UI/UX Fundamentals for LabVIEW

A practical approach to UI/UX for scientific and engineering applications

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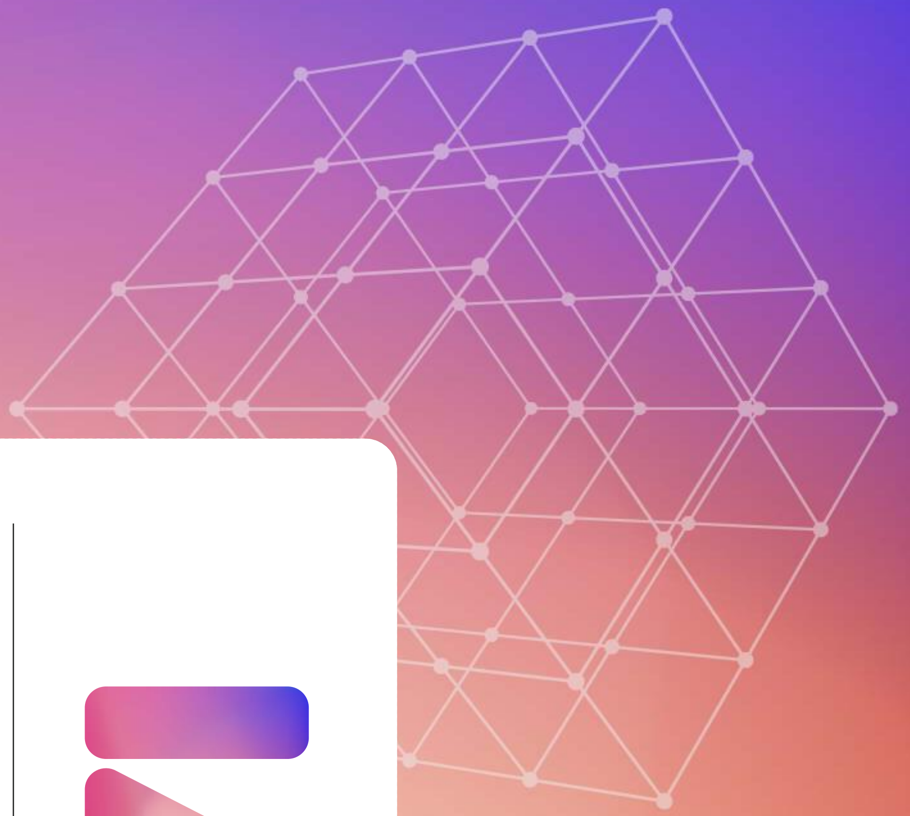
Software Architect

VI TECHNOLOGIES



Dr. Gladys West, PhD

Mathematician & Programmer

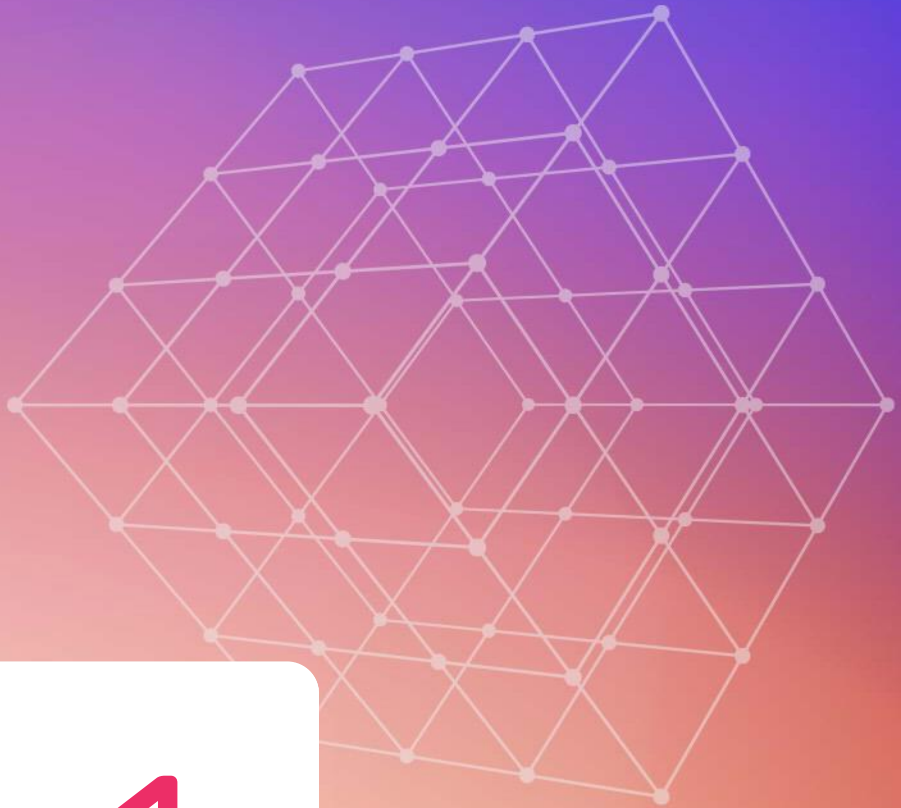
#OurGiantsAreFemale

- Born in 1930 in rural Virginia, USA (Jim Crowe)
- Parents were sharecroppers
- Studied Mathematics at Virginia State College (now University)
- Hired at Naval Surface Warfare Center as a programmer and project manager
- Analyzed data from satellites
- Wrote programs to calculate precise models of the shape of the earth – the geoid
- Her data became the basis for GPS
- Inducted into US Air Force Hall of Fame in 2018

Image: Wikimedia Commons

Disclaimer

- I am a software architect, not a designer
- I have a lot of opinions about design.
- You don’t need to agree with me
- This talk covers a lot of theory
- It’s a crash-course
- You should probably just hire a professional designer



