

Fast And Robust Interface Generation for Ubiquitous Applications

The SUPPLE Project

University of Washington, Seattle

Krzysztof Gajos, David Christianson,
Raphael Hoffmann, Tal Shaked, Kiera Henning,
Jing Jing Long, and Daniel S. Weld

Automatic, On The Fly
Fast And Robust Interface
Generation for Ubiquitous
Applications

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Motivation



Motivation

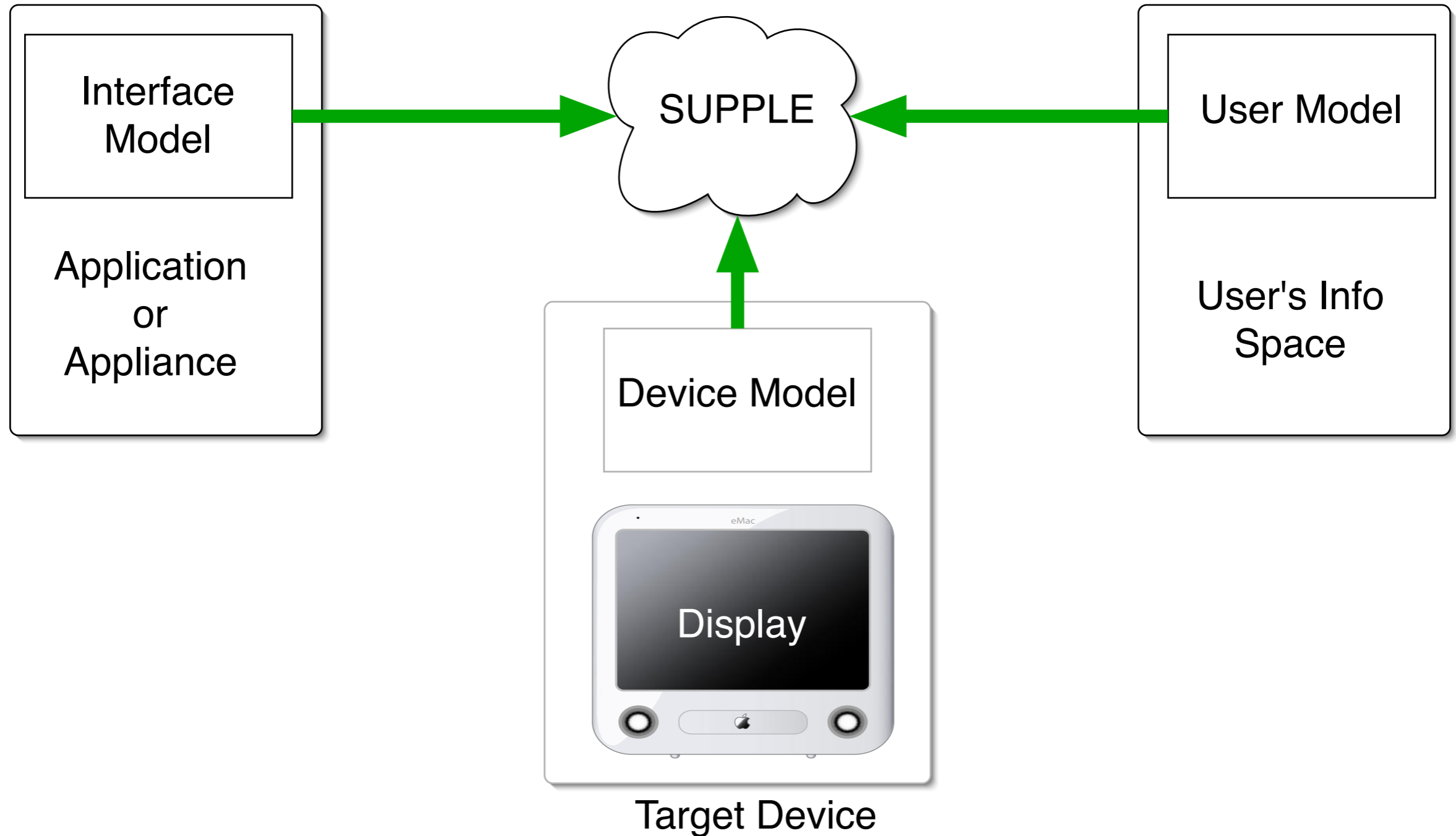
- Variety of display devices & interaction contexts makes hand-designed interfaces expensive
 - ⇒ Adapt to **device characteristics**
- Current interfaces: complex & “One size fits all”
 - ⇒ Adapt to **users** and **tasks**

⇒ Automatic interface generation is a scalable solution

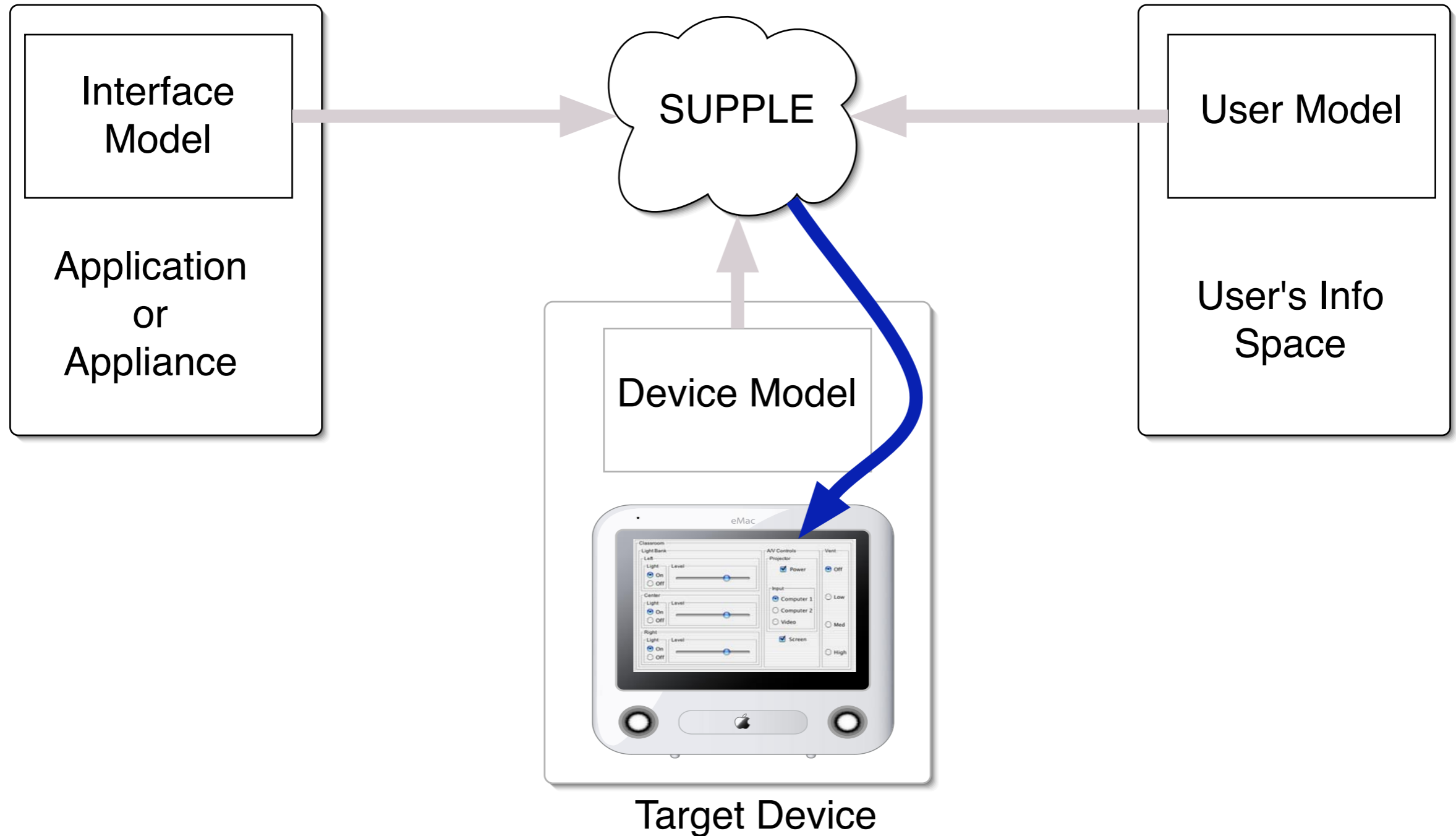
Approach

- Develop abstract representation for:
 - Interfaces
 - Display devices
 - Users
- Automatically generate interfaces from the abstractions

SUPPLE Architecture



SUPPLE Architecture



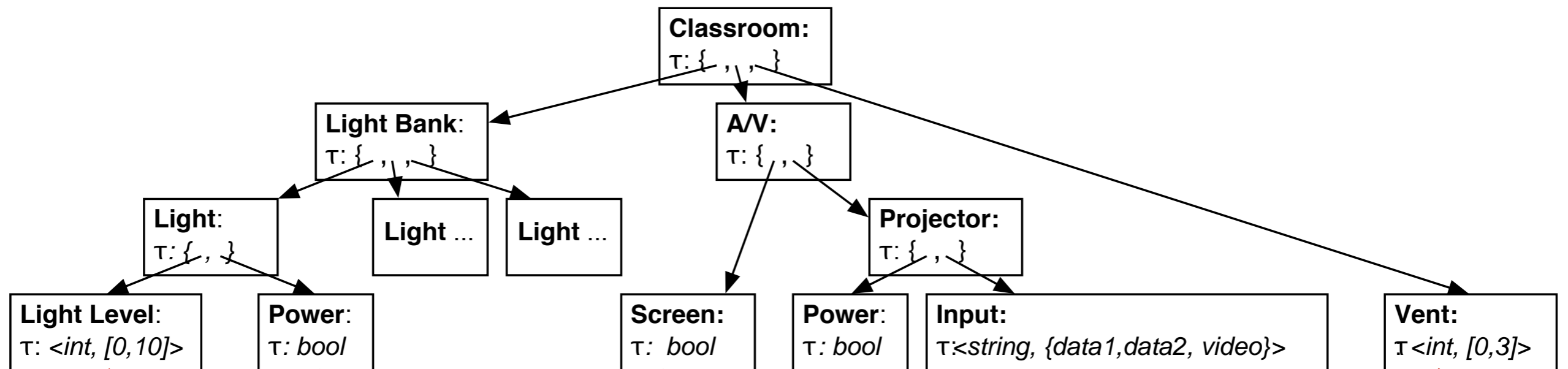
Road Map

- Motivation
- Modeling user interfaces in SUPPLE
- User interface generation as optimization
- Automatically adapting user interfaces
 - A preliminary user study
 - Adaptation in SUPPLE
- Customization support in SUPPLE
- Conclusions

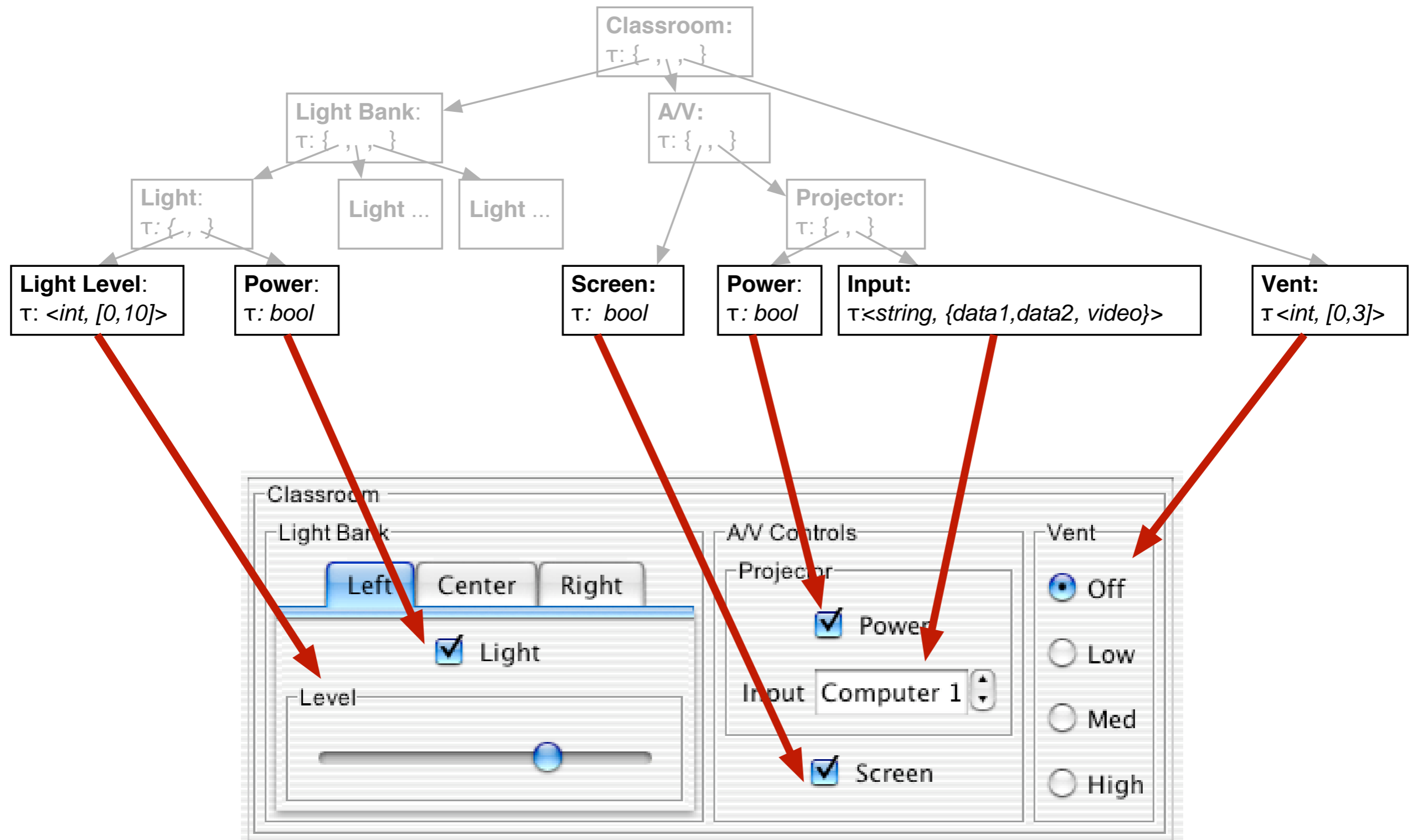
Modeling User Interfaces

- simple types: `int|float|string|bool`
- media types: *image|interactiveMap*
- containers: $\{\tau_i^{i \in 1 \dots n}\}$
- derivative types: $\langle \tau, \mathcal{C}_\tau \rangle$
- vectors: `vector(τ)`
- actions: $\tau_1 \rightarrow \tau_2$

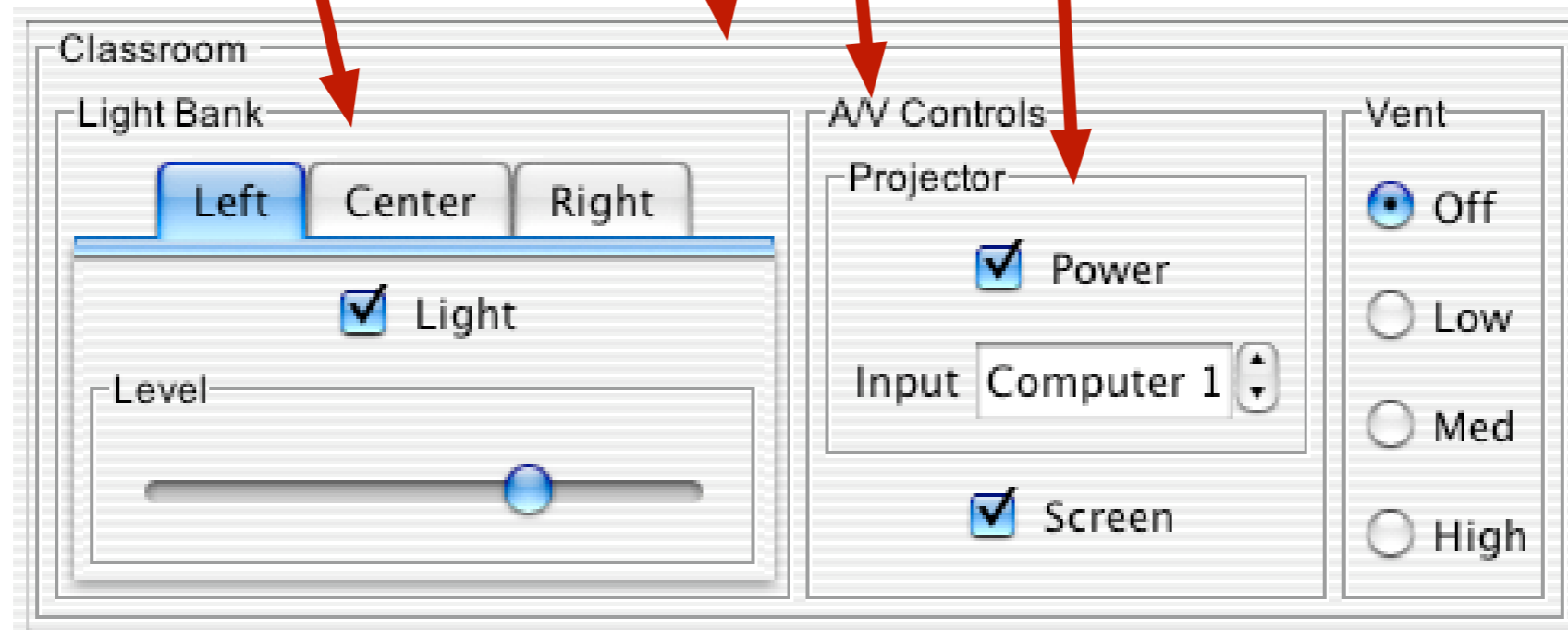
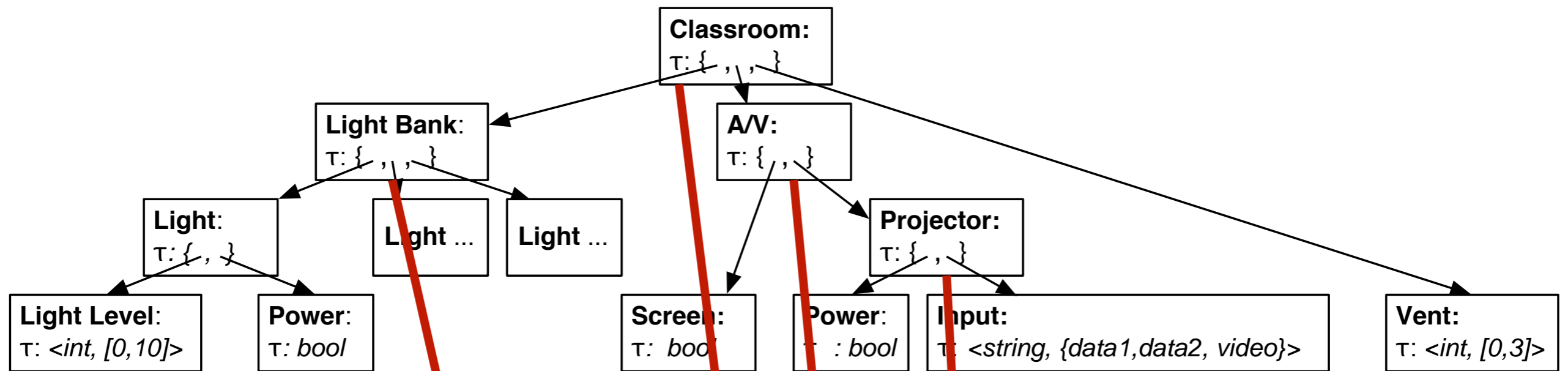
Modeling User Interfaces



Modeling User Interfaces



Modeling User Interfaces



Properties

Folders

- New Folder
- Junk-E-Mail
- New Folder 1
- New Folder 2
- Unerwünscht**
- Unbekannt
- INBOX
- Entwurf
- Papierkorb
- Gesendet
- Postausgang

- New
- Rename
- Delete
- Expunge

Messages

- 25.04 04:40 PM NOEL GARNET <XTHFREZONZHS@BIBEWELL.COM>
- 25.04 05:36 AM Suzette Schulz <CHWIZOKAIVQ@ADSVISION.COM> Sandy, check it out
- * 25.04 05:25 AM Elsie Bassett <BECEZKRWRTH@ACCESSIBLEINFO.COM> No Obliiii gation
- * 24.04 10:00 PM Fred Pace <jbibktyesnamt@beveragebooks.com> Professional Loans w
- * 24.04 02:36 PM OEM on Sale <zvrjhn@hurting.com> Get 96% Dis.counted OEM Microsc
- 24.04 06:01 AM Stephen Hood <Vern@be-lax.com> What do you think
- 24.04 04:35 AM Vito Aguirre <Guidry@ilovethemovies.com> Lose it
- 24.04 03:19 AM Meghan <hwdwysowbypek@jornaldiario.com> Swiss meds
- 24.04 02:42 AM Perdue <HMHTV@merseymail.com> , who do u want 2 win?
- 23.04 04:42 PM Thekla Upchurch <mira53.mcclimons@freemail.com.ua> Heisse News**
- 23.04 02:05 PM Anthony Wright <dhsqinsvfmvot@visinweb.com> Hi !!D

Details

Details

Senders: Thekla Upchurch <mira53.mcclimons@freemail.com.ua>
 Date: 23.04 04:42 PM
 Recipients: Olaf <supple@web.de>
 Subject: Heisse News

Content

Flatratesex, für nur 14,99 Euro kannst Du Dir einen monat lang über 200
 Private Livecams
 anschaun, dazu noch unzählige Bilder und Videos, ohne 0190 ohne versteckte
 Kosten.
 Der absolute Hammer !

