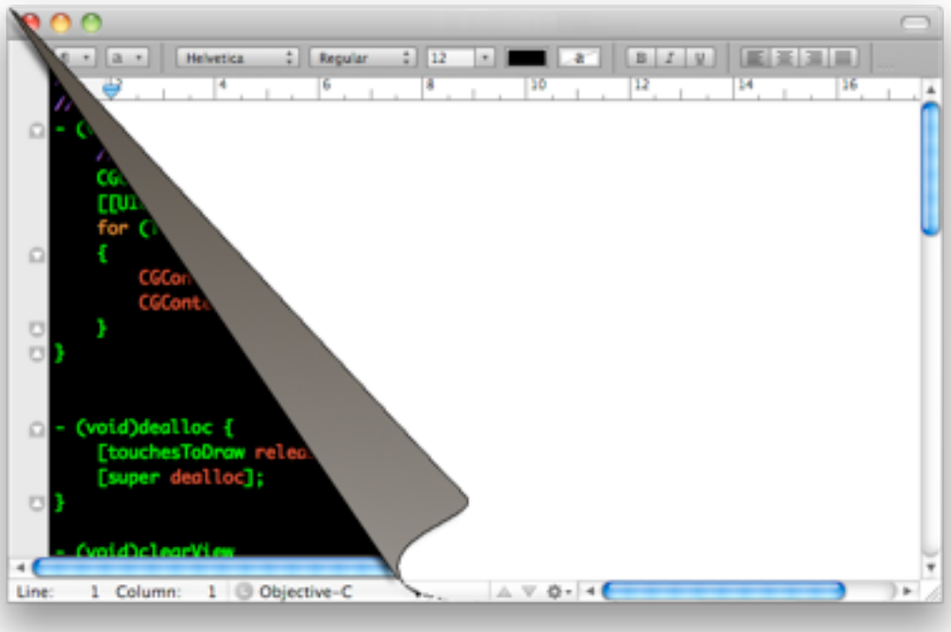


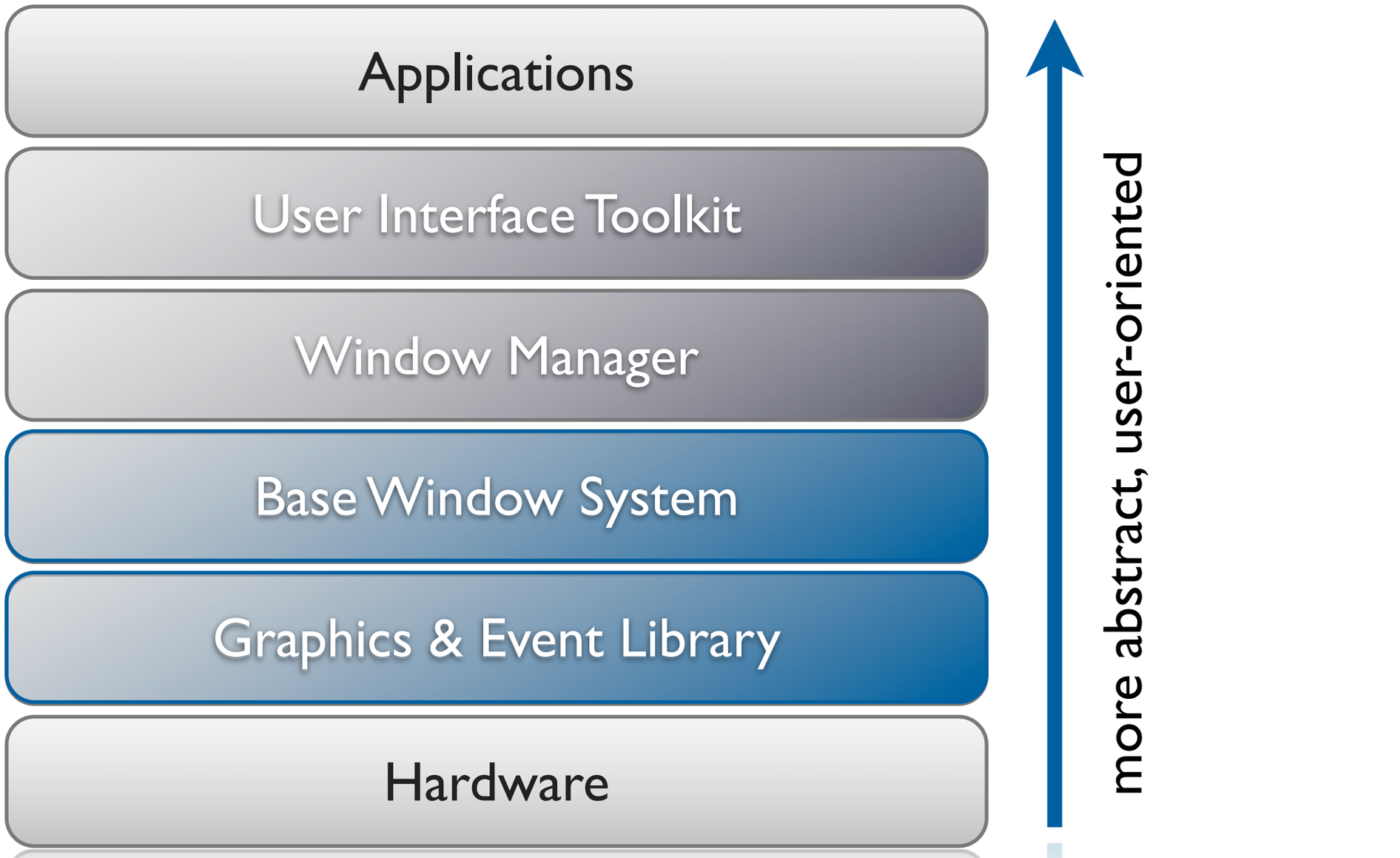
Designing Interactive Systems II

Computer Science Graduate Program SS 2011

Prof. Dr. Jan Borchers
Media Computing Group
RWTH Aachen University

http://hci.rwth-aachen.de/dis2

Review


Applications
User Interface Toolkit
Window Manager
Base Window System
Graphics & Event Library
Hardware
more abstract, user-oriented

