4 Overview on Approaches to Multimedia Programming

Literature:

http://www.squeak.org (tutorials)

Target Persons for Multimedia Programming Technology

Intended activities	Non-technical people	Experts
Passive consumption	Flash	—
Design of complex systems	Squeak, EToys	Flash, Squeak
Experimentation, learning		

Smalltalk and Learning

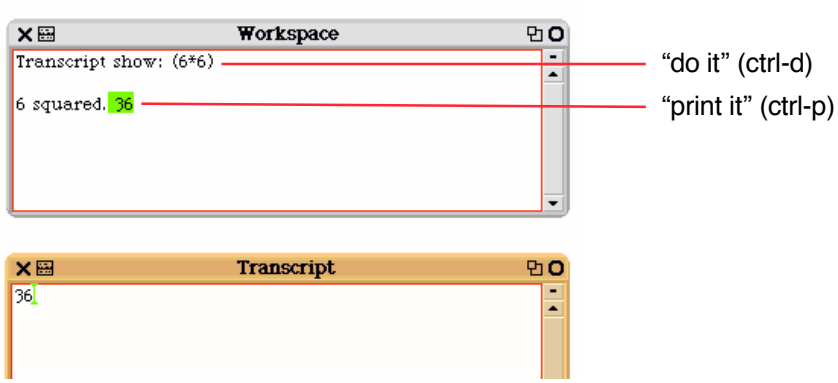
- Original intention of Smalltalk:
  - Make the programming system so intuitive that children can use it
  - In fact a first multimedia authoring system
  - Children projects at Xerox PARC
- What happened to Smalltalk?
  - Becomes commercially targeted programming language
  - ParcPlace
  - Smalltalk-80
- Smalltalk is still the environment in which most programming inventions appear:
  - Design patterns
  - Extreme programming

Smalltalk Interpreter in Squeak

- Smalltalk:
  - The language of the first systems with a graphical user interface
- Smalltalk-80:
  - Standardized syntax for Smalltalk
- Smalltalk in Squeak:
  - Squeak system contains a full interpreter for Smalltalk-80 syntax
  - Squeak system is written in Squeak mostly (and cross-complied to C)
    - » 95% of the system is in Squeak
  - Smalltalk is the serious programming language in Squeak
    - » Squeak scripting is just for kids... ???

Smalltalk Programming is Open & Interactive

- Smalltalk programs are always ready for execution, even small parts of the code can be evaluated instantly
- The interpreter state is saved/loaded in an “image” file.
- The full code of the runtime system can be inspected at any time.



Basic Rules of Smalltalk

- Every variable is an object.
  - There are no basic types which are not objects!
  - Even classes are objects!
- Code is always triggered by sending a message to an object.
- All methods return a value.
- There are three types of messages
  - Unary, e.g. `3 negated.`
  - Binary, e.g. `a + b.`
  - Keyword, e.g. `Transcript show: a.`
    - » `show` message with parameter `a` is sent to object `Transcript`
- All code is evaluated from left to right.
  - Unary messages first, then binary, then keyword messages
  - There are no operator precedence rules.
- Assignment evaluates right hand side and assigns the result to left hand side.

Smalltalk Blocks

- `a := [2 + 3].`
  `a value.`

  Result: 5

Assignment either by typing ":=" or by typing "_"

- `c := [:a :b | a + b].`
  `c value: 5 value: 7.`

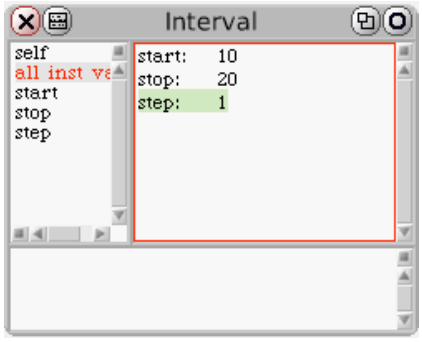
  Result: 12
  (a multiple-part message)

- `x := 3.`
  `y := 5.`
  `(x = y)`
  `ifTrue: [Transcript show: 'equal']`
  `ifFalse: [Transcript show: 'not equal'].`

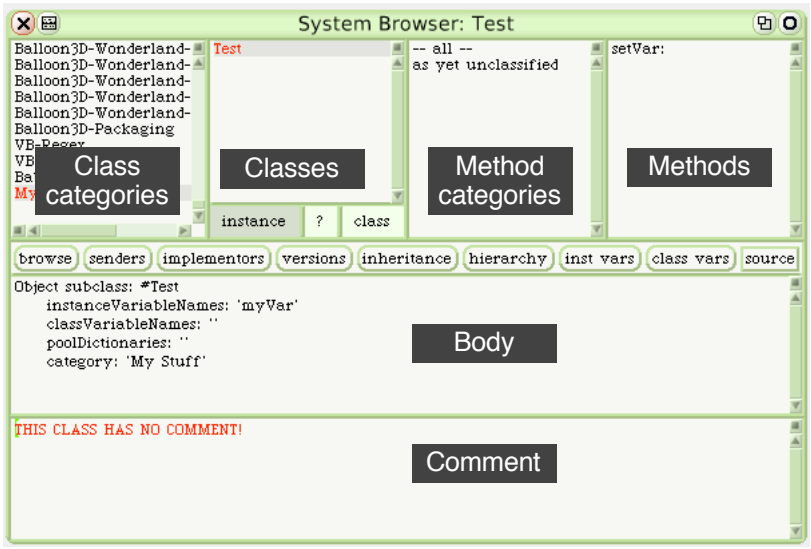
  Control flow realized by message passing mechanism

Interval Objects and Loops

- An Interval object:
  `a := 10 to: 20.`
  `a inspect.`
- Looping through the interval:
  `a do: [:i | Transcript show: i; cr].`



