

Building User Interfaces

Interaction Design

Yixin Hu & Cole Nelson

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 Design¹

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 is a text input field with placeholder text: "Please enter the description below: [REDACTED]". At the bottom right is a "SUBMIT" button.



INTERACTION DESIGN
FOUNDATION

INTERACTION-DESIGN.ORG

¹Interaction Design Foundation

Interaction Design Paradigms

What is a Design Paradigm?

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

Historical Interaction Design Paradigms⁹

1. Implementation-centric Design
2. Metaphoric Design
3. Idiomatic Design

⁹ Cooper et al., 2014, About Face

Implementation-centric Design

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

Source² ³



² Pinterest

³ Entrepreneur Magazine



Pros & Cons of Implementation-centric Design

Pros:

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

Cons:

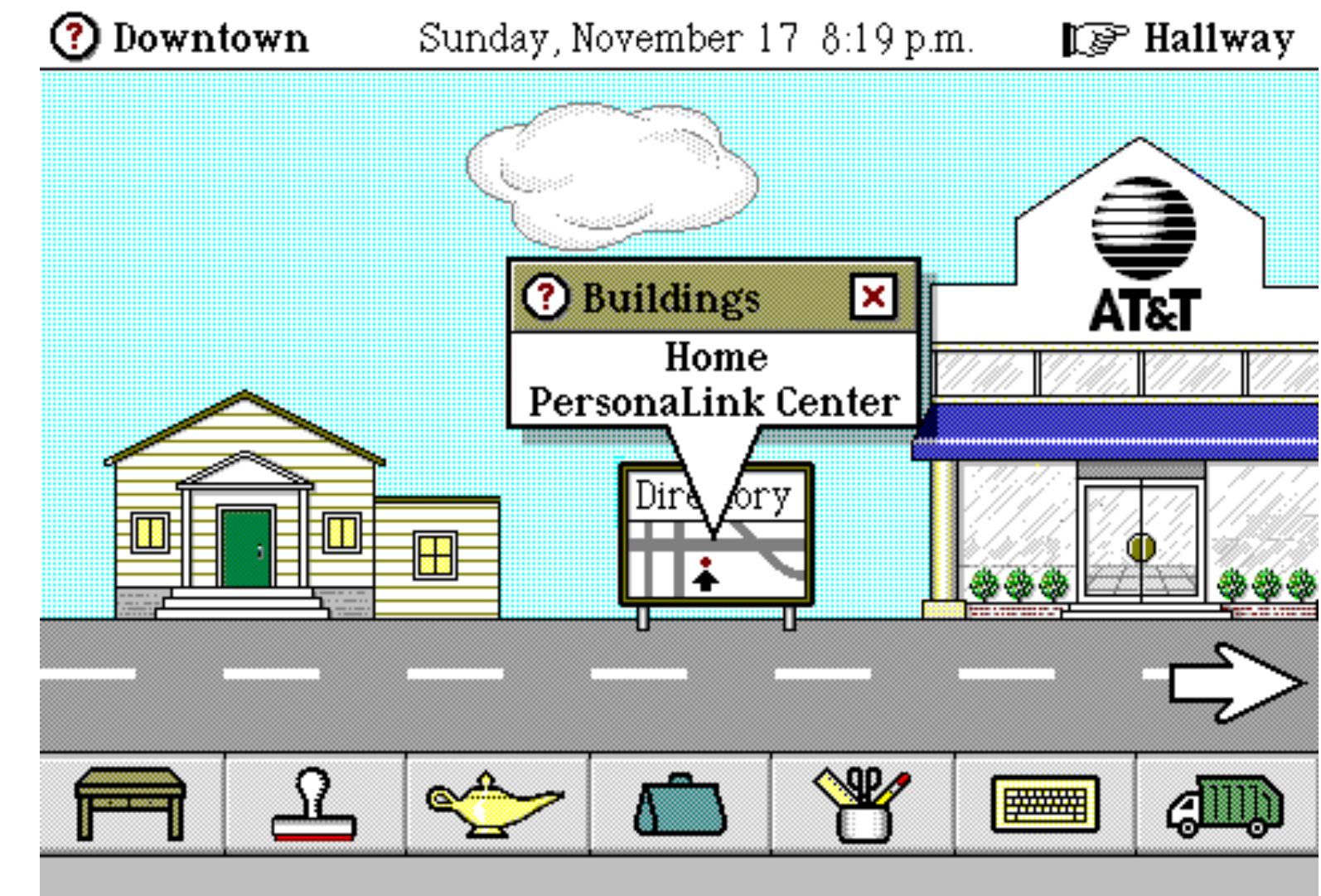
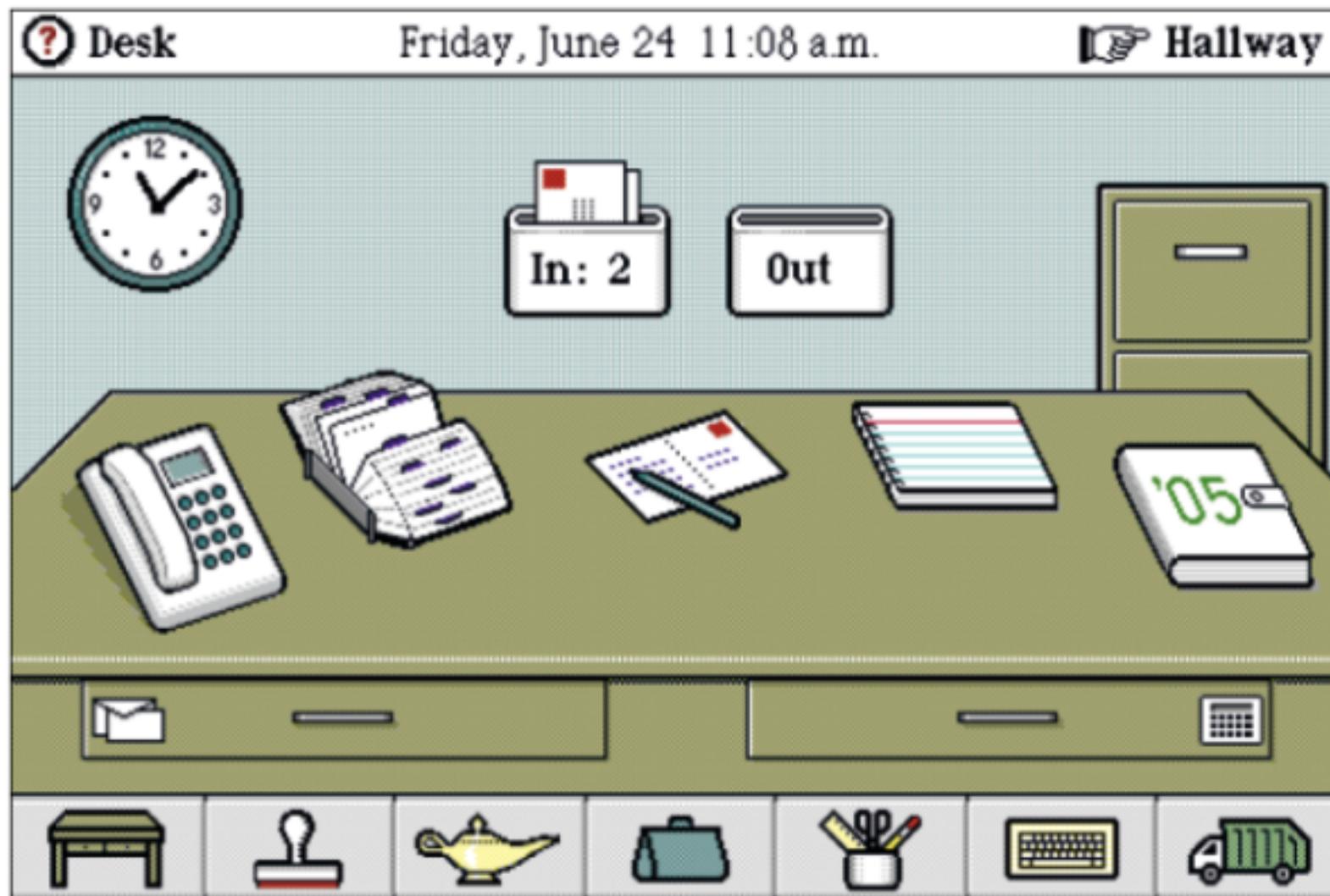
1. Requires learning how the functions work
2. Requires skills in using the functions
3. The system cannot perform high-level actions

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.

Source⁴



⁴ Wikipedia: [Magic Cap, Demo](#)

Source⁷

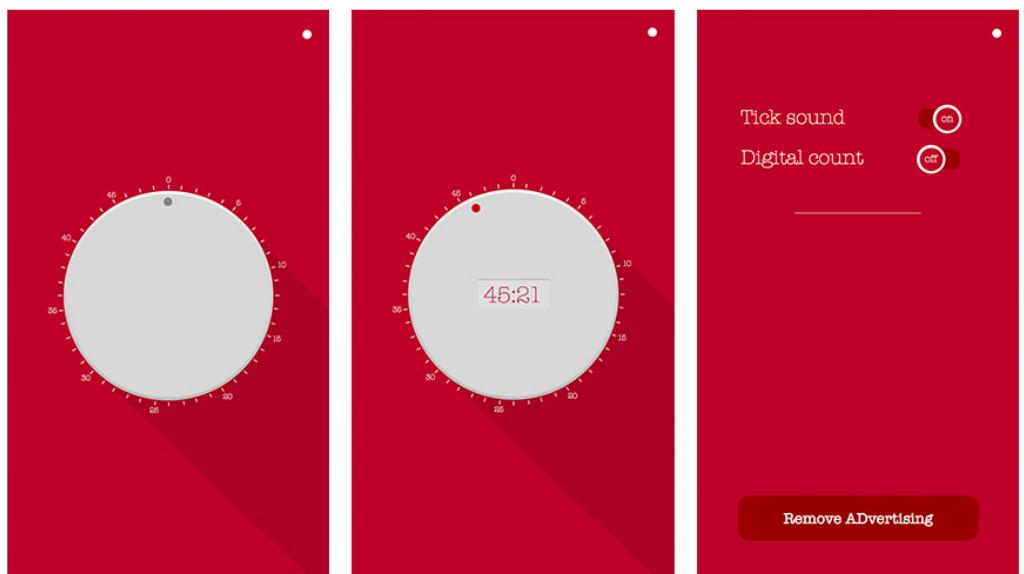
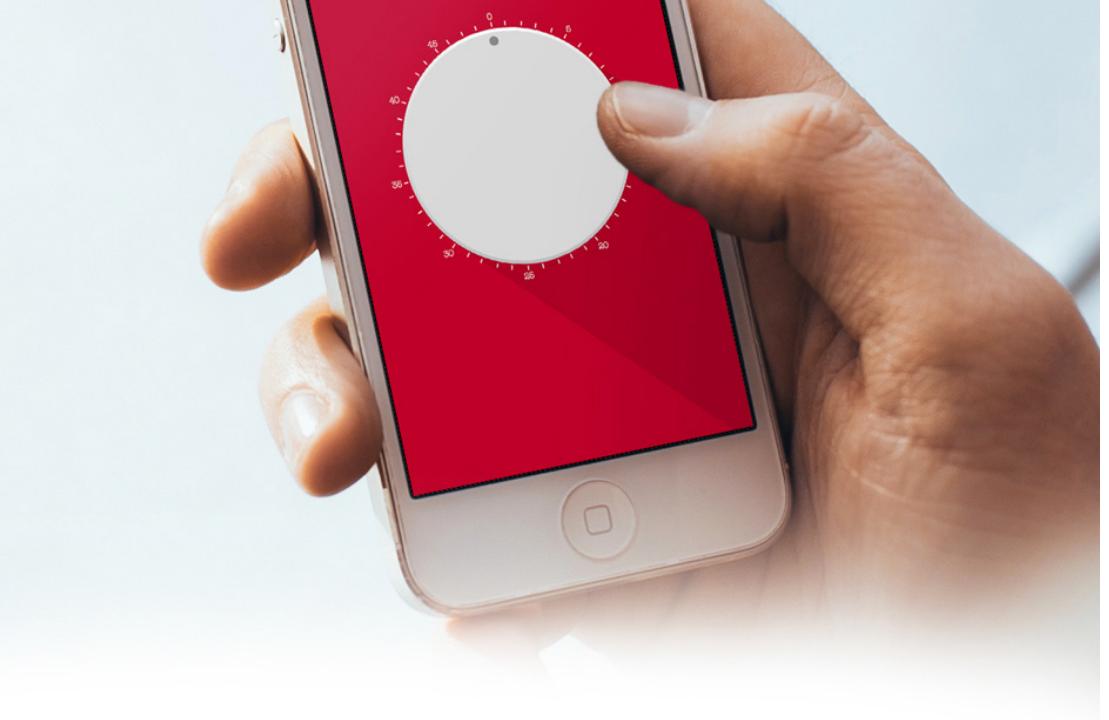
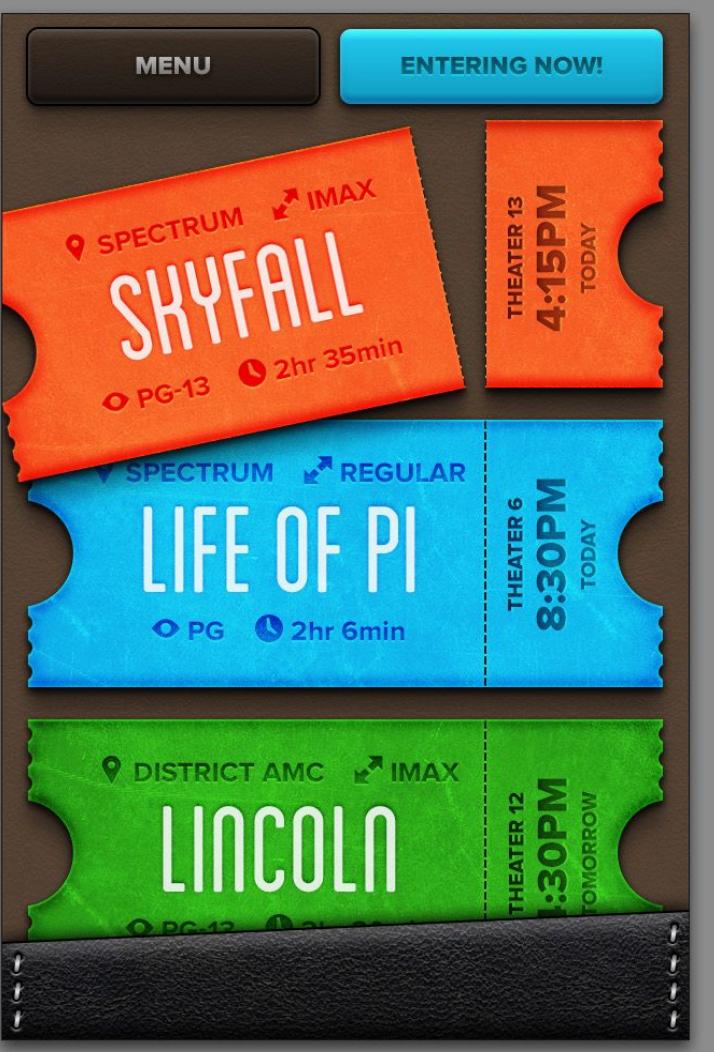


