Concrete Abstractions for End-User Computing in Creative Applications

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Motivation

Motivation — Computer Music

Goal: Provide a better Computer-Music Environment

Capture intentions

Disclaimers

- We did not invent lambda calculus.
- We did not invent editing.
- Being a Programmer is a Good Thing.
- `eli@cs.bgu.ac.il`
- I just like music.

Propaganda

A fundamental concept of CS:

Express intentions using sharing and abstractions

- Reference objects by identities.
- Generalize common patterns.

Not only in CS...

Examples

- Natural language.
- Learning, remembering.
- Music is a good example.

Music and Programming

If programming is so great, just use it to make music:

- Common Music — extending Lisp with music.
  `http://sourceforge.net/projects/commonmusic`
- Haskore — a younger example in Haskell
  `http://www.haskell.org/haskore/`

A major problem with this approach...

Programming is Hard

- Takes years to be a good programmer.

  (still, even expert programmers have problems)

- Much worse for non-programmers.

  (many attempts, no substantial success)

- The challenge: programming power to the people.

  (composing is a good candidate)

Concrete Abstractions

- Suggested solution from Grame.

  `http://www.grame.fr/Research/`

- Basic idea: don't leave the concrete world.

Problems So Far

- Technicality: names.
- Domain extensions are problematic.
- Still complicated.
- Non-trivial examples are a mess.

Elody

A real system that implements these principles.

`http://www.grame.fr/Elody/`

Same Problems

- Still very complex.

  (requires almost the same effort as programming)

- Domain extension: can't unify the treatment of abstraction.

  (what is the meaning of "$\lambda C.CDC$"?)

  (similar problems in GCalc)

But. . .

The basic idea is still attractive:

- It *does* allow people to create functions without programming.
- All you need to know is music.

  (well, almost. . .)

Generalized Abstractions

What all this is trying to get at is a general way of discovering a function, given a concrete input/output pair.

- Works for what they have.
- Shows how it would behave in an ideal world.
  (applying "$\lambda 123\ .\ 123213$" on "5678" yields "5678765678")
- Impossible to get:
  ambiguous because there is no way to know the intention.
  ("$(\lambda 2\ .\ 4)3 =?$")

Ideal World

Assume that there was some black magic that made it possible.

- Still a problem: when we have some transformation in mind, we have to specify it indirectly through two concrete examples.
- Useful only in cases you *already have* two values.
- We use the computer to transform an object, then expect it to guess what we just did...

But this is a good hint for what we *can* do!

Back to Structure

- Creative activity is usually spontaneous.
- Still, the result is structured.
- We want both.

Editor Classification

- Roughly place editors on an extension—intension range.

  (WYSIWYG—hierarchy)

- WYSIWYG is usually preferred,

  (less “unrelated junk”)

- but the general direction is to add information on top.

Editor Classification

- Structure is unrelated to abstractions.
- Example: Elody vs. XFig.

Editor Classification

- Further distinguish between abstractions with and without structure.
- Value abstractions (done on a simple flat object).
- Structure abstractions (generated by references).

BOOMS

Question — can we have both.

- BOOMS was started as an attempt to have both.
- And other goodies to.
- Side goal: clean system.

Identities

Identities: an important feature.

