

# Human Computer Interaction CS449 – CS549

## Week 2-1

Interaction: Economics, HCI Theories, Frameworks

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KÜRŞAT ÇAĞILTAY

# Week-2 Readings – Read Them!!!

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- Landaurer Trouble with computers
- Landaurer (1995) Excuses, Ch4, pp. 83-113. Trouble with computers: Usefulness, Usability, and Productivity. MIT Press
- Norman - Design of everyday things
- **Norman, D. (2013). The psychology of everyday actions, Ch.2 pp. 37-122. The design of everyday things. Basic Books.**
- Shneiderman-ch3 Guidelines Principles and Theories
- **Shneiderman, B. et.al. (2016). Guidelines, Principles and Theories. pp. 81-120. Designing the User Interface: Strategies for Effective Human-Computer Interaction, 6th Edition**

An abstract graphic featuring a network of white nodes connected by thin white lines, set against a dark blue background with a subtle bokeh effect. The network structure is complex and interconnected, symbolizing digital connectivity.

Digital Economy is  
equivalent to  
15.5% of global  
GDP...

Does IT make  
Enough Impact?

<https://www.worldbank.org/en/topic/digitaldevelopment/overview#1>

## Nobel Economy laureate Robert Solow

"You can see the computer age everywhere but in the productivity statistics."

Productivity/Solow  
Paradox



# Productivity Paradox

## Brynjolfsson (1994)

### THE PRODUCTIVITY PARADOX OF INFORMATION TECHNOLOGY

*Erik Brynjolfsson*

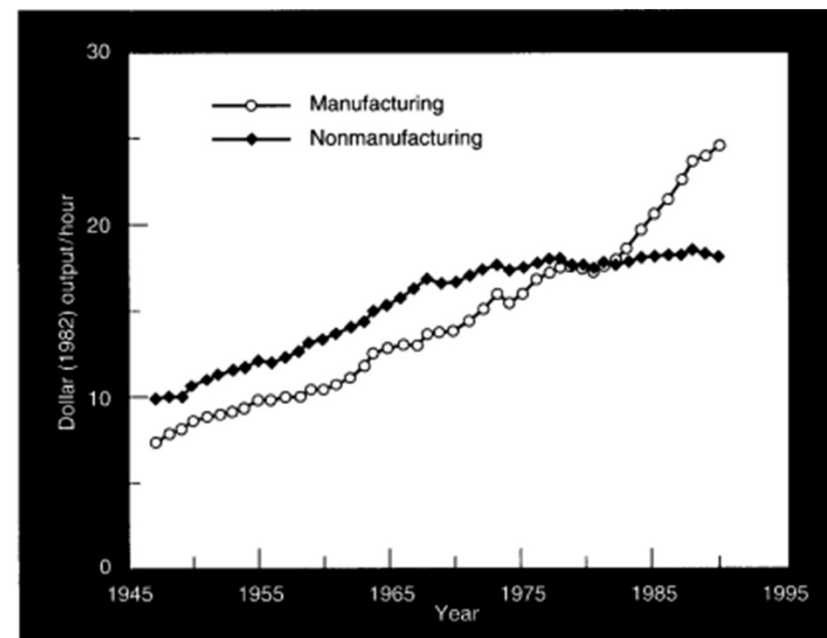
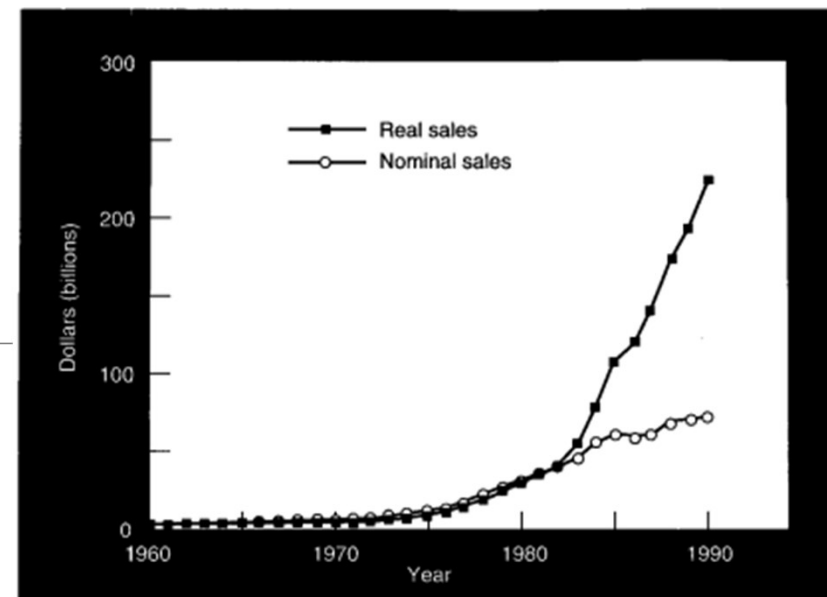
The relationship between information technology (IT) and productivity is widely discussed but little understood. Delivered computing power in the U.S. economy has increased by more than two orders of magnitude since 1970 (Figure 1) yet productivity, especially in the

service sector, seems to have stagnated (Figure 2). Given the enormous promise of IT to usher in "the biggest technological revolution men have known" [29], disillusionment and even frustration with the technology is increasingly evident in statements like "No, computers do not boost productivity, at least not most of the time" [13].

search. After reviewing and assessing the research to date, it appears that the shortfall of IT productivity is as much due to deficiencies in our measurement and methodological tool kit as to mismanagement by developers and users of IT. The research considered in this article reflects the results of a computerized literature search of 30 of the leading journals

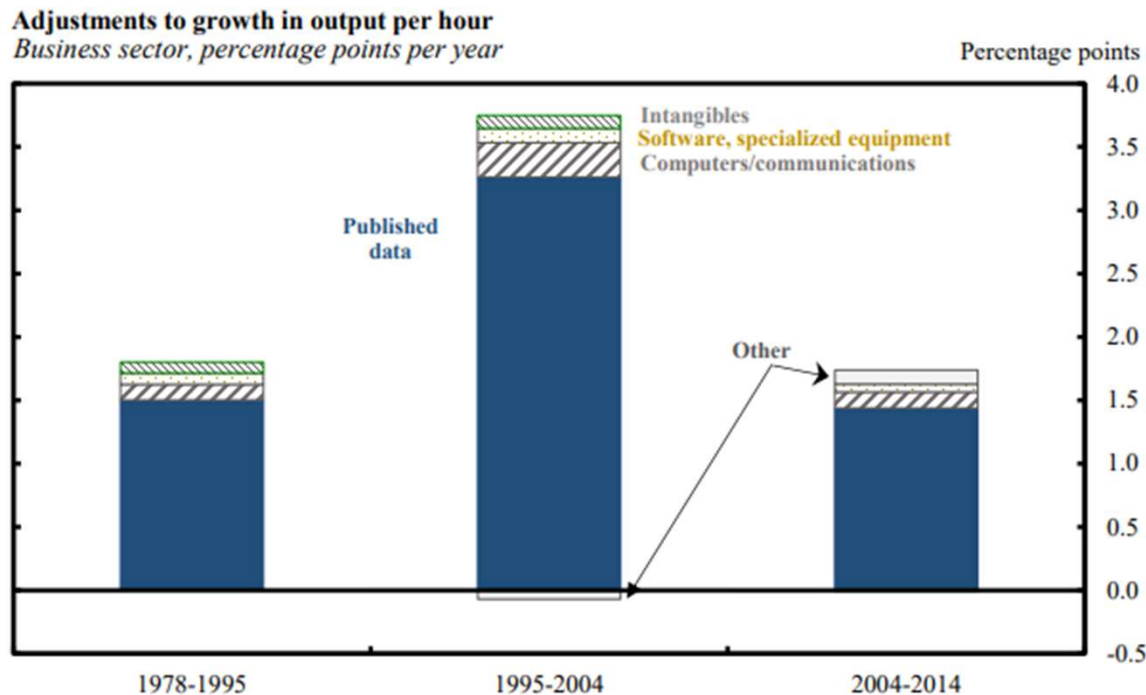
problems assessing the contributions of this critical new technology, and this has been generally interpreted as a negative signal of its value.

