

# Building User Interfaces

# Interaction Design

**Yuhang Zhao & Cole Nelson**

# Use of AI tools in ICAs and Assignments

- Use AI properly to help you learn
- Do not use AI as an answer machine
- Disclose the use of AI and the prompts in ICAs

# What we will learn today?

- Interaction Paradigms
- Principles of navigation

# What is interaction design?

# Interaction Design

**Definition:** Defining behaviors for a system that engages the full spectrum of its user's perception, cognition, and movements.

Differs from visual design in its closer and more complex relationship to user behavior and context.

*Example:* visual designers do not think about navigation models!

# Five Dimensions of Interaction Design<sup>1</sup>

1. 1D: Words
2. 2D: Visual representations
3. 3D: Physical objects and space
4. 4D: Time
5. 5D: Behavior

## 5 DIMENSIONS OF INTERACTION DESIGN

The image shows a wireframe of a web-based application form. At the top, it says "Application Form". Below that, there is a text input field with placeholder text: "Please enter the description below: [REDACTED]". At the bottom right of the form area is a "SUBMIT" button.



INTERACTION DESIGN  
FOUNDATION

INTERACTION-DESIGN.ORG

<sup>1</sup>Interaction Design Foundation

# Interaction Design Paradigms

# What is a Design Paradigm?

**Definition:** An archetypal solution or an approach to solving design problems.

# Historical Interaction Design Paradigms<sup>9</sup>

1. Implementation-centric
2. Metaphoric
3. Idiomatic

<sup>9</sup> Cooper et al., 2014, About Face

# Implementation-centric Design

**Definition:** Interaction design maps directly to how system functions are implemented.

# Source<sup>2</sup> <sup>3</sup>



<sup>2</sup>Pinterest

<sup>3</sup>Entrepreneur Magazine



# Pros & Cons of Implementation-centric Design

## Pros:

1. Very easy to build, easy to debug, easy to troubleshoot

## Cons:

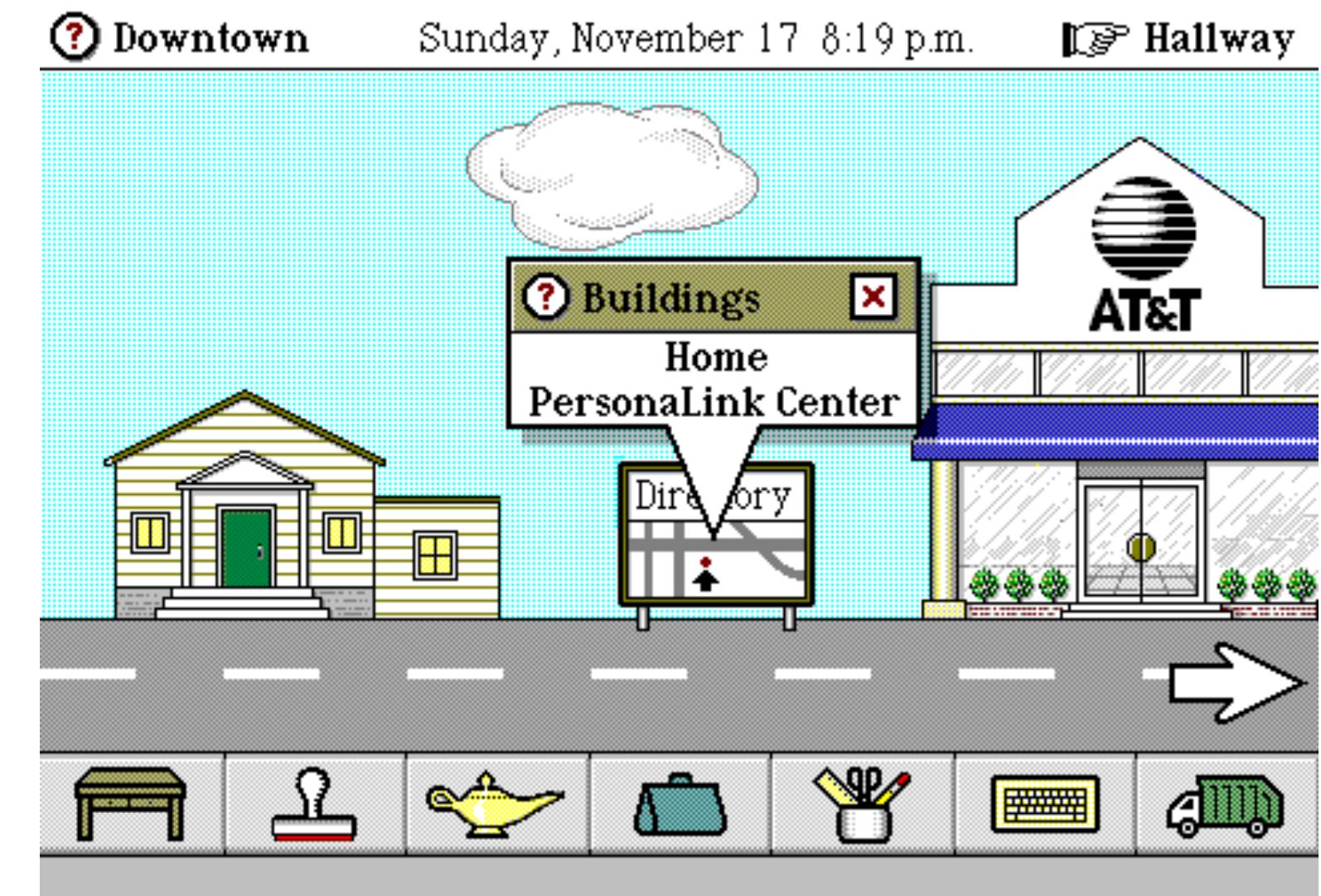
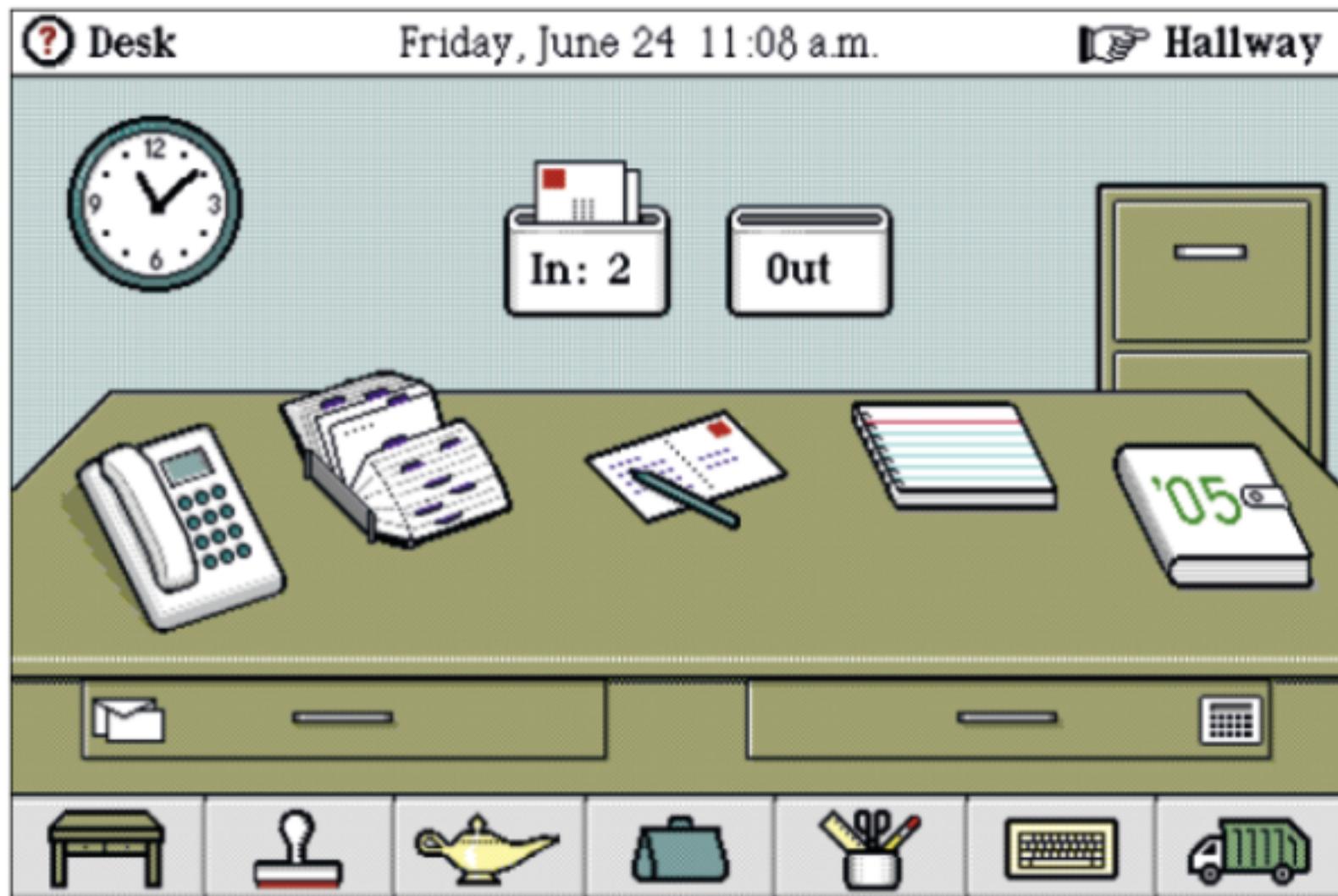
1. Requires learning how the functions work
2. Requires skills in using the functions
3. The system cannot perform high-level actions

# Metaphorical Design

**Definition:** Following a real-world metaphor that users are expected to be familiar with.

Metaphorical designs "jump-start" user mental models, rely on their existing knowledge of how things work in the real-world, and thus eliminate learning.

# Source<sup>4</sup>



<sup>4</sup>Wikipedia: [Magic Cap](#)

# Source<sup>7</sup>

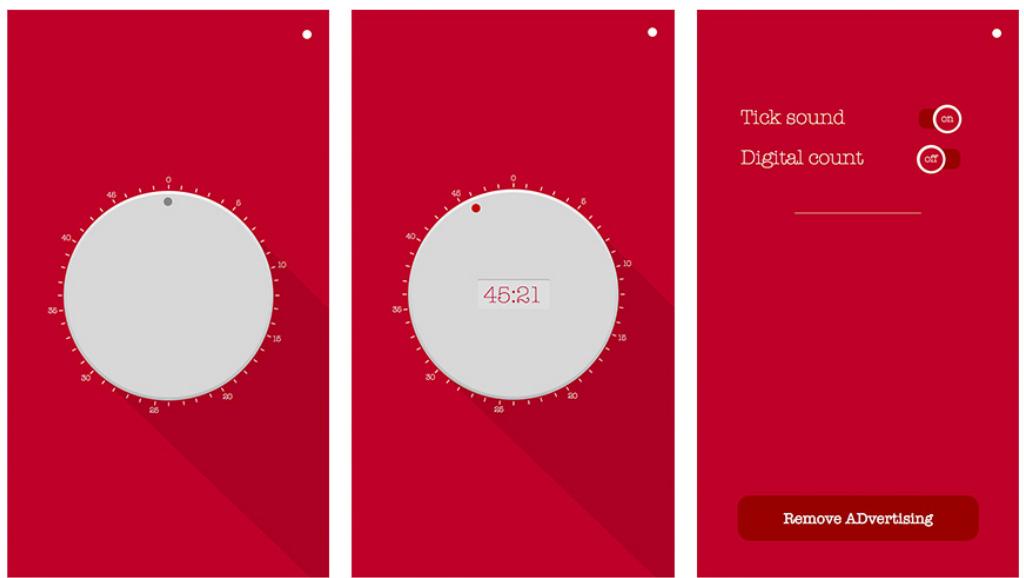
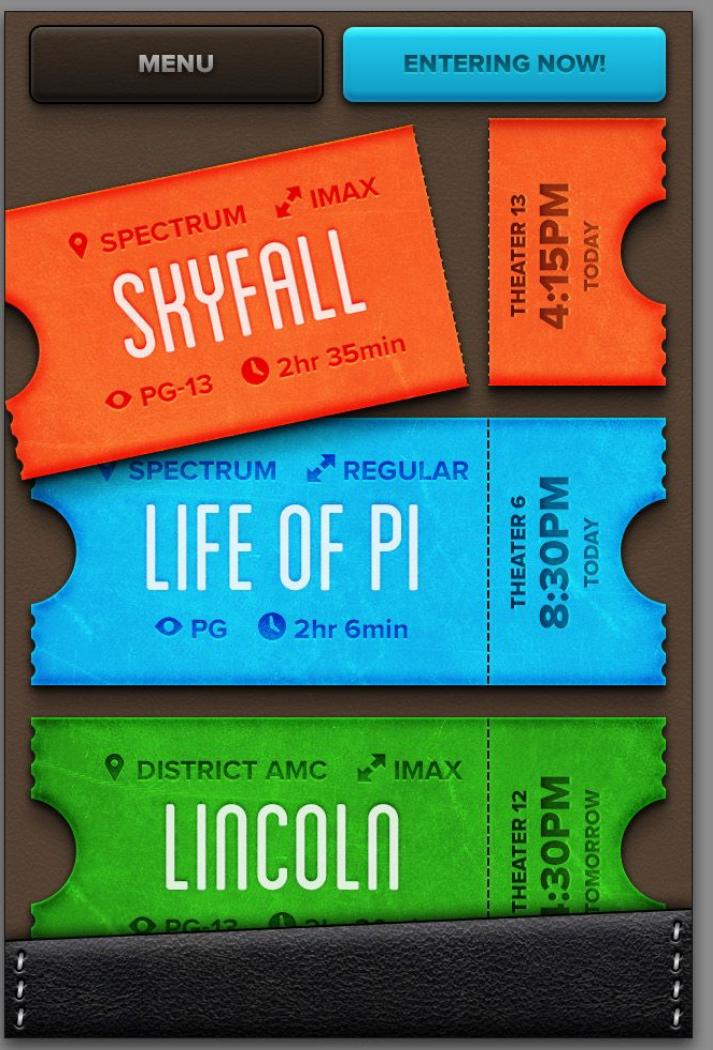


<sup>7</sup>UX Planet: [Metaphorical Design](#)

# Source<sup>8</sup>



<sup>8</sup> Apple App Store: [76 Synthesizer](#)



AND REDESIGN FOR APPLE WATCH



*Pro Tip 1:* Metaphors can be applied at different levels of abstraction.