⁷ UX Planet: Metaphorical Design

Source⁸



⁸ Apple App Store: [76 Synthesizer](#)



AND REDISEIGN 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.

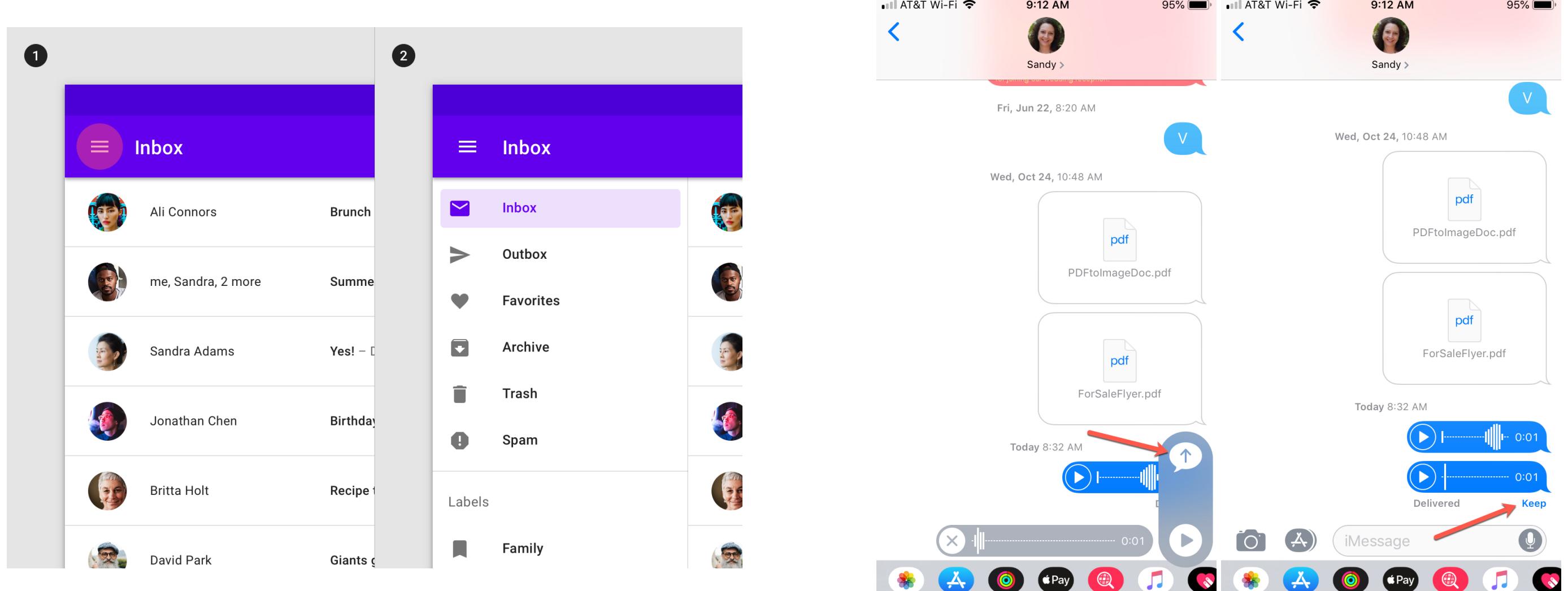
Idiomatic Design¹⁰

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.

¹⁰ [Image Source](#)

Source¹¹ ¹²



¹¹ Image Source

¹² 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*.

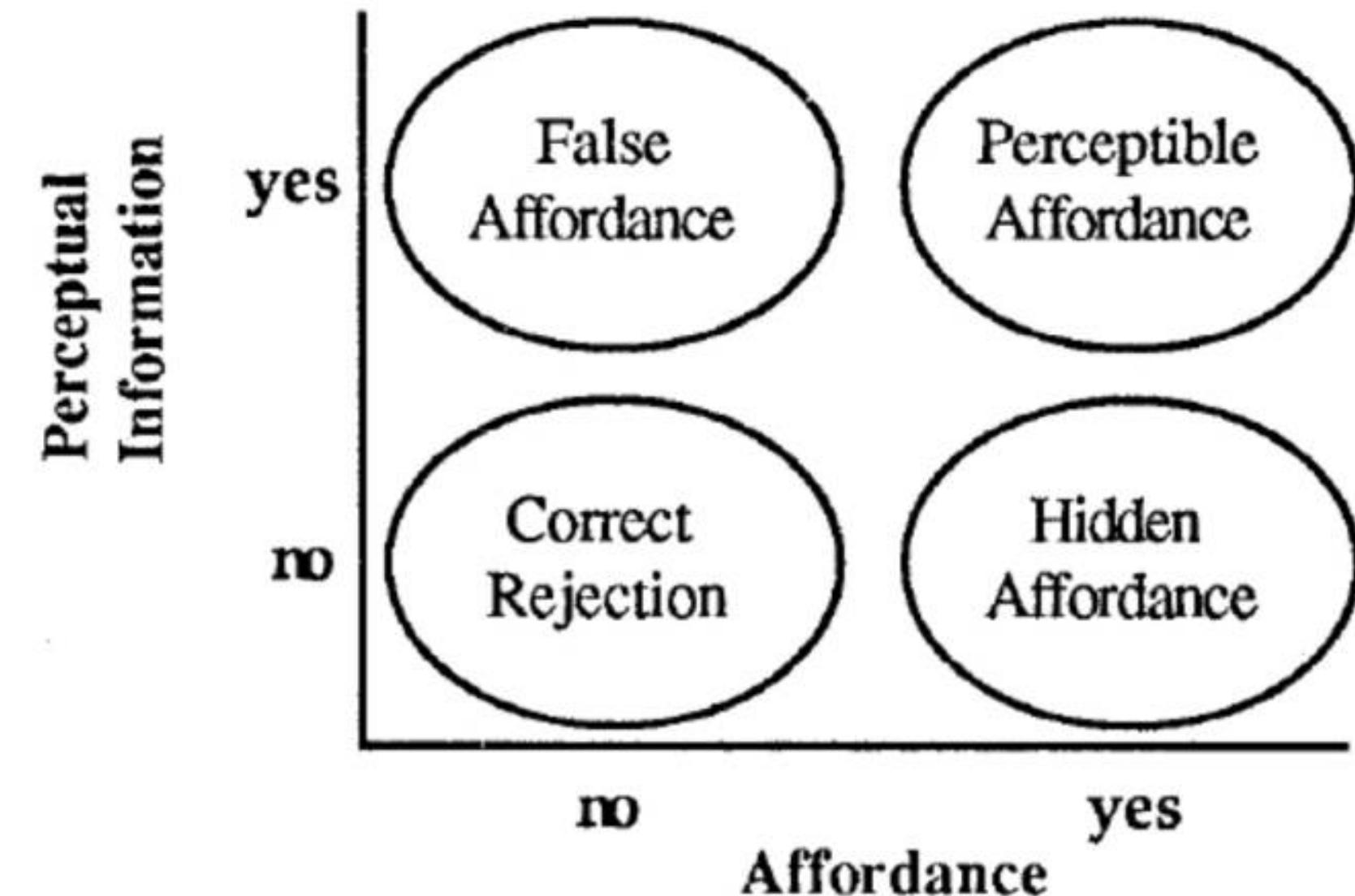
Which environment affords *walking*?



