

13: Patterns and Interface Implementation

May 7, 2024

Project Status*

3a – Paper Prototype: Due Tomorrow @ 3pm

3b – Heuristic Evaluation: In-Class Activity on Thursday

3c/3d – Usability Testing:

Check-in (3c) due Thurs 3/16 @ 8pm

Review (3d) due Mon 3/20 @ 3pm

The Exam*

Scheduled for next Tuesday, 5/14, @ standard Lecture time

Planned format:

10-13 Short Answer Questions

0-1 Long Answer Question(s)

A few notes on Grading*

Exam is NOT curved/adjusted

How Final Grades work:

Everyone gets a Raw grade for Core Content

Core Content: Project + Exam + Participation

Scaled linearly from 0 (0%) – 3.7 (100%)

All grades shifted *positively* by $3.7 - \text{Raw}_{max}$

EXP “Bonus” added to adjusted grade

Each EXP = +0.02; cap at +0.4 for 20EXP

Final Adjustments

Any scores above 4.0 → clipped to 4.0

Any “borderline” grades adjusted up

Overview

Controlled A/B Experiments

Patterns

Case Study of Model-View-Controller

Case Study of Animation

Role of Interface Tools

Objectives

Be able to:

Describe the benefit of design patterns,
contrast them with guidelines or templates

Describe the Model/View/Controller
approach to organizing interface implementation

Describe how tools evolve with patterns,
the benefits we gain from interface tools

Describe why tools eventually limit design thinking

Controlled A/B Experiments

Some questions ultimately resolve through data

Example: Amazon Shopping Cart Recommendations

Add an item to your shopping cart

Most sites show the cart

At Amazon, Greg Linden had idea to
show recommendations based on cart items

From Greg Linden's Blog: <http://glinden.blogspot.com/2006/04/early-amazon-shopping-cart.html>

Controlled A/B Experiments

Evaluation

Pro: cross-sell more items

Con: distract people from checking out

Highest Paid Person's Opinion:

Stop the project

Simple experiment run:

Wildly successful

From Greg Linden's Blog: <http://glinden.blogspot.com/2006/04/early-amazon-shopping-cart.html>

Controlled A/B Experiments

Many names for it

A/B tests or
Control/Treatment

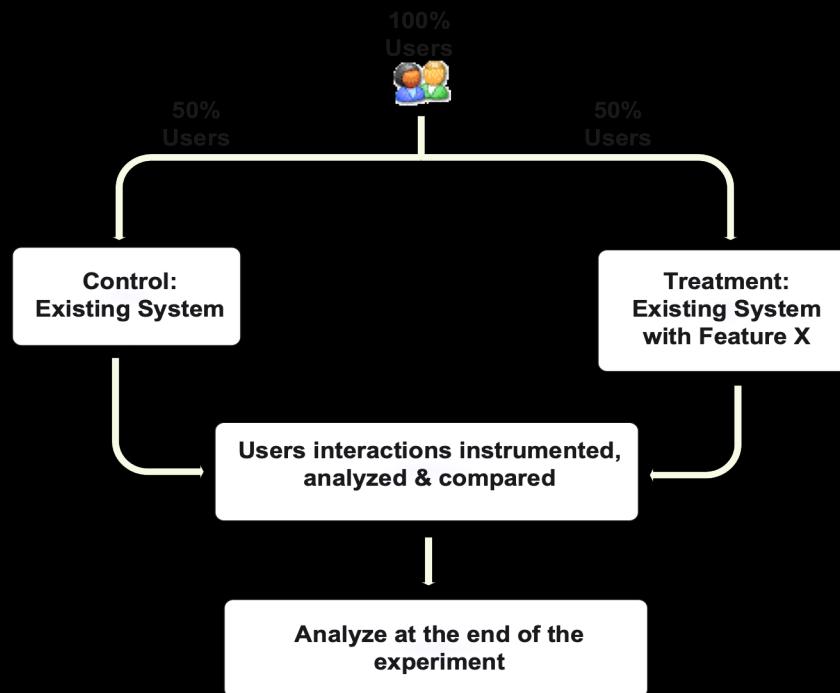
Randomized
Experimental Design

Controlled experiments

Split testing

Parallel flights

(examples from Ronny Kohavi)



Checkout Page

Conversion rate is percentage of visits that include purchase

The image shows two versions of a website's checkout page, labeled A and B, displayed side-by-side. Both pages have a blue header with the logo 'Doctor FootCare™' and a 'Shopping Cart' icon. Below the header is a navigation bar with links: Home, Products, Learn More, Tips, Testimonials, FAQ, About Us, Contact Us, and a phone number 1-866-211-9733.

Version A: The top section features a heading 'Shop With Confidence' followed by two columns of checkboxes. The left column contains: 'Satisfaction Guaranteed' (checked), '100% Safe, Secured shopping' (checked). The right column contains: '30-day, hassle-free Returns' (checked), 'We assure your Privacy' (checked). Below this is a '100% Secured Checkout' section with a lock icon. It includes a table with columns: Item Name, Item Number, Quantity, Remove, Unit Price, and Subtotal. A single item 'Trial Kit' with item number 'FFCS' is listed, quantity 1, unit price \$0.00, and subtotal \$0.00. There is an 'Update' button and a 'Total: \$0.00' summary. A dropdown menu for 'Select Shipping Method' shows 'Standard (\$5.95)'. Below this is another '100% Secured Checkout' section with a lock icon. At the bottom are links: Home, Products, Learn More, Tips, Testimonials, FAQ, About Us, Contact Us, Shopping Cart, and a copyright notice: Copyright © 2003 Doctor Foot Care Inc. All Rights Reserved. [Privacy Policy](#).

Version B: The layout is identical to Version A, but the content in the 'Shop With Confidence' section is swapped. The left column now contains: '30-day, hassle-free Returns' (checked), 'We assure your Privacy' (checked). The right column contains: 'Satisfaction Guaranteed' (checked), '100% Safe, Secured shopping' (checked). The rest of the page, including the checkout tables and footer, is identical to Version A.

Which version has a higher conversion rate?

Example from Bryan Eisenberg's article on clickz.com

Checkout Page

Conversion rate is percentage of visits that include purchase

The image displays two versions of a checkout page, labeled A and B, side-by-side. Both pages have a blue header with the logo 'Doctor FootCare™' and a 'Shopping Cart' icon. Below the header is a navigation bar with links: Home, Products, Learn More, Tips, Testimonials, FAQ, About Us, Contact Us, and a phone number 1-866-211-9733.

Version A: This version has several red circles highlighting specific elements:

- A red circle surrounds the 'Quantity' input field, which contains the value '1'.
- A red circle surrounds the 'Update' button below the quantity input.
- A red circle surrounds the 'Total: \$0.00' button.
- A red circle surrounds the 'Home' link in the footer navigation bar.

Version B: This version also has red circles highlighting specific elements:

- A red circle surrounds the 'Shopping Cart' icon in the header.
- A red circle surrounds the 'Discount' row in the cart table, which shows '\$0.00'.
- A red circle surrounds the 'Total' row in the cart table, which shows '\$0.00'.
- A red circle surrounds the 'Enter Coupon Code' input field.
- A red circle surrounds the 'Select Shipping Method' dropdown menu.
- A red circle surrounds the 'Recalculate' button.

Both versions include a '100% Secured Checkout' message with a lock icon. They also feature a 'Continue Shopping' button and a 'Proceed To Checkout' button.

Which version has a higher conversion rate?

Example from Bryan Eisenberg's article on clickz.com

Checkout Page

Conversion rate is percentage of visits that include purchase

A Doctor FootCare™

Shop With Confidence

Satisfaction Guaranteed 30-day, hassle-free Returns
 100% Safe, **Secured** shopping We assure your Privacy

100% Secured Checkout

Item Name	Item Number	Quantity	Remove	Unit Price	Subtotal
Trial Kit	FFCS	<input type="text" value="1"/>		\$0.00	\$0.00

Continue Shopping > Proceed To Checkout

100% Secured Checkout

Item Name	Item Number	Quantity	Remove	Unit Price	Subtotal
Trial Kit	FFCS	<input type="text" value="1"/>		\$0.00	\$0.00

Discount: \$0.00
Total: \$0.00

Select Shipping Method: Standard (\$5.95)

Enter Coupon Code:

Continue Shopping > Proceed To Checkout

Home | Products | Learn More | Tips | Testimonials | FAQ | About Us | Contact Us | Shopping Cart

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B Doctor FootCare™

Shop With Confidence

Satisfaction Guaranteed 30-day, hassle-free Returns
 100% Safe, **Secured** shopping We assure your Privacy

100% Secured Checkout

Item Name	Item Number	Quantity	Remove	Unit Price	Subtotal
Trial Kit	FFCS	<input type="text" value="1"/>		\$0.00	\$0.00

> Proceed To Checkout

100% Secured Checkout

Item Name	Item Number	Quantity	Remove	Unit Price	Subtotal
Trial Kit	FFCS	<input type="text" value="1"/>		\$0.00	\$0.00

Discount: \$0.00
Total: \$0.00

Enter Coupon Code:

Select Shipping Method: Standard (\$5.95)

Recalculate Continue Shopping > Proceed To Checkout

Home | Products | Learn More | Tips | Testimonials | FAQ | About Us | Contact Us | Shopping Cart

Copyright © 2003 Doctor Foot Care Inc. All Rights Reserved. [Privacy Policy](#)

Which version has a higher conversion rate?

Coupon Code decreases by factor of 10

Office Online Feedback

A

Please let us know if this content was helpful.

Rate this content:

★★★★★

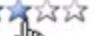
Tell us why you rated the content this way (optional):

Remaining characters: 650

Submit

B

How helpful was this information?
Click a star.

Not helpful  Very helpful

Click to rate: 3 out of 5 stars

↓

How helpful was this information?
Click a star.

Not helpful  Very helpful

Why did you rate the information this way?

Remaining characters: 650

Submit

Feedback A puts everything together, whereas feedback B is two-stage: question follows rating.

Feedback A just has 5 stars, whereas B annotates the stars with “Not helpful” to “Very helpful” and makes them brighter.

Which one has a higher response rate? By how much?

Office Online Feedback

A

Please let us know if this content was helpful.

Rate this content:

★★★★★

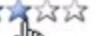
Tell us why you rated the content this way (optional):

Remaining characters: 650

Submit

B

How helpful was this information?
Click a star.

Not helpful  Very helpful

Click to rate: 3 out of 5 stars

↓

How helpful was this information?
Click a star.

Not helpful  Very helpful

Why did you rate the information this way?

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Submit

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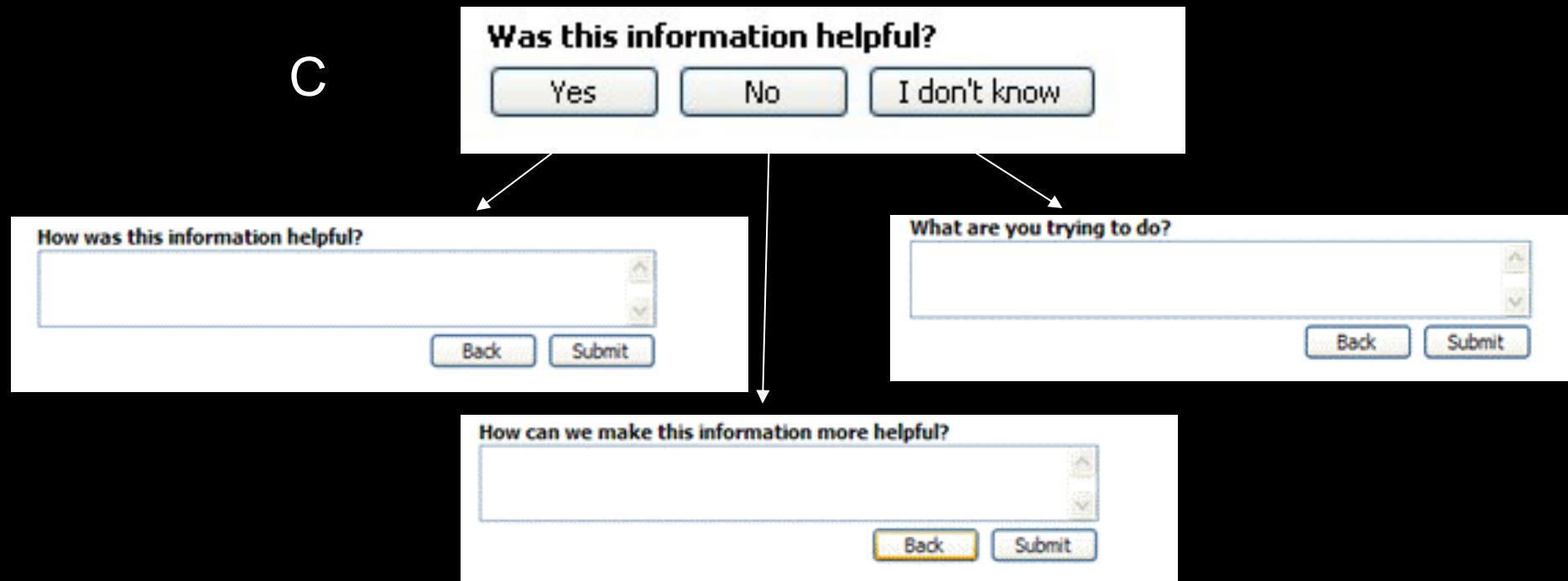
Which one has a higher response rate? By how much?

B gets more than double response rate.

Another Feedback Variant

Variant C. Like B, also two-stage.

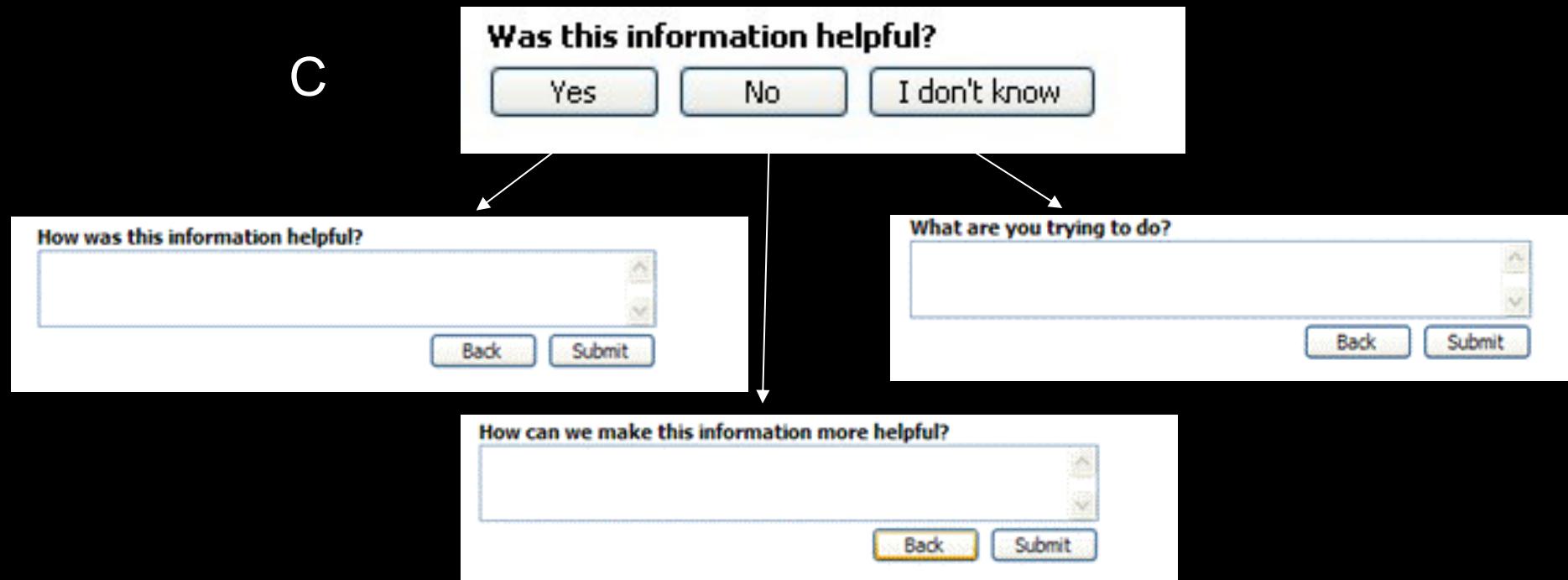
Which one has a higher response rate, B or C?