The disappointment in IT has been chronicled in articles disclosing broad negative correlations with economywide productivity and information worker productivity. Econometric estimates have also in-



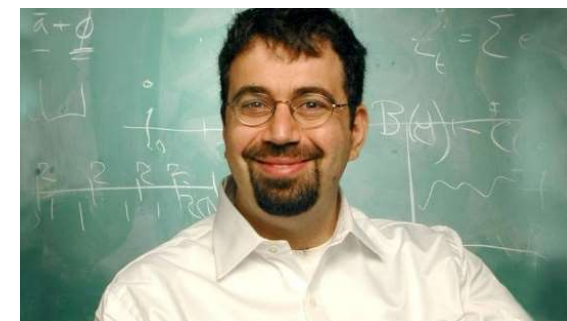
# Technology Boom – Declining Productivity

Figure 1: U.S. labor productivity, 1978-2014: published and adjusted



- THE PRODUCTIVITY SLUMP – FACT OR FICTION: THE MEASUREMENT DEBATE
- Kemal Derviş & Zia Qureshi
- 2016





# Return of the Solow Paradox? IT, Productivity, and Employment in U.S. Manufacturing

Daron Acemoglu, David Autor, David Dorn, Gordon H.  
Hanson & Brendan Price

RESEARCH BRIEFS | NOVEMBER 10, 2020

# Understanding and Addressing the Modern Productivity Paradox

ERIK BRYNJOLFSSON, SETH BENZELL, DANIEL ROCK

RB13-2020

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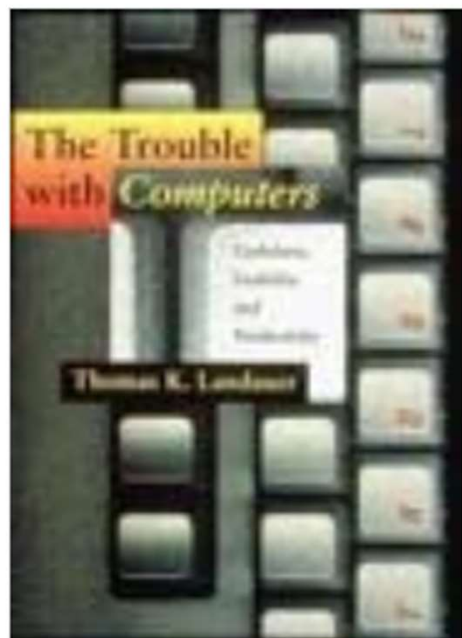


DOWNLOAD RESEARCH BRIEF

We are in the midst of a technological revolution driven by advances in artificial intelligence (AI). Machines can now accomplish many tasks that only human minds could do as recently as 10 years ago (Perrault et al., 2019), from recognizing images (Russakovsky et al., 2015) and understanding speech (Schmelzer, 2020), to generating plausible text (Brown et al., 2020) and diagnosing diseases as well as or better than human doctors (Esteva et al., 2017). These are not insignificant tasks.

- Brynjolfsson
- 2020 - MIT
- <https://workofthefuture.mit.edu/research-post/understanding-and-addressing-the-modern-productivity-paradox/>



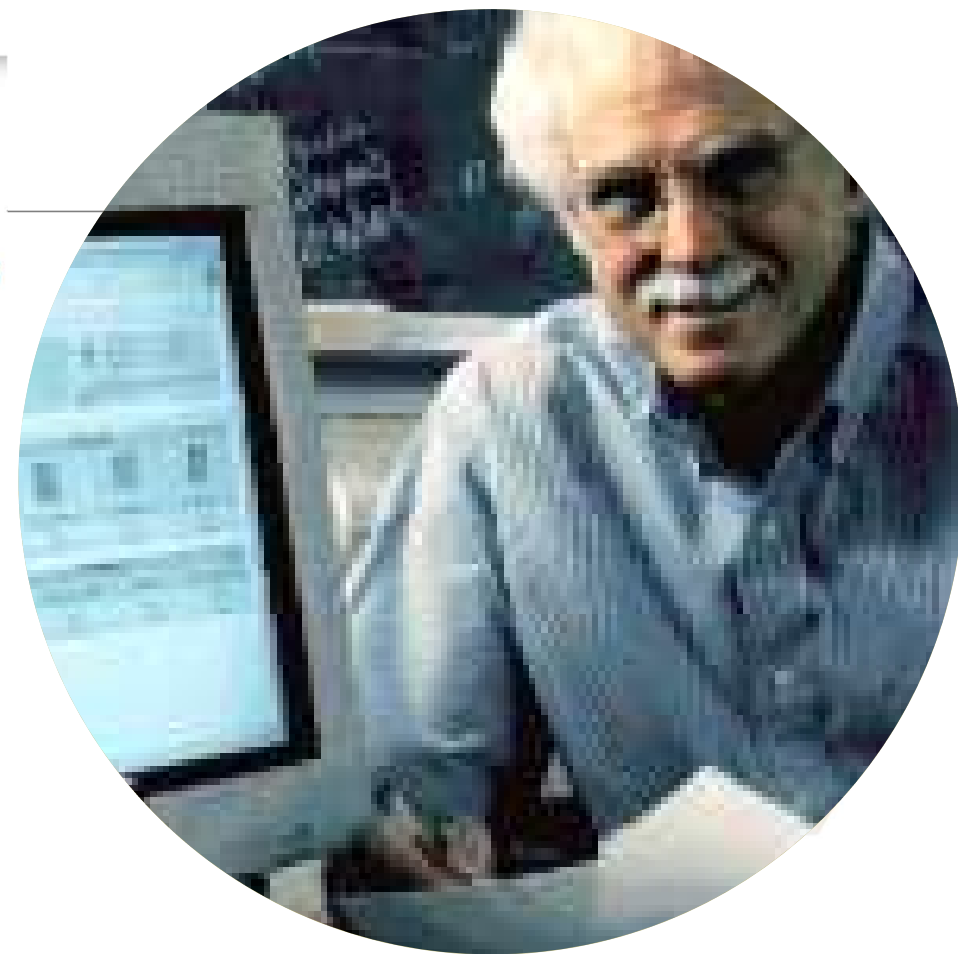
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## The Trouble with Computers

Usefulness, Usability, and Productivity

By Thomas K. Landauer

A Bradford Book



Landauer (1995) Excuses, Ch4, pp. 83-113. Trouble with computers: Usefulness, Usability, and Productivity. MIT Press

# The Productivity Paradox (Landauer, 1995)

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- Productivity data negatively correlates with IT investments
- Counter arguments are unconvincing
  - Takes time for benefits to accrue
  - Sales success means they must be good! e.g. ATMs
  - Testimonials (weakness of anecdotal evidence)
  - Measurement problems (Don Norman says, don't just measure quantitatively but qualitatively)
  - Satisfaction!

