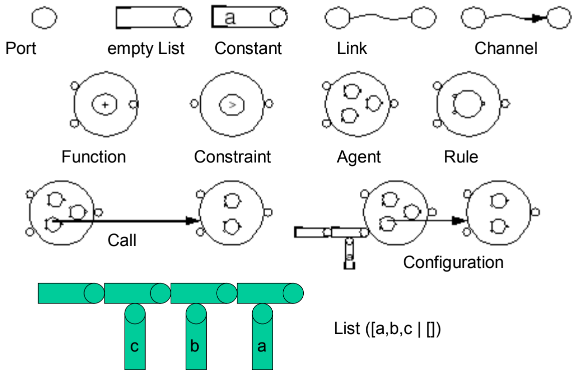


Bild 5-11 Constraints in ThingLab.

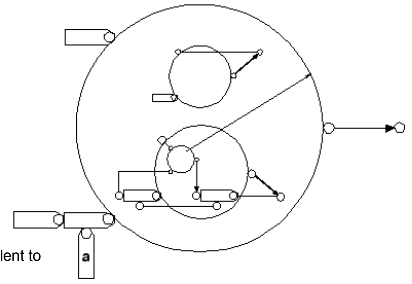
Fahrenheit vs. Celsius: f = c * 1,8 + 32 ⇔ c = (f - 32) / 1,8

Concurent Constraint Visual Programming: Pictorial Janus



List ([a,b,c | []])

PJ Example: append([],[a],X)



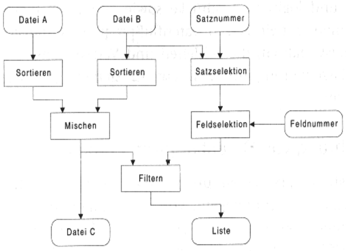
This is roughly equivalent to

append([], X2, X4) :- X4=X2.
append([X4 | X5], X2, X3) :- X3=[X4|X7], append(X5, X2, X7).

together with the call append([],[a],X).

Data-Flow based VP

- Implicit execution order
- Parallel execution of data-independent operations
- No side effects
- No variables



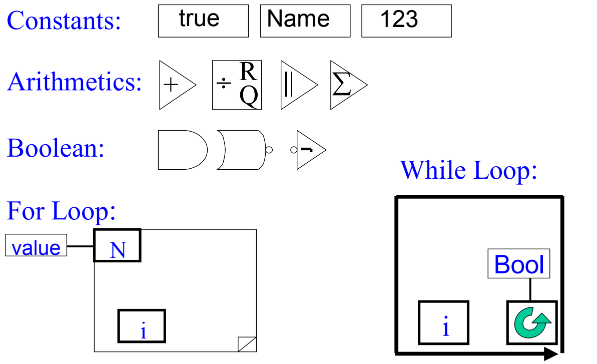
Dateifilterung

LabView

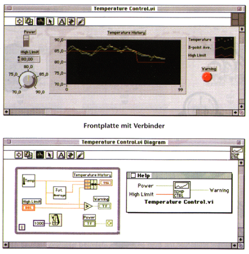
- Laboratory Virtual Instrument Engineering Workbench
- graphical development environment for acquisition, analysis, presenation of measuring data and control of measuring devices
- Virtual instruments = Front Panel + Block Diagram
- Dataflow programming
  - Deviatation: variables, sequences
  - No recursion or even procedural abstraction