*Pro Tip 2:* Mixed metaphors bring together models from different domains in a single design.

# Global Metaphor

**Definition:** A *global metaphor* provides a single, overarching framework for all the metaphors in the system (e.g., Magic Cap).

*Pros:* They work well in expert interfaces where the interface simulates a real-world system.

*Cons:* Inability to scale; lack of familiar real-world system for entirely new capabilities; cultural differences; inability to adapt as capabilities evolve.

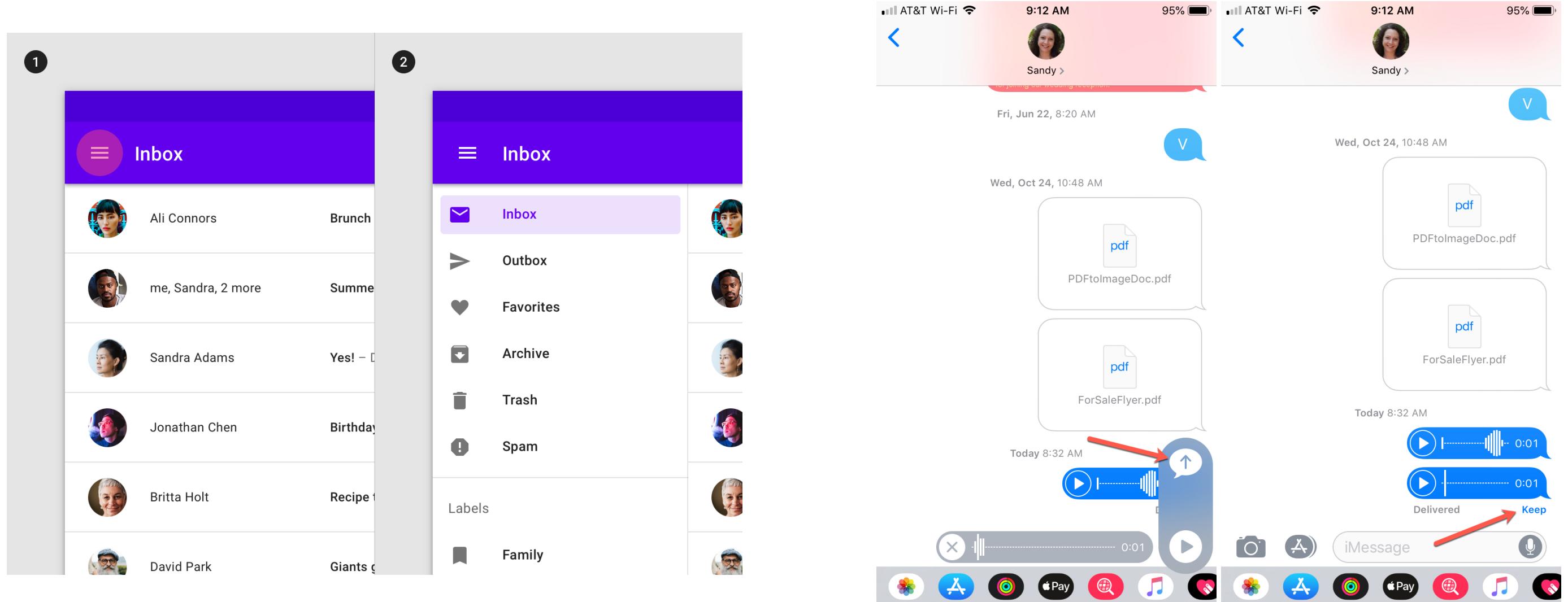
# Idiomatic Design<sup>10</sup>

**Definition:** Building dedicated, highly expressive interaction capabilities that users must learn.

Mapping cursor movements on a screen to mouse movements is an extremely successful example.

<sup>10</sup>Image Source

## Source<sup>11</sup> <sup>12</sup>



<sup>11</sup>Image Source

<sup>12</sup>Image Source

# Affordances

# Affordances

**Definition:** The perceived properties of a design element that give clues about how to interact with it. Designers have borrowed the concept from ecological psychology.

**Theoretical Roots:** James Gibson (1977, 1979) suggested that the human environment is structured in a way that communicates action possibilities through *affordances*.

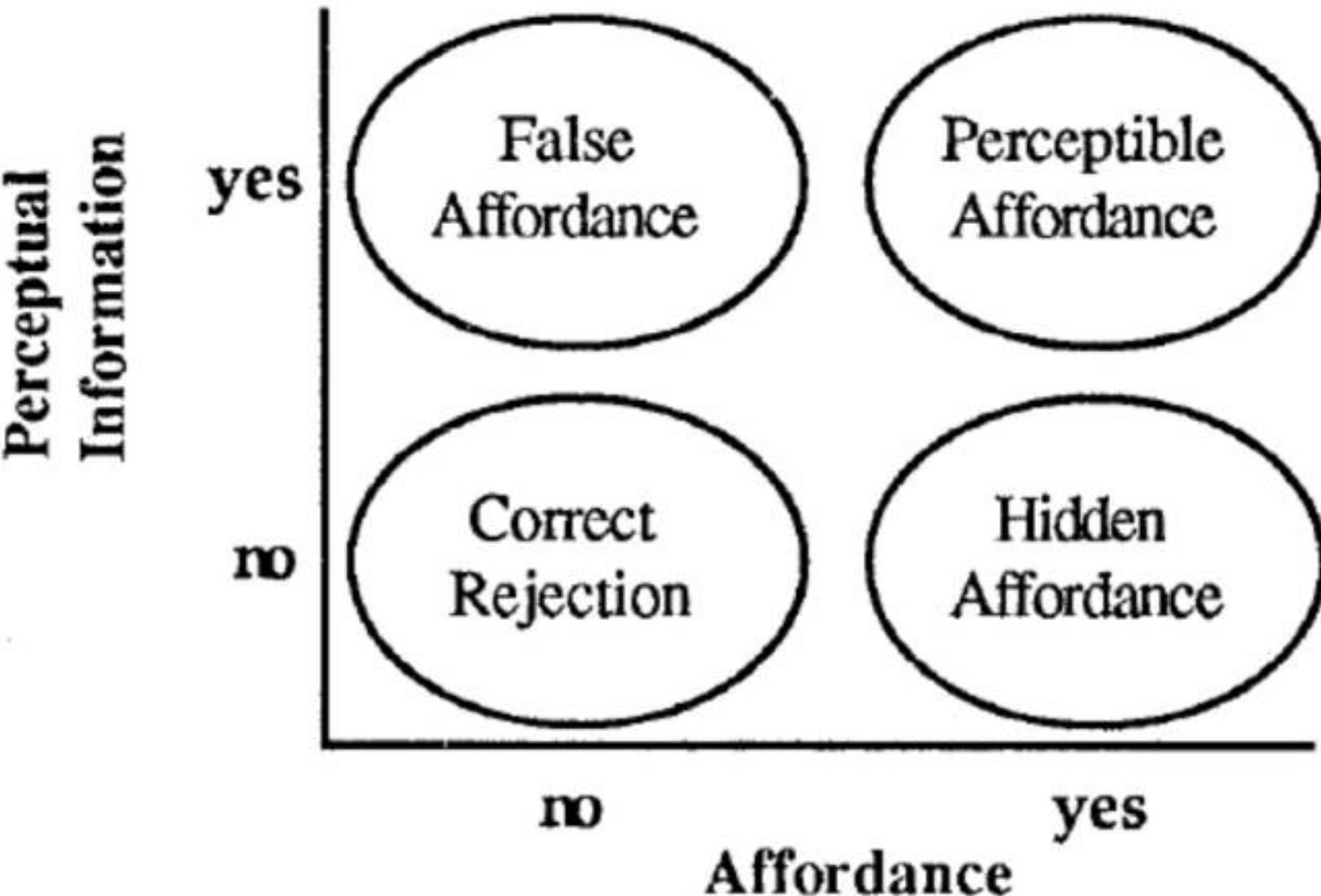
Which environment affords *walking*?



# Affordances in Design

*Perceptible affordances* enable users to intuitively recognize actions that are possible with interface elements.<sup>14</sup>

Affordances can also be *hidden* and *false*.