Affordances in Design

Perceptible affordances enable users to intuitively recognize actions that are possible with interface elements.¹⁴

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

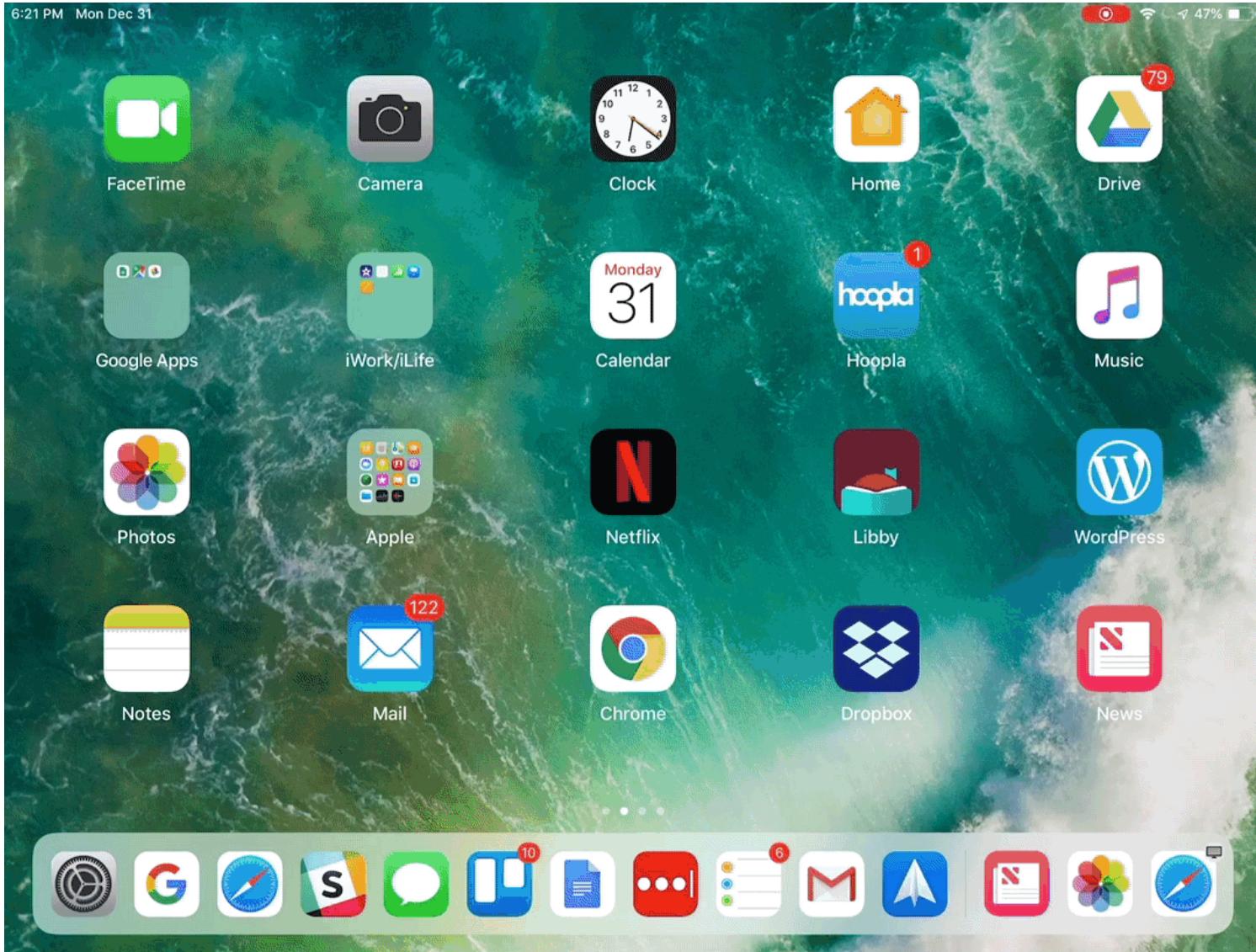


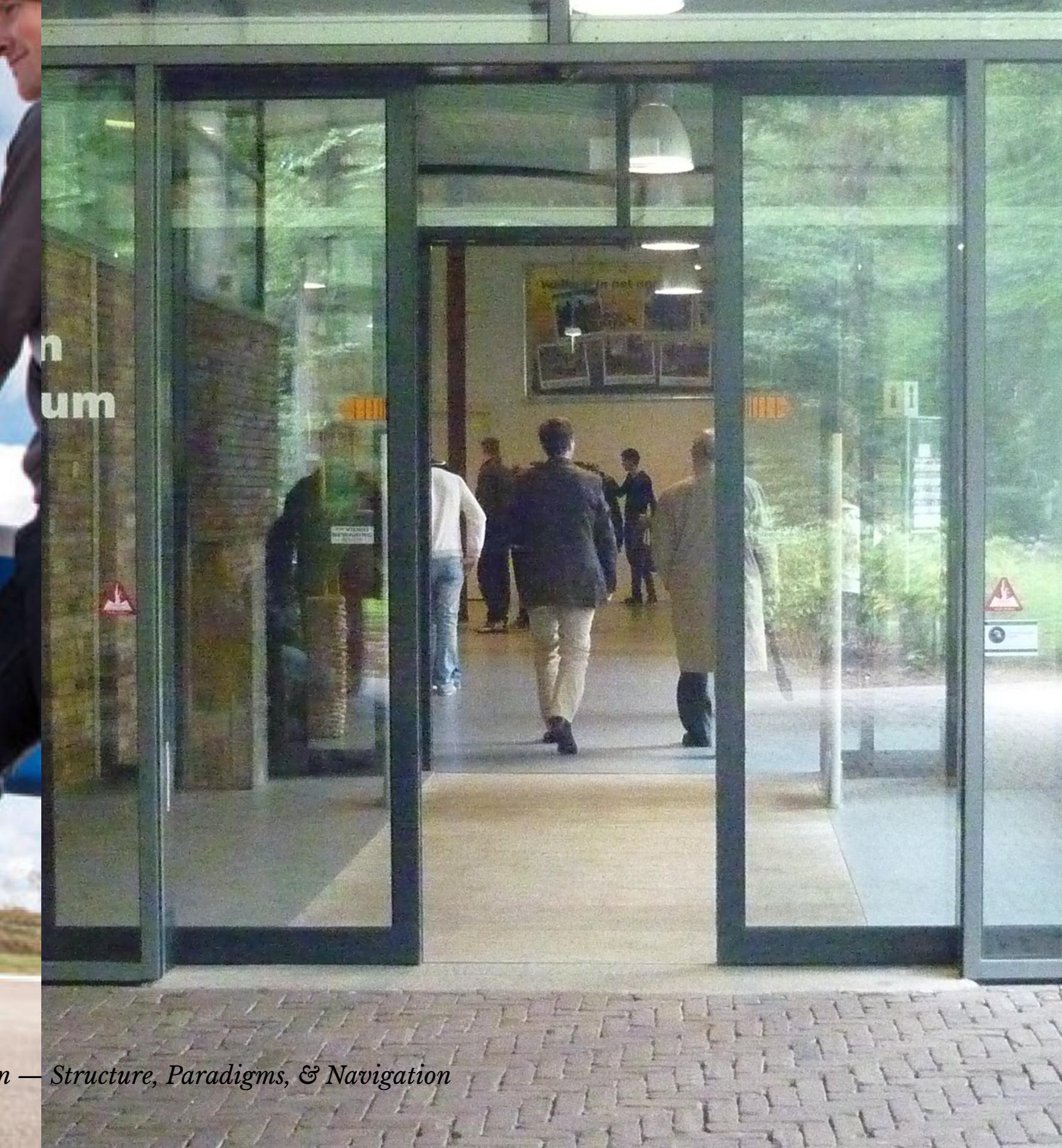
¹⁴ Figure: Gaver, 1991, *Technology Affordances*

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

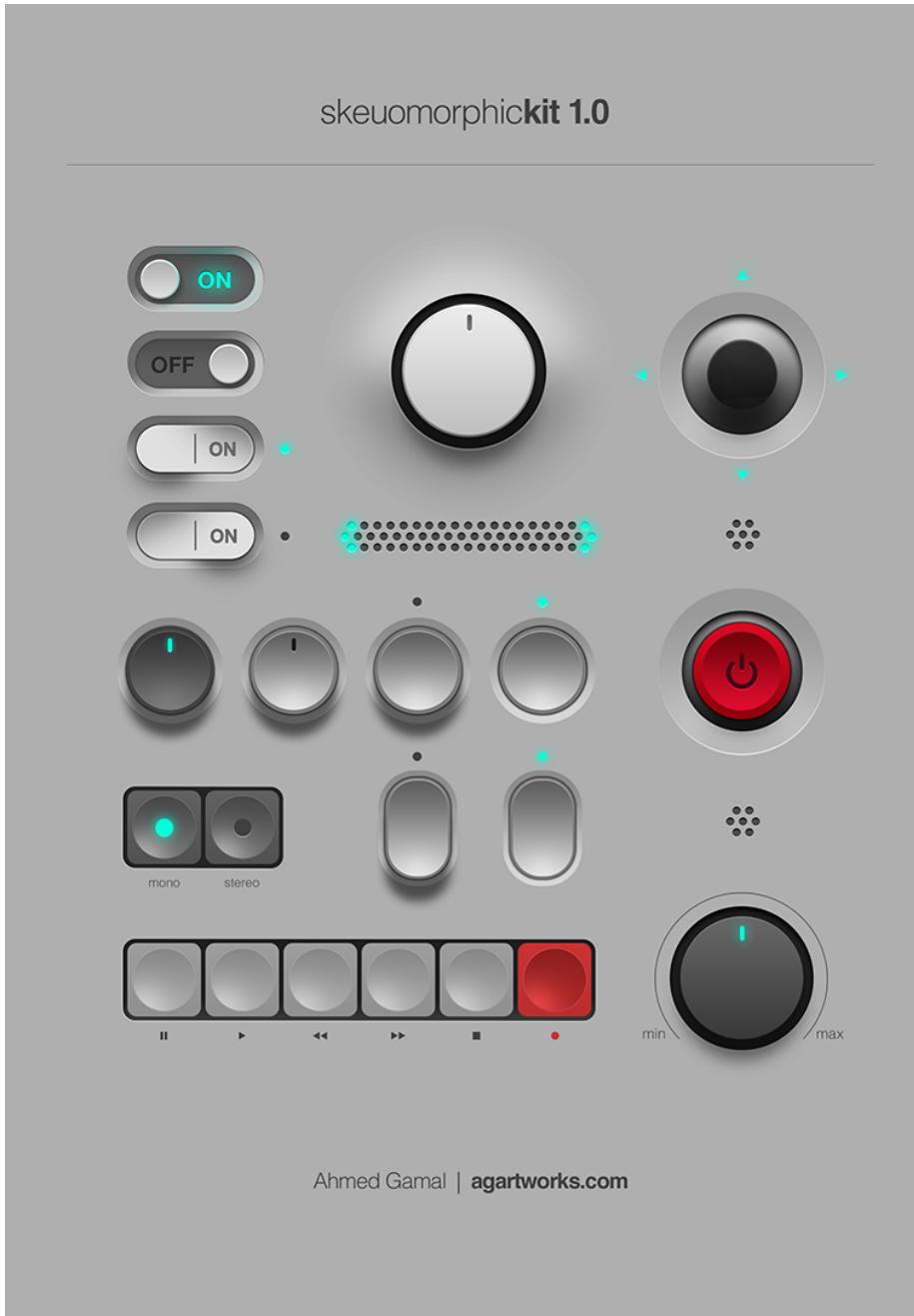
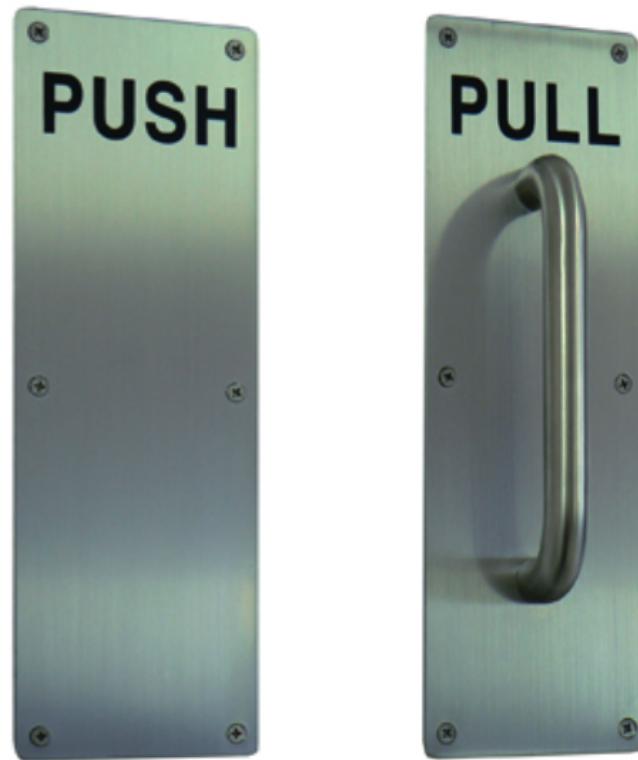


Hidden Affordance: the affordance is not too obvious.