# Landauer – one of the reasons

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- Usefulness and Usability: The poor design of software
- Phase-1: Automation, has occurred
- Phase-2: Augmentation, is providing difficult
- User-centered systems design is our best hope

# Interaction with ATM

- First money, next card?
- First card, next money?
- Cost US \$2-4.5 M
- Your bank's ATM?



# Today

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- e-commerce sales of \$738 billion, US and EU,
- potential for 35.26% increase translates to \$260 billion worth of lost orders recoverable by better usability (UX)

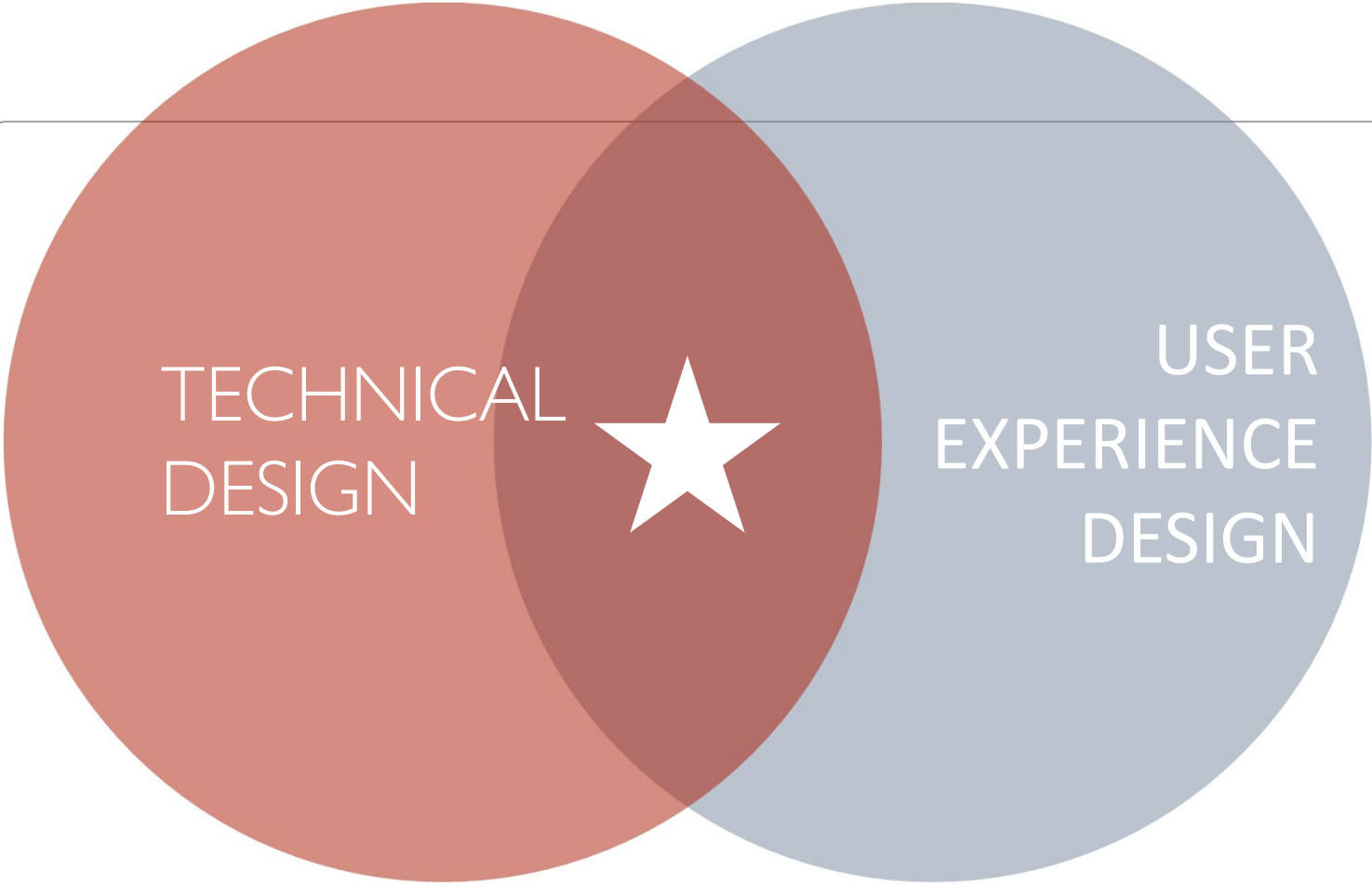
# Economical Impact of Investing in HCI

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- 70% of projects fail due to inability to either attract or retain users
- UX design reduce the time developers need to re-work or 'fix' a product by up to 50%.
- For every dollar invested in UX design, a company can expect 100 dollars in return
- study of 408 companies
  - Companies who considered themselves to be fully user-centric, saw their sales increase by 75%

Reference: <https://uxmastery.com/impact-of-investing-in-ux/#:~:text=Even%20small%20investments%20in%20UX,moved%20through%20its%20product%20cycles.>





TECHNICAL  
DESIGN

A Venn diagram consisting of two overlapping circles. The left circle is reddish-brown and contains the text 'TECHNICAL DESIGN'. The right circle is blue-grey and contains the text 'USER EXPERIENCE DESIGN'. The intersection of the two circles is a darker shade of red and contains a white five-pointed star. A thin horizontal line passes through the top of the circles. A thick orange horizontal bar is at the bottom of the image.

USER  
EXPERIENCE  
DESIGN

01-29-09

## The \$300 Million “Continue” Button

Everyone gets exasperated by bad websites. But we think of those things as tiny annoyances, and assume that users will eventually get what they need. Not true: Tiny mistakes can cost businesses dearly—in fact one poorly designed button might cost \$300 million.