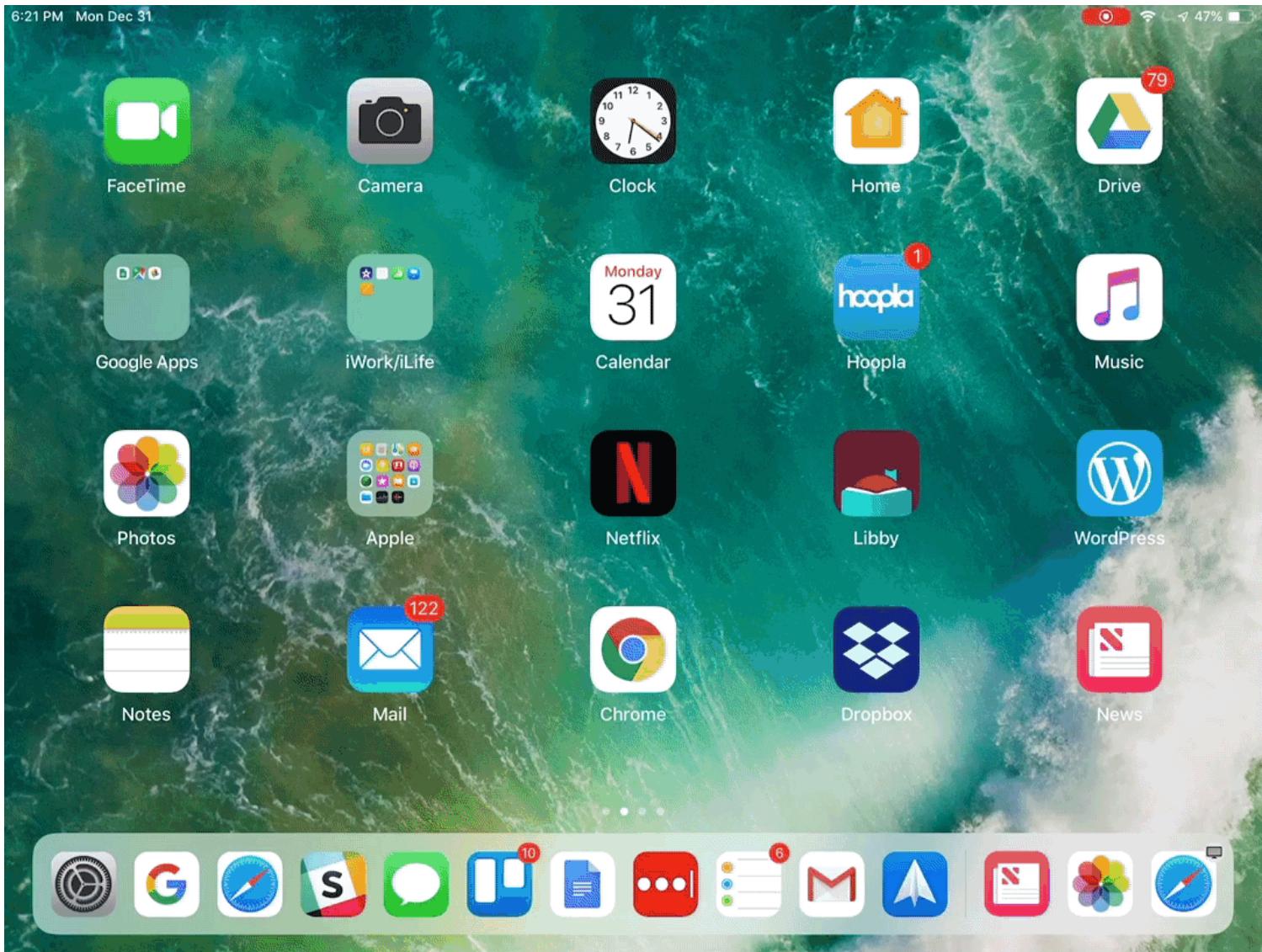


<sup>14</sup> Figure: Gaver, 1991, *Technology Affordances*

**False Affordances:** an action that is perceived by the user but in fact does not work as expected.

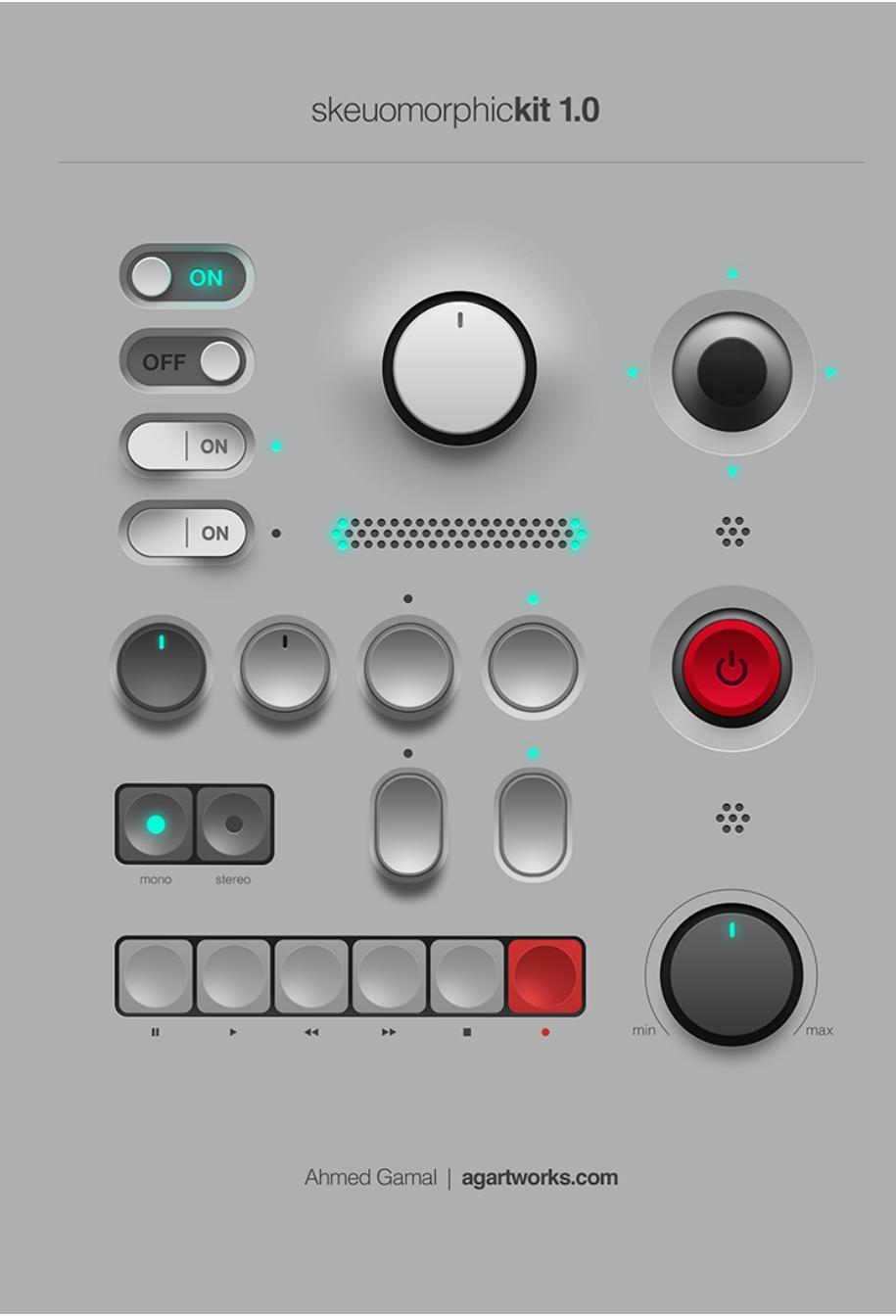
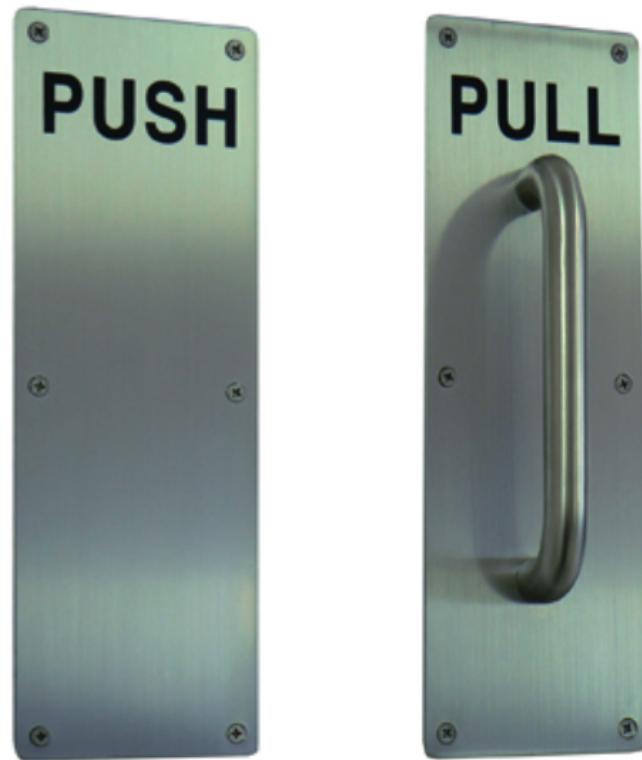


# Hidden Affordance: the affordance is not too obvious.





# Perceptible Affordances: an object's characteristics imply an action.



# ICA D: Interaction Design

Deconstruct an application and identify a...

- metaphor
- idiom
- hidden affordance



Angle PRQ

$$\cos A = \frac{(9\sqrt{2})^2 + 13^2 - 8^2}{2(9\sqrt{2})(13)}$$

$$\cos A = 0.924$$
$$A = 22.38$$

6.  $f(x) = x^2 + 8axc + 4a^2, x \geq 0$   
 $g(x) = 6x - 2a, x \in \mathbb{R}$

(a)  $f(g(x)) = f(6xc - 2a)$

$$\begin{aligned} &= (6x - 2a)^2 + 8a(6x - 2a) + 4a^2 \\ &= [36x^2 - 12ax - 12ax + 4a^2] \\ &= [36x^2 - 24ax + 4a^2] + 48ax - 16a + 4a^2 \\ &= 36x^2 + 24ax - 8a^2 \end{aligned}$$

IF  $a = 4$

(b)  $f(g(z))$

$$\begin{aligned} &= f(6(z) - 2(4)) \\ &= f(4) \\ &= 4^2 + 8(4)(4) + 4(4)^2 \\ &= 208 \end{aligned}$$

(c)

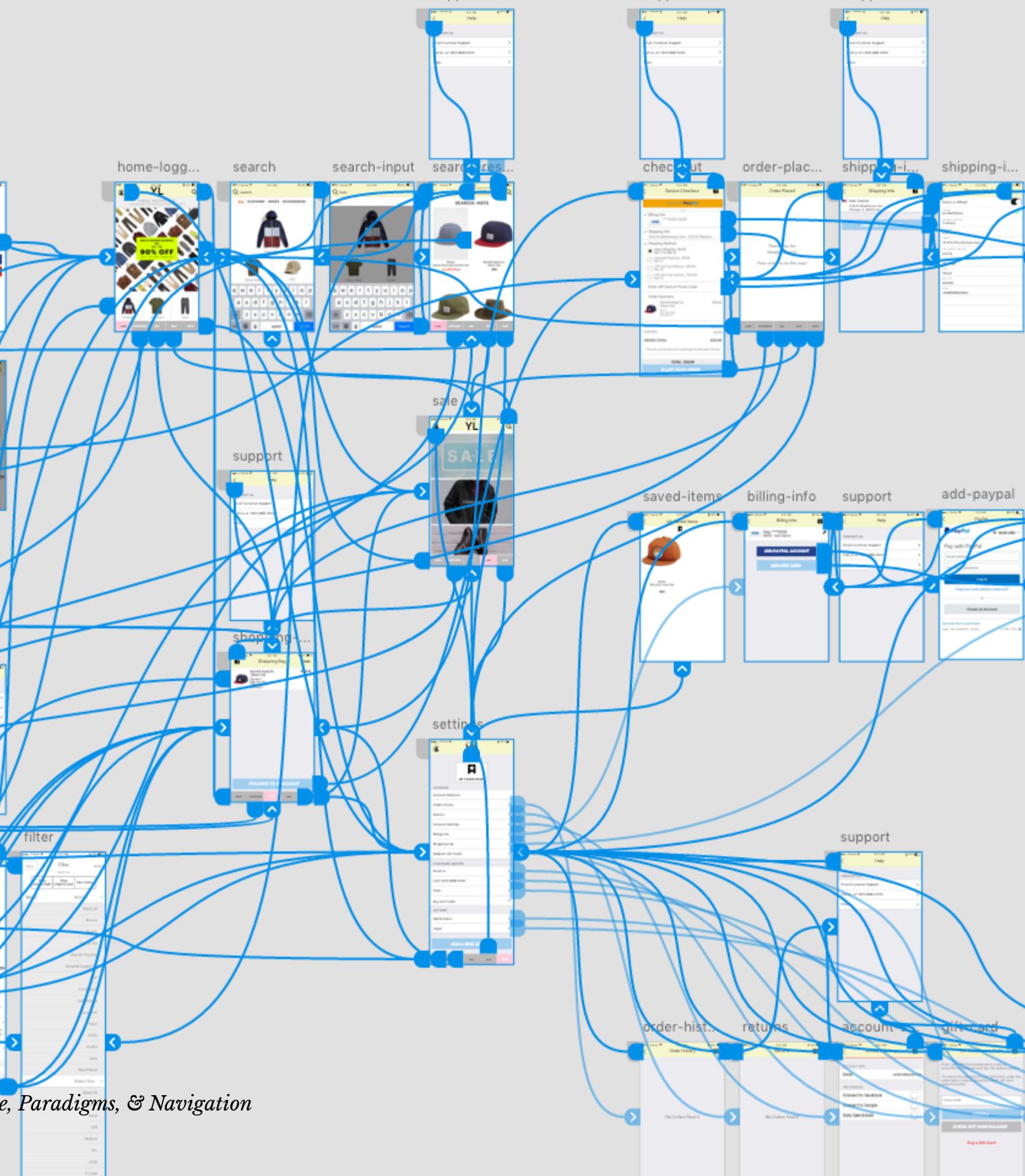
$$\begin{aligned} f^{-1}(x) : & x^2 + 8(4)x + 4(4)^2 \\ y &= x^2 + 8(4)x + 4(4)^2 \\ Y &= x^2 + 32x + 64 \\ Y &= (x+16)^2 - 192 \\ Y+192 &= (x+16)^2 \\ \sqrt{Y+192} &= |x+16| \\ -16 \mp \sqrt{Y+192} &= x \end{aligned}$$

So  $f(x) = -16 + \sqrt{x+192}$

# Principles of Navigation

# Principles of Navigation<sup>6</sup>

1. Wayfinding
2. Cost
3. Aids
4. Models



<sup>6</sup>Tidwell, 2010, *Designing Interfaces*

# Wayfinding

**Definition:** User behavior where navigation across components follows a particular workflow or supports user goals.

Three key elements:

1. Signage
2. Environmental clues
3. Maps, *e.g.*, site maps



[BACK TO SHOP](#)

SECURE CHECKOUT

Home &amp; Kitchen ▾



EN

Hello, Sign in  
Account & Lists ▾

Orders

Today's Deals Your Amazon.com Gift Cards Help Whole Foods Registry Sell

## Complete Your Purchase

- NEED HELP?**  
If you need help, contact us and let us help you. Support is available for 24 hours.  
+111 2 345 678 mail@company.com
- 1 CART
  - 2 INFORMATION
  - 3 SHIPPING
  - 4 PAYMENT

[BACK](#)

## SHIPPING METHOD

Choose one of the shipping methods below

<input type="radio"/> Standard Shipping	2-3 Days	\$3.00
<input type="radio"/> Special Shipping	1-2 Days	\$7.50

## SHIPPING TO

John Doe  
32 Syarifudin Street, West Bogor, West Java,  
Indonesia 112233  
PHONE 012 34 567 89  
ETD 1-2 Days

## ESTIMATION

Order	\$137.19
Shipping	\$0.00
Discount	\$0.00
Tax	\$10.00

**TOTAL**  
**\$147.19**

[GO TO PAYMENT METHOD →](#)

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## Shop Cookware Sets

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**Cuisinart MCP-12N Multiclad Pro Stainless Steel 12-Piece Cookware Set**  
by Cuisinart 2,264 customer reviews | 729 answered questions **Amazon's Choice** for "cuisinart cookware sets"

**\$197.21** & FREE Shipping. Details & FREE Returns

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Qty: 1 90s Governance

Roll over image to zoom in

Get \$50 off instantly: Pay \$197.21 \$147.21 upon approval for the Amazon Rewards Visa Card. No annual fee.