Another Feedback Variant

Variant C. Like B, also two-stage.

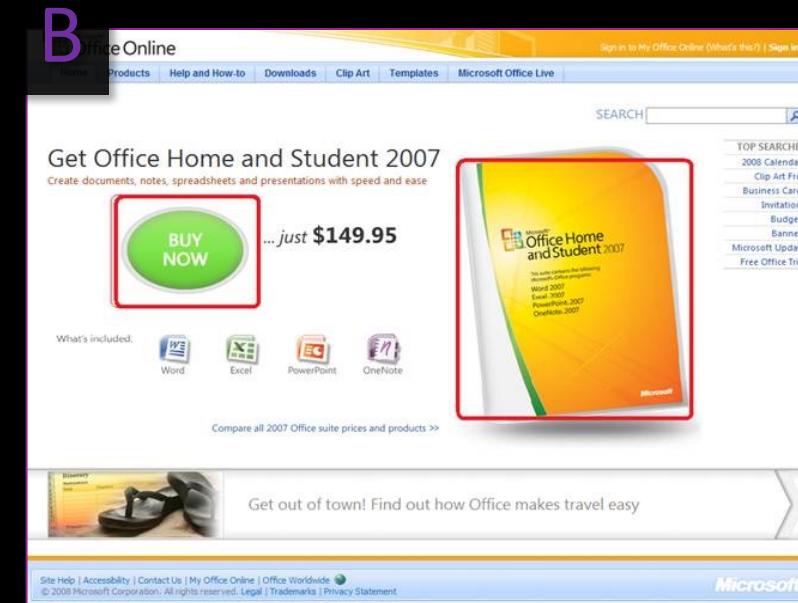
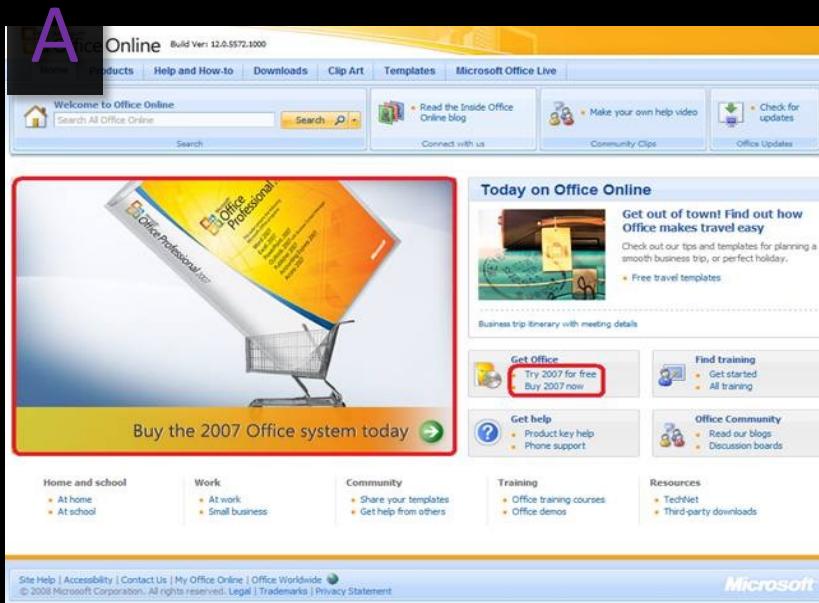
Which one has a higher response rate, B or C?



C outperforms B by a factor of 3.5

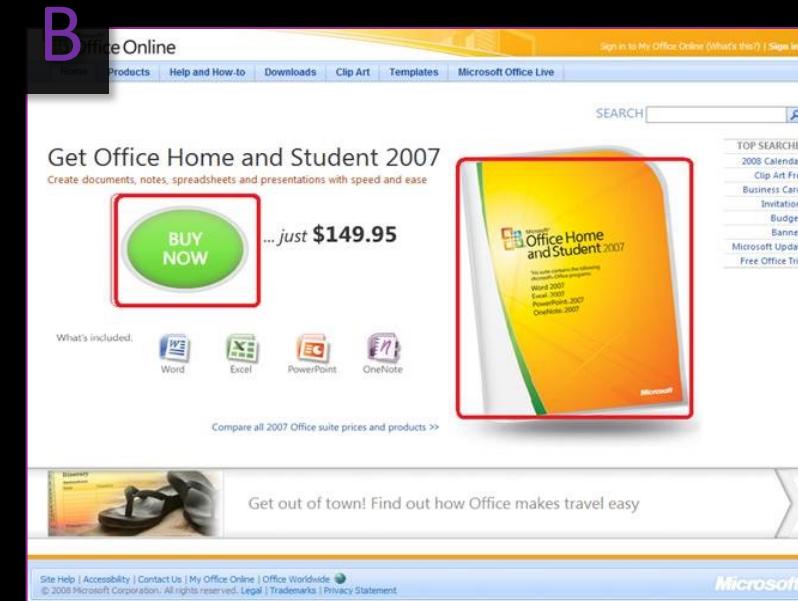
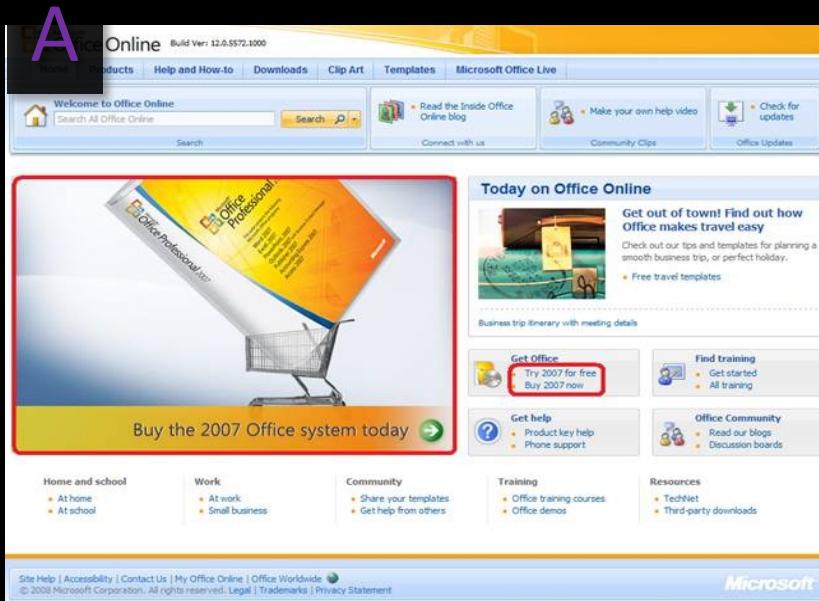
Office Online

Clicks on revenue generating links (red links)



Office Online

Clicks on revenue generating links (red links)



A gets many more clicks

Office Online

Clicks on revenue generating links (red links)

A

Office Online Build Ver: 12.0.5572.1000

Welcome to Office Online

Today on Office Online

Buy the 2007 Office system today

Get out of town! Find out how Office makes travel easy

Get Office Try 2007 for free Buy 2007 now

Find training Get started All training

Get help Product key help Phone support

Office Community Read our blogs Discussion boards

Home and school At home At school

Work At work Small business

Community Share your templates Get help from others

Training Office training courses Office demos

Resources TechNet Third-party downloads

Site Help Accessibility Contact Us My Office Online Office Worldwide © 2008 Microsoft Corporation. All rights reserved. Legal Trademarks Privacy Statement

Microsoft

B

Office Online

Get Office Home and Student 2007

... just \$149.95

What's included:

Word Excel PowerPoint OneNote

Compare all 2007 Office suite prices and products >>

Buy Now

Office Home and Student 2007

Get out of town! Find out how Office makes travel easy

Site Help Accessibility Contact Us My Office Online Office Worldwide © 2008 Microsoft Corporation. All rights reserved. Legal Trademarks Privacy Statement

Microsoft

B gets more revenue

Examples Where Data Is Wrong

If something is “amazing,” find the flaw

If you have a mandatory birth date field,
and people think it’s unnecessary,
you will find lots of 11/11/11 or 01/01/01

If you have an optional drop down,
do not default to the first alphabetical entry,
or you will have lots of: jobs = Astronaut

Traffic to doubled between 1-2am Nov 6 for many web sites,
relative to same hour week prior

MSN US Home Page

Proposal: New Offers module below Shopping

Shopping

- Lancôme: Free deluxe compact w/ purchase
- Special promotions at your favorite stores
- Warm fall fashion styles are here
- Save on top brand digital cameras
- Free shipping on furniture for every room

Advertisements

A smart way to buy a diamond

- Wal-Mart: Back-to-school
- Our editor picks budget electronics
- Get fit & save money: Sports sale

Control

Shopping

- Lancôme: Free deluxe compact w/ purchase
- Special promotions at your favorite stores
- Warm fall fashion styles are here
- Save on top brand digital cameras
- Free shipping on furniture for every room

Advertisements

A smart way to buy a diamond

- Wal-Mart: Back-to-school
- Our editor picks budget electronics
- Get fit & save money: Sports sale

Offers

Search GM Certified
With our 117-Point Inspection
GM Certified means no worries

Online University
Earn degree from a top school
100% Online. Get Free Info!

\$200k Loan, Get Low Rates
Secure Financing and Increase
Cash Flow. Click Here Now!

Treatment

Experiment Results

Ran A/B test for 12 days on 5% of MSN US visitors

Clickthrough: decreased 0.49%

Page views per person-day: decreased 0.35%

Value of click from home page: X cents

Net = Expected Revenue –
Value Per Click * Direct lost clicks –
Value Per Click * Lost Due to Decreased Views

Experiment Results

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Value of click from home page: X cents

Net = Expected Revenue –
Value Per Click * Direct lost clicks –
Value Per Click * Lost Due to Decreased Views

Net was negative (in millions of dollars),
offers module did not launch

Limitations of Data Driven Testing

Drives hill-climbing, but not overall design

A design may be better, but is it good?

Can be difficult to scale to many features

Impossible for new designs to compete

The new design may have the potential to be much better,
but is not yet “tuned” by this same process

Can lead to optimizing what is measurable
rather than what is important

Today

Controlled A/B Experiments

Patterns

Case Study of Model-View-Controller

Case Study of Animation

Role of Interface Tools

Design Equals Solutions

Design is about finding solutions

Designers often reinvent

- Hard to know how things were done before

- Why things were done a certain way

- How to reuse solutions

One option is patterns

- You can look to models, you can look to prior research

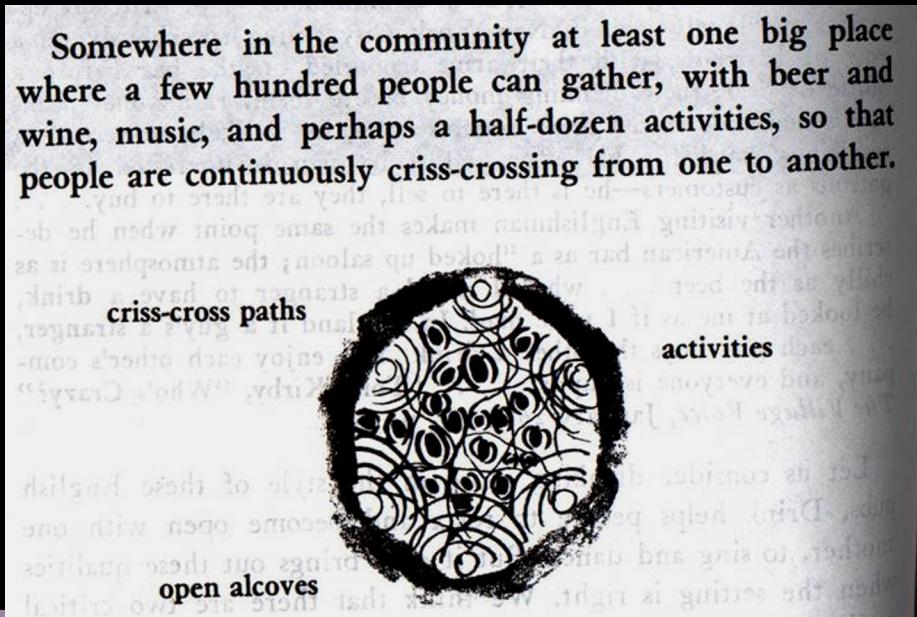
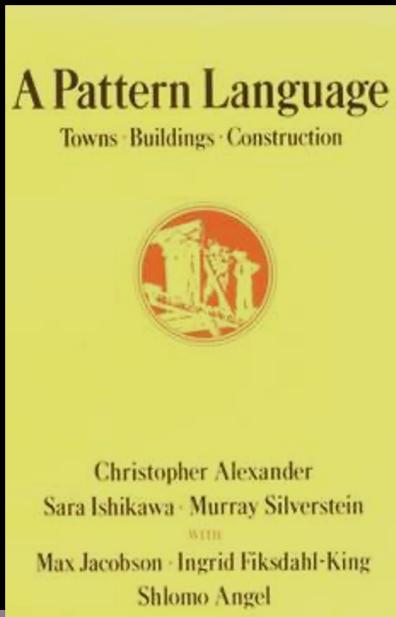
- Patterns can also help you look to prior solutions

Design Patterns

Design patterns communicate common design problems and solutions

First used in architecture

How to create a beer hall where people socialize?



