CS-639 — Interaction Design Studio

The Intelligence Design Toolkit*

Professor Bilge Mutlu

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The Final Week

— This is the **last lecture** of CS-639
— **A3 (Ethical Audit & Redesign)** due Monday, May 4
— **Wednesday and Friday** are whiteboard gallery crits — present your A3 redesigns, give and receive feedback
— Today: what you built, what you learned, where it goes

Today is a look-back, a look-inward, and a look-forward.

From Forlizzi to Your Work

Friday's guest lecture showed design operating at the **systems level** — products, services, processes, governance. This semester, you worked at the **product level**.

— Same frameworks, different scale
— Stakeholder mapping works for a mobile app and for workforce policy
— VSD works for a single feature and for an entire organization
— The four questions apply whether you are designing a screen or a service

You learned to design intelligent products. The same thinking applies to services, processes, and systems.

Part 1: Connecting to the Bigger Picture

From course arc to career arc

The Course Arc

Phase	Weeks	Assignment	Question
Foundations	W01-W07	A1: Visual & Interaction Portfolio	Can you design well?
Intelligence	W08-W11	A2: Intelligent System Design	Can you design with intelligence?
Systems	W12	--	Can you systematize your design?
Responsibility	W13-W14	A3: Ethical Audit & Redesign	Can you design responsibly?

A1 proved craft. A2 proved intelligence. A3 proves judgment.

Part 2: The Toolkit

Four layers, one system

— **Frame** — What to decide (the four questions)

— **Guide** — How to decide (the principles)

— **Build** — What to make visible (the components)

— **Evaluate** — How to question it (the method)

Each layer depends on the one before it. Skip a layer and the system breaks.

Layer 1: Frame — The Four Questions

Every intelligent system starts here. Before principles, before pixels — what are you deciding?

Question	Framework	Design Tool
How much should the system do?	Parasuraman et al. (2000)	Four factors + levels of automation
When should it act?	Horvitz (1999)	Expected utility + Act/Ask/Wait
How do they work together?	Johnson et al. (2014)	OPD + collaboration spectrum
What does the system know?	Dey (2001)	Context dimensions + SA levels

These four questions frame the design space. The next layer tells you how to fill it.

Layer 2: Guide — The Principles

The four questions frame what to decide. The principles tell you **how** to decide well.

— **P1-P12** — prescriptive: what to do (Amershi et al., 2019; Weisz et al., 2024)

— **Five ethical principles** — evaluative: what to ask (Jobin et al., 2019)

Principles without framing are arbitrary. Framing without principles is directionless.

Layer 3: Build — The Components

Principles are abstract. Components are **where principles become pixels.**

Component	Principles Served
Confidence indicators	P4 (Communicate Uncertainty)
Processing states	P3 (Honest Capabilities), OPD-O
Explainers	P3, P7 (Explain When Needed)
Override controls	P9 (User Correctability), P10, OPD-D
Adaptation indicators	P6 (Contextual Awareness), P8

P4 says "communicate uncertainty." A confidence indicator is how you do it.

Layer 4: Evaluate — The Method

You framed, guided, and built. Now: **does it serve the right values?**

— **VSD** (Friedman & Hendry, 2019) — conceptual (stakeholders), empirical (failure scenarios), technical (redesign)

— **Six-step ethical audit** + contextual integrity (Barth et al., 2006)