User Experience

1

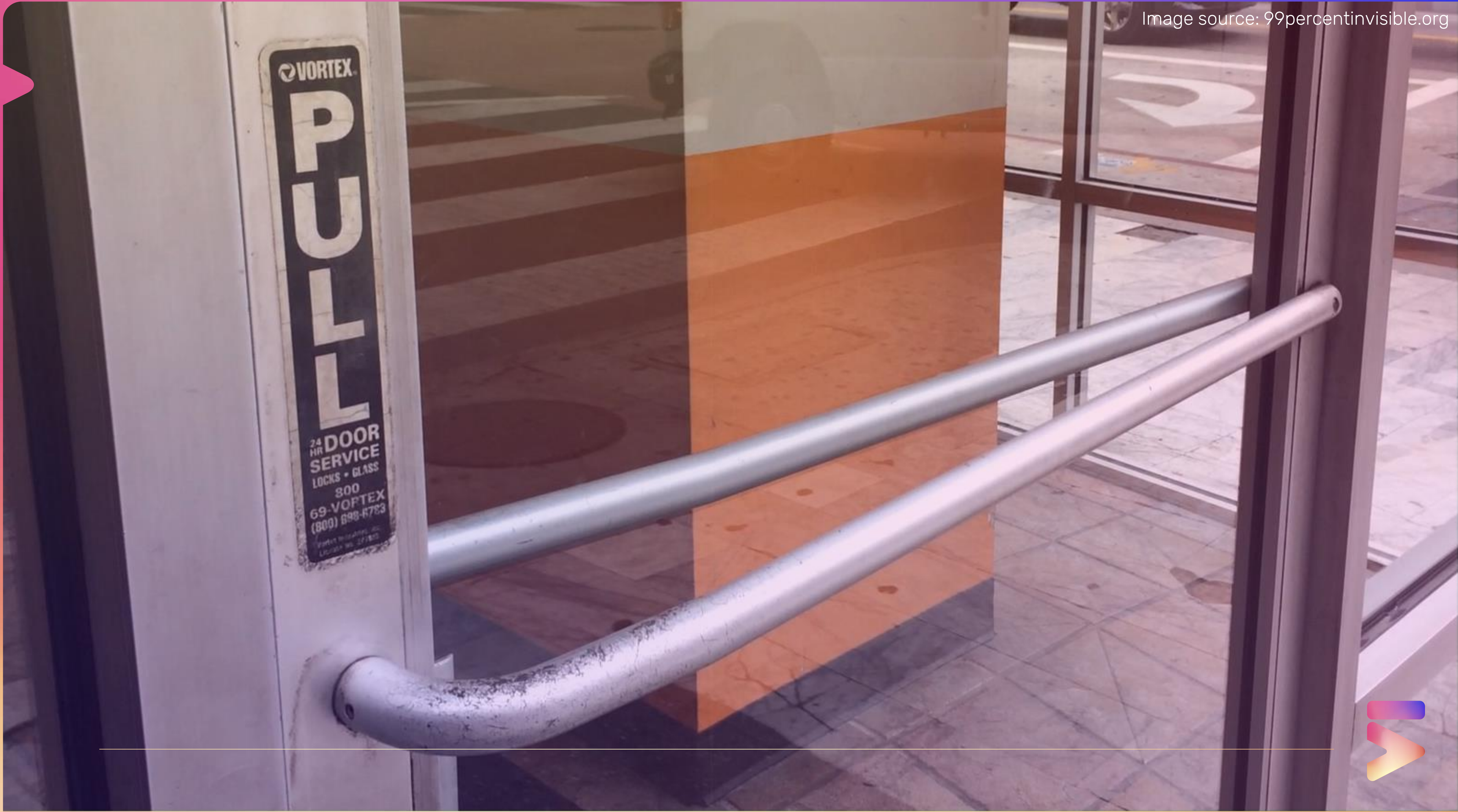
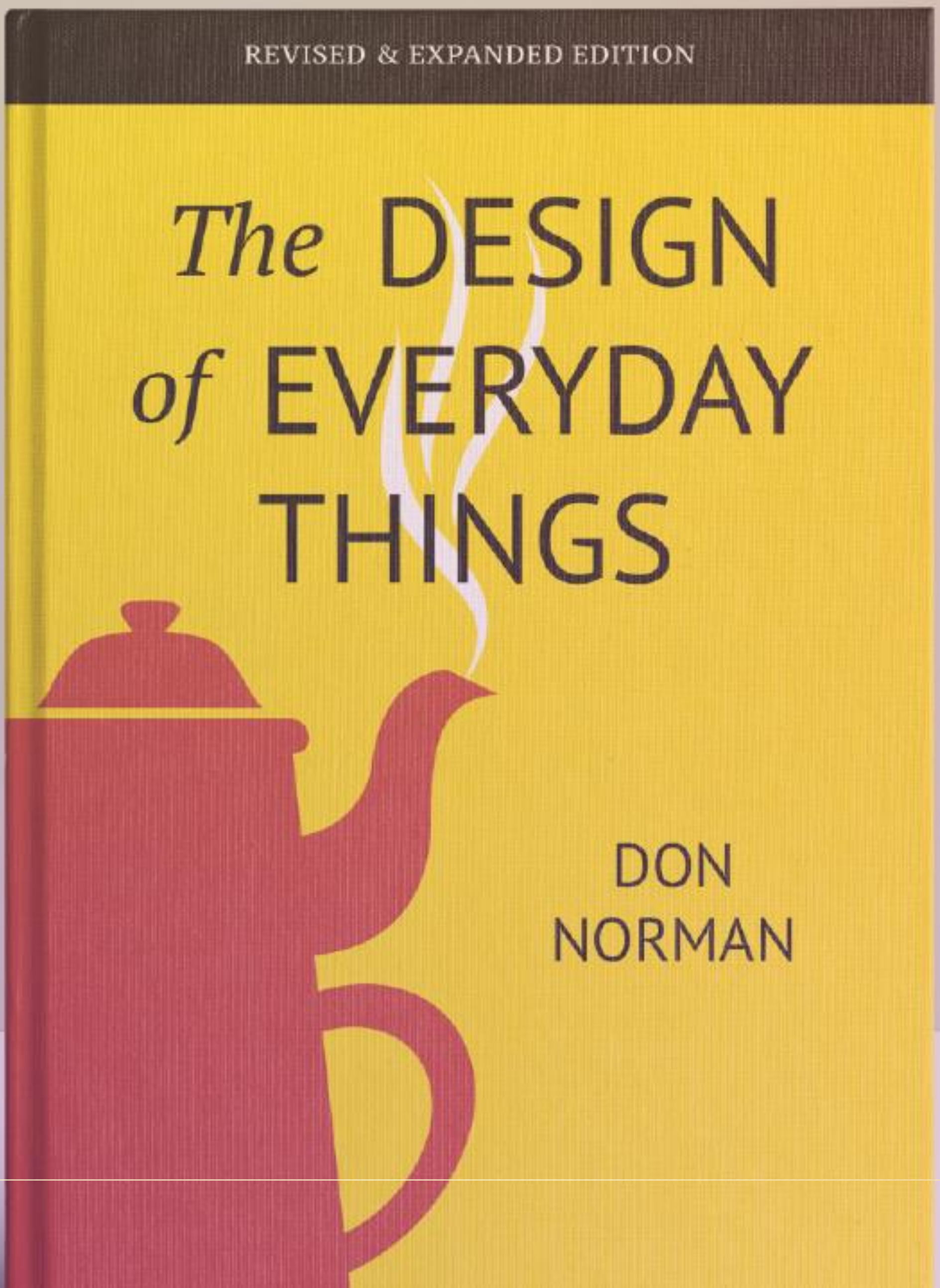


Image source: 99percentinvisible.org

Norman door (n.):

1. A door where the design tells you to do the opposite of what you’re actually supposed to do

2. A door that gives the wrong signal and needs a sign to correct it


REVISED & EXPANDED EDITION
The DESIGN of EVERYDAY THINGS
DON NORMAN

What is Usability?

- Learnability
- Efficiency
- Memorability
- Errors
- Satisfaction

What is UX

All aspects of the end-user’s experience interacting with an object*

*Could be software, a company, a service, a door, etc.

What is UX

All aspects of ~~the end-user~~'s experience interacting with an object*

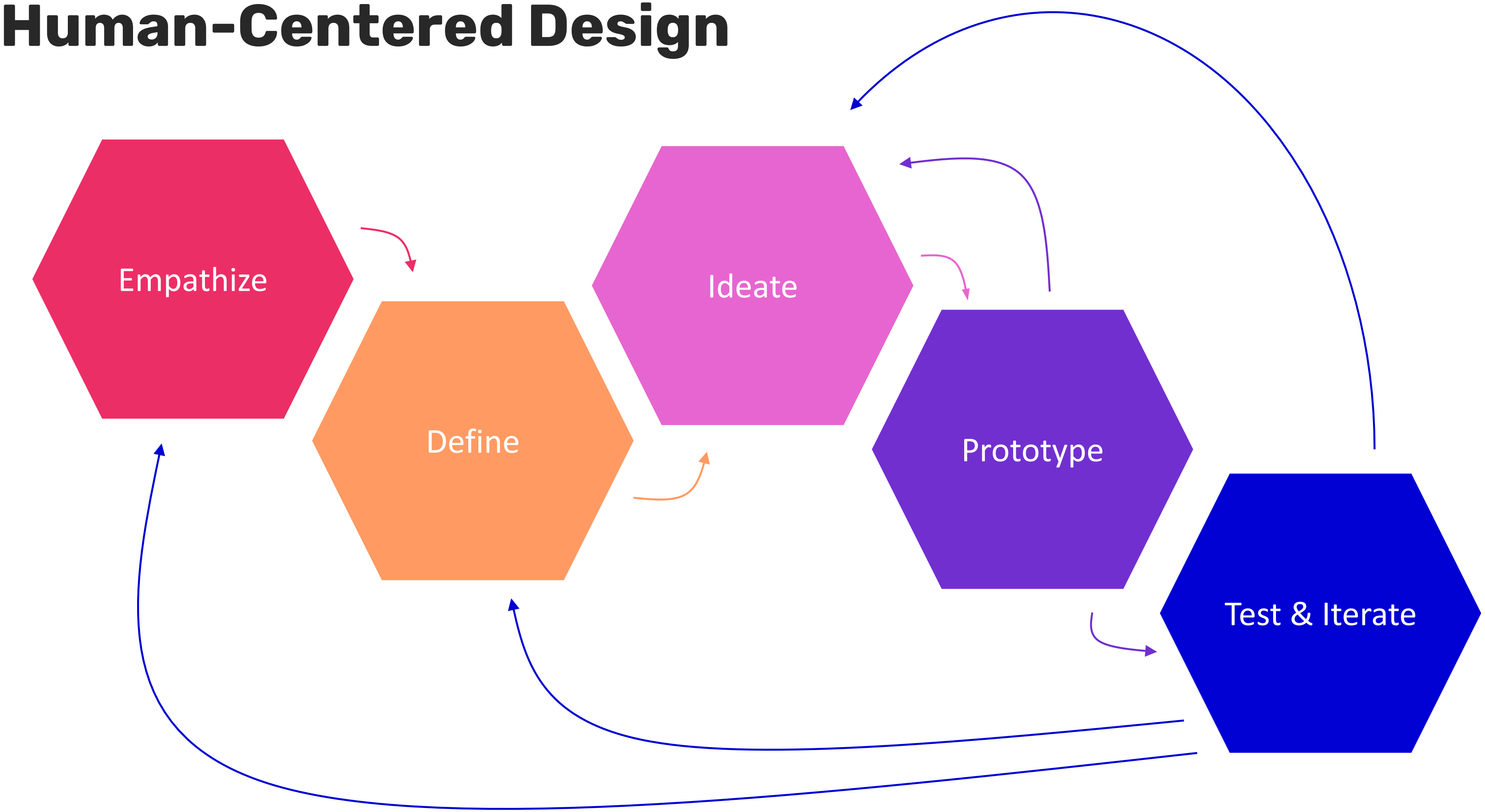
*Could be software, a company, a service, a door, etc.