Using Design Patterns

Not too general and not too specific

use a solution “a million times over,
without ever doing it the same way twice”

Design patterns are a shared language

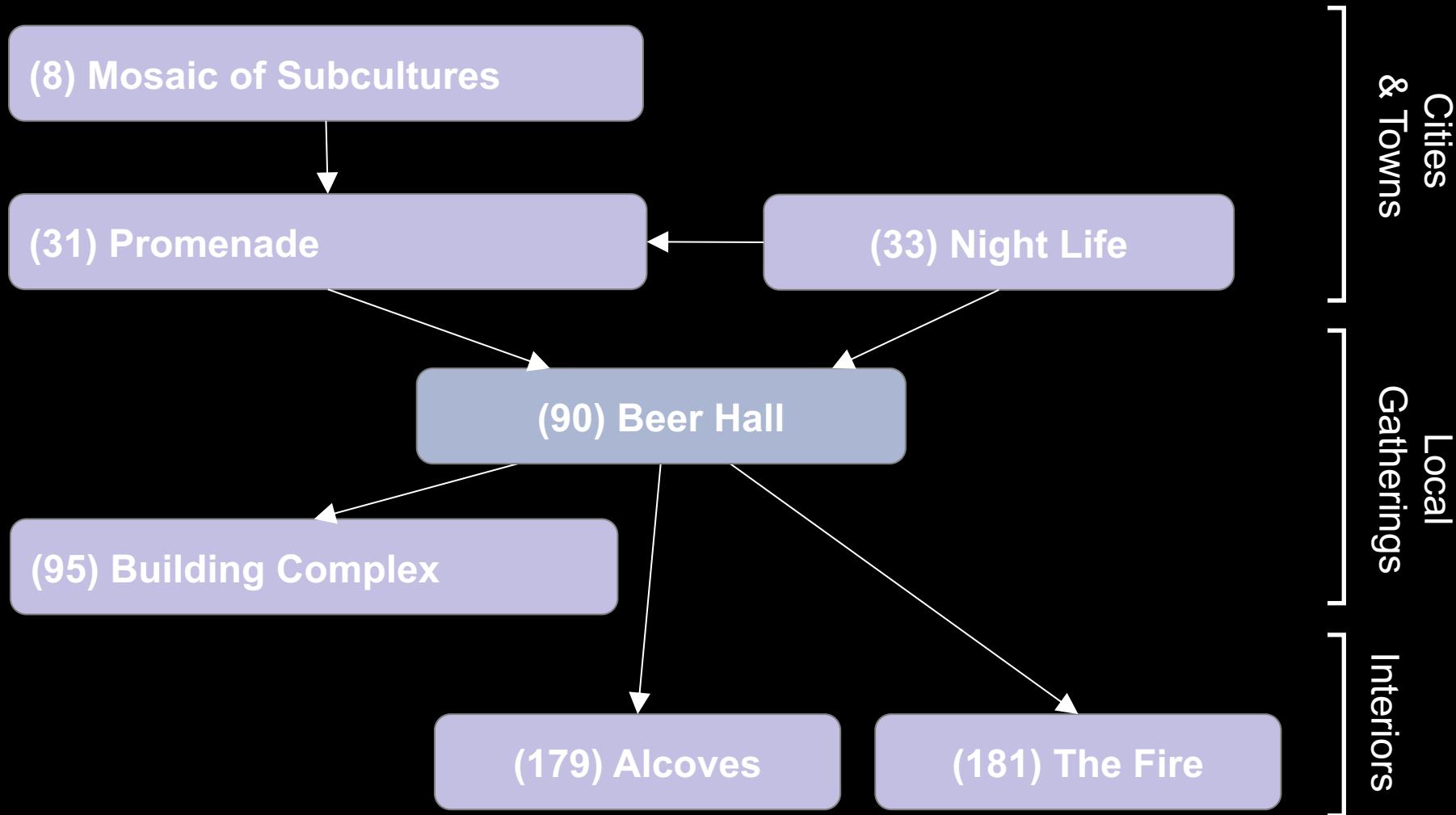
for “building and planning towns,
neighborhoods, houses, gardens, and rooms”

Beer hall is part of a center for public life

Beer hall needs spaces for groups to be alone

ALCOVES

A Web of Design Patterns



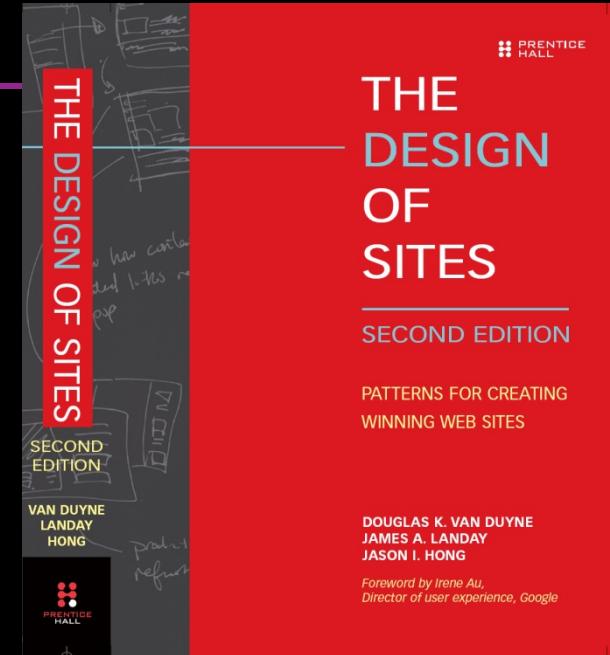
Web Design Patterns

Communicate design
problems & solutions

how to create navigation bars
for finding relevant content

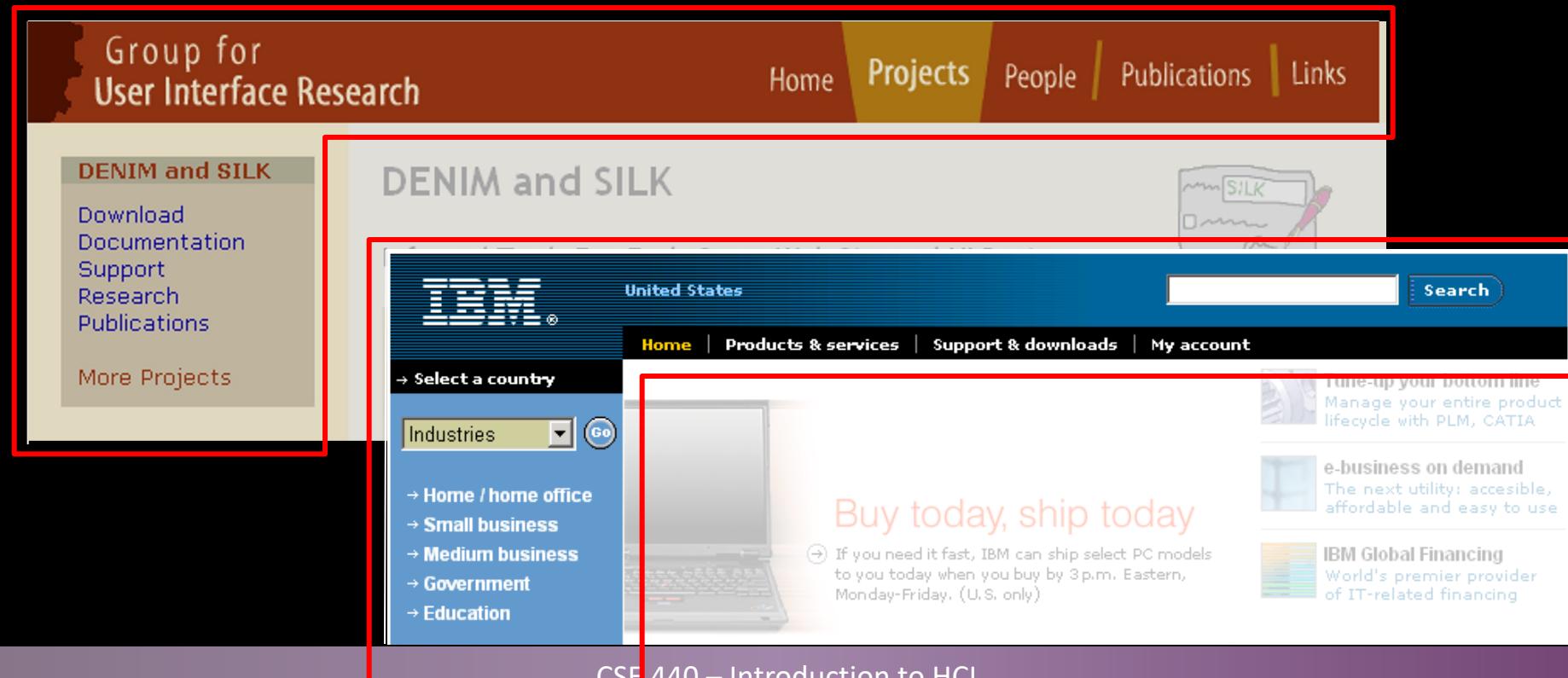
how to create a shopping cart
that supports check out

how to make e-commerce sites
where people return & buy



NAVIGATION BAR (K2)

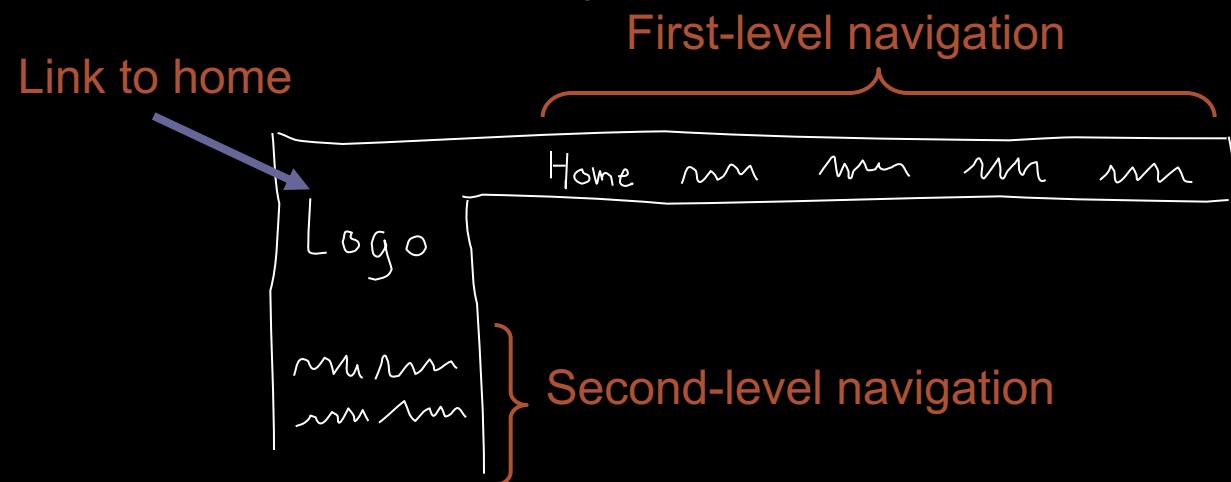
Problem: Customers need a structured, organized way of finding the most important parts of your Web site



NAVIGATION BAR (K2)

Solution diagram

Captures essence of how to solve problem



PROCESS FUNNEL (H1)

Problem:

Need a way to help people complete highly specific stepwise tasks

Ex. Create a new account

Ex. Fill out survey forms

Ex. Check out

PROCESS FUNNEL (H1)

The screenshot shows a vintage web interface for Half.com, a subsidiary of eBay. At the top, there's a navigation bar with links for 'my account', 'cart', 'help', 'eBay home', and 'sign in'. Below the navigation is a horizontal menu with categories: Home, Books, Music, DVDs/Movies, Video Games, Computers & Software, Electronics, and Everything Else... A secondary menu below it includes Gift Certificates, Wish List, Pre-Orders, Sell Your Stuff, and New Users. A search bar is present with a dropdown menu set to 'All Categories' and a 'go' button.

In the main content area, there's a sidebar titled 'People with similar tastes also enjoyed...' featuring album covers for 'Weezer (1994)', 'Pinkerton', and 'All Killer No Filler [ECD]'. The main section displays a 'Shopping Cart' containing a single item: 'Weezer (2001)' by Weezer (Music). The item details include: CD, Release Year: 2001, Seller: naotia@hotmail.com (35), Condition: Like New • Notes: Perfect condition. To the right of the item, shipping information is listed: Item: \$8.30, Media Mail: \$2.45, with a link to 'Change Shipping Method'. Below the item, there are links to 'Move to WishList', 'Remove from Cart', and 'Find another one'. The total price for the cart is displayed as \$10.75.

At the bottom of the page, there's a section titled 'Gift Certificates and Coupons' with instructions for redeeming them. It includes a text input field for the claim code and a 'Redeem' button. There are also 'Proceed to Checkout' and 'Speedy Checkout' buttons at the bottom right.

PROCESS FUNNEL (H1)

What's different?

The screenshot shows the half.com checkout process at Step 1 - Choose Shipping Address. At the top, there is a yellow header bar with the text "Checkout" and a progress bar showing "1 Shipping" followed by arrows pointing to "2 Billing" and "3 Place Order". A "Secure Shopping" badge with a lock icon is also present. Below the header, the text "Step 1 - Choose Shipping Address" is displayed. The main form area contains a section titled "Ship my order to:" with a pre-filled address: "Jason Hong, 387 Soda Hall Computer Science UC Berkeley, Berkeley, CA 94720". A red "Use This Address" button is located next to the address. Below this, the word "OR" is followed by a section titled "Enter a new shipping address:". This section includes fields for Name (text input), Street address (text input), City (text input), State (dropdown menu with placeholder "Select State"), ZIP code (text input), and Country (dropdown menu with placeholder "USA"). A note below the state field states: "If U.S. Military, enter APO/FPO for City." and "If U.S. Military, select AE, AP or AA from bottom of list for State." A red "Save Changes" button is at the bottom of this section.

What's the same?

PROCESS FUNNEL (H1)

The screenshot shows a web page from half.com, a subsidiary of eBay. At the top, there's a yellow header bar with the text "1 Step". Below it, the main content area has a title "Step 1 - Choose Shipping Address". A sub-section titled "Ship my order to:" displays a pre-filled address: "Jason Hong, 387 Soda Hall Computer Science UC Berkeley, Berkeley, CA 94720" with a "Use This Address" button. Below this, there's an "OR" option followed by a form for entering a new shipping address. The form fields include "Name" (text input), "Street address" (text input), "City" (text input), "State" (dropdown menu with placeholder "Select State"), "ZIP code" (text input), and "Country" (dropdown menu with placeholder "USA"). There are also explanatory notes for military addresses and a "Save Changes" button at the bottom.

What's different?
No tabs, no distractions
Navigation is linear

What's the same?
Logo, layout, colors, fonts

This example is dated, but this pattern is still what you encounter

PROCESS FUNNEL (H1)

Problem:

What if people need extra help?

PROCESS FUNNEL (H1)

Dell.com About Dell | Contact | Search | Support Order Status | My Cart

HOME & HOME OFFICE

DELL

Buy Online or Call
1-800-915-3355

Purchase Assistance

- Payment Solutions
- Tax & Shipping Info
- Secure Shopping Guarantee
- Privacy Policy

Recommended Systems

Click here for more Dimension 4100 recommended systems.

FEATURED SYSTEM

Featured Dimension 4100



The Dimension 4100 desktop offers you amazing power and flexibility at a price that won't break your budget.