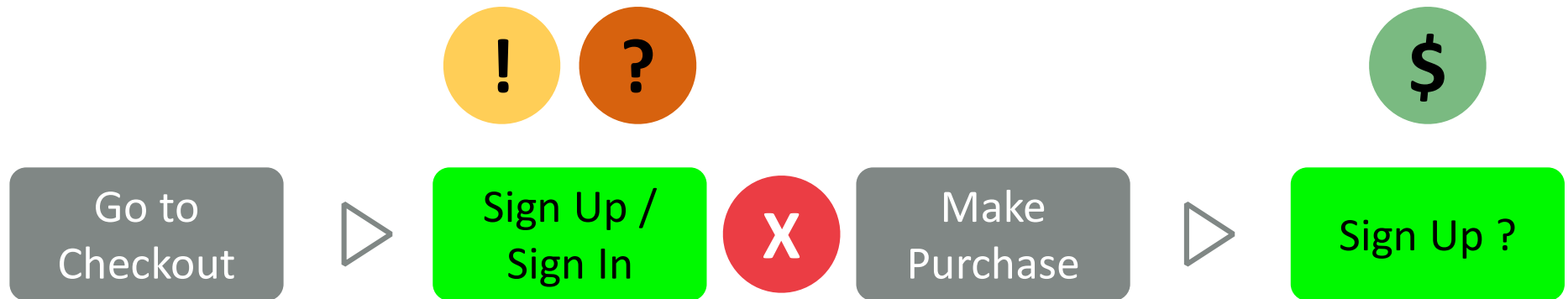


\$300 Million  
Button

Spool, UIE,  
2009

UX design fails when  
the solution does not match users' goals

# The Consumer's Goal on an Ecommerce Site



Spool, UIE,  
2009

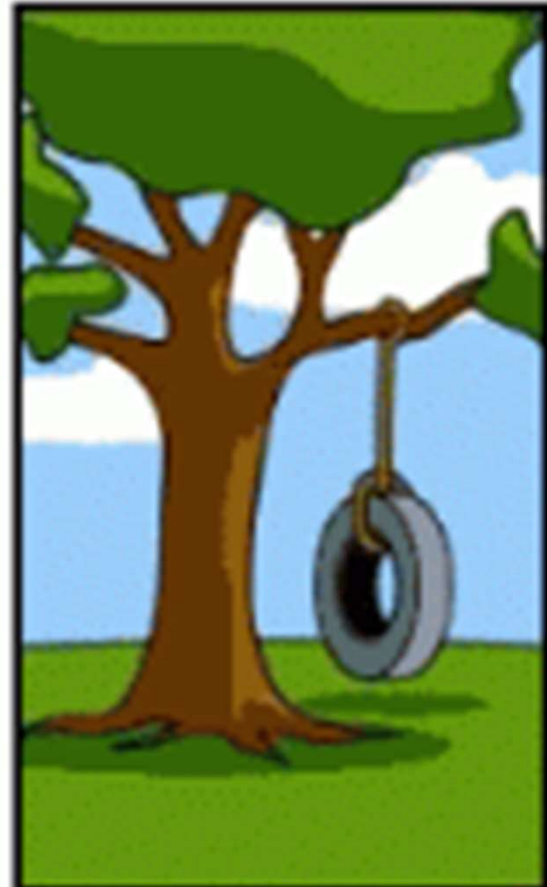
UX design fails when  
the solution does not match users' goals



How the Analyst  
designed it

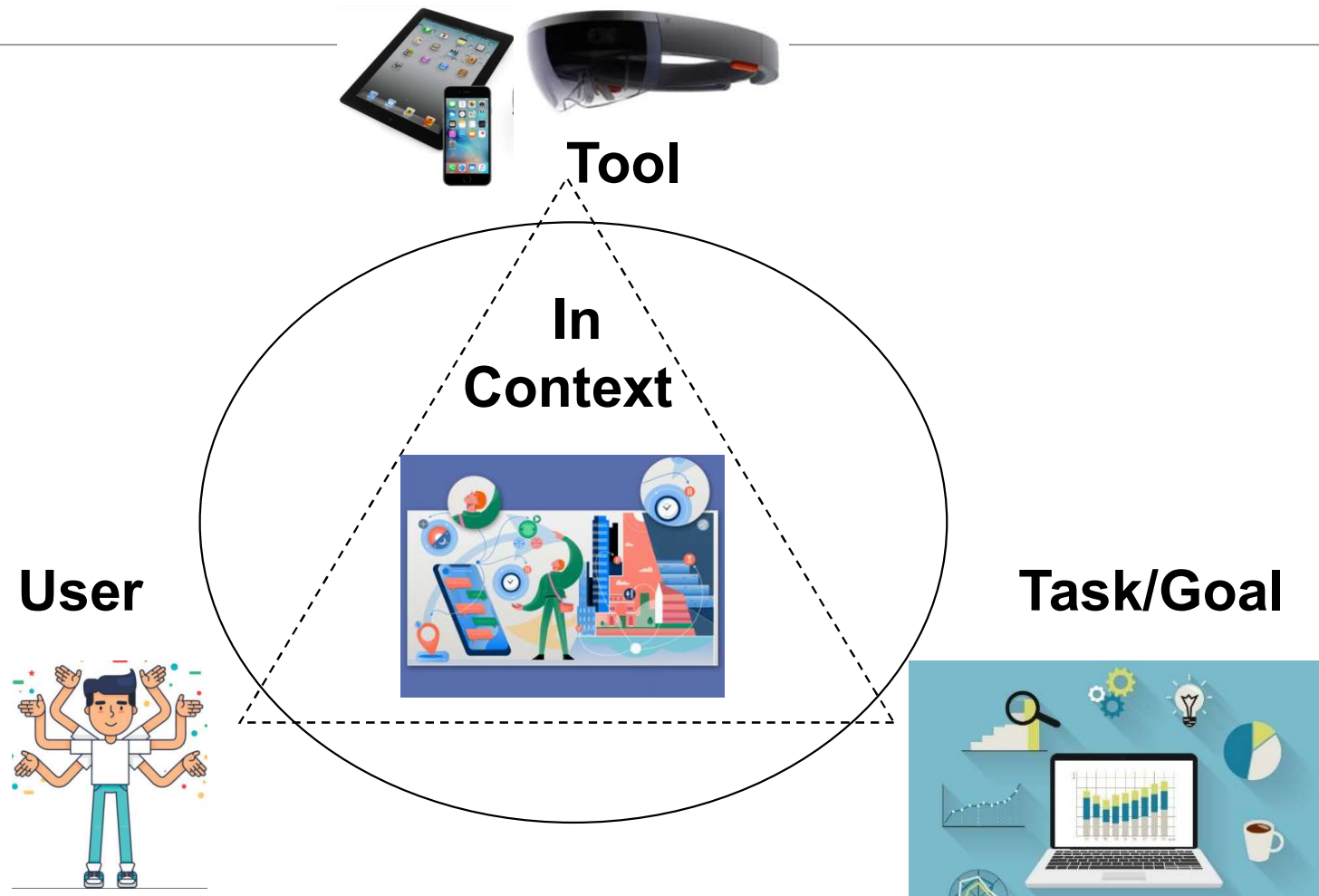


How the Programmer  
wrote it



What the customer  
really needed

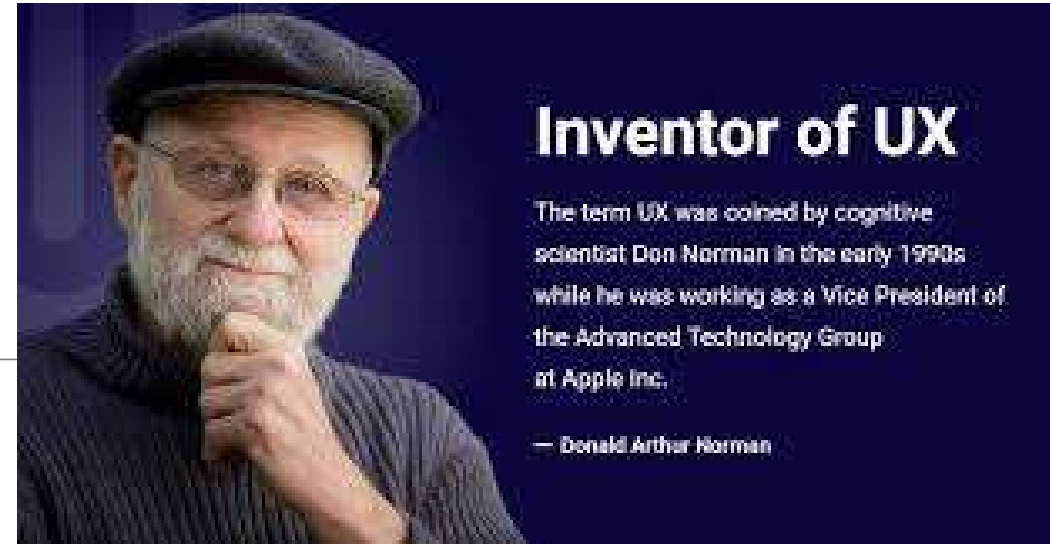
# Four Principle components of an HCI System



