

Machine Learning as a Design Material Imagining Beyond Automation, Reminders and Recommenders



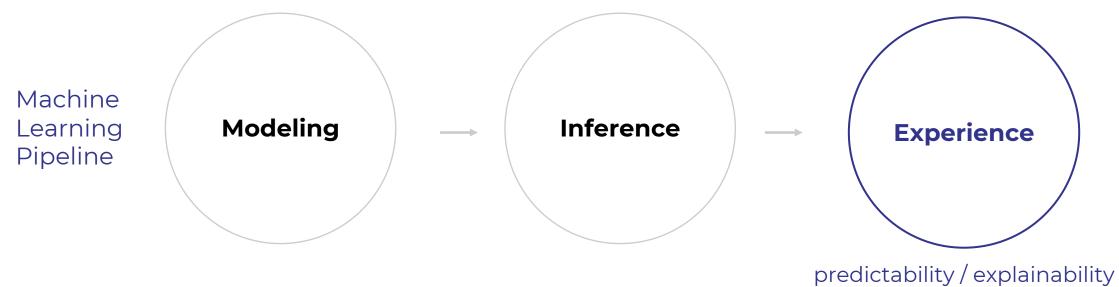
Qian Yang (HCII)

Joint work with John Zimmerman (HCII)

Aaron Steinfeld (RI)