GUI   Implementation

LabView



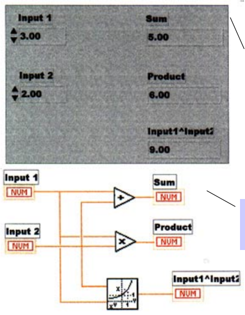
Examples



Frontplatte mit Verbinder

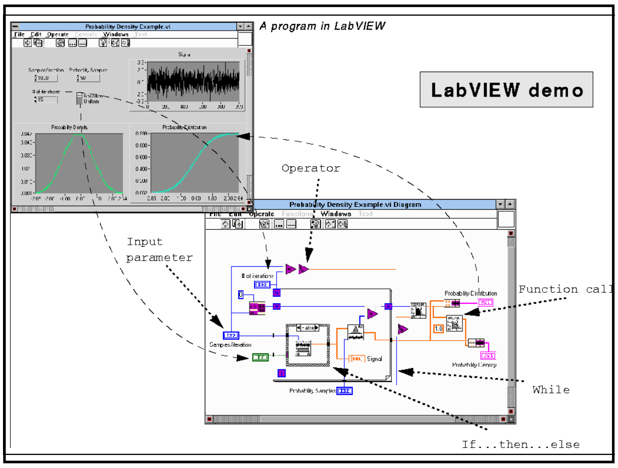
Blockschaltbild mit Hilfefenster für Verbinder.

Bild 6-4 Frontplatte und Blockschaltbild eines LabVIEW-Programms zur Temperaturmessung.

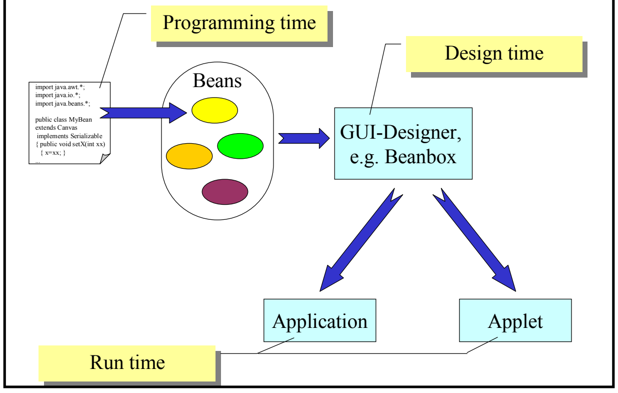


Front Panel

Block Diagram



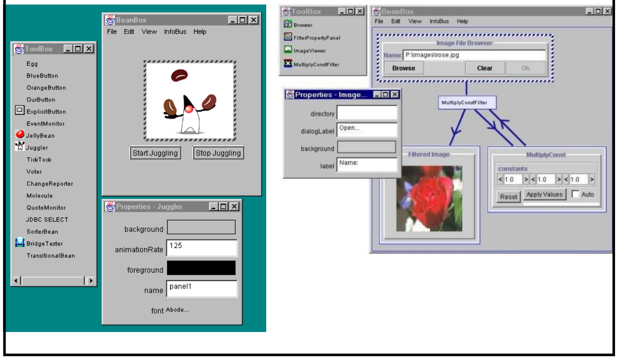
Component-based VP

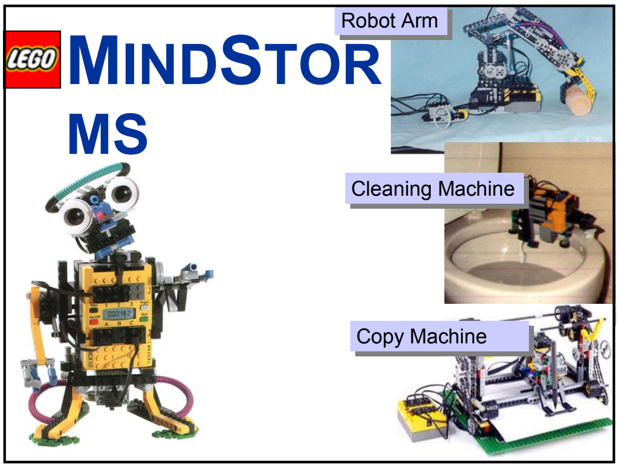


```
import java.awt.*;
import java.io.*;
import java.beans.*;

public class MyBean
extends Canvas
 implements Serializable
{ public void setX(int xx)
   { x=xx; }
...
```