# Donald Norman

## Ch-2 Design of Everyday Things

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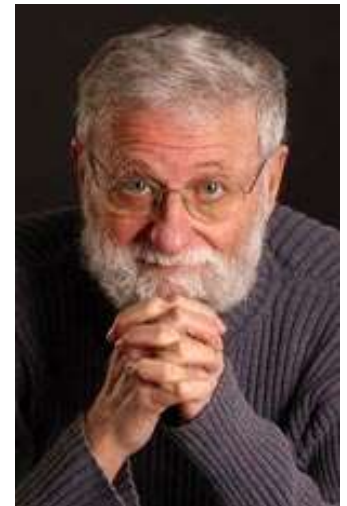
- MIT – Electrical Engineering
- Mathematical Psychology – Ph.D. - University of Pennsylvania
- Department of Cognitive Science-Univ of California, San Diego
- Cognitive science to Cognitive engineering
- Apple Computer, User Experience Architect
  - Vice President of the Advanced Technology Group
- Nielsen Norman Group



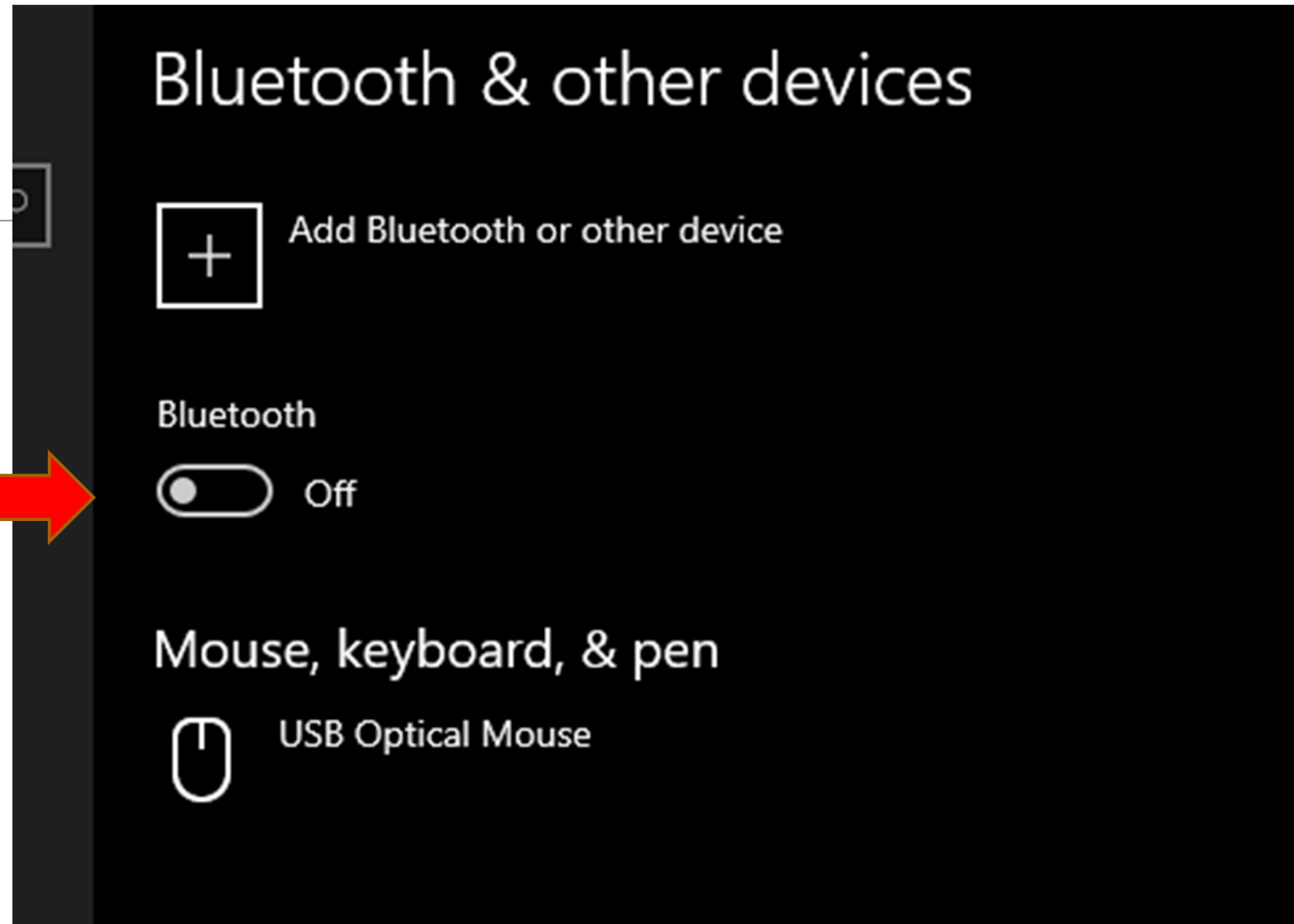
# Norman and Interaction

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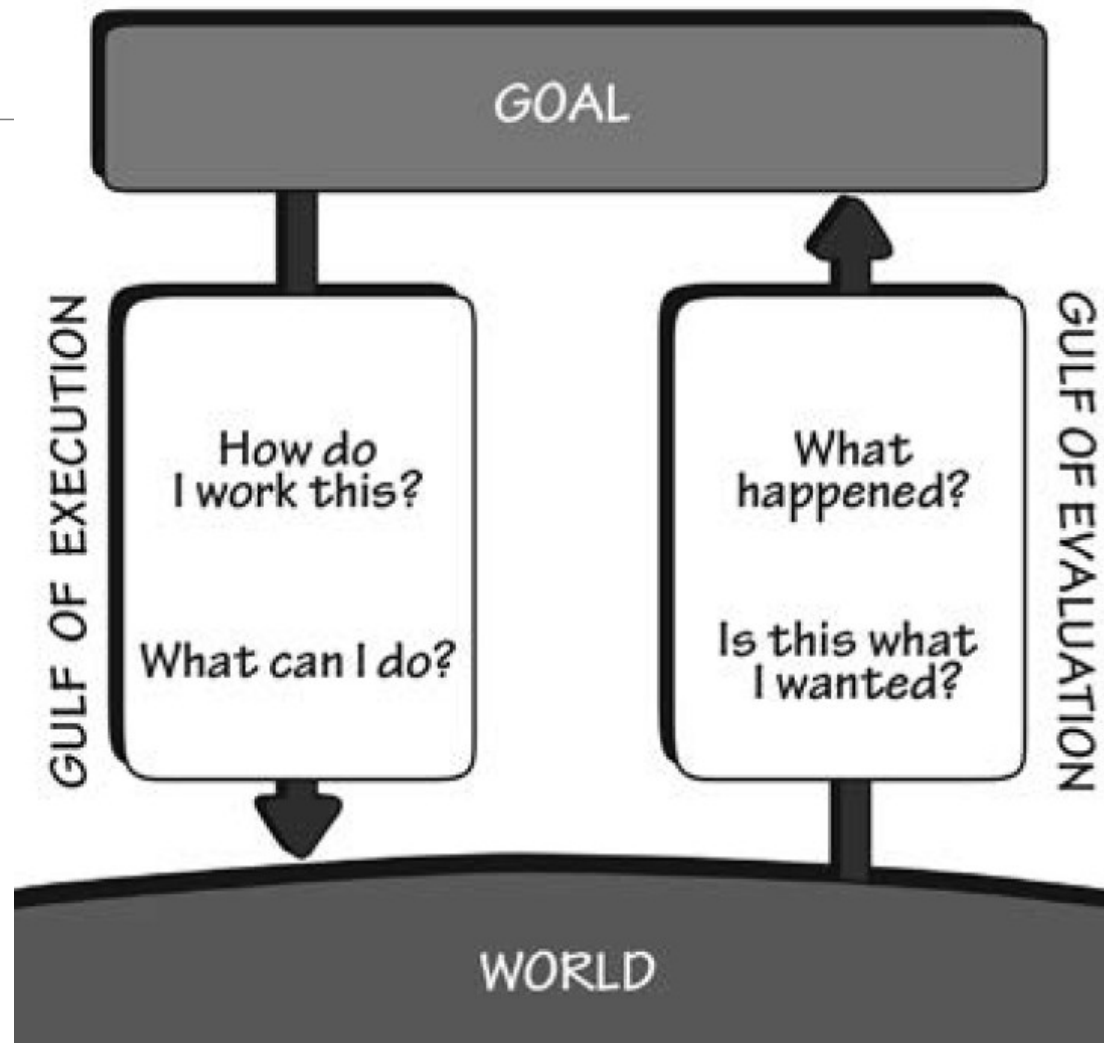
- Based on the user's information processing behavior
- Models the interaction process by dividing it into specific processing levels
- Practical and popular solutions to make existing technologies more usable
- Norman's Motto:
  - “How can we design computer interfaces better so that users with different features can use them in the most comfortable way and get the highest performance”



- Is Bluetooth On or Off?



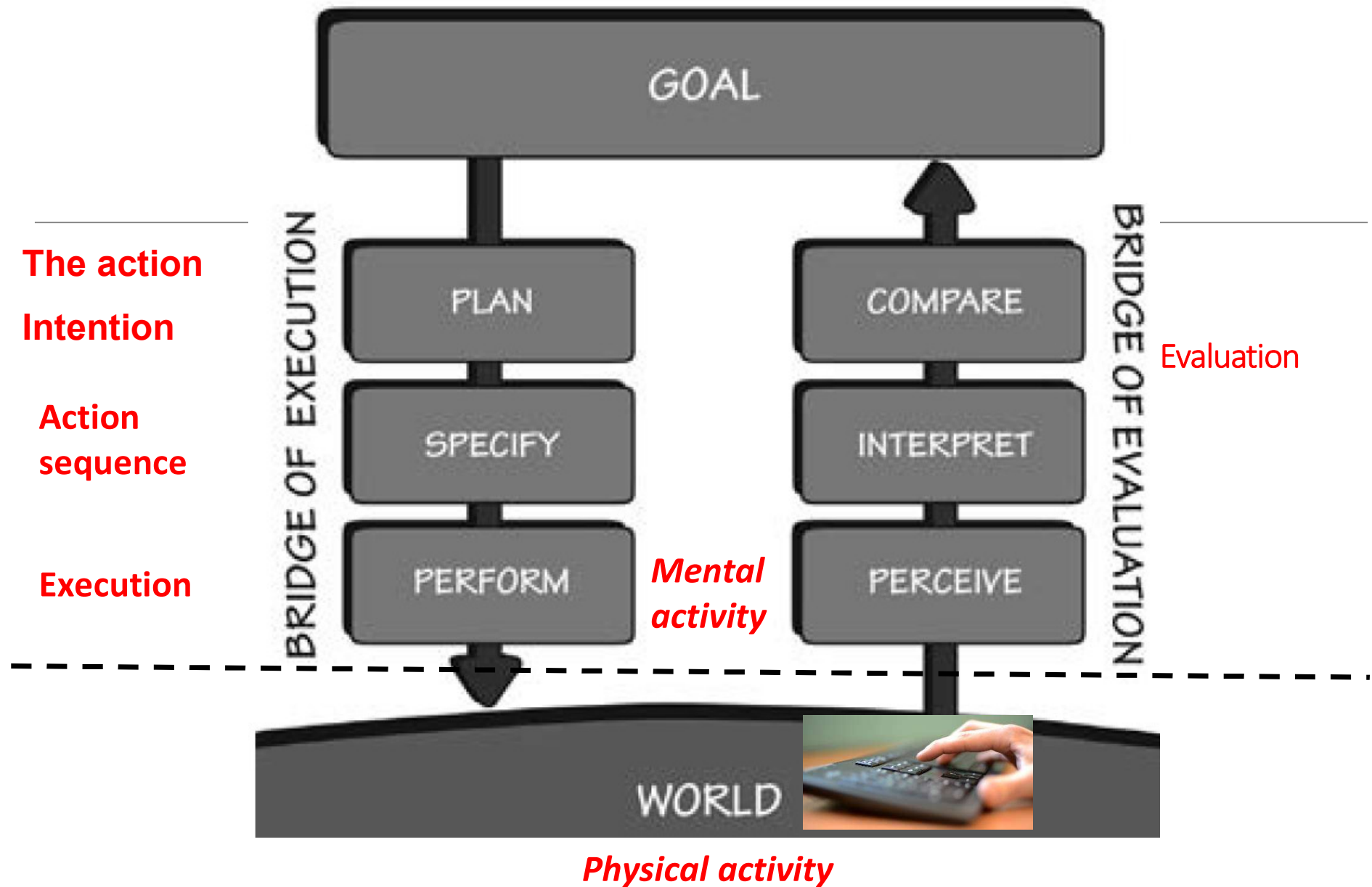
## Interaction at high level: Norman's Gulfs