- Intel® Pentium® III processor at 933Mhz
- 40GB⁵ Hard Drive
- 128MB SDRAM
- 32MB Nvidia GeForce2 MX 4X AGP Graphics Card

Free Ground (3-5 day) Shipping with purchase of any new Dell Home System. Offer ends 4/23/01.
[Click Here for Details.](#)

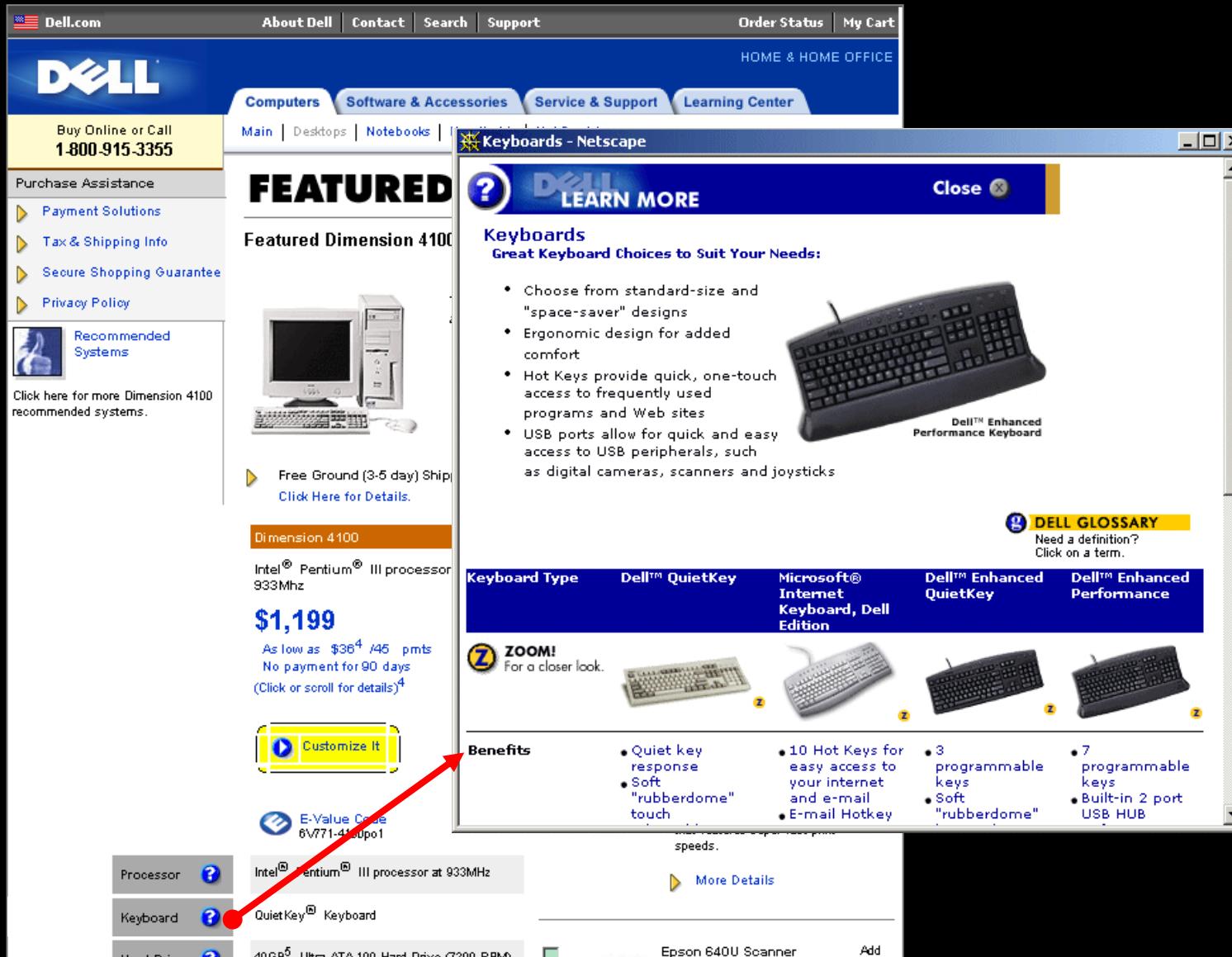
Dimension 4100	Great Add-Ons For This System	Price
Intel® Pentium® III processor at 933Mhz	Check any item(s) you wish to add to this system, then click Customize It.	
\$1,199	 3 Year On-Site Service Add With on-site service, you don't have to leave your home or ship your computer to us should you have a problem.	\$99
As low as \$36 ⁴ /45 pmts No payment for 90 days (Click or scroll for details) ⁴	 Epson Stylus Color 880 Ink Jet Printer Add A creative and versatile printer that features super fast print speeds.	\$149
 Customize It	 Epson 640U Scanner Add	
E-Value Code 6V771-4100po1	 More Details	
Processor ?	Epson Stylus Color 880 Ink Jet Printer Add A creative and versatile printer that features super fast print speeds.	
Keyboard ?	 More Details	
Hard Drive ?	Epson 640U Scanner Add	

Keyboard QuietKey® Keyboard

40GB⁵ Ultra ATA-100 Hard Drive (7200 RPM)

CSE 440 – Introduction to HCI

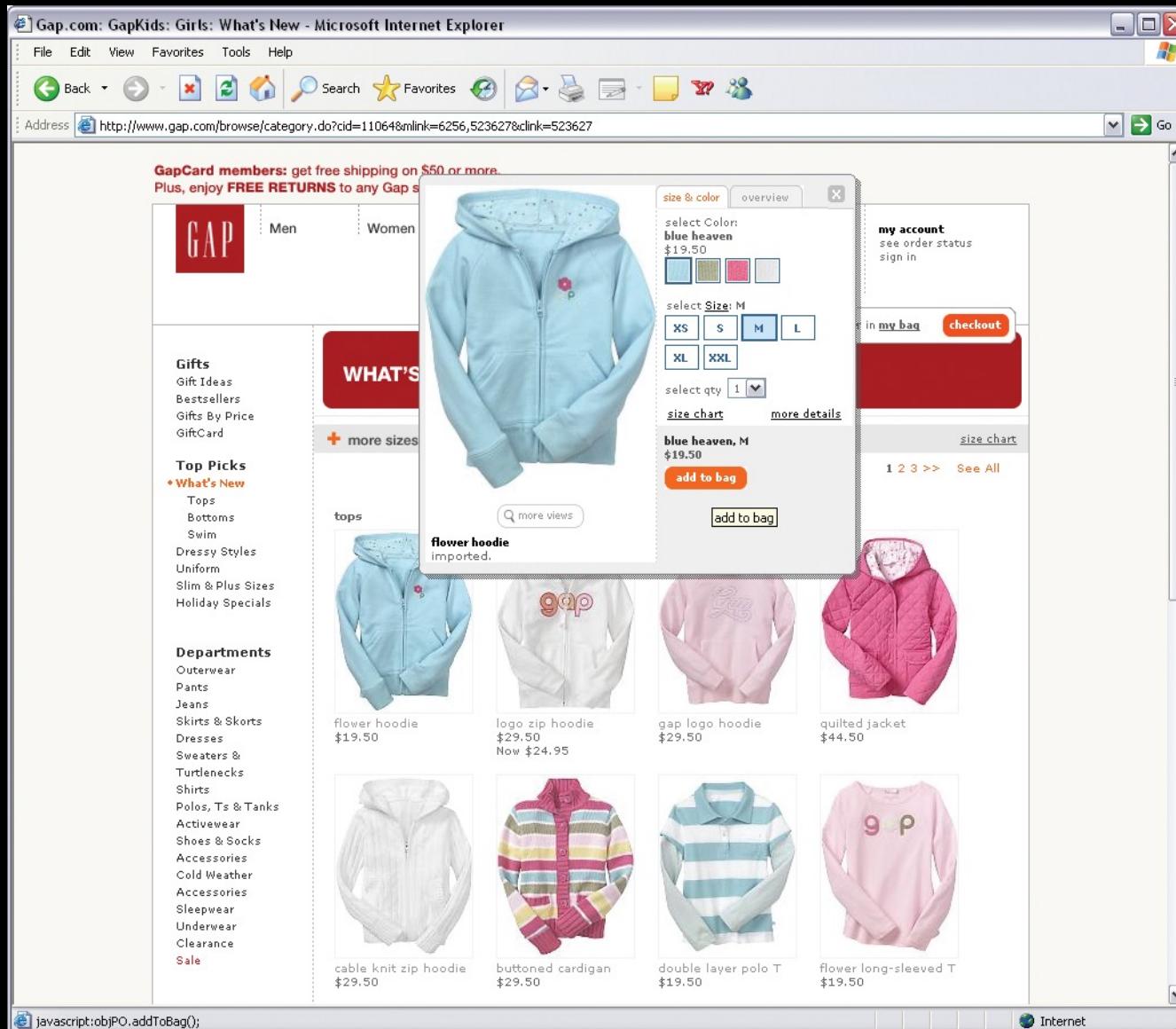
CONTEXT-SENSITIVE HELP (H8)



FLOATING WINDOWS (H6)

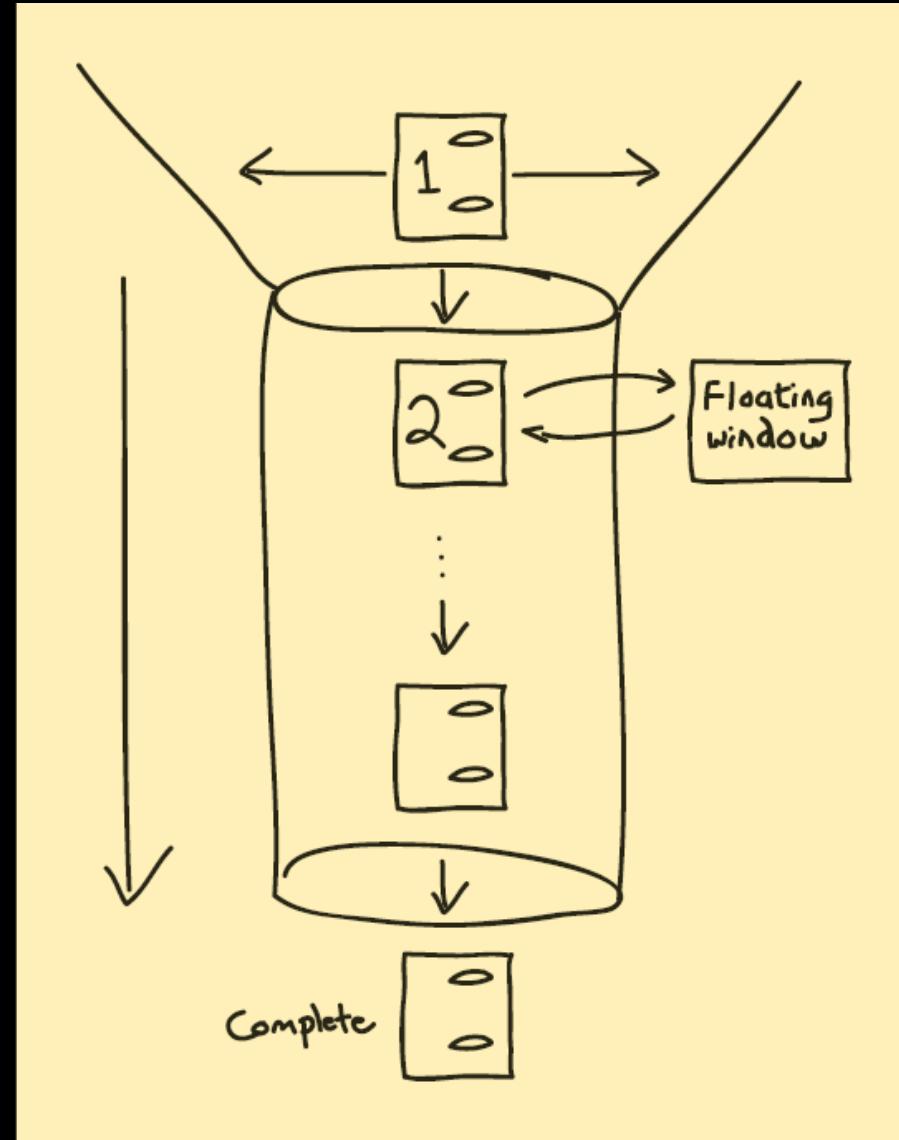


FLOATING WINDOWS (H6)

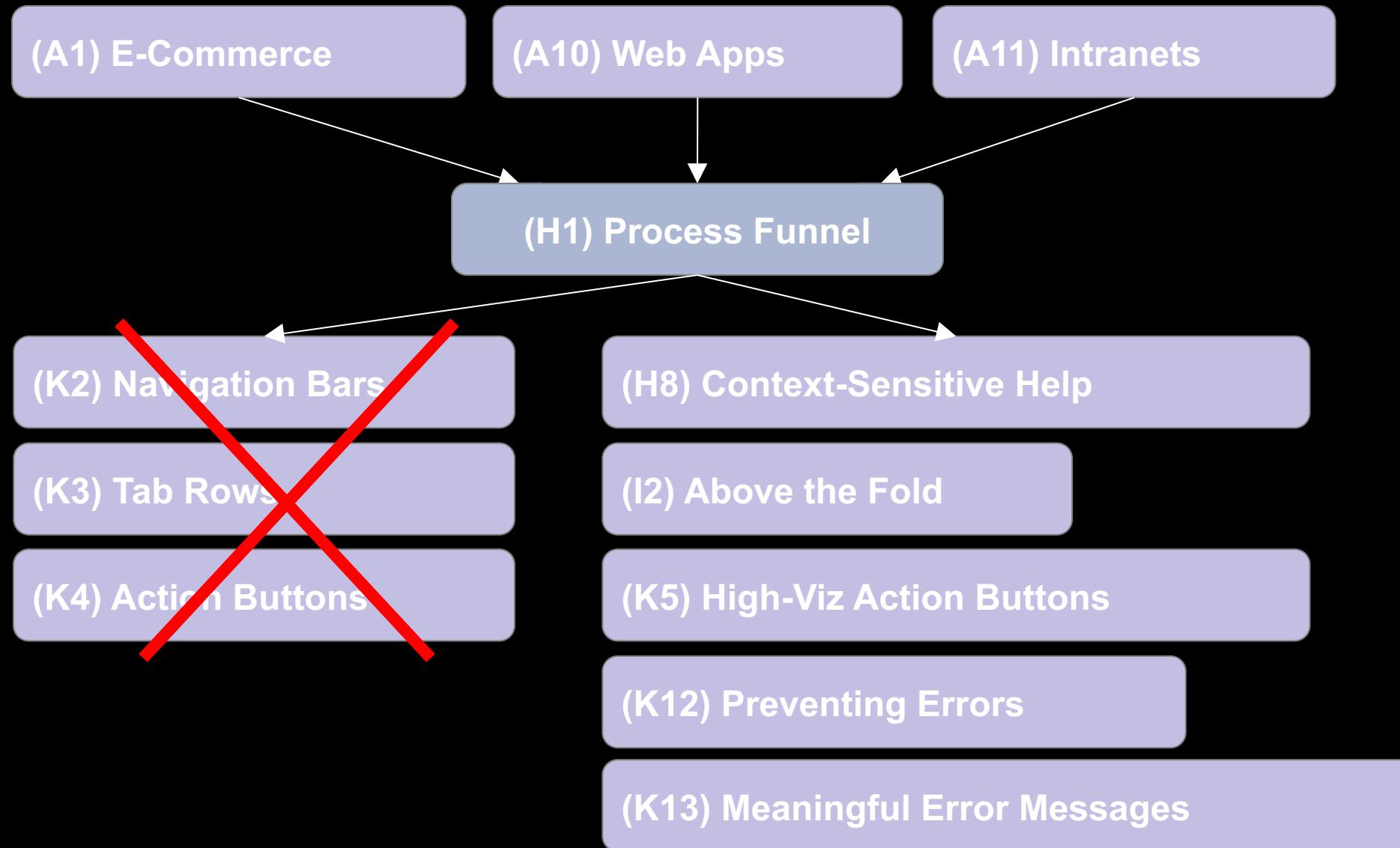


PROCESS FUNNEL (H1)