Java BeanBox



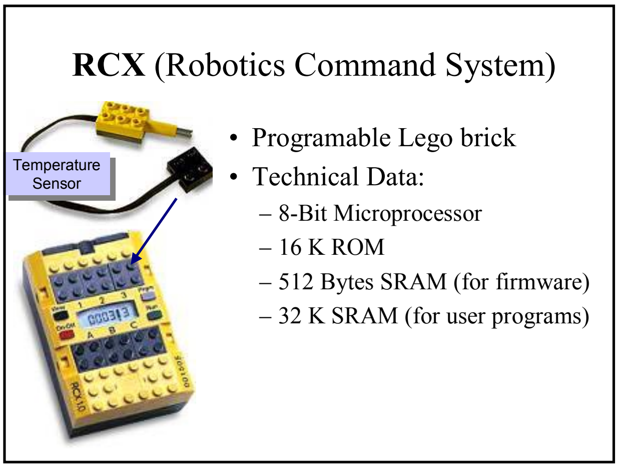


MINDSTOR MS

Robot Arm

Cleaning Machine

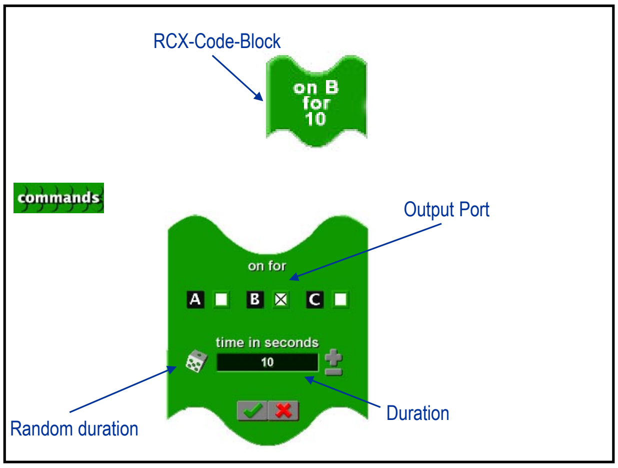
Copy Machine



RCX (Robotics Command System)

Temperature Sensor

- Programable Lego brick
- Technical Data:
  - 8-Bit Microprocessor
  - 16 K ROM
  - 512 Bytes SRAM (for firmware)
  - 32 K SRAM (for user programs)