Browser Window



Infinite Number Precision

- `100 factorial.`
  `933262154439441526816992388562667004907159682643816214685929638952175999932299156089414639761565182862536979208272237582511852109168640000000000000000000000000`
- `1000 factorial / 999 factorial. 1000`

- `(1/3) + (2/3). 1`

- `1 class. SmallInteger`
- `1 class maxVal. 1073741823`
- `1 class maxVal + 1. 1073741824`

- `Float infinity + 1. Infinity`
- `Float infinity / Float infinity. NaN`

While Loops, Lazy Evaluation, Local Variables

```
| f n |
f := 1.
n := 4.
[n > 1] whileTrue: [f := f*n. n := n-1].
f.
```

Smaller Steps:

```
s := [n > 1].
s inspect.
s whileTrue: [Transcript show: n. n := n-1.]
```


High-Level Iterators

```
a := #(100 200 300).
a do: [:x | Transcript show: x; cr].
a collect: [:x | x*2]. #(200 400 600)

a := #(1 2 3).
15 odd.
a reject: [:x | x odd]. #(2)
```

BankAccount Example

- Constructed interactively
  - Create new class template
  - Fill in instance variable (balance)
  - Fill in methods
    - » initialize
    - » deposit
    - » withdraw
- At any point in time, creation of objects and inspection is possible
- (Credits for the example: John Maloney)

Defining Classes: BankAccount

```
Object subclass: #BankAccount
  instanceVariableNames: 'balance'

balance
  ^ balance.
initialize
  balance := 0.
deposit: amount
  balance := balance + amount.
withdraw: amount
  (amount > balance)
     ifTrue: [^ self inform: 'No more money!'].
     balance := balance - amount.
```

BankAccount with History

- Extend class with history variable
  - Initialize with empty ordered collection

```
history := OrderedCollection new.
```

- Update history

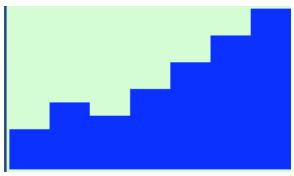
```
balance: newBalance
  balance := newBalance.
  history addLast: newBalance.
deposit: amount
  self balance: (balance + amount).
withdraw: amount
  (amount > balance)
   ifTrue: [^self inform: 'No more money!'].
  self balance: (balance - amount).
```


Graphical Object (Morph) for BankAccount

```
historyMorph
  "displays account history as barchart"
  | bars m |
  bars := history collect:
                    [:v | Morph new extent: 30@v].
  m := AlignmentMorph newRow
          hResizing: #shrinkWrap;
          vResizing: #shrinkWrap;
          cellPositioning: #bottomRight.
  m addAllMorphs: bars.
  ^m.
```

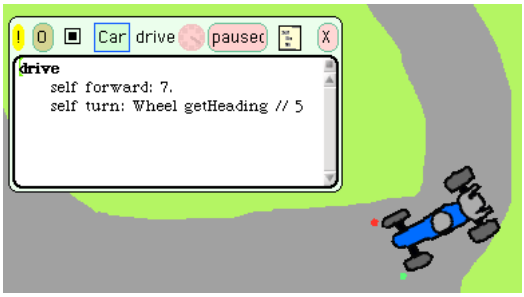
Make visible by:

```
acc historyMorph openInWorld.
```



EToys and Smalltalk

- EToy scripts can be switched between iconic or textual representation
- EToy scripts are found in the browser hierarchy
- EToy scripts are just shortcuts in writing Smalltalk



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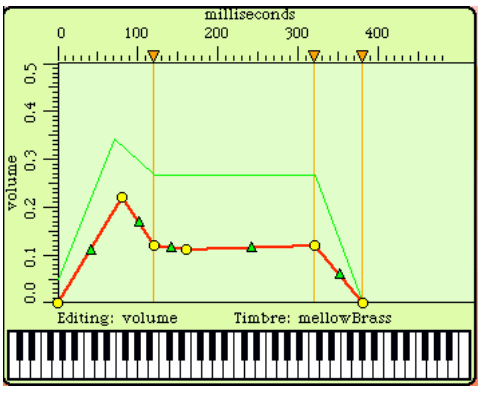
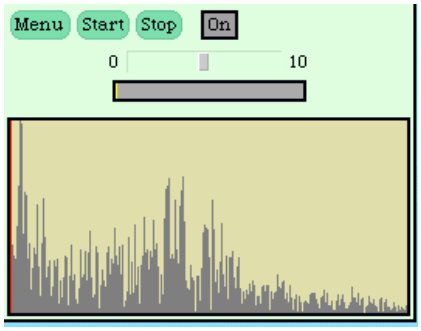
Wonderland: 3D Worlds in Squeak

- 3D objects can be moved around in intuitively simple manner
  - Prefabricated models
  - Simple self-drawn sketches (“Pooh drawings”)
- 3D objects are EToys.
- 3D objects can be manipulated with Smalltalk programs.

Squeak as a Multimedia Experimentation Platform

- Example: Sound in Squeak





Example: Playing Musical Notes in Smalltalk

```
instr := AbstractSound soundNamed: 'oboe1'.
note1 := instr soundForPitch: #c4 dur: 0.5 loudness: 0.4.
note2 := instr soundForPitch: #ef4 dur: 0.5 loudness: 0.4.
note3 := instr soundForPitch: #g4 dur: 0.5 loudness: 0.4.
(note1, note2, note3) play.
(note1 + note2 + note3) play.

song := AbstractSound noteSequenceOn: instr from: #(
    (c4 0.35 400)
    (c4 0.15 400)
    (d4 0.5 400)
    (c4 0.5 400)
    (f4 0.5 400)
    (e4 1.0 400)).
song play.
```