Solution Diagram



Related Patterns



Patterns Support Creativity

Patterns come from successful examples

sites that are so successful that lots of people are now familiar
designs that work well across many sites (e.g., shopping carts)

Not too general and not too specific

you need to specialize to your needs

Patterns let you focus on the hard,
unique problems of your design situation

Principles, Guidelines, Templates

Patterns help design without over-constraining

unlike principles, patterns are not too general

unlike guidelines, patterns discuss tradeoffs,
show good examples, and tie to other patterns

unlike style guides, patterns not too specific,
can then be specialized to a design

unlike templates,
patterns illustrate flows and relationships among different elements,
guide your understanding, not just instantiate a single instance

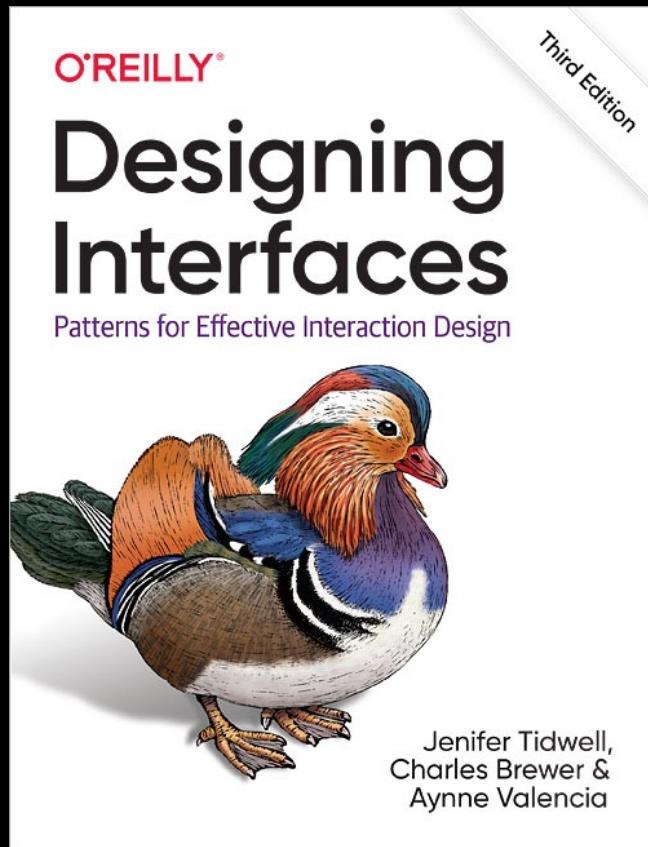
Additional Reading

Classic collection
of web-focused patterns



Additional Reading

Both have some online resources



Patterns

When you see advice, consider its depth

- Result of an individual study / rant

- Pre-pattern based on some meta-analysis

- Established pattern

Be aware of misapplying patterns

And be aware of anti-patterns

Touch and Microsoft Windows



2004



2012

Consistency vs. Specialization

Beware of simply copying a design language

Consistency is your friend
until it is not your friend

Not limited to platform-level decisions

One “look” for your app
Or targeted at each device

Deceptive Design Patterns

A Deceptive Design Pattern is an interface that has been carefully crafted to trick people into doing things, such as buying insurance with their purchase or signing up for recurring bills.

(aka Dark Pattern, but shifting away from that language)

Disguised Ads

Ads that are disguised as other kinds of content or navigation, in order to get people to click on them

Friend Spam

A site or game asks for your credentials, then goes on to publish content or send out bulk messages

Today

Controlled A/B Experiments

Patterns

Case Study of Model-View-Controller

Case Study of Animation

Role of Interface Tools

Model-View-Controller

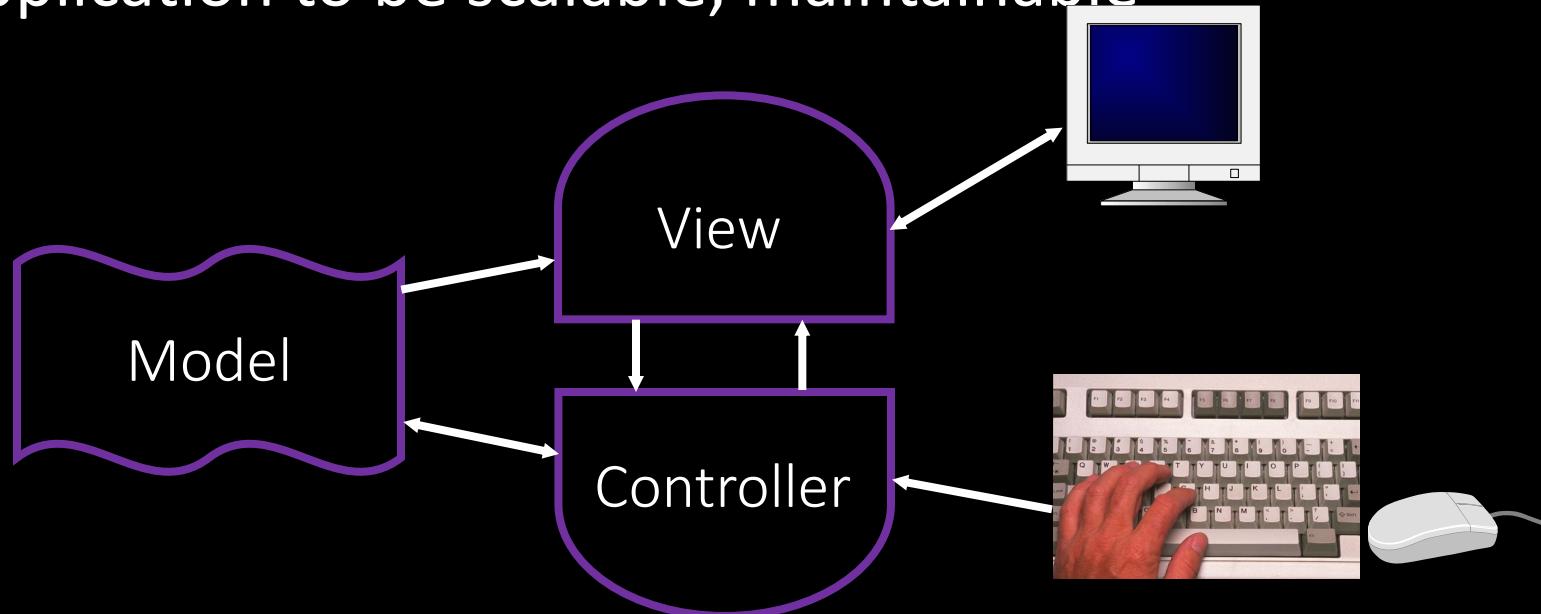
How to organize the code of an interface?

This is a surprisingly complicated question,
with unstated assumptions requiring significant background to
understand and resolve

Model-View-Controller

Introduced by Smalltalk developers at PARC

Partitions application to be scalable, maintainable



A pattern!

View / Controller Relationship

In theory:

Pattern of behavior in response to input events

(i.e., concerns of the controller)

are independent of visual geometry

(i.e., concerns of the view)

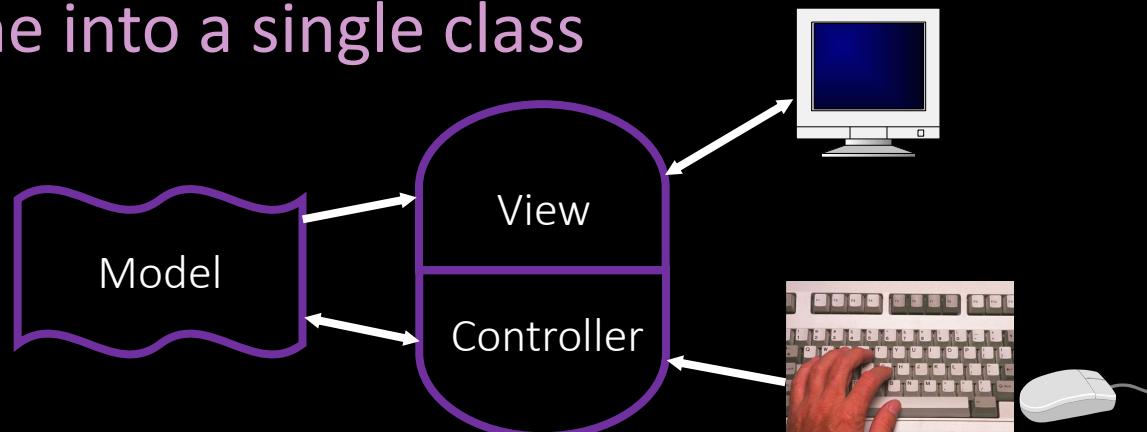
Controller contacts view to interpret what input events mean
in context of a view (e.g., selection)

View / Controller Relationship

In practice:

View and controller often tightly intertwined,
almost always occur in matched pairs

Many architectures combine into a single class



Model-View-Controller

MVC separates concerns and scales better than global variables or putting everything together

Separation eases maintenance

- Can add new fields to model,
new views can leverage, old views will still work

- Can replace model without changing views

Separation of “business logic” can require care

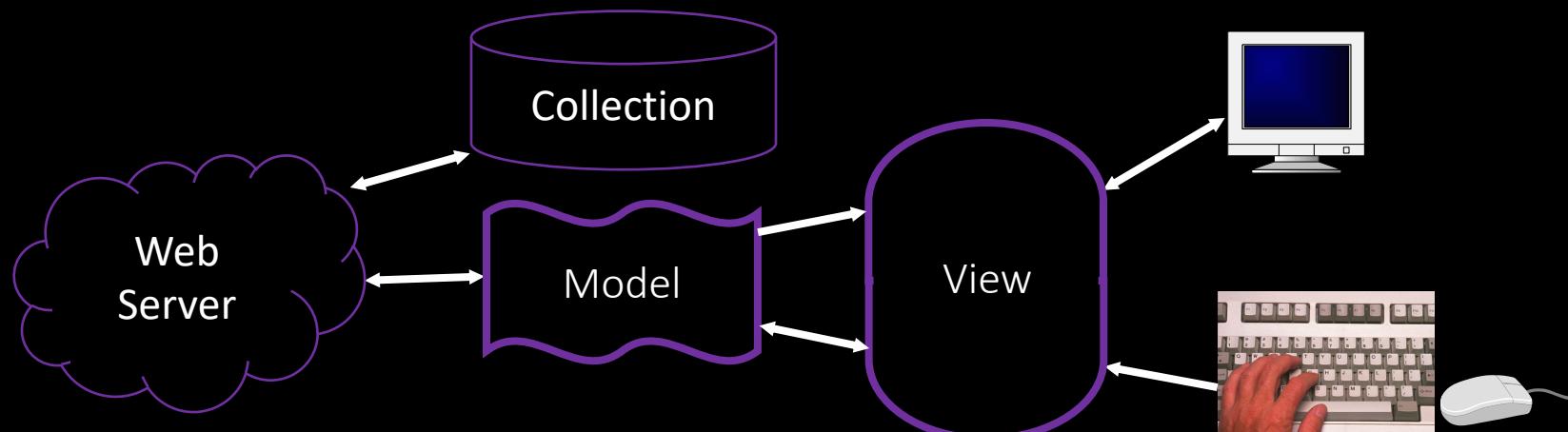
- May help to think of model as the client model

Model-View-Collection on the Web

Core ideas manifest differently according to needs

For example, backbone.js implements client views of models,
with REST API calls to web server

Web tools often implement views as templates

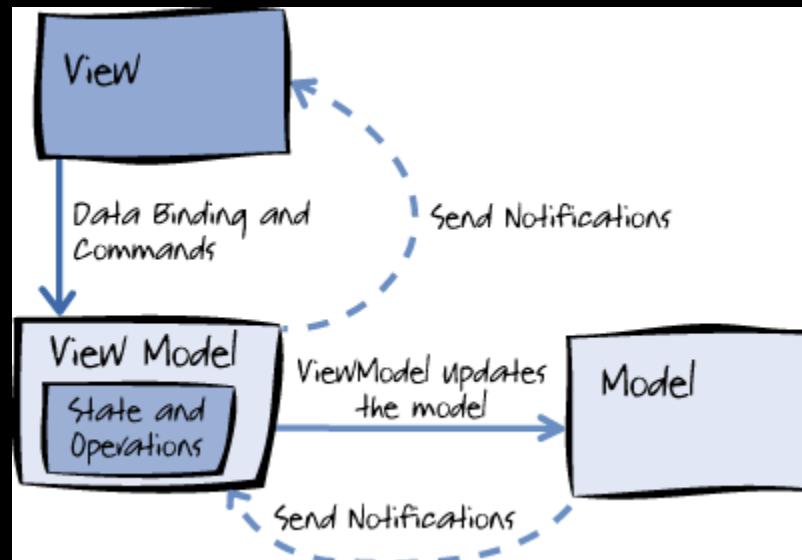


An instantiation of the pattern, adapted to the needs of the web

Model View View-Model

Design to support data-binding
by minimizing functionality in view

Also allows greater separation of expertise



An instantiation of the pattern, adapted to the needs of design tools

Today

Controlled A/B Experiments

Patterns

Case Study of Model-View-Controller

Case Study of Animation

Role of Interface Tools

Animation Case Study

Principles of Traditional Animation Applied to 3D Computer Animation

Lasseter, 1987

<http://dx.doi.org/10.1145/37402.37407>

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PRINCIPLES OF TRADITIONAL ANIMATION APPLIED TO 3D COMPUTER ANIMATION

John Lasseter
Pixar
San Rafael
California

"There is no particular mystery in animation... it's really very simple, and like anything that is simple, it is about the hardest thing in the world to do." Bill Tytla at the Walt Disney Studio, June 28, 1937. [14]

ABSTRACT

This paper describes the basic principles of traditional 2D hand drawn animation and their application to 3D computer animation. After describing how these principles evolved, the individual principles are detailed, addressing their meanings in 2D hand drawn animation and their application to 3D computer animation. This should demonstrate the importance of these principles to quality 3D computer animation.