What is UX

All aspects of **a person’s** experience interacting with an object*

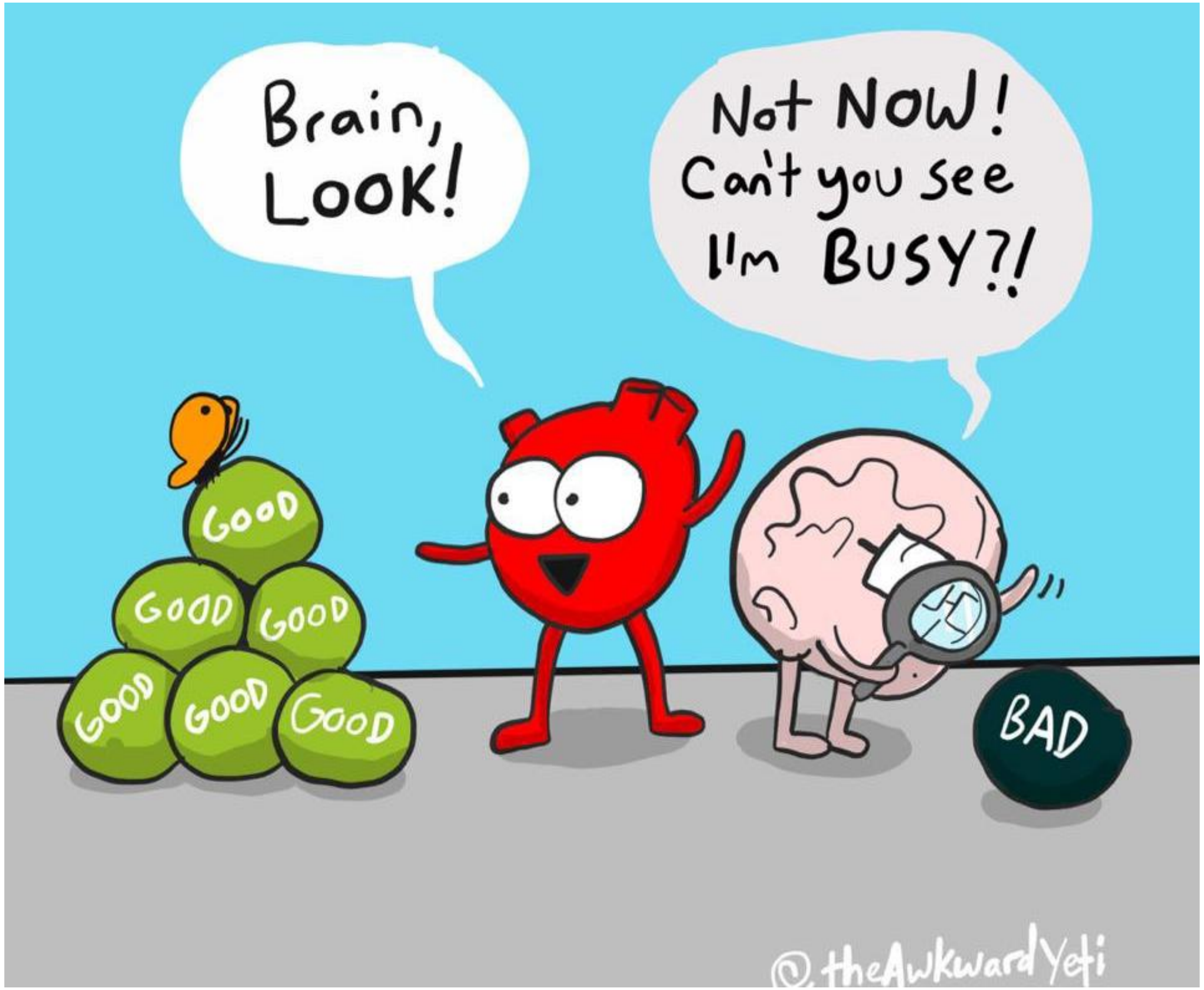
*Could be software, a company, a service, a door, etc.

Human-Centered Design



Negativity Bias

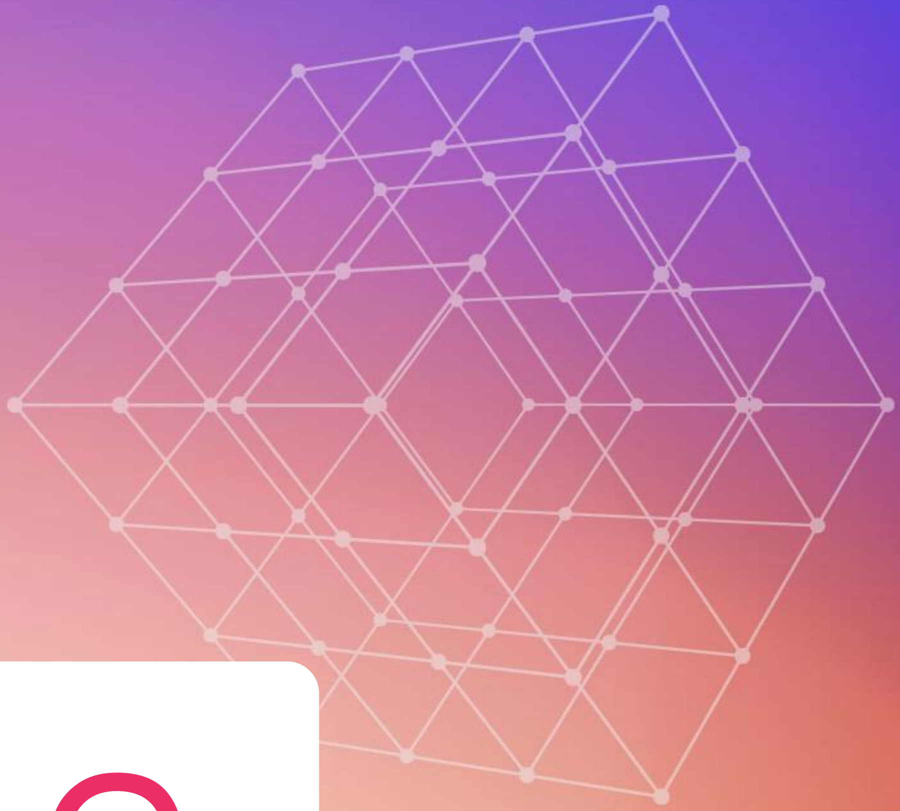
- Our brains automatically give more weight to negative experiences than positive ones
- One flaw in usability can make the whole UX feel unpleasant
- Good design is invisible