Size: **12-PC Set**

- Polished cooking surface does not discolor, react with food or alter flavors.
- Cookware also features cool grip handles secured with stainless steel rivets and self-basting, tight fitting lids, Triple-Ply construction

## SITEMAP

- Monki Animal welfare
- H&M HOME Chemicals
- & Other Stories Climate positive value cha
- ARKET Water
- Afound Business ethics
- Get involved**
- Care for your clothes
- Recycle your clothes
- Sustainability Summary 201
- Career**
- Grow with us
- Be yourself
- Enjoy our culture**
- More about our values
- Be proud
- Investors**
- Financial calendar
- Reports and presentations
- The H&M group 2017 in wor
- pictures
- Capital Markets Day 2018
- Randall April, H&M
- Andreas Sjunnesson, Weekday
- Anna Norling, Cheap Monday
- Michael Hafner, Monki
- Sofia Carpentier, & Other Stories
- Helene Fredell, H&M Home
- Five year summary
- Subscribe
- Media**
- Newsroom
- Image galleries
- Calendar
- Social media
- Media contacts
- Sustainability**
- Vision and strategy
- Sustainability strategy
- Stakeholder engagement

# Cost

**Definition:** The time and effort required by users to navigate between components.

Two key principles:

1. Minimize factors that increase cost of navigation: *context switch, errors, delays*
2. Minimize travel time by minimizing number of steps and context switches

# Aids

**Definition:** Design elements that aid users in navigating through content.

Three types of navigation aids:

1. Global navigation aids, *e.g.*, menus, tabs, sidebars
2. Utility navigation aids, *e.g.*, sign in, help, print
3. Associative/in-line navigation aids, *e.g.*, related links



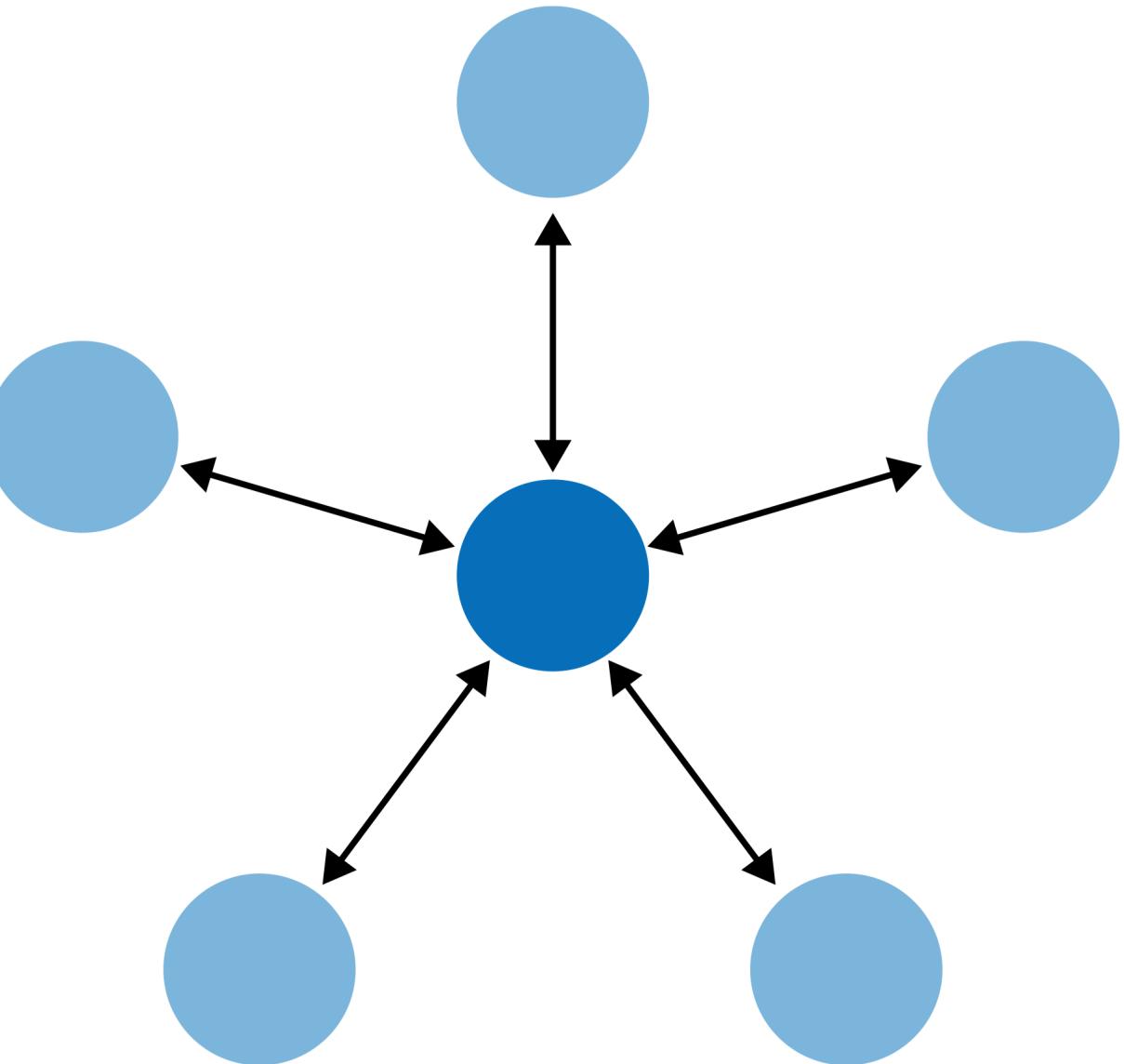
# Models

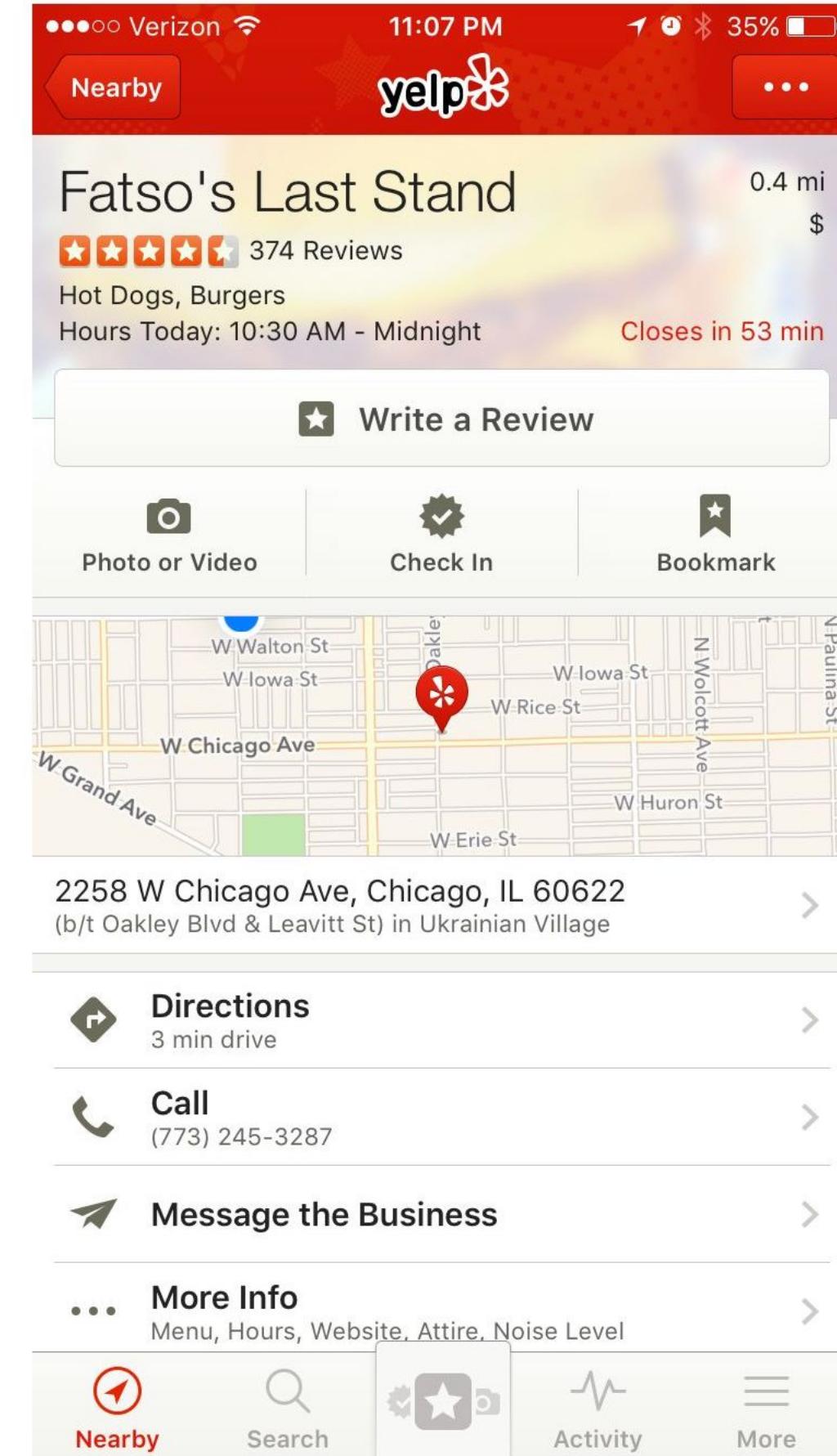
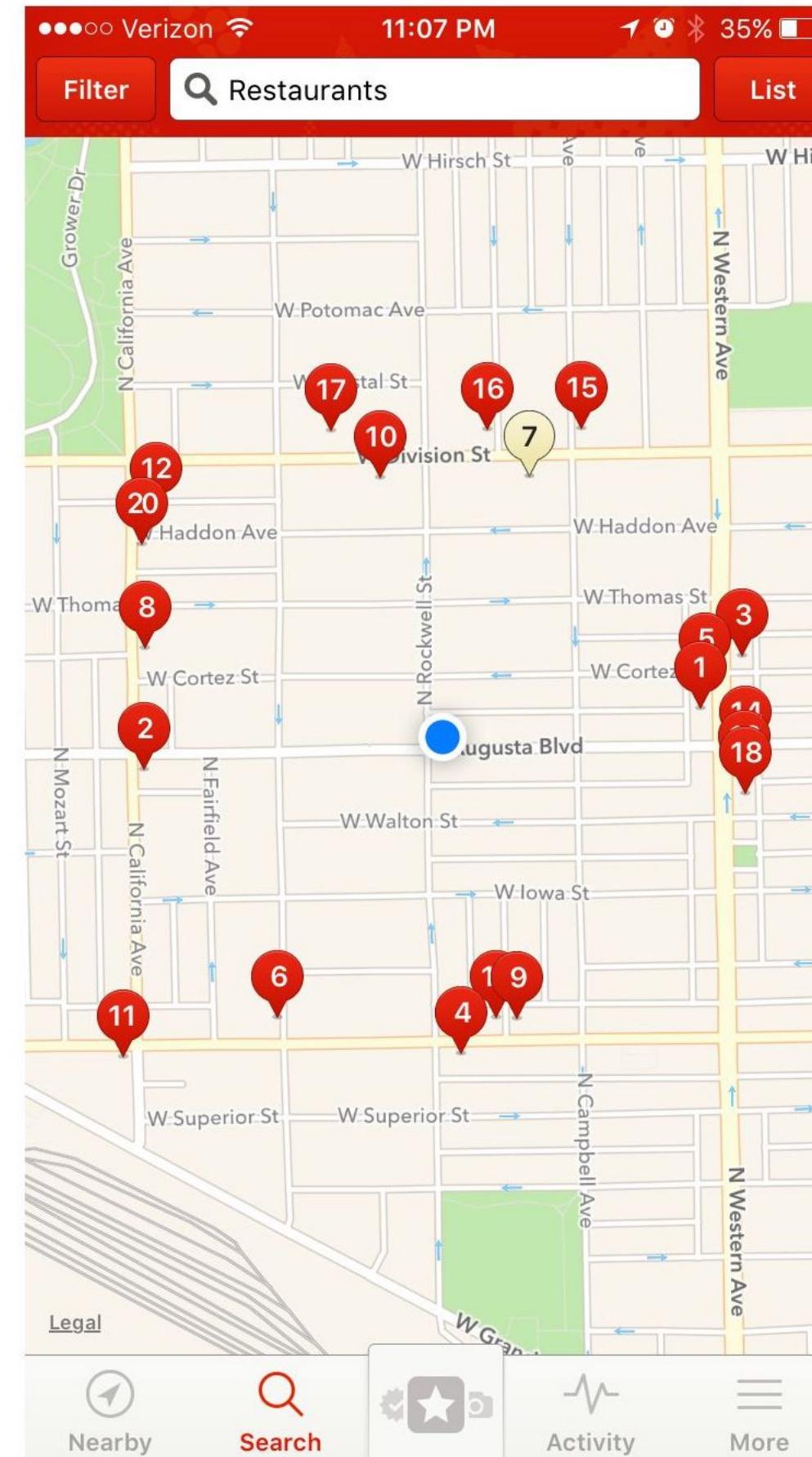
**Definition:** Commonly used patterns of navigation through interactive applications.