CR Categories and Subject Descriptors:
I.3.6 *Computer Graphics : Methodology and Techniques - Interaction techniques*
I.3.7 *Computer Graphics : Three-dimensional Graphics and Realism - Animation*
J.5 *Computer Applications : Arts and Humanities - Arts, fine and performing*

General Terms: Design, Human Factors.

Additional Keywords and Phrases: Animation Principles, Keyframe Animation, Squash and Stretch, Luxo Jr.

1. INTRODUCTION

Early research in computer animation developed 2D animation techniques based on traditional animation. [7] Techniques such as storyboarding [11], keyframe animation, [4,5] inbetweening, [16,22] scanpaint, and multiplane backgrounds [17] attempted to apply the old animation process to the computer. As 3D computer animation research matured, more resources were devoted to 3D rendering than to animation. Because 3D computer animation was a new field, many of the techniques used in 2D animation from traditional animation were applied. Early 3D animation systems were script based [6], followed by a few spline-interpolated keyframe systems. [22] But those systems were developed by companies for internal use, and so very few traditionally trained animators found their way into 3D computer animation.

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The last two years have seen the appearance of reliable, user friendly, keyframe animation systems from such companies as Wavefront Technologies Inc., [29] Alias Research Inc., [2] Abel Image Research (RIP), [1] Veritgo Systems Inc., [28] Symbolics Inc., [25] and others. These systems will enable people to produce more high quality computer animation. Unfortunately, these systems will also enable people to produce more bad computer animation.

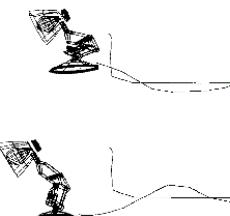
Much of this bad animation will be due to unfamiliarity with the fundamental principles that have been used for hand drawn character animation for over 50 years. Understanding these principles of traditional animation is essential to producing good computer animation. Such an understanding should also be important to the designers of the systems used by these animators.

In this paper, I will explain the fundamental principles of traditional animation and how they apply to 3D keyframe computer animation.

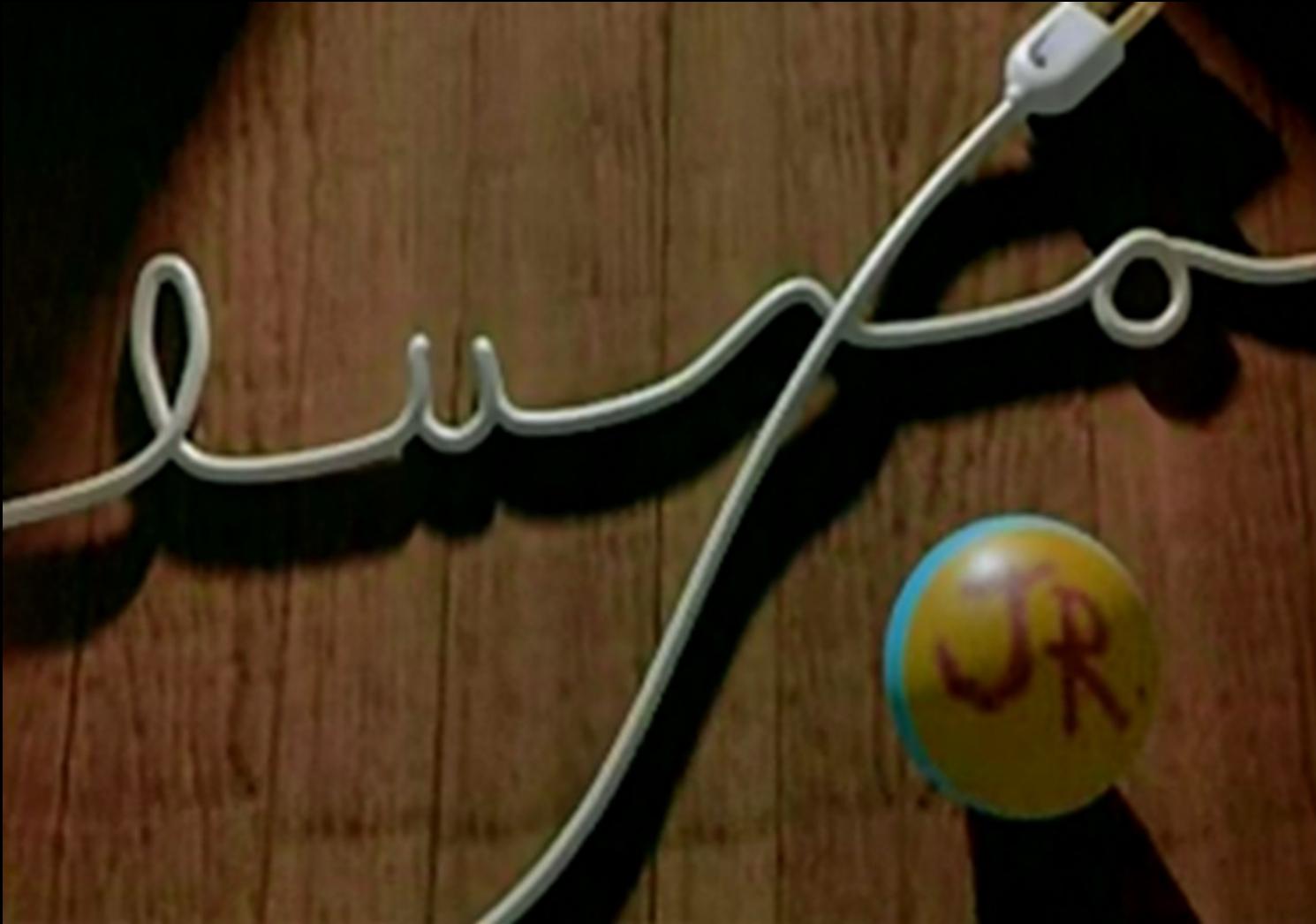
2. PRINCIPLES OF ANIMATION

Between the late 1920's and the late 1930's animation grew from a novelty to an art form at the Walt Disney Studio. With every picture, actions became more complex and characters were coming to life in realities. Audiences were enthusiastic and many of the animators were satisfied, however it was clear to Walt Disney that the level of animation and existing characters were not adequate to pursue new story lines- characters were limited to certain types of action and, audience acceptance notwithstanding, they were not appealing to the eye. It was apparent to Walt Disney that no one could successfully animate a humanized figure or a life-like animal; a new drawing approach was necessary to improve the level of animation exemplified by the *Three Little Pigs*. [10]

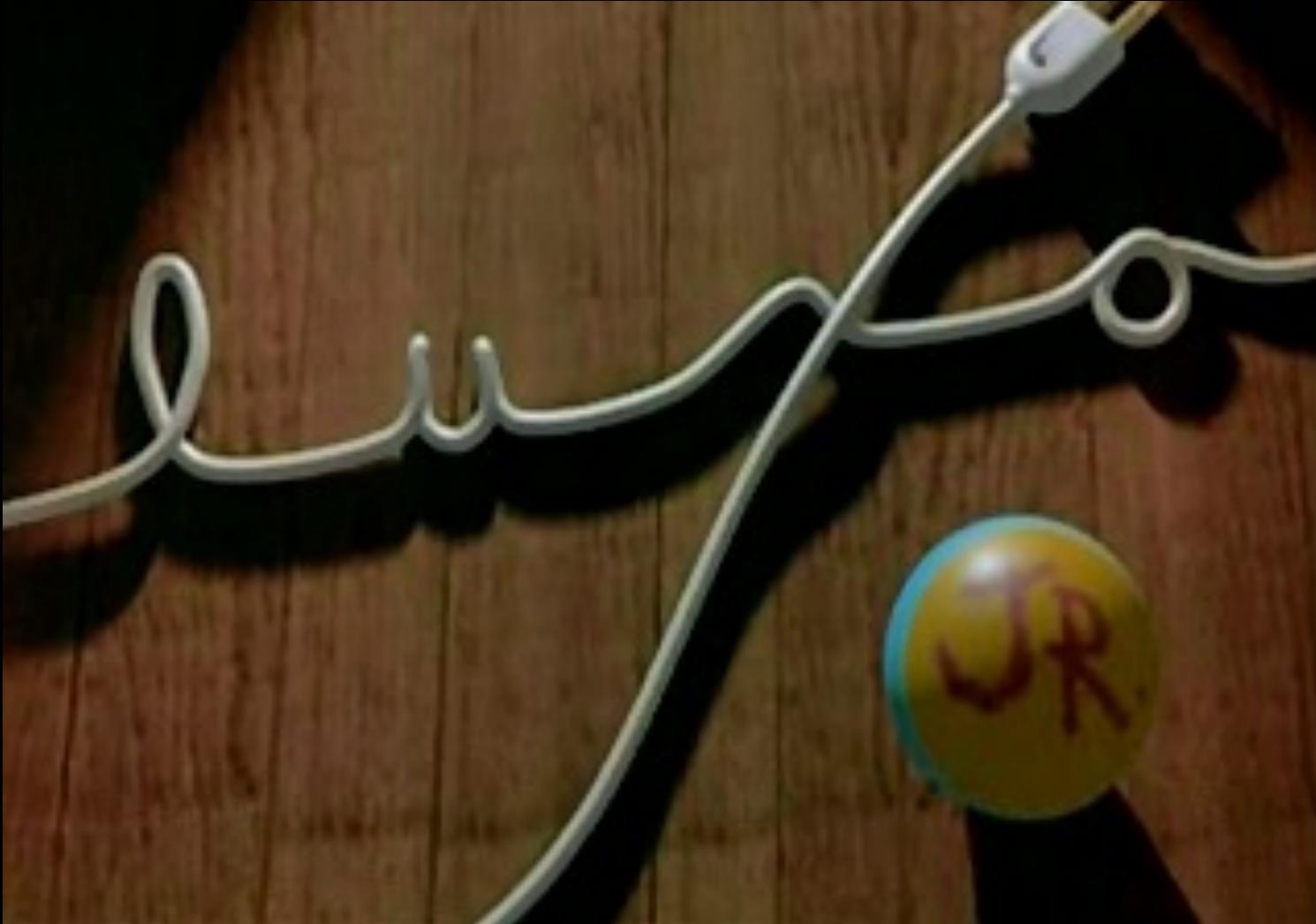
FIGURE 1. Luxo Jr.'s hop with overlapping action on cord. Flip page from last page of paper to front. The top figures are frames 1-5, the bottom are frames 6-10.



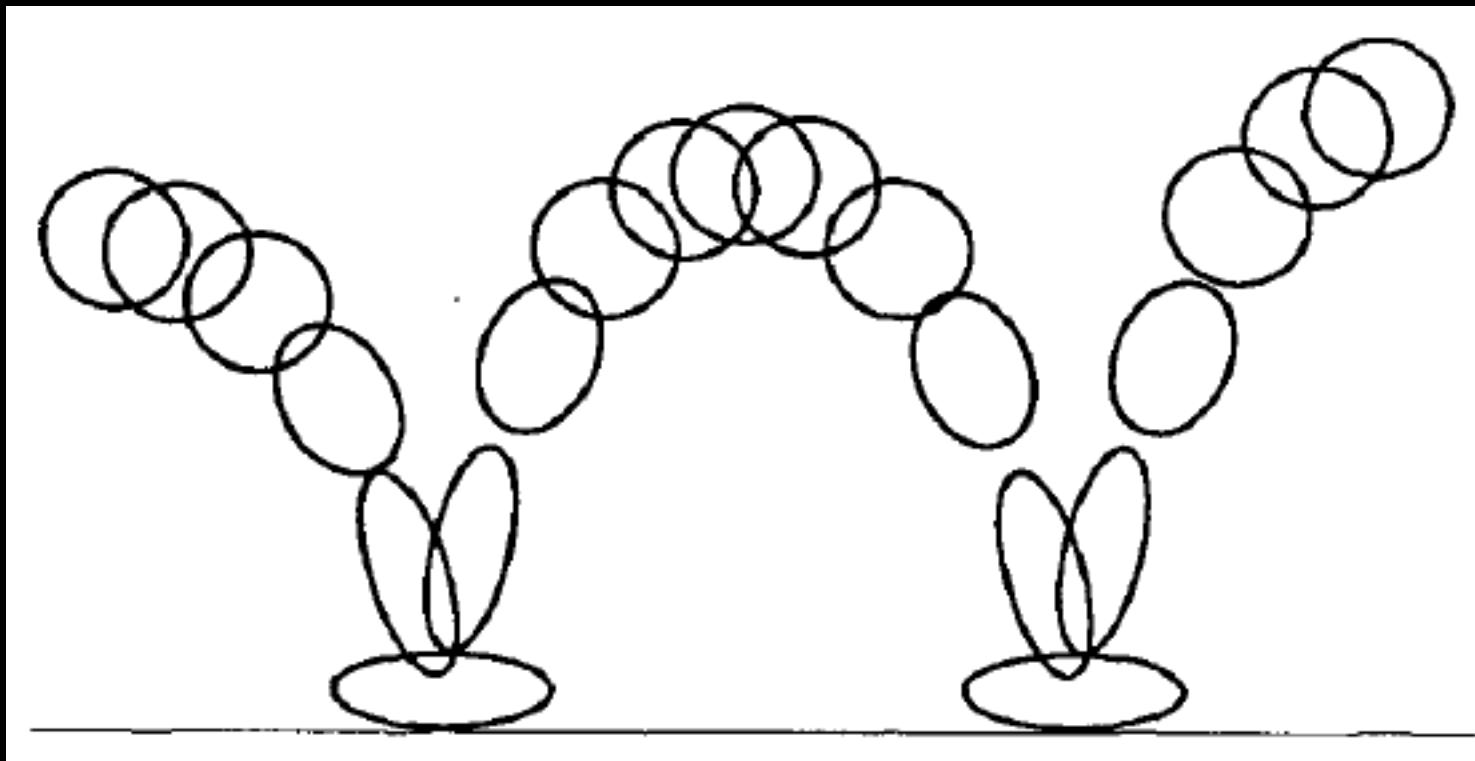
Luxo Jr.