HCI=Bridging the gulfs of execution and evaluation

# Norman's Metaphore:Gulf





Seven stages of user activities involved in task performance

GOAL

Plan - Action

Compare – outcome  
with the goal

Specify – an action sequence

Interpret- Perception

Perform – the action  
sequence

Perceive – state of  
the world

**Mental Activity**

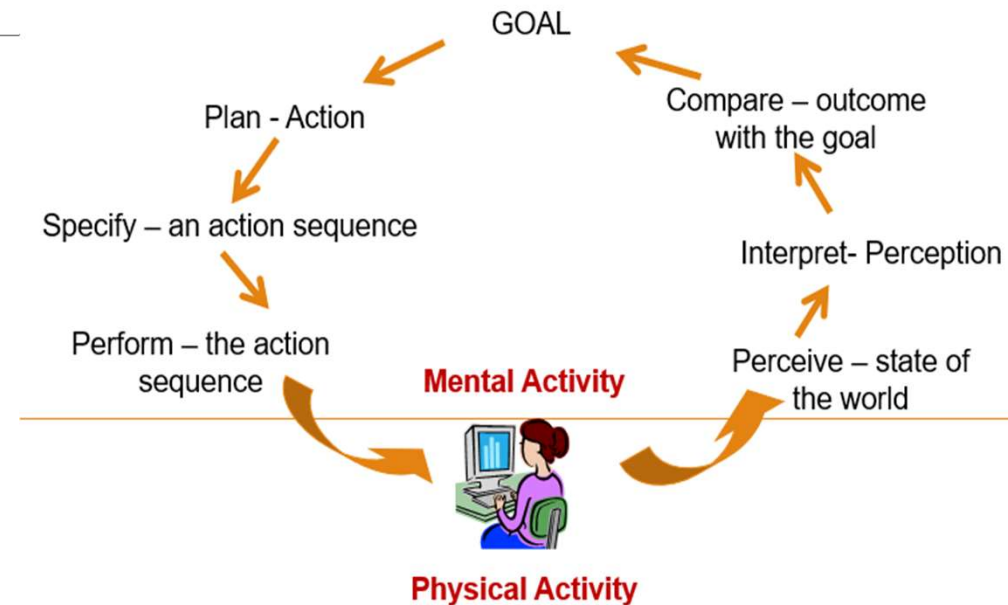


**Physical Activity**



# Norman's 7 Stages

- The user determines the goal and the action to be taken,
- Performs the operation with the interface,
- Observes the result; detects and interprets the state of the system,
- Evaluates the result, decides on the next step.



