Design Tools

CS 347
Michael Bernstein

Announcements

Quiz 2 is a week from today—covers four lectures

- Design Cognition
- Design Process
- Design Tools (today)
- Social Media (next week)

Last time

The design process is a set of structured activities meant to address problems in how we generate and develop ideas

These activities are well attuned to solving **wicked problems**, which feature contradictory or conflicting goals

Participatory design is a movement to decenter the designer's power in these activities. We still struggle to achieve our goals here.

Design patterns help us avoid reinventing the wheel.

We can intervene on these activities to address shortcomings in how we practice design: e.g., **parallel prototyping** and **comparing multiple designs** (to reduce **design fixation** and **demand characteristics**)

Today

Schön's reflective practitioner

Empowering design reflection through tools and technology

- **Ideation:** low-fidelity input
- **Implementation:** rapid construction
- **Evaluation:** feedback

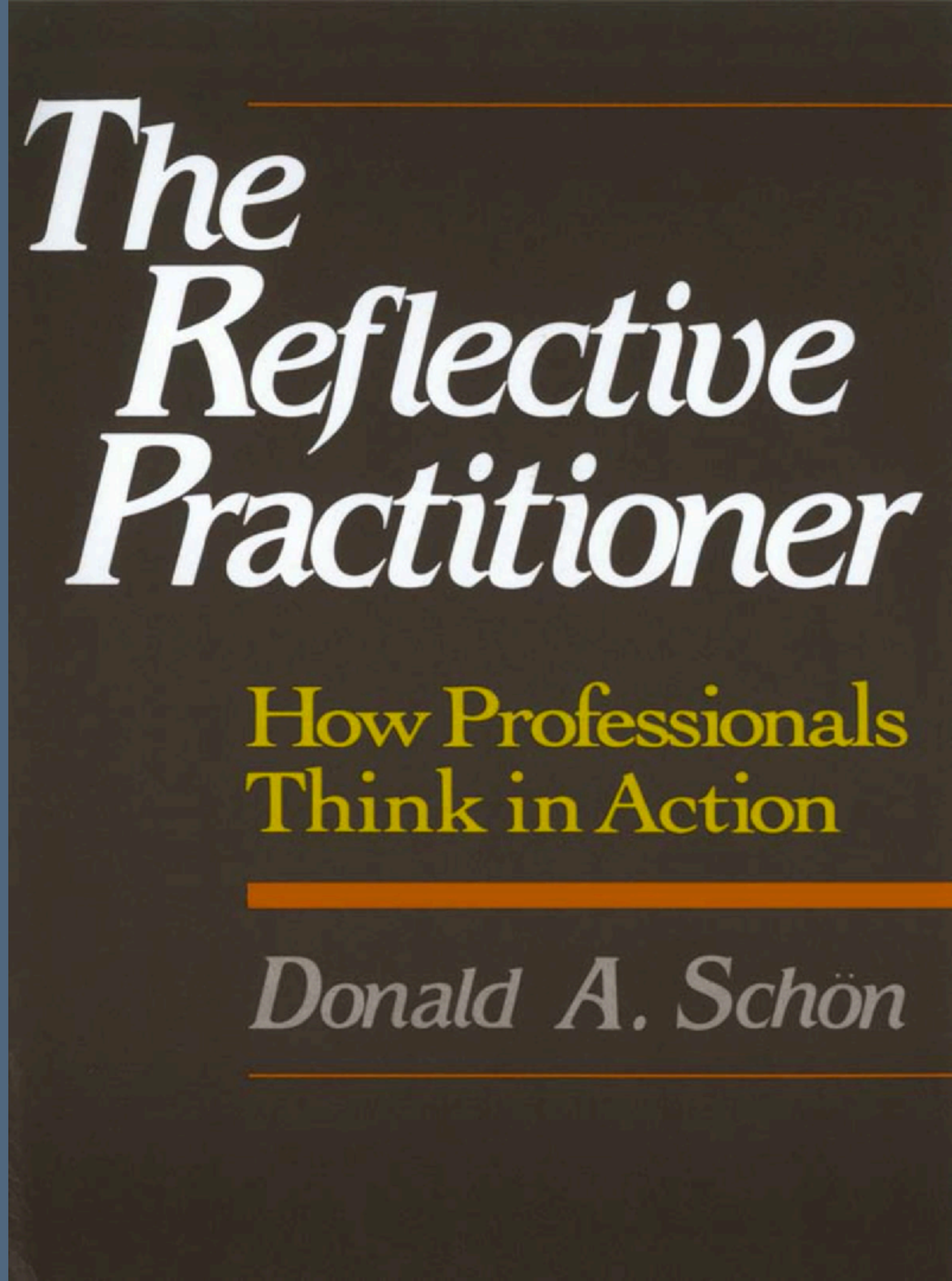
…with examples of each

The Reflective Practitioner

Reflective practitioner

How does design work? Why does it work?

Donald Schön [1984] studied a variety of professionals, including designers, and articulated a theory of the how and the why that has remained influential.