Review

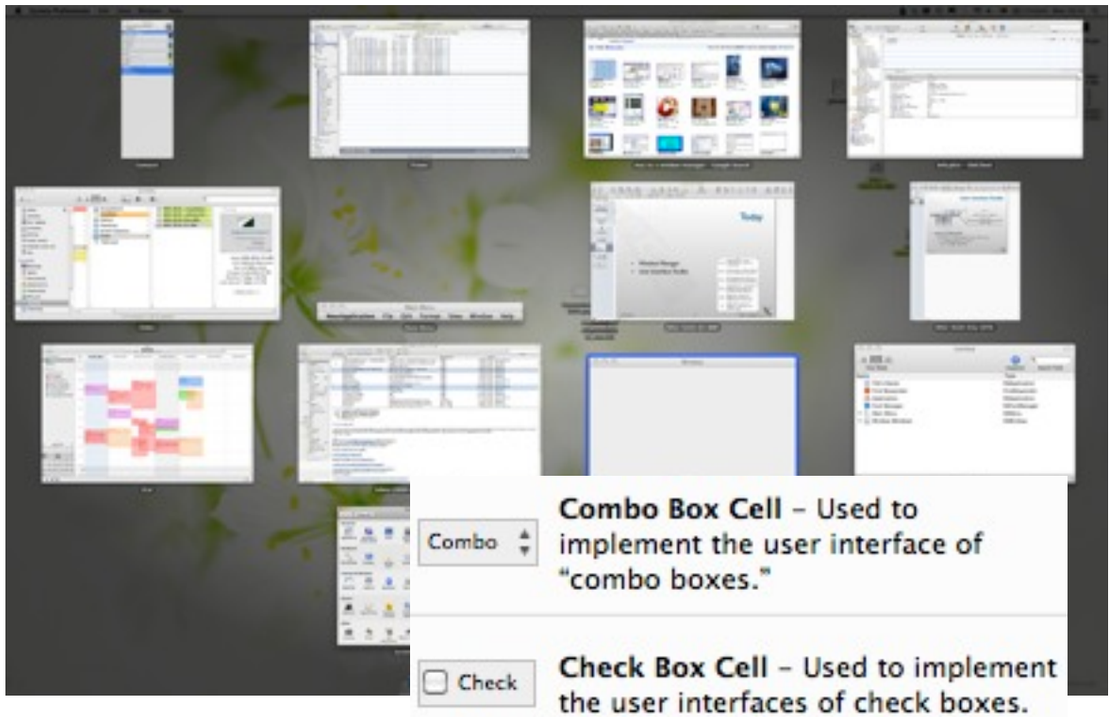
- Graphics and Event Library
  - Hides hardware and OS aspects
  - Drawing operations
  - Event handling

Review

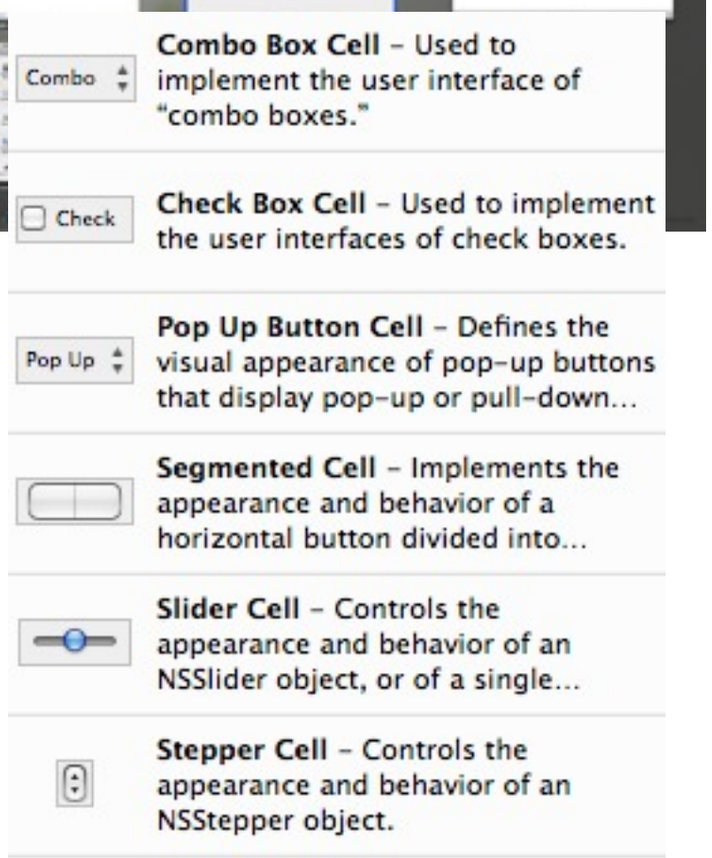
- Base Window System
  - Map n applications with virtual resources to 1 hardware
  - Offer shared resources, synchronize access
  - Windows & canvas, graphics contexts, color tables, events
  - Event multiplexing and demultiplexing
  - Window hierarchies