**Gaps/ambiguities in this cycle create difficulties and errors**

# Let's try it: Any volunteer?

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**Mental Activity**

Perceive – state of  
the world



**Physical Activity**

Interpret- Perception



Perceive – state of  
the world

**Mental Activity**



**Physical Activity**

Compare – outcome  
with the goal



Interpret- Perception



Perceive – state of  
the world

**Mental Activity**



**Physical Activity**

GOAL



Compare – outcome  
with the goal



Interpret- Perception



Perceive – state of  
the world

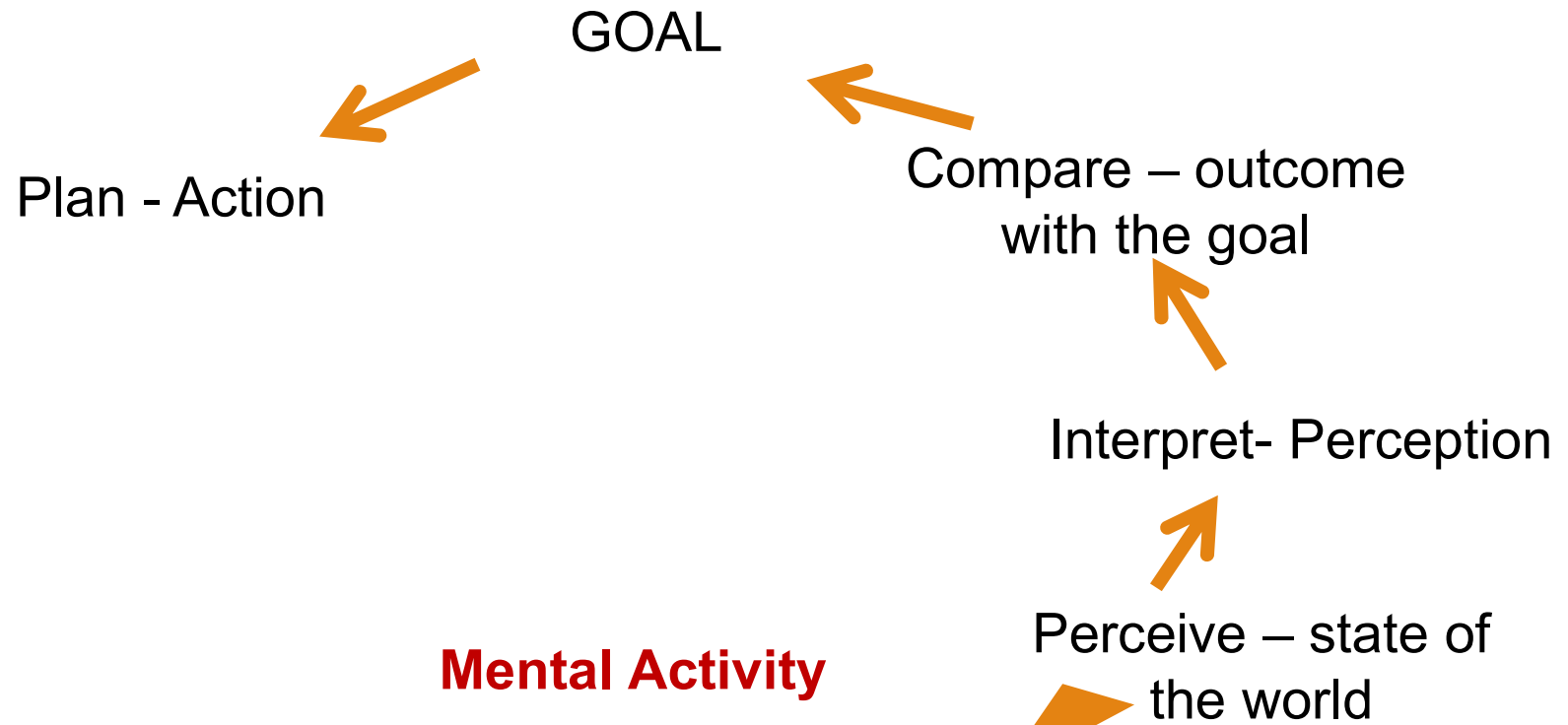
**Mental Activity**



**Physical Activity**







**Mental Activity**



**Physical Activity**

GOAL

Plan - Action

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**Mental Activity**



**Physical Activity**

GOAL

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**Mental Activity**



**Physical Activity**

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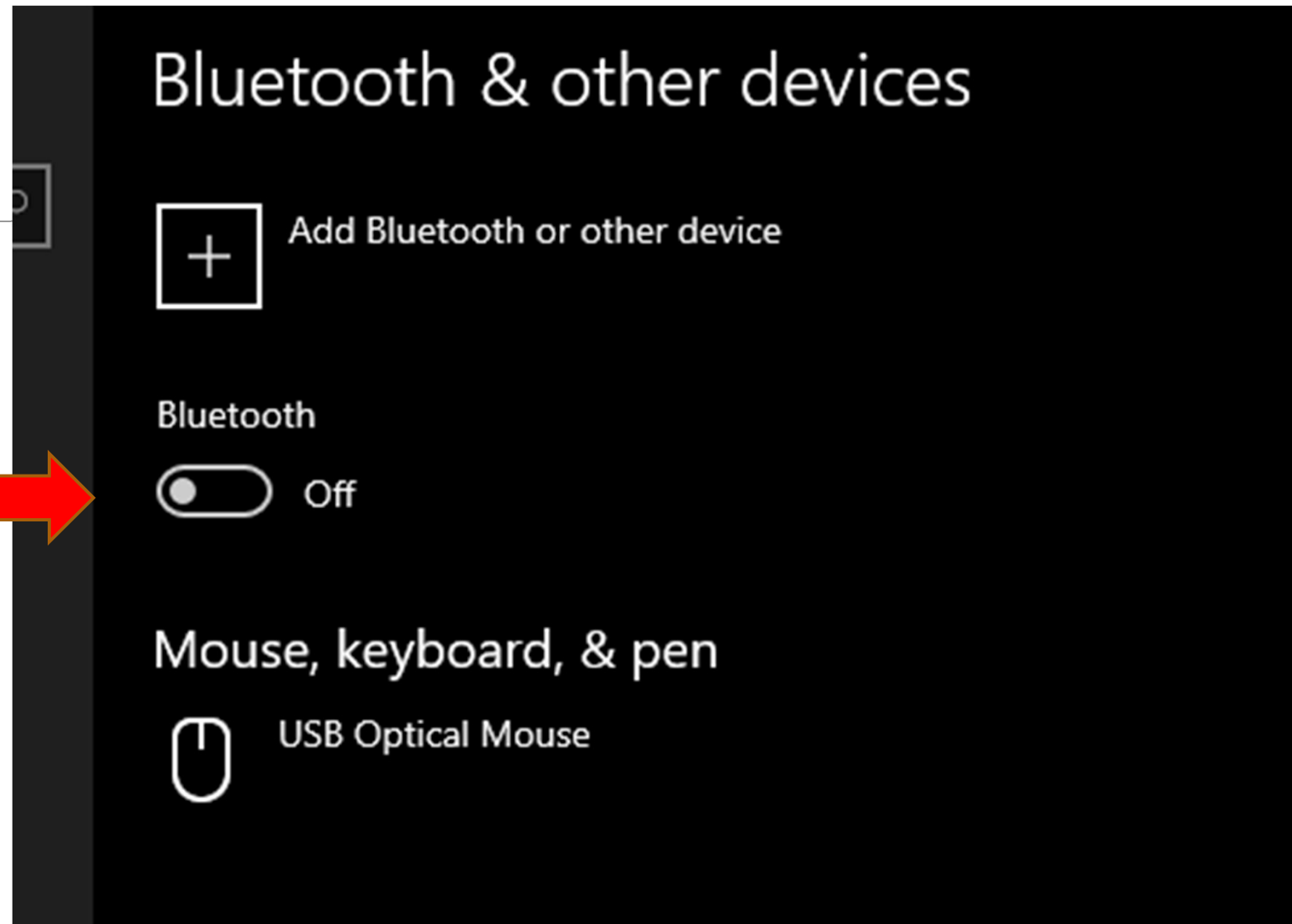
**Mental Activity**



**Physical Activity**

- Is Bluetooth On or Off?

- Gulf of?



# Using the seven stage model

- Norman suggest you ask: How easily can a user:
  - ▮ Determine the function of the device?
  - ▮ Determine the mapping from intention to physical movement?
  - ▮ Perform the action?
  - ▮ Tell what state the system is in?
  - ▮ Determine mapping from system state to intention?
  - ▮ Tell if the system is in the desired state?

# Norman on Interaction

- Error is a natural part of interaction
- We construct a model from fragmentary evidence
- We turn intentions into physical actions and try to interpret the results
- Events trigger our responses
  - we are embedded in a continuous cycle of interaction with the world