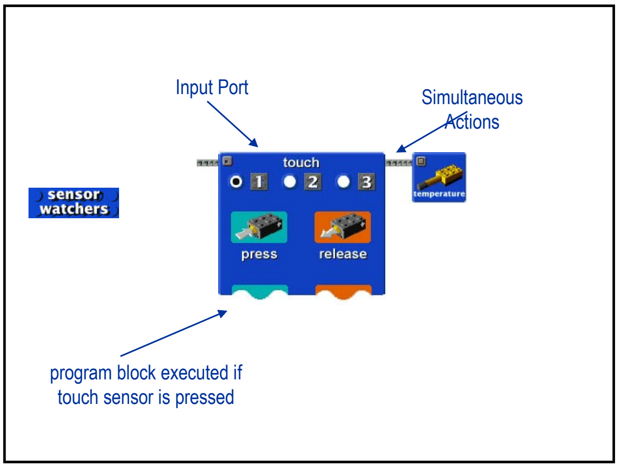


RCX-Code-Block

Output Port

Random duration

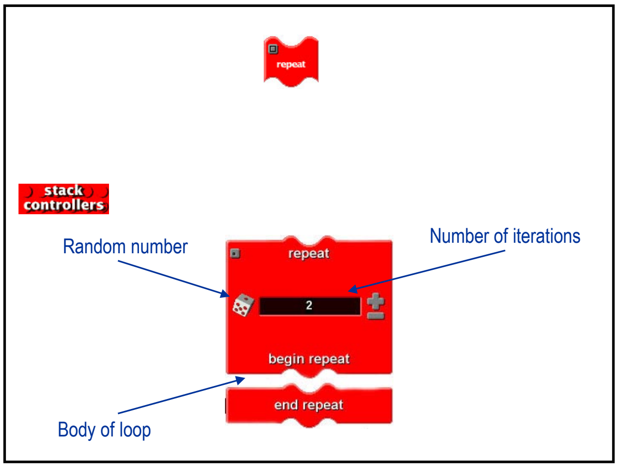
Duration



Input Port

Simultaneous Actions

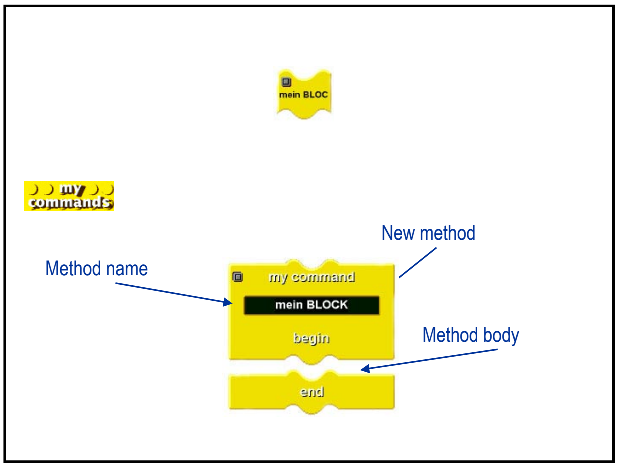
program block executed if touch sensor is pressed



Random number

Number of iterations

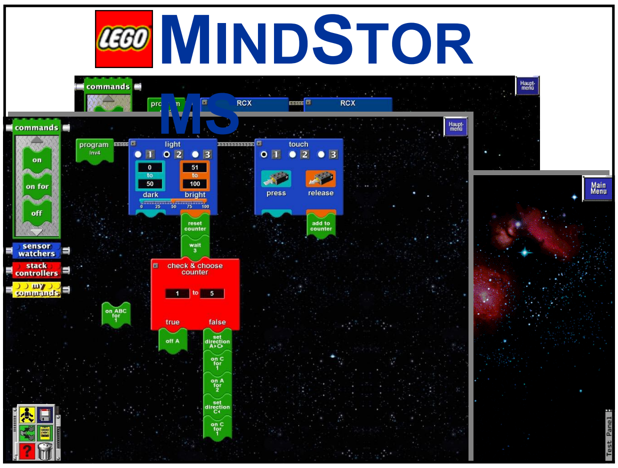
Body of loop



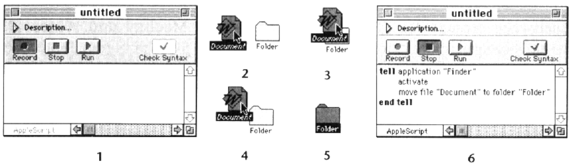
New method

Method name

Method body



Programming-by-example: Script Editor



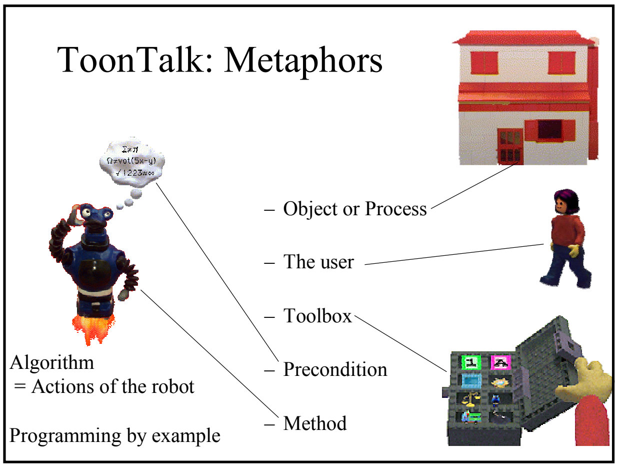
```
tell application "Finder"
    activate
    move file "Document" to folder "Folder"
end tell
```

Bild 5-14 Programmierung mit Beispielen mit Script Editor.