Today

- Window Manager



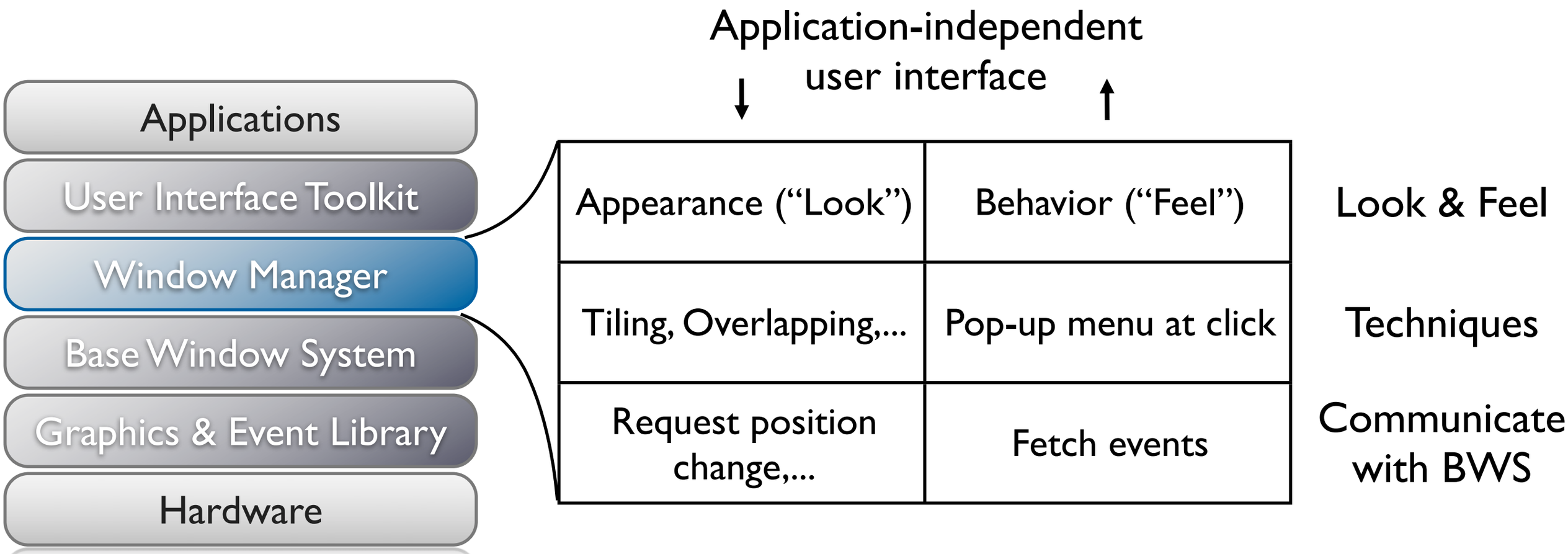
- User Interface Toolkit



Window Manager: Motivation

- Position and decorate windows
- Provide Look&Feel for interaction with window system
- So far: applications can output to windows
  - User control defined by application
  - May result in inhomogeneous user experience
- Now: let user control windows
  - Independent of applications
  - User-centered system view
- BWS provides mechanism vs. WM implements policy

Window Manager: Structure



Screen Management

- What is rendered where on screen? (layout question)
- Where empty space? What apps iconified? (practical q's)
- Example: Negotiating window position
  - Application requests window at (x,y) on screen;
    ignores position afterwards by using window coordinate system
  - BWS needs to know window position at any time to handle coordinate transformation, event routing, etc. (manages w)
  - User wishes to move window to different position
  - Or: Requested position is taken by another window
- Three competing instances (same for color tables,...)
- Solution: Priorities, for example:
  - Prior (app) < Prior (WM) < Prior (user)
  - WM as advising instance, user has last word

Session Management

- Certain tasks are needed for all apps in consistent way
  - Move window, start app, iconify window
- Techniques WM uses for these tasks
  - Menu techniques
    - Fixed bar+pull-down (Mac), pop-up+cascades (Motif),...
  - Window borders
    - Created by WM, visible/hidden menus, buttons to iconify/maximize, title bar

Session Management

- WM techniques continued
  - Direct manipulation
    - Manipulate onscreen object with real time feedback
    - Drag & drop,...
    - Early systems included file (desktop) manager in window manager; today separate "standard" application (Finder,...)
  - Icon technique: (de)iconifying app windows
  - Layout policy: tiling, overlapping
    - Studies showed tiling WM policy leads to more time users spend rearranging windows

Window Manager Examples

KDE 4.6 Gnome 3 Mac OS X 10.6

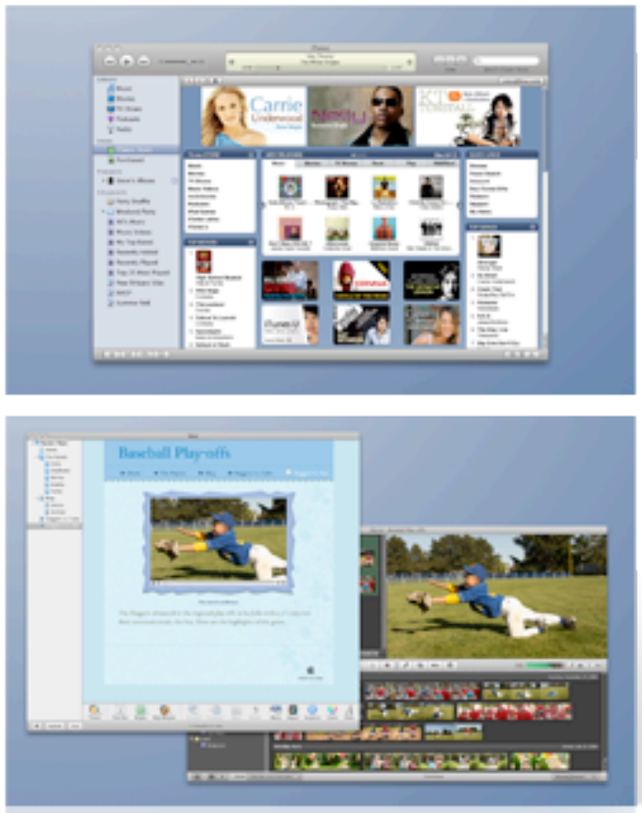
Session Management

- WM techniques continued
  - Input focus: Various modes possible
    - Implicit (focus follows pointer): mouse/keyboard/... input goes to window under specific cursor (usually mouse)
    - Explicit (click to type): clicking into window activates it (predominant mode today)
  - Virtual screens
    - Space for windows larger than visible screen
    - Mapping of screen into space discrete or continuous

Virtual Desktops

KDE

Mac OS X



Session Management

- WM techniques continued
  - Look & Feel evolves hand-in-hand with technology
    - Audio, video I/O
    - Gesture recognition
    - 2.5-D windows (implemented by WM, BWS doesn't know)
    - Transparency
  - To consider:
    - Performance hit?
    - Just beautified, or functionally improved?

Late Refinement

- WM accompanies session, allows user to change window positions, etc. (changing app appearance)
- For this, application must support late refinement
  - App developer provides defaults that can be changed by user
  - Attributes must be publicized as configurable, with possible values
  - App can configure itself using startup files (may be inconsistent), or WM can provide those values when starting app
  - With several competing instances: priorities (static/dynamic!...)