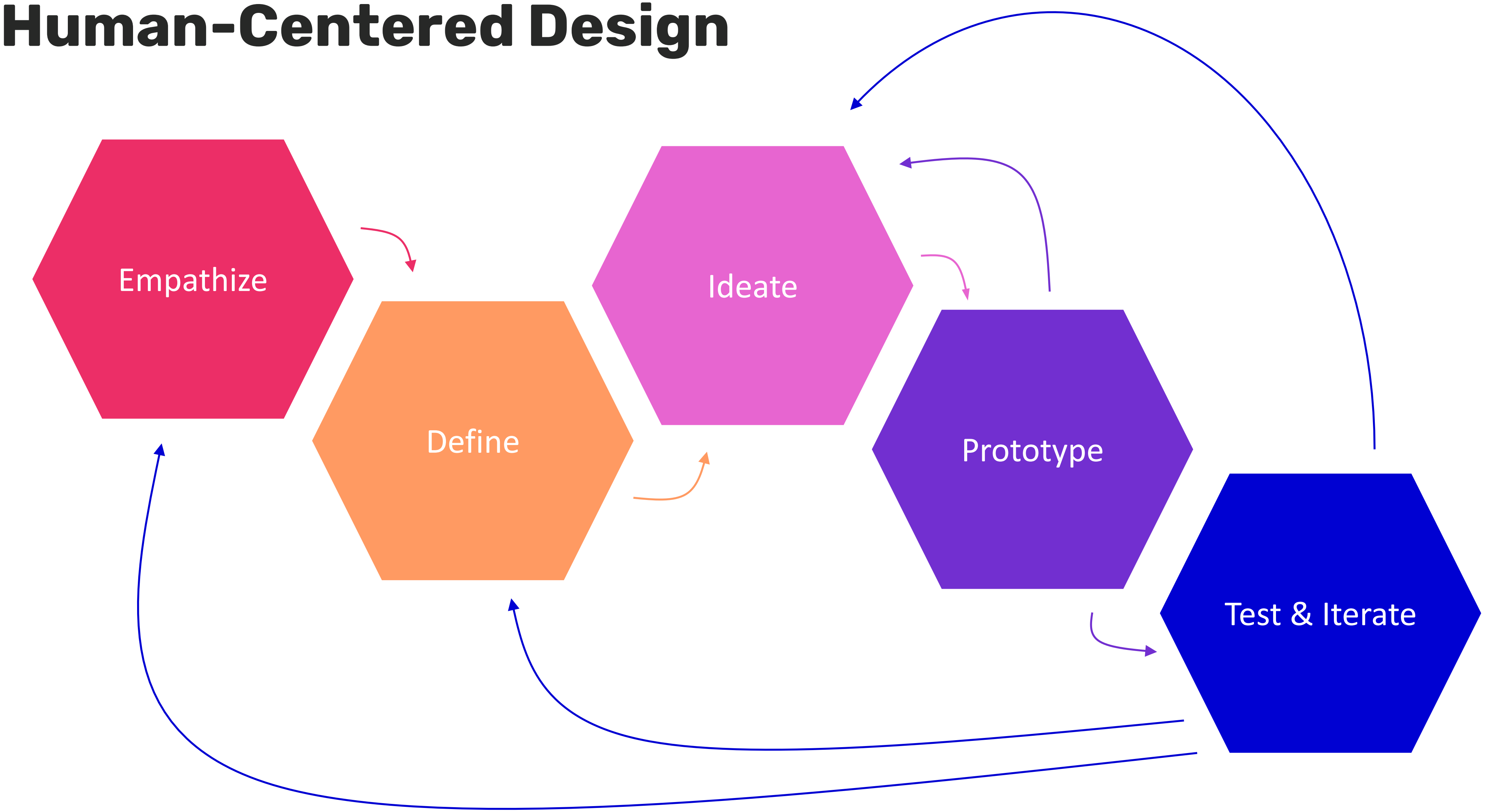
Tools for UX

2

Thinking about Workflow



Human-Centered Design



Empathize

Define

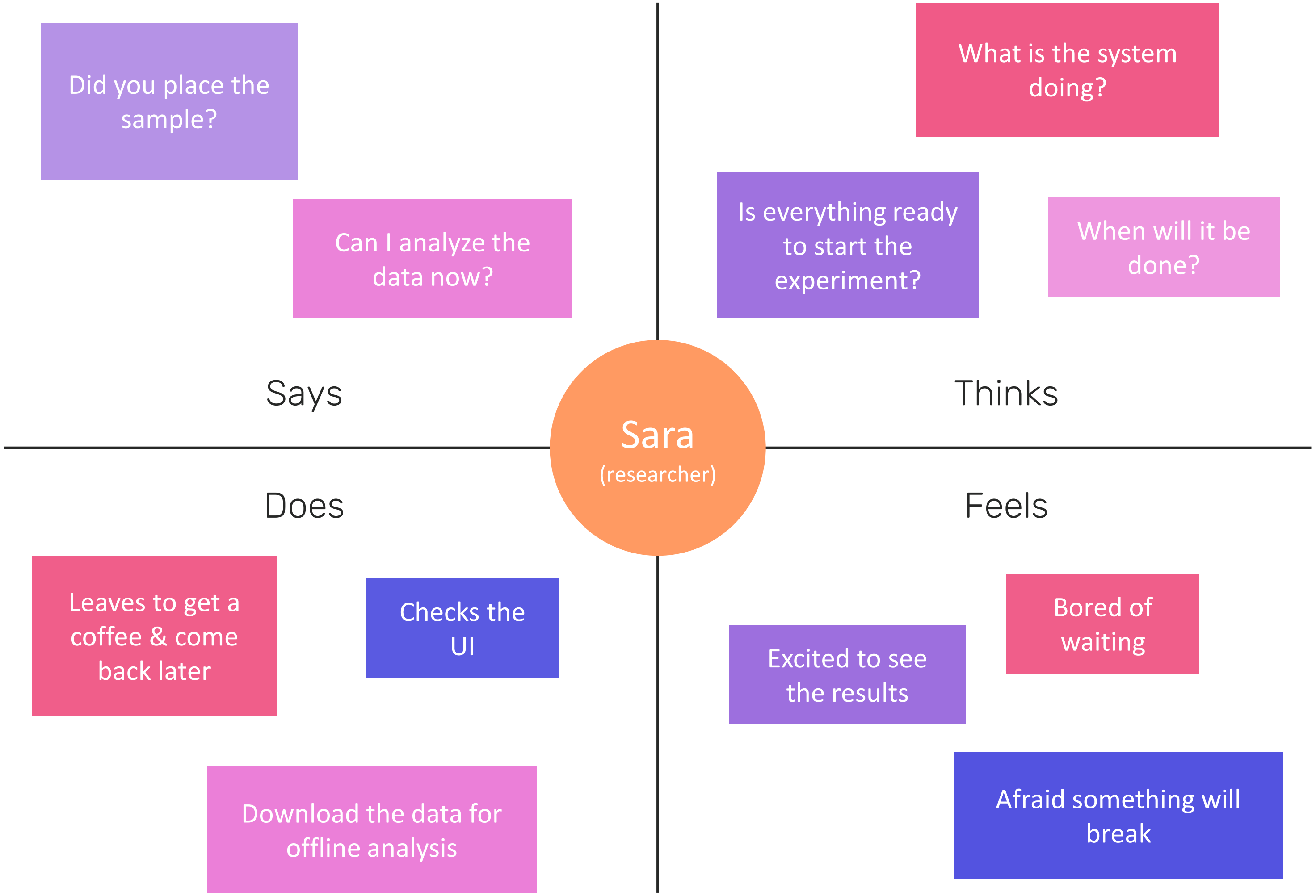
Ideate

Prototype

Test & Iterate

Empathy Mapping

- Who is using this software?
- Make a map for each type of user
- Understand their perspective


Did you place the sample?
Can I analyze the data now?
What is the system doing?
Is everything ready to start the experiment?
When will it be done?
Says
Sara
(researcher)
Thinks
Does
Feels
Leaves to get a coffee & come back later
Checks the UI
Download the data for offline analysis
Bored of waiting
Excited to see the results
Afraid something will break

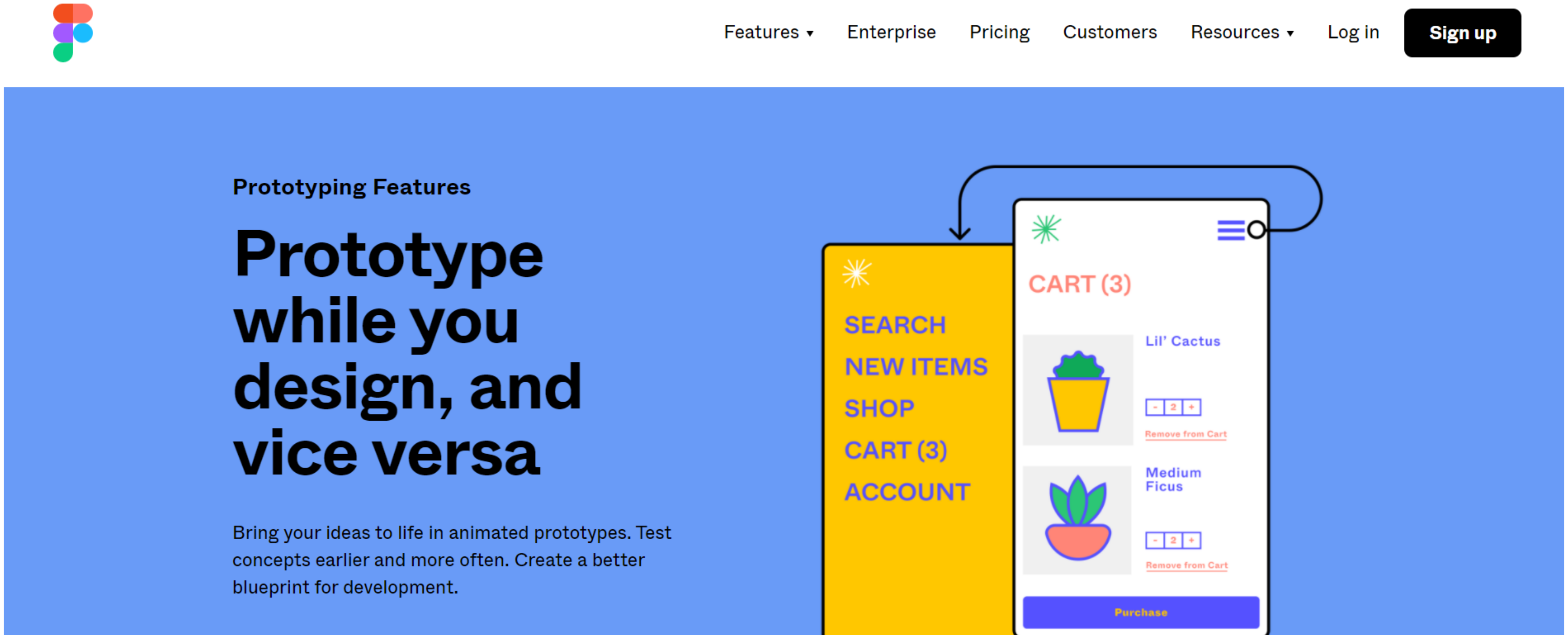
User Stories

- As a [Type of User] I want to [goal] so that [benefit]
- Commonly used with Agile projects
- Examples:
  - As an **operator**, I want to **load an experiment** so that I can **run it**
  - As an **operator**, I want to **view the status of an ongoing experiment** so that I can **know what it is doing**
  - As an **operator**, I want to **view the time remaining in an experiment** so that I can **know how long I have to drink coffee before it finishes**
  - As a **researcher**, I want to **load the data from a previous experiment** so that I can **analyze it**