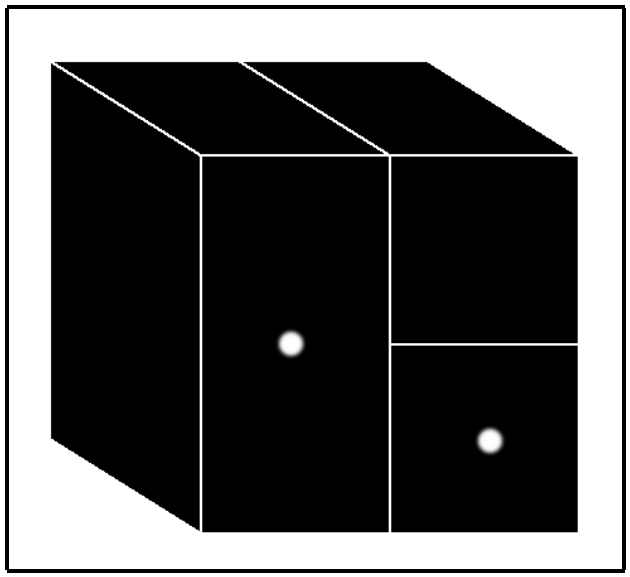
- Being the same vs. observably equal.
- Trivial with a structure editor.
- Impossible with extensional editors.

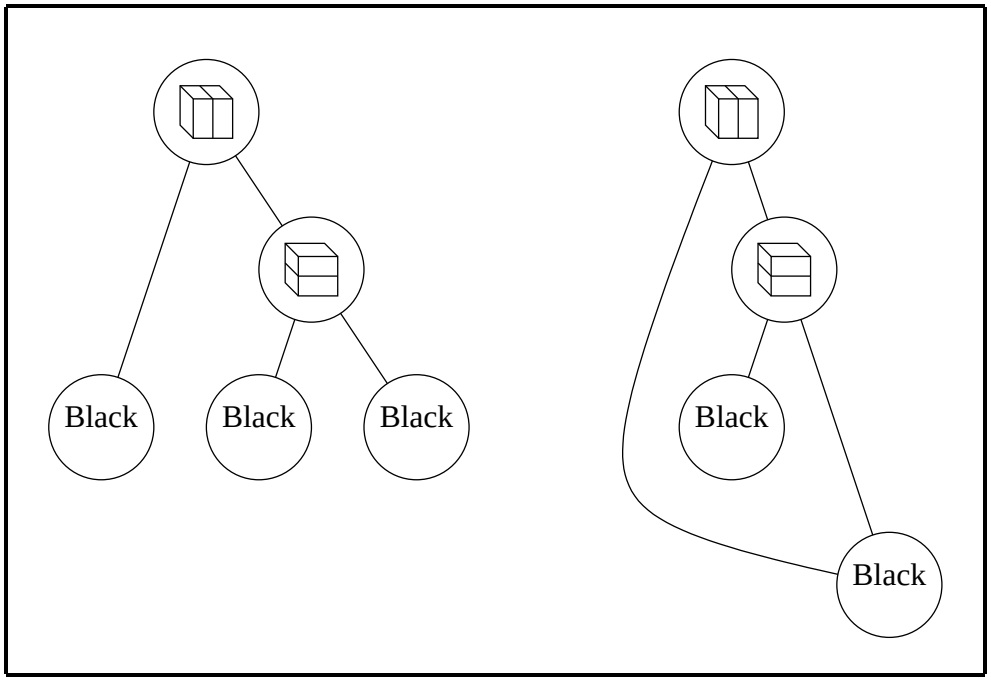
Abstractions can play an additional role to achieve this.