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)

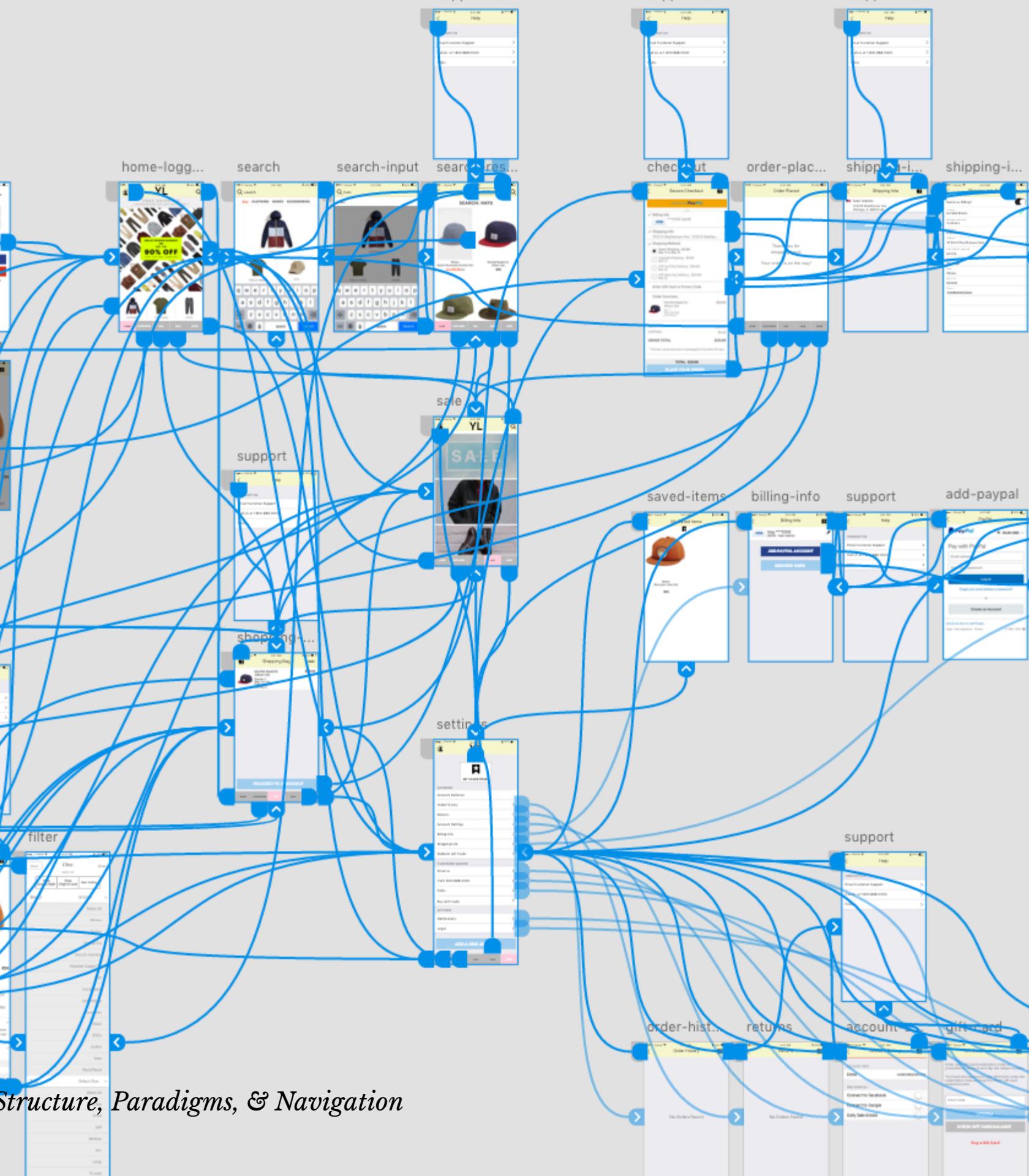
$$\begin{aligned} f^{-1}(x) : & x^2 + 8(4)x + 4(4)^2 \\ y &= x^2 + 8(4)x + 4(4)^2 \\ Y &= x^2 + 32x + 64 \\ Y &= (x+16)^2 - 192 \\ Y+192 &= (x+16)^2 \\ \sqrt{Y+192} &= |x+16| \\ -16 \mp \sqrt{Y+192} &= x \end{aligned}$$

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

Principles of Navigation

Principles of Navigation⁶

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



⁶ 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



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SECURE CHECKOUT

Home & Kitchen ▾



EN

Hello, Sign in

Account & Lists ▾

Orders

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

oom Discover Shop by Style Home Décor Furniture Kitchen & Dining Bed & Bath Ga



ing > Cookware > Cookware Sets

Complete Your Purchase

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If you need help, contact us and let us help you. Support is available for 24 hours.

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1

2

3

4

CART

INFORMATION

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Choose one of the shipping methods below

 Standard Shipping 2-3 Days

\$3.00

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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

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Water

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Sustainability Summary 201

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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



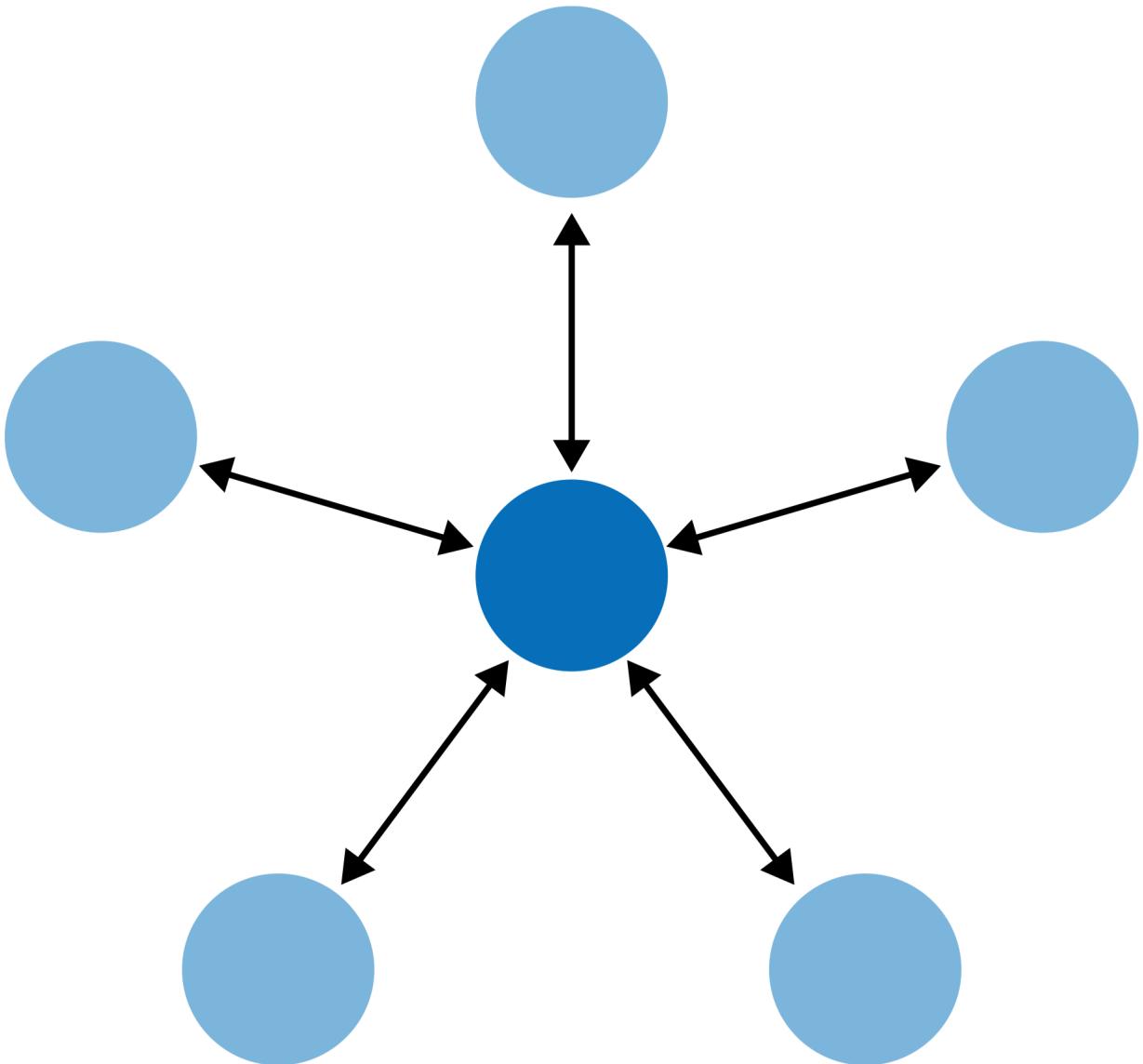
Models

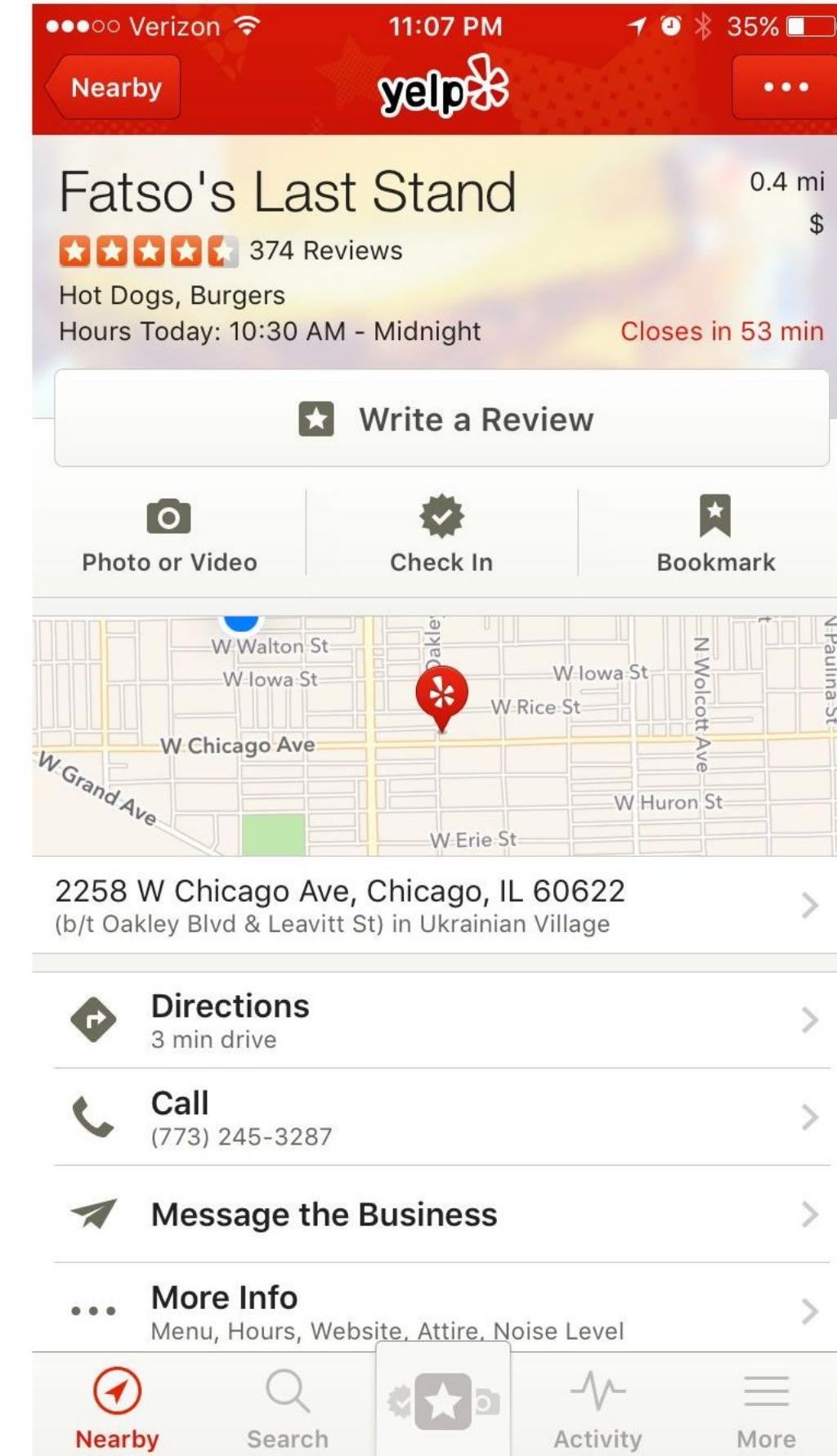
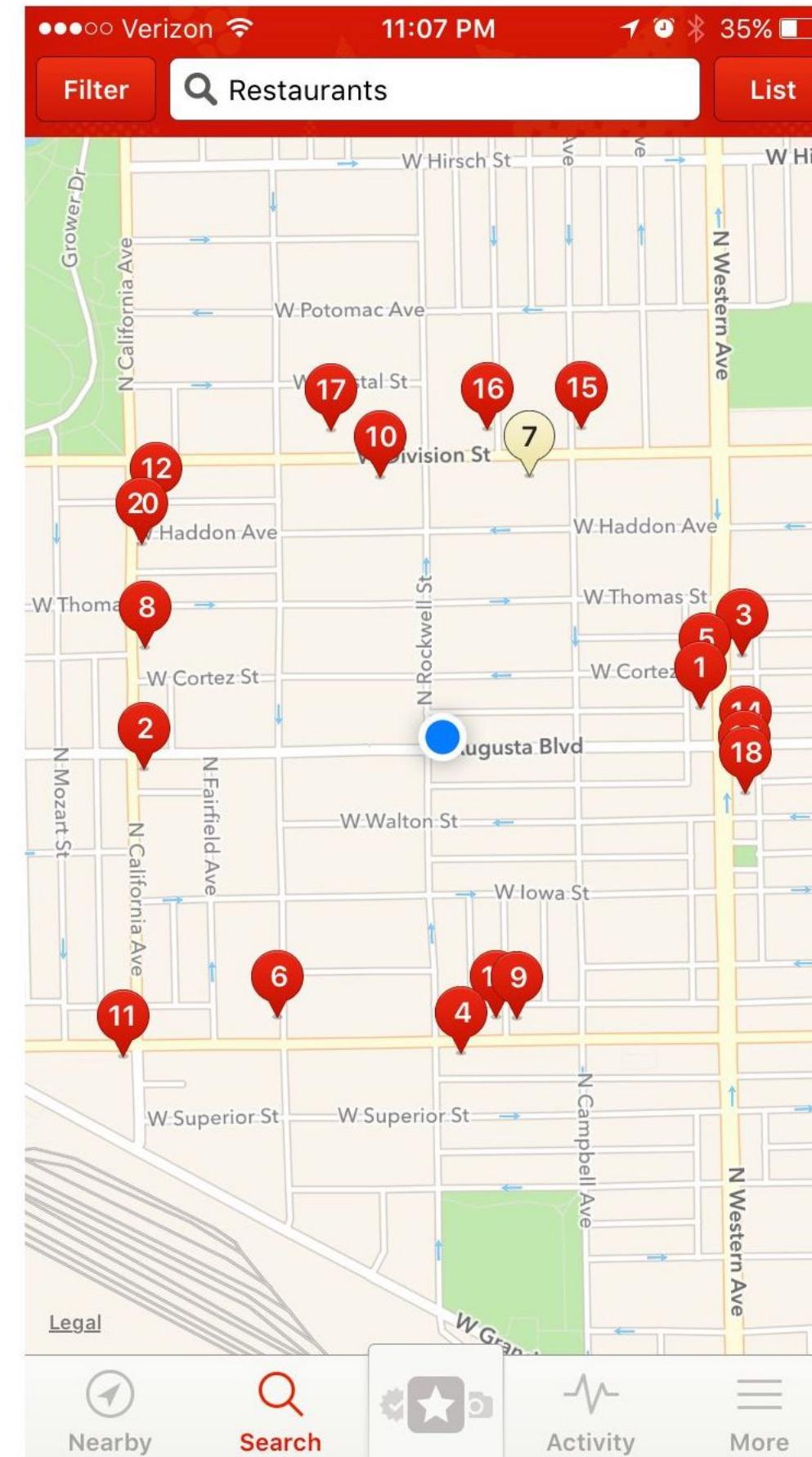
Definition: Commonly used patterns of navigation through interactive applications.