- 1. Hub and spoke
- 2. Fully connected
- 3. Multi-level
- 4. Stepwise
- 5. Pyramid
- 1. Pan-and-zoom
- 2. Flat navigation
- 3. Modal panel
- 4. Clear entry points
- 5. Bookmarks
- 6. Escape hatch

# Models: Hub & spoke

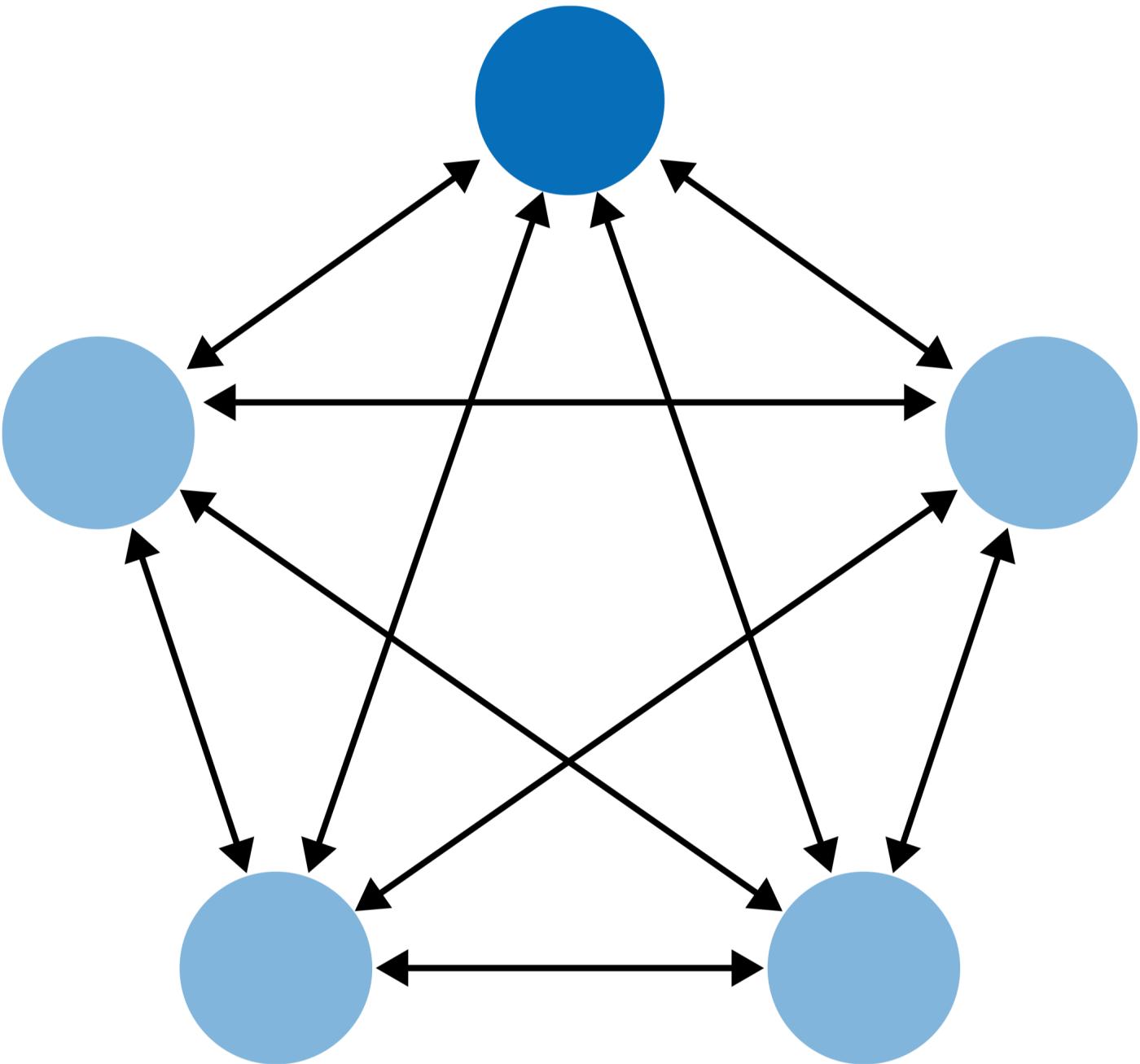
**Definition:** Involves a central hub, e.g., a home screen, that provides transitions to and from several specialized components.





# Models: Fully connected

**Definition:** A central component/page is connected to all other components that are also linked to each other.





YUHANG ZHAO

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Projects

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I am an assistant professor in the department of Computer Sciences at the University of Wisconsin-Madison. My research interests include Human-Computer Interaction (HCI), accessibility, augmented and virtual reality (AR/VR), human-centered AI, and mobile interaction. **I design and build intelligent interactive systems to enhance human abilities.** Via my research, I seek to understand the challenges and needs of people with diverse abilities, and design systems and interaction techniques to empower them in both the real life activities and the emerging virtual worlds. My work has been published at many top-tier conferences and journals in the field of Human-Computer Interaction (including three best paper nominees), as well as 3 U.S. and international patents. I received my Ph.D. degree from Cornell Tech, Cornell University, and B.E. degree and M.S. degree with distinction on thesis in Computer Science at Tsinghua University.

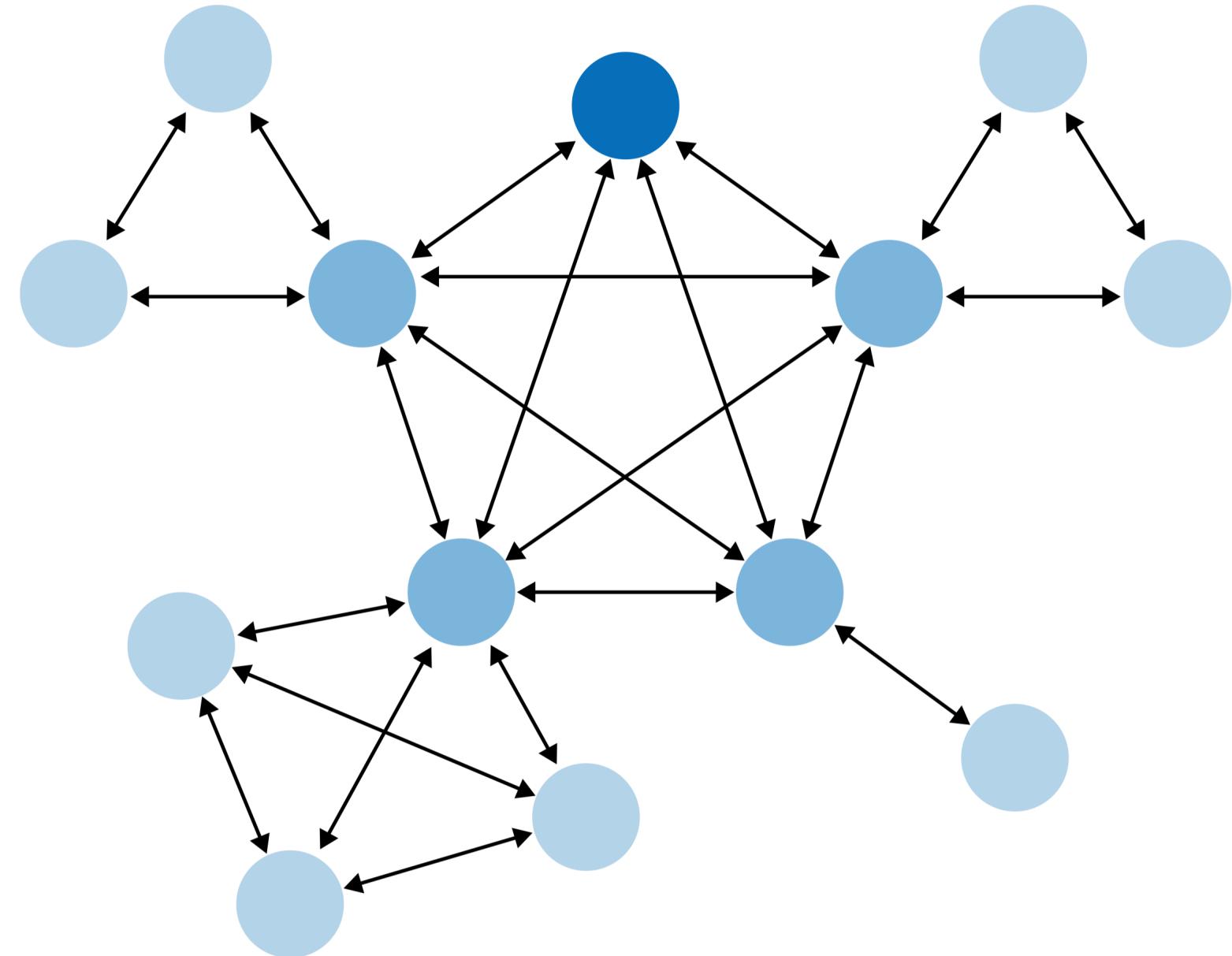
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# Models: Multi-level

**Definition:** Involves main components that are fully connected with each other and sub-components that are only connected among themselves.





Deliver to Wei  
Waunakee 53597

Home & Kitchen ▾

Search Amazon



EN ▾

Hello, Zoey  
Account & Lists ▾

Returns  
& Orders



Prime Big Deal Days

Medical Care ▾

Prime Video

Best Sellers

Buy Again

Amazon Home

Amazon Basics

Livestreams

Prime Big Deal Days  
ends in

01 : 48 : 39

Amazon Home

Shop by Room

Discover

Shop by Style

Home Décor

Furniture

Kitchen & Dining

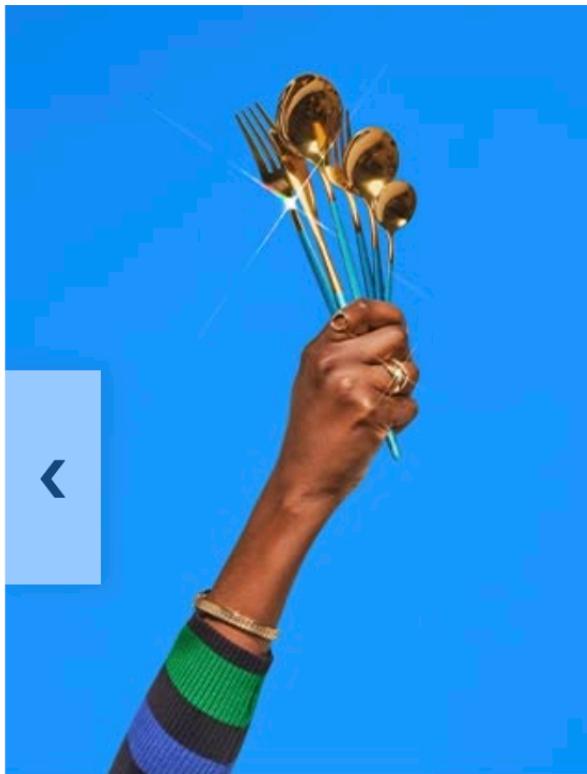
Bed & Bath

Garden & Outdoor

Home Improvement

## Amazon Home

### New & now



Prime Big Deal Days  
Shop epic home savings

Meet Our Newest Innovations  
Shop iRobot

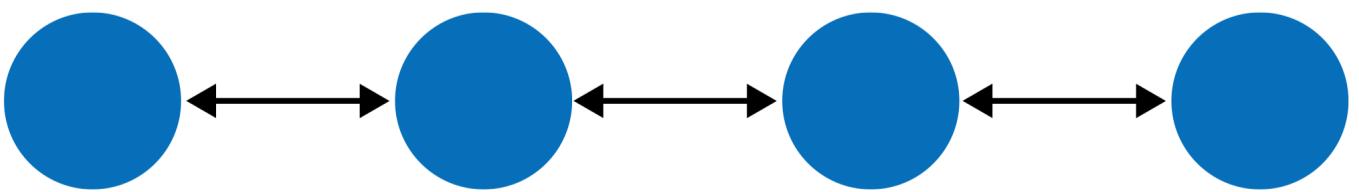
Fall Crafting Must-Haves  
Shop now

Hints Make Holidays Happier  
Create a Holiday Gift List

New F  
Shop no

# Models: Stepwise

**Definition:** Follows a sequential or branching navigation that represents step-by-step process, e.g., checking out on an e-commerce site.





## Set up your Amazon selling account

Have the following available:



**Business name &  
address**



**Mobile or  
telephone number**



**Chargeable credit  
card & valid bank  
account**



**Tax information  
account**

### Legal name

[What is a legal name? ›](#)

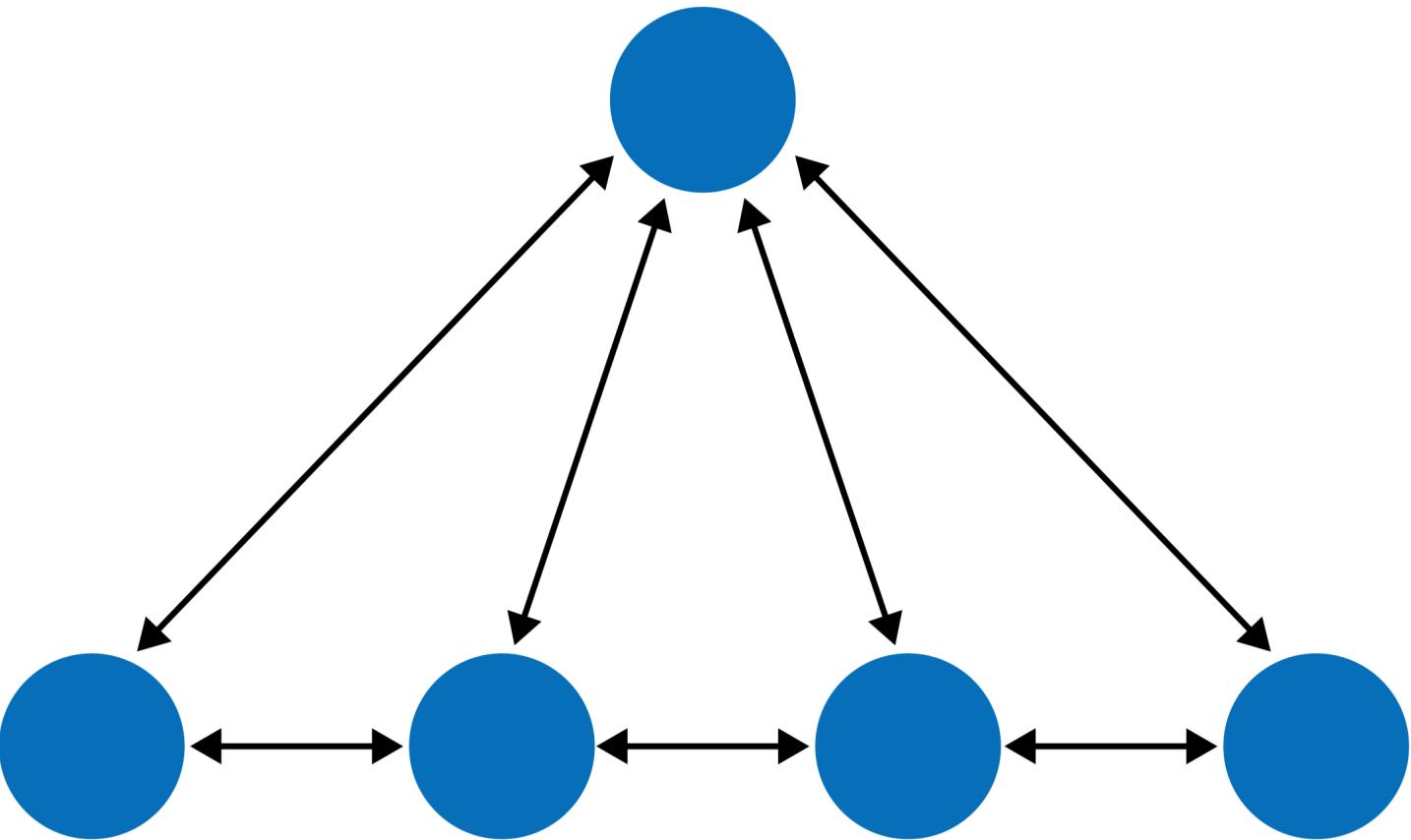
### Seller agreement

I have read and accepted the terms and conditions of the  
[Amazon Services Business Solutions Agreement](#)