<http://www.sexania.com>

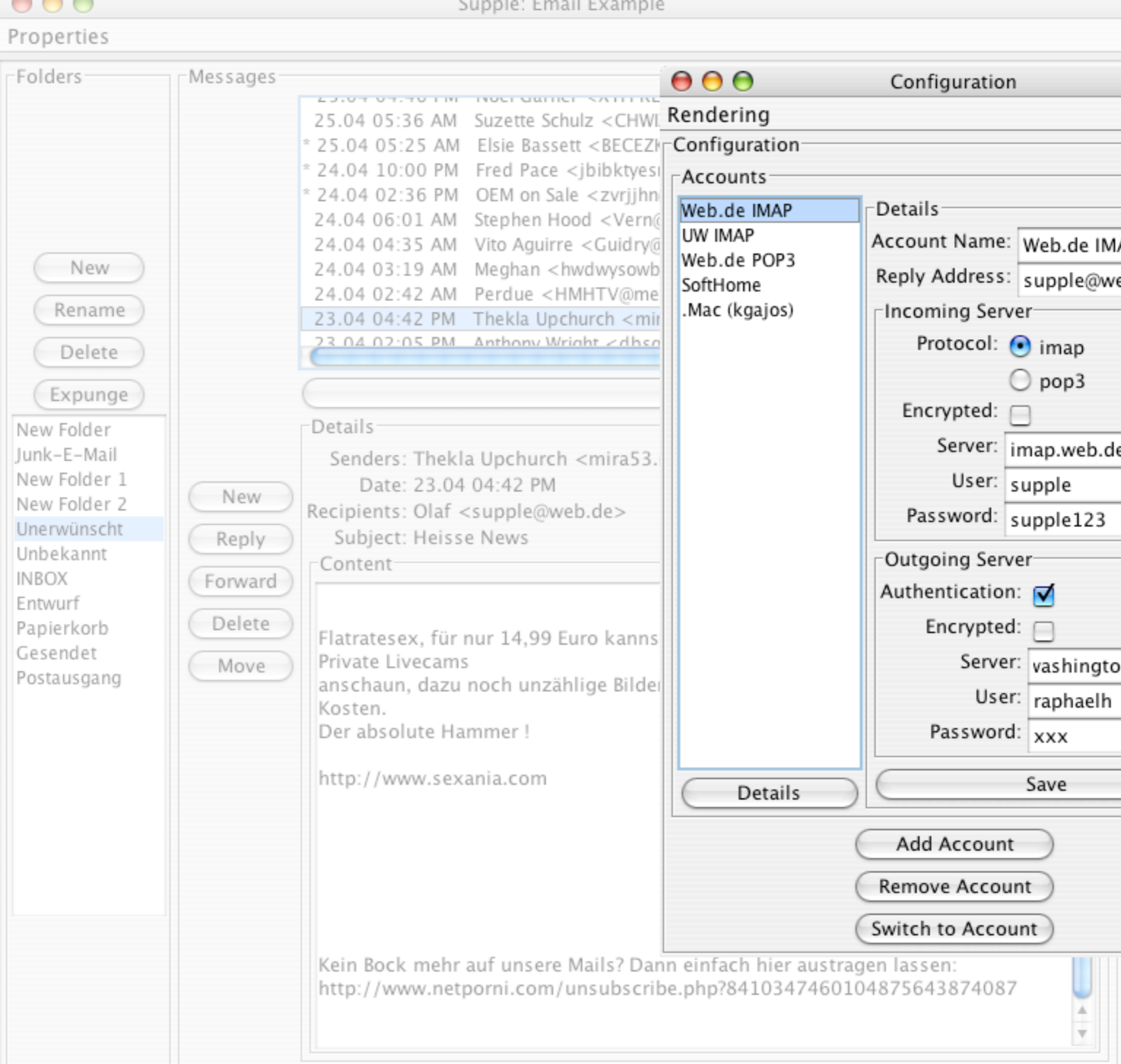
Kein Bock mehr auf unsere Mails? Dann einfach hier austragen lassen:
<http://www.netporni.com/unsubscribe.php?8410347460104875643874087>

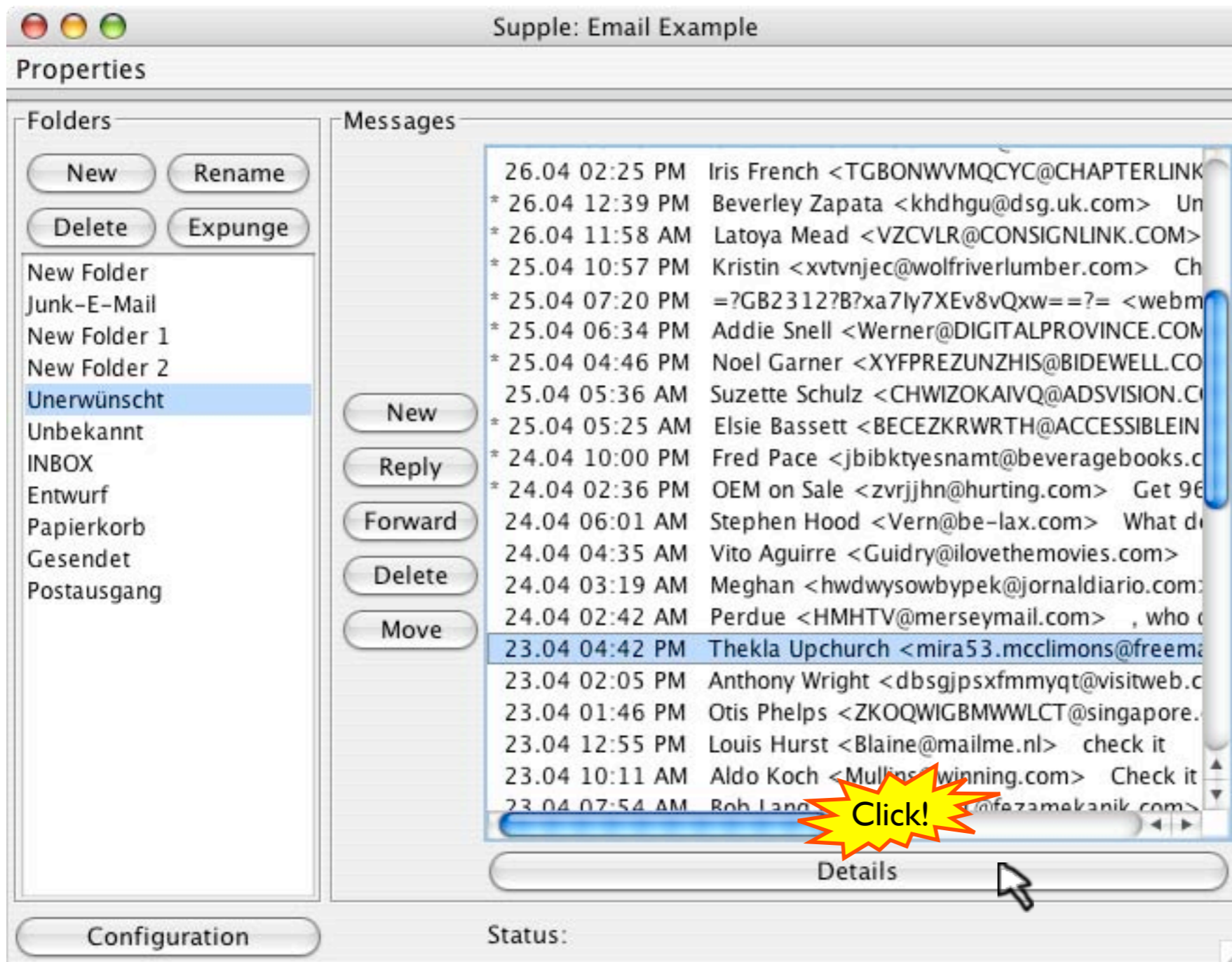
- New
- Reply
- Forward
- Delete
- Move

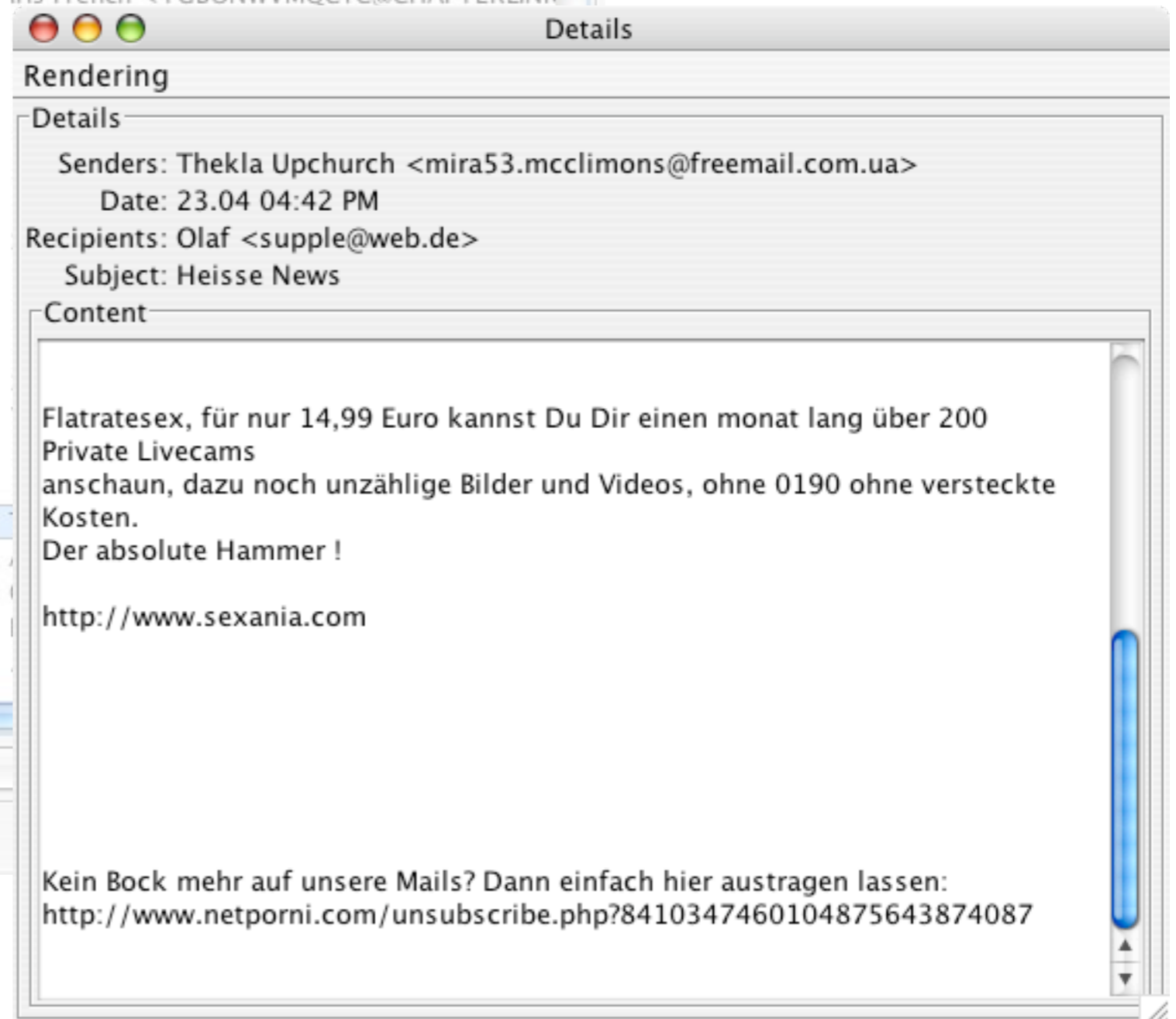
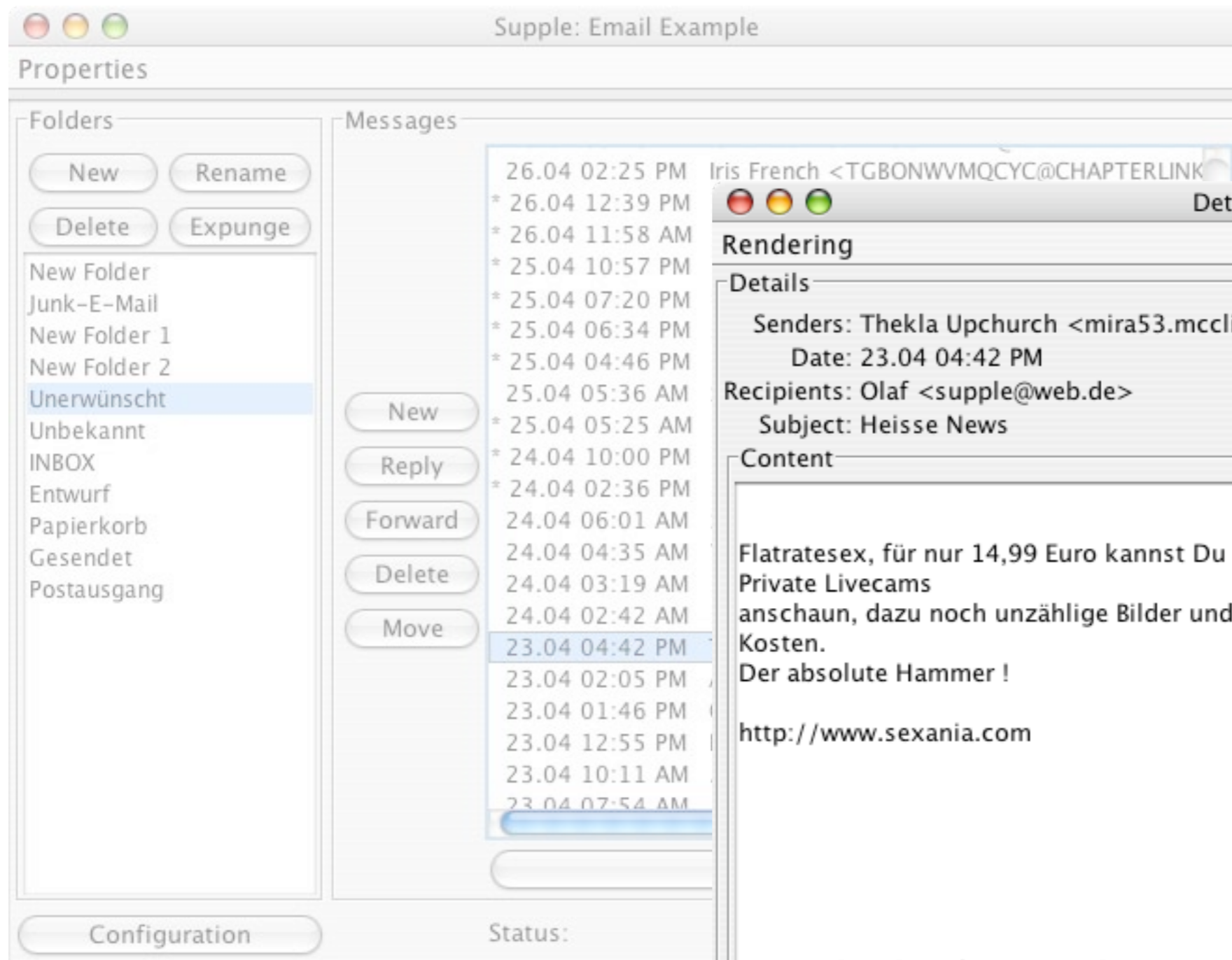
Configuration

Status:









Media Types

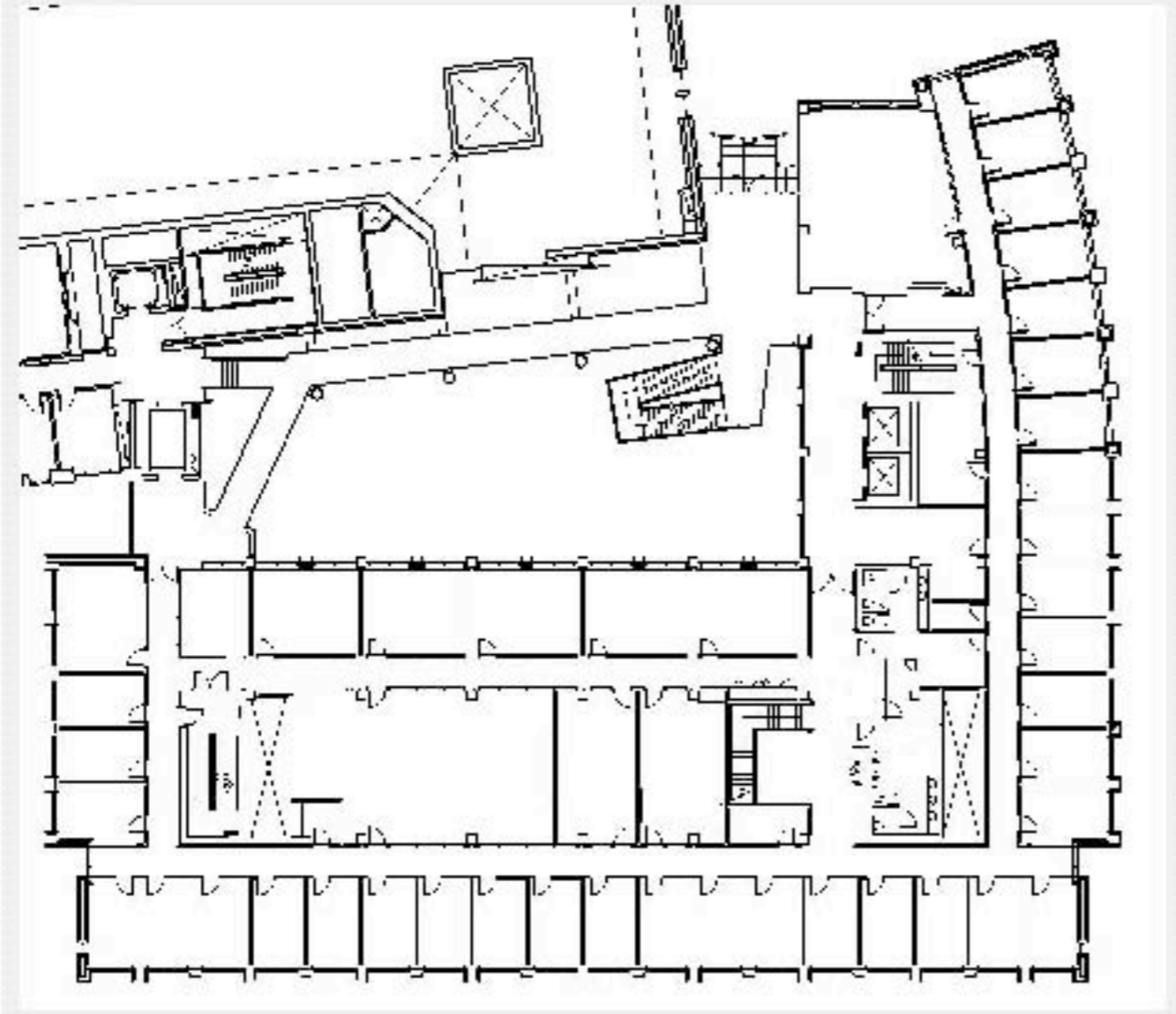
Supple: Map Demo

Properties

Map Demo

Pick a location


The Map



Location: (847.0,240.0)

Info

Photo



Name: Dan
Office: 588

Subtyping

Properties

SUPPLE | UW CSE

Amazon Search


Search: digital cameras

Search

Search Results

Understanding Exposure: How to Shoot Great Photographs with a Film or Digital Camera
Shooting Digital: Pro Tips for Taking Great Pictures with Your Digital Camera
How To Do Everything with Your Digital Camera by Dave Johnson
50 Fast Digital Camera Techniques by Chris Maher
202 Digital Photography Solutions : Solve Any Digital Camera Problem in Ten Minutes
TechTV's Digital Camera and Imaging Guide by Les Freed
Amphoto's Complete Book Of Photography: How to Improve Your Pictures With Your Digital Camera
Learn the Canon EOS Digital Rebel Camera for 5 Bucks (Learn...for 5 Bucks)
Get The Most From Your Digital Camera by Simon Joinson
Portable Electronics Product Design & Development : For Cellular Phones, PDA's, and More

Details



Product: 50 Fast Digital Camera Techniques
Price: \$24.99

Click!

More details

SUPPLE | UW CSE

Properties

Amazon Search


Search: digital cameras

Search

Search Results

Understanding Exposure: How to Shoot Great Photographs with a Film or Digital Camera
Shooting Digital: Pro Tips for Taking Great Pictures with Your Digital Camera
How To Do Everything with Your Digital Camera by Dave Johnson
50 Fast Digital Camera Techniques by Chris Maher
202 Digital Photography Solutions : Solve Any Digital Camera Problem in Ten Minutes
TechTV's Digital Camera and Imaging Guide by Les Freed
Amphoto's Complete Book Of Photography: How to Improve Your Pictures With Your Camera
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Details



Product: 50 Fast Digital Camera Techniques
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More details

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Title: 50 Fast Digital Camera Techniques
Author: Chris Maher
Price: \$24.99
Publisher: Wiley

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Search Results

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 202 Digital Photography Solutions : Solve Any Digital Camera Problem in Ten Minutes
 TechTV's Digital Camera and Imaging Guide by Les Freed
 Amphoto's Complete Book Of Photography: How to Improve Your Pictures With Your Digital Camera
 Learn the Canon EOS Digital Rebel Camera for 5 Bucks (Learn...for 5 Bucks)
 Get The Most From Your Digital Camera by Simon Joinson
 Portable Electronics Product Design & Development : For Cellular Phones, PDA's, and More

Details



Product: 50 Fast Digital Camera Techniques
 Price: \$24.99


More details

Details



Title: 50 Fast Digital Camera Techniques
 Author: Chris Maher
 Price: \$24.99
 Publisher: Wiley

Details



Product: Canon PowerShot A95 5MP Digital Camera
 Price: \$379.95

Features

- Highly advanced 5.0-megapixel digital camera camera with 3x optical/4.1x digital/12x combined zoom
- 14 shooting modes, with special Scene Modes for spectacular shots in special situations
- New, larger 1.8-inch vari-angle LCD monitor for easier image preview and review
- 9-point AiAF plus FlexiZone AF/AE for off-center subjects
- New Print/Share button for easy direct printing and downloads

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- Conclusions

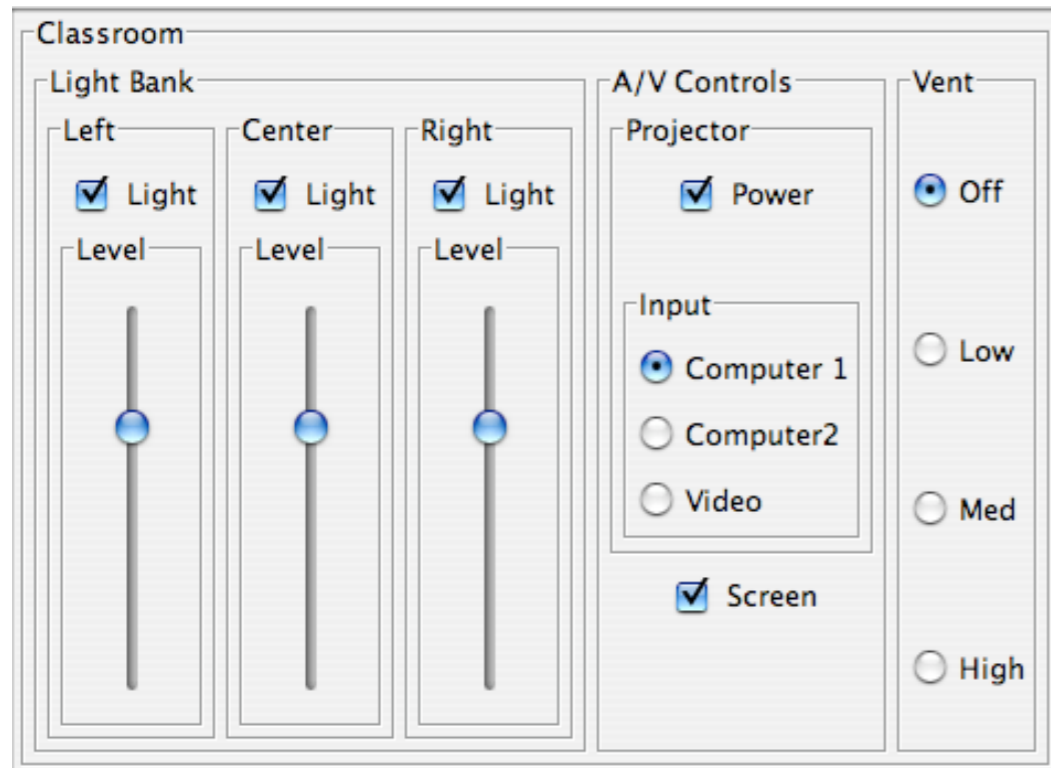
User Interface Generation as Optimization

- Driven by a **Cost function** (\$) -- estimated user effort to manipulate a rendering of the interface
- Cost function derived from device model
- Algorithm: branch-and-bound search with full constraint propagation at each step
- Performance: 0.2 - 2.0 seconds on a desktop computer

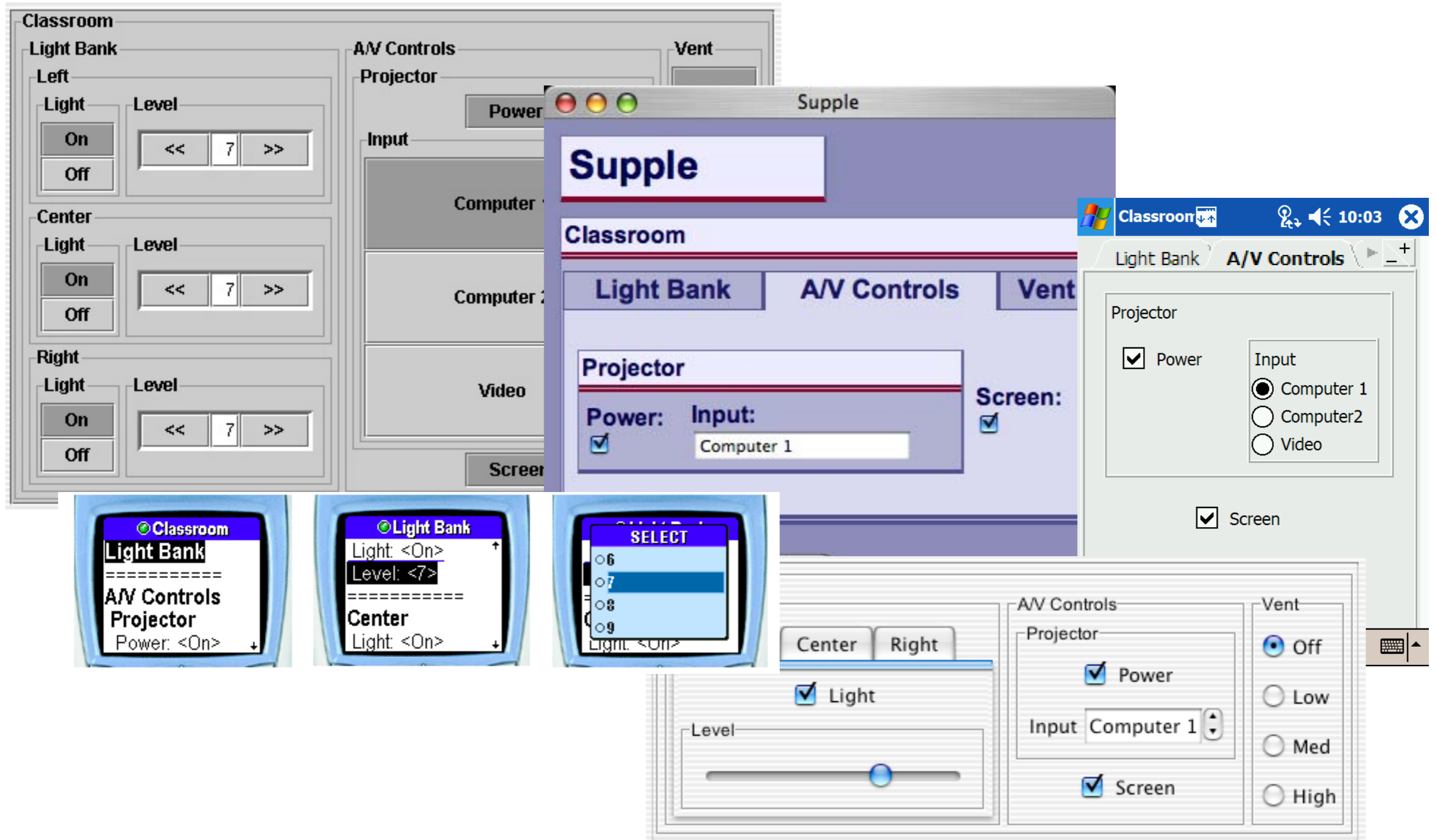
User Interface Generation as Optimization

- **Flexible** with respect to screen size
- **Versatile:** Same algorithm for different devices
- Allows new concerns to be included in the rendering process, e.g.:
 - Cross-device **consistency**
 - **Adaptation** to usage patterns

Robustly Adapting to Different Screen Sizes

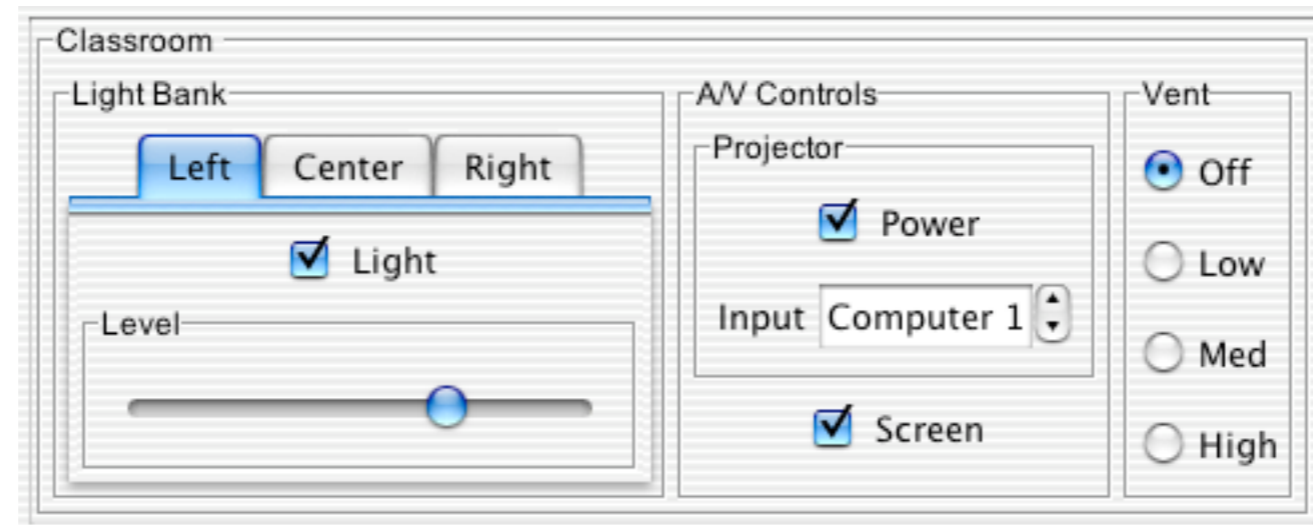


Single Algorithm -- Many Devices

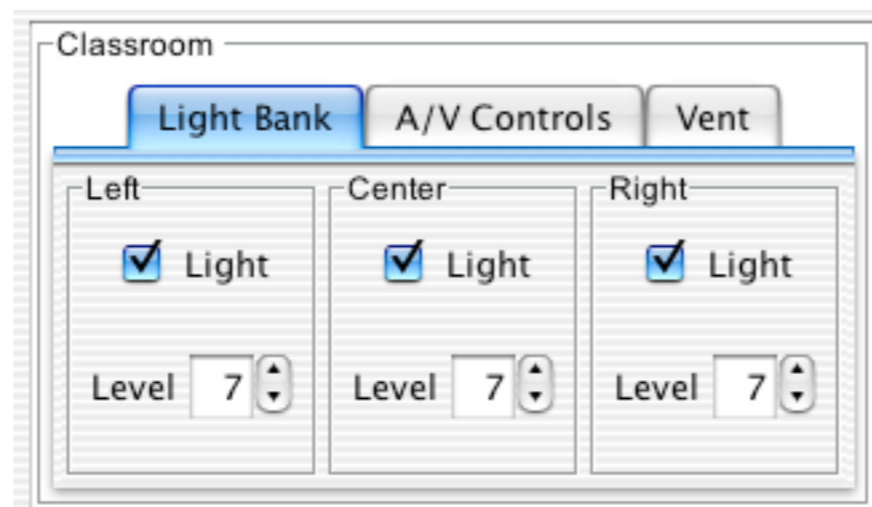


Adapting To Usage Patterns

SUPPLE with
an empty
trace



SUPPLE with a
“lights-heavy”
trace

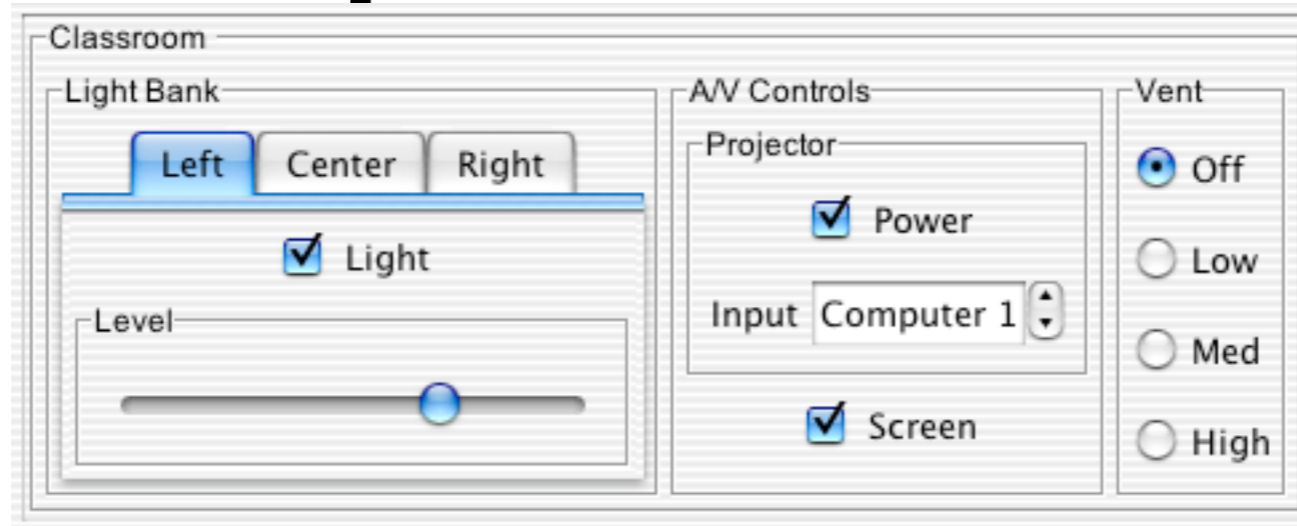


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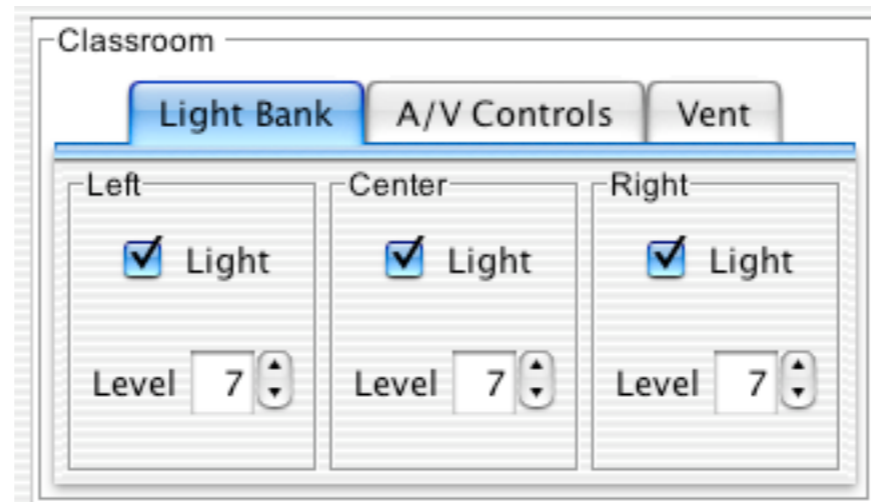
Adapting To Usage Patterns By Complete Makeover