- 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

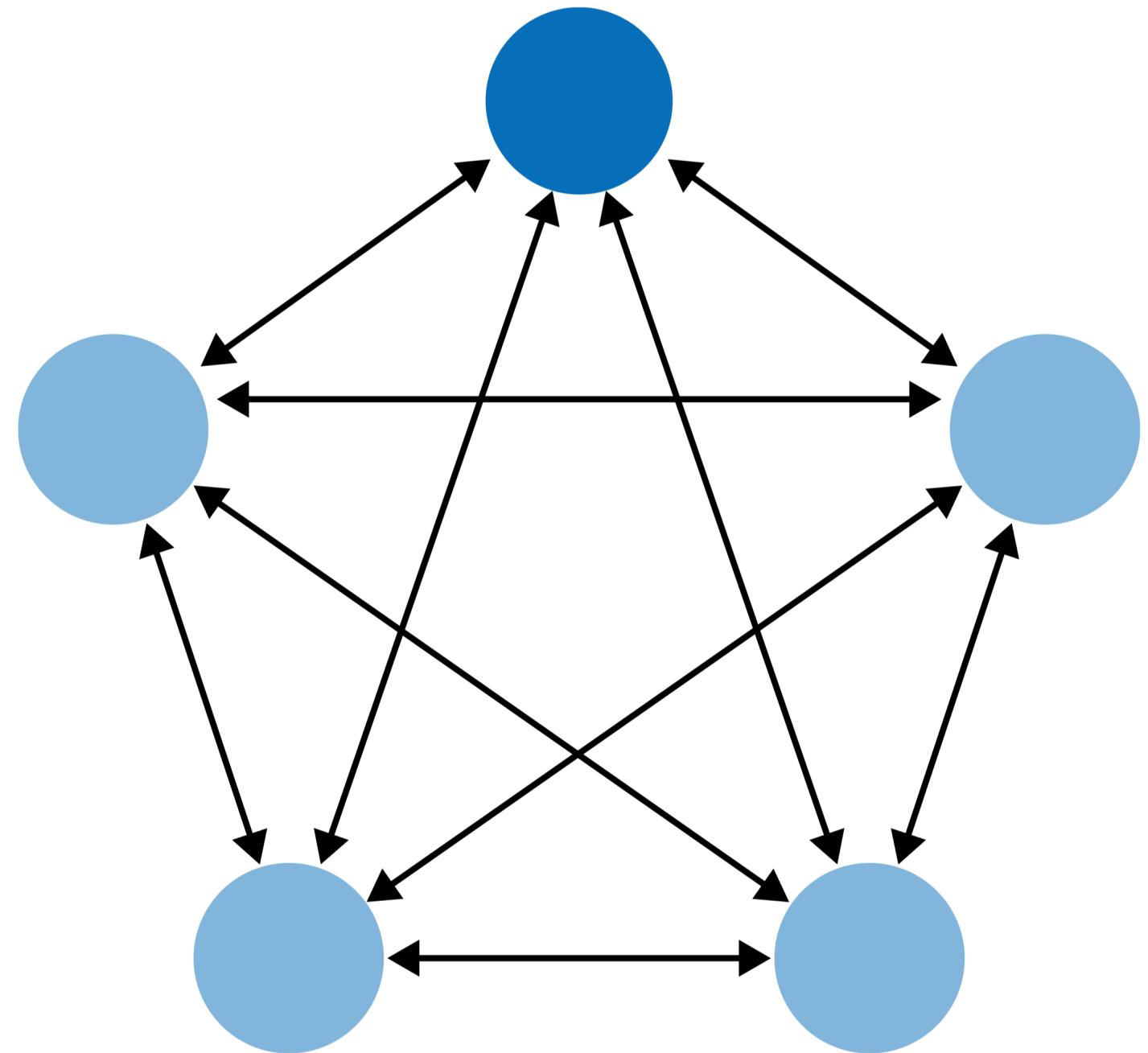
Definition: Involves a central hub, e.g., a home screen, that provides transitions to and from several specialized components.





Models: Fully connected

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





YUHANG ZHAO

Home

Projects

Teaching

Publications & Awards



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Email: yuhang.zhao@cs.wisc.edu

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.

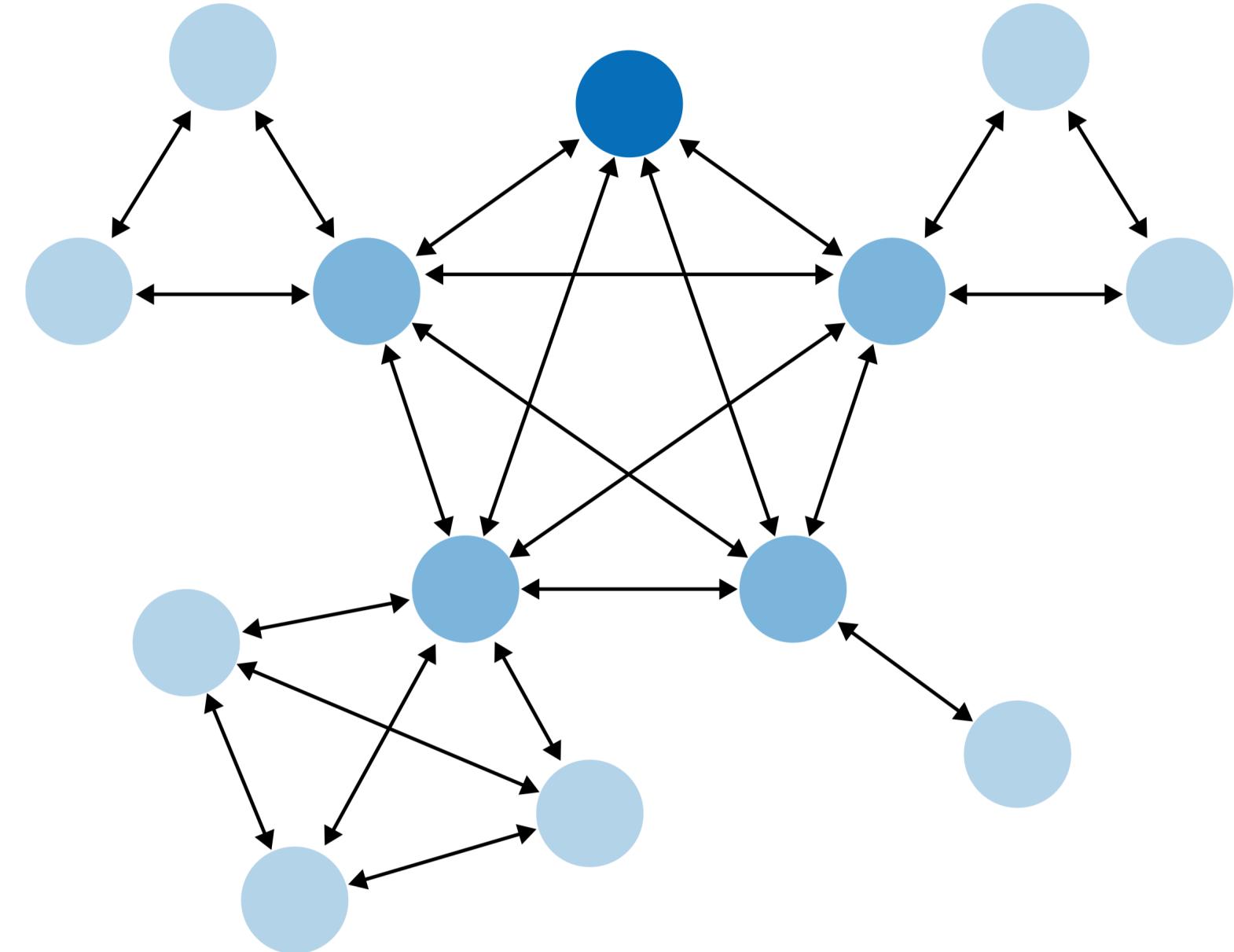
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Models: Multi-level