Levels of Late Refinement

- Per session, for all users
  - System-wide information (table, config file,...) read by WM
- Per application, for all users
  - Description for each application, in system-wide area
- Per application, per user
  - Description file for each application, stored in home directory
- Per application, per launch
  - Using startup parameters (options) or by specifying specific other description file

Implementing Late Refinement

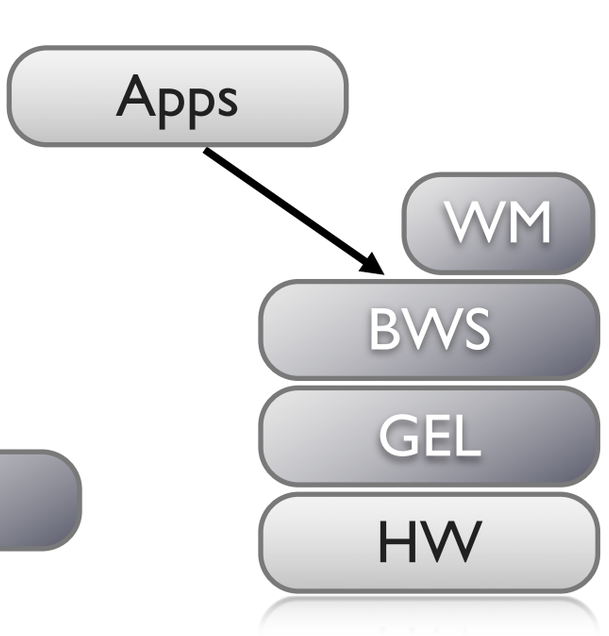
- Table files
  - Key-value pairs, with priority rule for competing entries
  - Usually clear text (good idea), user versions usually editable
  - Modern versions: XML-based
- WM-internal database
  - Access only via special editor programs
  - Allows for syntax check before accepting changes, but less transparent; needs updating when users are deleted,.....
    - Random Rant: Why Non-Clear-Text Config Files Are Evil
- Delta technique
  - Starting state + incremental changes; undo possible

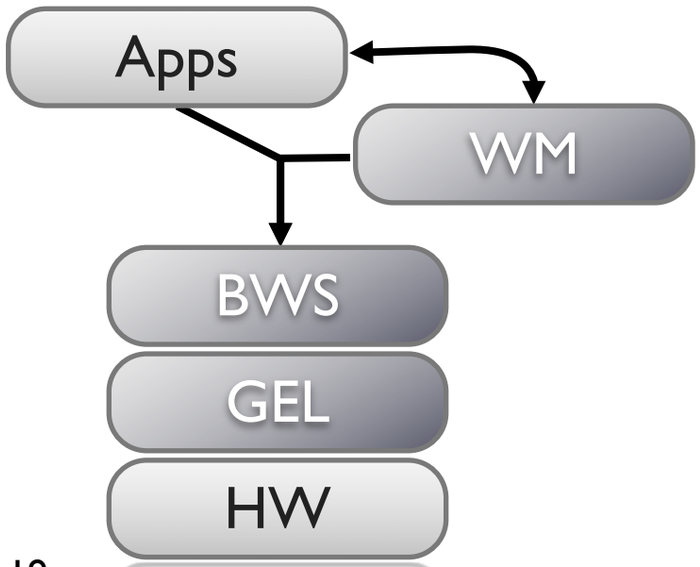
Example: plist for login window application (Mac OS X)