# Errors: Users' or Designers'?

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- ✗ Slips: the goal is correct, but the required actions are not done properly: the execution is flawed. e.g. Click on a button accidentally.  
Unconscious
- ✓ Better screen design
- ✗ Mistake: occurs when the wrong goal is established or the wrong plan is formed. Conscious
- ✓ Hard to fix, need to understand the system.



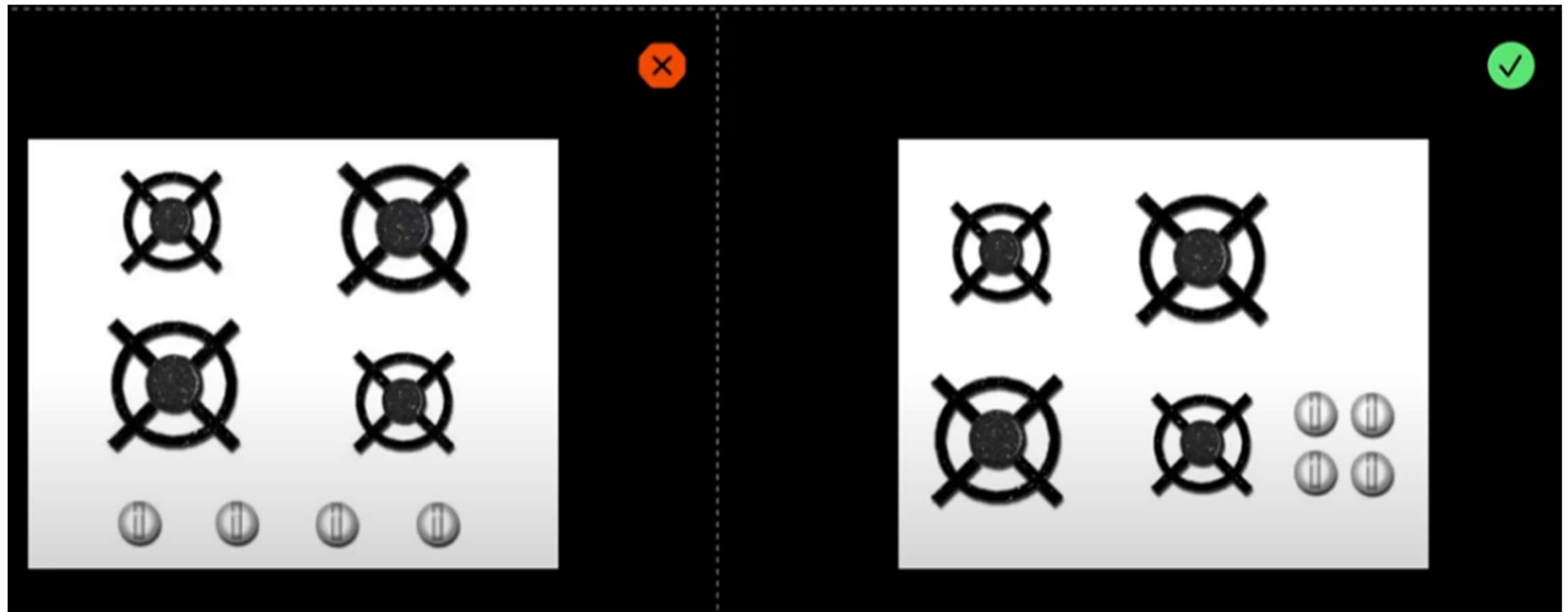
# Norman's Principles of Good Design

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1. **Discoverability** - State and action alternatives should be **Visible**
2. A **good conceptual model** with a consistent system image
3. **Good mappings** for the relationship between stages
4. Continuous **Feedback**
5. **Affordances** – possible interactions between people and the environment
6. **Signifiers** – what actions are possible and how
7. **Constraints** - physical, logical, semantic, and cultural

# Mappings?

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Gulf?  
Evaluation?  
Execution?  
Errors?



# Gulfs of Volvo's Handsfree Power Tailgate



Alternative solution <https://www.youtube.com/watch?v=XxnkueBZG98>

# Interaction and Helplessness

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- **Learned helplessness**
  - I tried it, I couldn't use it, I give up!
  - I cannot use a computer!
- **Taught helplessness**
  - Like your Math class
  - You cannot do it!

# Design Diary Assignment Pointer

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- **7 stage model and 7 Principles of Good Design are good mechanisms for exploring design issues**
- **Analyze existing designs via the steps and issues they outline**
- **More details about the assignment will be on Friday**

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