SUPPLE with
an empty
trace

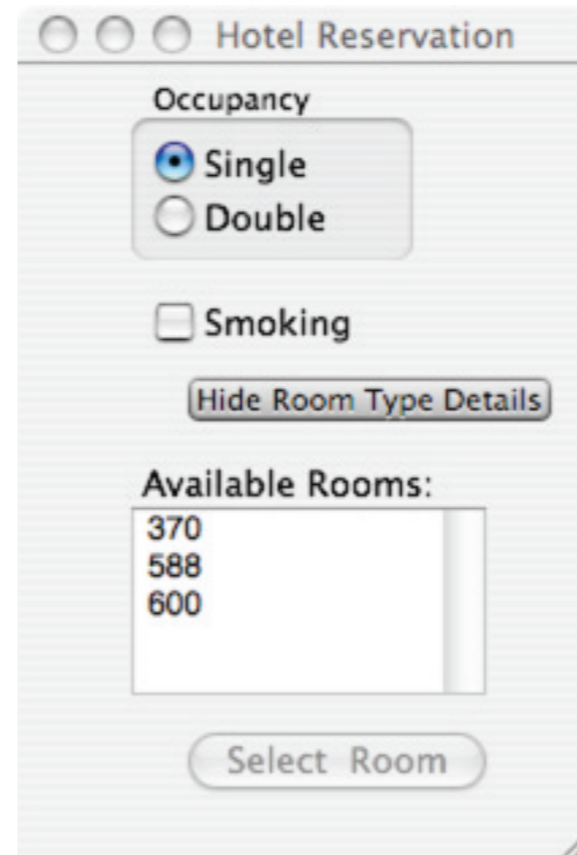
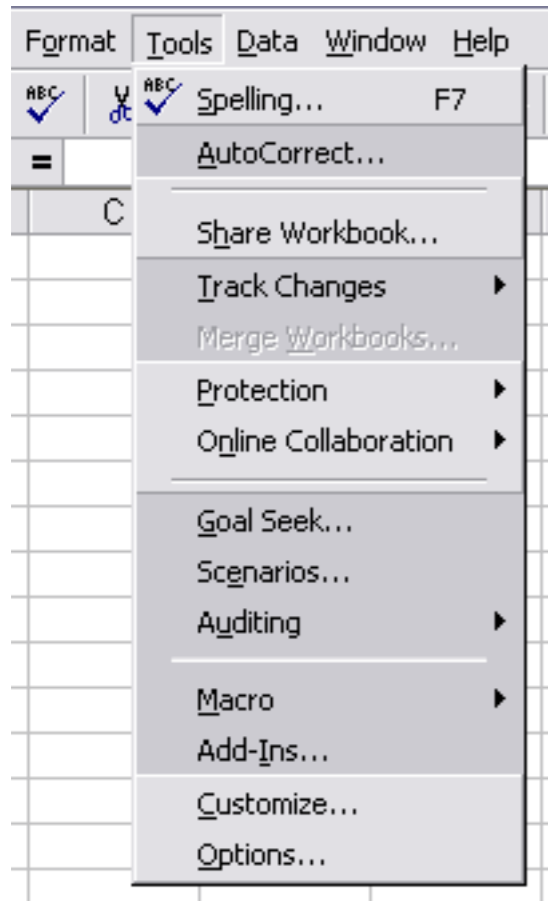


Is this the only way to adapt?

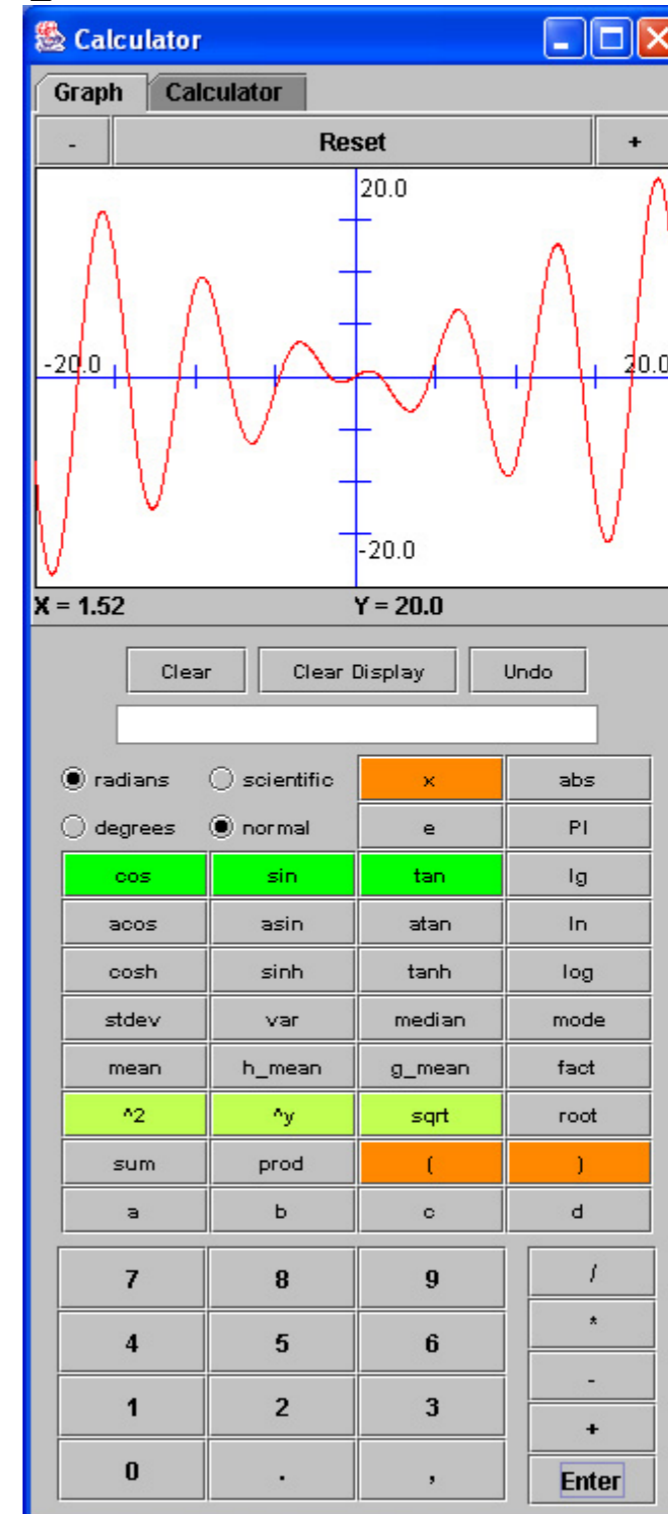
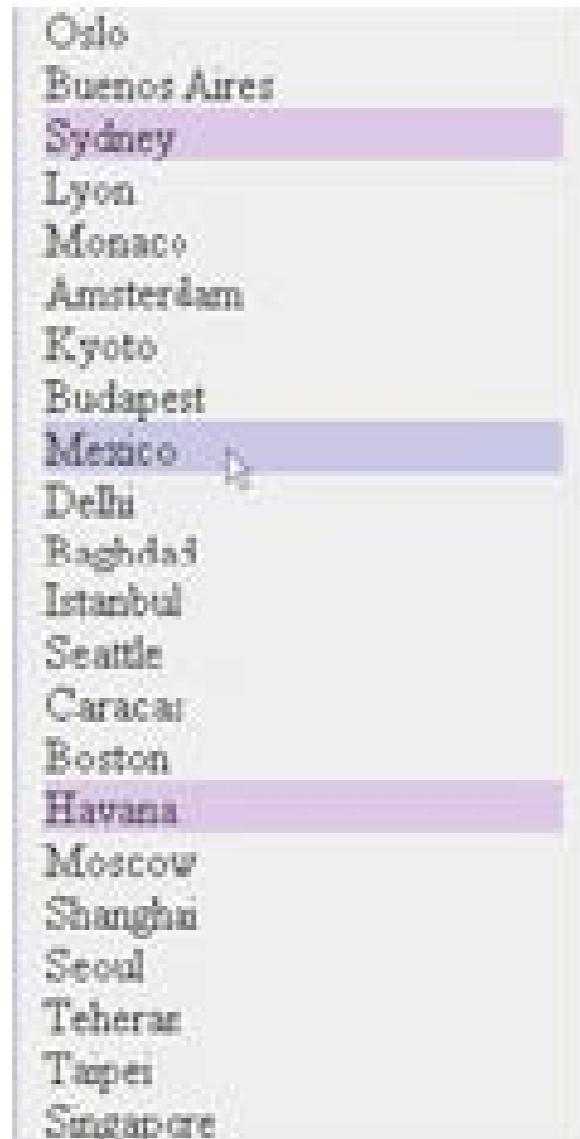
SUPPLE with a
“lights-heavy”
trace



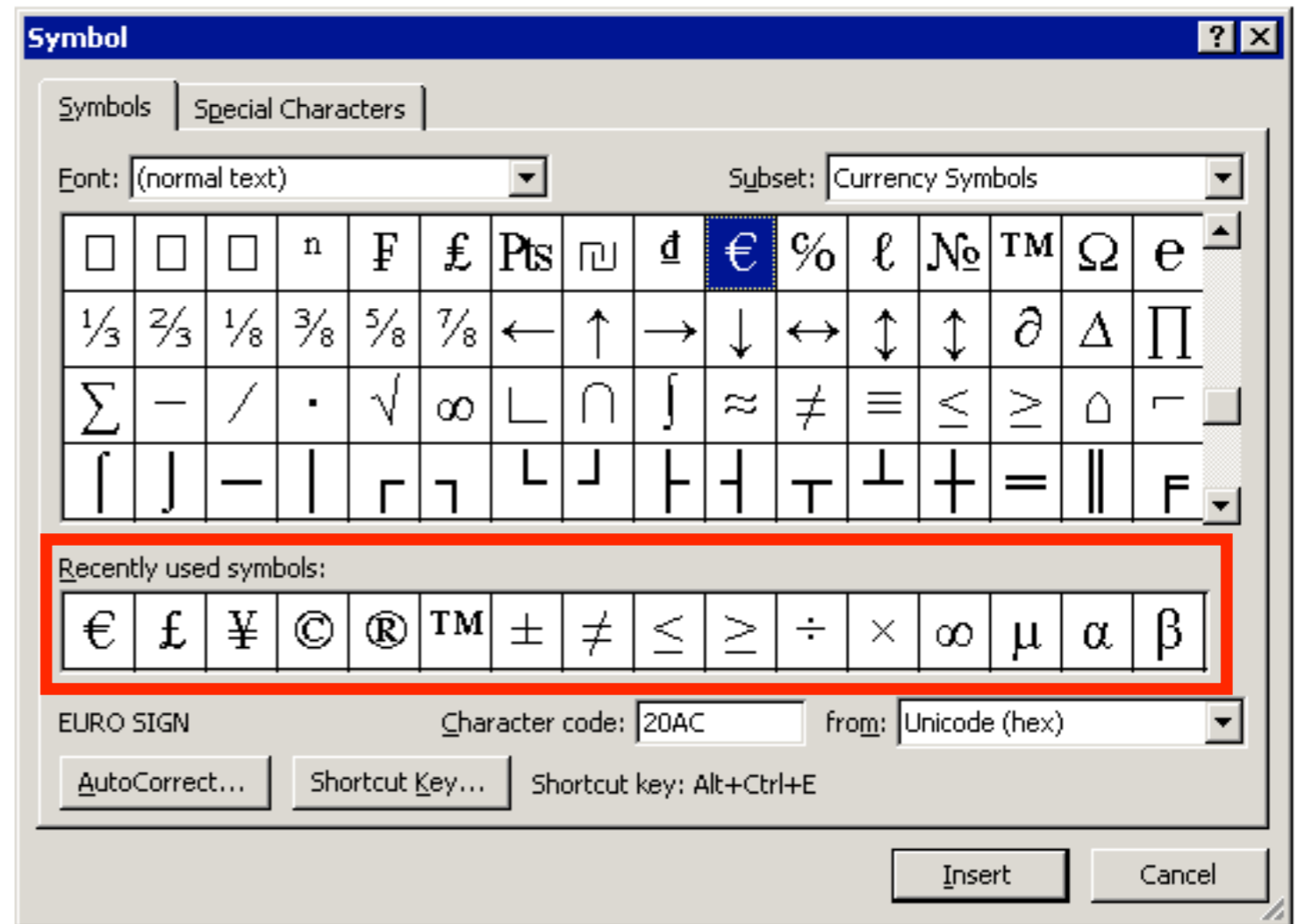
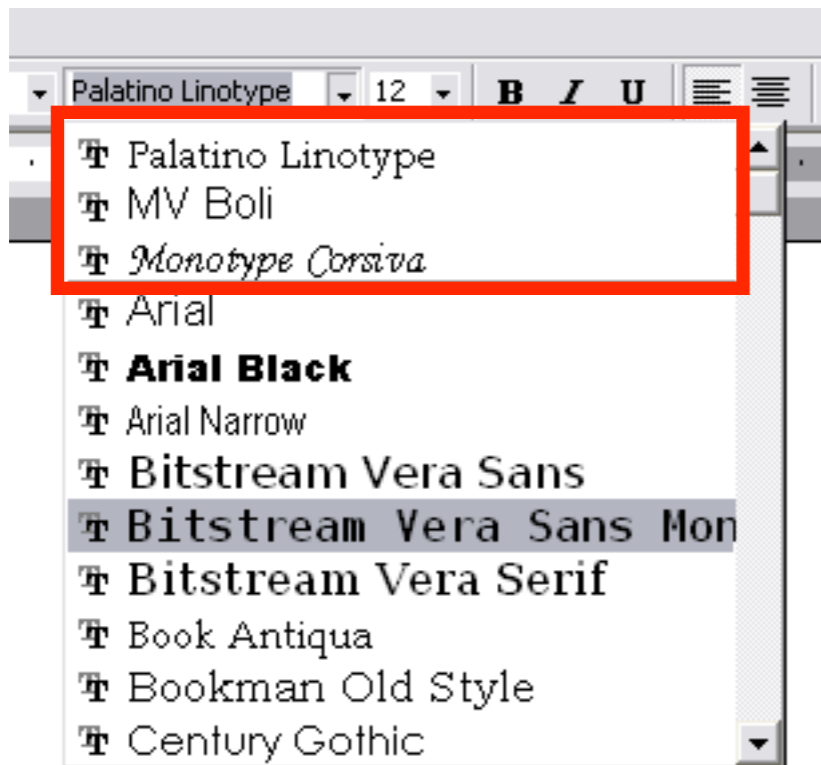
Content Eliding