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

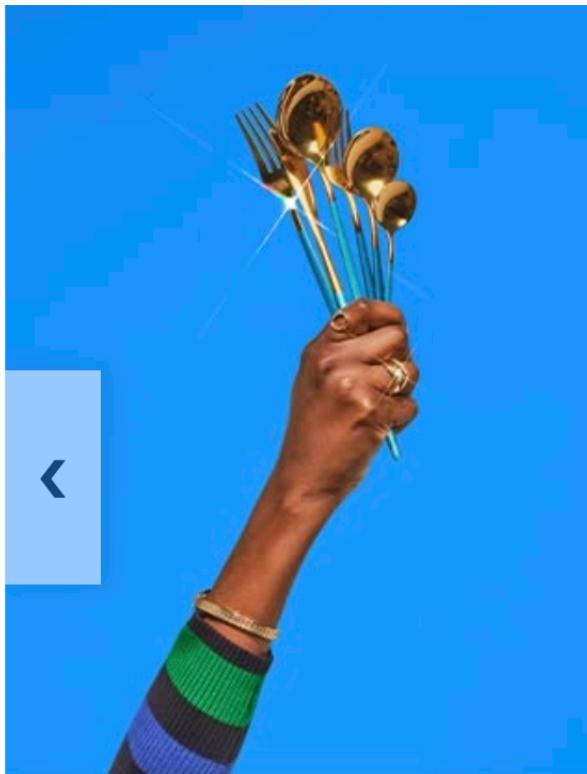
Bed & Bath

Garden & Outdoor

Home Improvement

Amazon Home

New & now



Prime Big Deal Days
Shop epic home savings

Meet Our Newest Innovations
Shop iRobot

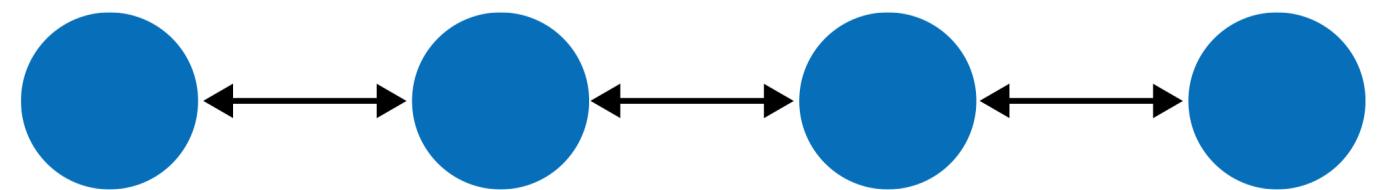
Fall Crafting Must-Haves
Shop now

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? ›](#)

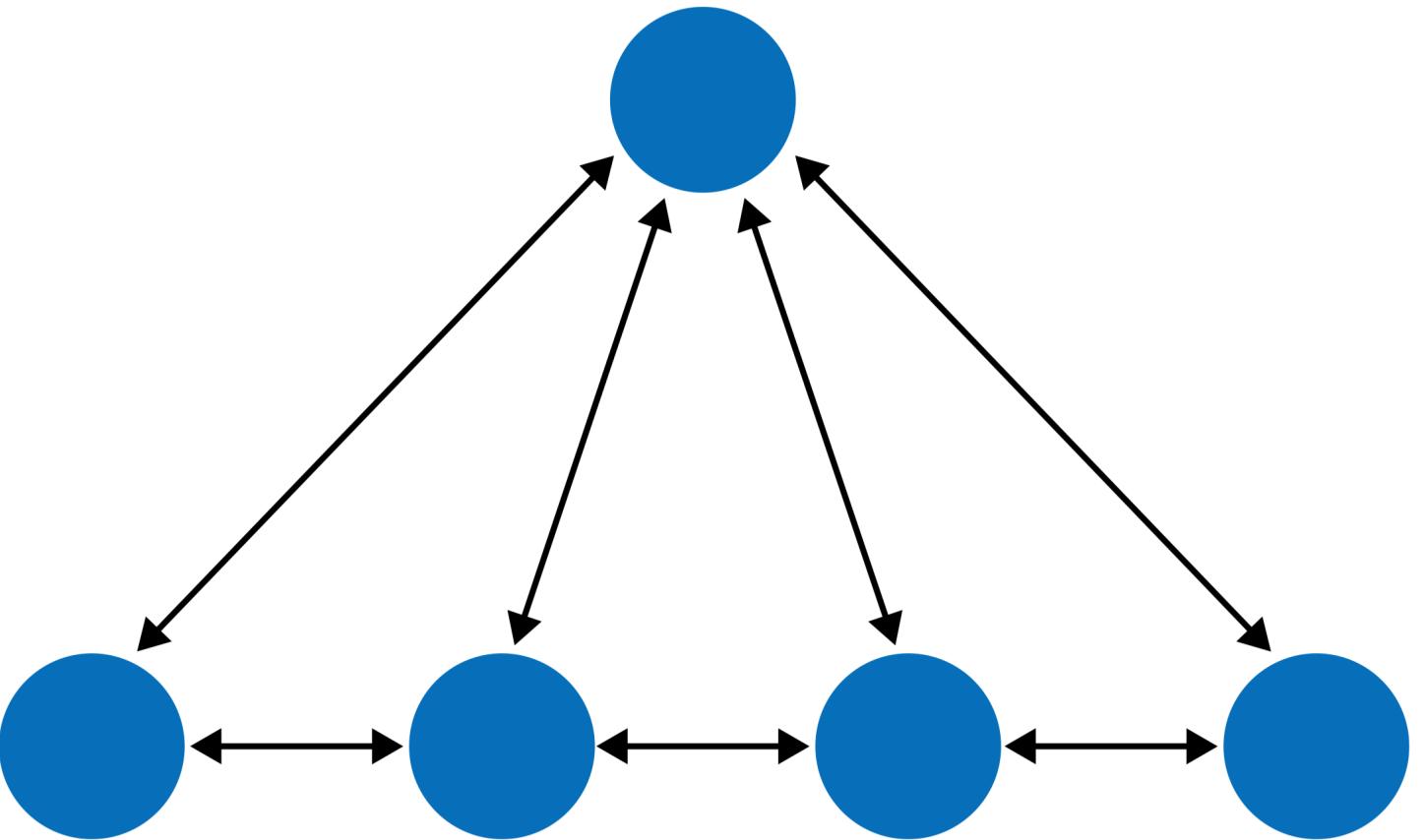
Seller agreement

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:

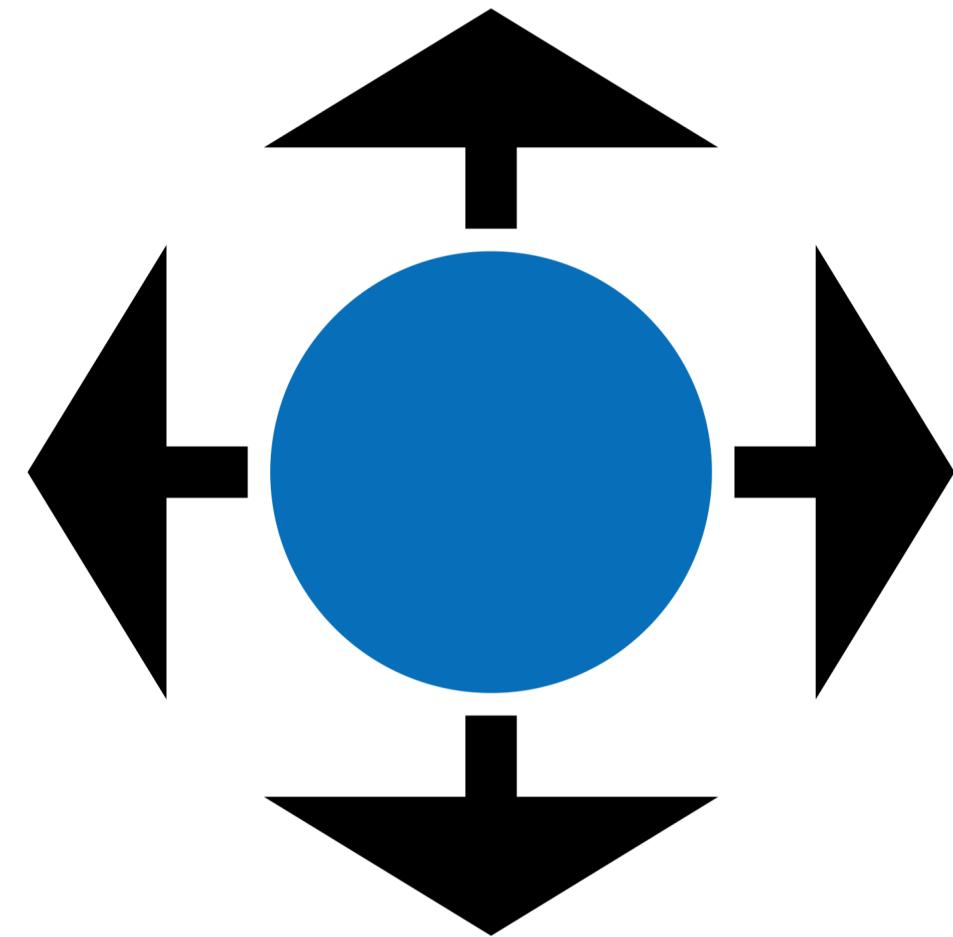
- We'll cover your state requirements
- We'll search for state tax breaks
- We'll help ensure your taxes are accurate

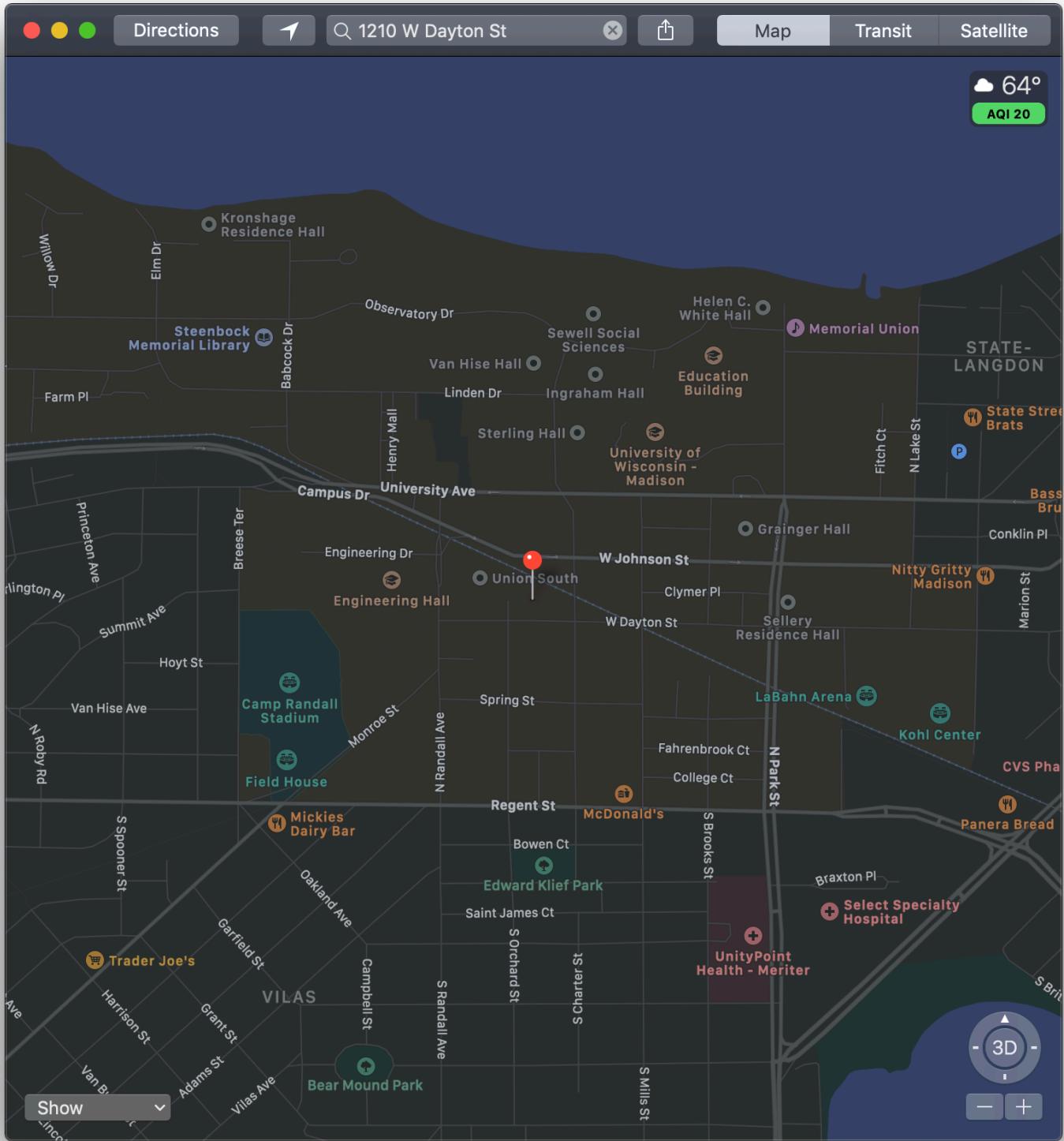
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Models: Pan-and-zoom