BOOMS

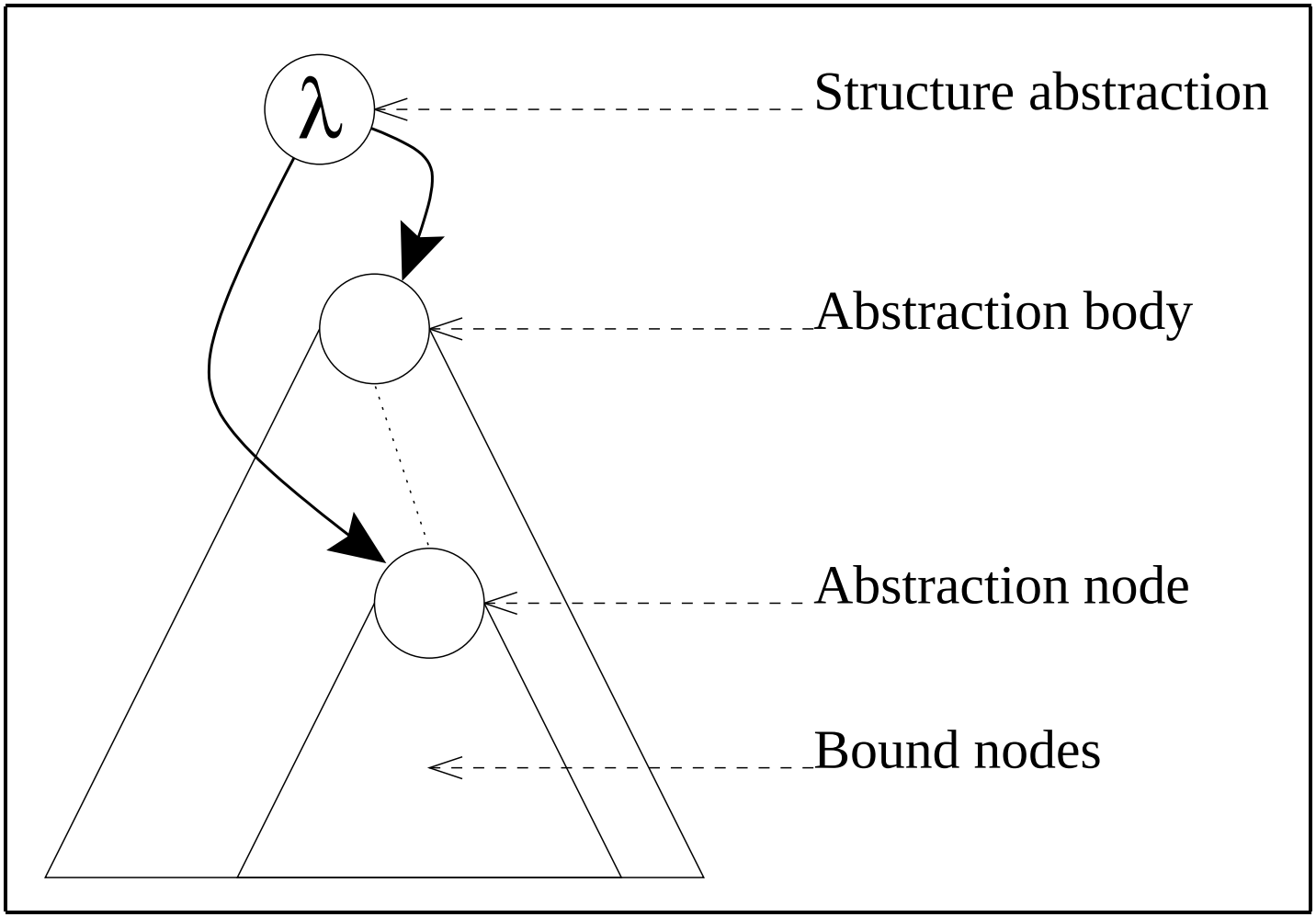
Demo.