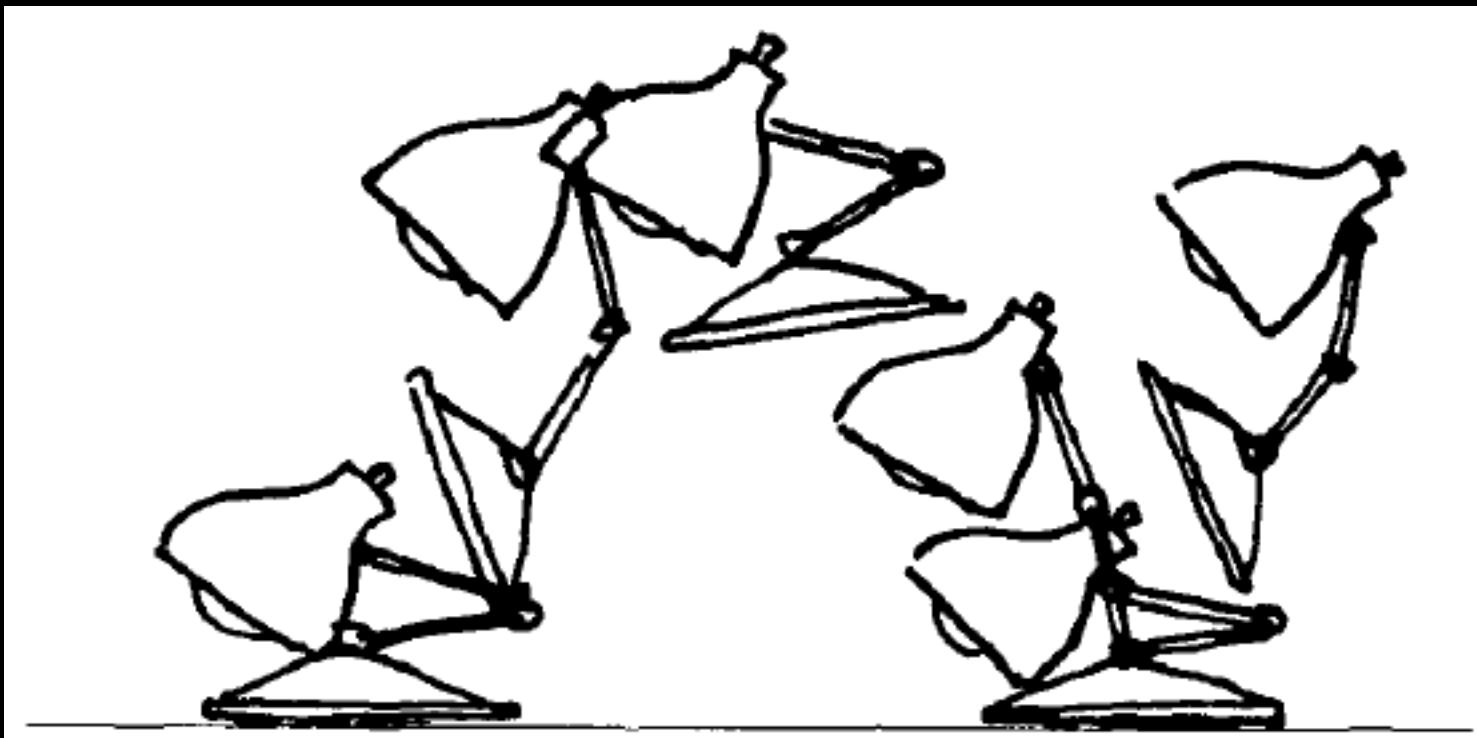
Luxo Jr.



Squash and Stretch



Squash and Stretch



Squash and Stretch

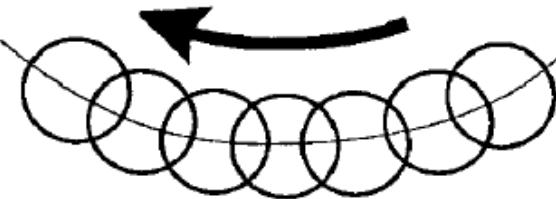


FIGURE 4a. In slow action, an object's position overlaps from frame to frame which gives the action a smooth appearance to the eye.

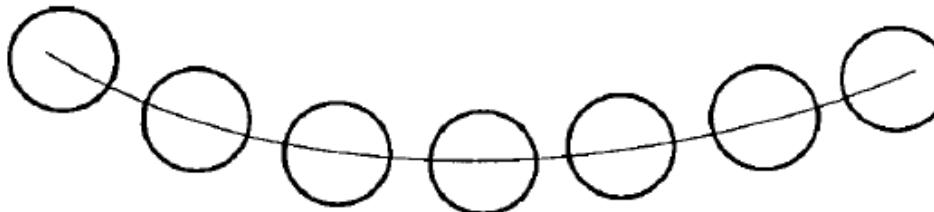


FIGURE 4b. Strobing occurs in a faster action when the object's positions do not overlap and the eye perceives separate images.

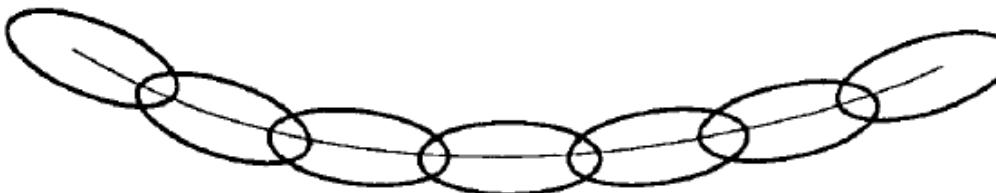


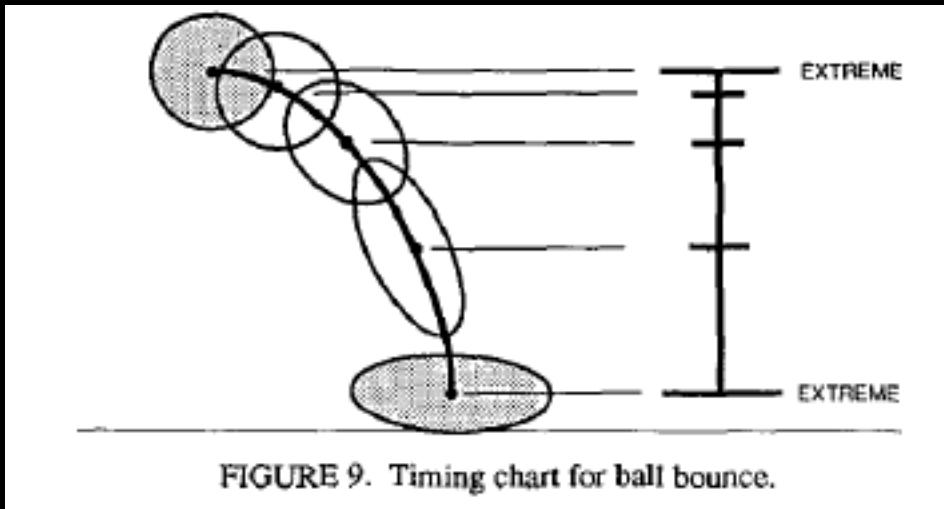
FIGURE 4c. Stretching the object so that it's positions overlap again will relieve the strobing effect.

Staging



FIGURES 7-8. In *Luxo Jr.*, all action was staged to the side for clarity.

Pose-to-Pose, Slow In, Slow Out



Objects with mass must accelerate and decelerate
Interesting frames are typically at ends,
 tweaks perception to emphasize these poses

Animation Case Study

Animation Support in a User Interface Toolkit: Flexible, Robust, and Reusable Abstractions

Hudson and Stasko, 1993

<http://dx.doi.org/10.1145/168642.168648>

Animation Support in a User Interface Toolkit: Flexible, Robust, and Reusable Abstractions

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ABSTRACT

Animation can be a very effective mechanism to convey information in visualization and user interface settings. However, integrating animated presentations into user interfaces has typically been a difficult task since, to date, there has been little or no explicit support for animation in window systems or user interface toolkits. This paper describes how the Artkit user interface toolkit has been extended with new animation support abstractions designed to overcome this problem. These abstractions provide a powerful but convenient base for building a range of animations, supporting techniques such as simple motion-blur, "squash and stretch", use of arcing trajectories, anticipation and follow through, and "slow-in / slow-out" transitions. Because these abstractions are provided by the toolkit they are reusable and may be freely mixed with more conventional user interface techniques. In addition, the Artkit implementation of these abstractions is robust in the face of systems (such as the X Window System and Unix) which can be ill-behaved with respect to timing considerations.

Keywords: object-oriented user interface toolkits, window systems, animation techniques, dynamic interfaces, motion blur, real-time scheduling.

This work was supported in part by the National Science Foundation under grants IRI-9015407, DCA-9214947, CCR-9121607 and CCR-9109399.

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1 INTRODUCTION

Human perceptual capabilities provide a substantial ability to quickly form and understand models of the world from moving images. As a result, in a well designed display, information can often be much more easily comprehended in a moving scene than in a single static image or even a sequence of static images. For example, the "cone tree" display described in [Robe93] provides a clear illustration that the use of continuous motion can allow much more information to be presented and understood more easily.

However, even though the potential benefits of animation in user interfaces have been recognized for some time ([Bae90] for example, surveys a number of uses for animation in the interface and cites their benefits and [Stask93] reviews principles for using animation in interfaces and describes a number of systems that make extensive use of animation in an interface), explicit support for animation is rarely, if ever, found in user interface support environments. The work described in this paper is designed to overcome this problem by showing how flexible, robust, and reusable support for animation can be incorporated into a full scale object-oriented user interface toolkit. Specifically, this paper describes how the extension mechanisms of Artkit — the Advanced Reusable Toolkit (supporting interfaces in C++) [Hens90] — have been employed to smoothly integrate animation support with other user interface capabilities.

The animation abstractions provided by the Artkit system are designed to be powerful and flexible — providing basic support that can be used to build a range of sophisticated techniques such as: simple motion-blur, "squash and stretch", use of arcing

November 3-5, 1993

IUI'93

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Events and Animation

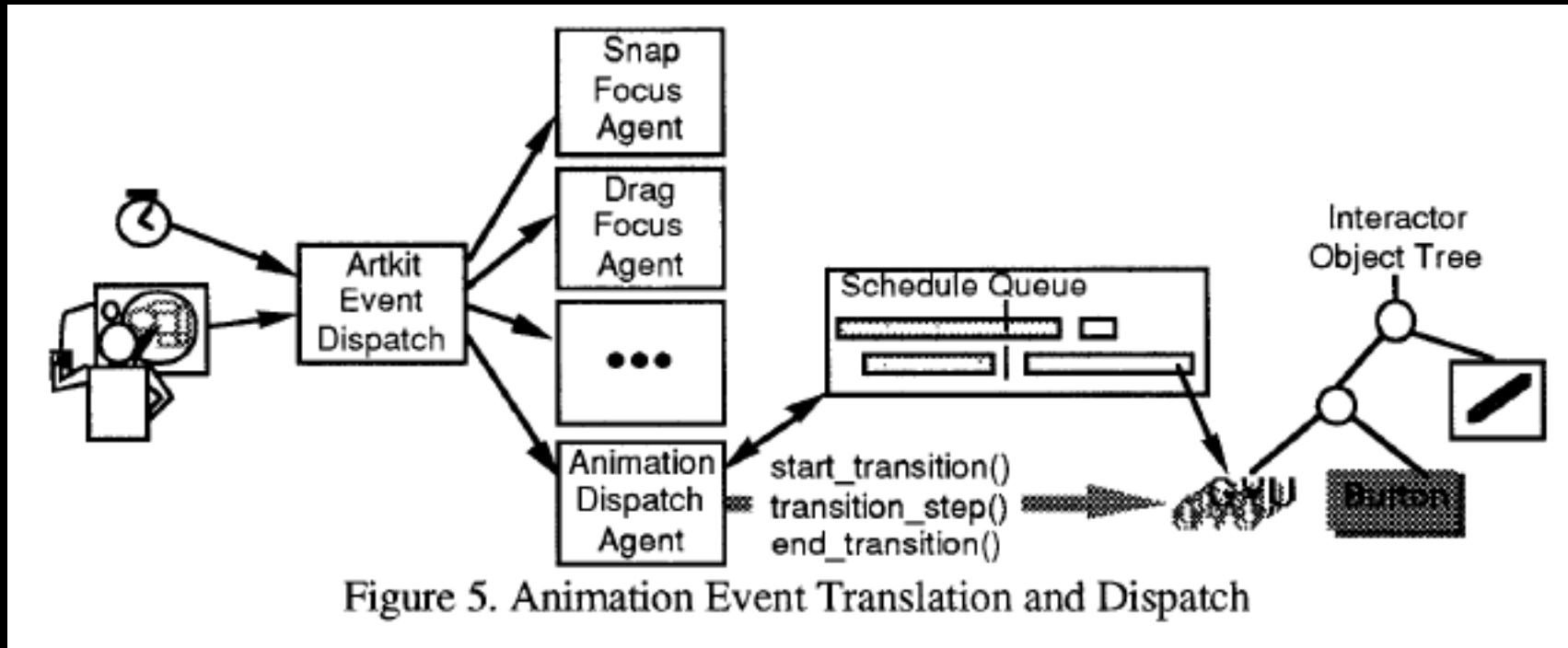


Figure 5. Animation Event Translation and Dispatch

Not Just an Implementation

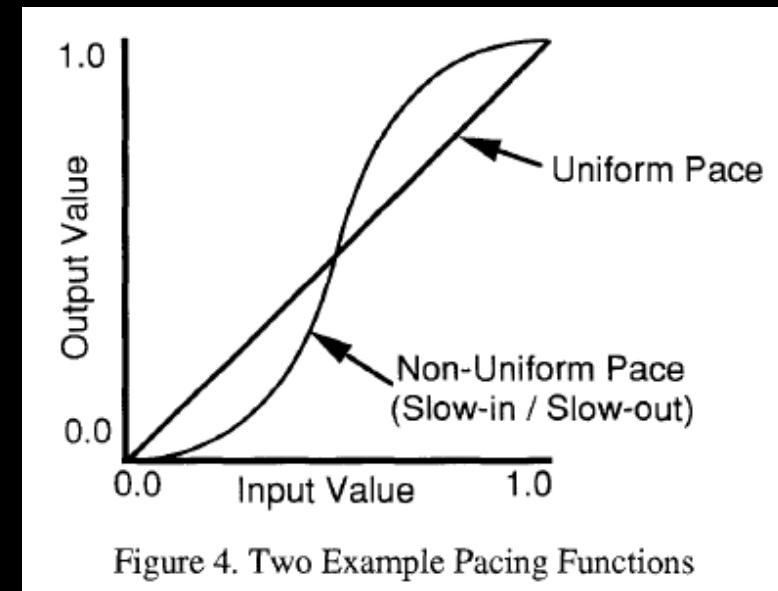
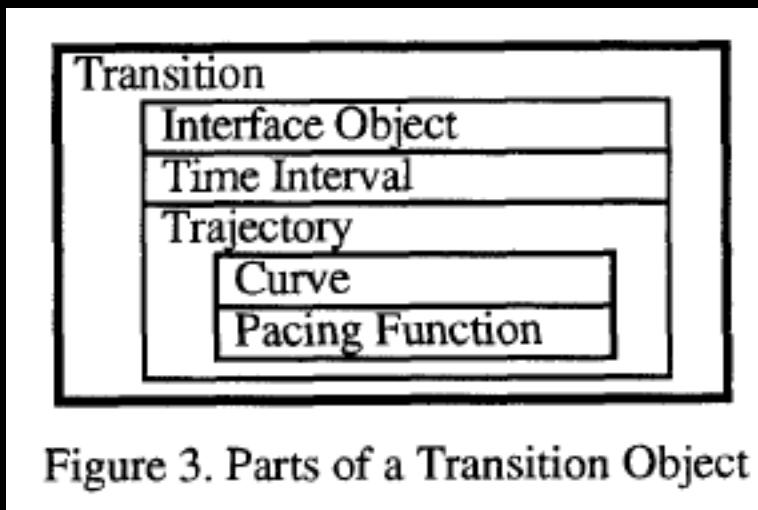
Provides tool abstractions for
implementing previously presented styles of animation