Wireframes

- Page schematic
- Which elements will go where and how to navigate between screens
- Shows which functions are available
- Rules for displaying certain information
- Used for rapid prototyping – are often interactable
- Very useful for testing

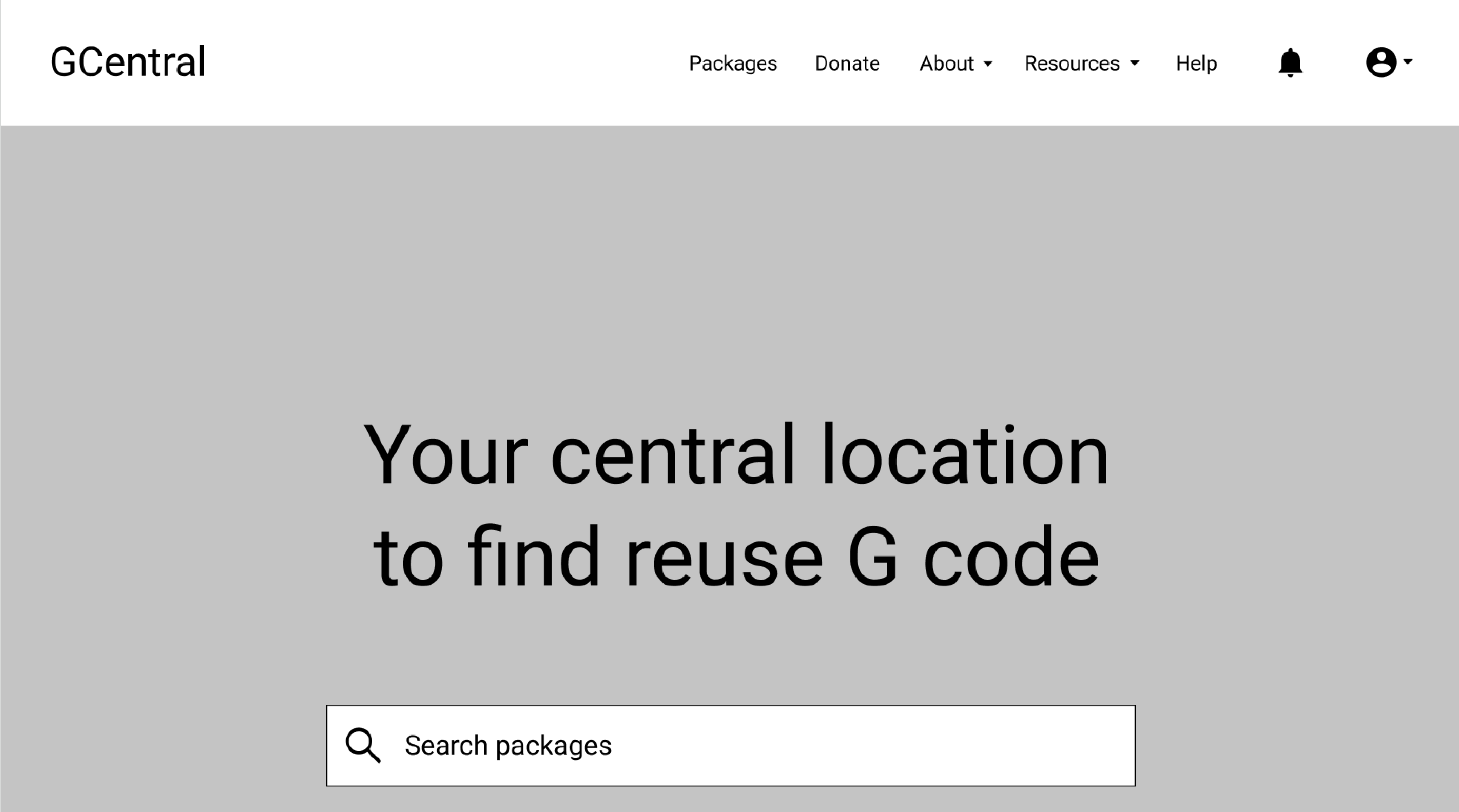
Figma is my favorite tool for Wireframe



Prototyping Features

Prototype while you design, and vice versa

Bring your ideas to life in animated prototypes. Test concepts earlier and more often. Create a better blueprint for development.



Your central location to find reuse G code

Usability testing

- Get representative users to perform the tasks they need to do with the software
- The goal is to understand what the problem is and how to solve that
- Observe how they do it – “shut up and let them do the talking”
- Pay attention to interaction cost

Image: hotjar.com

10 Usability Heuristics

From Jakob Nielsen

1. Visibility of system status

The status of the system
and all relevant information
should be at-a-glance visible
within reasonable time

2. Match between system and the real world

- Use words familiar to the user
- Not system-oriented terms
- Show information in an order that feels natural to the user

3. User control and freedom

- Give an “Emergency Exit” if in unwanted state (without extended dialog)
- Undo and redo

4. Consistency and standards

- Always use consistent terminology and patterns throughout the platform

5. Error prevention

- A good design that prevents errors is better than a good error message

6. Error recovery

If an error does happen:

- Explain what happened in plain language,
- Precisely indicate the problem,
- And constructively suggest a solution

7. Recognition rather than recall

- Make options, actions, and objects visible
- The user shouldn’t have to remember information
- Instructions should be visible or retrievable

8. Flexibility and efficiency of use

- Accelerators to speed up interactions for expert users
- Allow users to tailor frequent actions

9. Aesthetic and minimalist design

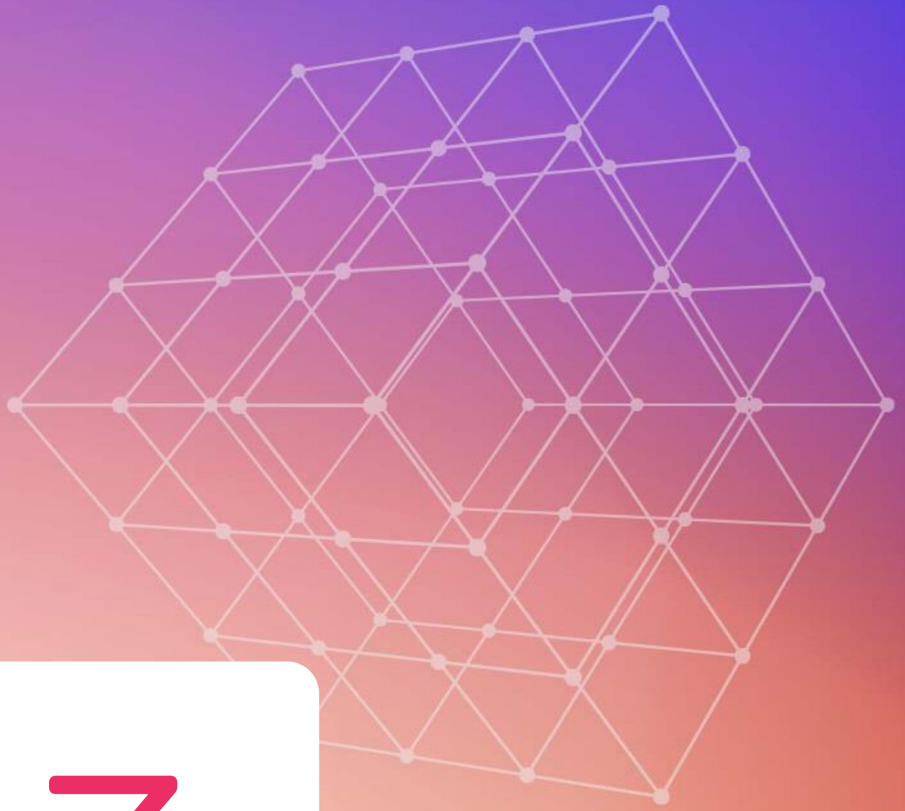
- Every extra unit of information competes with relevant information
- Balance is reached through usability testing

10. Help and documentation

- Easy to search
- Focused on the user’s tasks
- List concrete steps to be carried out
- Not too large