Identity with Structures

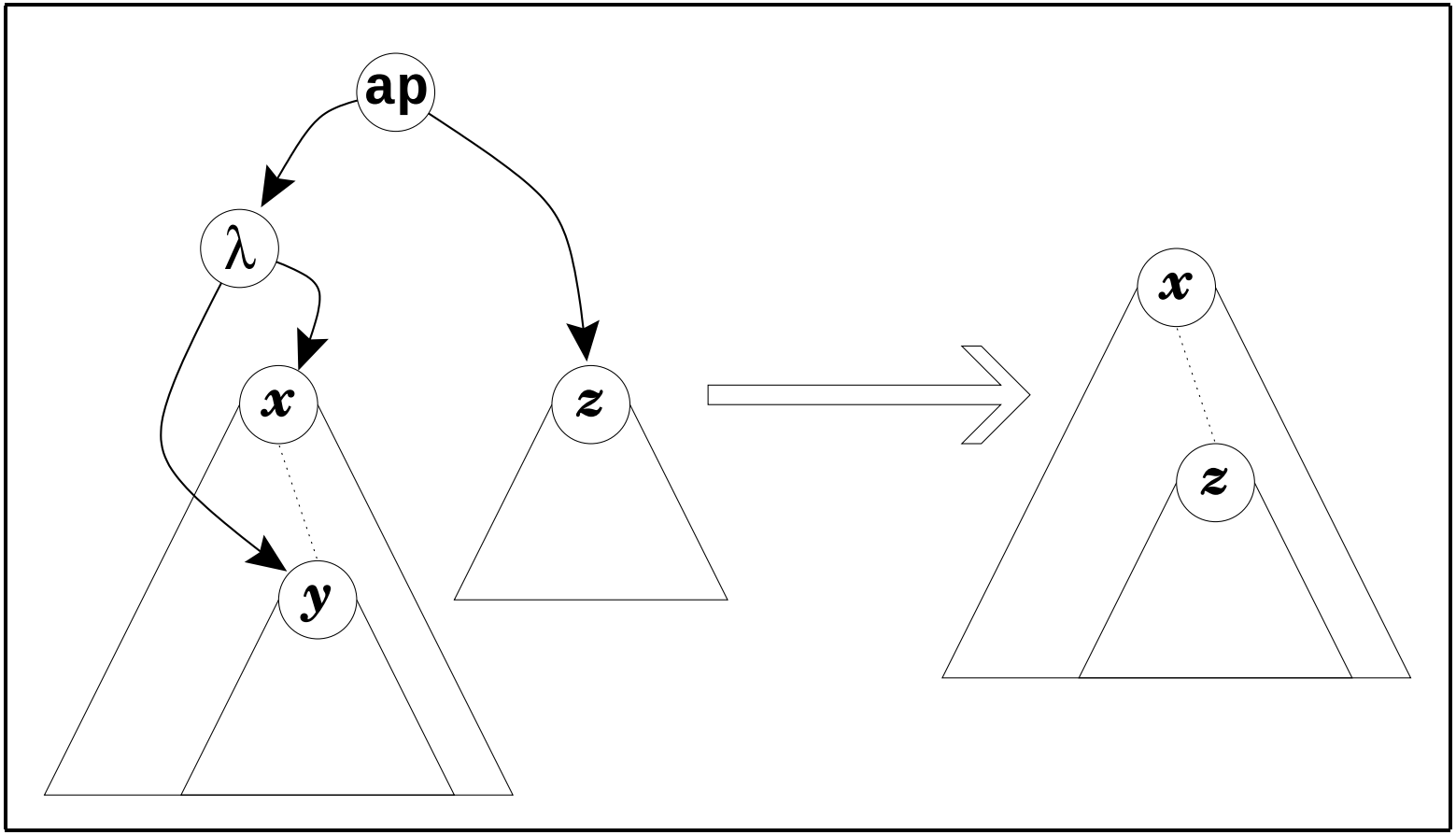




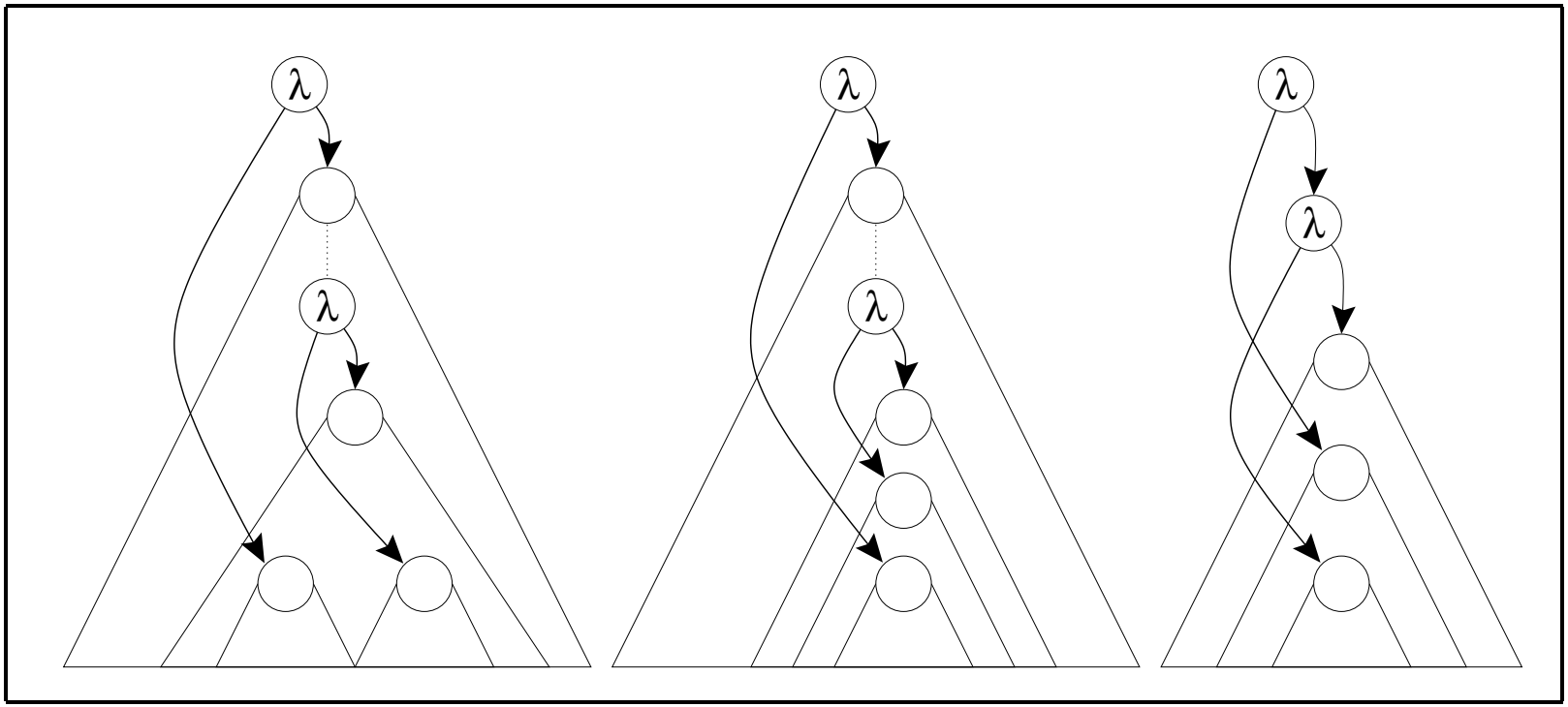
Structure Abstractions