And Others

Backstories

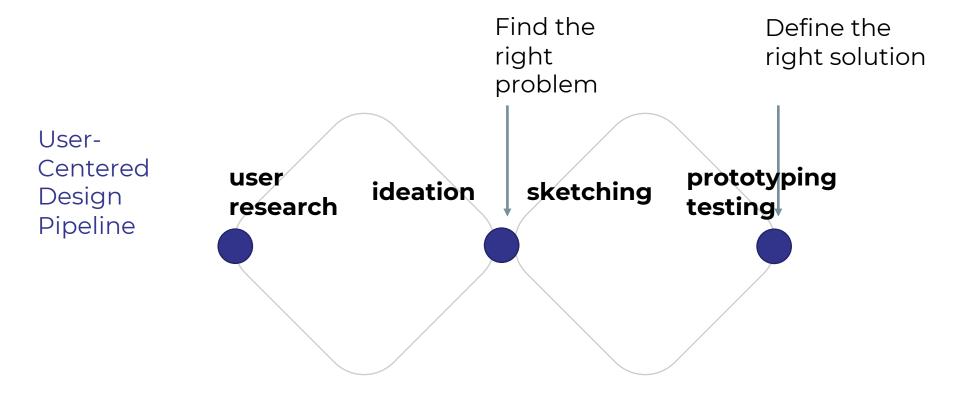


trust / transparency

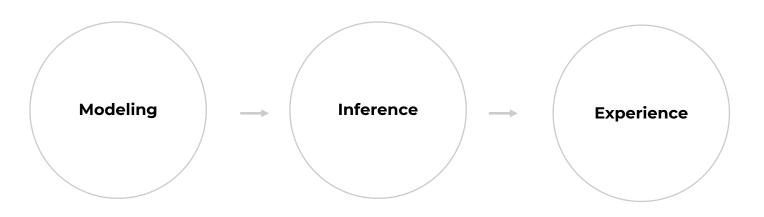
UX cost of inference errors

feeling of control / agency

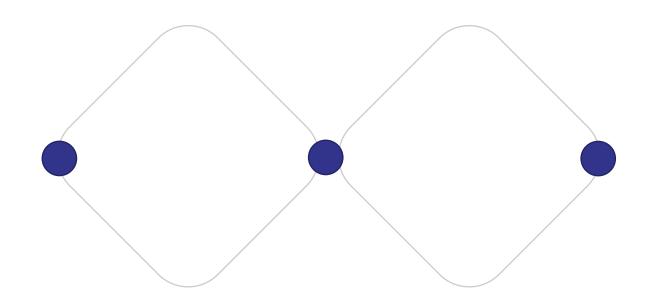
Backstories



Machine Learning Pipeline



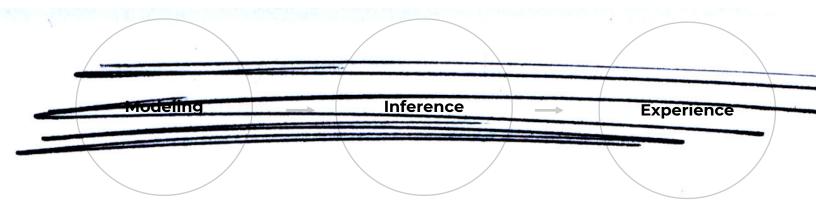
User-Centered Design Pipeline



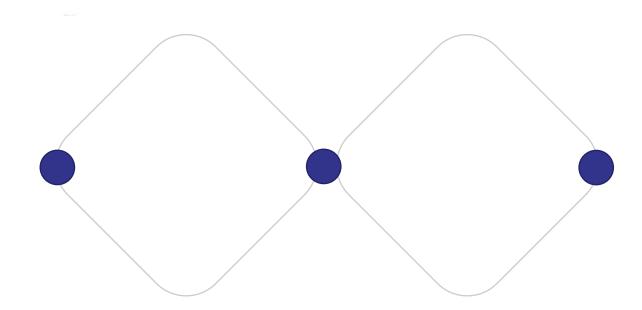
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Designing Context-Aware UI
 DIS'16
Designing Clinical Decision Support
 CHI'16
UX-ML Design Workshops
unpublished
Synthesis of HCI Literature
 CHI'18
Investigating Best Practice in Industry
 DIS'18
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My Starting Point

Machine Learning Pipeline



User-Centered Design Pipeline

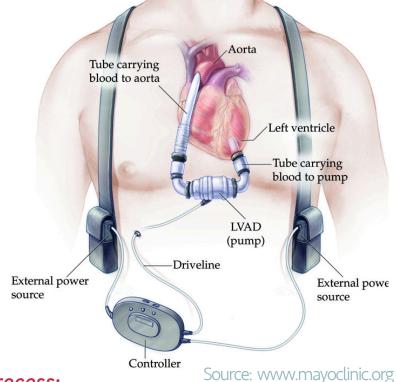


Designing a Machine Learning Tool
In Support of Artificial Heart Implant Patient Selection

A difficult end-of-life decision

- High-risk surgery and recovery
- Lifestyle change
- Critical implant window

Available data and learning algorithms that predict likely outcome of a patient's implant



Yang et al. Investigating the Heart Pump Implant Decision Process: Opportunities for Decision Support Tools to Help. CHI '16

Reframing the Problem of Designing Human-Centered ML

Technology in Searching for a Purpose

Machine Learning Technical Advances in Searching for a Purpose

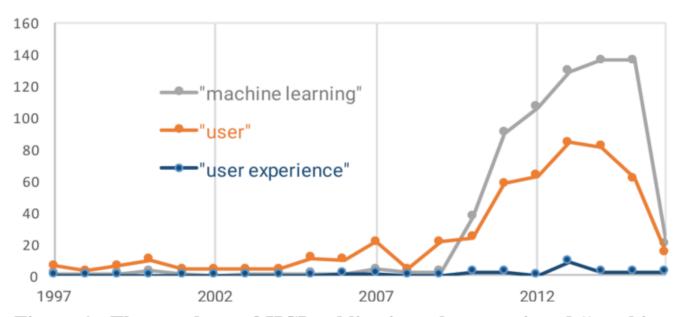


Figure 1. The numbers of HCI publications that mentioned "machine learning", "machine learning" and "user", and "machine learning" and "user experience" over the years.

Qian Yang, Nikola Banovic, and John Zimmerman. Mapping Machine Learning Advances from HCI Research to Reveal Starting Places for Design Research. CHI '18.

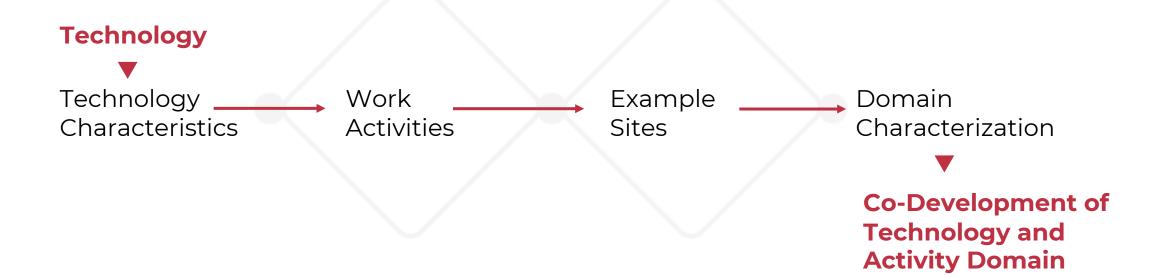
Reframing the Problem of Designing Human-Centered ML

Technology in Searching for a Purpose

Machine Learning Technical Advances in Searching for a Purpose

Match-Making

S. Bly and E. F. Churchill. 1999. **Design through matchmaking: technology in search of users. interactions** 6, 2 (March 1999), 23-31.