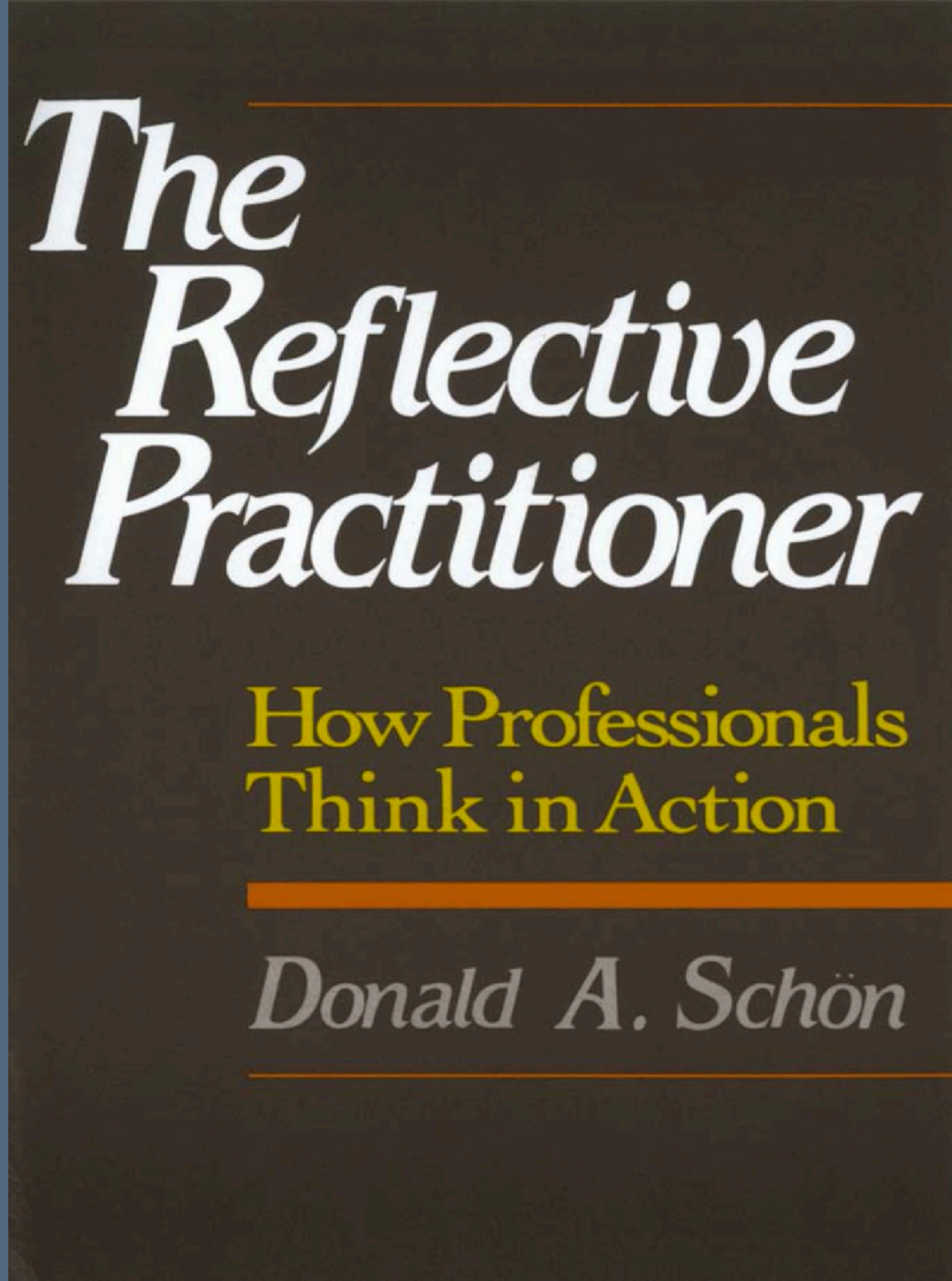


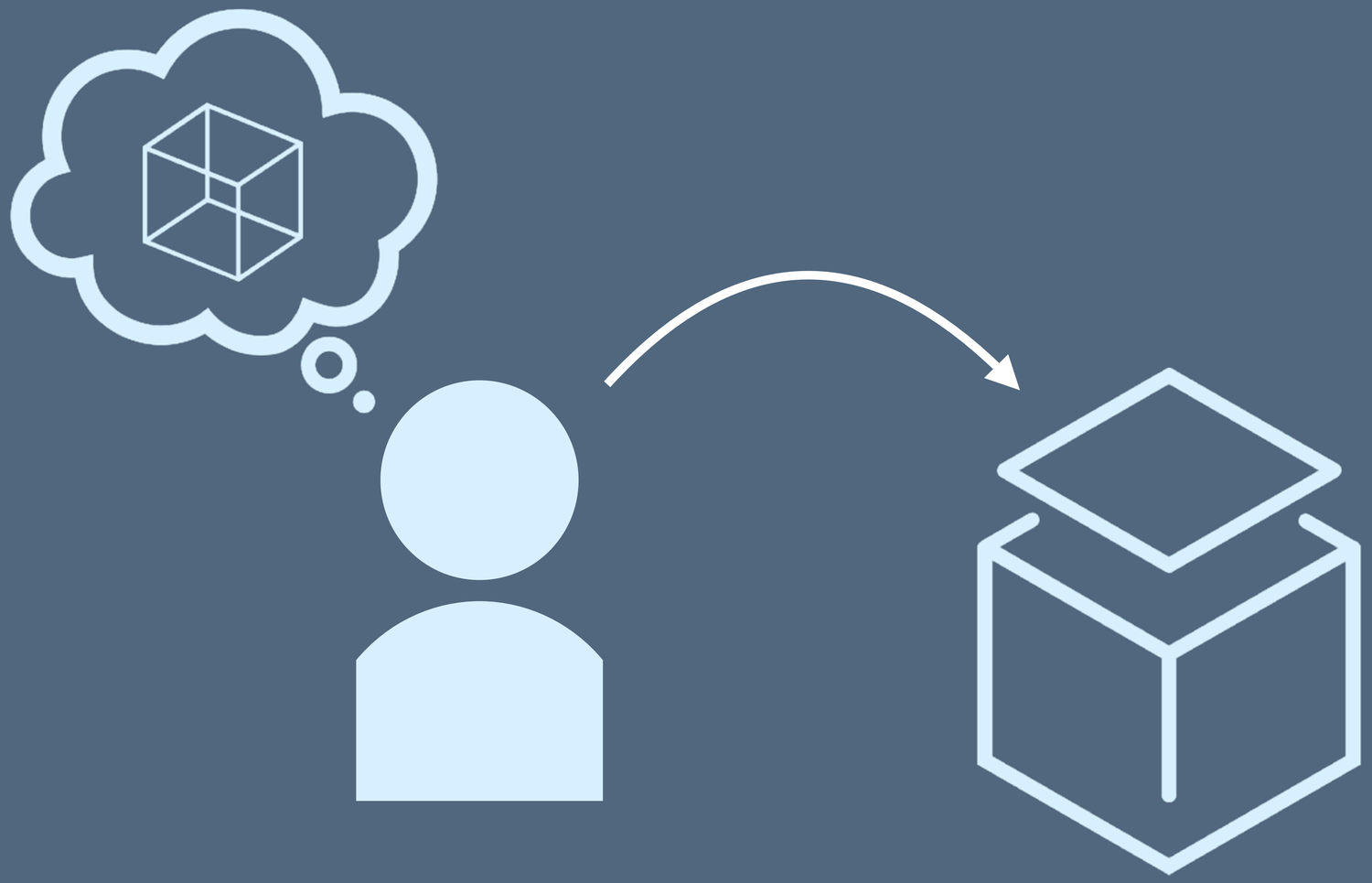
Reflective practitioner

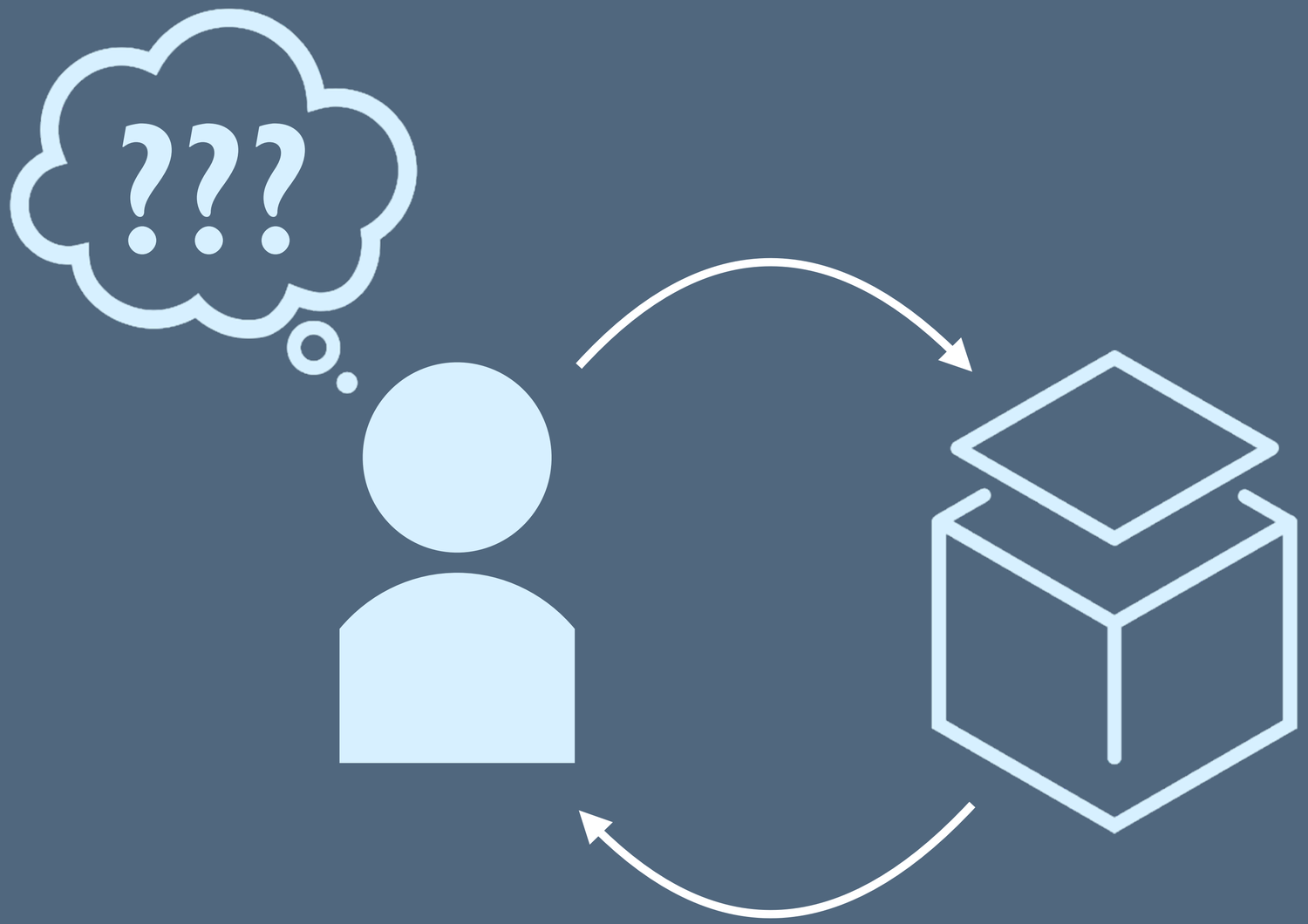
Design is not a "plan, then do" praxis

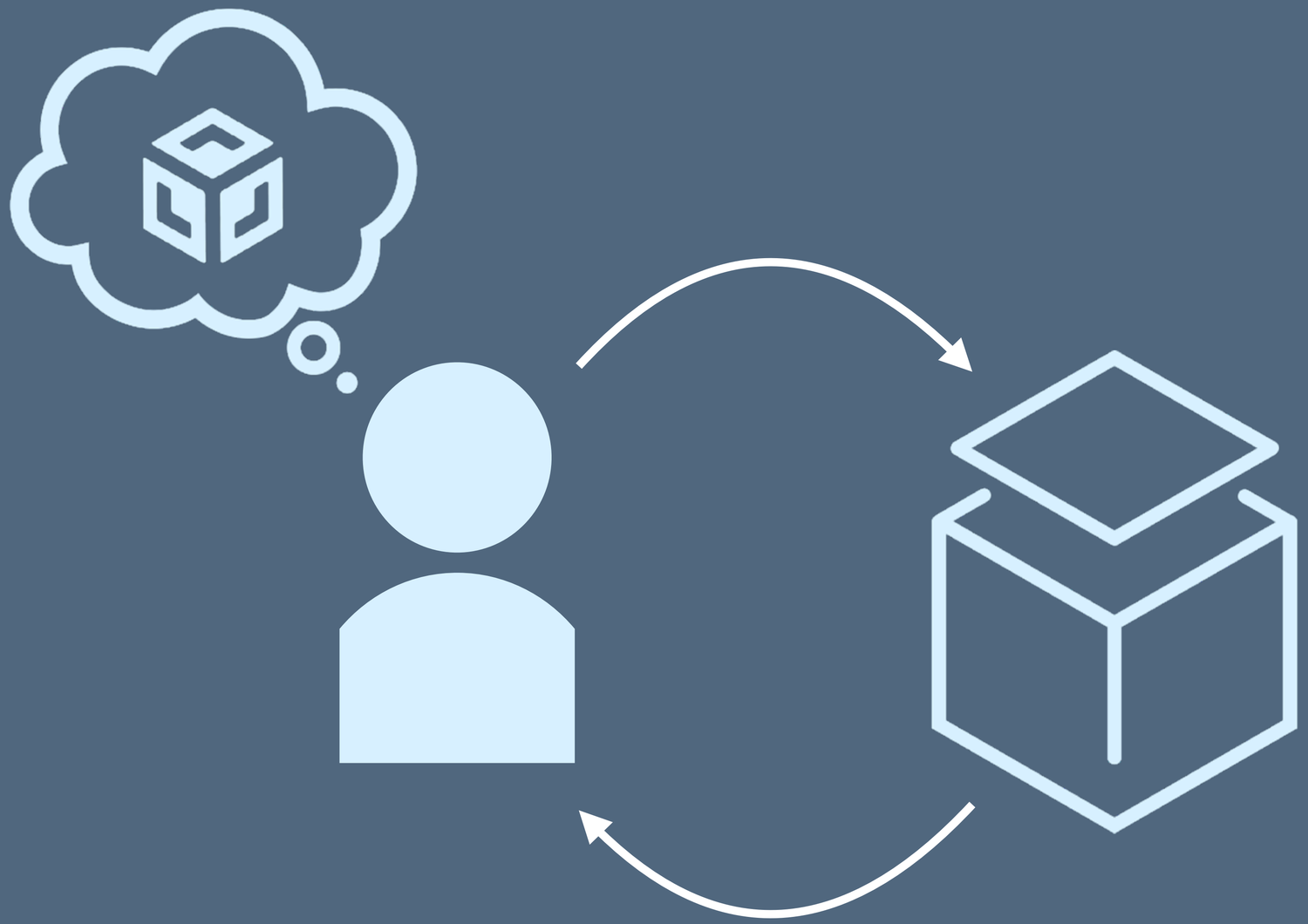
Instead, the designer is engaged in an ongoing conversation with the design

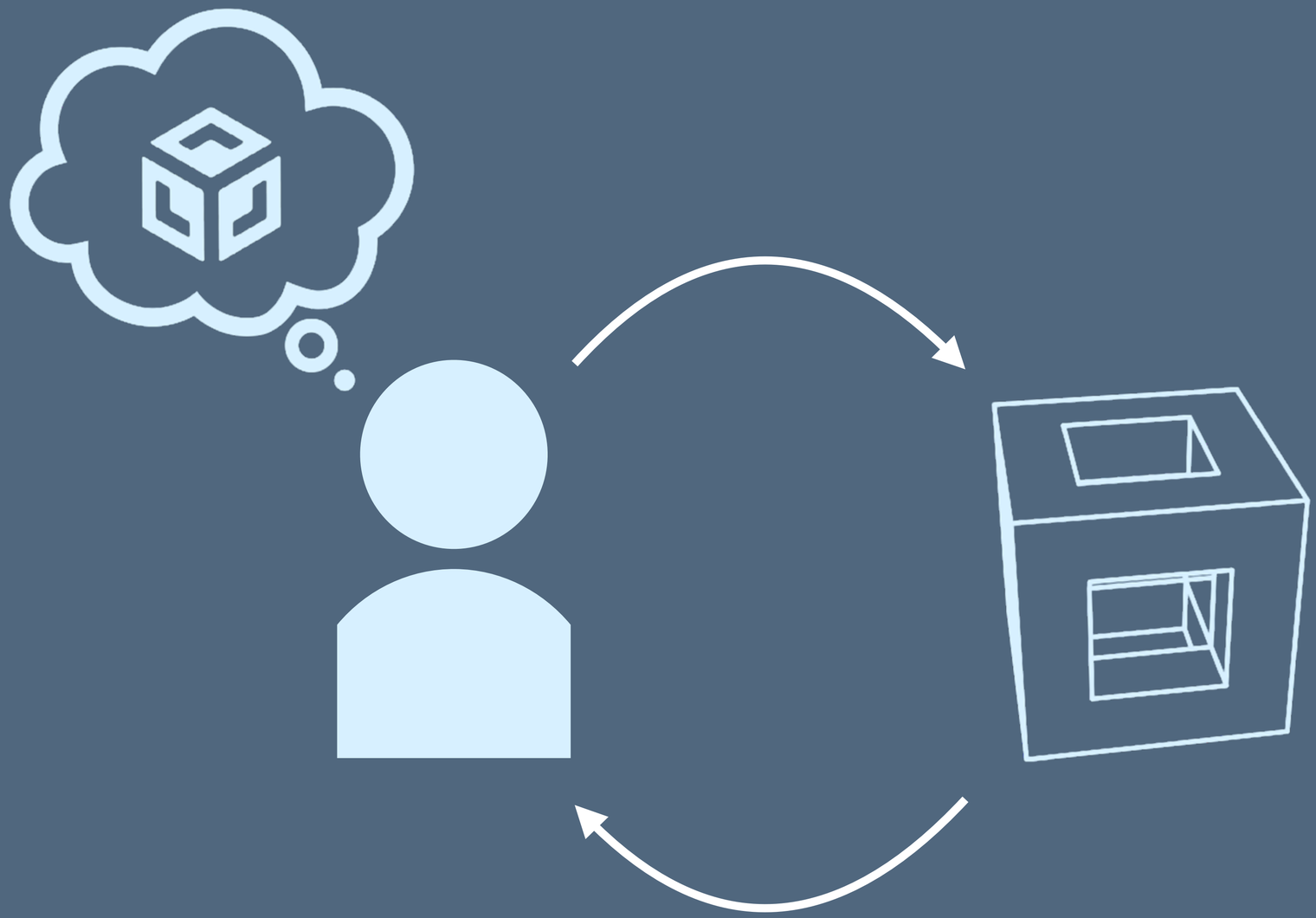
Critically, it's only by **observing the result of the doing can the designer engage in reflection**, allowing them to reorient and better solve the problem



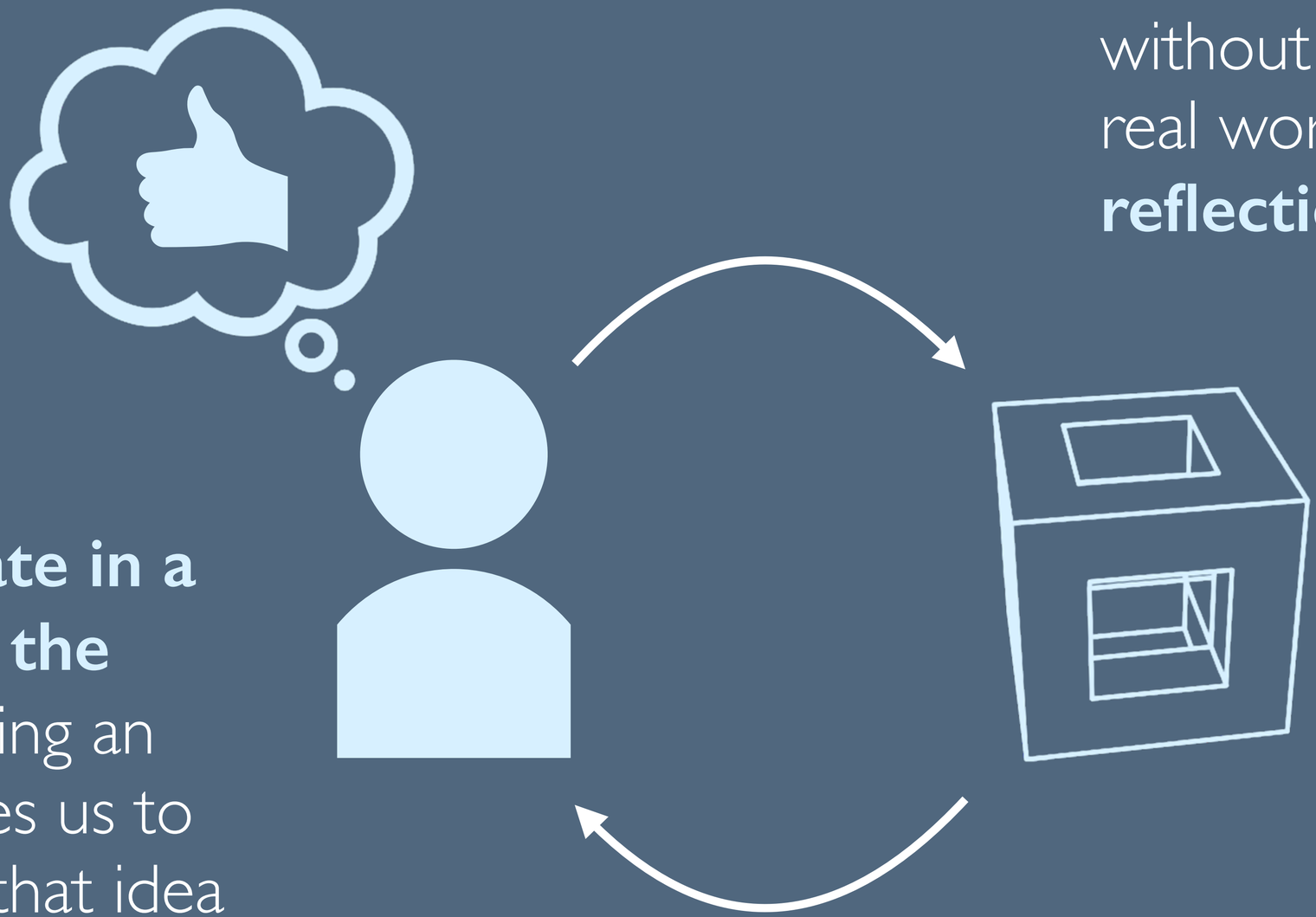








We learned something that we couldn't have without testing it in the real world. Schön calls this **reflection-in-action**

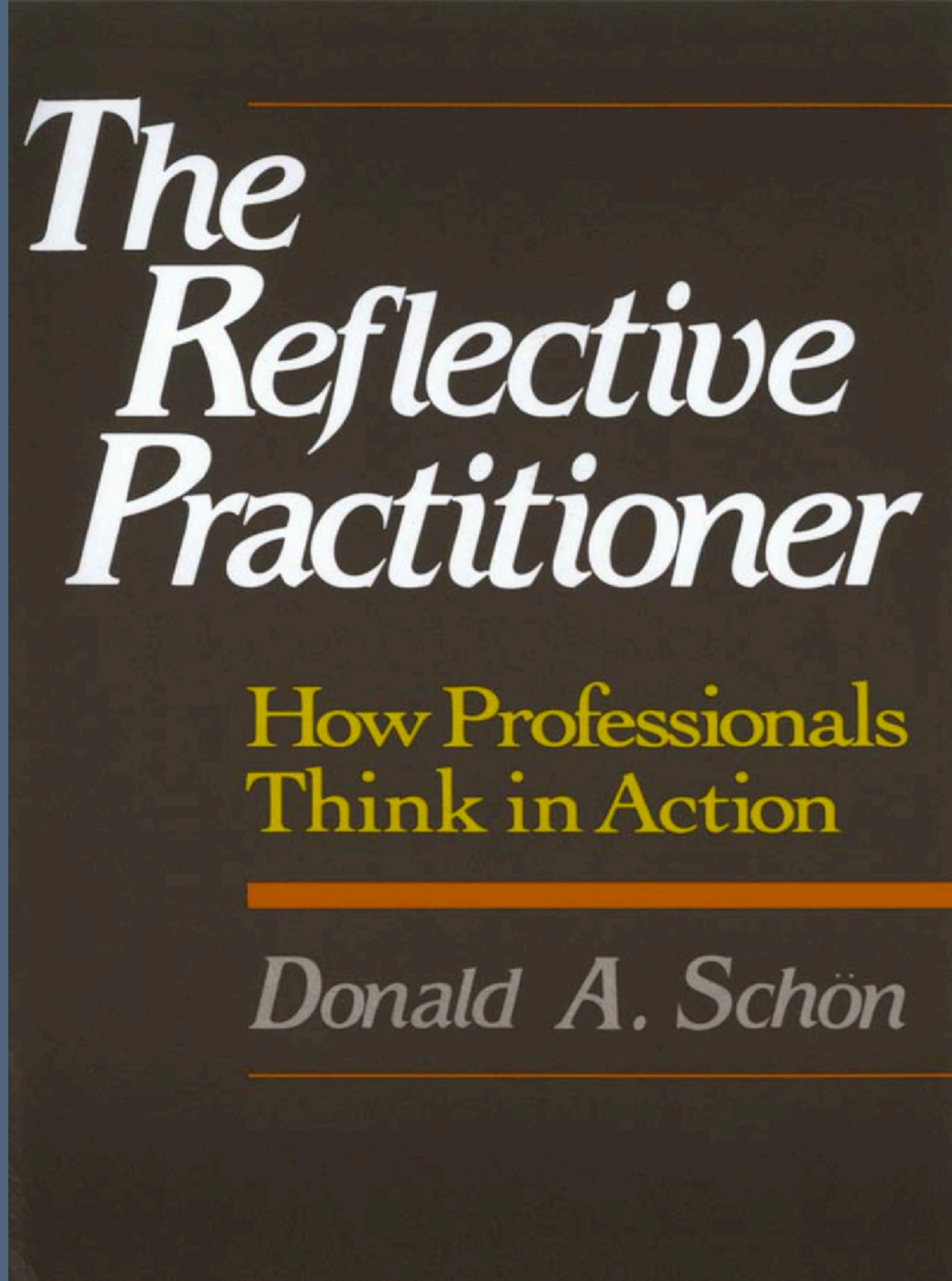


We operate in a loop with the world: trying an idea enables us to reflect on that idea and improve it