Structure Abstractions



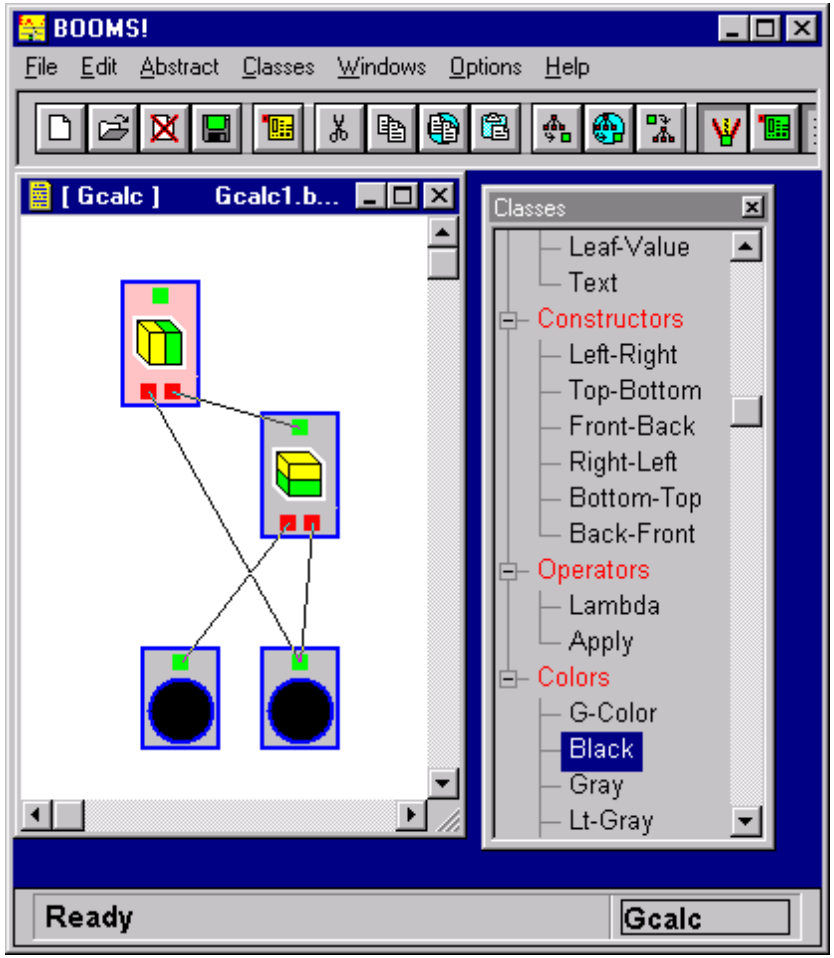
Restrictions on Structure Abstractions



Double View

- Obviously, structure editing is more expressive.
- But there is still an important advantage for extensional editing.
- Structure is on still distracting from the real object.