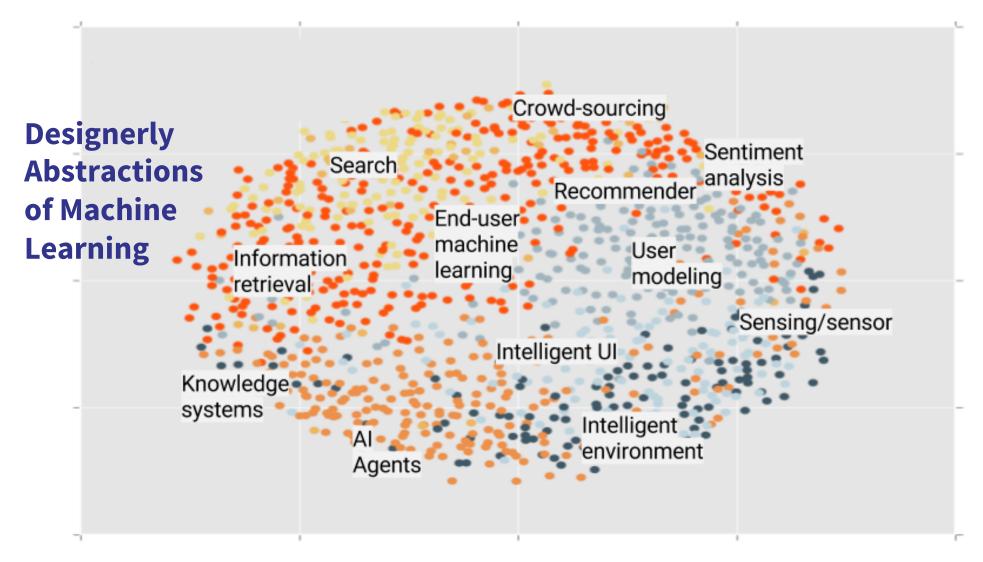
Match-Making

S. Bly and E. F. Churchill. 1999. **Design through matchmaking: technology in search of users. interactions** 6, 2 (March 1999), 23-31.

Machine Learning



Co-Development of Technology and Activity Domain



Qian Yang, Nikola Banovic, and John Zimmerman. **Mapping Machine Learning Advances** from HCI Research to Reveal Starting Places for Design Research. CHI '18.

INFERENCE **ACTING**

Sensing Individual Users Designerly ls knowledge Reinforcing inference **Abstractions** by judging Social connections stereotype fi of Machine 's instantaneous activity rnysical status and activity Learning system individual's activity · Task, or activity sequence Error and compensation of error Infer individual's instantaneous internal status Availability or engagement level · Attention level and focus

Identify patterns of the individual's activity

Identify patterns of the individual's internal status

· Intention or intended activity

Awareness and expertise

Patterns of activity sequences

Judge individual's character

Routine and deviation from routine

Mood and emotion

· Preference, attitude

Interests

 Expertise Personality

Sensing Collective Users Sensing Context

Detect context

- Time
- Location
- Device

Detect resources

- Network
- Power

Learning Correlations and Patterns

Map social connections

Structures

Strengths

Detect and track

Collect opinions

Task models

Awareness

attention

Interests

Attitudes

collective activities

- Commonsense
- Expertise

React to preidentified triggers

- Inform or engage user
- Assist user
- Persuade user
- · Cooperate with user
- Automate

Act proactively or autonomously

Prohibits following characteristics...

Social awareness

- Empathy
- Influence
- Change catalyst
- · Conflict management
- Collaboration

Intellency

- · Ouestion & answer
- Object recognition
- Media comprehension

Collecting Universal Knowledge

Collect universal knowledge

Infer behavioural rituals

Social norms

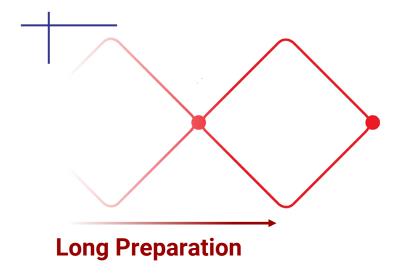
Qian Yang, Nikola Banovic, and John Zimmerman. Mapping Machine Learning Advances from HCI Research to Reveal Starting Places for Design Research. CHI '18.

Machine Learning Technical Advances in Searching for a Purpose

Investigating the Best Practice in Industry

Qian Yang, Alex Scuito, John Zimmerman, Jodi Forlizzi, and Aaron Steinfeld. 2018. Investigating How Experienced UX Designers Effectively Work with Machine Learning. In *Proceedings of DIS '18*

Best Practice in Industry: Match-Making

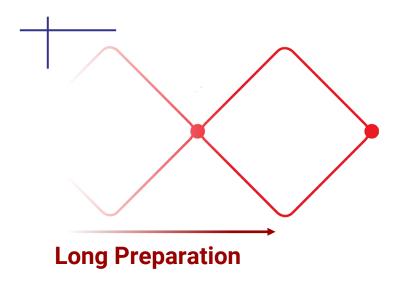


Stage1: Long Preparation

- Design and visualize/analyze telemetry data.
- Observe and monitor user behavioral patterns.
- Imagining what user behavior might be worth learning and what learned interactions might be valuable for users.
- (I) framed the questions not as do you (data scientist) know what would work, but in your gut, do you think this would be possible. Possible on a scale of 1-10. (P8)

^{**} Design and implement baseline interactions at the same time.

