Designing User Interfaces

CS4501/6501: Engineering Interactive Technologies

Seongkook Heo

Spring 2020, Department of Computer Science

University of Virginia | School of Engineering & Applied Science

What is a Good User Interface?

Easy to use

Efficient

Effective

Safe

Easy to learn

Beautiful

A user interface that is …

Comfortable to use

Cheap

Accessible

~~What you developed~~

Easy to use

Efficient

Effective

Safe

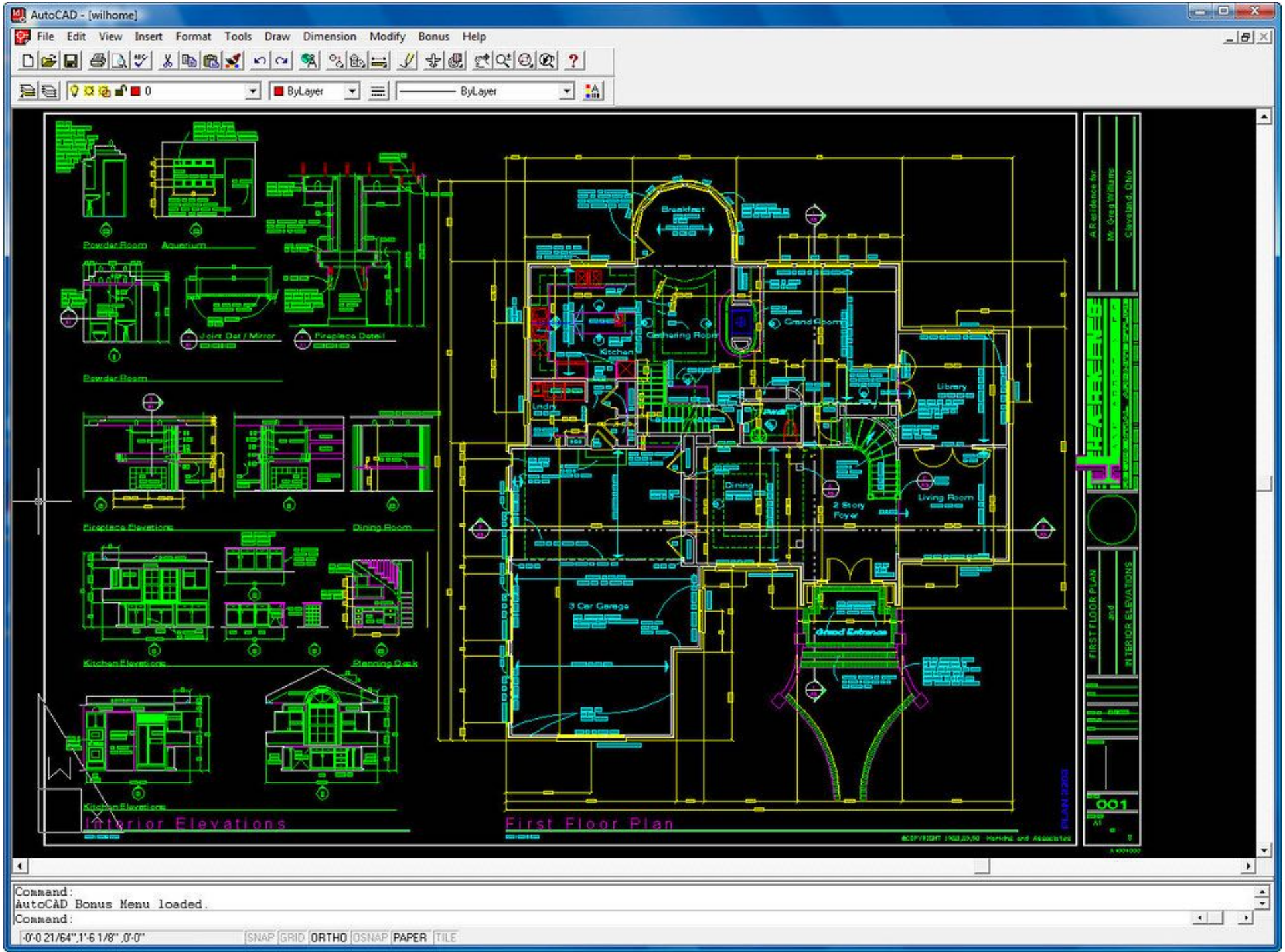
Easy to learn

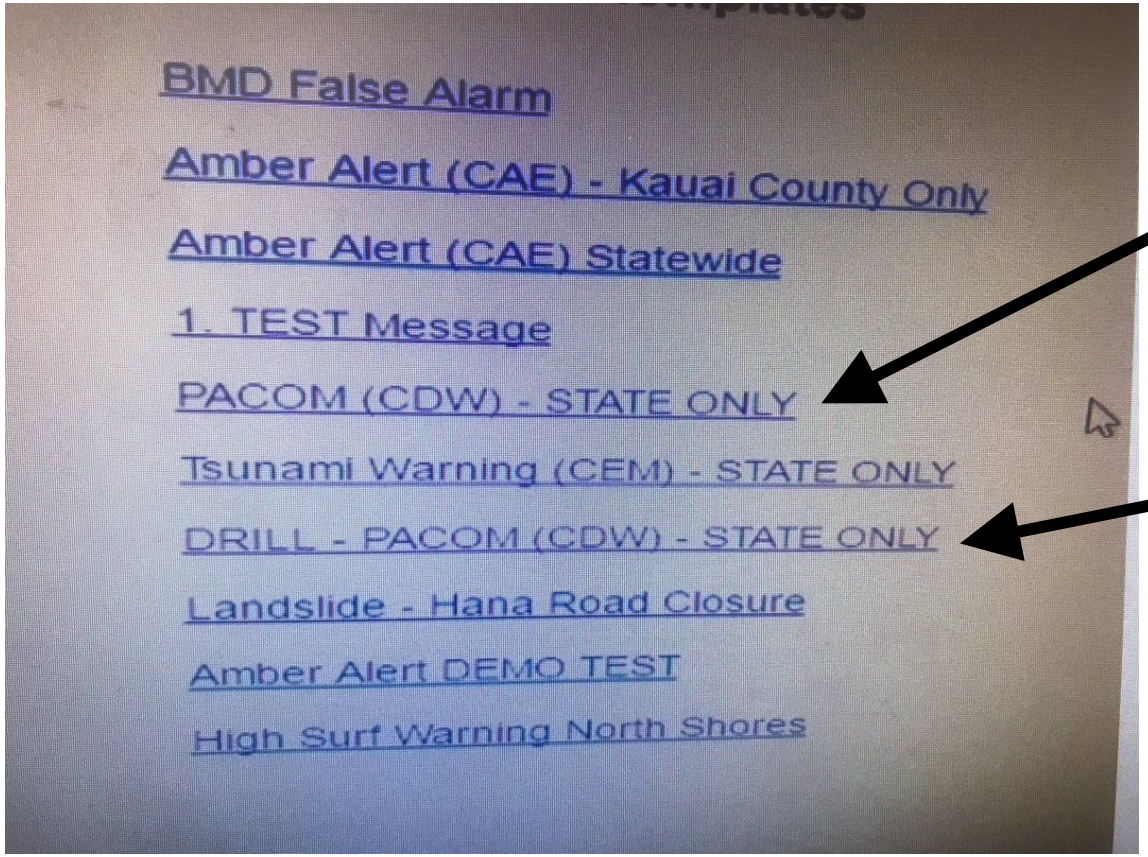
Beautiful

What’s the most important?

It depends on the task, context, and the user

Photo by Marco Verch, https://www.flickr.com/photos/149561324@N03/43591131451, CC2.0