Please Leave Feedback

# Models: Pyramid

**Definition:** Similar to the stepwise model, but at each step, the user can navigate to the hub and back.



TurboTax Online

**intuit** **turbotax** Federal Free Edition

Upgrade My Account Search Contact

< Tax Timeline Personal Info Federal Taxes State Taxes Review File

\$0 Federal Refund \$0 NY Refund (in progress) Hide

Prepare State Your State Returns State Review



Let's get your state taxes done right

Here's what's coming up:

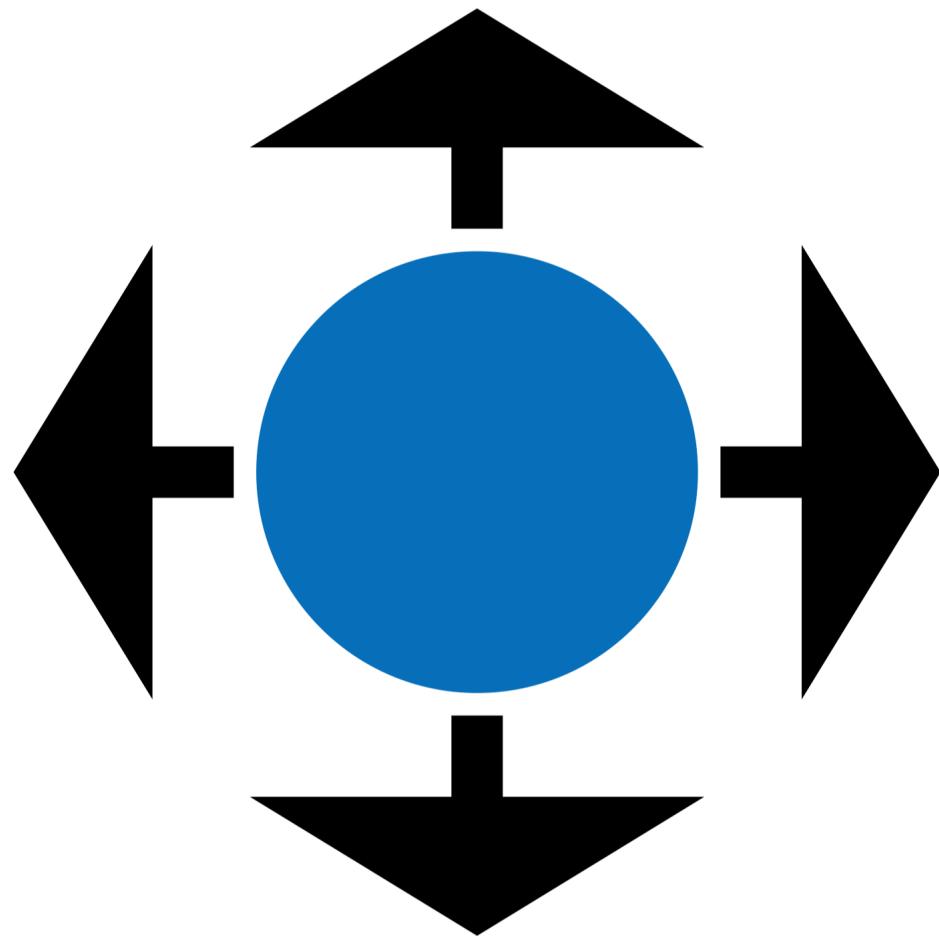
- We'll cover your state requirements
- We'll search for state tax breaks
- We'll help ensure your taxes are accurate

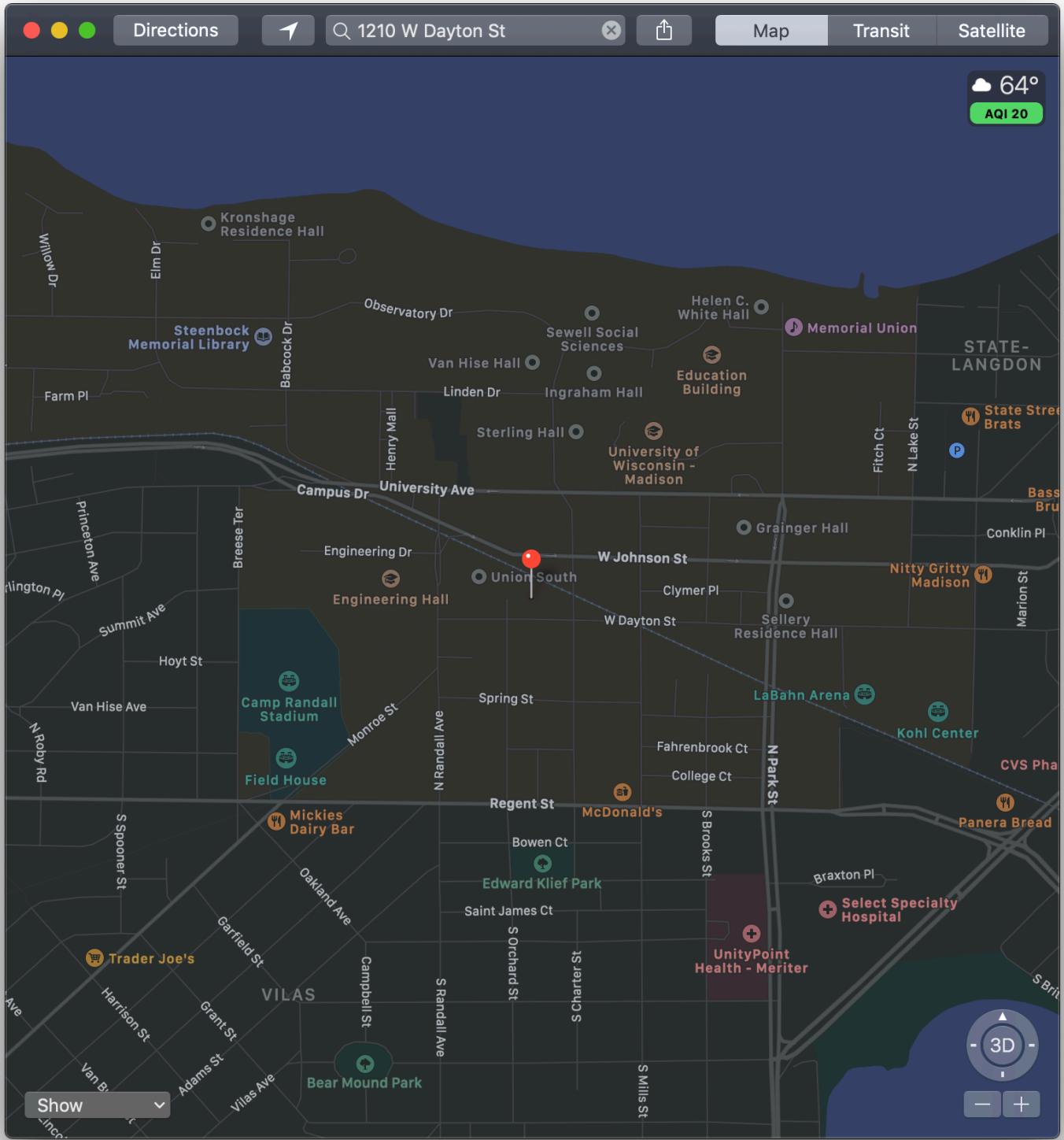
< Back Continue

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# Models: Pan-and-zoom

**Definition:** Provides users with the ability to continuously navigate across a large space of content, e.g., a map, a list, or a written document.





Vestibulum sodales sem sit amet erat faucibus pellentesque. Duis vestibulum in velit ac cursus. Nullam ultrices feugiat nisl sed fermentum. Donec neque eros, molestie vel ullamcorper at, molestie vitae risus. Cras ut vestibulum mi. Pellentesque vitae bibendum sapien, sed mattis sem. Nam eu quam orci. In ut imperdiet nibh. Sed lectus est, commodo non augue at, vehicula tristique tellus. Proin condimentum, orci sed imperdiet commodo, nisl ipsum sodales ipsum, et maximus mauris dui sed felis. Aliquam tincidunt quam sed aliquet elementum. Aliquam nec ex et diam luctus semper vel in augue.

Cras eu scelerisque enim. Sed id diam pharetra, gravida lectus at, maximus nisl. Curabitur eu magna imperdiet, accumsan purus id, faucibus neque. Praesent quam mauris, tincidunt in turpis et, posuere porttitor justo. Donec in dignissim risus. Sed ut ultricies orci, nec pharetra ante. Sed quis ex augue. Aenean id magna quis purus tristique sodales. Quisque bibendum dolor at ante viverra, sed placerat erat suscipit. Proin finibus lacus quis ligula pulvinar imperdiet.

Etiam ultrices massa vitae neque malesuada, a malesuada nulla vulputate. Curabitur at odio a ligula hendrerit mattis eget nec lectus. Sed elementum ex et lorem facilisis, non pharetra nunc fermentum. Etiam id sagittis tortor. Ut suscipit tristique porttitor. Nullam condimentum rhoncus feugiat. Nam odio lorem, pellentesque id euismod ornare, finibus vitae felis. Maecenas tempus facilisis ipsum in venenatis. Fusce porttitor ante vel quam elementum, ac pulvinar augue tristique. Duis justo nisi, condimentum placerat ipsum ut, fermentum pretium

# Models: Flat navigation

**Definition:** Involves a central workspace that is always visible and functions that do not require context switches or navigation.

Drafts / Untitled

Share

32%

COMMENTS

Show Resolved Comments

Receive email notifications

Page 1

Maria, a few seconds ago  
Let's add some UI elements to make it clear  
that they should scroll down further. 😊  
a few seconds ago

Maria, 26 minutes ago  
This is cool.