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple Computer//DTD PLIST 1.0//EN"
"http://www.apple.com/DTDs/PropertyList-1.0.dtd">
<plist version="1.0">
<dict>
    <key>PicturePathLW</key>
    <string>/Library/User Pictures/Flowers/Sunflower.tif</string>
    <key>RetriesUntilHint</key>
    <integer>3</integer>
    <key>lastUserName</key>
    <string>borchers</string>
    <key>lightWeightLogin</key>
    <false/></dict>
</plist>
```

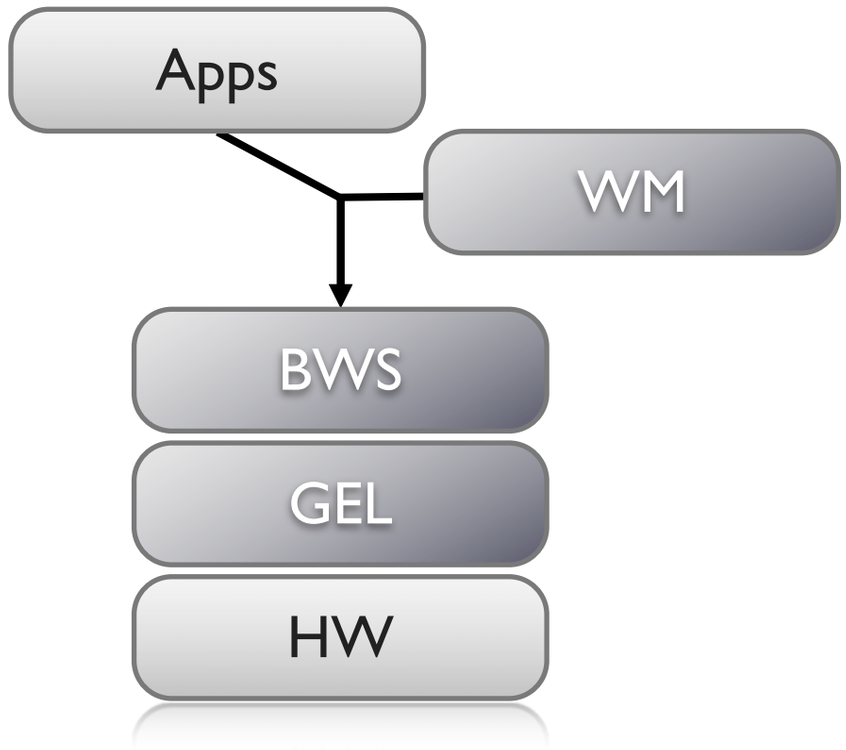

Window Manager: Location

- WM=client of BWS, using its access functions
- WM=server of apps, can change their appearance
- Several possible architectures
  - WM as upper part of BWS
    - Saves comms overhead
    - But overview suffers
  - WM as separate server
    - More comms
    - But exchangeable WM





Window Manager: Location



- Separate user process
  - Uses mechanism of shared resources
  - E.g., requests window position from BWS, checks its conformance with its layout policy, and requests position change if necessary
  - More comms, but same protocol as between apps & BWS no direct connection app—WM

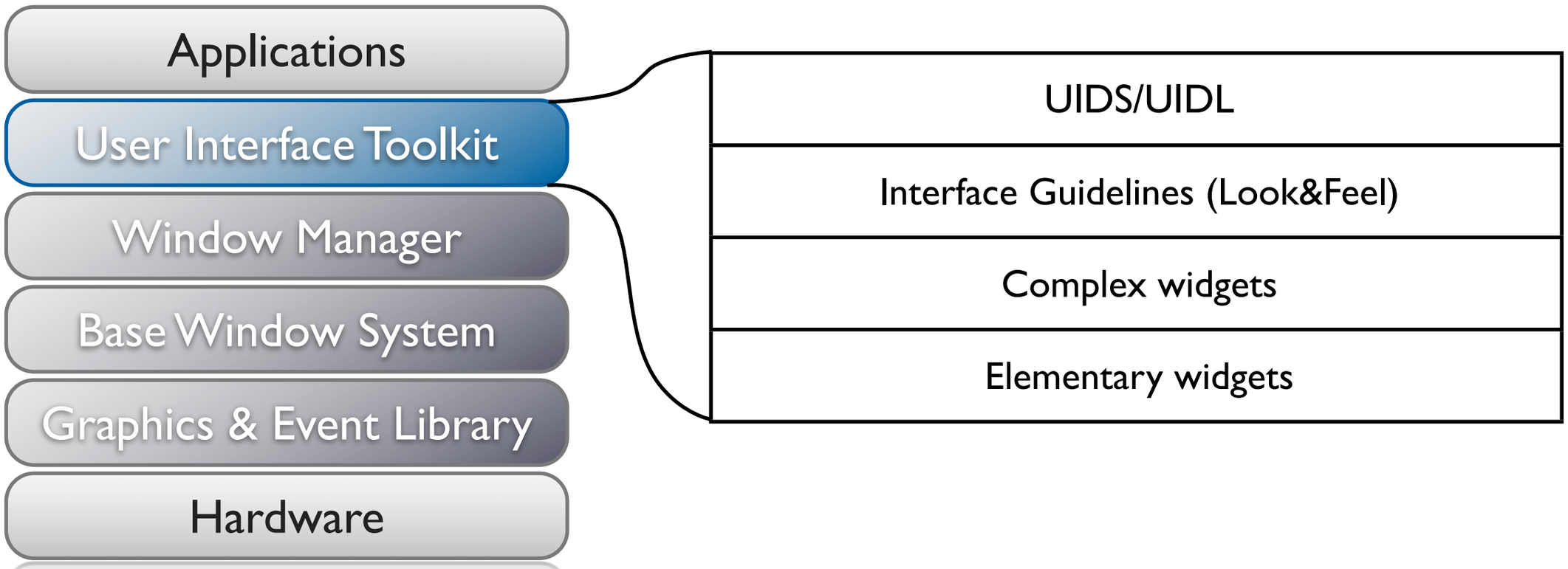
Window Manager: Conventions

- Visual consistency
  - For coding graphical information across apps
  - Reduce learning effort
- Behavioral consistency
  - Central actions tied to the same mouse/keyboard actions (right-click for context menu, ⌘-Q to quit) - predictability
- Description consistency
  - Syntax & semantics of configuration files / databases consistent across all levels of late refinement
  - Usually requires defining special language

Window Manager: Conclusions

- WM leads from system- to user-centered view of WS
- Accompanies user during session
- Potentially exchangeable
  - Allows for implementation of new variants of desktop metaphor without having to change entire system
  - E.g., still much room for user modeling (see, e.g., IUI 2002)
- WM requires UI Toolkit to implement same Look&Feel across applications

User Interface Toolkit



- Motivation: Deliver API
  - problem/user-oriented instead of hardware/BWS-specific
  - 50–70% of SW development go into UI
    - UITK should increase productivity

UITK: Concept

- Two parts
  - Widget set (closely connected to WS)
  - UIDS (User Interface Design System to support UI design task)
- Assumptions
  - UIs decomposable into sequence of dialogs (time) using widgets arranged on screen (space)
  - All widgets are suitable for on-screen display (no post-desktop user interfaces)
  - Note: decomposition not unique

UITK: Structure

- Constraints
  - User works on several tasks in parallel → parallel apps
  - Widgets need to be composable, and communicate with other widgets
  - Apps using widget set (or defining new widgets) should be reusable
- Structure of procedural/functional UITKs