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

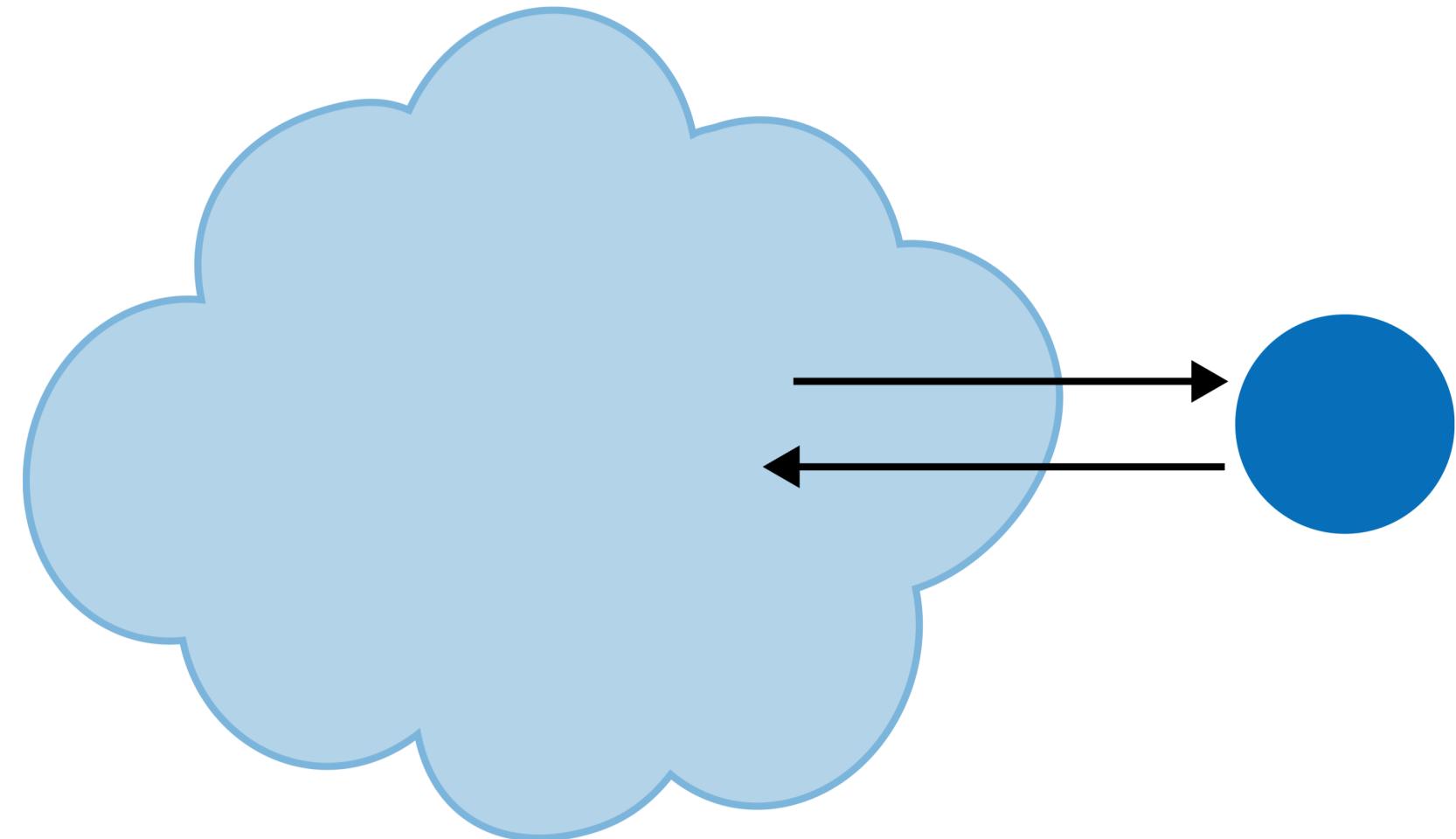
Group

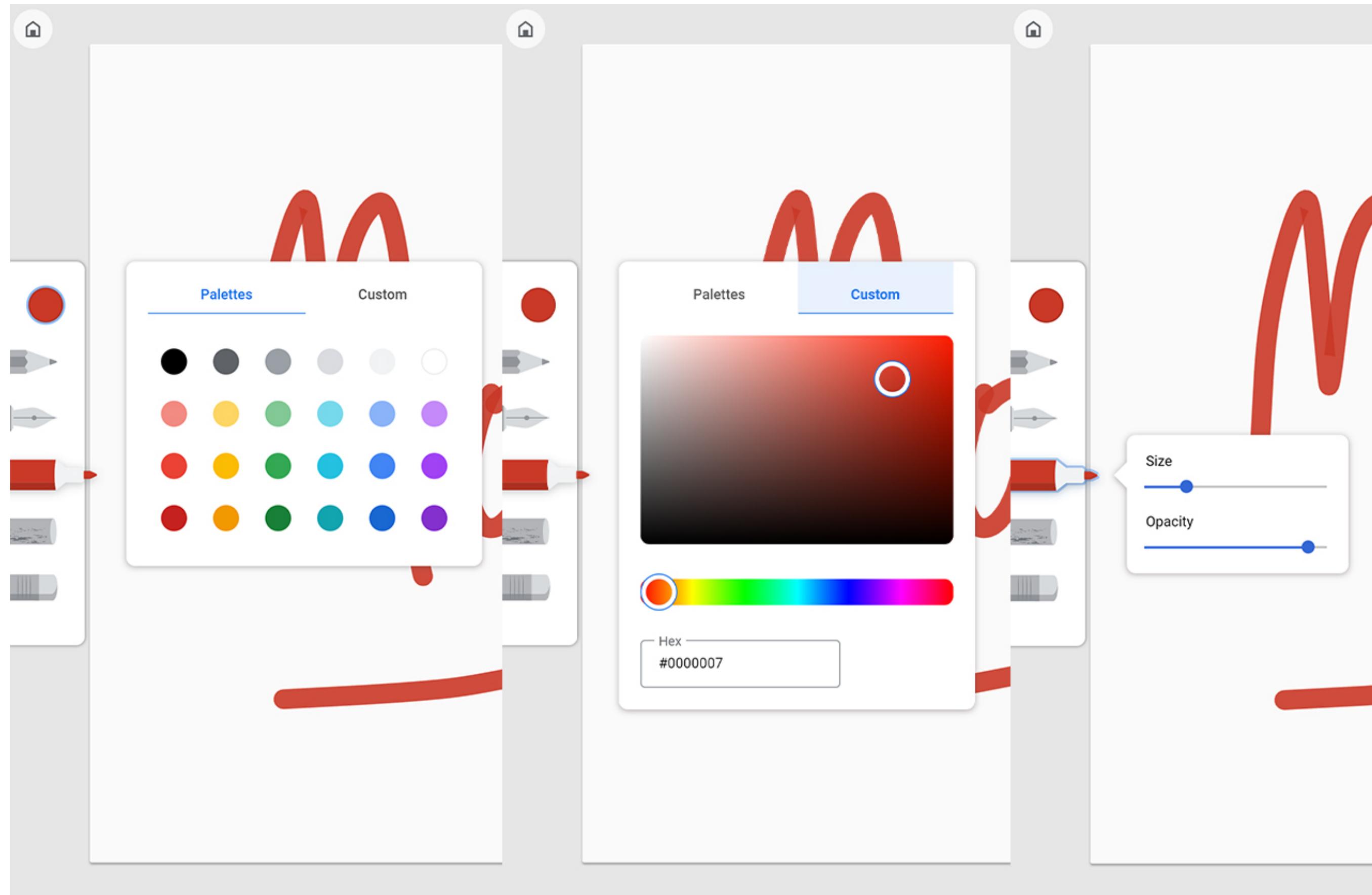
Comments

?

Models: Modal panel

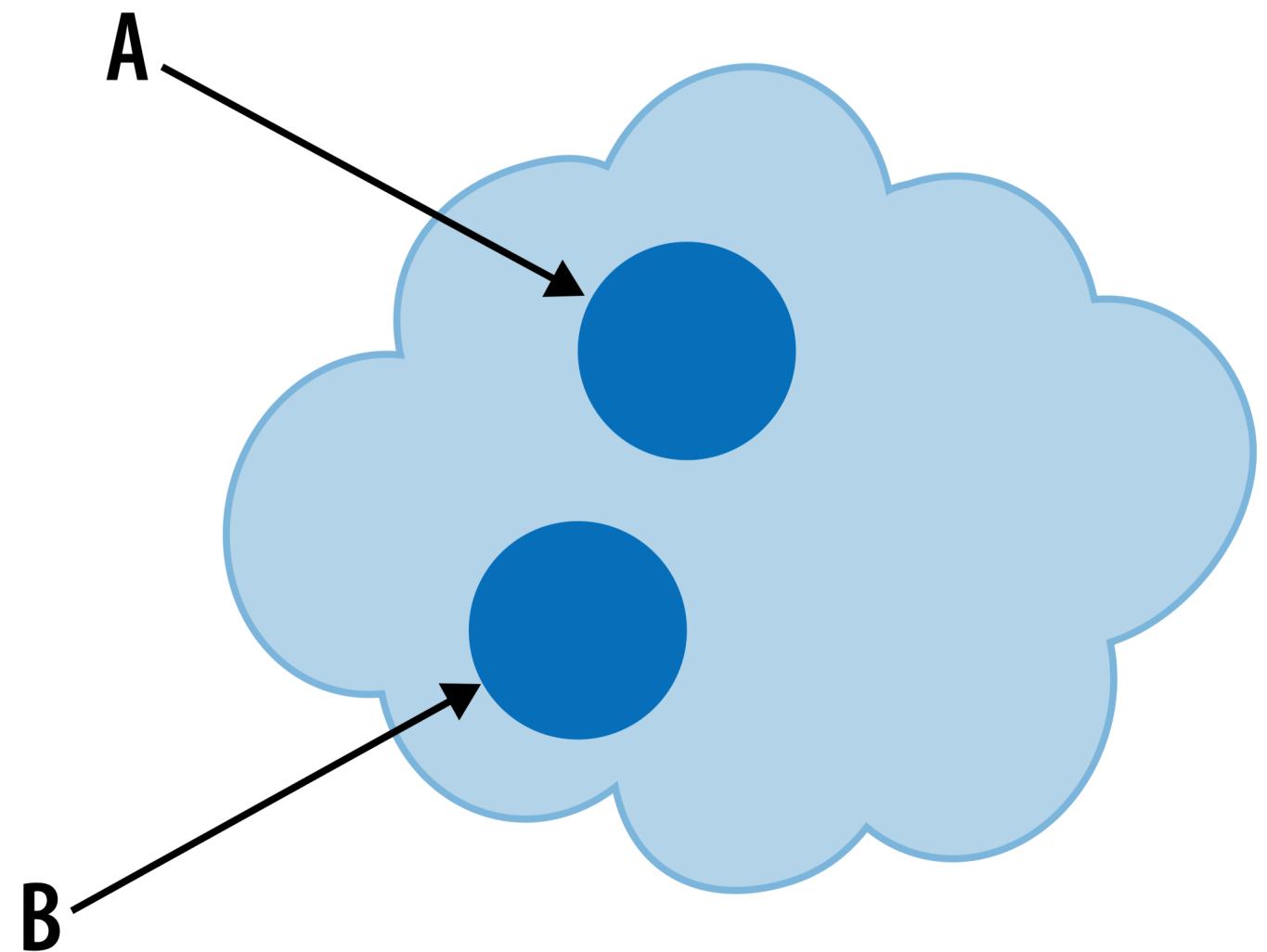
Definition: Follows the flat navigation model except for modal dialogs that are temporarily overlaid on the canvas to help the user perform specific functions.