ToonTalk
http://www.toontalk.com/

- Animated world where kids can create, execute, debug and even exchange programs.
- Goals:
  - Playful training of intellectual skills
  - Identify problems and divide them into subproblems
  - Solution by combining solutions of the subproblems
  - Abstraction

ToonTalk: Metaphors

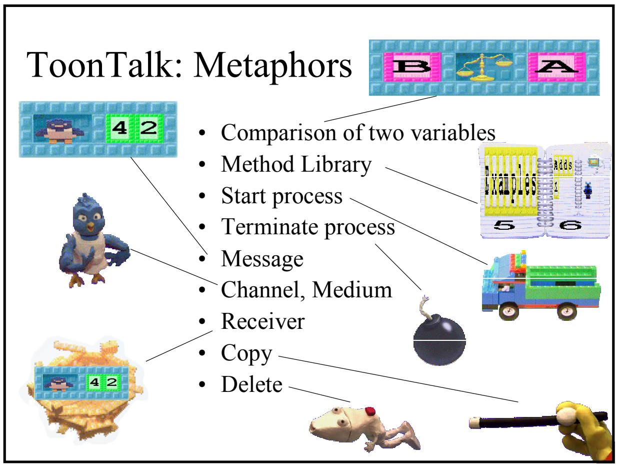


- Object or Process
- The user
- Toolbox
- Precondition
- Method

Algorithm
= Actions of the robot

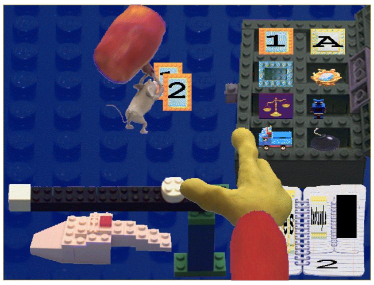
Programming by example

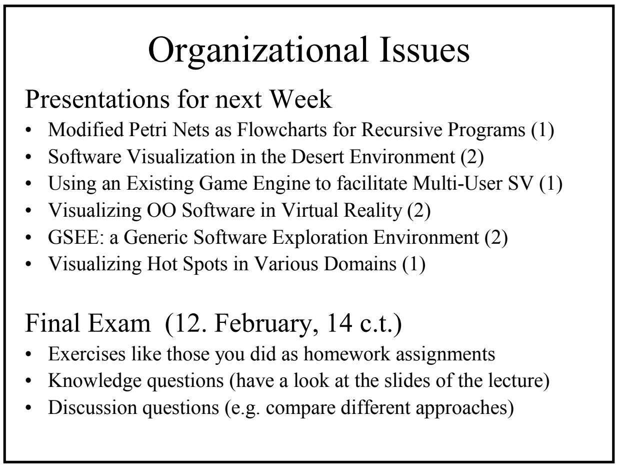
ToonTalk: Metaphors



- Comparison of two variables
- Method Library
- Start process
- Terminate process
- Message
- Channel, Medium
- Receiver
- Copy
- Delete

Demo





Organizational Issues

Presentations for next Week

- Modified Petri Nets as Flowcharts for Recursive Programs (1)
- Software Visualization in the Desert Environment (2)
- Using an Existing Game Engine to facilitate Multi-User SV (1)
- Visualizing OO Software in Virtual Reality (2)
- GSEE: a Generic Software Exploration Environment (2)
- Visualizing Hot Spots in Various Domains (1)

Final Exam (12. February, 14 c.t.)

- Exercises like those you did as homework assignments
- Knowledge questions (have a look at the slides of the lecture)
- Discussion questions (e.g. compare different approaches)