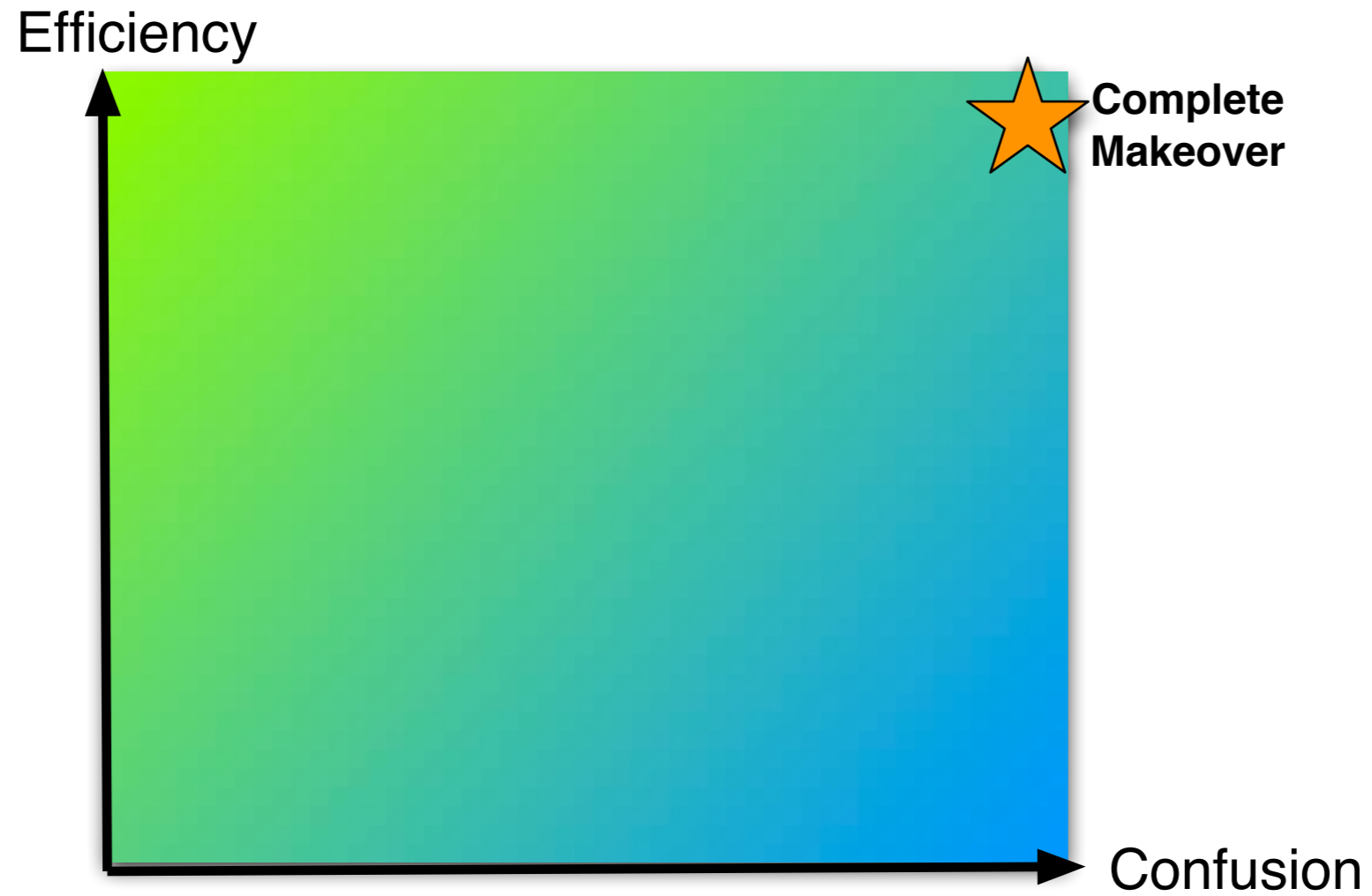
Visual Popout



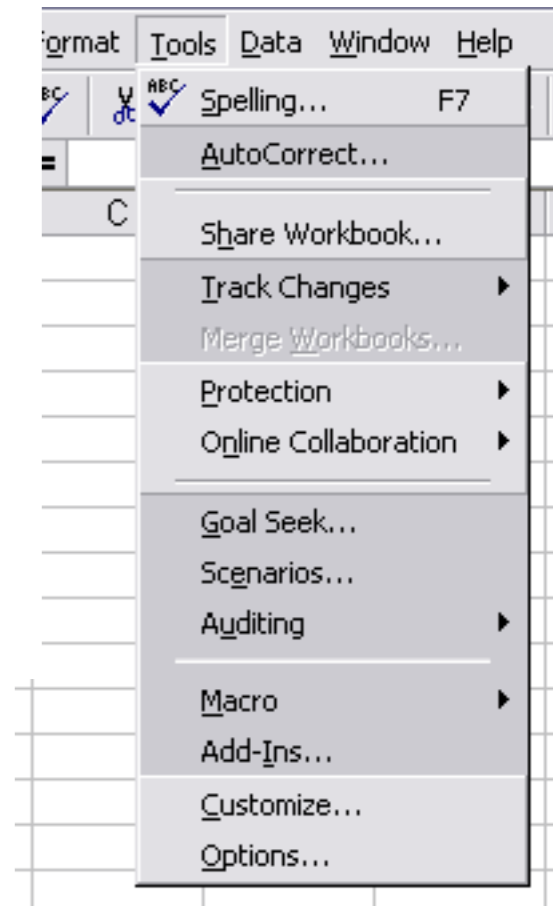
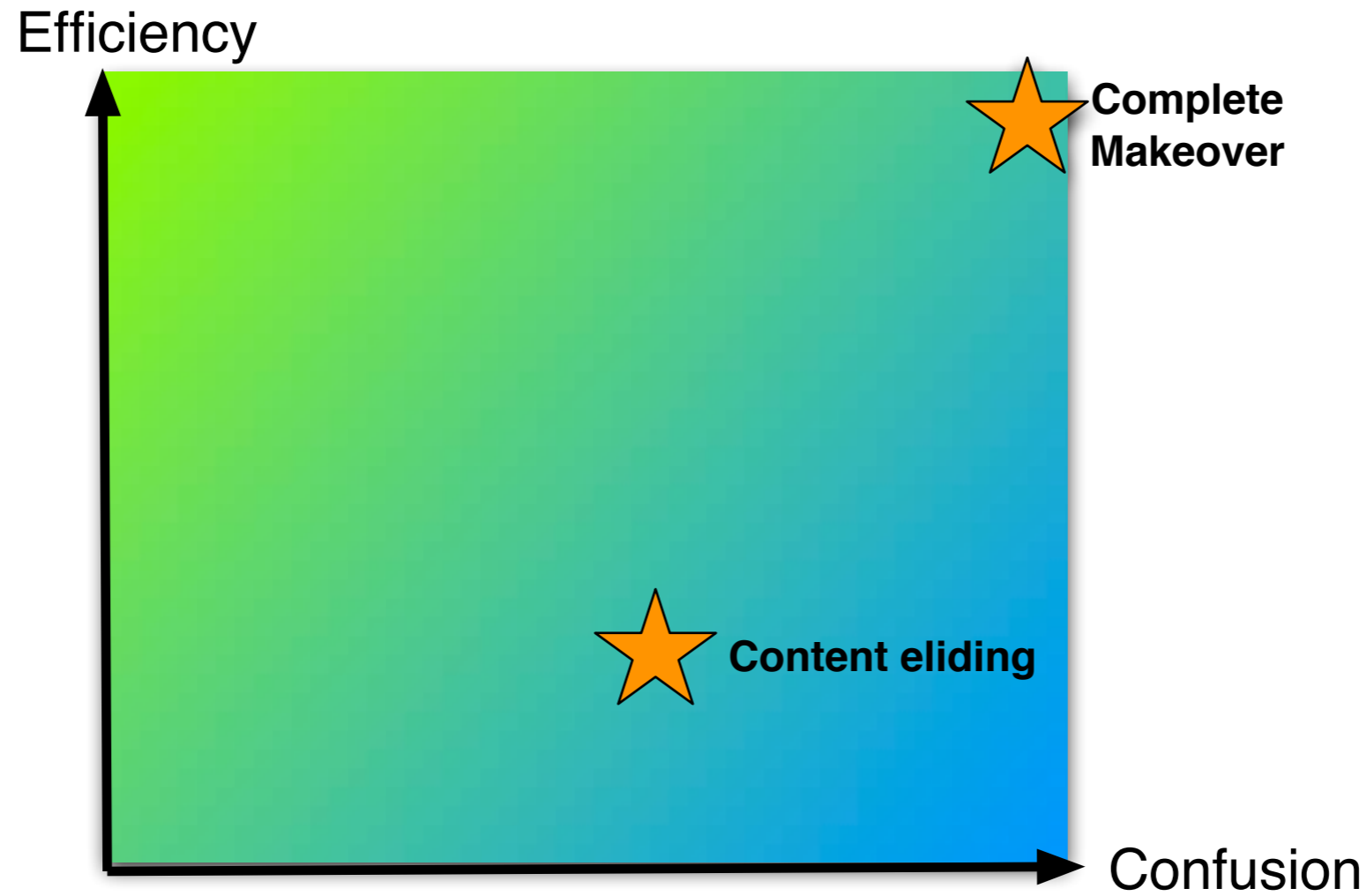
Split Interfaces



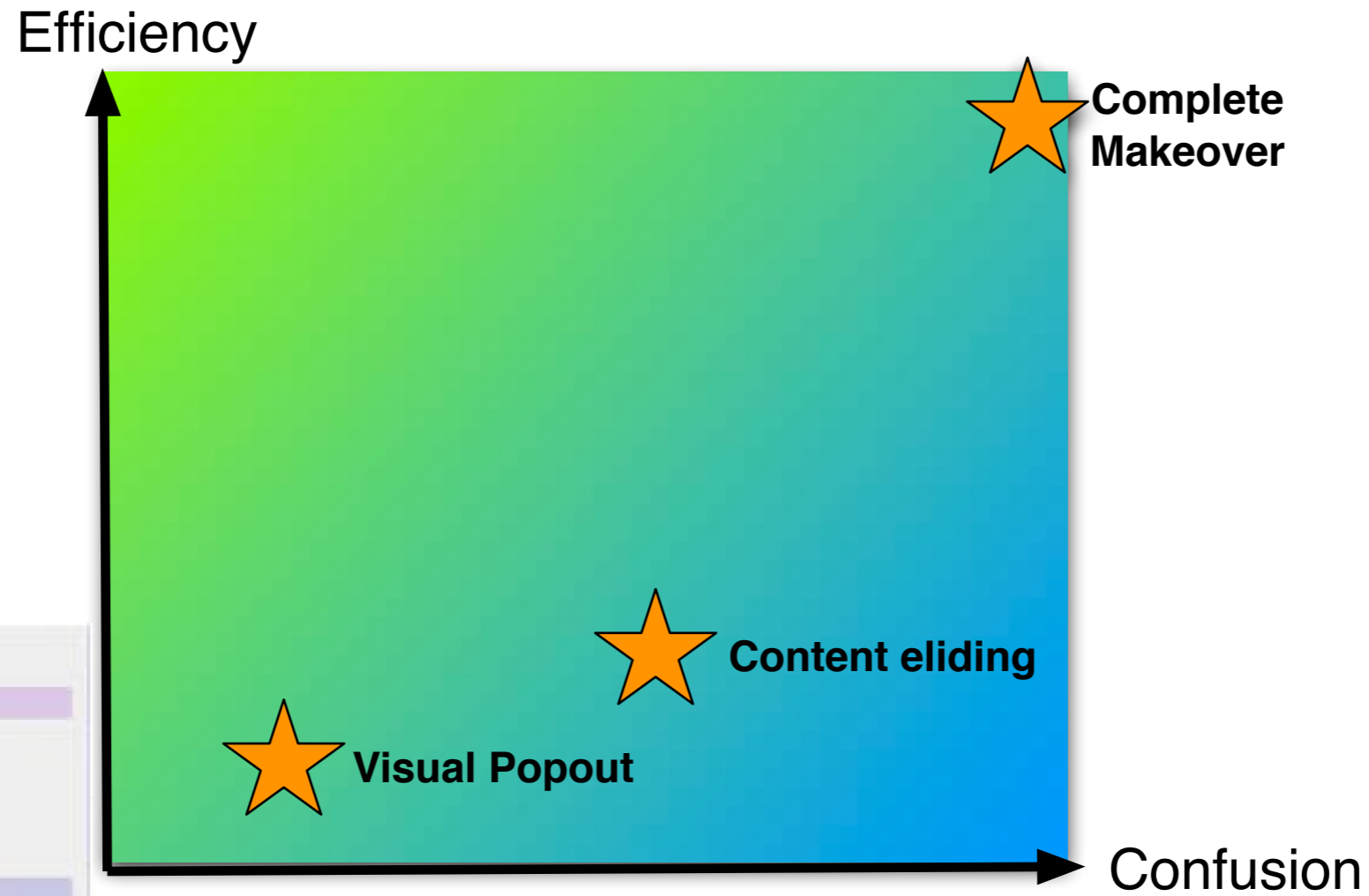
Adaptation Strategies



Adaptation Strategies

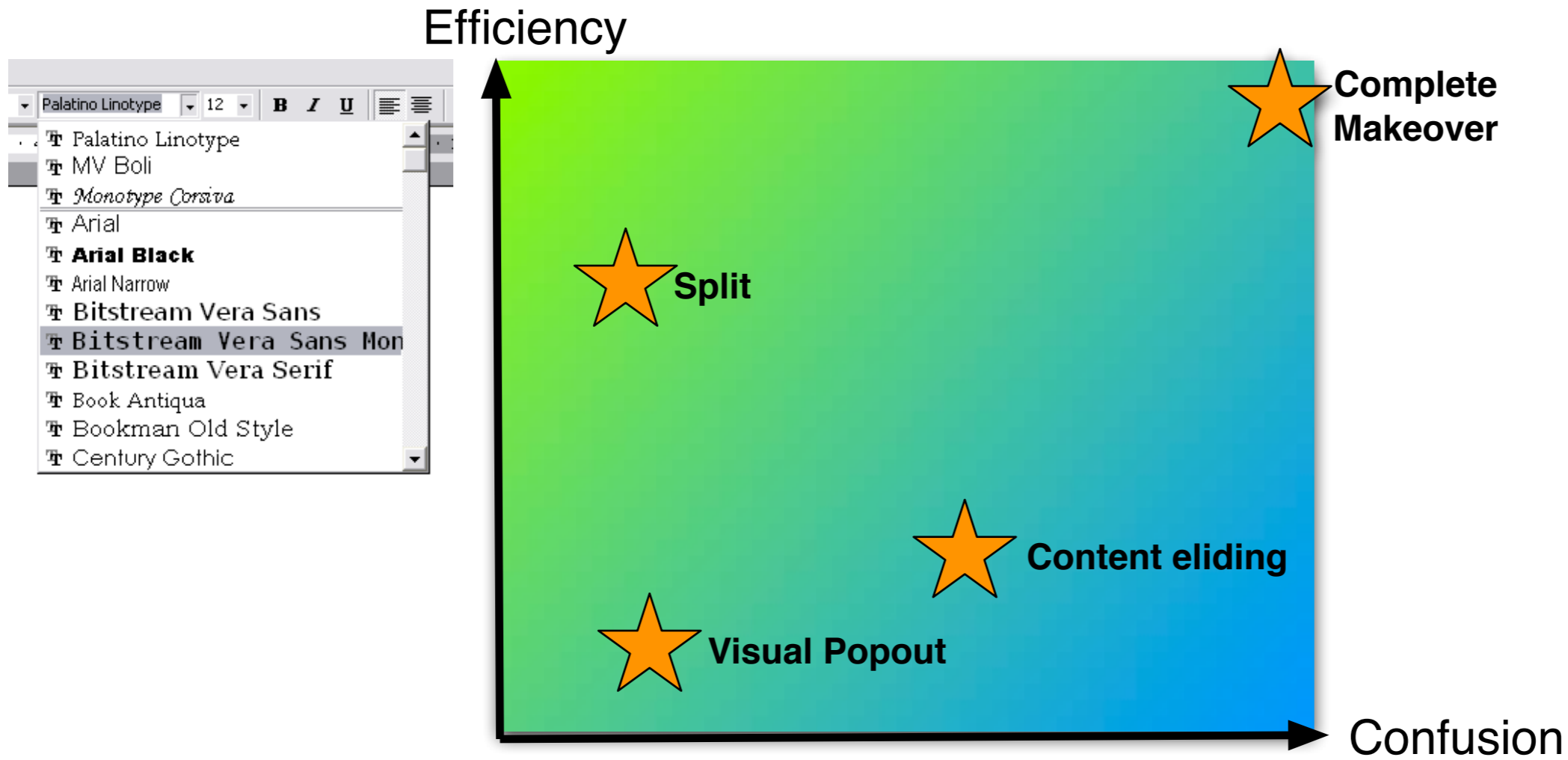


Adaptation Strategies

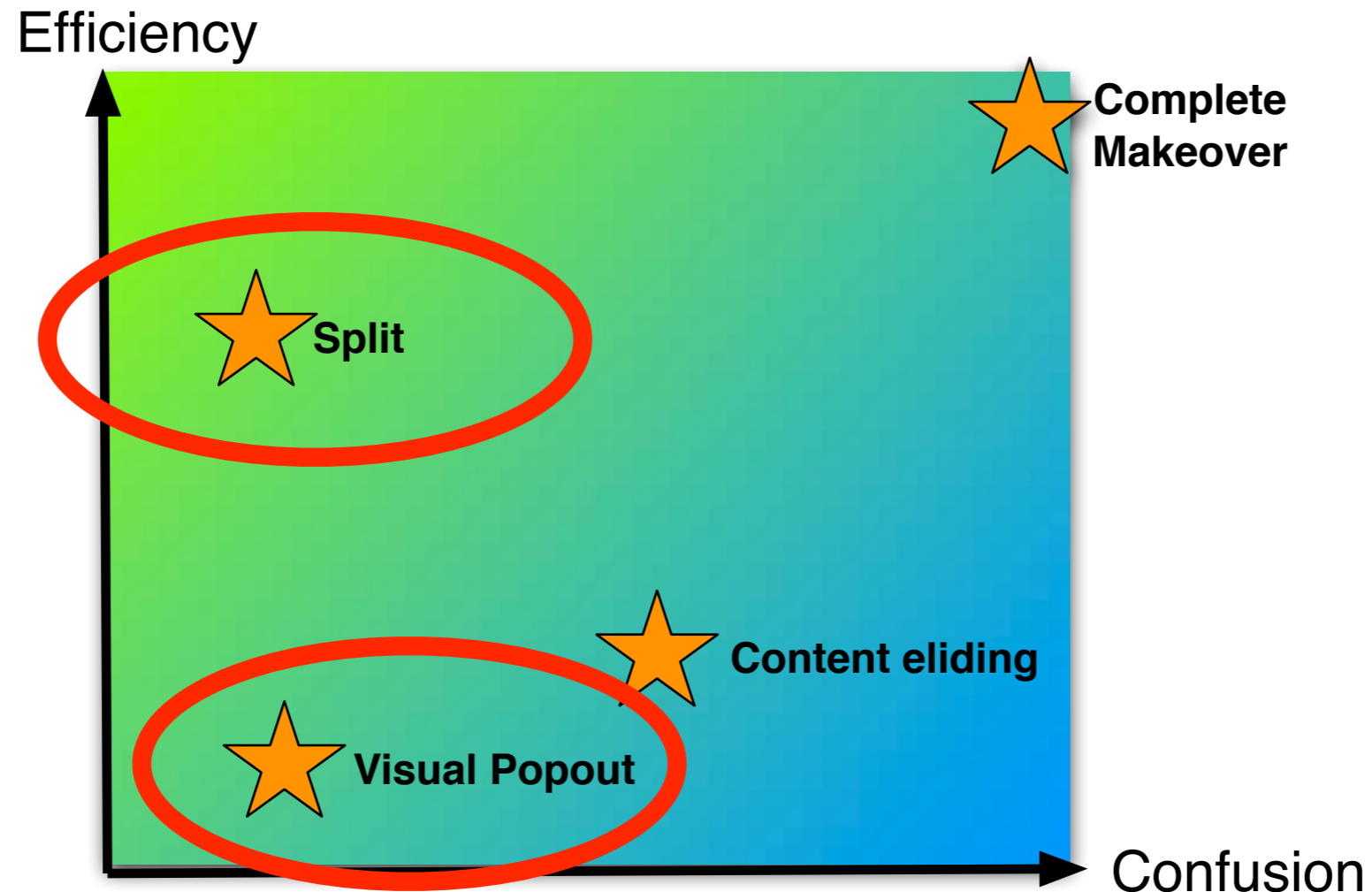


- Oslo
- Buenos Aires
- Sydney
- Lyon
- Monaco
- Amsterdam
- Kyoto
- Budapest
- Mexico
- Delhi
- Baghdad
- Istanbul
- Seattle
- Caracas
- Boston
- Havana
- Moscow
- Shanghai
- Seoul
- Teheran
- Taipei
- Singapore