  - Matched procedural languages and FSM-based, linear description of app behavior
  - But: Apps not very reusable

UITK: Structure

- OO Toolkits
  - Widget handles certain UI actions in its methods, without involving app
  - Only user input not defined for widget is passed on to app asynchronously (as seen from the app developer)
    - Matches parallel view of external control, objects have their own "life"
  - Advantage: Subclass new widgets from existing ones
  - Disadvantage:
    - Requires OO language (or difficult bridging, see Motif)
    - Debugging apps difficult

UITK: Control Flow

- Procedural model:
  - App needs to call UITK routines with parameters
  - Control then remains in UITK until it returns it to app
- OO model:
  - App instantiates widgets
  - UITK then takes over, passing events to widgets in its own event loop
  - App-specific functionality executed asynchronously in callbacks (registered with widgets upon instantiation)
  - Control flow also needed between widgets

Defining Widgets

- Widget :

$$(W = (w_1 \dots w_k), G = (g_1 \dots g_l), A = (a_1 \dots a_m), i = (i_1 \dots i_n))$$

  - Output side: windows W, graphical attributes G
  - Input side: actions A that react to user inputs I
  - Mapping inputs to actions is part of the specification, can change even at runtime
  - Actions can be defined by widget or in callback
- Each widget type satisfied a certain UI need
  - Input number, select item from list,...

Simple Widgets

- Elementary widgets
  - Universal, app-independent, for basic UI needs
  - E.g., button (trigger action by clicking), label (display text), menu (select 1 of n commands), scrollbar (continuous display and change of value), radio button (select 1 of n attributes)

In-Class Exercise: Button

- What are the typical components (W, G, A, I) of a button?
- Sample solution:
  - W=(text window, shadow window)
  - G=(size, color, font, shadow,...)
  - A=(enter callback, leave callback, clicked callback)
  - I=(triggered with mouse, triggered with key, enter, leave)

Simple Widgets

- Container widgets
  - Layout and coordinate other widgets
  - Specification includes list C of child widgets they manage
  - Several types depending on layout strategy
- Elementary & Container widgets are enough to create applications and ensure Look&Feel on a fundamental level

Complex Widgets

- Applications will only use subset of simple widgets
- But also have recurring need for certain widget combinations depending on app class (text editing, CAD,...)
  - Examples: file browser, text editing window
- Two ways to create complex widgets
  - Composition (combining simple widgets)
  - Refinement (subclassing and extending simple widgets)
  - Analogy in IC design: component groups vs. specialized ICs

Widget Composition

- Creating dynamic widget hierarchy by hierarchically organizing widgets into the UI of an application