Best Practice in Industry: Match-Making



Stage1: Long Preparation

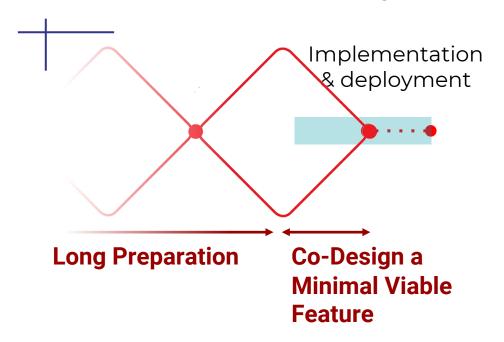
Arriving on a design goal shared between designers and data scientists, i.e.:

We use machine learning so that we can build something that can personalize for a lot of people. (P3)

In consumer tech, we try to **raise the level of abstraction** [of user commands] rather than doing everything manually. (P7)

[I want users] **foreseeing our relationship improve**, where the relationship is the recommendations we are giving them. :ater there is a kind of an acknowledgment when we talk about "personalization"... An acknowledgment that a more personalized experience is a better experience that one is less likely to walk away from. (P14)

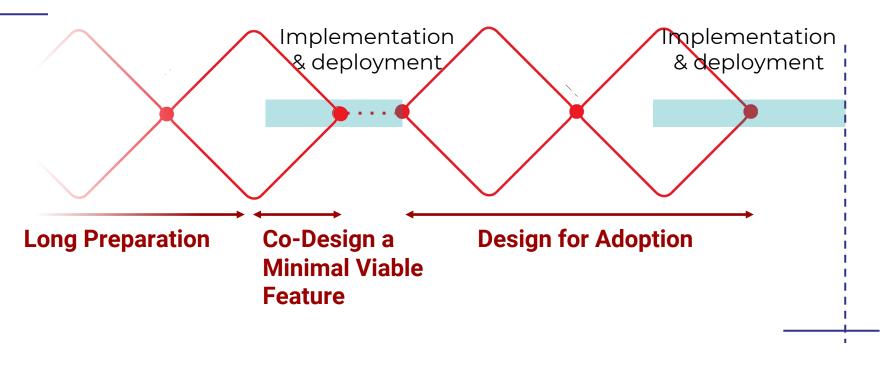
Best Practice in Industry



Stage2: Design, Develop and Deploy a Minimal Viable Product

- Develop a funnel of visions, a funnel of what exists and what is possible in the company (P8).
- Test basic dimensions of the design: i.e. Could users make sense of the ML interaction? Could users easily recover from ML inference errors.
- ** Always offer users the option to turn a new ML feature off.

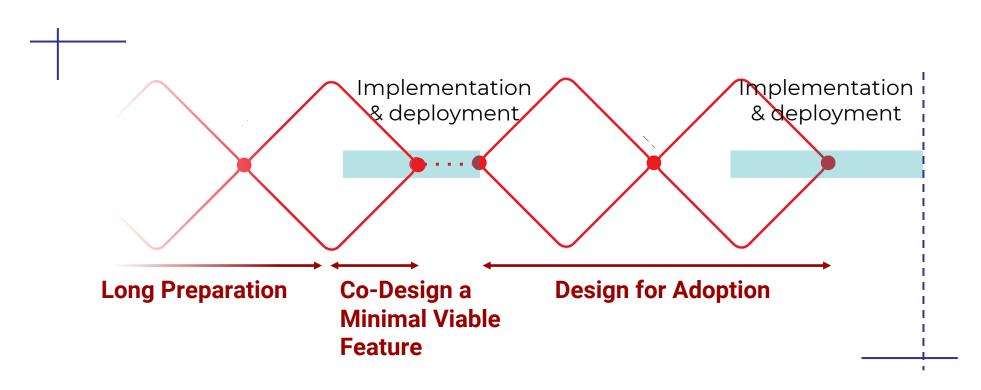
Best Practice in Industry



Stage3: Design for Adaptation

- Understand user mental models via field study and other traditional UCD methods;
- Re-design and potentially re-develop the system.

Best Practice of Designing Machine Learning in Industry



Thank you.

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