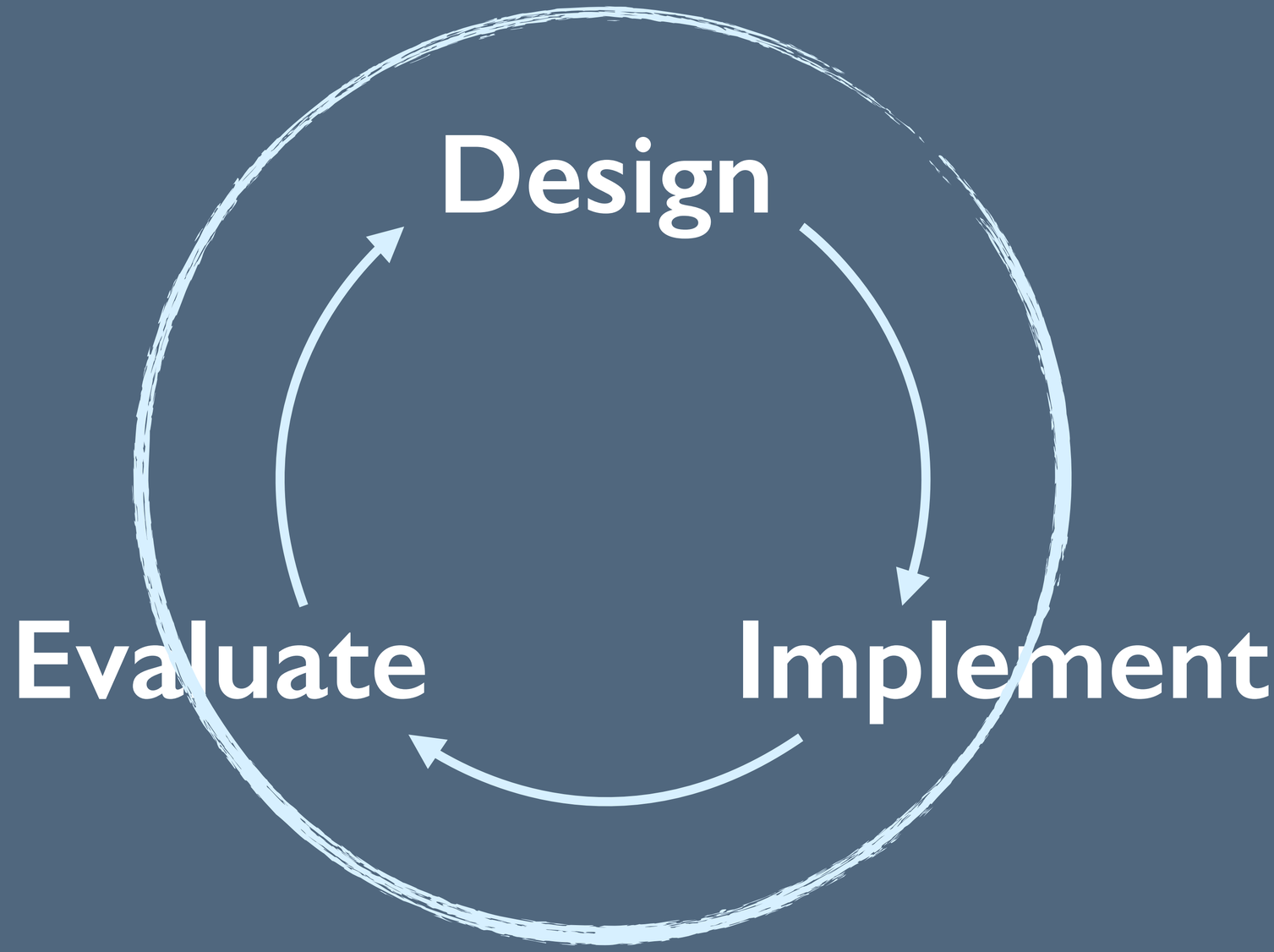
Implication

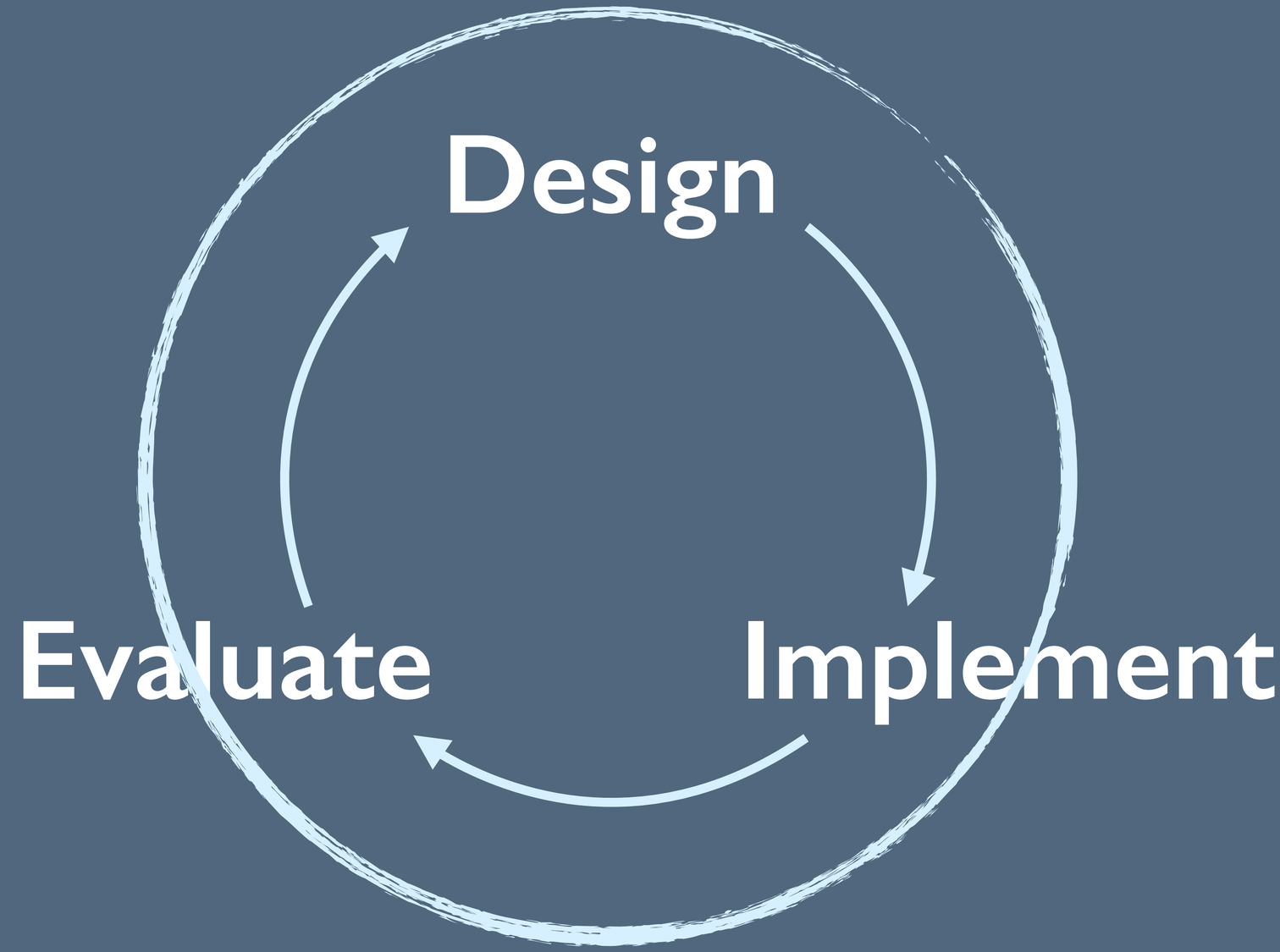
To improve the process:
encourage more rapid reflection, or
improve the quality of the reflection

To improve the tools:
create alternatives that make reflection
easier to do or more informative



The tighter we can tune this loop…

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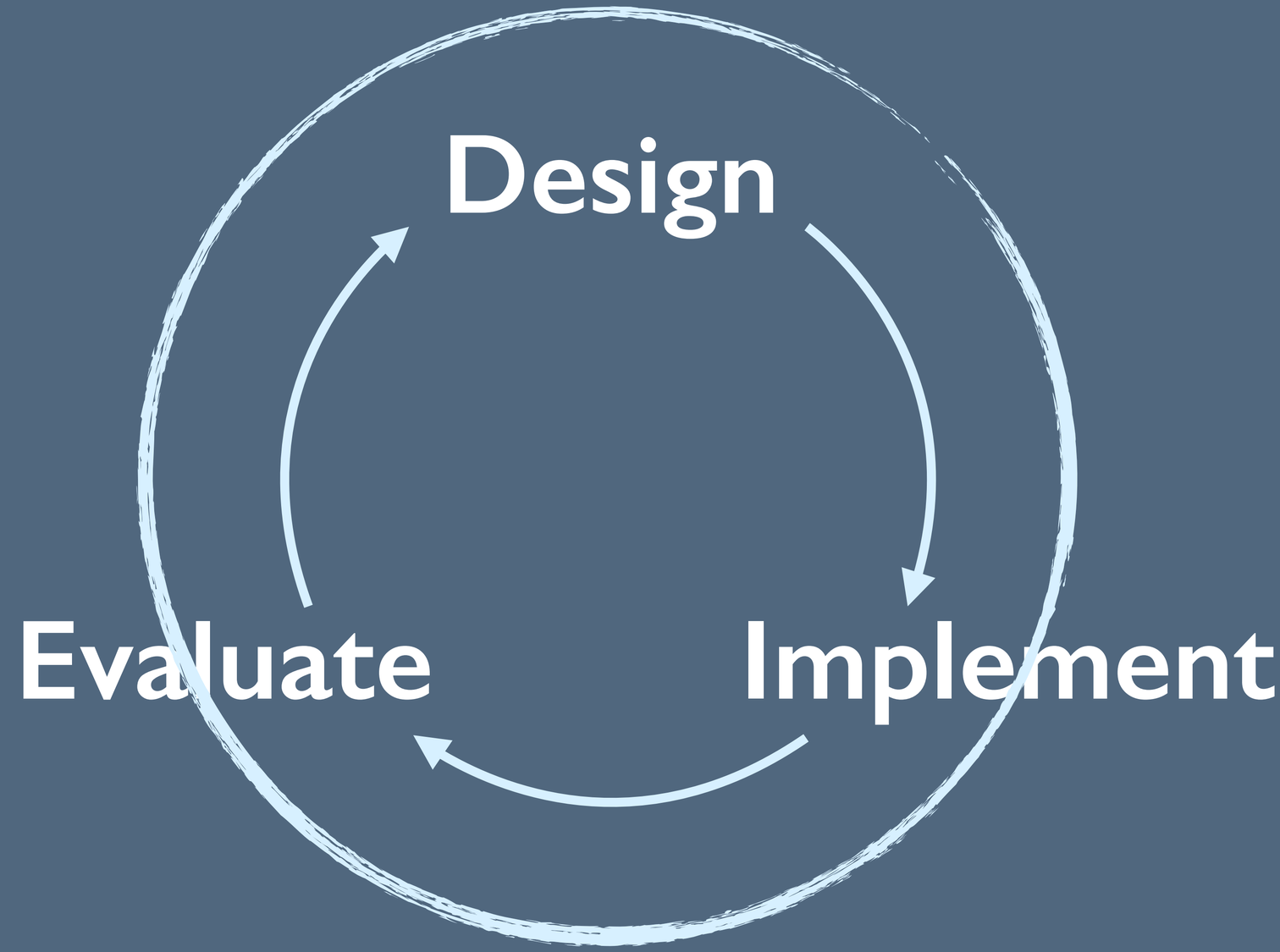
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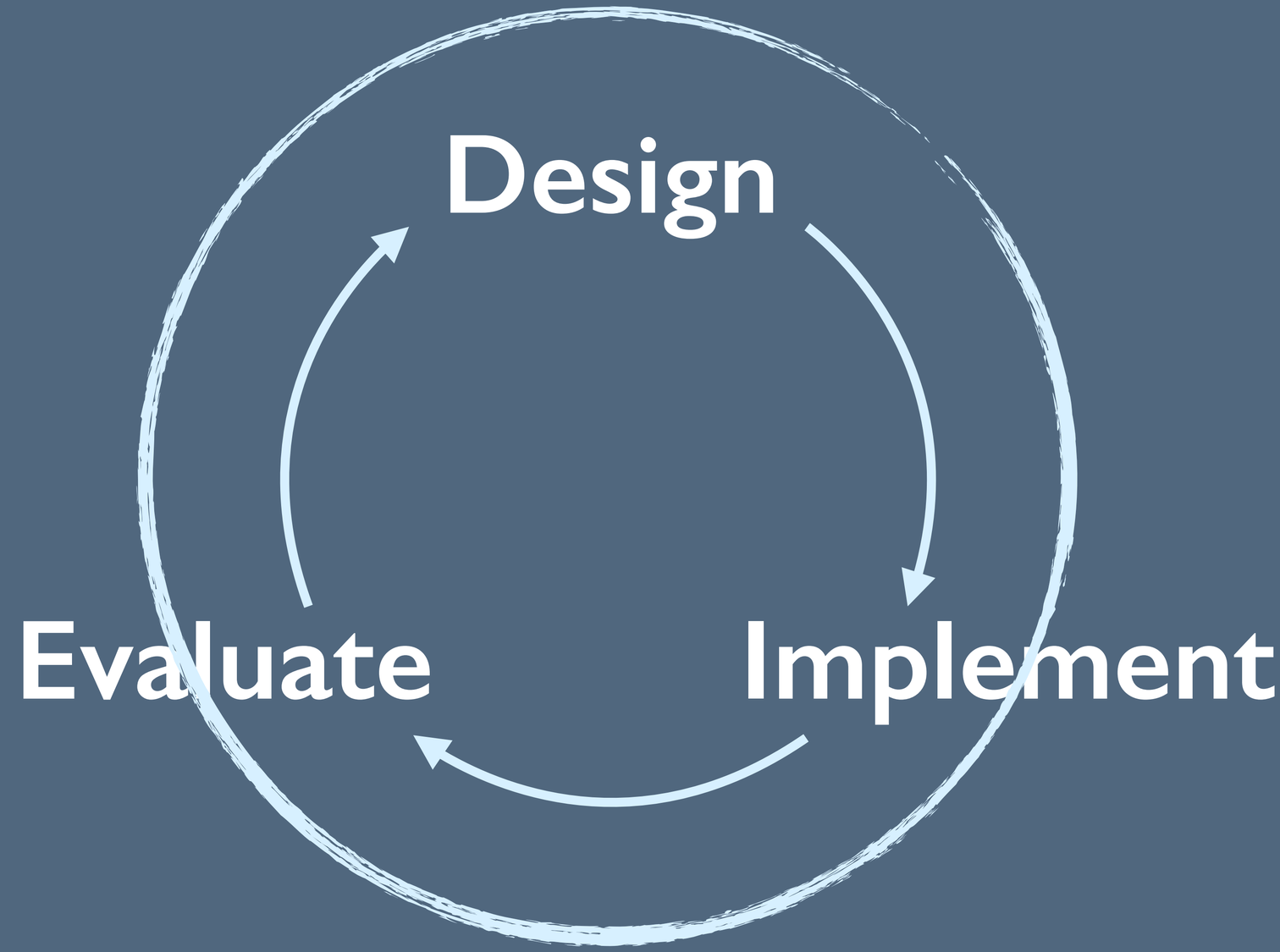
Design
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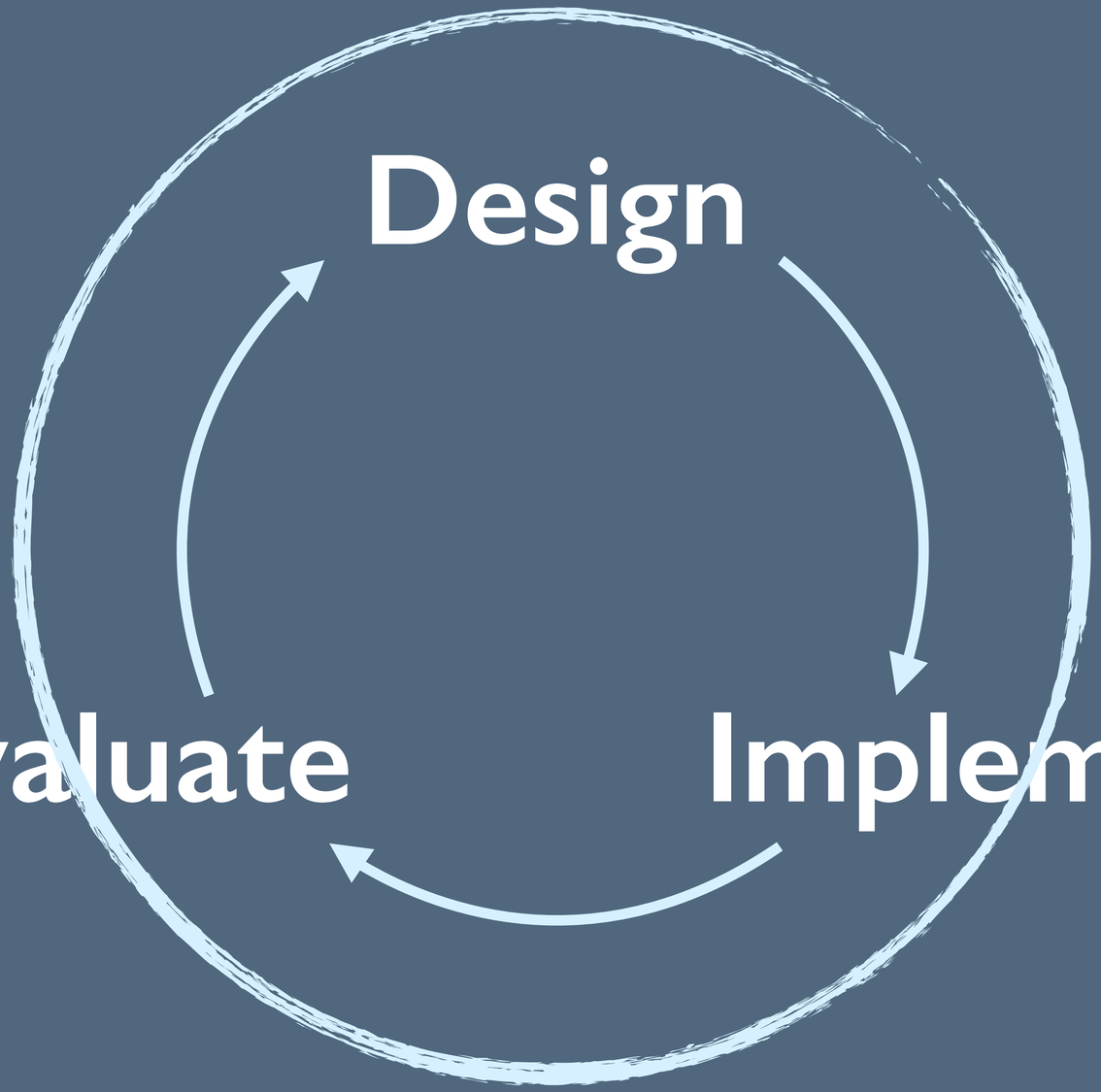
…the more reflection we are doing, and the better our designs are.