Double View

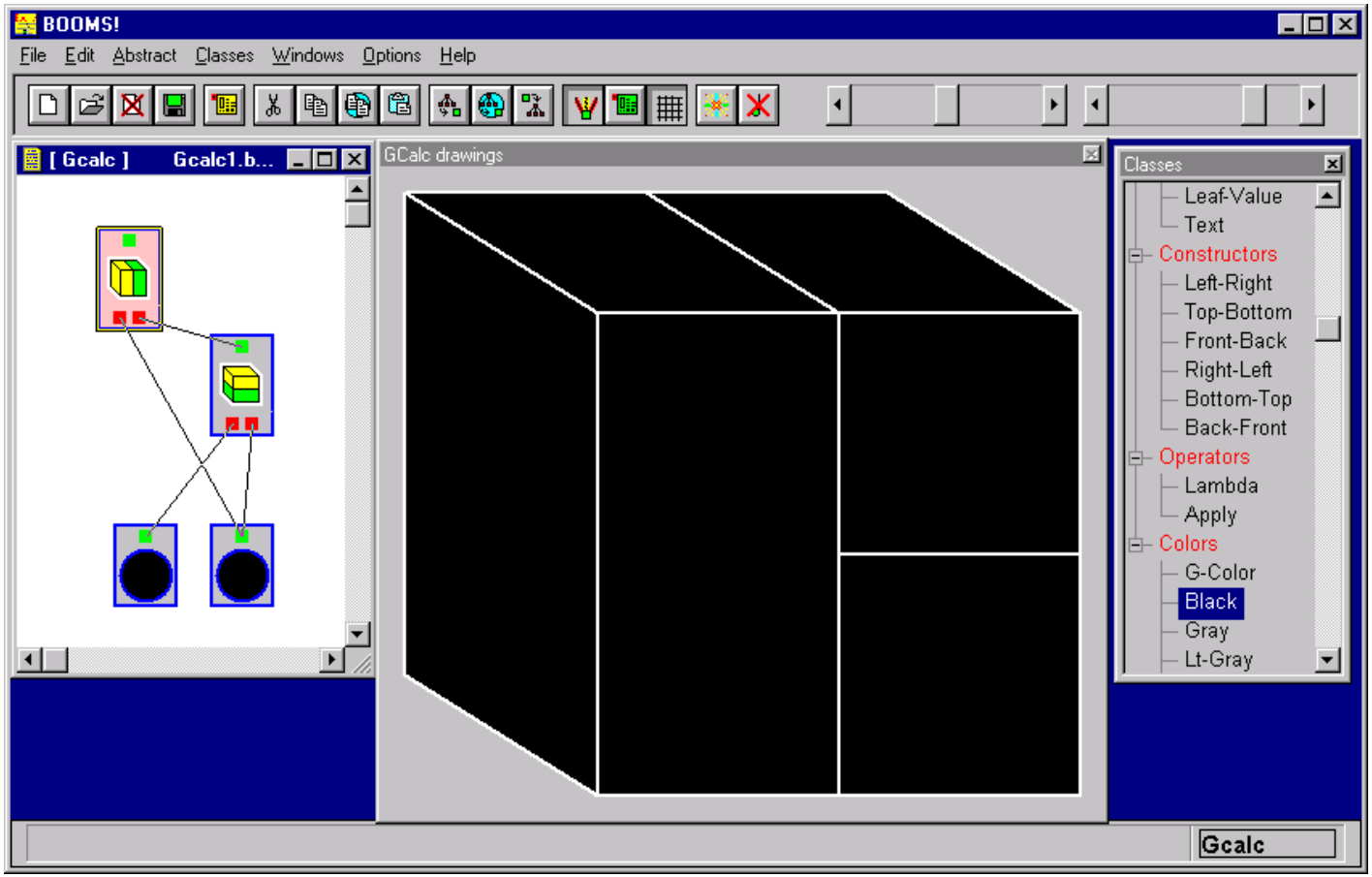


- Lose the immediate connection with the object you manage.
- Elody stuck to real world object and nothing more.
- So, we want to get both options.