Overcomes a fundamental clash of approaches

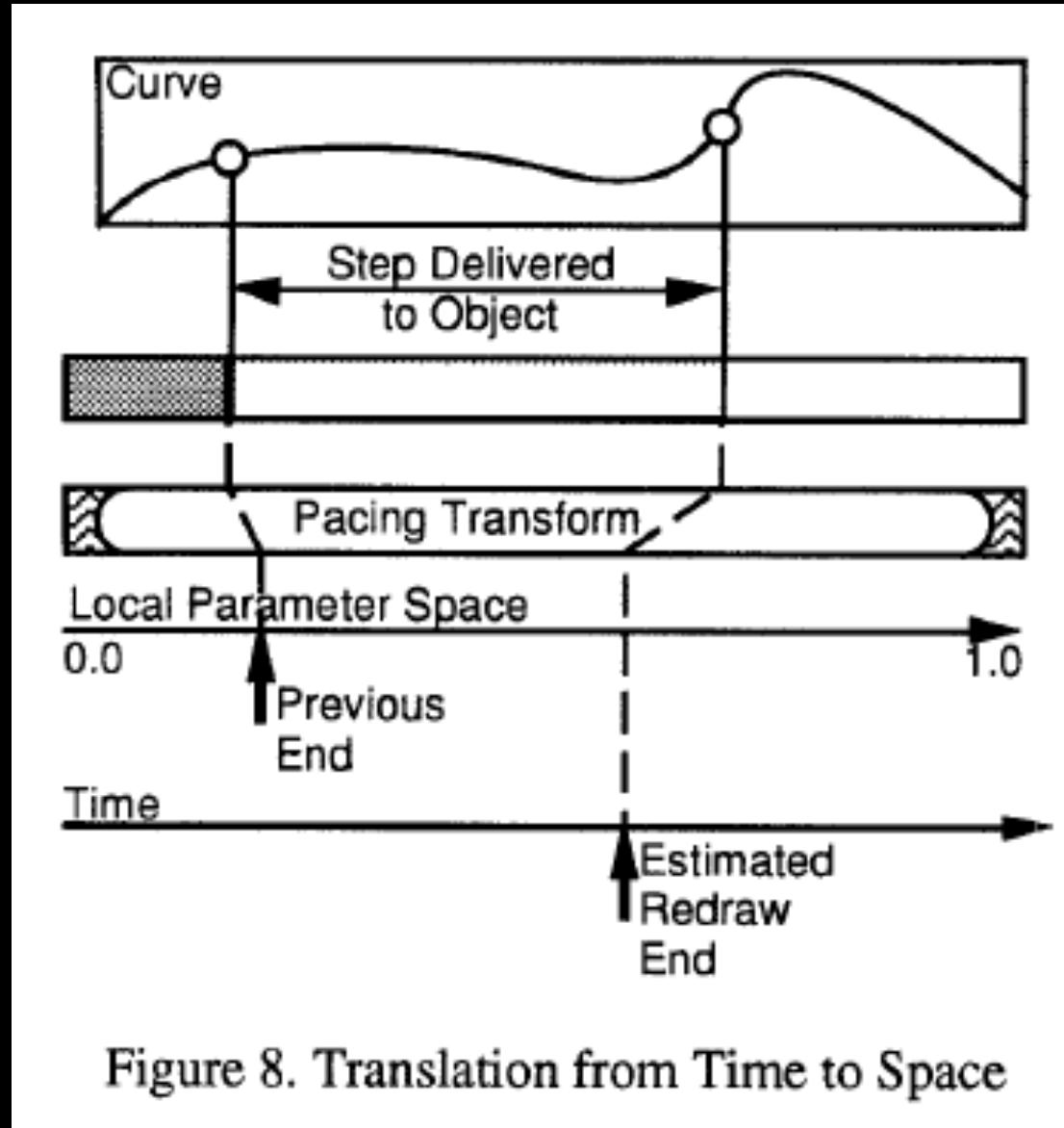
Event loop receives input, processes, repaints

Animations expect careful control of frames,
but the event loop has variable timing

Transition and Pacing



Computing a Frame



Animation Case Study

Now built into major commercial toolkits
(e.g., as jQuery's "easing functions")

Based on increased understanding
of how to animate interface transitions,
increasingly mature patterns and tools develop

Once mature, begins to be used as a
building block in even more complex behaviors

Today

Controlled A/B Experiments

Patterns

Case Study of Model-View-Controller

Case Study of Animation

Role of Interface Tools

Understanding Tools

We use tools because they

- Identify common or important practices

- Package those practices in a framework

- Make it easy to follow those practices

- Make it easier to focus on our application

What are the benefits of this?

- Being faster allows more iterative design

- Implementation is generally better in the tool

- Consistency across applications using same tool

Sapir-Whorf Hypothesis



Sapir-Whorf Hypothesis

Roughly, some thoughts in one language cannot be stated or understood in another language

Language is not simply a way of voicing ideas,
but is the very thing which shapes those ideas

Our tools define the language of interaction

Beyond the simple matter of code
Frame how we think about possibilities

You must be aware of this when choosing tools,
designing applications, and creating new tools

Animation Case Study

Phosphor: Explaining Transitions in the User Interface Using Afterglow Effects

Baudisch et al, 2006

<http://dx.doi.org/10.1145/1166253.1166280>

Phosphor: Explaining Transitions in the User Interface Using Afterglow Effects

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Ken Hinckley, Maneesh Agrawala, Shengdong Zhao, and Gonzalo Ramos
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collomb@lirmm.fr, {sszhao, bonzo}@dgp.toronto.edu

ABSTRACT

Sometimes users fail to notice a change that just took place on their display. For example, the user may have accidentally deleted an icon or a remote collaborator may have changed settings in a control panel. Animated transitions can help, but they force users to wait for the animation to complete. This can be cumbersome, especially in situations where users did not need an explanation. We propose a different approach. Phosphor objects show the outcome of their transition instantly, at the same time they explain their change in retrospect. Manipulating a phosphor slider, for example, leaves an afterglow that illustrates how the knob moved. The parallelism of instant outcome and explanation supports both types of users. Users who already understood the transition can continue interacting without delay, while those who are inexperienced or may have been distracted can take time to view the effects at their own pace. We present a framework of transition designs for widgets, icons, and objects in drawing programs. We evaluate phosphor objects in two user studies and report significant performance benefits for phosphor objects.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces - Graphical user interfaces.

General terms: Design, Human Factors.

Keywords: Phosphor, comic animation, cartoon animation, user interfaces, information visualization, diagrams.

INTRODUCTION

Computer users sometimes make mistakes, such as accidentally deleting an icon or filing it into the wrong folder. Similarly, unexpected things may occur in collaboration scenarios. Users trying to replicate a process demonstrated by a collaborator may later realize that they missed some of the steps. This is particularly difficult for actions that leave no trace, such as shortcut commands.

The potential changes that users need to keep track of continues to rise with increasing user interface complexity, more concurrently running applications, large screens where the user may be attending to the wrong location, and

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UIST '06, October 15–18, 2006, Montreux, Switzerland
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the possibility of remote collaboration. Without knowing what changed and how it changed, users can find it hard to detect and correct unintended or unexpected actions.

Animated transitions have been proposed to help users understand changes in the user interface [9, 19] and have found their way into a range of products. *Windows Media Player 10*, for example, hides its play controls in fullscreen mode by slowly moving them off screen. While this can help users understand where the controls went and how to get them back, it also introduces “lag” into the interaction, i.e., it forces users to wait for the animation to complete. For experienced users who do not need an explanation, this forced pause can be cumbersome and may break their concentration.

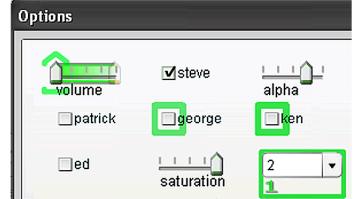


Figure 1: These phosphor widgets use green afterglow effects to show how they have changed. The slider labeled ‘volume’ was dragged all the way to the left. Two of the checkboxes in the next row were unchecked. The combo box was set from 1 to 2.

PHOSPHOR USER INTERFACE OBJECTS

We propose explaining user interface transitions without forcing users to wait. We define a *phosphor transition* as a transition that:

1. shows the outcome of the change *instantly* and
2. explains the change in retrospect using a diagrammatic depiction

The space of retrospective diagrammatic descriptions encompasses a great number of possible designs. In this paper, we concentrate on a specific subset based on the notion of afterglow. Figure 1 shows an example. When a user op-

Phosphor

Animation can help people follow interface transitions

But the right speed is crucial

Too fast increases error rate

Too slow increases task time

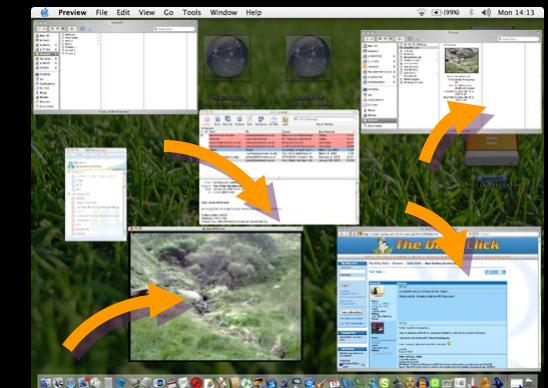
The right speed depends on familiarity, distraction, etc.

It cannot be determined

Windows Media Player

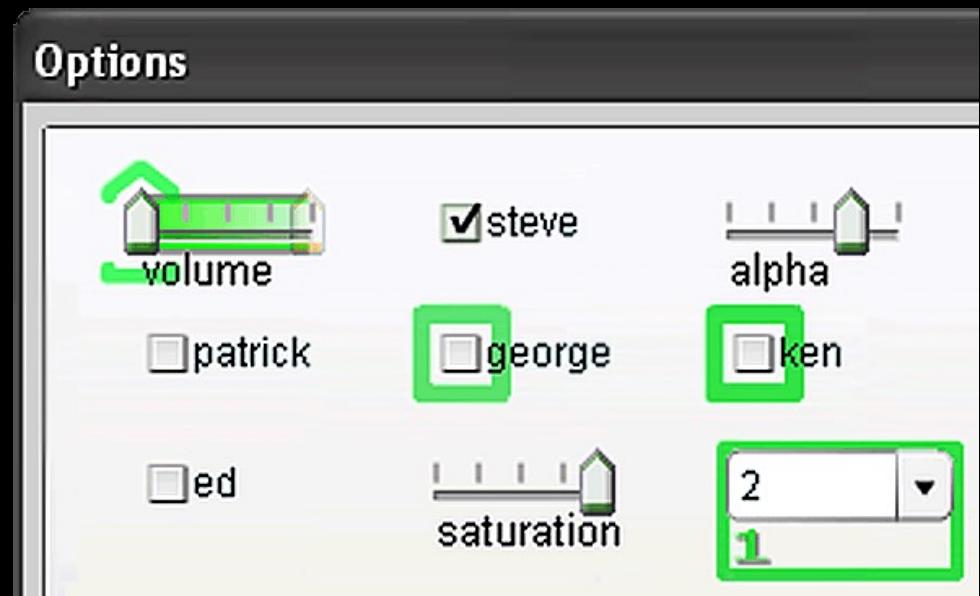


Apple Expose



Phosphor

Phosphor shows the outcome immediately, then explains change in retrospect using a diagrammatic depiction



Phosphor

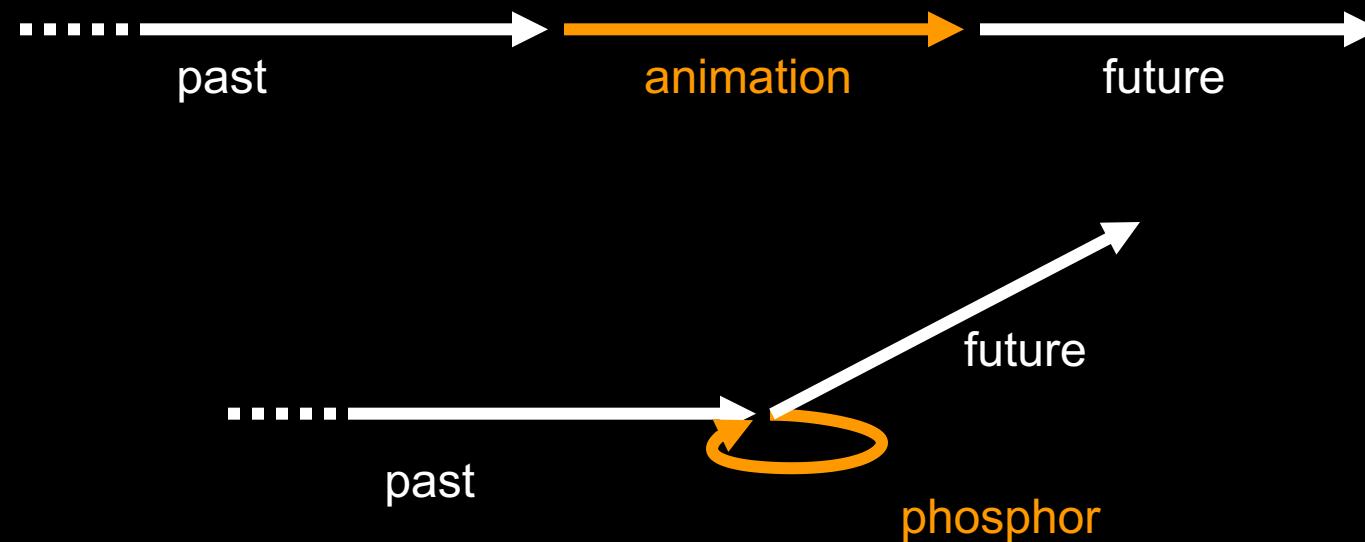
phosphor

Phosphor

phosphor

Challenging the Pattern in Tools

Phosphor breaks from the pattern that has evolved into current transition tools



Understanding Tools

Codification eventually constrains design

Inevitable consequence of codification versus
evolving understanding of emerging technologies

Codification goes deeper than the code

Frames how we think about our applications

Tools and Interfaces

Tools embody expertise and assumptions

Tools evolve based on emerging understanding of how to address categories of problems

Be conscious of your tool decisions

- Try to think about designs before tying to a tool

- Choose good and appropriate tools

- Understand what you are getting in a tool

- Push yourself to think outside the tool

Rebuilding the Language of Design

We regularly rebuild the entire system

Command Line, Text Screens

Multiple Generations of Desktop

Multiple Generations of Web

Mobile Apps

We will do it again

Several near-term challenges require it

e.g., Touch, Cloud, Distributed Interfaces

Backward compatibility helps, but is not required

13: Patterns and Interface Implementation

May 7, 2024