Design tools improve reflection-in-action.

To create a design tool, look for a part of the reflection loop that feels loose—where reflection is slow or difficult—and tighten that part of the loop.

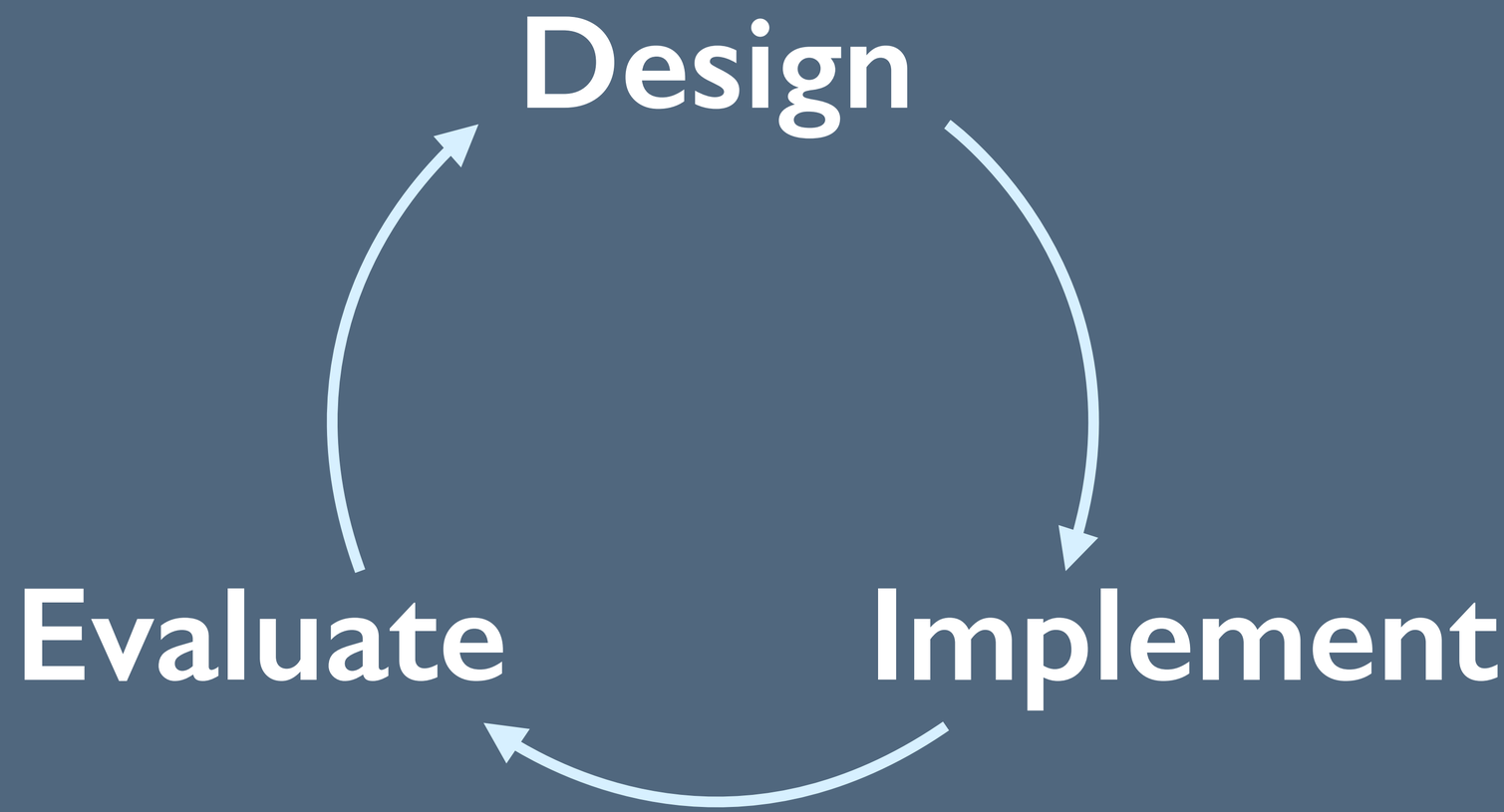
Design tools should...

[Hartmann 2009]

Decrease UI construction time

Isolate designers from implementation details

Enable designers to explore an interface technology previously reserved to engineers or other technology experts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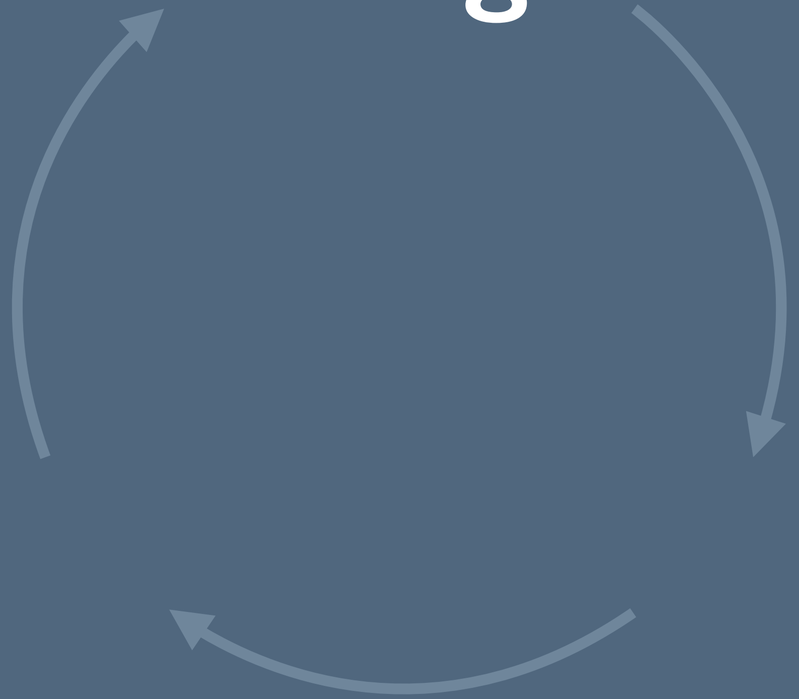
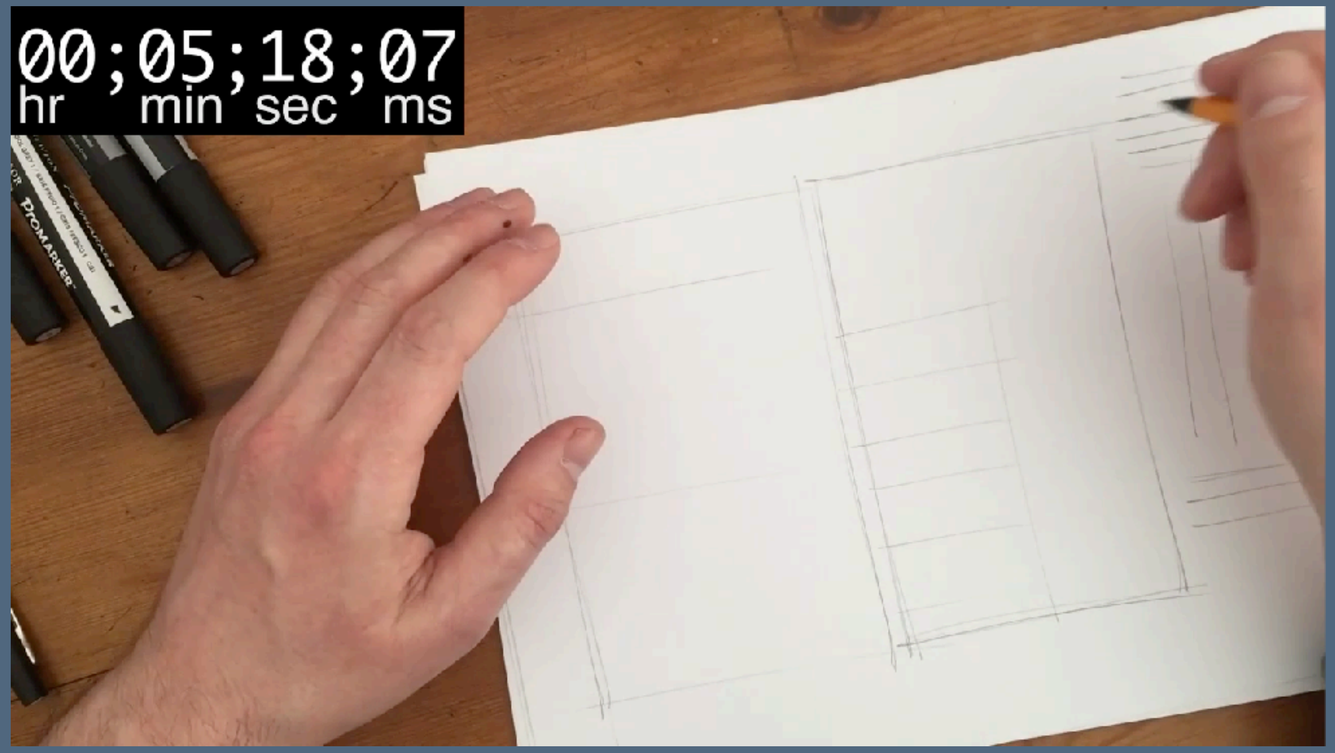