Adaptation Strategies

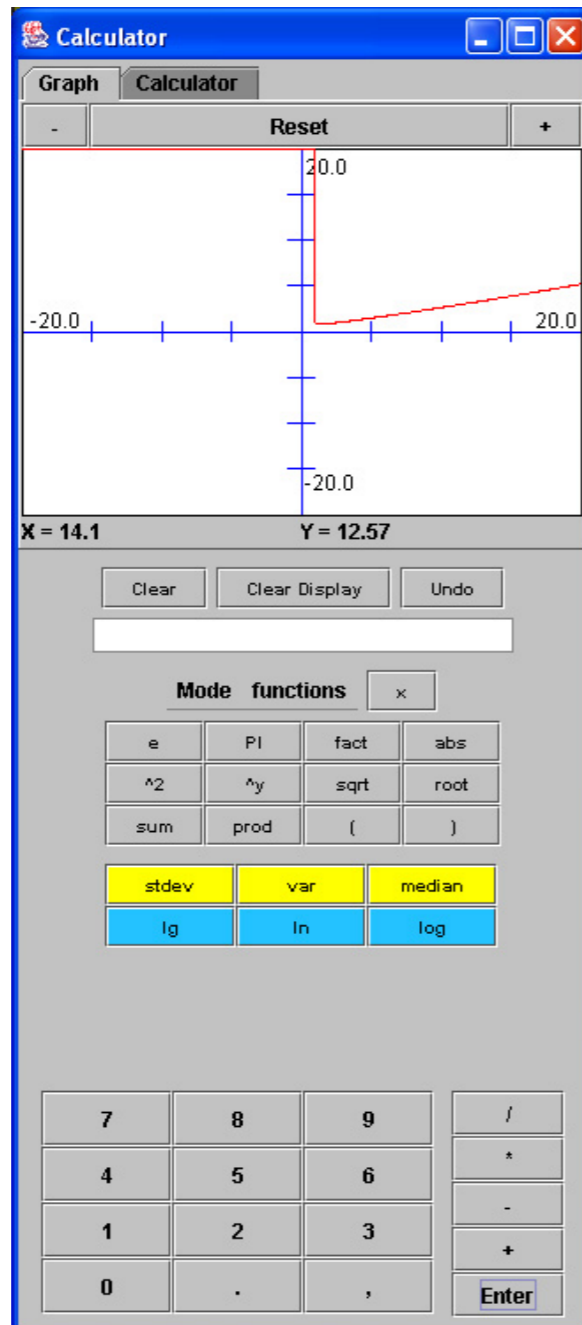


Adaptation Strategies

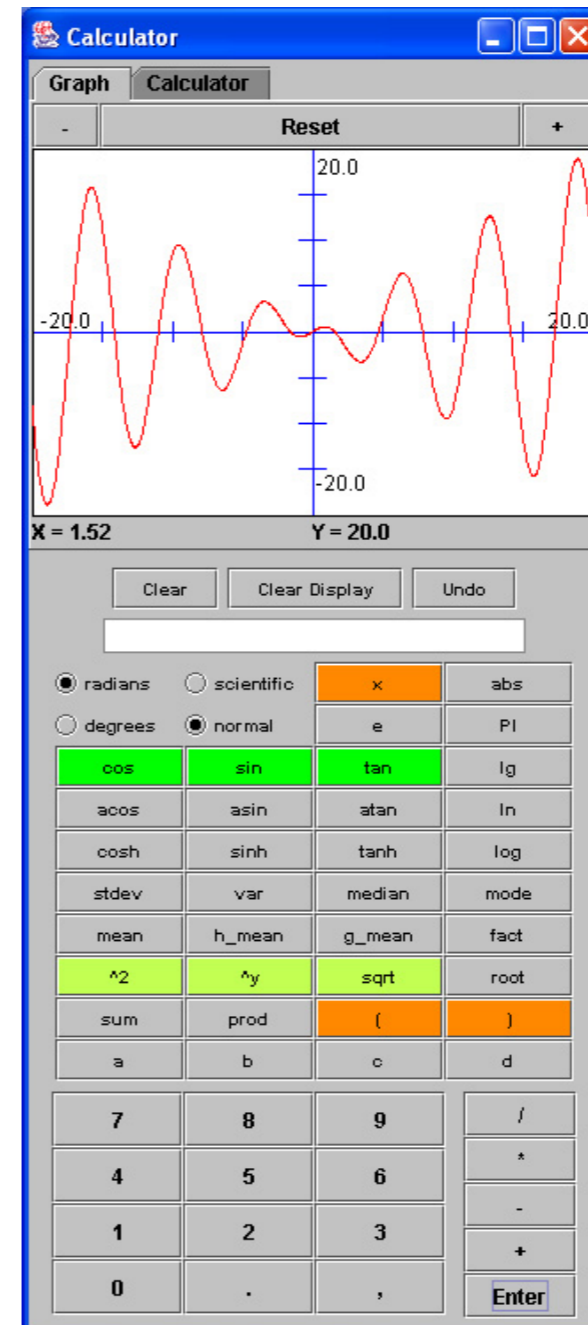


Preliminary User Study

Split
Interface



Visual
Popout
Interface



Preliminary User Study Results

- **Split Interface** strongly preferred over non-adaptive
- Both adaptive interfaces slightly **faster** than non-adaptive
- But: **Visual Popout** interface often found distracting

Sneak Peak: Followup Study

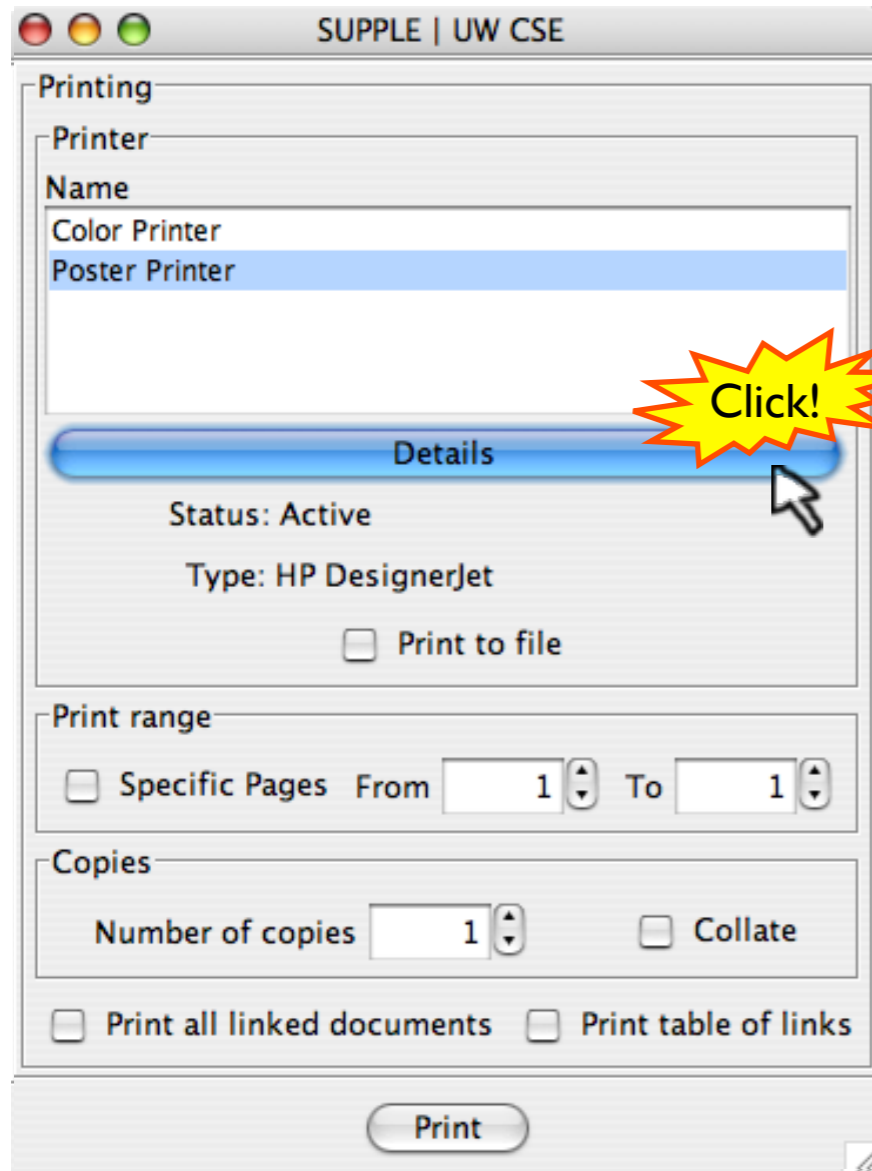
- In a different setting, we tested three adaptation strategies including Split Interface and Visual Popout Interface
- Users strongly **preferred** and were significantly **faster** using **Split Interface**
- Users strongly **disliked** **Visual Popout Interface**

with Mary Czerwinski and Desney Tan

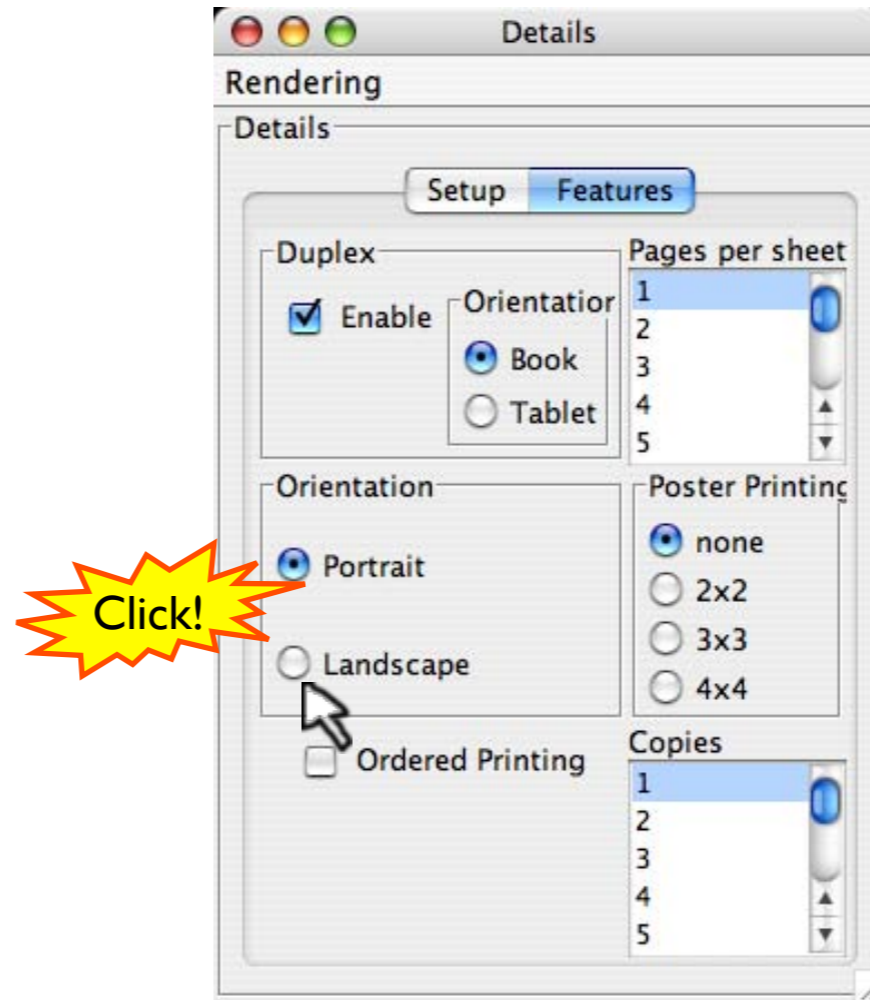
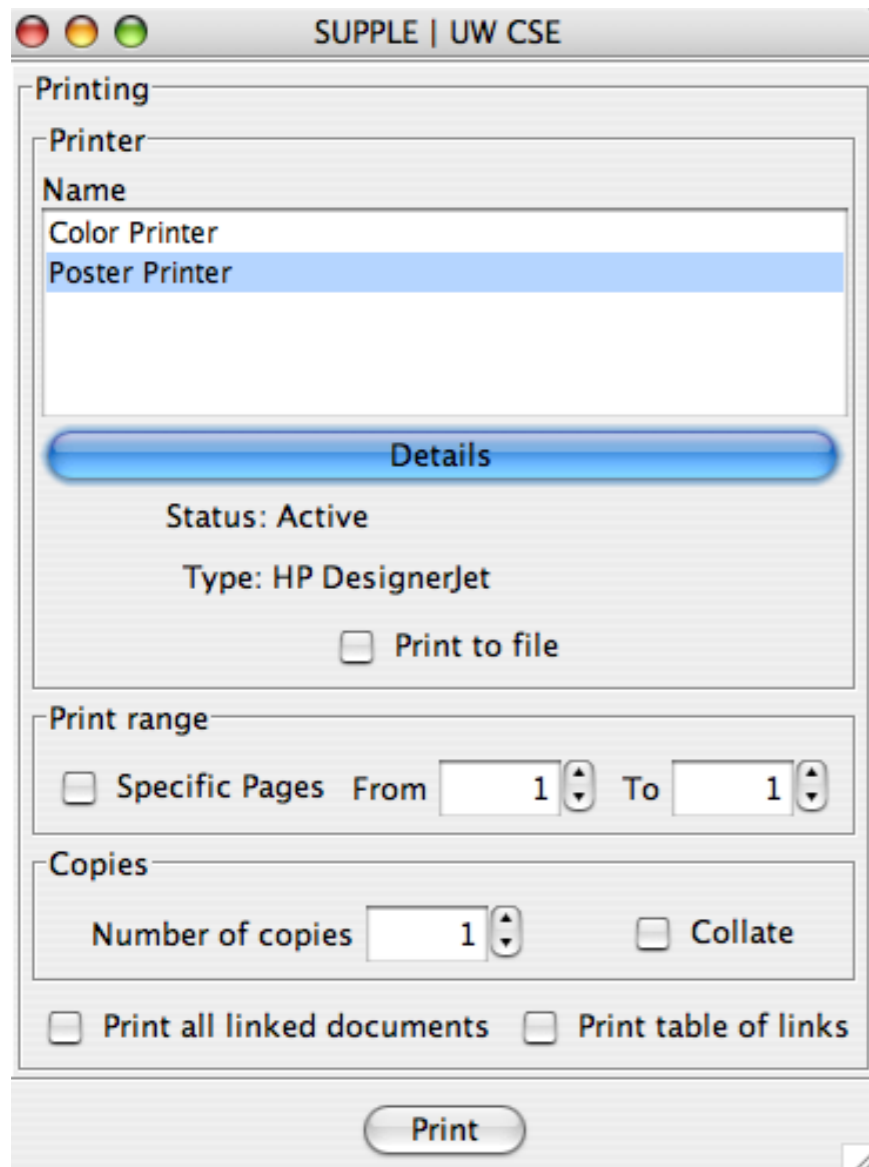
Split Interfaces in SUPPLE

- Adapting by promoting hard-to-reach but frequently used functionality

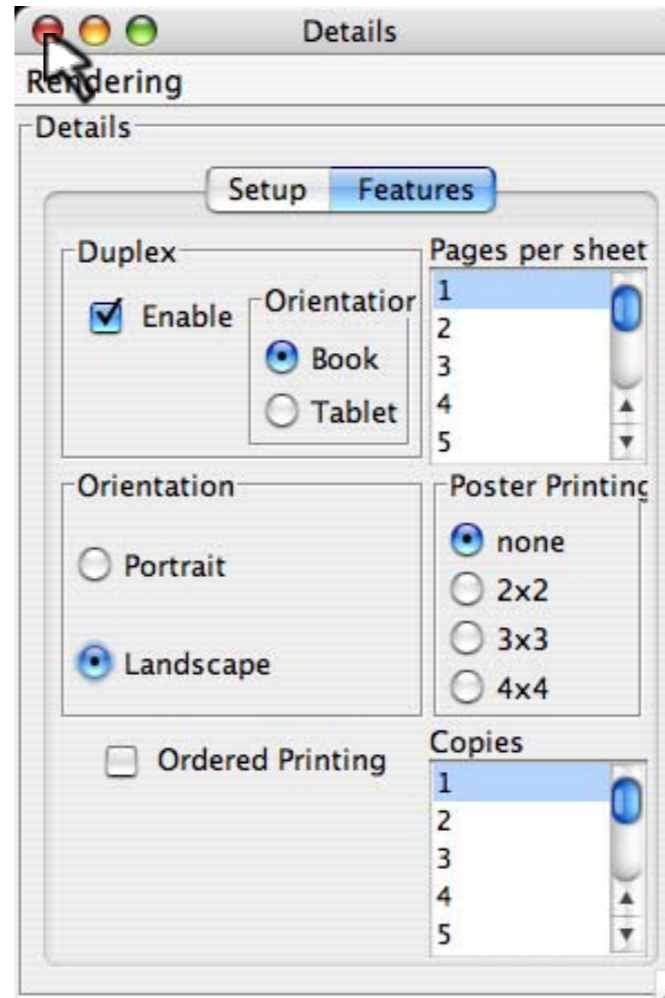
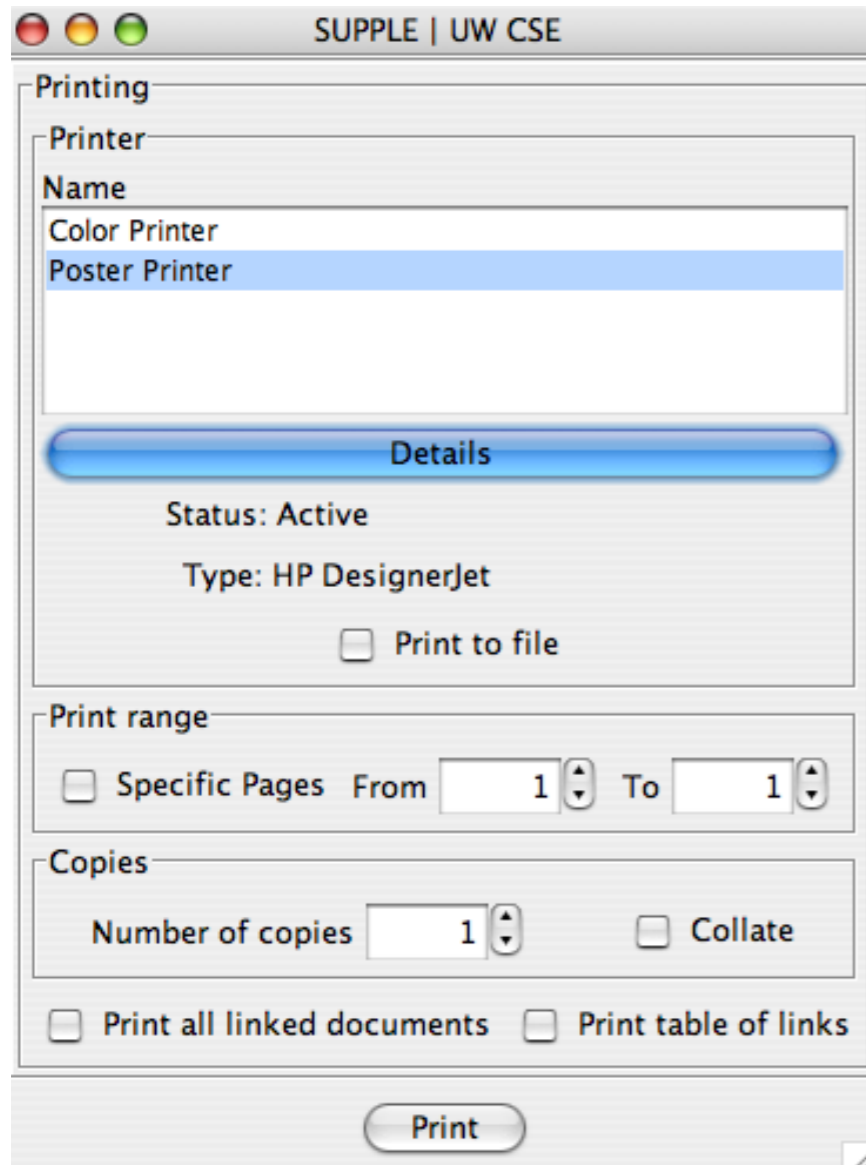
Split Interfaces in SUPPLE