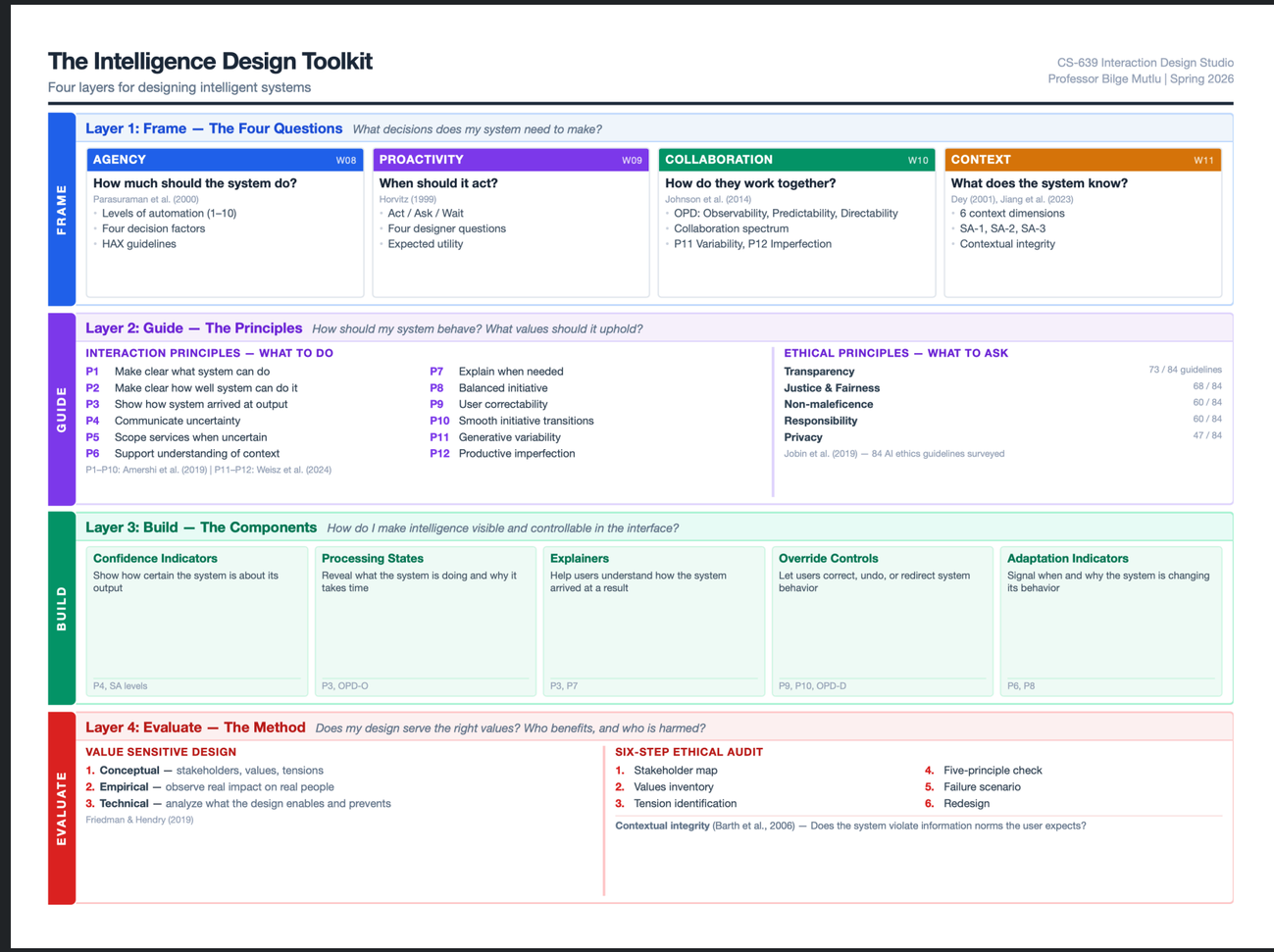
A system can follow every principle and still cause harm. This layer asks: for whom?

Your Toolkit Reference Card

You are receiving a **printed reference card** today.

Four layers. Every framework. One page.

Keep it. Use it in your next design project, your next internship, your next job.



The Intelligence Design Toolkit

Four layers for designing intelligent systems

CS-639 Interaction Design Studio
Professor Bilge Mutlu | Spring 2026

FRAME — Layer 1: Frame — The Four Questions

What decisions does my system need to make?

AGENCY W08
How much should the system do?
Parasuraman et al. (2000)
- Levels of automation (1–10)
- Four decision factors
- HAX guidelines

PROACTIVITY W09
When should it act?
Horvitz (1999)
- Act / Ask / Wait
- Four designer questions
- Expected utility

COLLABORATION W10
How do they work together?
Johnson et al. (2014)
- OPD: Observability, Predictability, Directability
- Collaboration spectrum
- P11 Variability, P12 Imperfection

CONTEXT W11
What does the system know?
Dey (2001), Jiang et al. (2023)
- 6 context dimensions
- SA-1, SA-2, SA-3
- Contextual integrity

GUIDE — Layer 2: Guide — The Principles

How should my system behave? What values should it uphold?

INTERACTION PRINCIPLES — WHAT TO DO

P1	Make clear what system can do	P7	Explain when needed
P2	Make clear how well system can do it	P8	Balanced initiative
P3	Show how system arrived at output	P9	User correctability
P4	Communicate uncertainty	P10	Smooth initiative transitions
P5	Scope services when uncertain	P11	Generative variability
P6	Support understanding of context	P12	Productive imperfection

P1–P10: Amershi et al. (2019) | P11–P12: Weisz et al. (2024)

ETHICAL PRINCIPLES — WHAT TO ASK

Transparency	73 / 84 guidelines
Justice & Fairness	68 / 84
Non-maleficence	60 / 84
Responsibility	60 / 84
Privacy	47 / 84

Jobin et al. (2019) — 84 AI ethics guidelines surveyed

BUILD — Layer 3: Build — The Components

How do I make intelligence visible and controllable in the interface?

Confidence Indicators	Processing States	Explainers	Override Controls	Adaptation Indicators
Show how certain the system is about its output	Reveal what the system is doing and why it takes time	Help users understand how the system arrived at a result	Let users correct, undo, or redirect system behavior	Signal when and why the system is changing its behavior
P4, SA levels	P3, OPD-O	P3, P7	P9, P10, OPD-D	P6, P8

EVALUATE — Layer 4: Evaluate — The Method

Does my design serve the right values? Who benefits, and who is harmed?