Visual Design

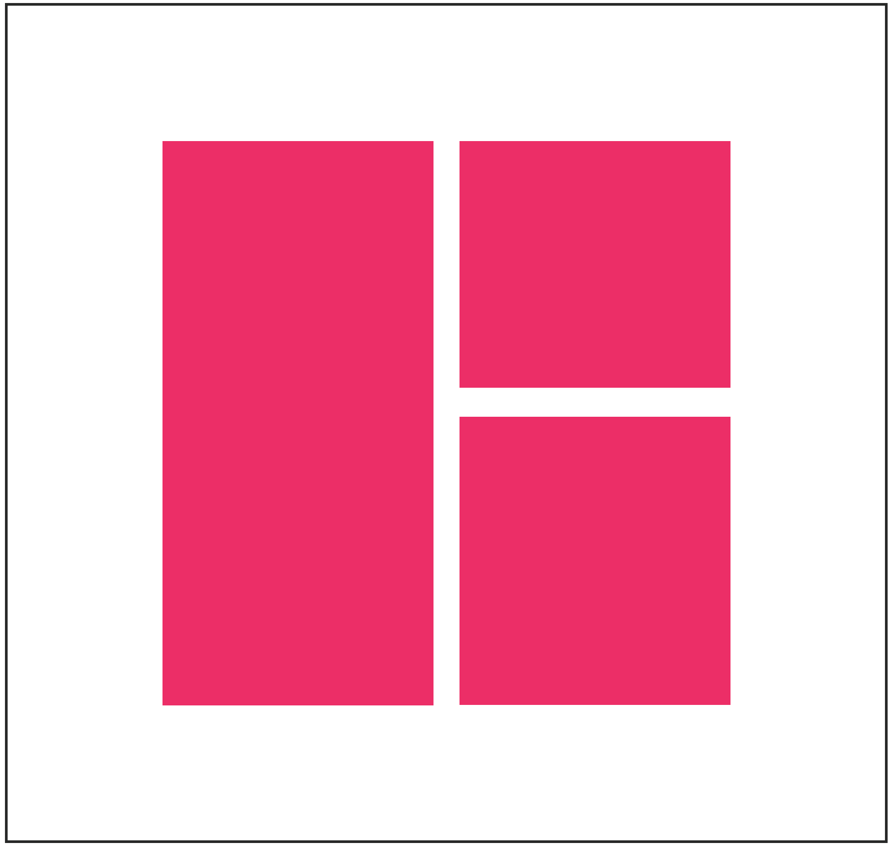
3



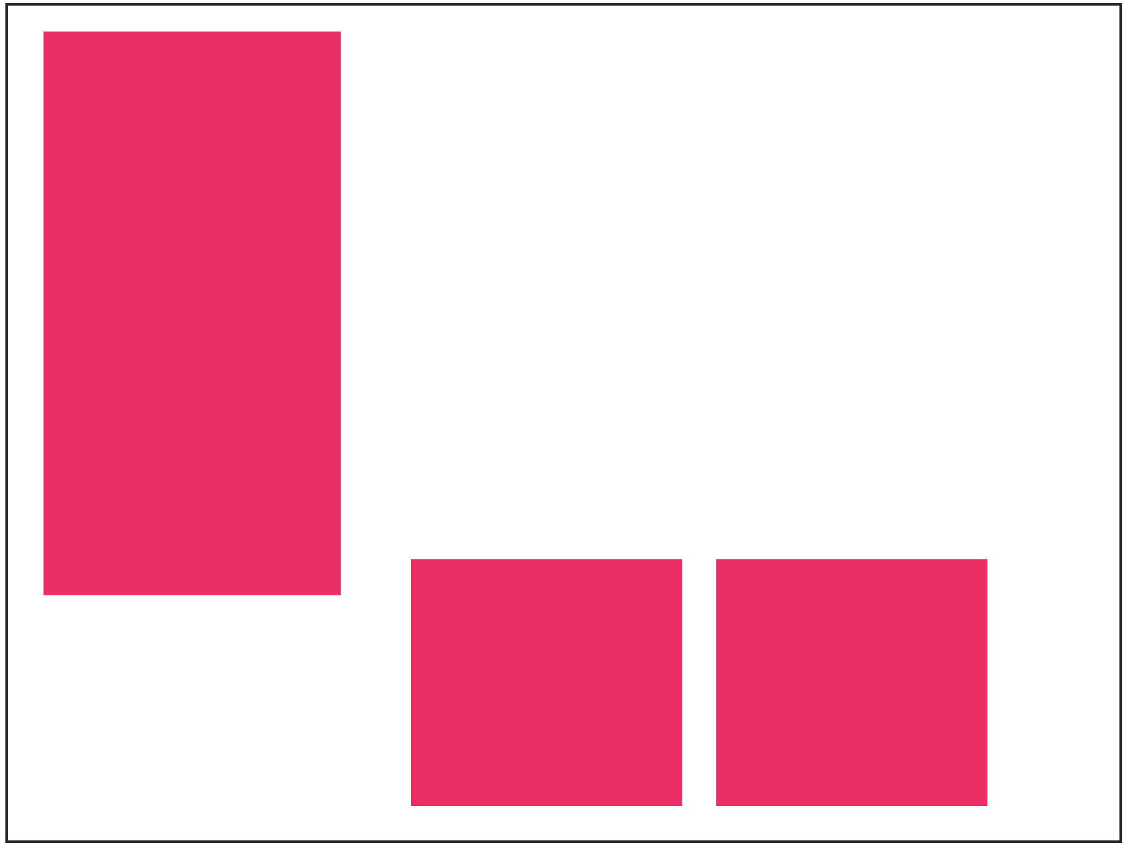
Layout

- Balance
- Scale
- Grouping (aka Gestalt)

Balance



Balance



Imbalance

Scale

Relative size of elements with respect to one another

To create hierarchy or add emphasis on certain elements

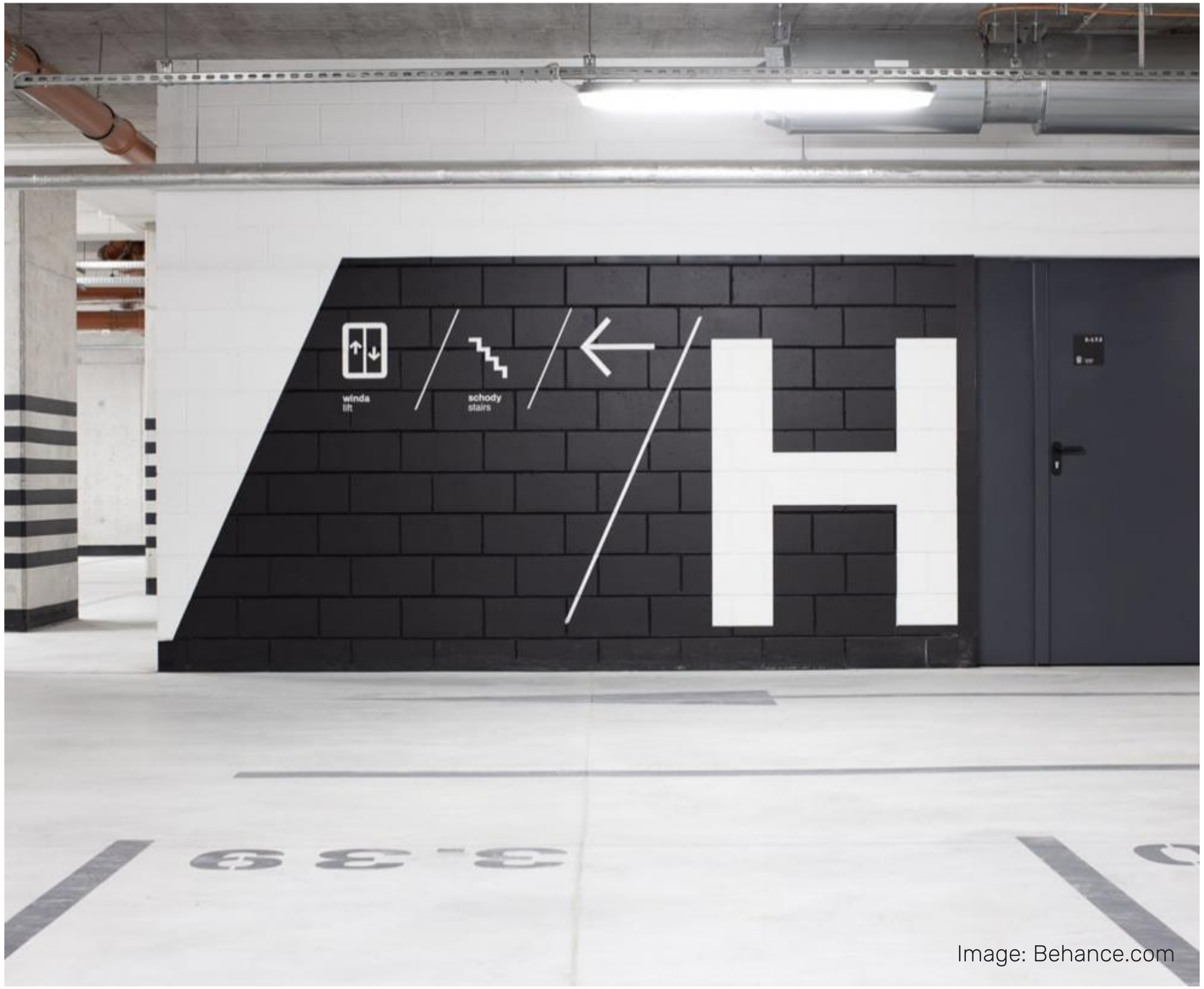
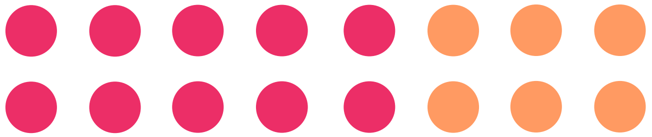