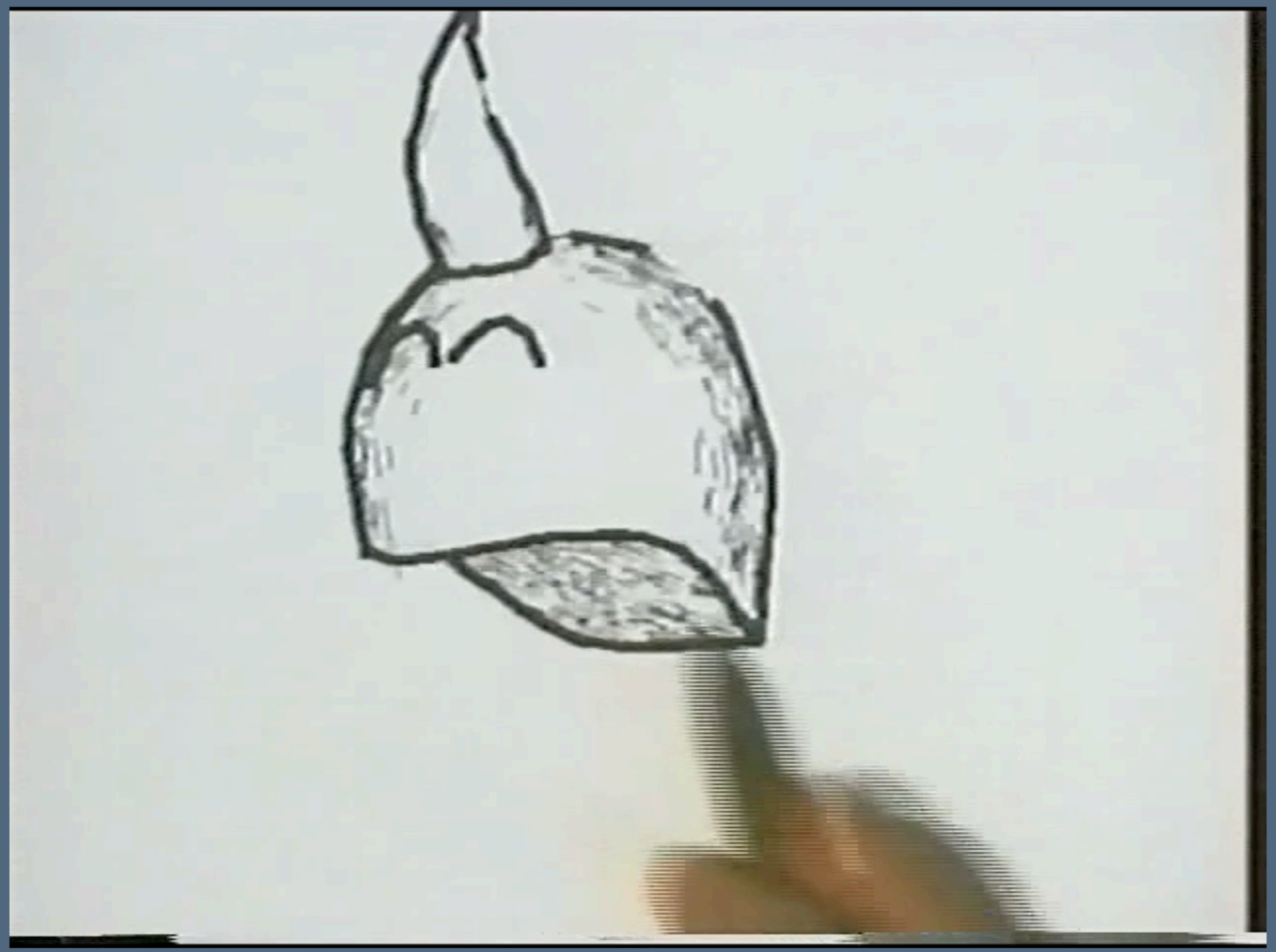
Goal of early-stage design tools: low-fidelity sketching

One major open loop in the design phase is the translation of an idea from the designer's head out into a sketch: the most rapid externalized representation possible



[Matt Corrall, edited by Bernstein]

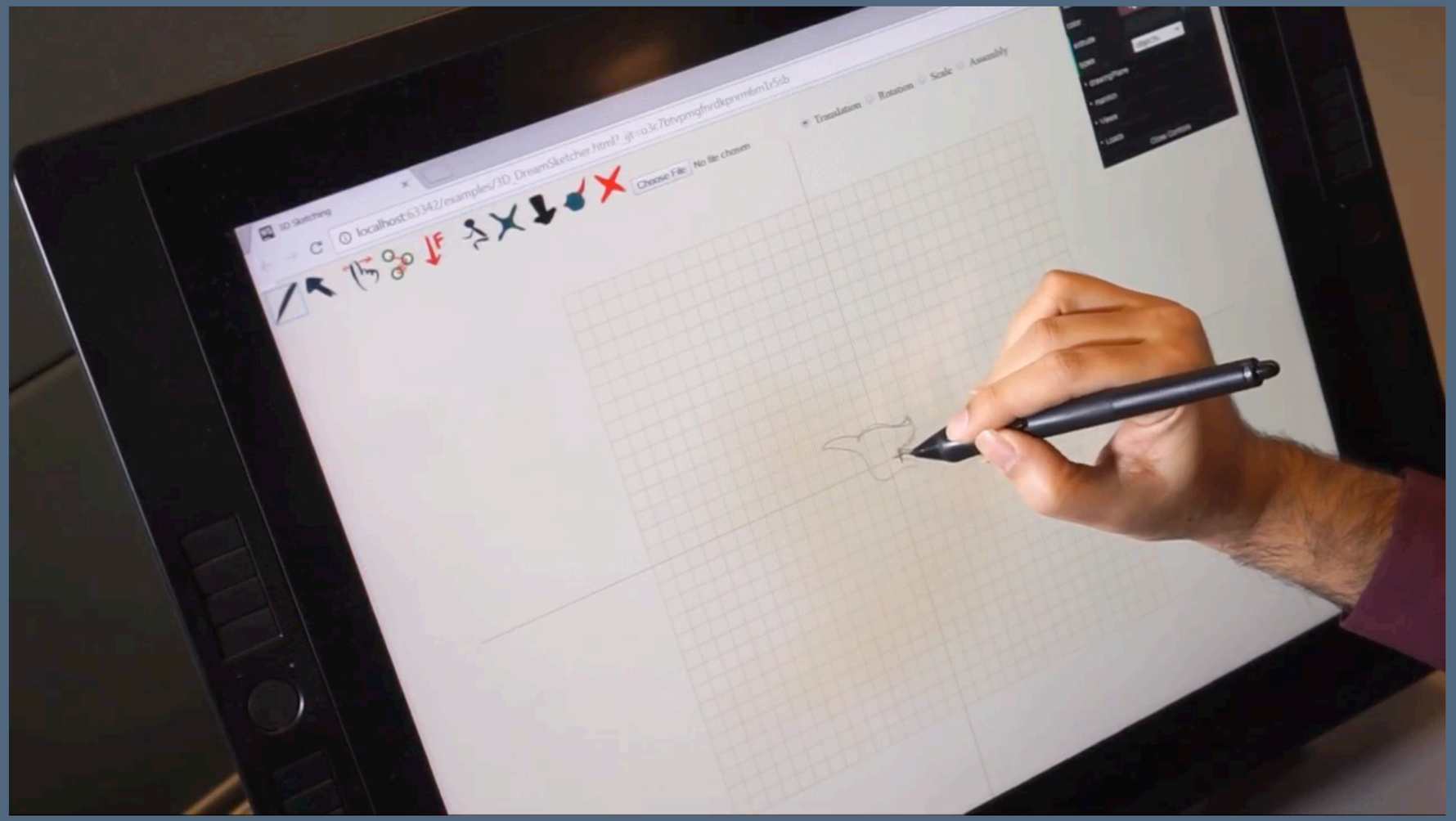
Enable rapid sketching



And keep the output sketchy + uncommitted.

Here, the designer uses the system to sketch a 3D shape to convey their idea [Igarashi, Matsuoka, and Tanaka 1999]

Computational sketches

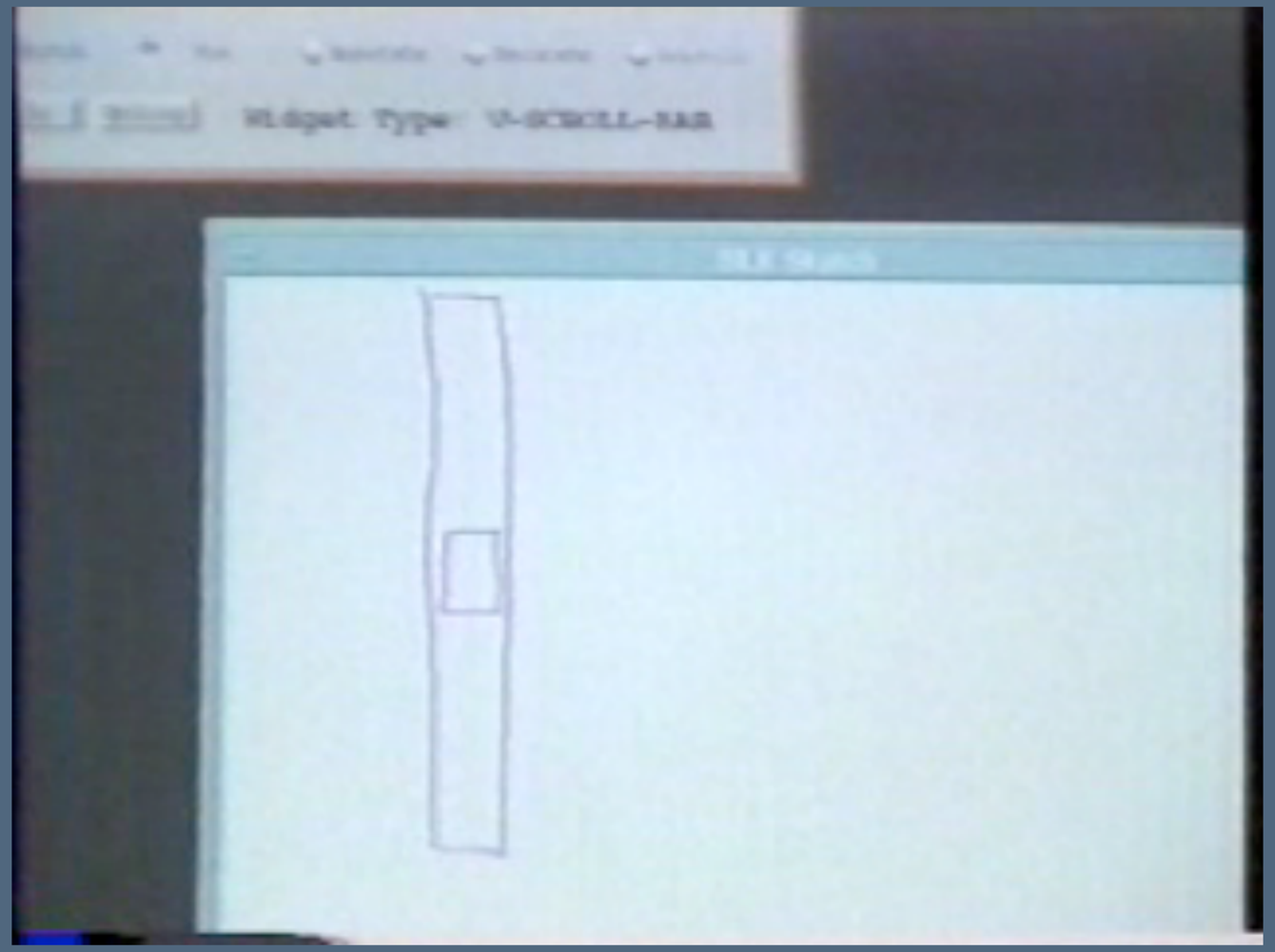


Imbue the sketch with computational properties.

The designer sketches while the system helps visualize potential physical constraints [Kazi 2017]

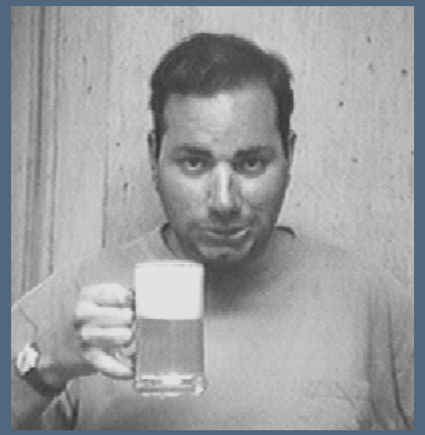
Low-fidelity prototypes

[Landay and Myers 1996]



Sketch recognition of UI components

Led to many projects on low fidelity prototyping of UIs

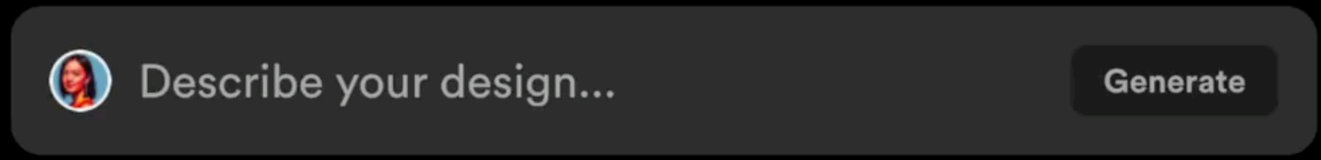


GenAI

This kind of technique is probably solid at producing hi-fi designs that follow established design patterns

But:

- It's incredibly difficult to control
- Inherent mismatch: high-fidelity designs when you are still doing concept development



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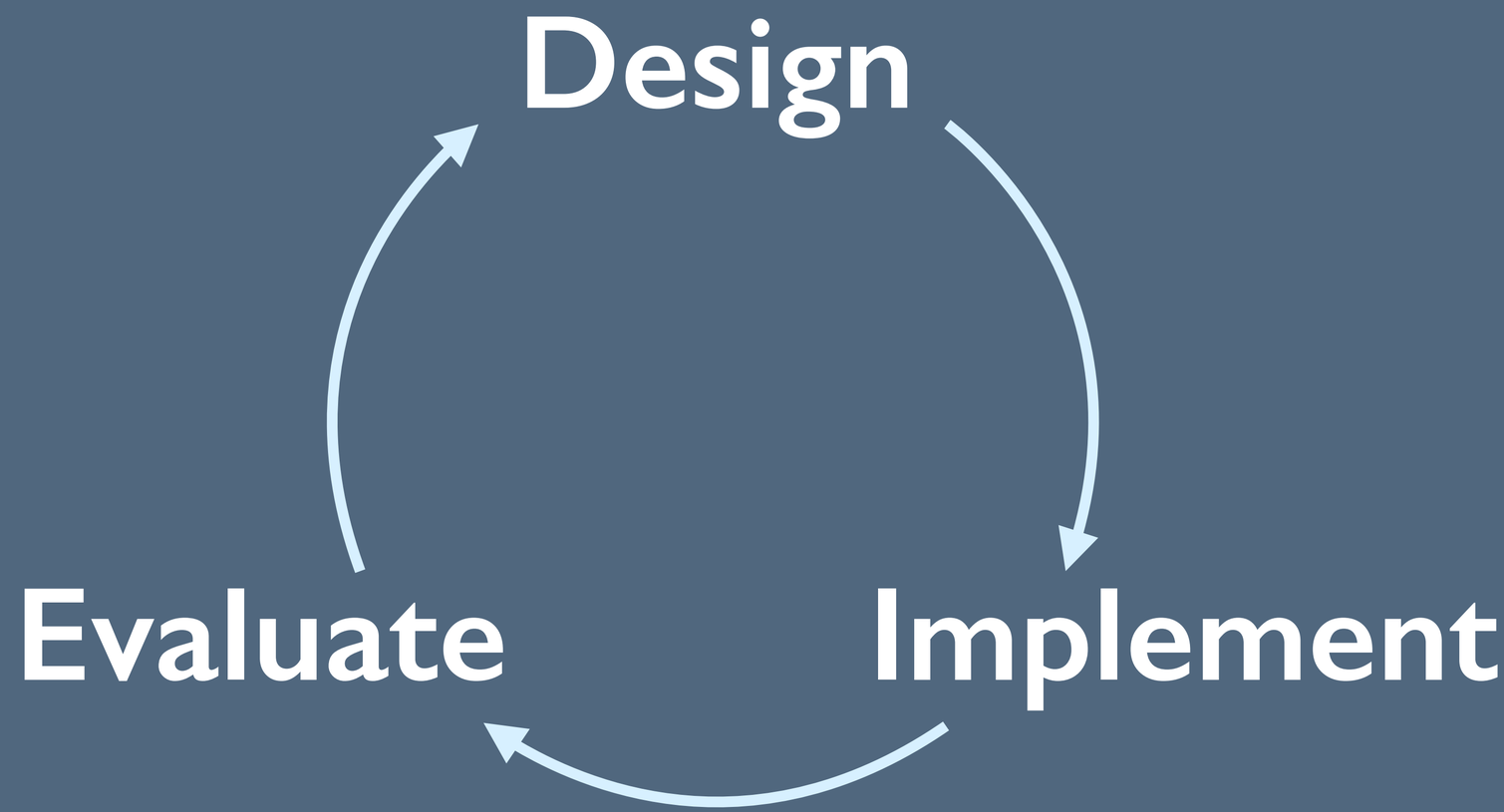
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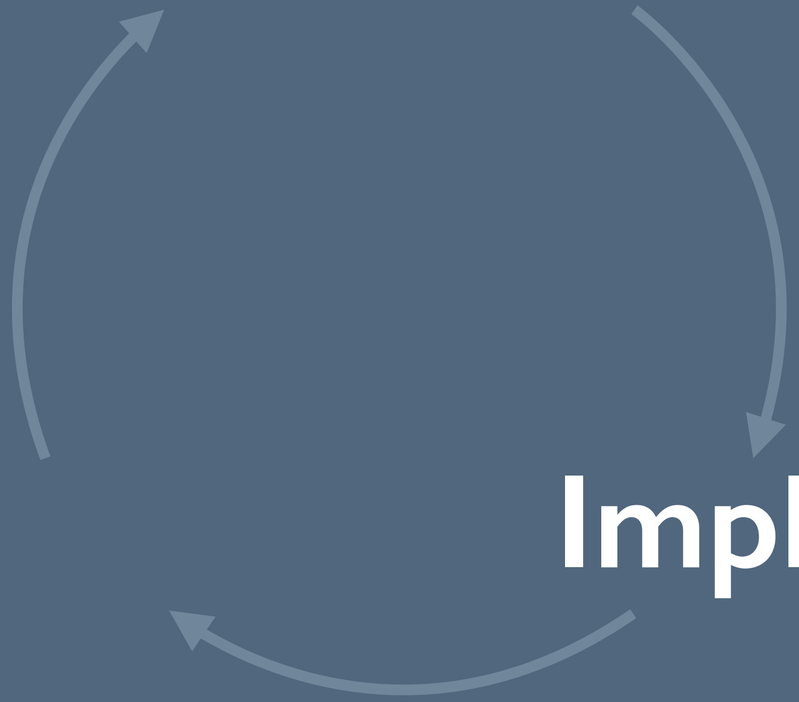