  - Some will not be visible in the UI
- Starting at root of dynamic widget tree, add container and other widgets to build entire tree
  - Active widgets usually leaves
  - Dynamic because it is created at runtime
  - Can even change at runtime through user action (menus,...)

Widgets and Windows

- The dynamic widget tree usually matches geographical *contains* relation of associated BWS windows
- But: Each widget usually consists of several BWS windows

→ Each widget corresponds to a subtree of the BWS window tree!

→ Actions A of a widget apply to is entire geometric range except where covered by child widgets

→ Graphical characteristics G of a widget are handled using priorities between it, its children, siblings, and parent

Refinement of Widgets

- Create new widget type by refining existing type
- Refined widget has mostly the same API as base widget, but additional or changed features, and fulfills Style Guide
- Not offered by all toolkits, but most OO ones
- Refinement creates the Static Hierarchy of widget subclasses
- Example: Refining text widget to support styled text (changes mostly G), or hypertext (also affects I & A)

Late Refinement of Widgets

- App developer can compose widgets
- Widget developer can refine widgets

→ User needs way to change widgets

→ Should be implemented inside toolkit

- Solution: Late Refinement (see WM for discussion)
- Late refinement cannot add or change type of widget characteristics or the dynamic hierarchy
- But can change values of widget characteristics

Style Guidelines

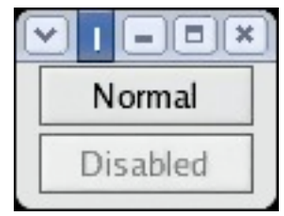
- How support consistent Look&Feel?
  - Document guidelines, rely on developer discipline
    - E.g., Macintosh Human Interface Guidelines (but included commercial pressure from Apple & later user community)
  - Limiting refinement and composition possible
    - Containers control all aspects of Look&Feel
    - Sacrifices flexibility
  - UIDS
    - Tools to specify the dialog explicitly with computer support

Types of UIDS

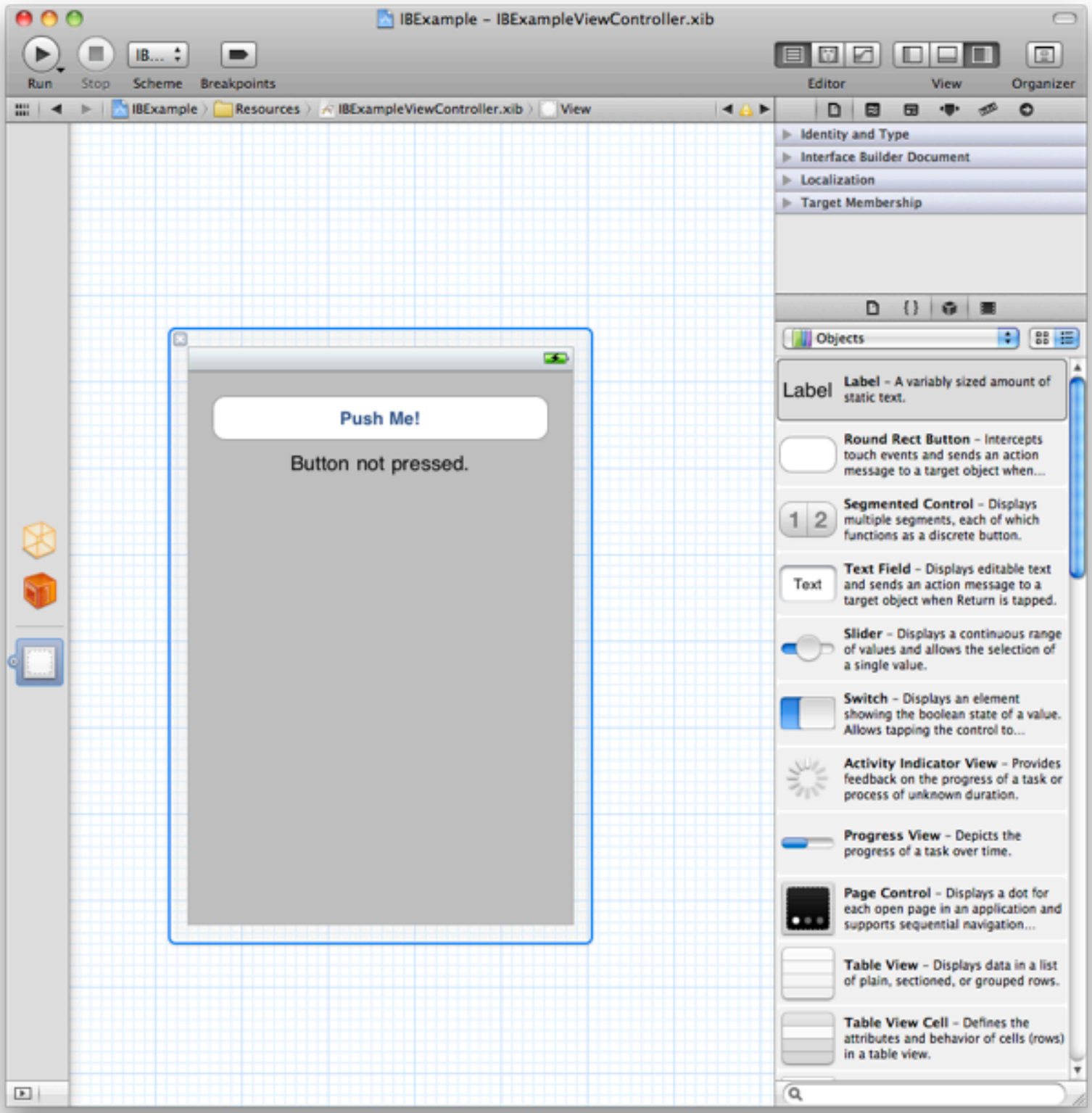
- Language-oriented
  - Special language (UIL) specifies composition of widgets
  - Compiler/interpreter implements style guidelines by checking constructs
- Interactive
  - Complex drawing programs to define look of UI
  - Specifying UI feel much more difficult graphically
    - Usually via lines/graphs connecting user input (I) to actions (A), as far as allowed by style guide
- Automatic
  - Create UI automatically from spec of app logic (research)

Language-Oriented UIDS

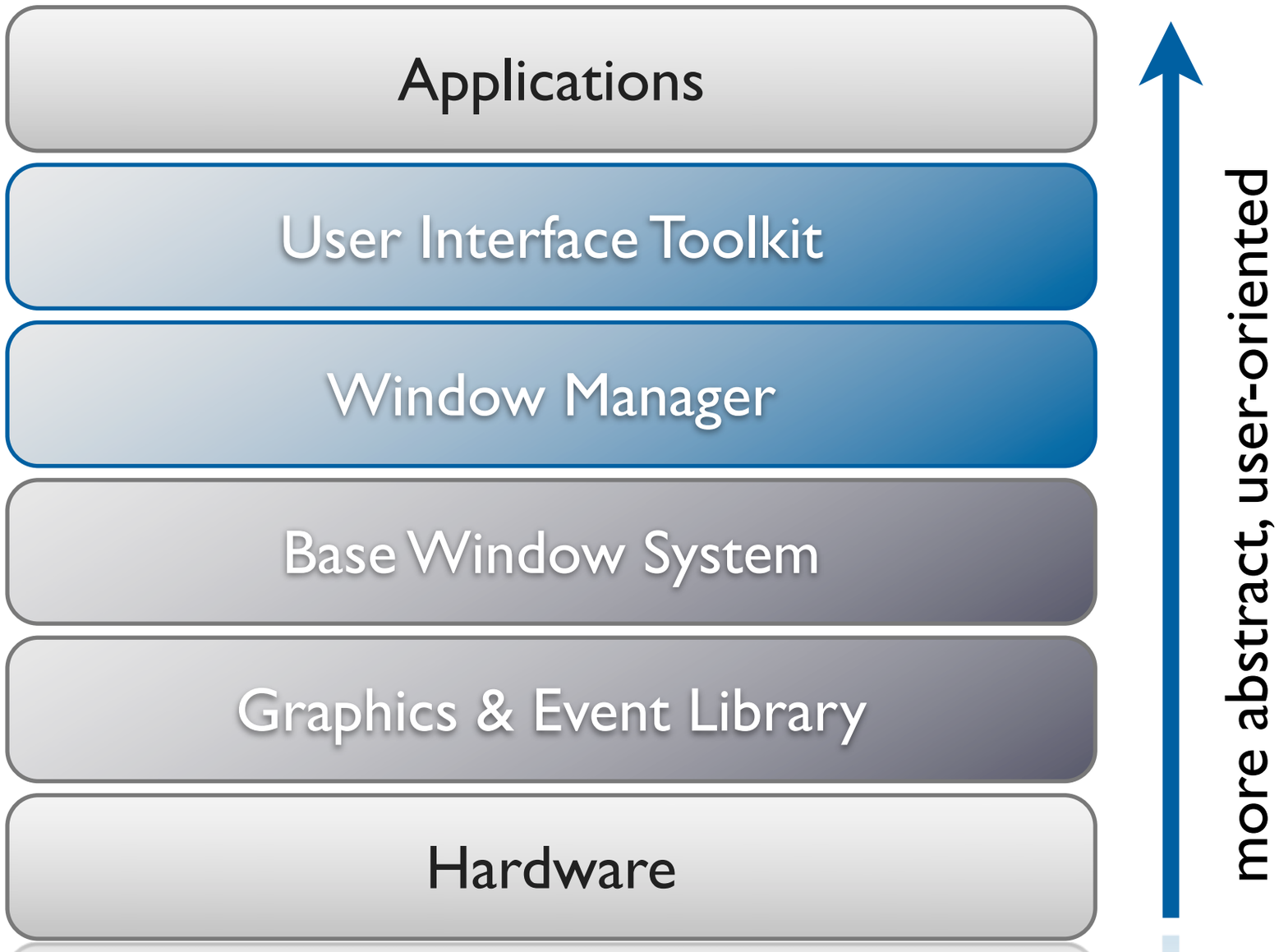
```
<?xml version="1.0"?>
<?xml-stylesheet href="chrome://global/skin/" type="text/css"?>
<window id="findfile-window"
        title="Find Files"
        orient="horizontal"
        xmlns="http://www.mozilla.org/keymaster/gatekeeper/there.is.only.xul">