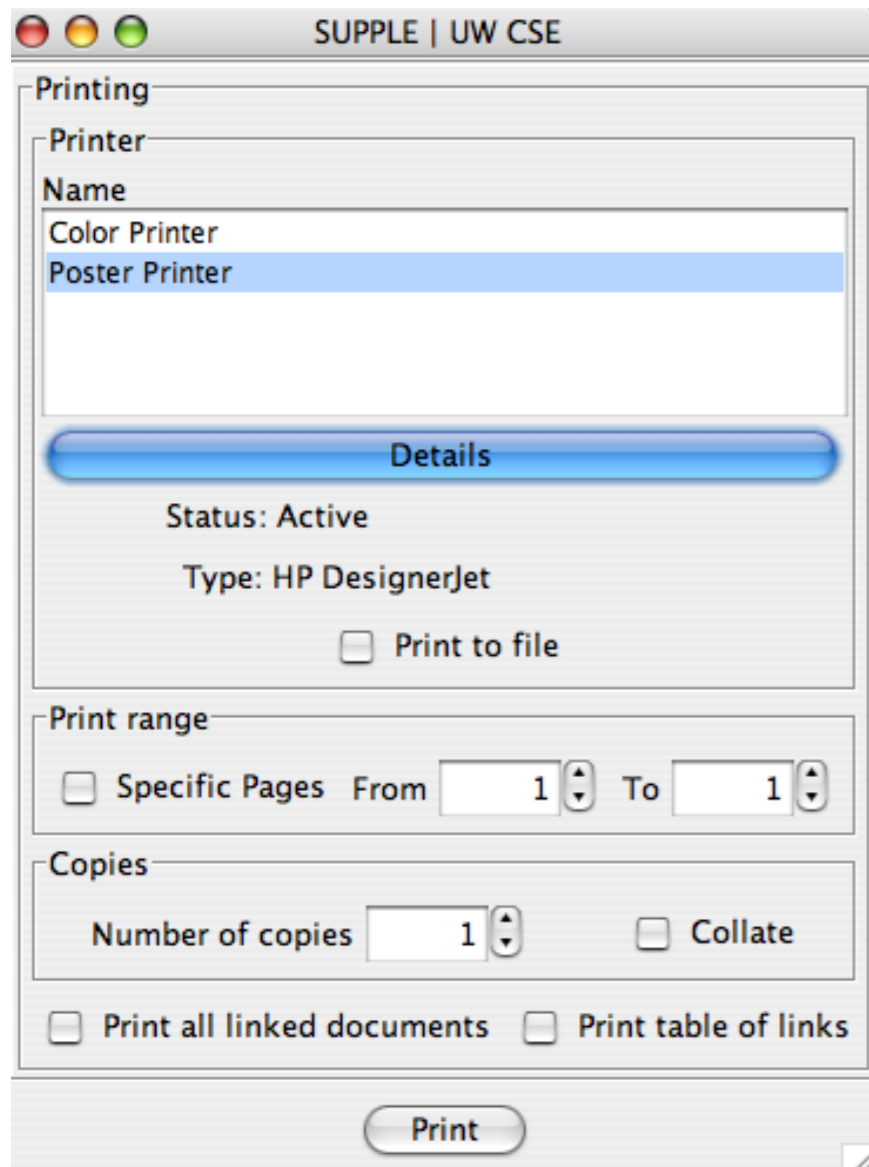
Split Interfaces in SUPPLE



Split Interfaces in SUPPLE

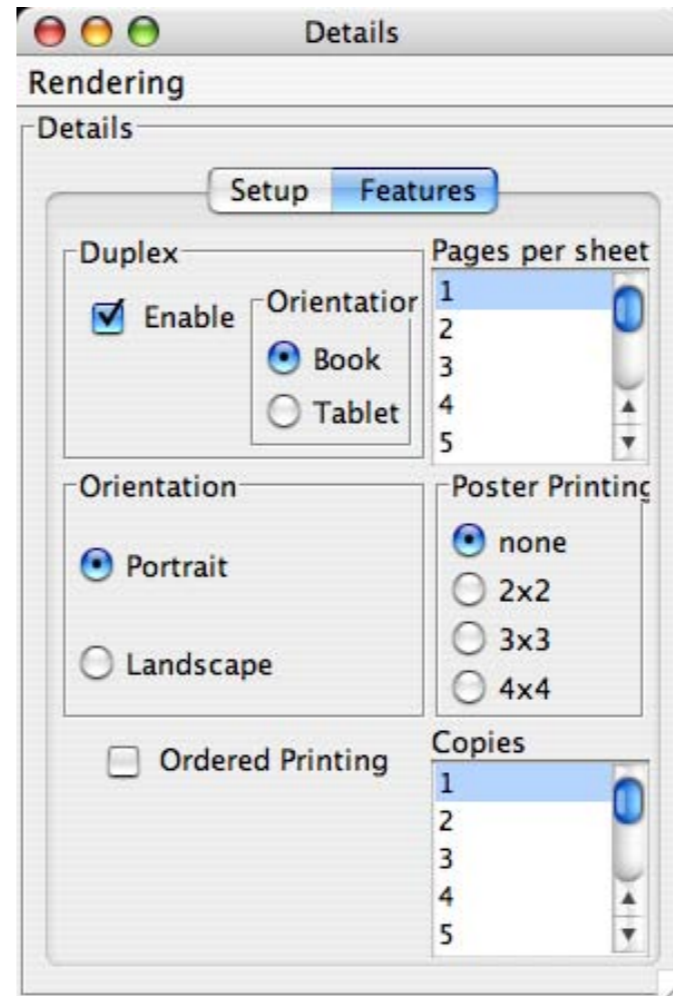
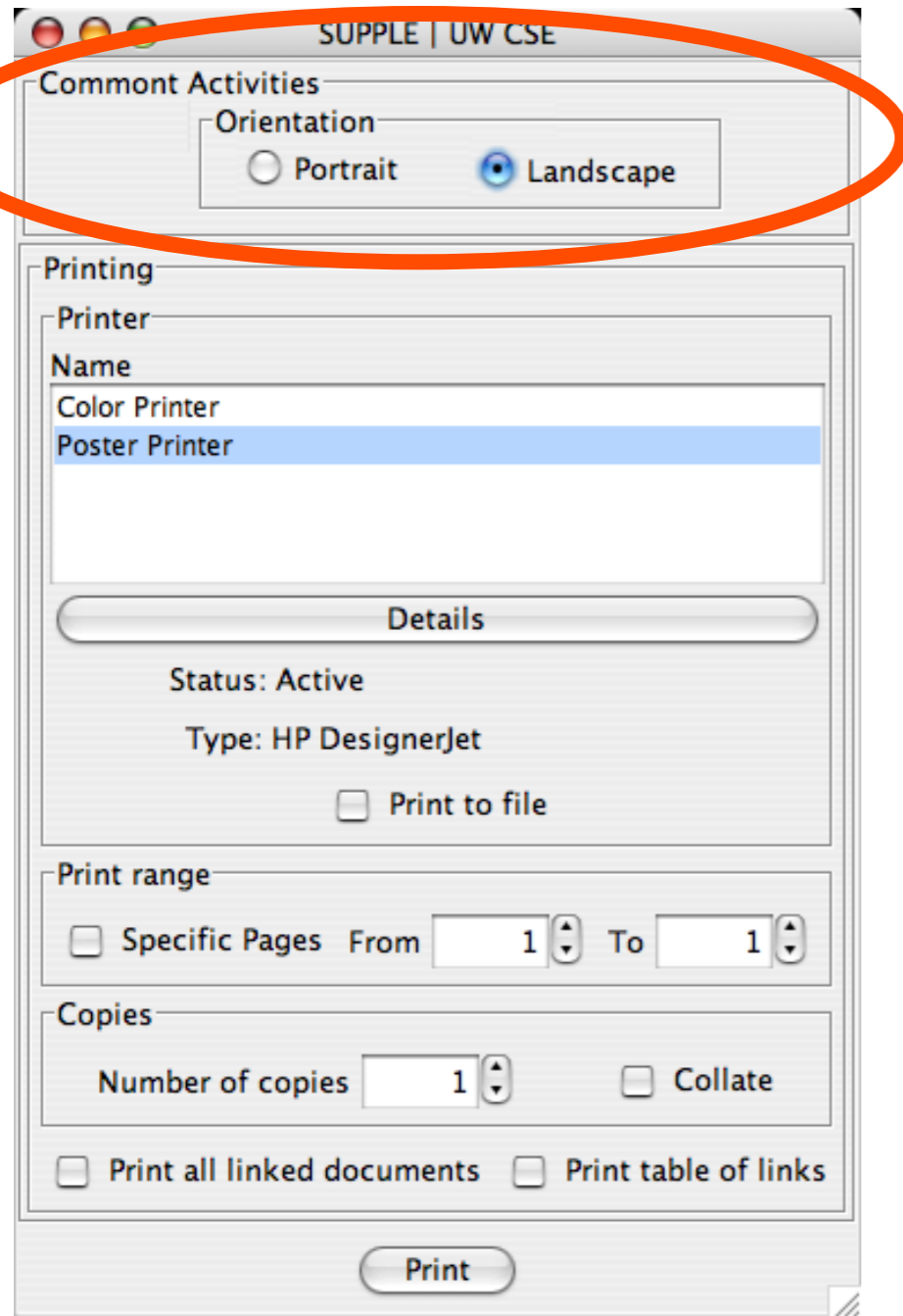


Split Interfaces in SUPPLE



Four extra clicks
required just to print in
landscape mode!

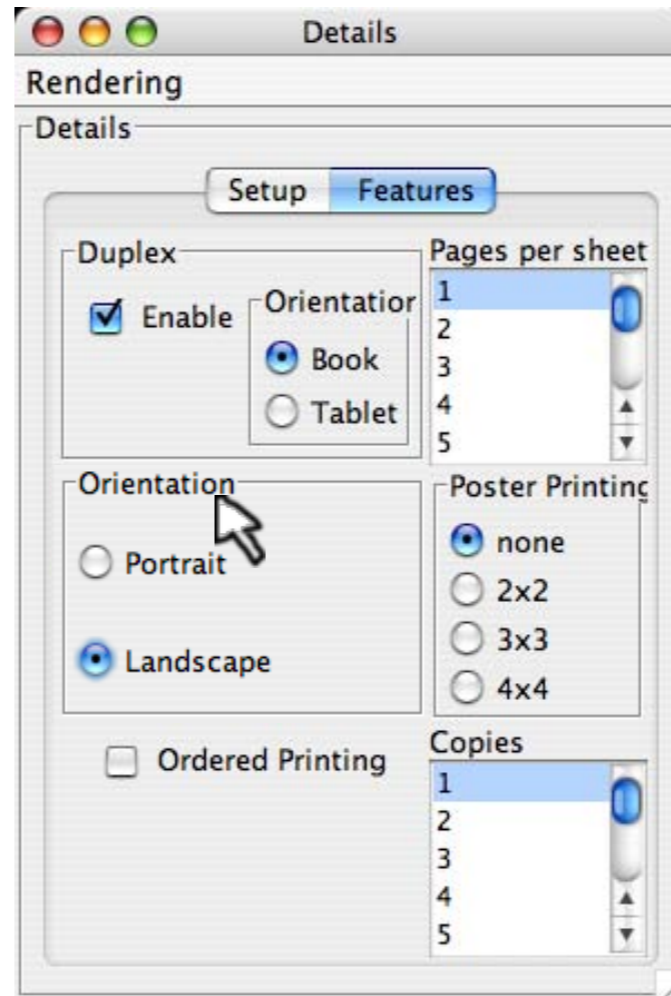
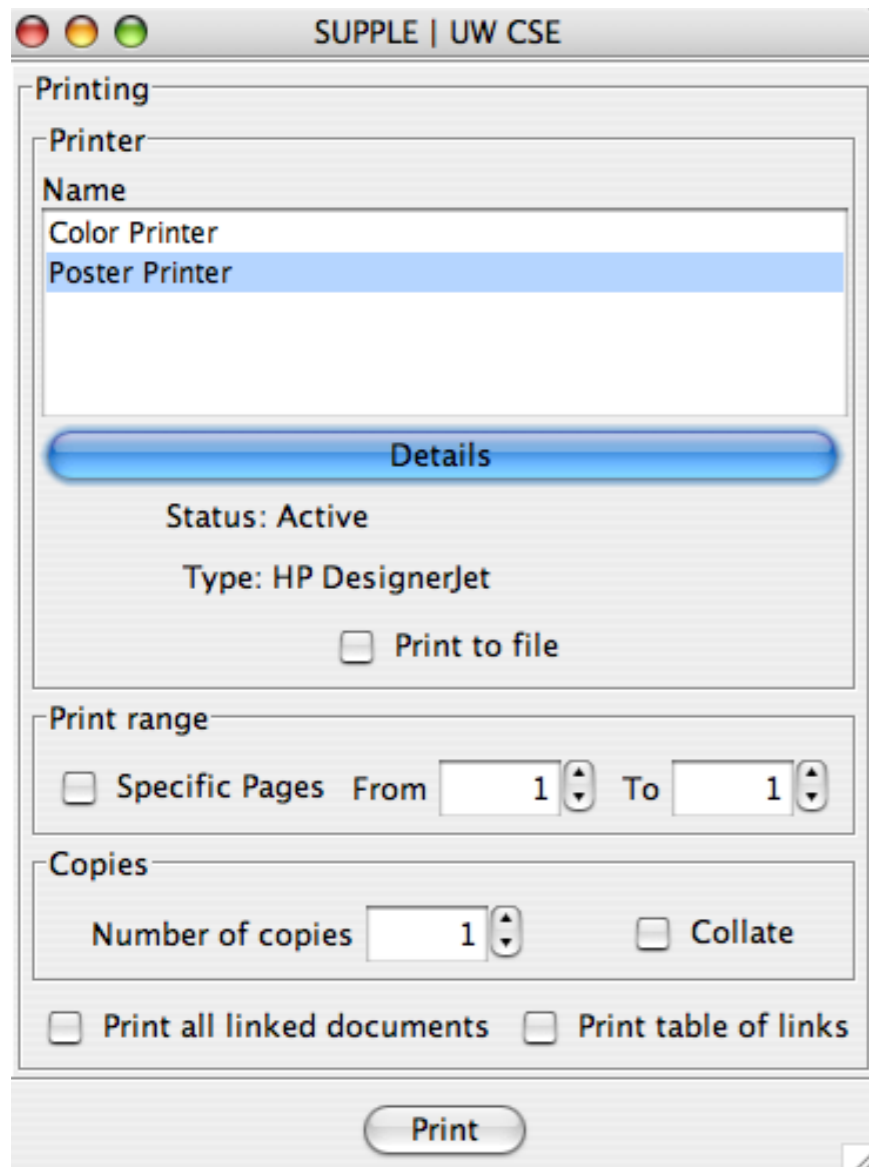
Split Interfaces in SUPPLE



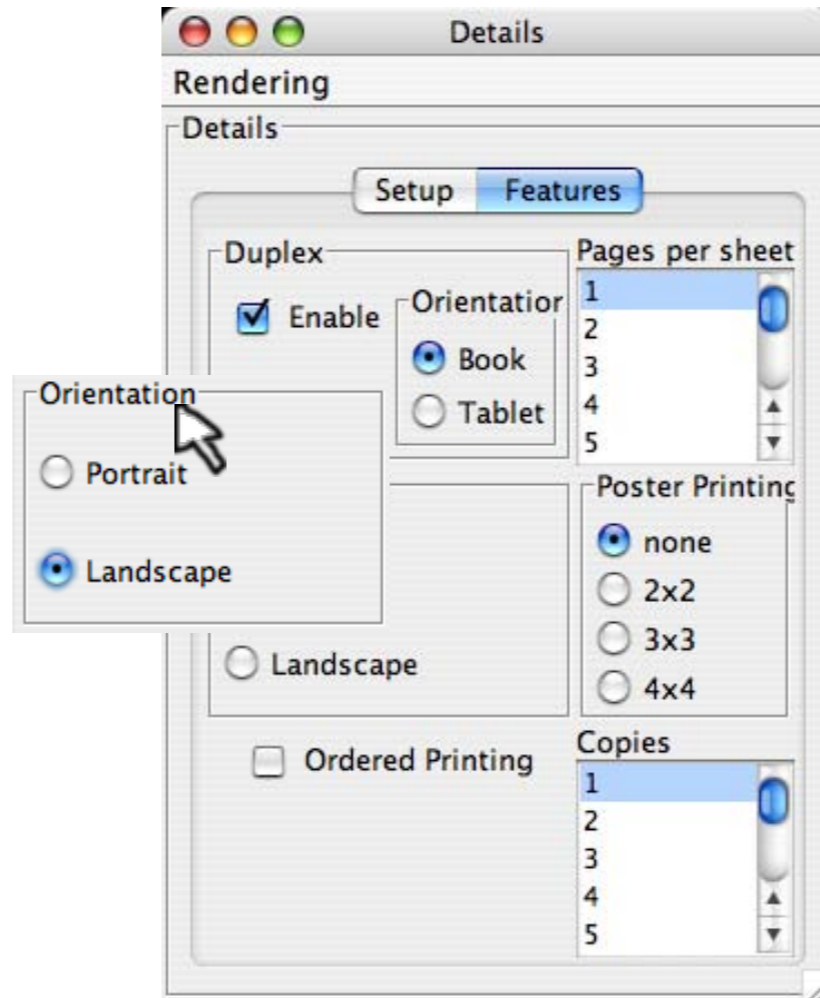
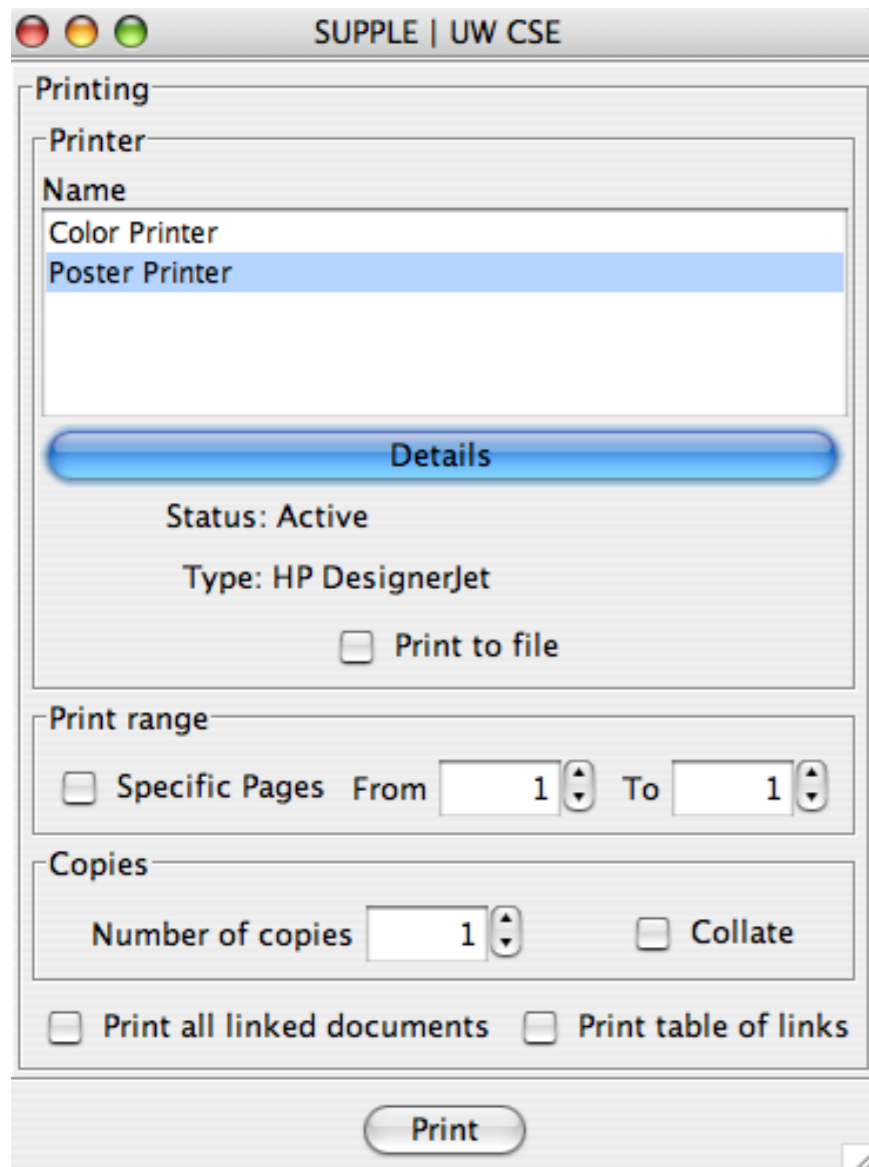
System- Vs. User-Initiated Adaptation: Customization