Image: Behance.com

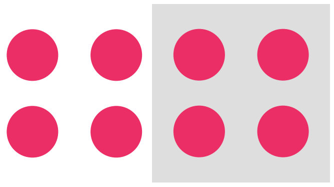
Grouping (Gestalt)

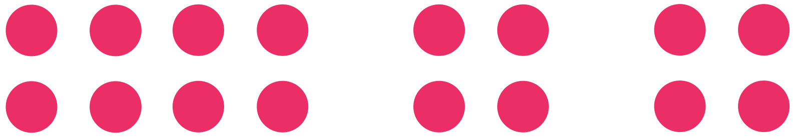
- How we combine separate shapes into a whole
- Our minds want to see patterns based on rules
- Users need to be able to understand what they see immediately



Similarity

Common Region

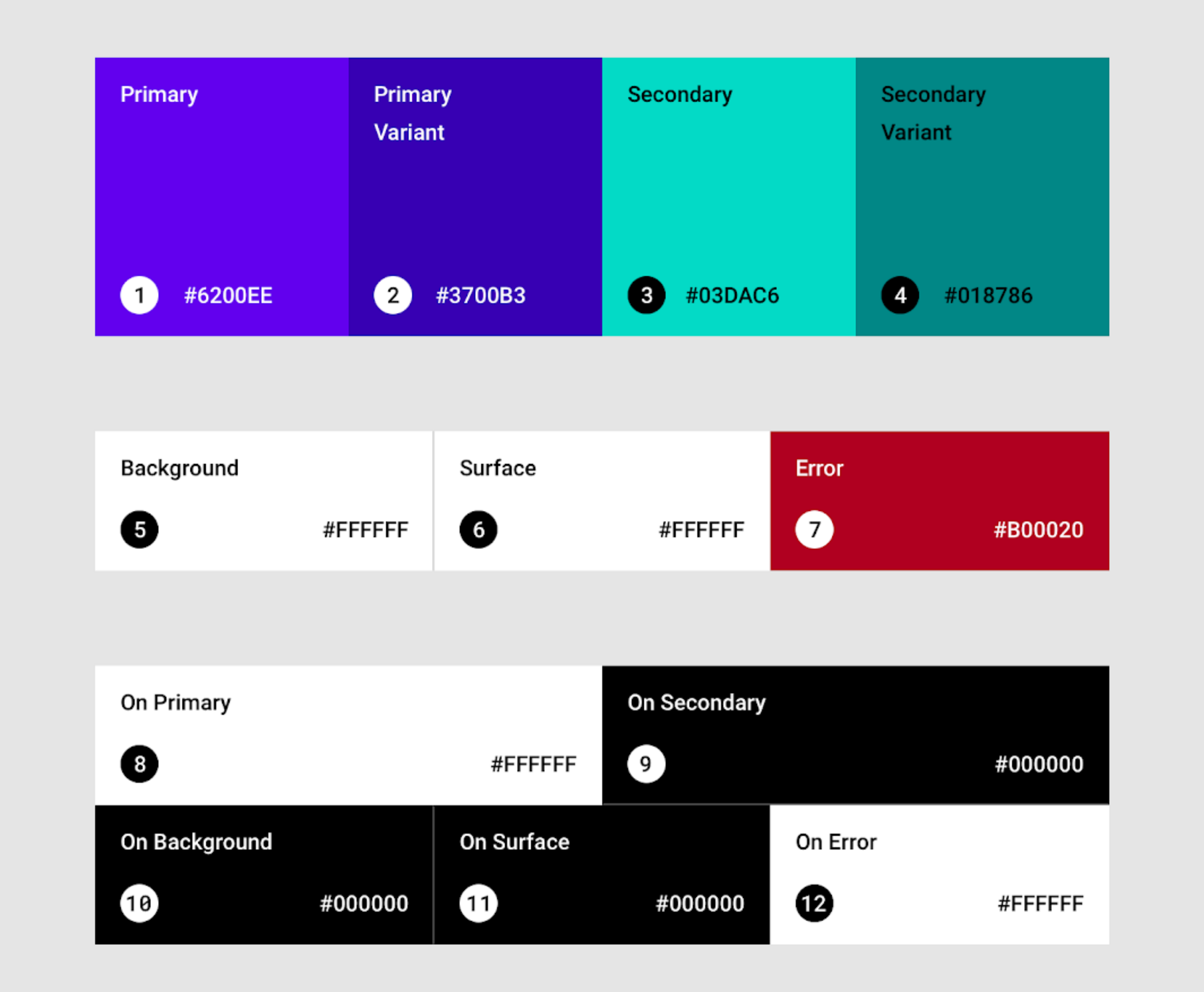




Proximity

Color

- Make a color palette
- Minimalist color variation
- Brand colors
- Influences hierarchy
- Color carries a meaning – be consistent
- Color indicating state and interaction
- Contrast
- Above all it must be legible



Primary 1 #6200EE

Primary Variant 2 #3700B3

Secondary 3 #03DAC6

Secondary Variant 4 #018786

Background 5 #FFFFFF

Surface 6 #FFFFFF

Error 7 #B00020

On Primary 8 #FFFFFF

On Secondary 9 #000000

On Background 10 #000000

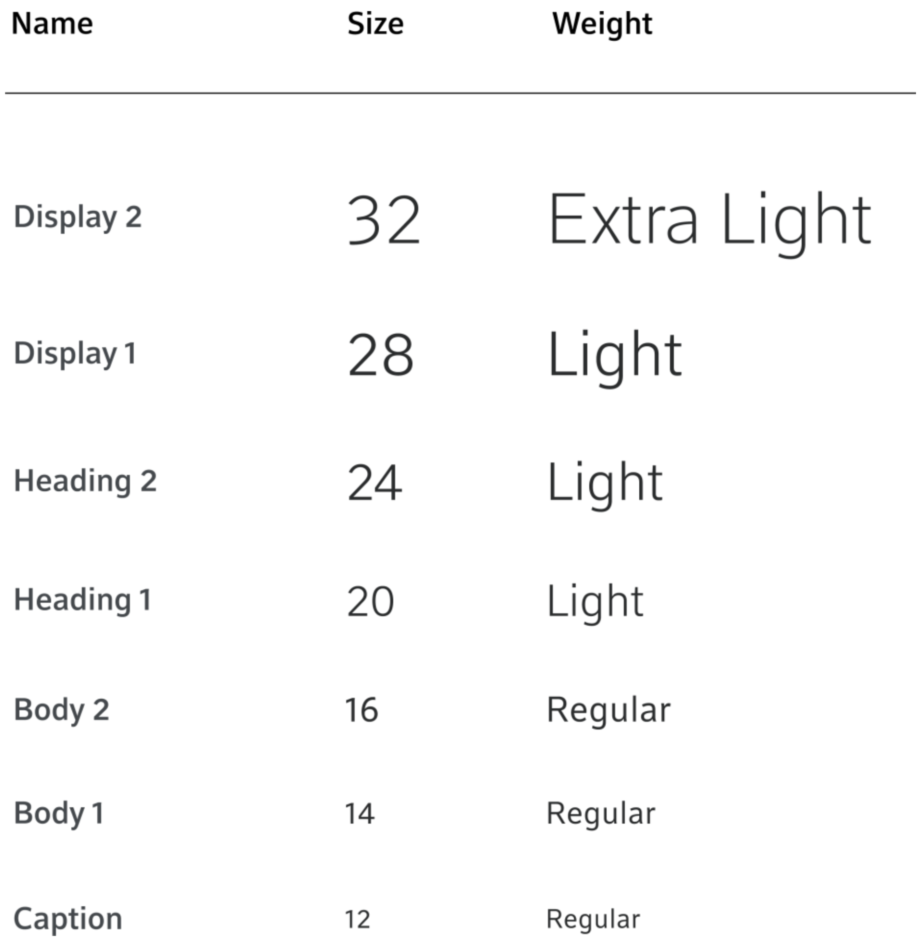
On Surface 11 #000000

On Error 12 #FFFFFF

Image: material.io

Typography

- Establish a consistent Type Scale and use it throughout your application
- One font to rule them all
- Above all, it must be legible



Name	Size	Weight
Display 2	32	Extra Light
Display 1	28	Light
Heading 2	24	Light
Heading 1	20	Light
Body 2	16	Regular
Body 1	14	Regular
Caption	12	Regular