Implement

Goal of prototyping tools: decrease construction time

If we can realize our idea or sketch into a prototype faster, then we can get to a reflection stage faster

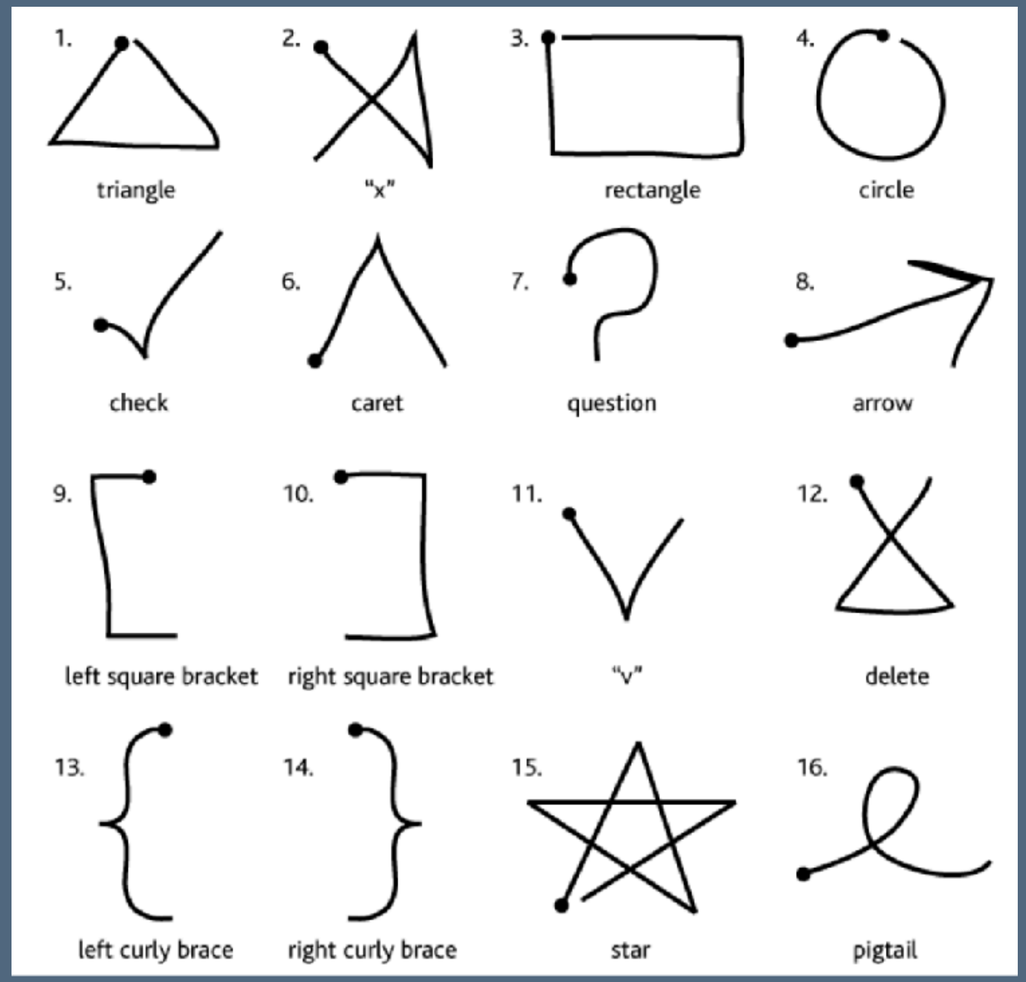
$1 gesture recognizer

[Wobbrock, Wilson, and Li 2007]

Training an end-to-end ML system for gesture recognition would take thousands of examples and a lot of time—infeasible for prototyping

The "$1 recognizer": quick 100 lines of code for 97% accuracy with only one example

Resample, rescale, rotate, and template match



Rapid, simple controls

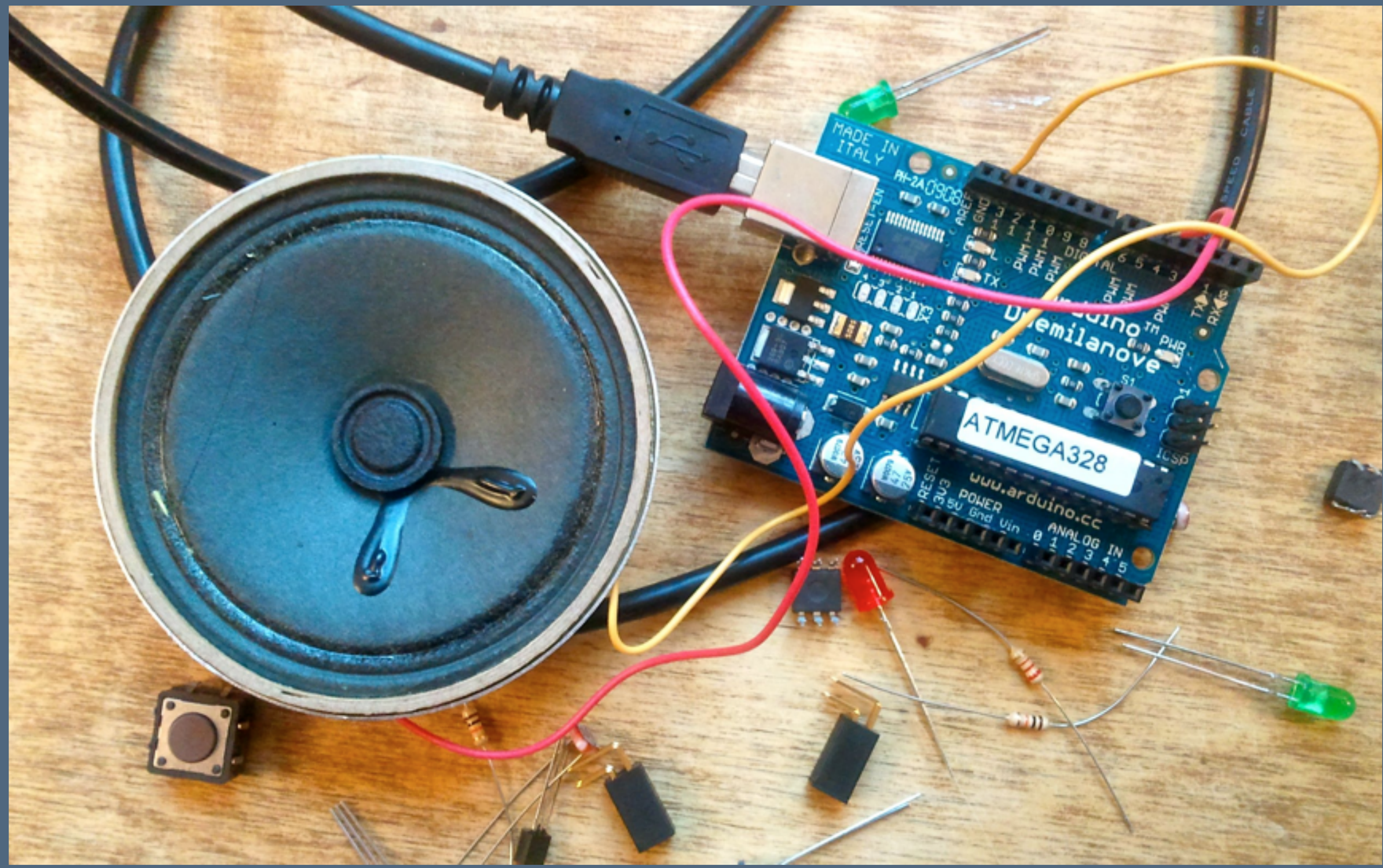
[Beginner's Mind Collective and Shaw 2012]

All you need is alligator clips

Can't do complex interaction with it, but lets you get off the ground quickly

Arduino

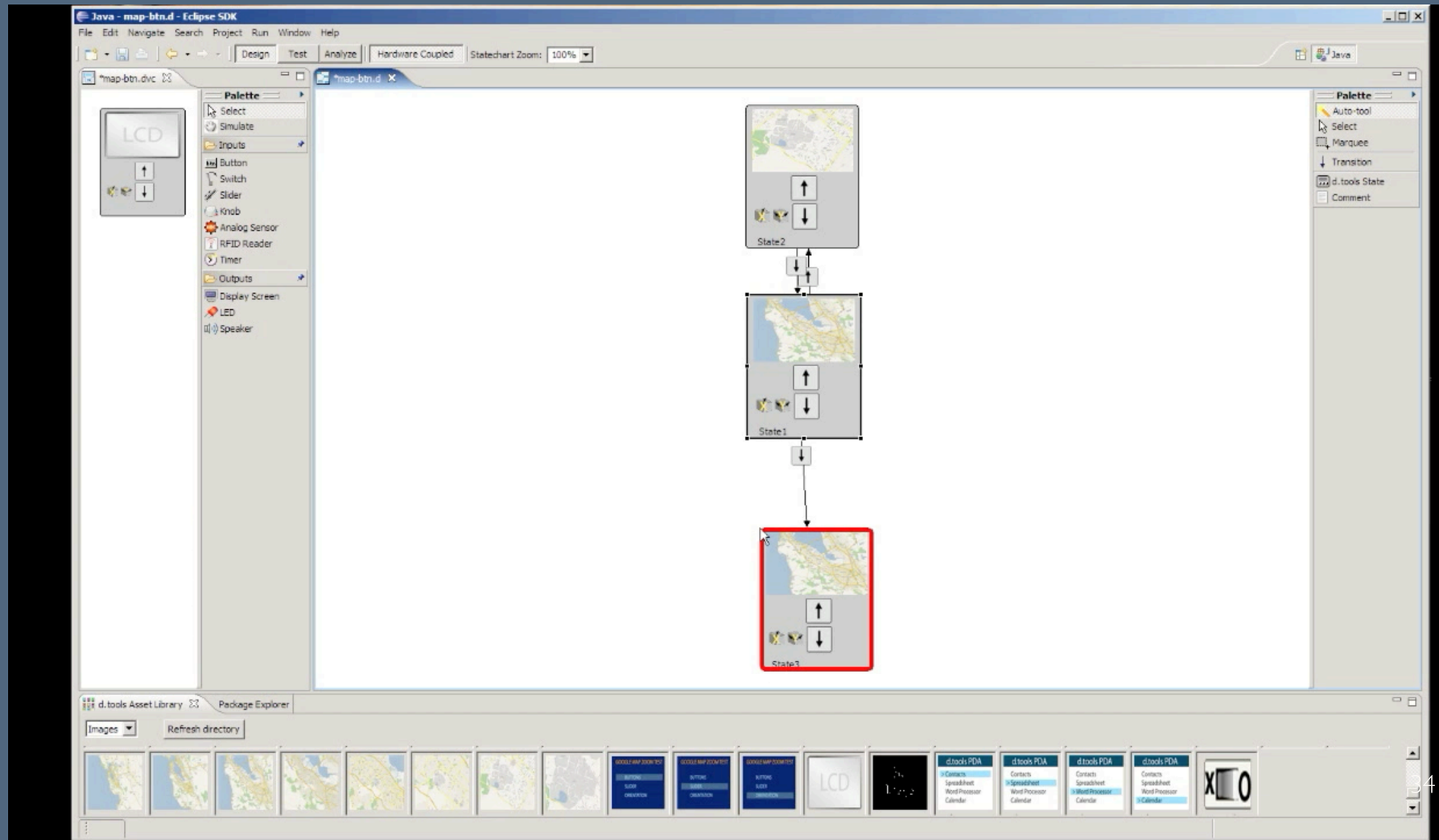
Maker board for artists, programmers and hobbyists



Prototyping physical computing

[Hartmann et al. 2006]

Plug-and-play hardware and visual statechart authoring



Replacing electronics with cameras [Savage et al. 2013]