- Customizing any part of the interface with drag and drop
- Out of order undo
- Generalization

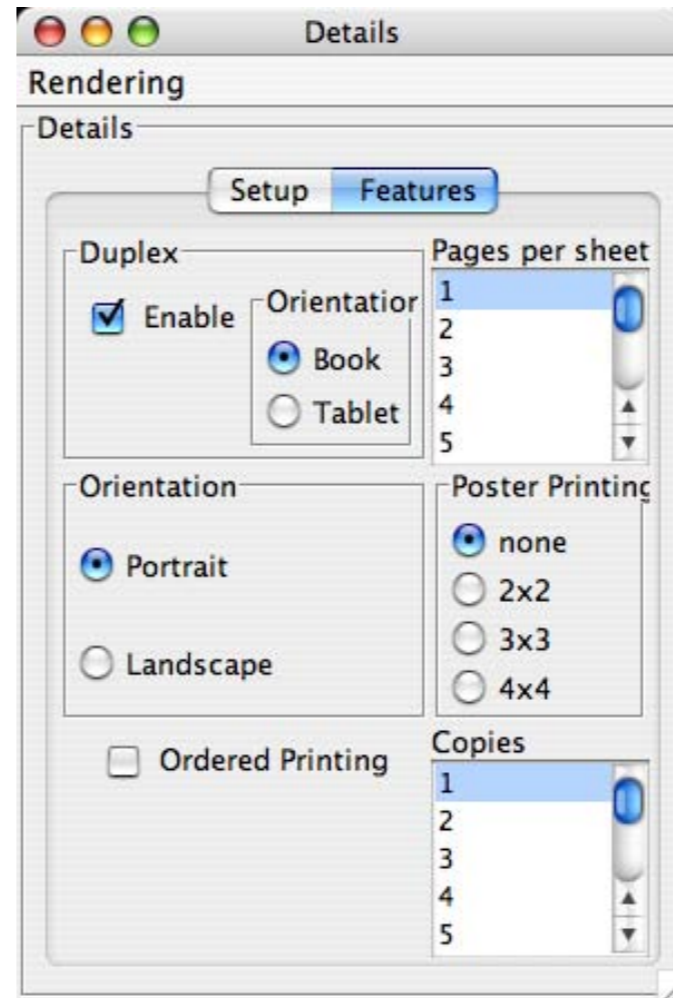
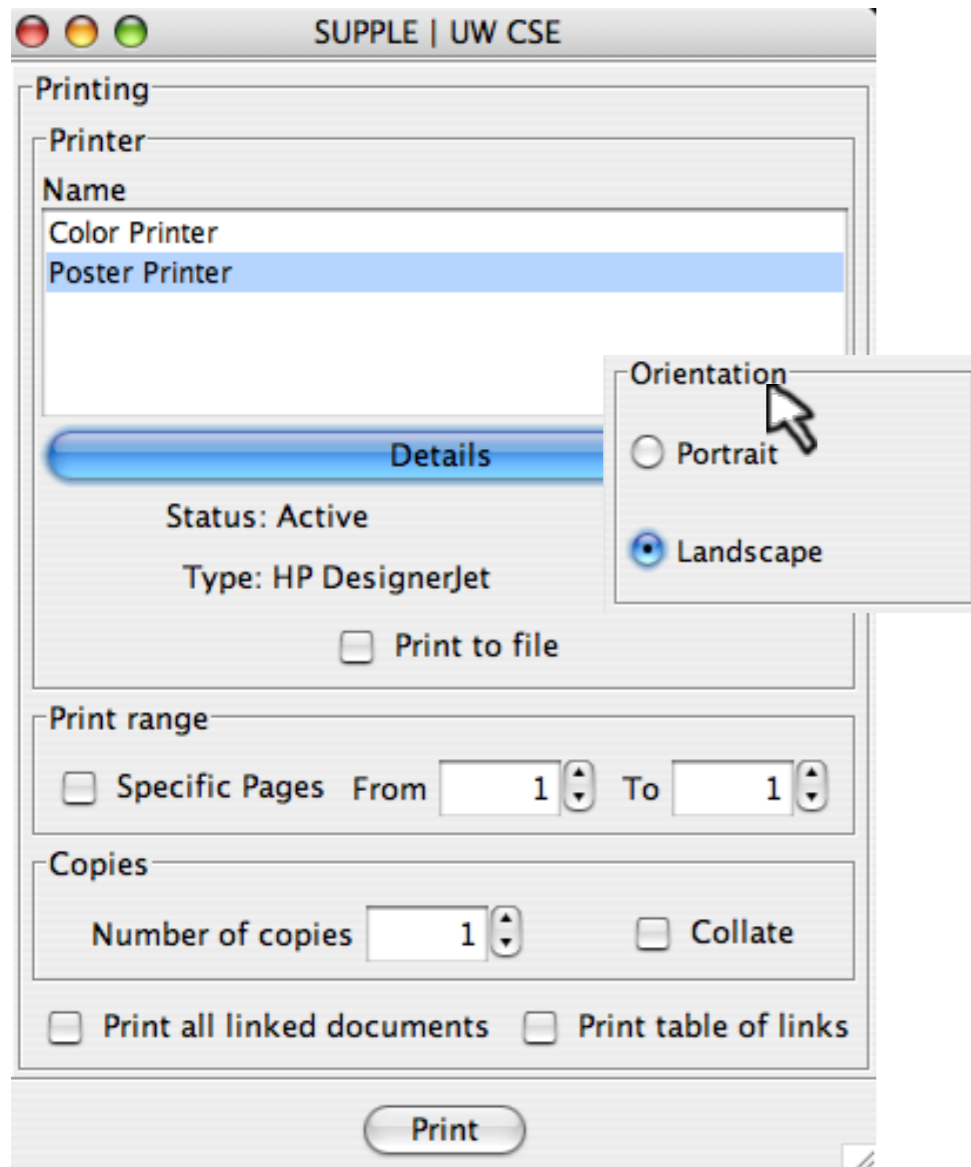
Customization



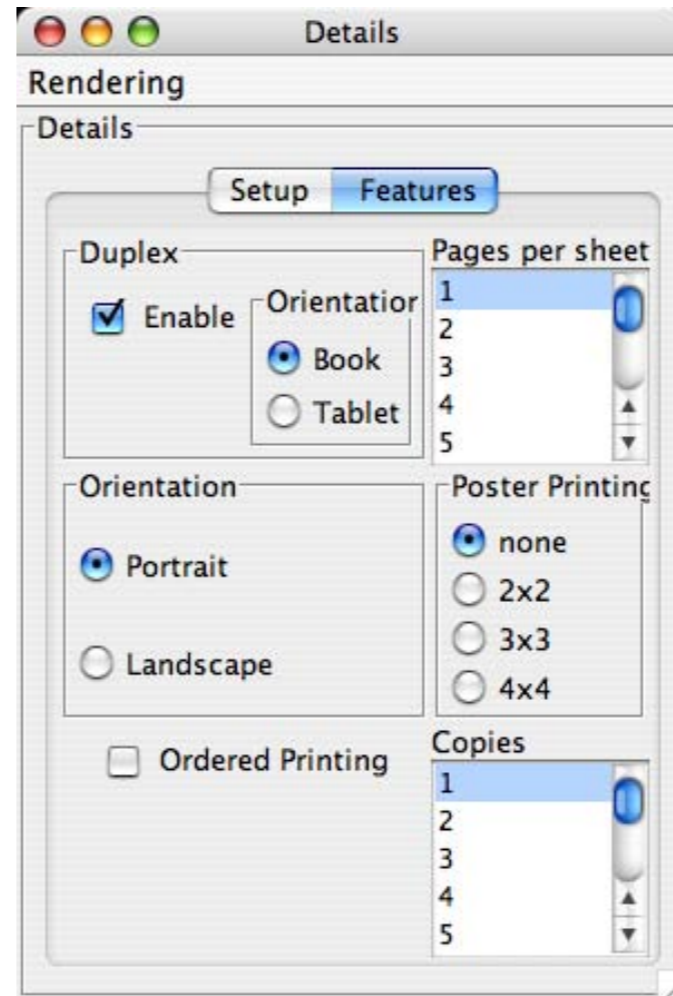
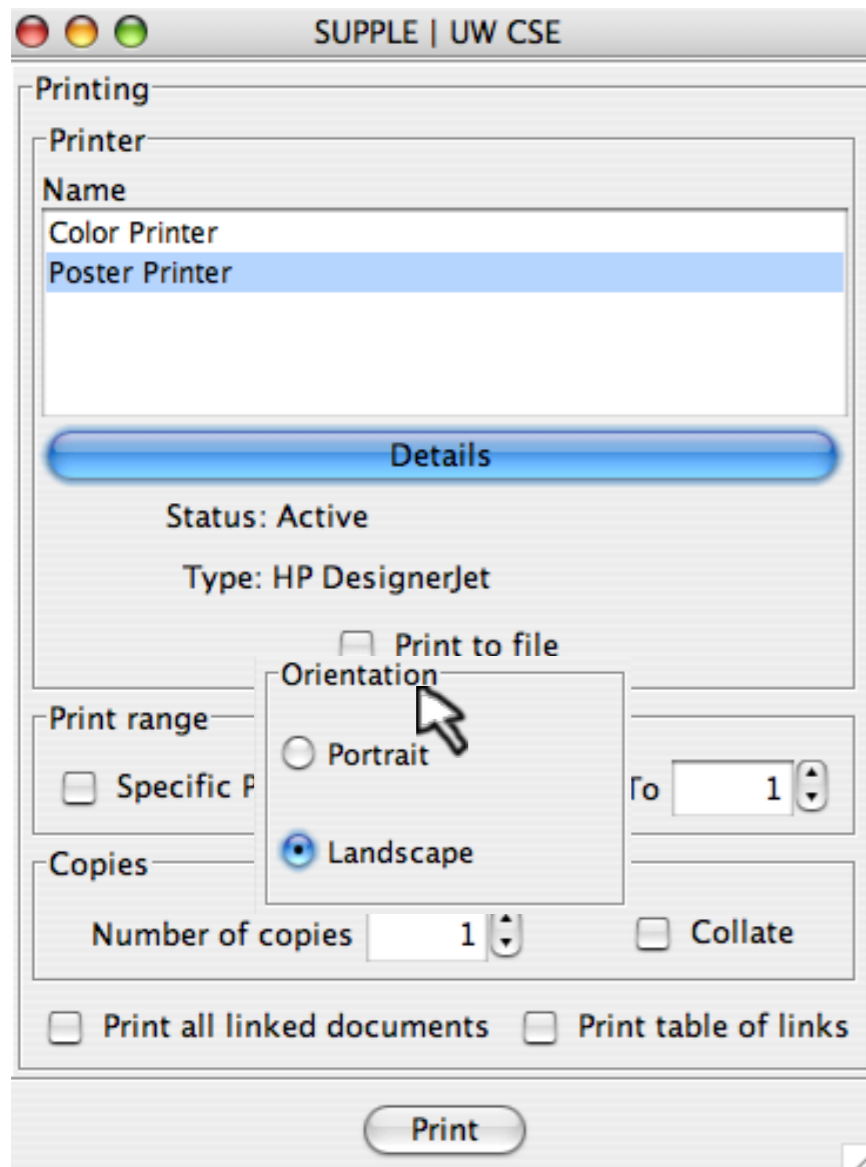
Customization



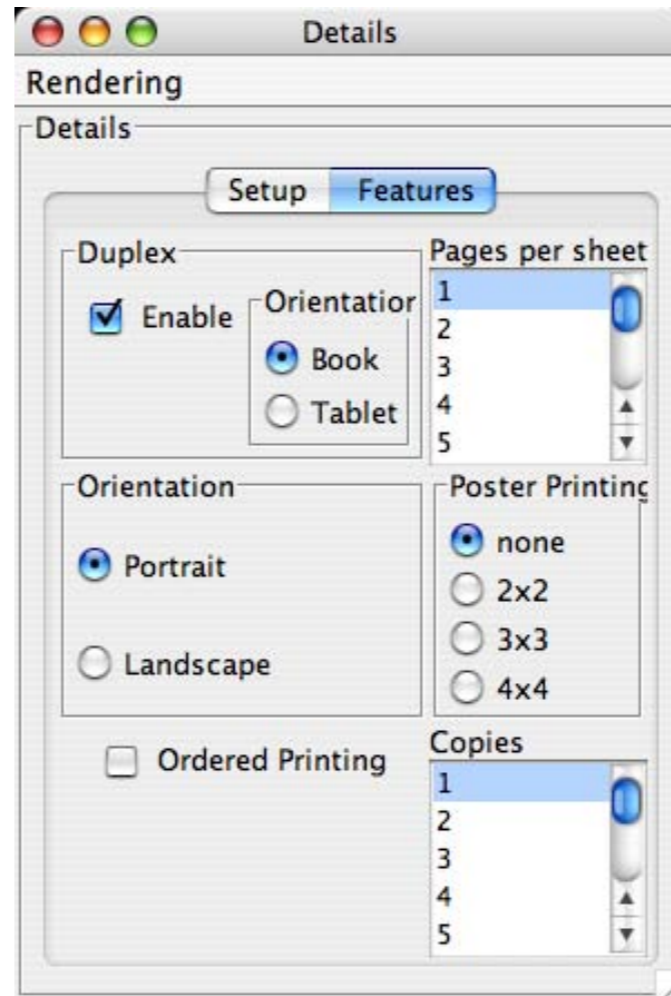
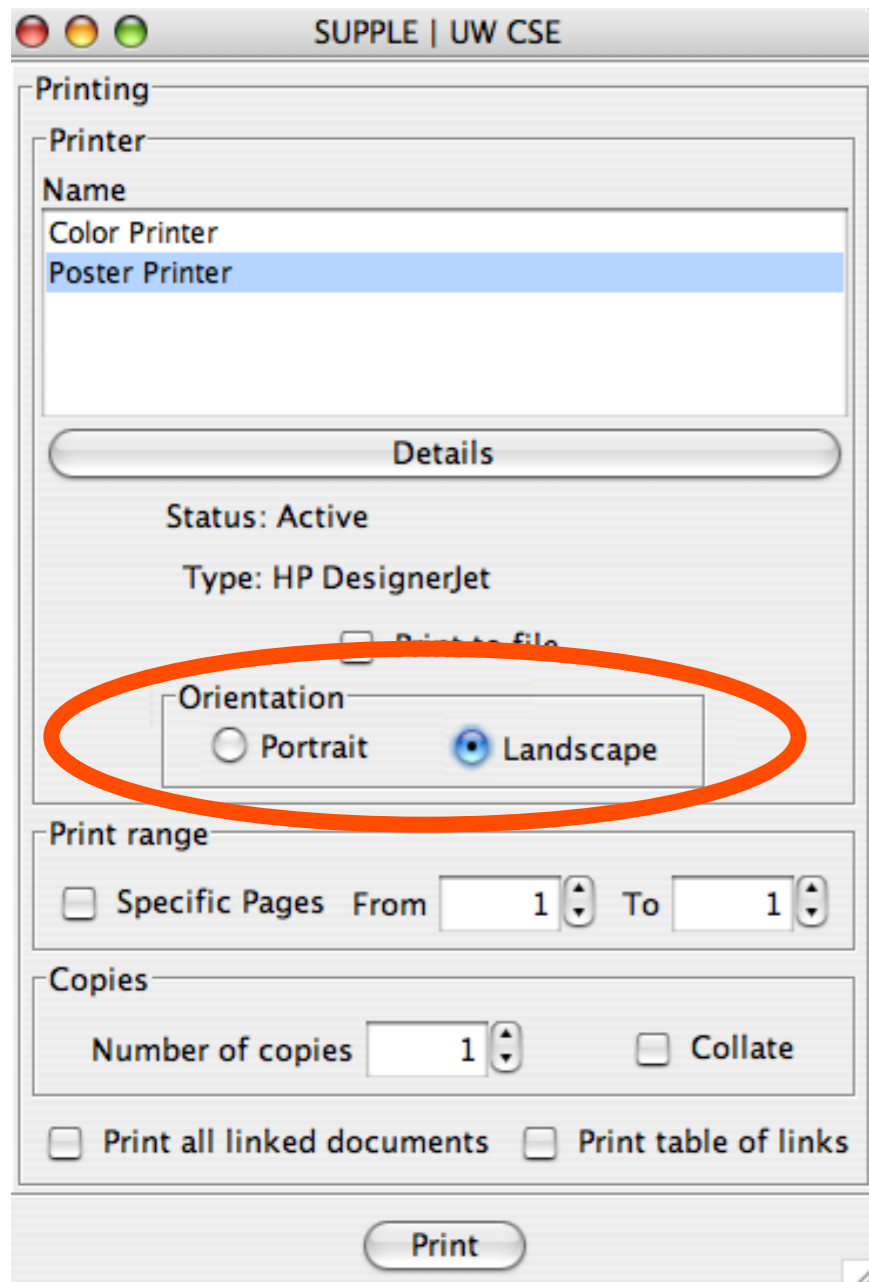
Customization



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Conclusions

- A powerful, flexible and practical tool for automatically generating user interfaces for multiple devices
- Adaptation and customization offer the possibility of creating custom-made UIs for each user
- Support for distributed operation and caching makes it practical even on small devices

Can I Have It?

Yes!

- We are awaiting permission to release SUPPLE as an **open source** toolkit
- Visit SUPPLE web site to sign up for the user's mailing list

Contributors



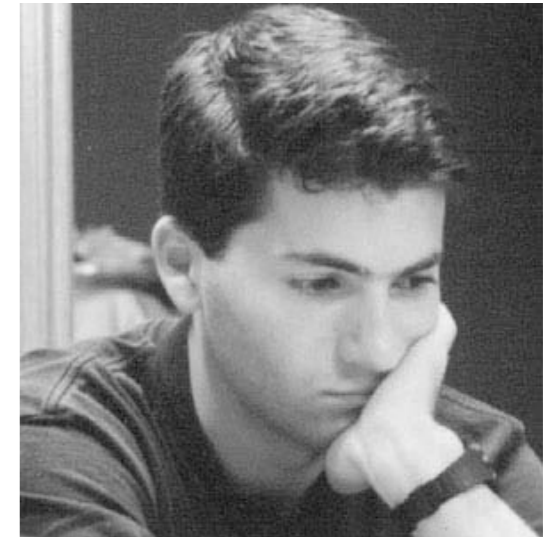
Daniel Weld



Dave Christianson



Raphael Hoffmann



Tal Shaked



Kiera Henning



Jing Jing Long




Anthony Wu



me

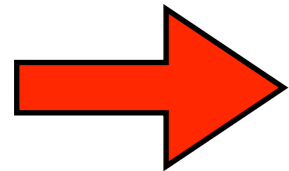
More Information

- **SUPPLE:**
<http://www.cs.washington.edu/ai/supple/>
: supple interfaces
- **Krzysztof Gajos:**
kgajos@cs.washington.edu
- **Daniel Weld:**
weld@cs.washington.edu

More Information

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Google: supple interfaces

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