Image: material.io

Icons

- Minimal form - simple
- Geometric
- Recognizable
- Symmetric
- Clarity at small sizes
- Consistent stroke weights
- Icon size – adequate space around icons
- When in doubt – material.io or JKI Flat UI Controls

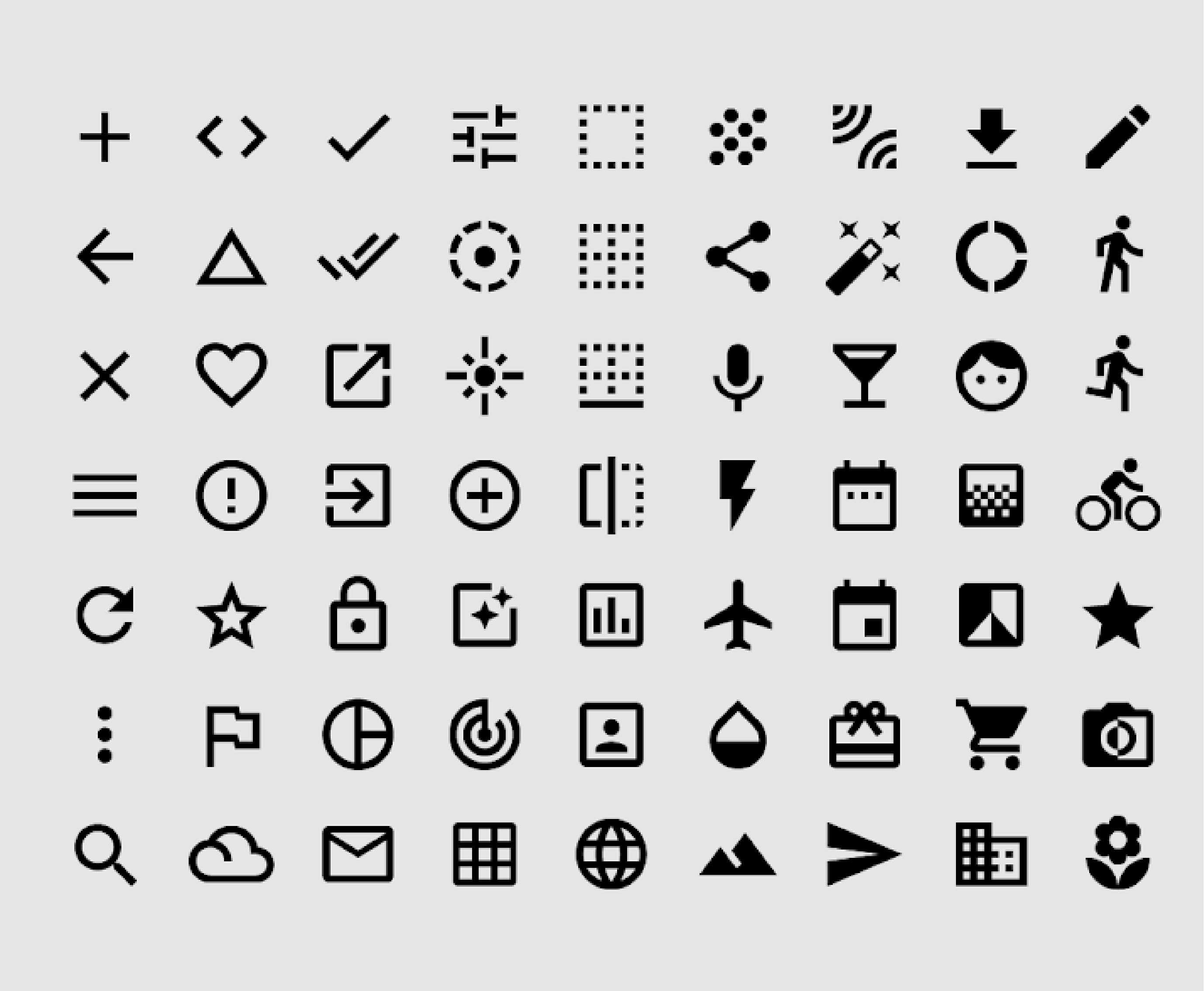


Image: material.io

Apply this to a LabVIEW Front Panel

I did a presentation on this a few years ago at JKI – watch that for the next steps

Customizing controls

Applying a design to the UI with the layout

Things to think about for touch UIs

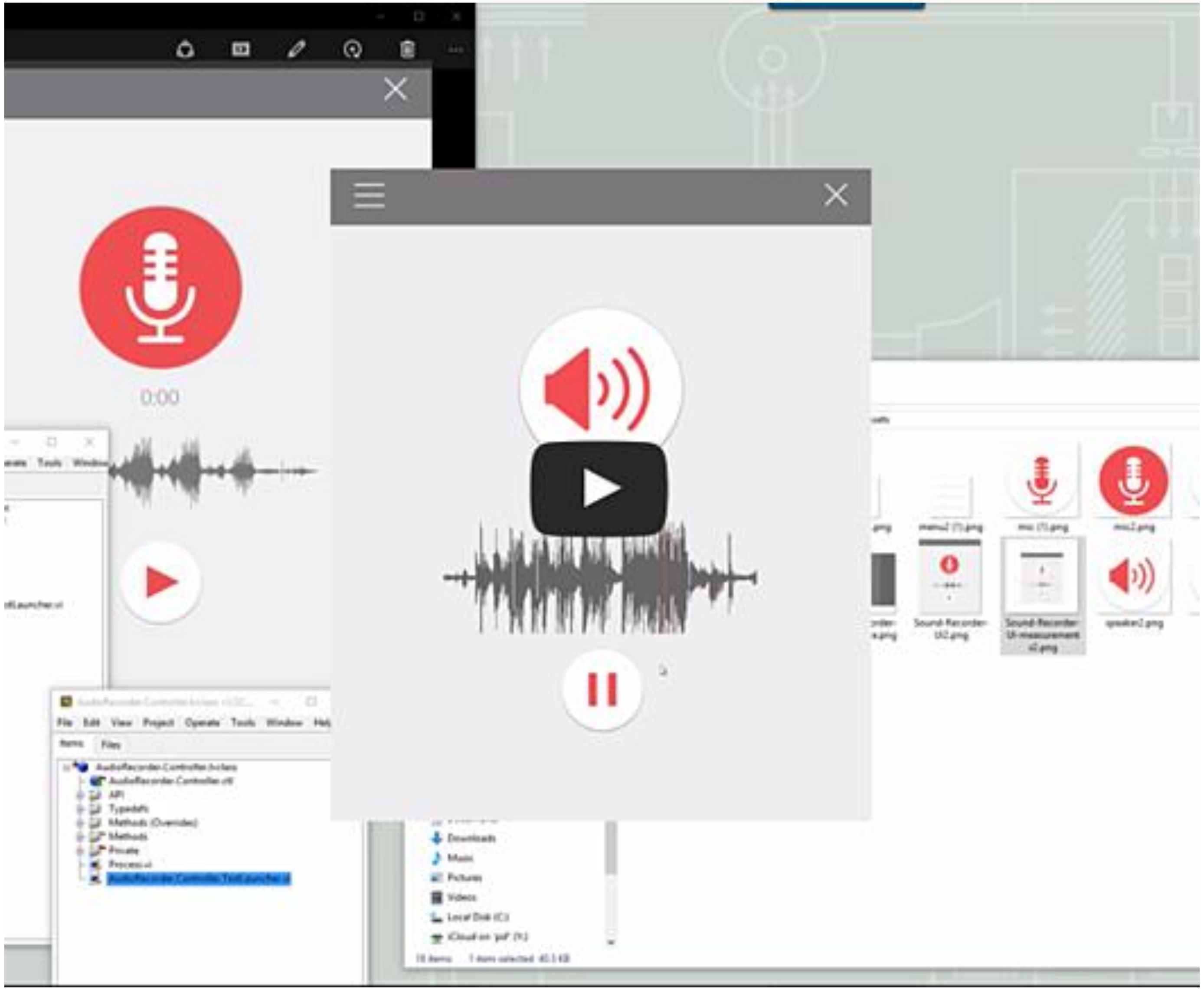


Image: JKI

Resources

- Learn about UX from the founders of research-based UX: https://www.nngroup.com/
- Figma design and wireframe tool: https://www.figma.com/
- Google Material Design – guidelines visual design: https://material.io/
- Material design Icons for download: https://material.io/resources/icons/?style=baseline
- Make custom icons as SVG - Use Inkscape: https://inkscape.org/ (free) or Illustrator: https://www.adobe.com/products/illustrator.html (better but costs money)
- How to make custom controls in LabVIEW: https://blog.jki.net/news/creating-modern-touch-uis-in-labview
- JKI Flat UI Controls: https://resources.jki.net/jki-flat-ui-controls-toolkit
- JKI Flat UI Controls 2.0: https://blog.jki.net/introducing-the-flat-ui-controls-2.0-jki-design-palette-for-labview

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