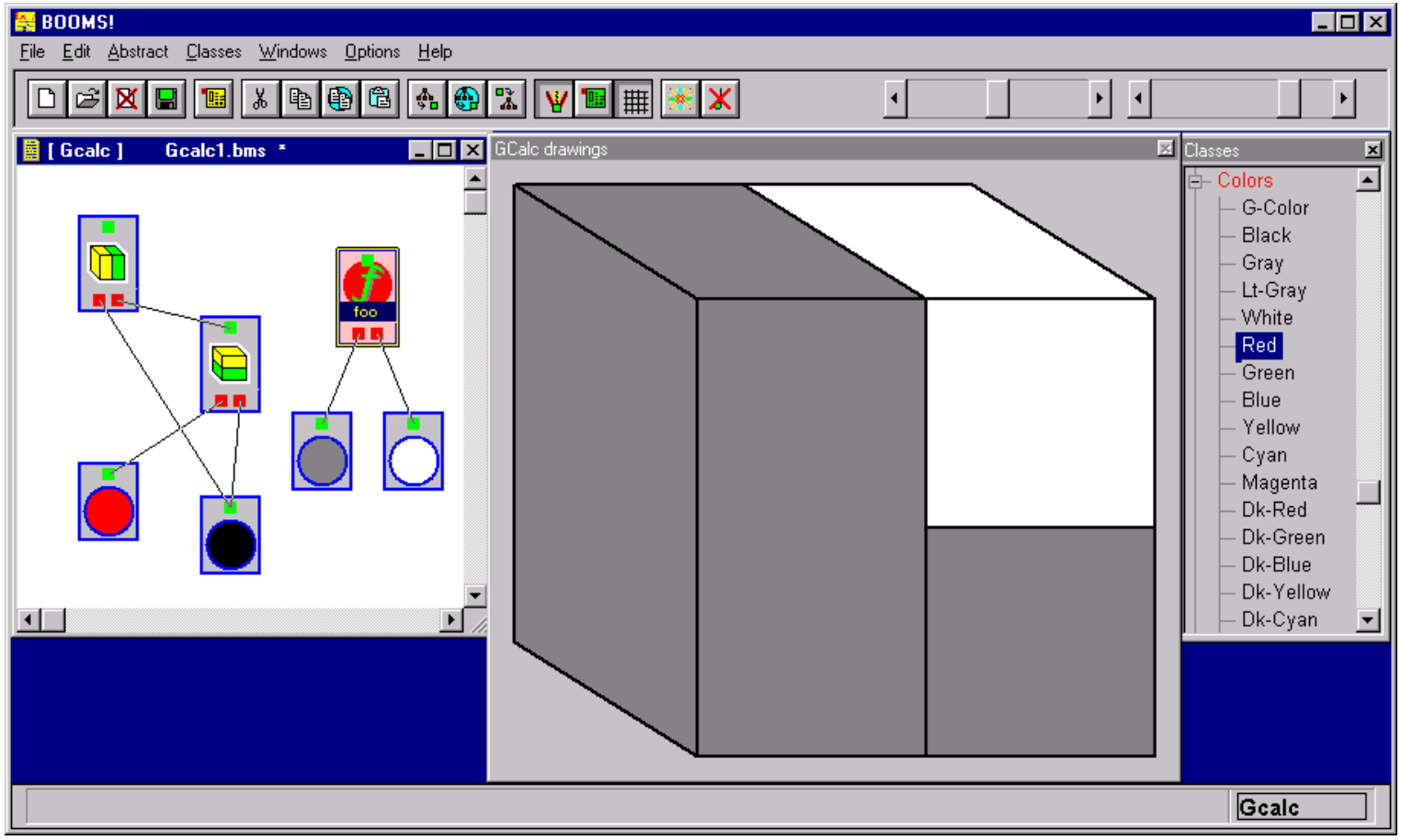
BOOMS and Elody

- Constructor nodes of BOOMS correspond to extensional editing operations.
- So why not let users do exactly that to create the hierarchy?
- While they work in an WYSIWYG environment, keep the generated editing structure.
- Example: copy-paste create a link to the same object.

Double View


BOOMS!
File Edit Abstract Classes Windows Options Help
[Gcalc]
Gcalc1.b...
GCalc drawings
Classes
Leaf-Value
Text
Constructors
Left-Right
Top-Bottom
Front-Back
Right-Left
Bottom-Top
Back-Front
Operators
Lambda
Apply
Colors
G-Color
Black
Gray
Lt-Gray
Gcalc

Double View


BOOMS!
File Edit Abstract Classes Windows Options Help
[Gcalc] Gcalc1.bms *
foo
GCalc drawings
Classes
Colors
G-Color
Black
Gray
Lt-Gray
White
Red
Green
Blue
Yellow
Cyan
Magenta
Dk-Red
Dk-Green
Dk-Blue
Dk-Yellow
Dk-Cyan
Gcalc

Double View

- Claim: useful structures will be created.
- The hierarchy can be used to express sharing as well as abstractions.

Getting Value Abstractions Back

- There is no problems in having this together with Elody's value abstractions.
- BOOMS has 'normal' abstraction and application nodes, corresponding to these Elody editing operations.
- It is also useful to solve the problem of making music from single notes in BOOMS.

Interaction Modes

Users will move:

- from a WYSIWYG-oriented mode,
- to understanding and using the hierarchy on occasions,
- to finally using it in its full power.

  (still using the WYSIWYG view)

Bottom Line

Such a hybrid system has all the benefits of both editing modes, while keeping away from irrelevant language formalism.