Maria, 39 minutes ago  
This should be a color-branded button

Frame

Welcome

START NOW

iPhone X

Welcome

START NOW

MacBook

Welcome

START NOW

VIDEO

iPhone X

375x812

Frame

Group

Rectangle 2

Group

Polygon

VIDEO

Rectangle 3

Frame

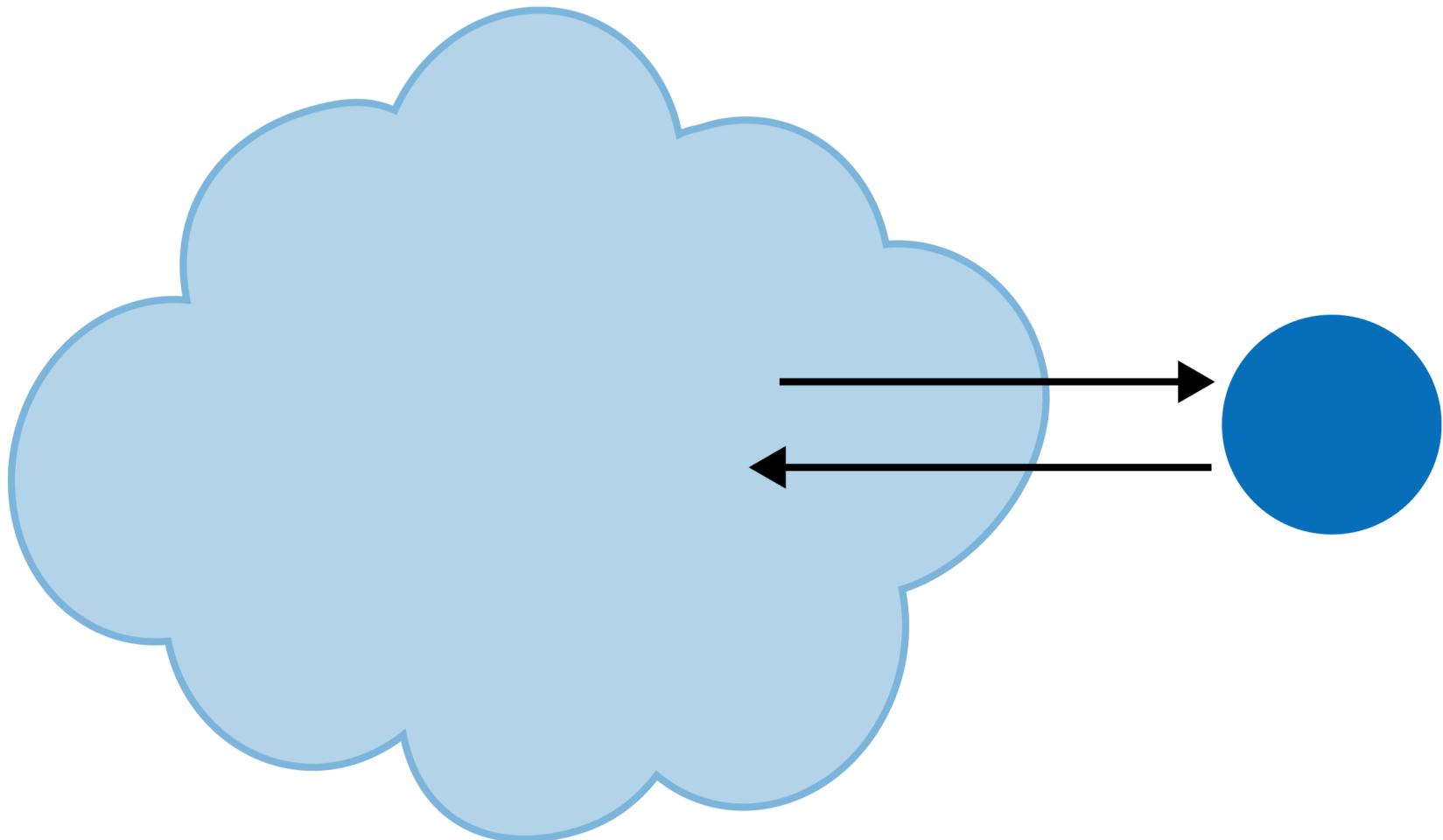
Group

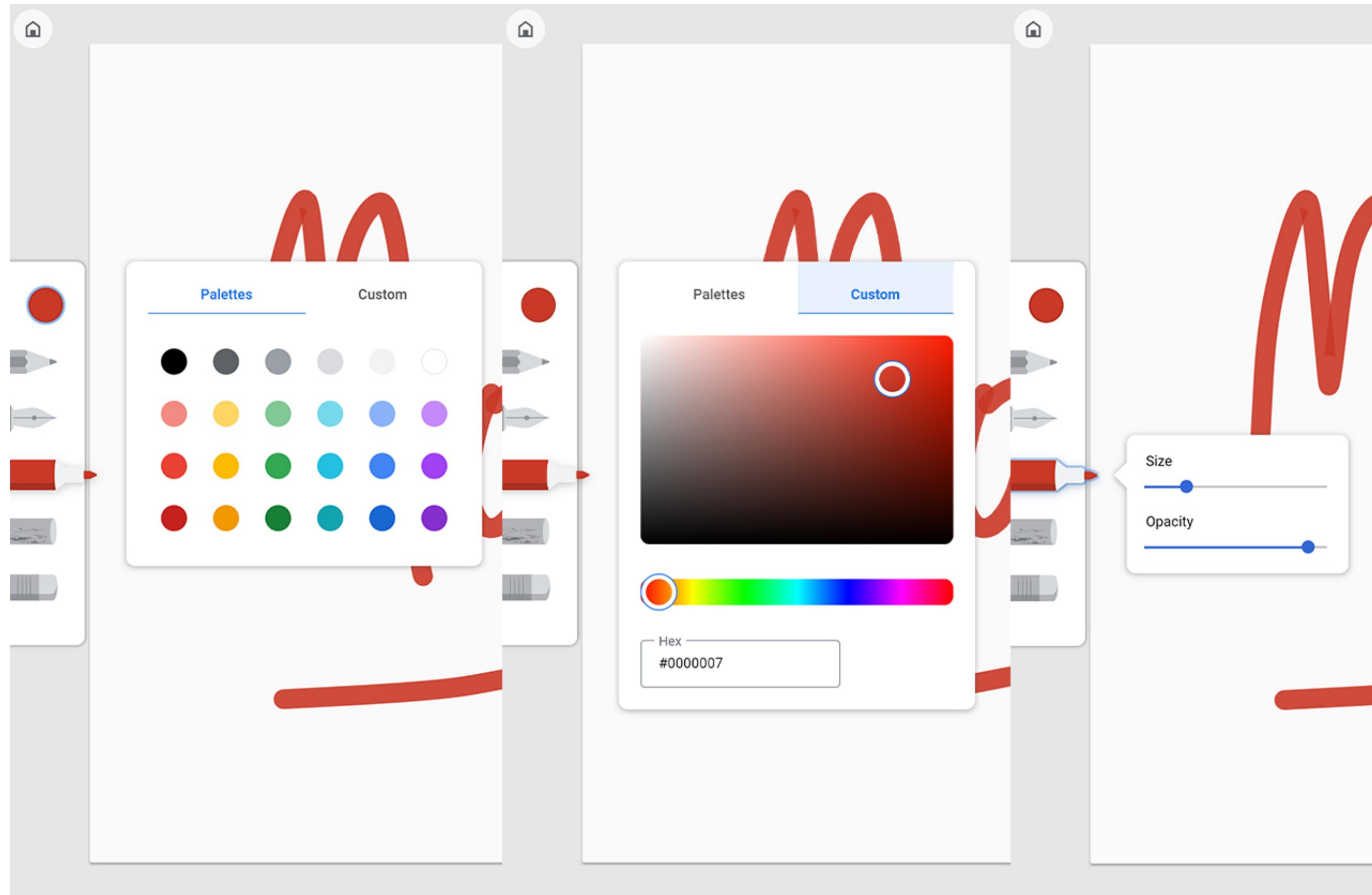
Comments

?

# Models: Modal panel

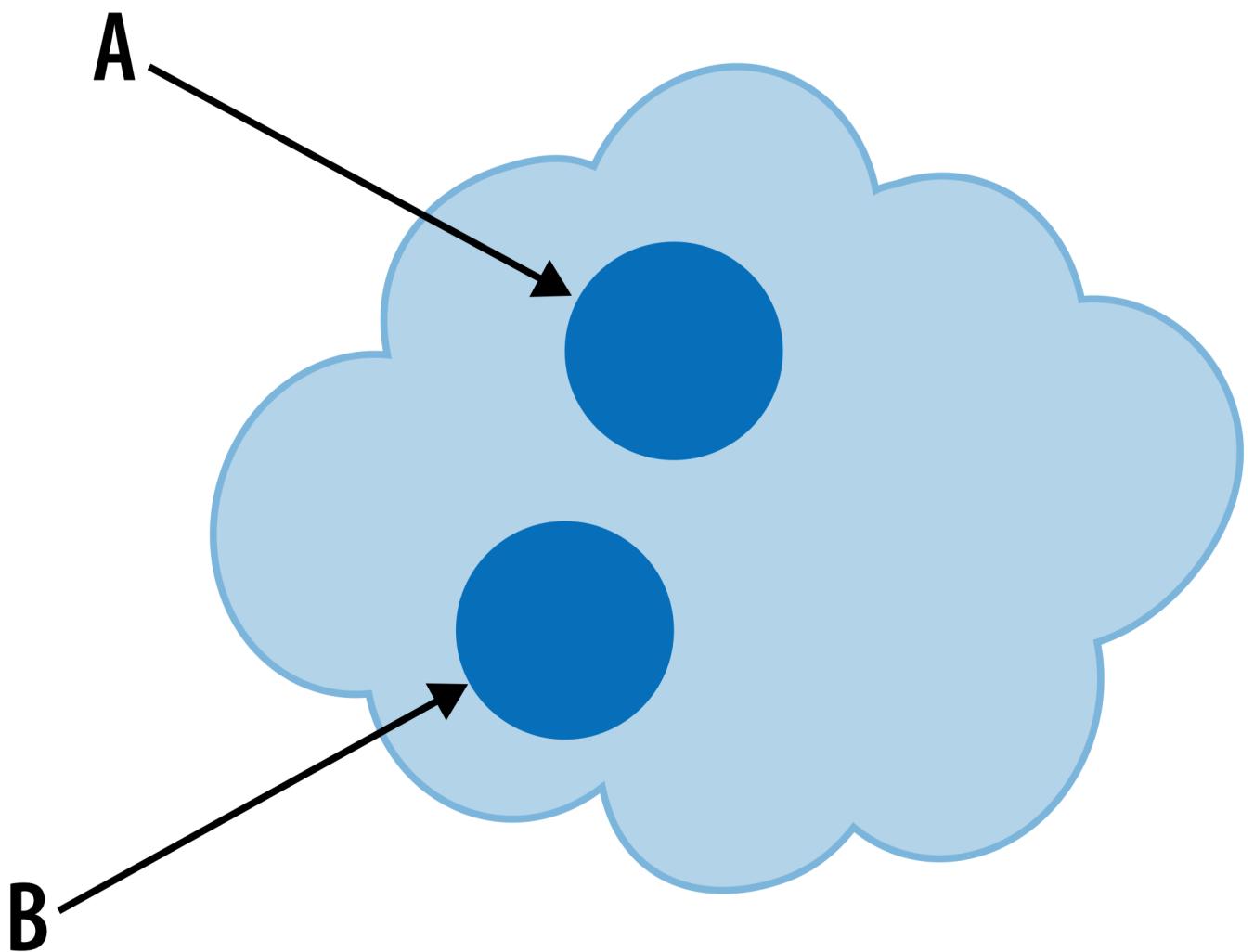
**Definition:** Follows the flat navigation model except for modal dialogs that are temporarily overlaid on the canvas to help the user perform specific functions.





# Models: Clear entry points

**Definition:** Complex applications involve navigational models with clear entry points that guide the user to frequently used or temporary functions without having to go through the hierarchical structure or a step-by-step process.



 Basecamp

How it works Before & after Got clients? Pricing Support Sign in Try it FREE

# Get it together and manage projects the right way.

**Before Basecamp:** Projects feel scattered, things slip, it's tough to see where things stand, and people are stressed. **After Basecamp:** Everything's organized in one place, you're on top of things, progress is clear, and a sense of calm sets in.

**Give Basecamp a Try**

4,883 companies signed up in the last week alone!

Create Basecamp projects for everything you're working on.

Involve everyone who's working on the project.

Acme Co  
2020 Marketing

The client

Message Board

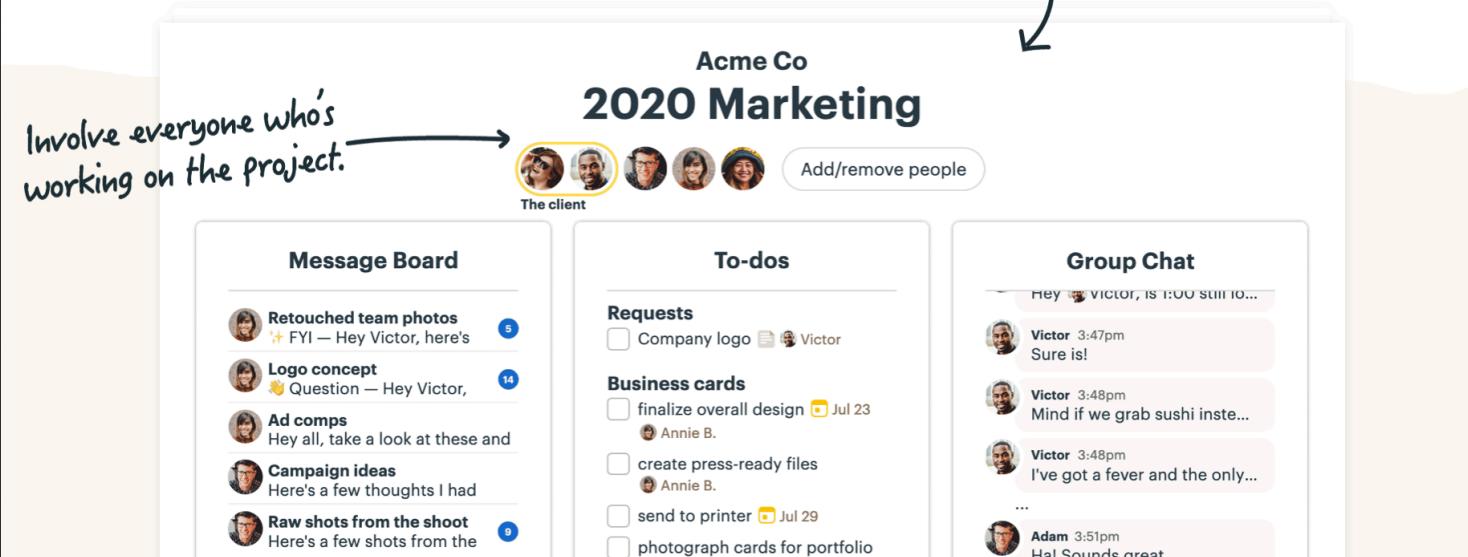
- Retouched team photos FYI — Hey Victor, here's
- Logo concept Question — Hey Victor,
- Ad comps Hey all, take a look at these and
- Campaign ideas Here's a few thoughts I had
- Raw shots from the shoot Here's a few shots from the

To-dos

- Requests  Company logo Victor
- Business cards  finalize overall design Jul 23 Annie B.
- create press-ready files Annie B.
- send to printer Jul 29
- photograph cards for portfolio