    <button label="Normal"/>
    <button label="Disabled" disabled="true"/>

</window>
```



Interactive UIDS



Summary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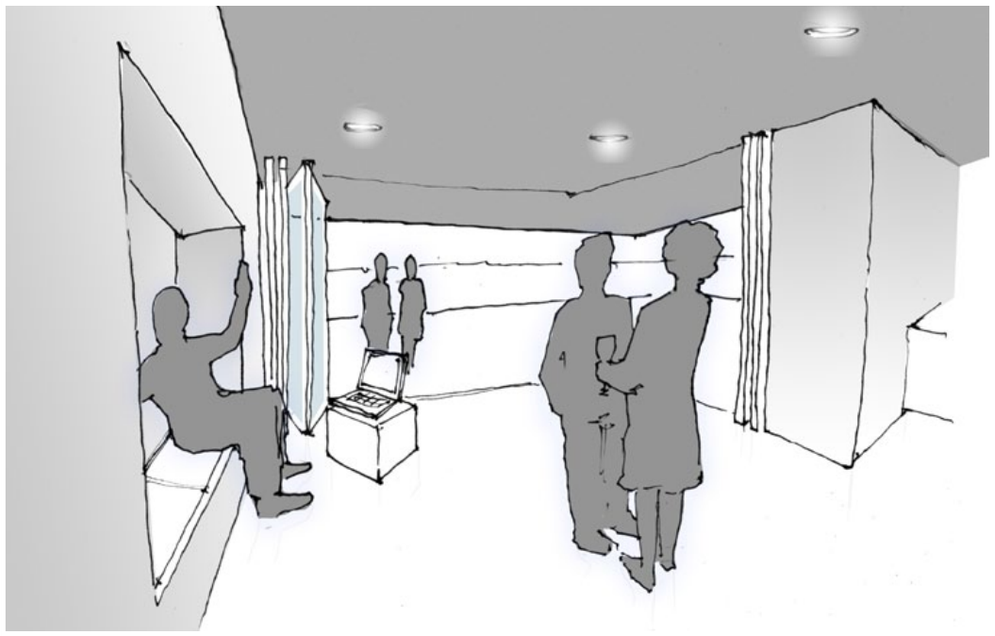

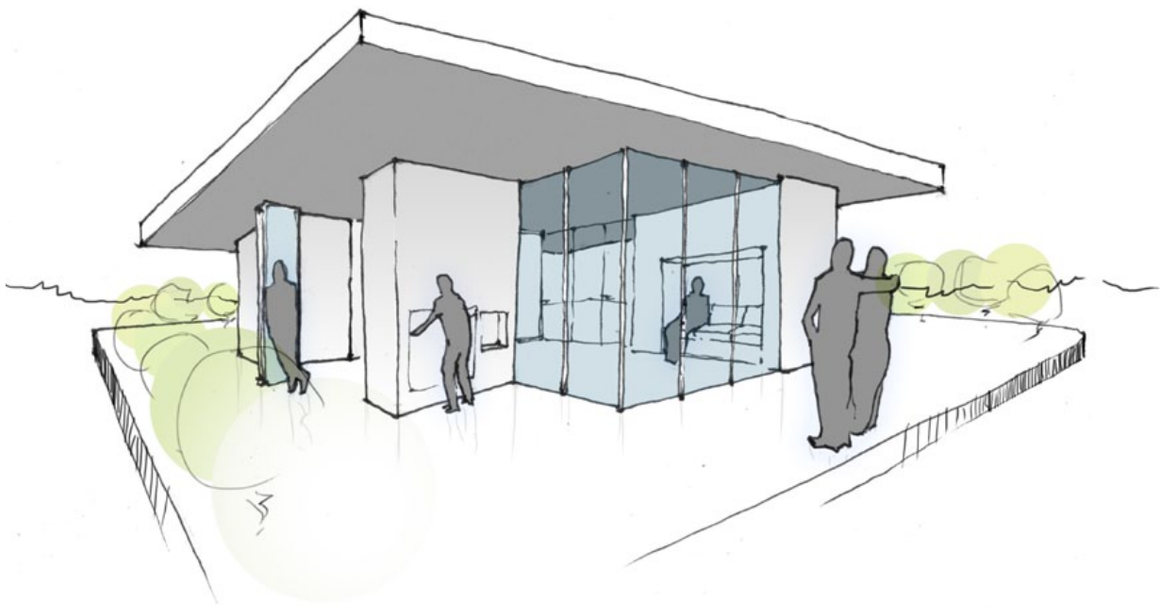

Team RWTH Aachen University | Solar Decathlon Europe 2012

Einladung

zum Startup-Treffen

am Freitag den 15.04 um
11.30 Uhr im Reiff-Museum
Schinkelstrasse 1 Raum 220

Ansprechpartner: Fabian Pech
fabian.pech@rwth-aachen.de

COUNTER ENTROPY

www.solar.arch.rwth-aachen.de

COUNTER ENTROPY

Das Team der RWTH Aachen hat sich erfolgreich für die Teilnahme am Solar Decathlon 2012 in Madrid beworben.

Bei diesem internationalen Studentenwettbewerb treten die ausgewählten Universitäten mit ihren architektonischen Entwürfen in 10 verschiedenen Disziplinen gegeneinander an.

Aufgabe des Wettbewerbs ist es ein nachhaltiges Wohnkonzept zu entwickeln, welches sich durch energieeffiziente Technik und die Eigenproduktion von Solarenergie auszeichnet und dadurch den Standard eines Plus-Energiehauses erreicht. Gleichzeitig dient der Wettbewerb dazu die Öffentlichkeit für das wichtige Thema des energieeffizienten Bauens, sowie für den Umgang mit erneuerbaren Energien zu sensibilisieren. Unser Entwurf, das „Counter Entropy House“, basiert auf der Idee eines ressourcenschonenden, energieoptimierten Lebenszyklus, bei dem sowohl die Herstellung der Bauteile, als auch ihr Transport und die spätere Entsorgungsmöglichkeit ganzheitlich betrachtet werden.

Neben dem umfangreichen Einsatz von Recyclingprodukten möchten wir den „Re-Use“-Gedanken an möglichst vielen Stellen unseres Gebäudes einfließen lassen. Auf diesem Wege entsteht nicht nur ein deutlich reduzierter Primärenergiebedarf, sondern auch eine spannende, individuelle Lösung zukünftigen Wohnens.

Haben wir Ihr Interesse geweckt und wollen auch Sie am „Counter Entropy House“ teilhaben? Wir stehen Ihnen gerne für weitere Auskünfte zur Verfügung und freuen uns auf eine erfolgreiche Zusammenarbeit.