VALUE SENSITIVE DESIGN
1. **Conceptual** — stakeholders, values, tensions
2. **Empirical** — observe real impact on real people
3. **Technical** — analyze what the design enables and prevents

Friedman & Hendry (2019)

SIX-STEP ETHICAL AUDIT
1. Stakeholder map
2. Values inventory
3. Tension identification
4. Five-principle check
5. Failure scenario
6. Redesign

Contextual integrity (Barth et al., 2006) — Does the system violate information norms the user expects?

Annotate Your Toolkit (2 min)

Look at your reference card and do three things:

1. **Circle** the framework you used most this semester
2. **Star** the one you wish you had used earlier
3. **Underline** the one you will use in your next project

2-3 volunteers share after.

Part 3: What Changed?

Reflection on the semester

Pair Discussion (5 min)

Find a partner. Discuss:

1. What is the **biggest shift** in how you think about design from W01 to now?
2. Which framework **changed how you see products** you use every day?
3. If you could redo A2 with everything you know now, **what would you do differently?**

You do not need to agree. You need to articulate.

Share-Out (5 min)

4-5 volunteers.

One sentence each: **what shifted for you?**

Part 4: Where This Goes

Beyond this course

Your Portfolio Arc

Your three assignments tell a story:

Assignment	What It Demonstrates
A1: Visual & Interaction Portfolio	Craft — you can design well
A2: Intelligent System Design	Intelligence — you can design with AI as a material
A3: Ethical Audit & Redesign	Judgment — you can question your own work

That is a portfolio narrative: from craft to intelligence to responsibility. Few undergraduates can show that arc.

Three assignments. One arc. That is a portfolio.

Where These Frameworks Apply

The toolkit you built this semester applies far beyond this course:

— **AI/ML product design** — the four questions, P1-P12, component types
— **UX research** — stakeholder mapping, contextual inquiry, failure scenarios
— **Product management** — automation levels, collaboration spectrum, tradeoff analysis
— **Policy and governance** — VSD, five ethical principles, contextual integrity (Forlizzi's path)

Intelligence is becoming a design material in every domain. You now have a vocabulary for it.

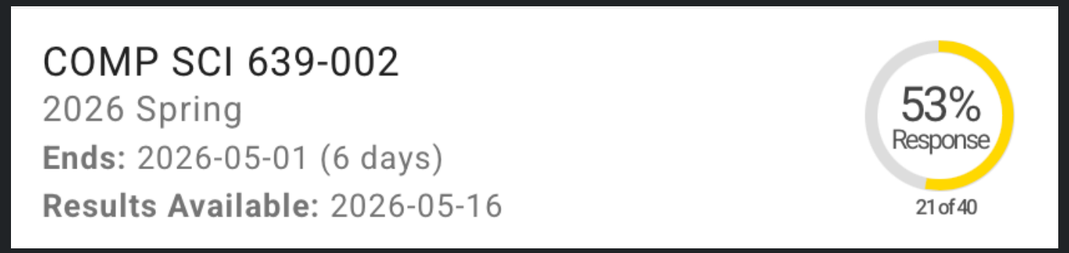
Intelligence as a design material is not a course topic. It is the future of the field.

This Week

Day	What Happens
Monday (today)	The Intelligence Design Toolkit
Wednesday	Whiteboard gallery crit
Friday	Whiteboard gallery crit

Use the crits to strengthen A3 before submission. Feedback now is worth more than feedback after the grade.

If you haven't completed your course evaluations, please do:



Thank You

This was the **first offering** of CS-639. You shaped it.

— Your questions made lectures better
— Your critiques made each other's work stronger
— Your struggles showed me where the course needed to grow
— Your designs proved that intelligence is a design material worth teaching

Keep designing. Keep questioning. Keep iterating.

Thank you for making this course what it became.

References

Course Frameworks:

— Parasuraman et al. (2000). "A Model for Types and Levels of Human Interaction with Automation" — IEEE SMC

— Horvitz (1999). "Principles of Mixed-Initiative User Interfaces" — CHI '99

— Johnson et al. (2014). "Coactive Design" — JCEDM

— Dey (2001). "Understanding and Using Context" — Personal and Ubiquitous Computing

— Jiang et al. (2023). "A Situation Awareness Perspective on Human-AI Interaction" — IJHCI

— Amershi et al. (2019). "Guidelines for Human-AI Interaction" — CHI '19

Ethics & Design Systems:

— Weisz et al. (2024). "Design Principles for Generative AI Applications" — CHI '24

— Jobin et al. (2019). "The Global Landscape of AI Ethics Guidelines" — Nature Machine Intelligence

— Friedman & Hendry (2019). Value Sensitive Design — MIT Press

— Friedman & Hendry (2012). "The Envisioning Cards" — CHI '12

— Barth et al. (2006). "Privacy and Contextual Integrity" — IEEE S&P

— Saffer (2013). Microinteractions — O'Reilly

Media Sources

No external media used in this lecture.