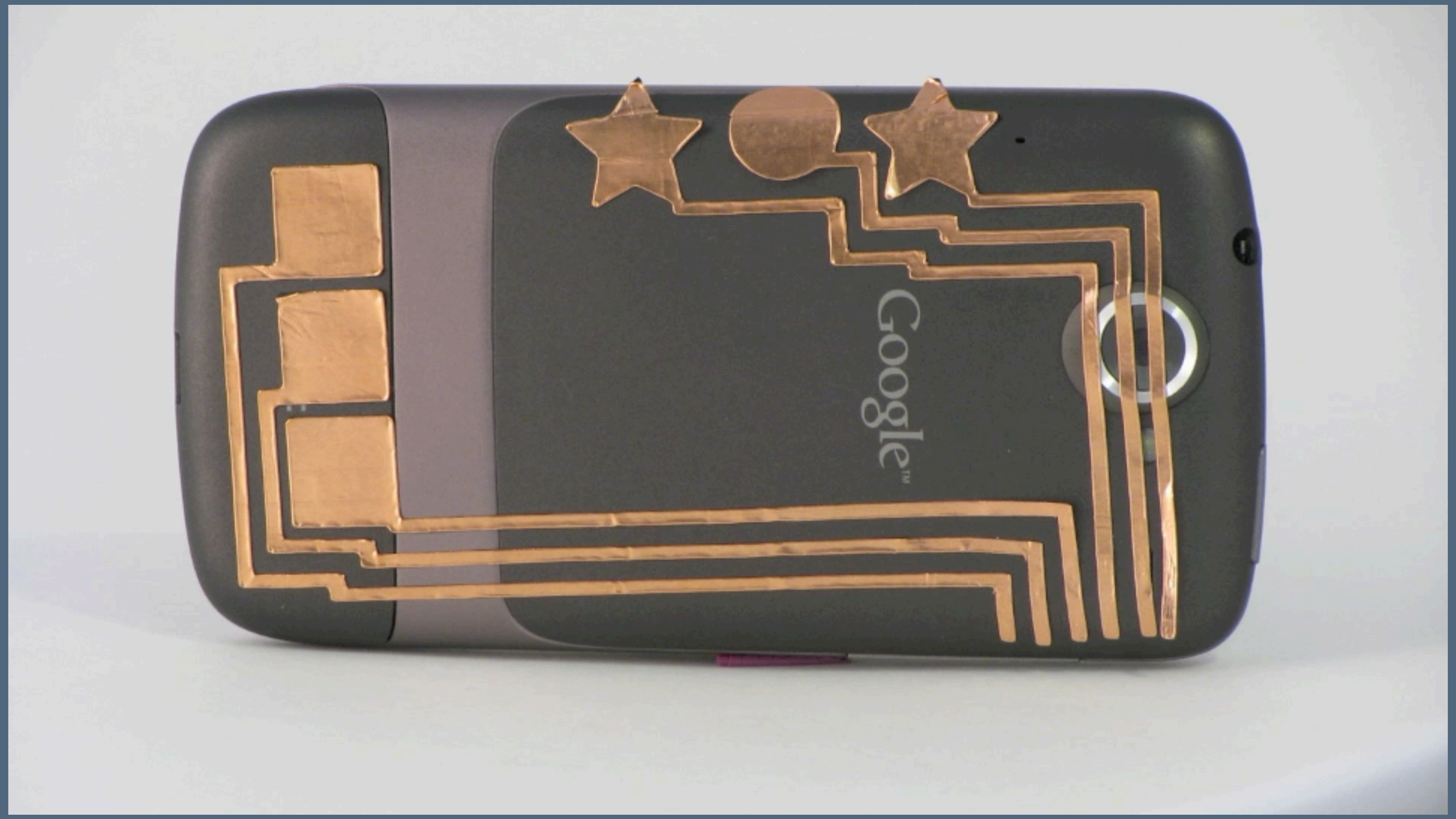
3D print your envisioned device, then screw a camera into the back of it and use computer vision instead of electronics

Prototyping touch-sensitive UIs

[Savage et al. 2012]

Make touch-sensitive physical devices in minutes

Create the UI layout, and software takes it from there



Goal of comparison tools: facilitate exploration

If we can generate many alternatives quickly, we can more rapidly explore a design space

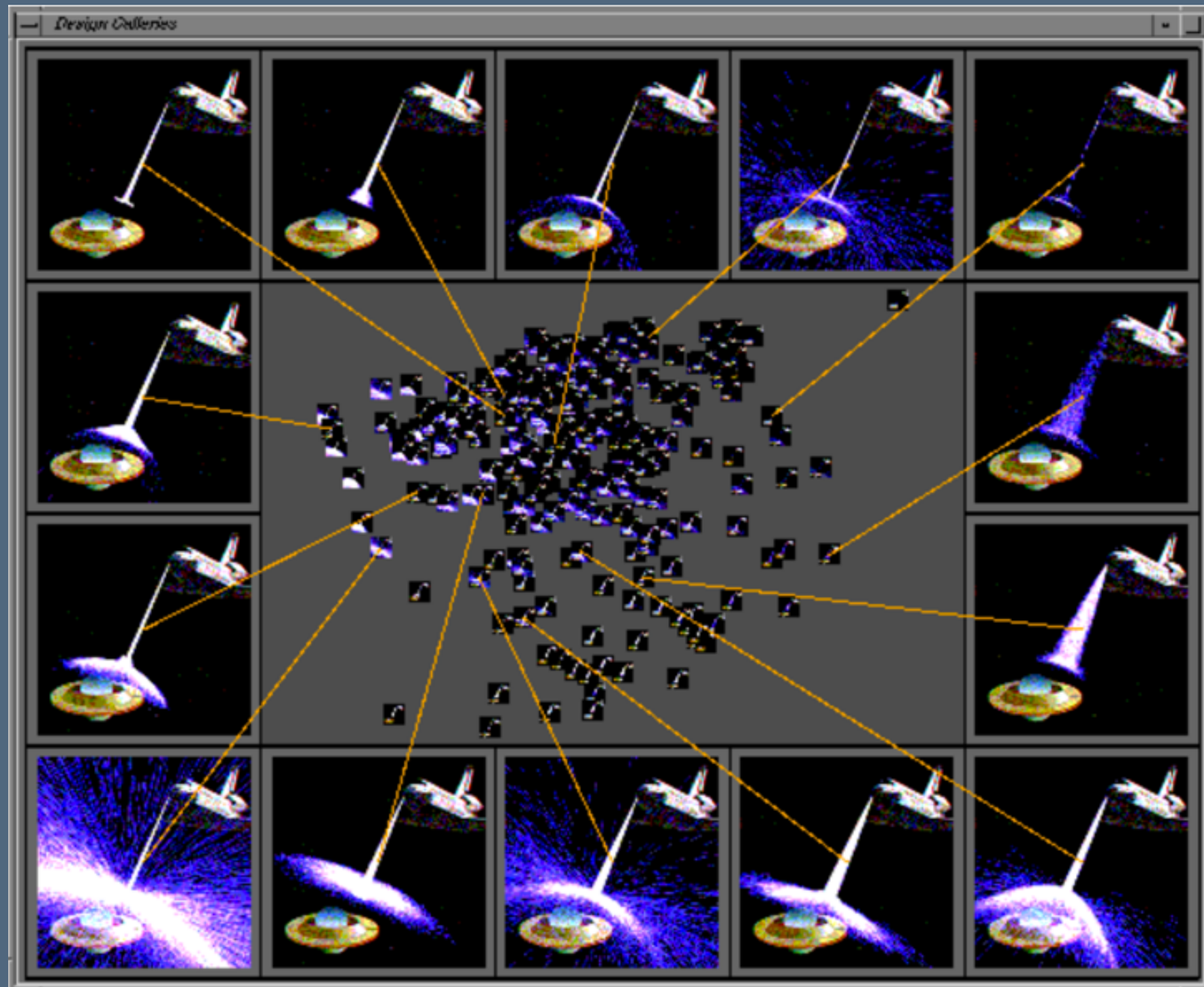
Design galleries

[Marks et al. 1997]

Automatically generate perceptually-varying alternatives within a design space

Helps the designer explore other feasible approaches

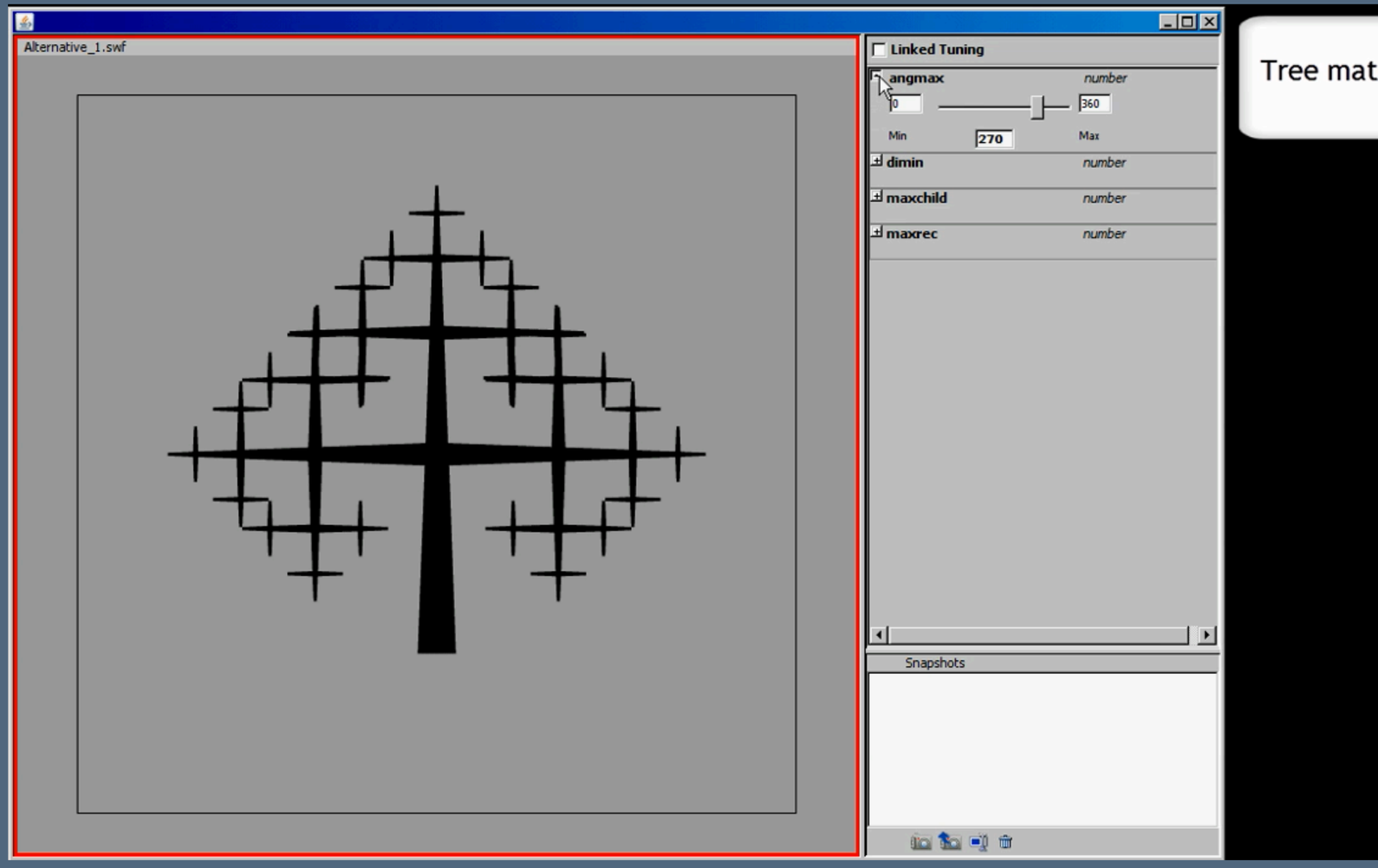
Now a widely-adopted technique inside of design tools



Explore alternatives

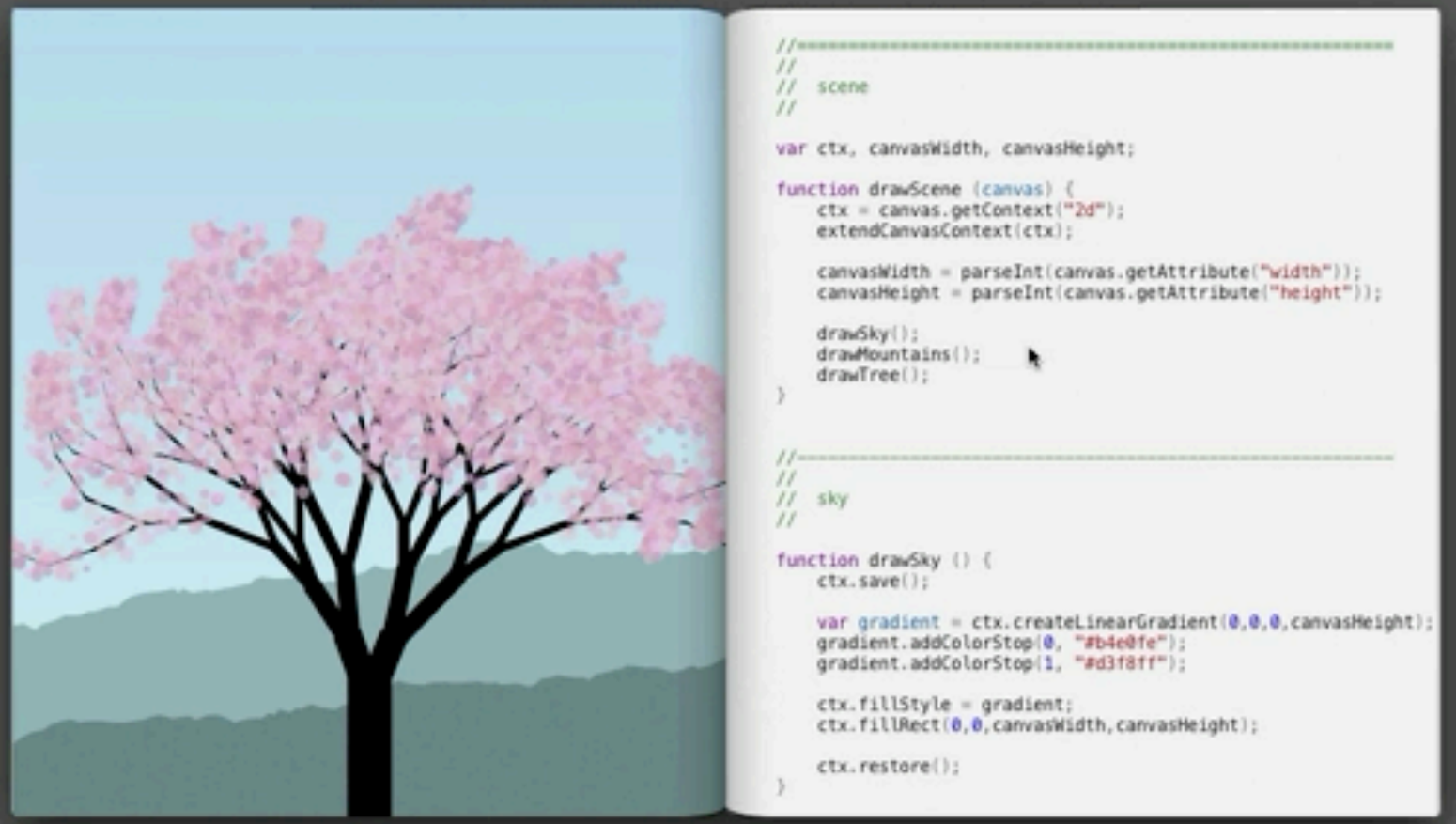
[Hartmann et al. 2009]