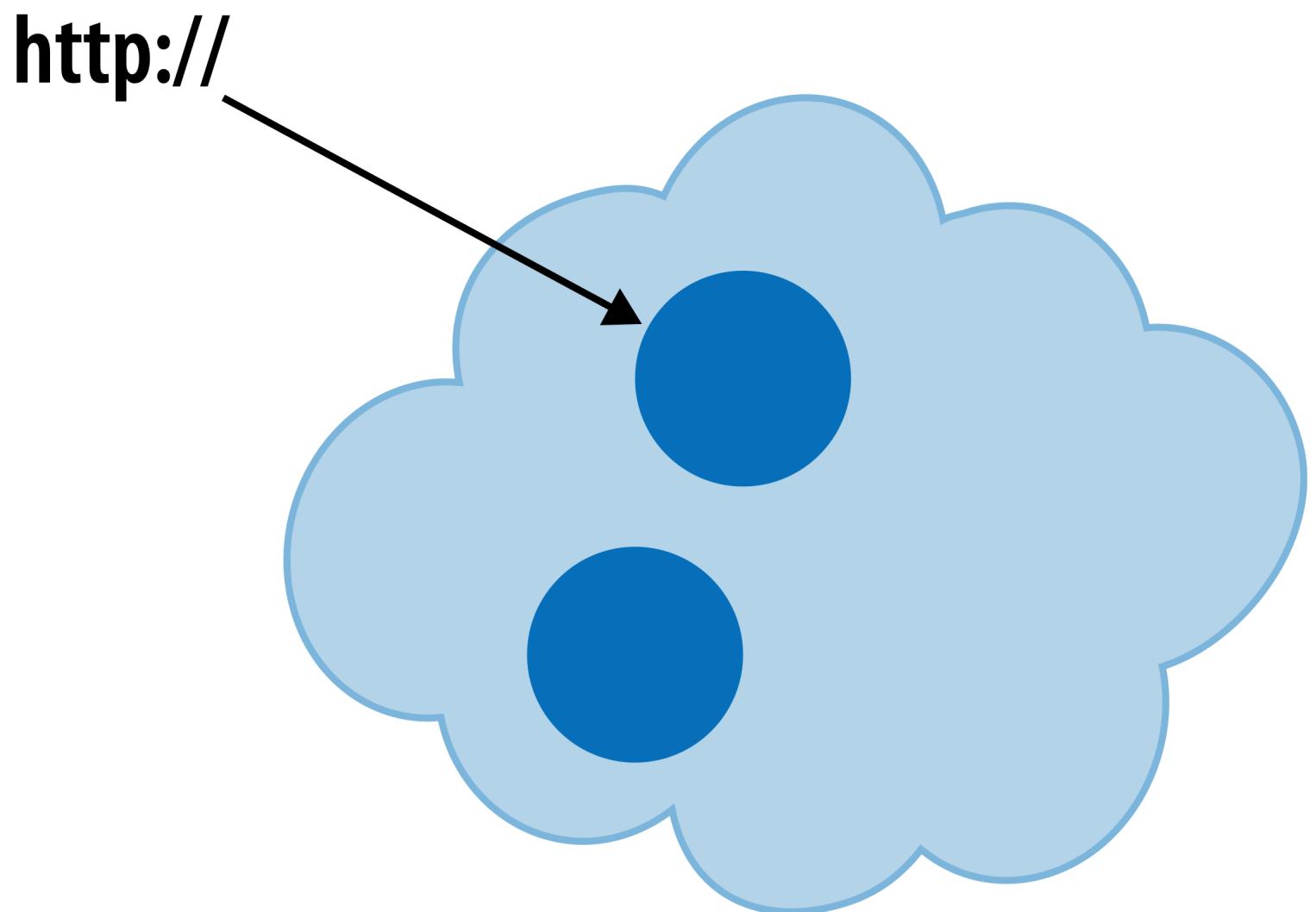
Group Chat

- Hey Victor, is 1:00 still on...
- Victor 3:47pm Sure is!
- Victor 3:48pm Mind if we grab sushi instead...
- Victor 3:48pm I've got a fever and the only...
- ...
- Adam 3:51pm Ha! Sounds great.



# Models: Bookmarks

**Definition:** Bookmarks allow users to conveniently navigate to a point of his choice, anytime he wants, even if it's deep inside a navigational structure. These give people a way to avoid traversing many links to get to a desired page or state.



what will Doran do? *What will his brother do to avenge our murdered prince?*" She moved closer to the captain. "And you say, he does not wish to be a



"He do

otah said again.

The captain of guards knew the prince he guarded. Once, long ago, a callow youth had come from Norvos, a big broad-shouldered boy with a mop of dark hair. That hair was white now, and his body bore the scars of many battles... but his strength remained, and he kept his longaxe sharp, as the bearded priests had taught him. *She shall not pass*, he told himself, and said, "The prince is watching the children at their play. He is *never* to be disturbed when he is watching the children at their play."

"Hotah," said Obara Sand, "you will remove yourself from my path, else I shall take that longaxe and—"

"Captain," came the command, from behind. "Let her pass. I will speak with her." The prince's voice was hoarse.

Areo Hotah jerked his longaxe upright and stepped to one side. Obara gave him a lingering last look and strode past, the maester hurrying at her heels. Caleotte was no more than five feet tall and bald as an egg. His face was so smooth and fat that it was hard to tell his age, but he had been here before the captain, had even served the

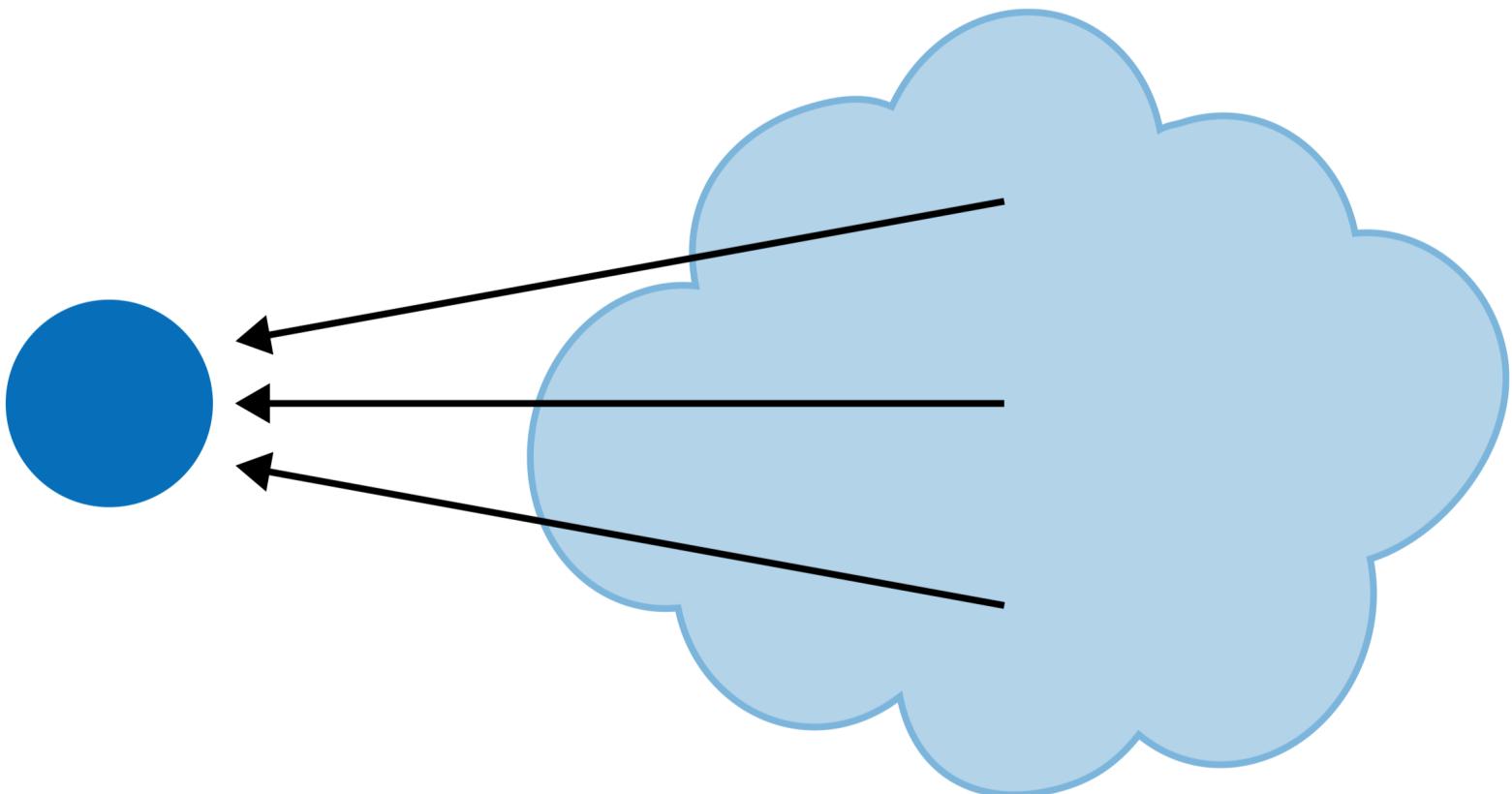
The screenshot shows a digital book reader interface with a vertical sidebar on the right containing navigation links: Table of contents, Bookmarks, Highlights, and Notes. The main area displays a list of highlighted text snippets with their timestamps and counts:

- Obara touched her whip. (20 MINS AGO, 38/767)
- The captain of guards knew the prince he guarded. (20 MINS AGO, 38/767)
- She snorted. "It has been twenty years, or near enough to make no matter. And I was not here long. I am the whore's whelp, or had you forgotten?" When he did not answer, she rose again and put her hands upon her hips. (19 MINS AGO, 39/767)
- hanged (7 HOURS AGO, 570/767)

At the bottom of the screen, there is a black banner with the text "Votre Artisan 24H/7J" and a navigation bar with icons for back, forward, and search.

# Models: Escape hatch

**Definition:** An "escape hatch" provides users with the ability to go back to the main component/page in a complex structure without having to trace steps back.



amazon.com

All EN Hello, Sign in Account & Lists Orders Try Prime

Deliver to Madison 53711 Today's Deals Your Amazon.com Gift Cards Help Whole Foods Registry Sell

## All-new blink XT2

Works with Alexa 2-year battery life 2-way audio

### Deal of the Day

\$117<sup>99</sup> - \$119<sup>00</sup>  
Save up to 40% on a BodyBoss Home Gym 2.0  
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### Jennifer's gift picks

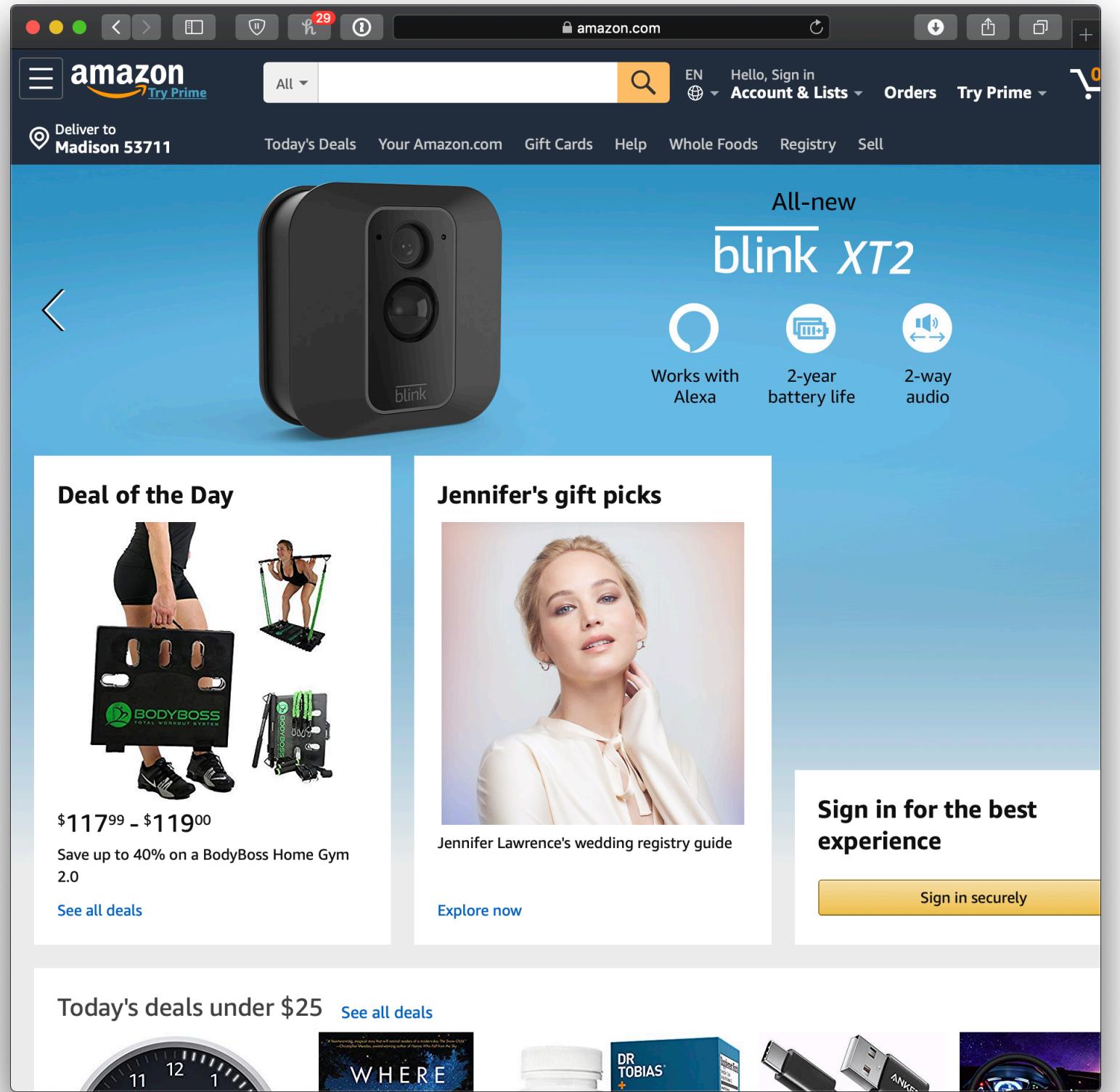
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# ICA D: Interaction Design

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# What did we learn today?

- Interaction Paradigms
- Principles of navigation