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

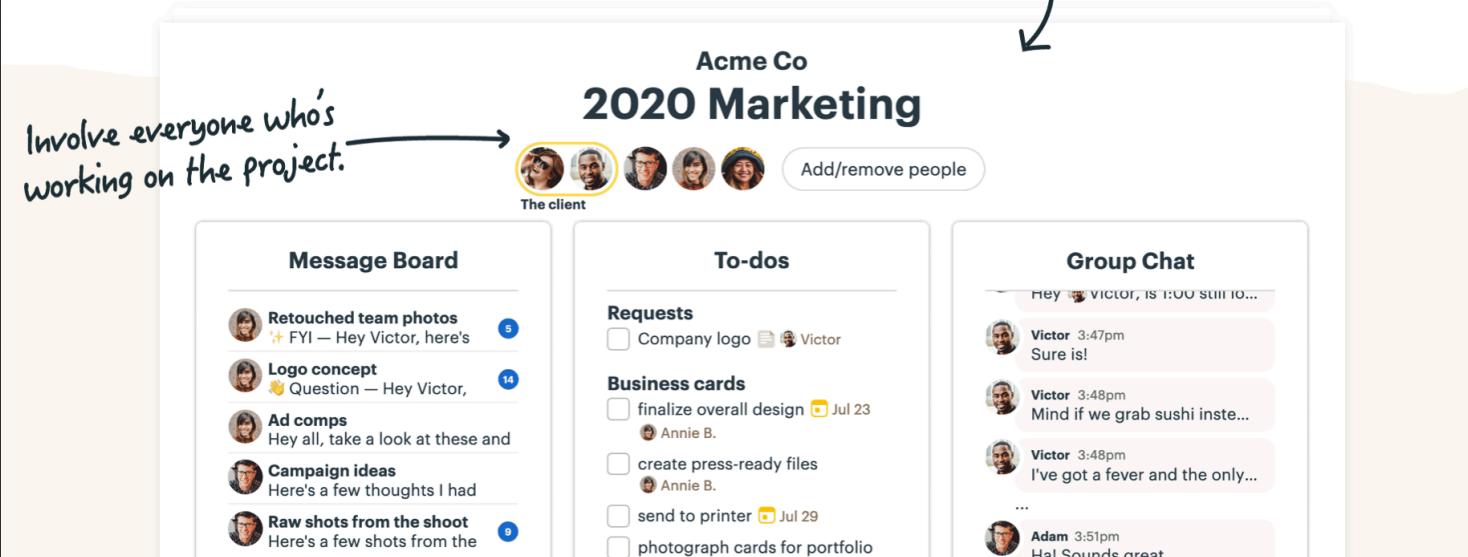
- Retouched team photos FYI — Hey Victor, here's
- Logo concept Question — Hey Victor,
- Ad comps Hey all, take a look at these and
- Campaign ideas Here's a few thoughts I had
- Raw shots from the shoot Here's a few shots from the

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

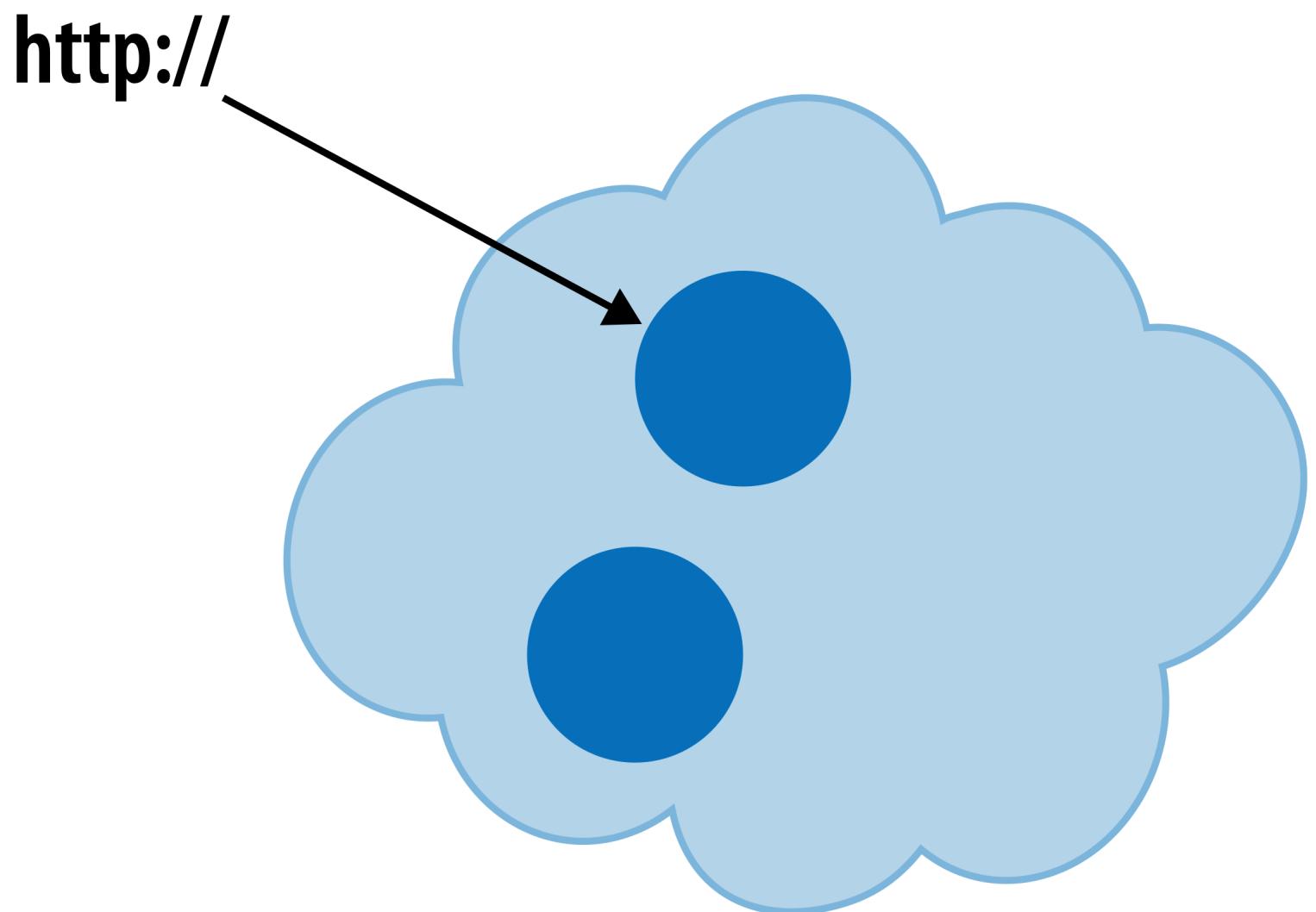
Group Chat

- 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

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

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

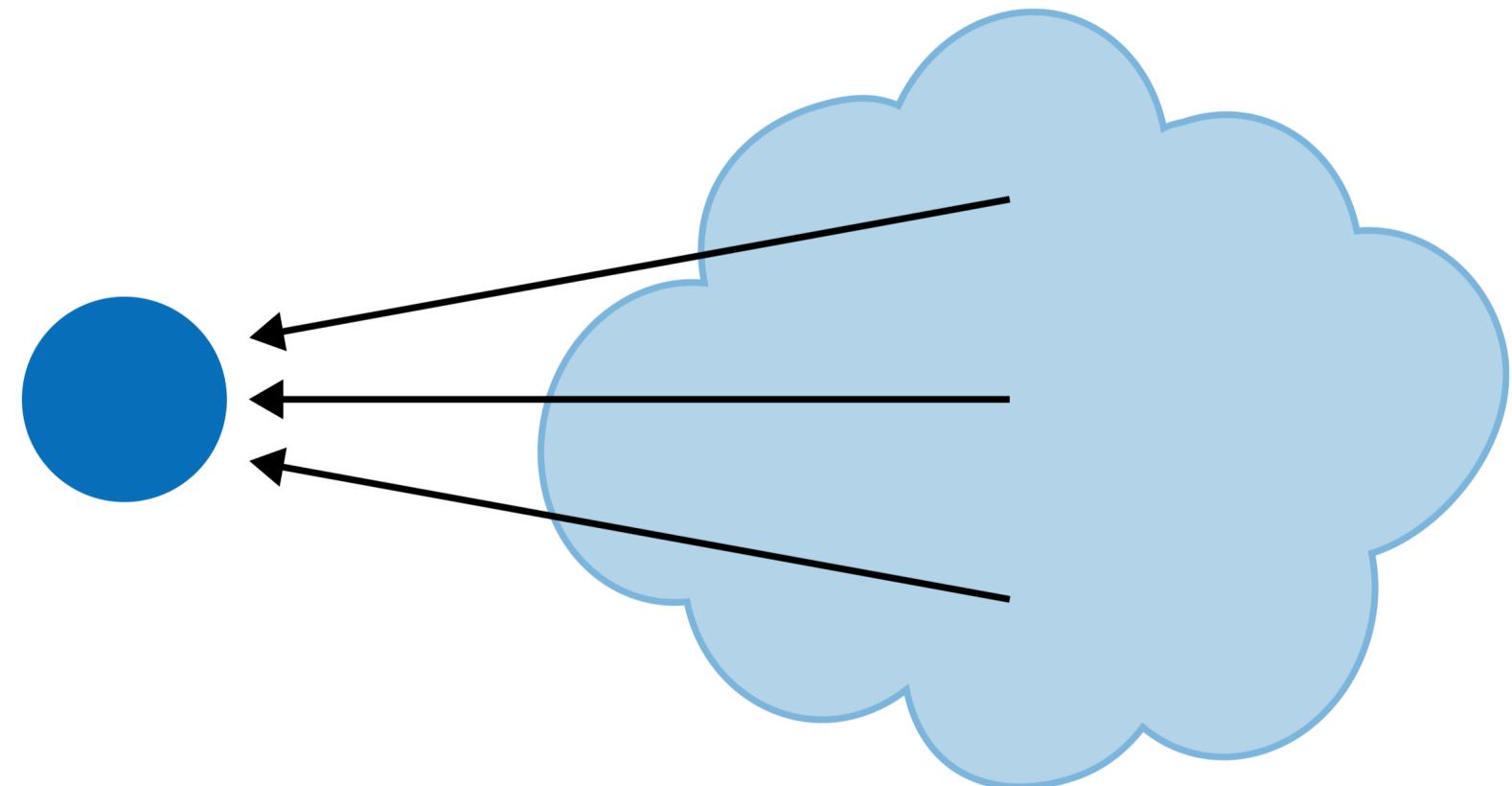
hanged
7 HOURS AGO
570 767

Votre Artisan 24H/7

Table of contents
Bookmarks
Highlights
Notes

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

\$117⁹⁹ - \$119⁰⁰

Save up to 40% on a BodyBoss Home Gym 2.0

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Jennifer Lawrence's wedding registry guide

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Sign in securely

Today's deals under \$25 See all deals

WHERE DR TOBIAS ANKER

The Amazon homepage features a prominent advertisement for the All-new blink XT2 smart camera. The camera is shown against a blue background. Below the camera, there are three icons: a white circle with a 'Q' for 'Works with Alexa', a battery icon for '2-year battery life', and a speaker icon for '2-way audio'. To the left, a 'Deal of the Day' section highlights the BodyBoss Home Gym 2.0 at a discounted price of \$117.99 - \$119.00, with a note that savings up to 40% are available. To the right, a 'Jennifer's gift picks' section features a portrait of Jennifer Lawrence. A sign-in prompt 'Sign in for the best experience' with a 'Sign in securely' button is located on the right side. At the bottom, there's a 'Today's deals under \$25' section with links to various products like WHERE, DR TOBIAS, and ANKER.

apple.com

Mac iPad iPhone Watch TV Music Support

iPhone 11 Pro

Pro cameras. Pro display. Pro performance.

From \$24.95/mo. or \$599 with trade-in.*

Learn more > Buy >

The Apple homepage features a large image of the iPhone 11 Pro with water splashes around it. The text 'iPhone 11 Pro' is displayed in a large, bold font. Below it, the tagline 'Pro cameras. Pro display. Pro performance.' is followed by the price information 'From \$24.95/mo. or \$599 with trade-in.*'. There are also 'Learn more >' and 'Buy >' buttons. The top navigation bar includes links for Mac, iPad, iPhone, Watch, TV, Music, and Support.

iPhone 11

Just the right amount of everything.

From \$16.62/mo. or \$399 with trade-in.*

ICA D: Interaction Design

Use Figma to create an interconnected navigation experience!

What did we learn today?

- Interaction Paradigms
- Principles of navigation