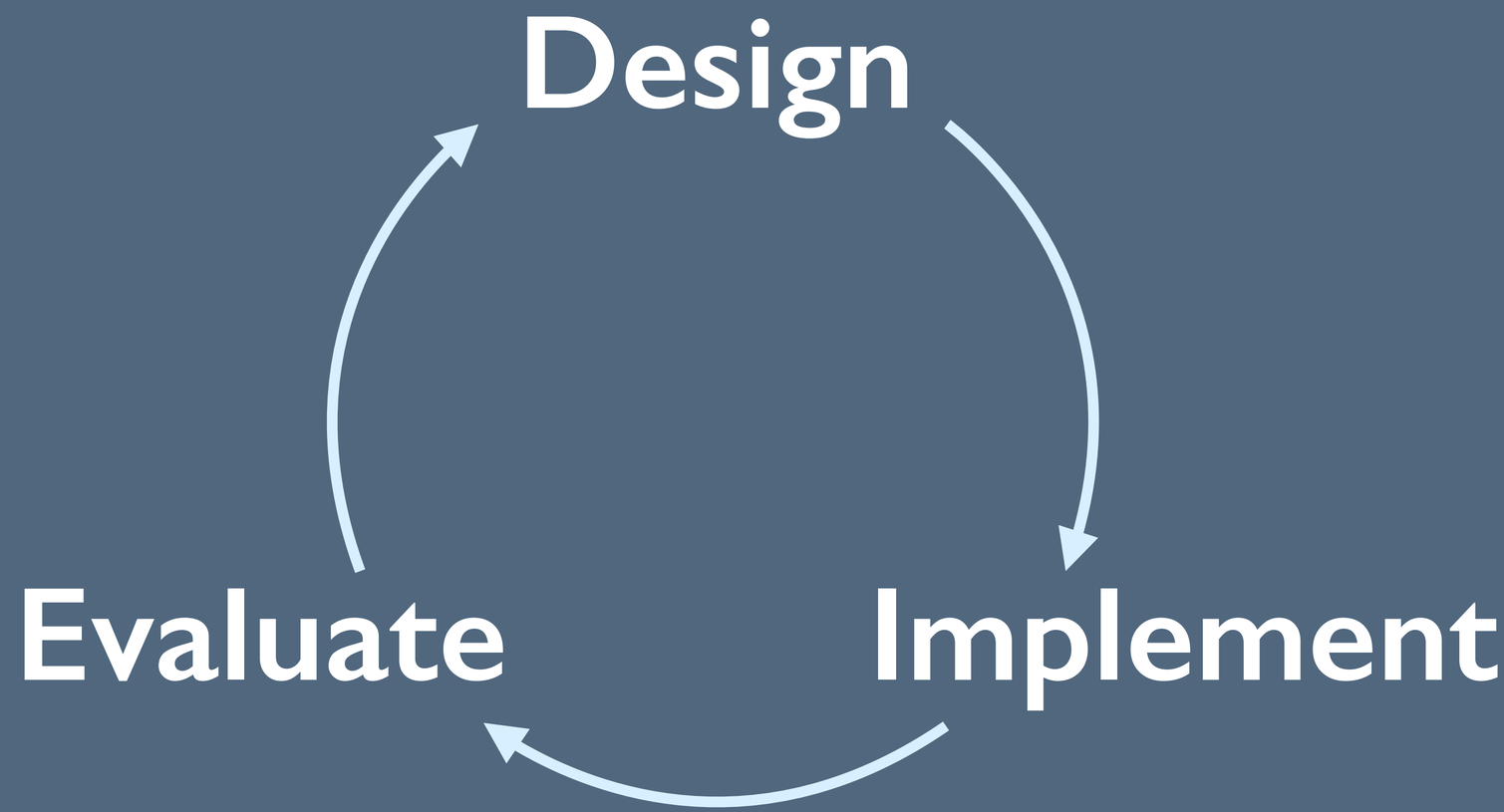
Tighten the loop by allowing exploration of design spaces and alternatives on a live version of the application



Explore alternatives

Inventing on Principle [Victor 2012]

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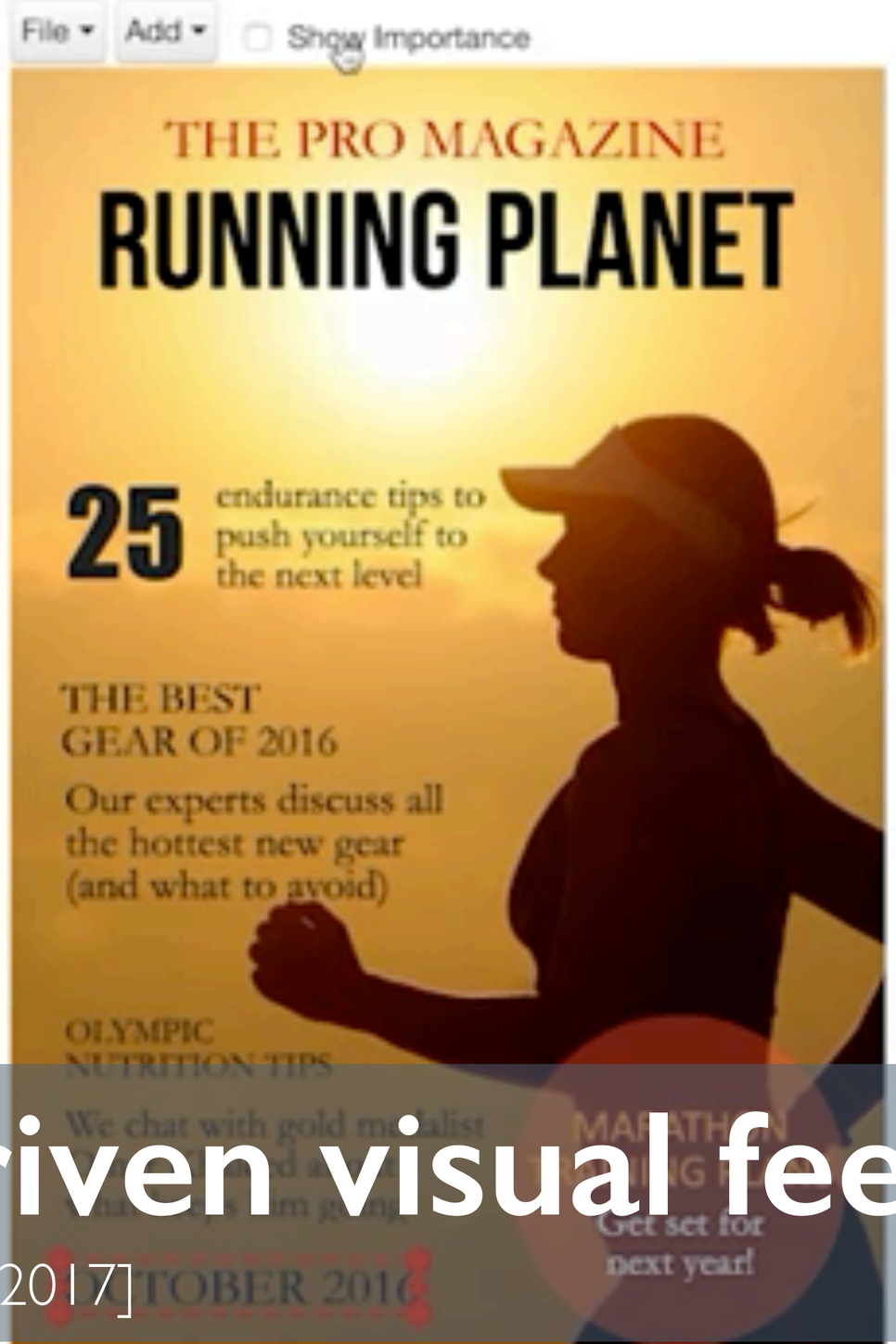
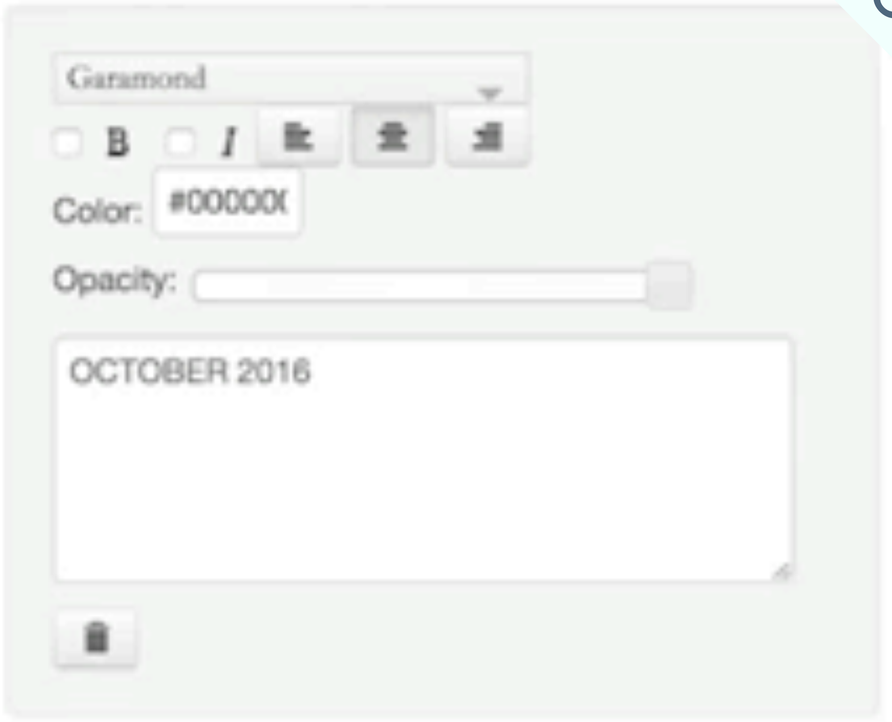




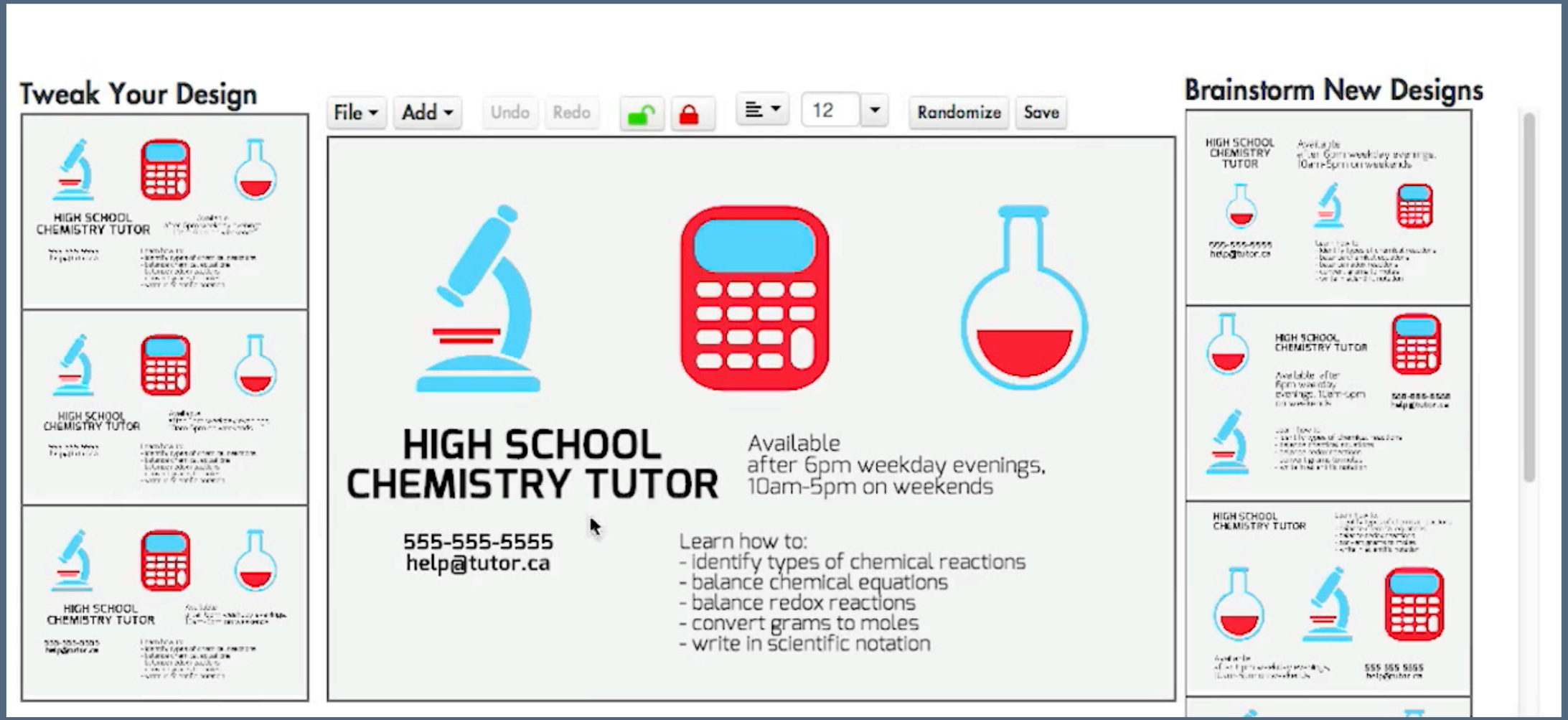
YOU READ THIS

AI-driven visual feedback

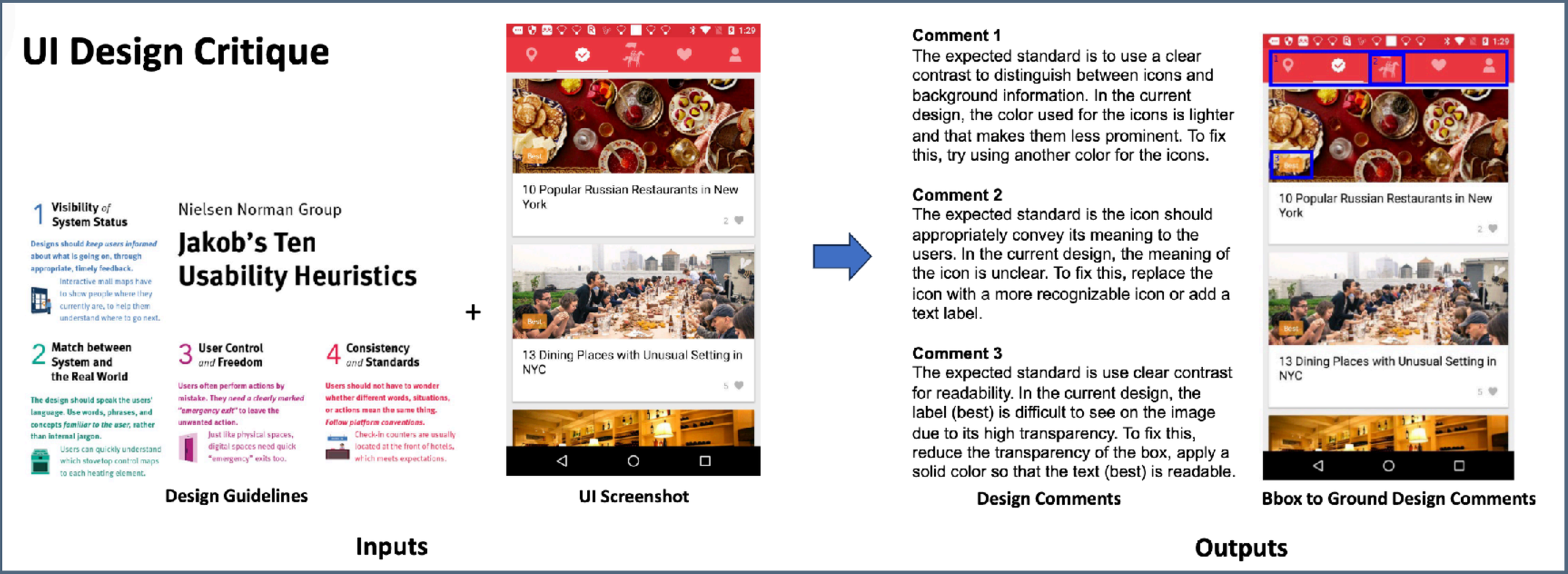
[Bylinskii et al. 2017]

What would a designer say?

[O'Donovan, Agarwala, and Hertzmann CHI '15]



AI feedback



Not open-ended feedback, but critiques according to specific design guidelines such as Nielsen's Heuristics [Duan et al. 2024a; 2024b]

Summary

Schön's reflective practitioner: designers think in cycles; action then reflection

So, to make the designer better, enable more and better reflection

Design tools aid by accelerating components of reflection-in-action:

Early stage design: translation of an idea from the designer's head out into a sketch, the **most rapid externalized representation possible**

Implementation: if we can **realize our sketch into a prototype faster**, then we can **get to a reflection stage faster**

Evaluation: provide **better or more rapid feedback** to support iteration

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