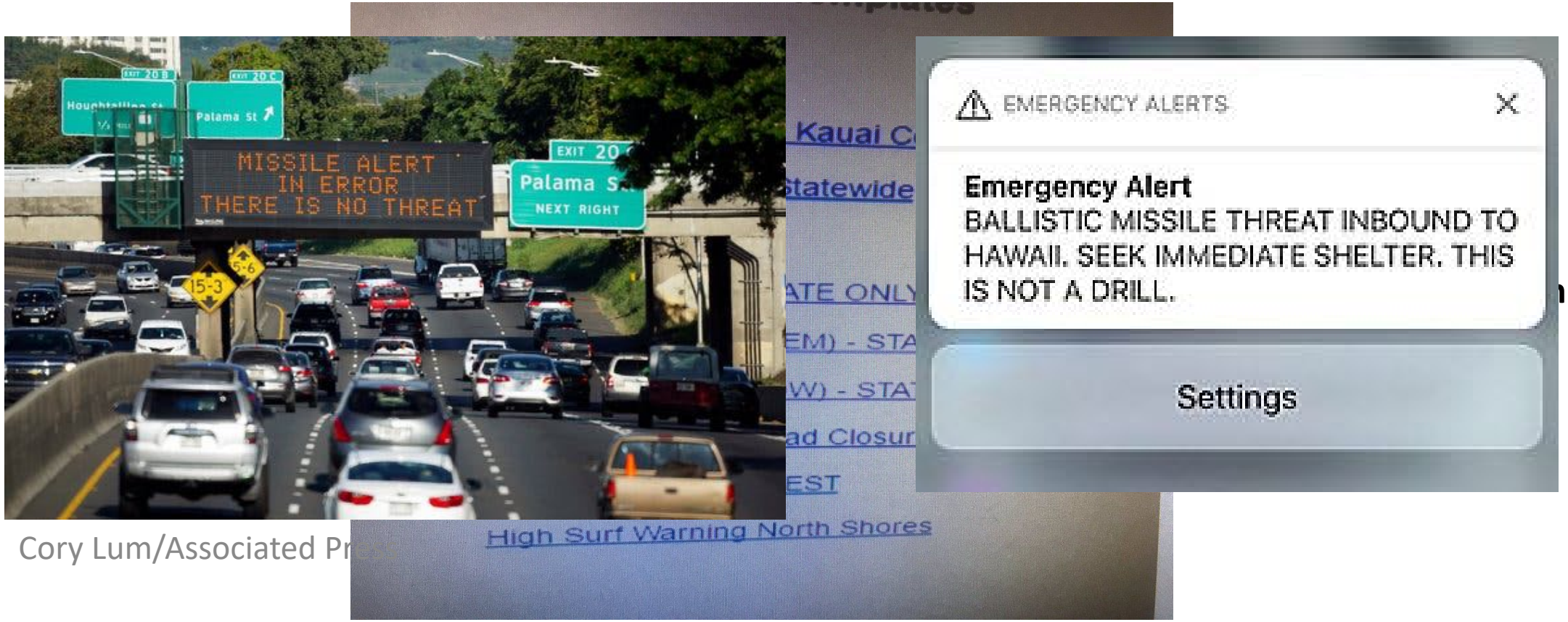

AutoCAD - [wilhome]
File Edit View Insert Format Tools Draw Dimension Modify Bonus Help
ByLayer
ByLayer
Powder Room
Aquarium
Joint Det / Mirror
Fireplace Detail
Powder Room
Fireplace Elevations
Dining Room
Kitchen Elevations
Planning Desk
Kitchen Elevations
Interior Elevations
Breakfast
Gathering Room
Grand Room
Kitchen
Library
Dining
2 Story Foyer
Living Room
3 Car Garage
Grand Entrance
First Floor Plan
A Residence for Mr. Greg Williams Cleveland, Ohio
FIRST FLOOR PLAN and INTERIOR ELEVATIONS
001
Command:
AutoCAD Bonus Menu loaded.
Command:
-0'-0 21/64",1'-6 1/8",0'-0"
SNAP GRID ORTHO OSNAP PAPER TILE



What was selected

What should have been selected

https://www.theverge.com/2018/1/16/16896368/hawaii-false-missile-alert-system-confusing-interface-poor-design



Cory Lum/Associated Pr

selected

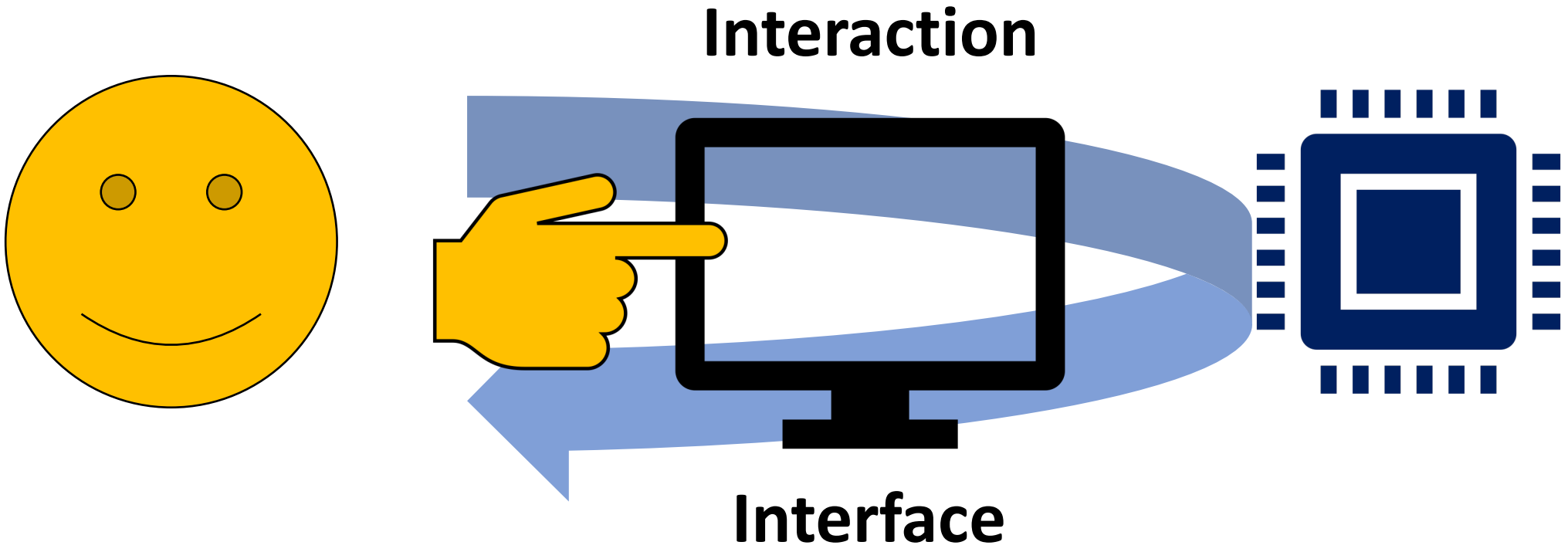
https://www.theverge.com/2018/1/16/16896368/hawaii-false-missile-alert-system-confusing-interface-poor-design

[Apple iPhone's accessibility feature
https://support.apple.com/en-us/HT203332](https://support.apple.com/en-us/HT203332)

Usability How well people can use the system's functionality

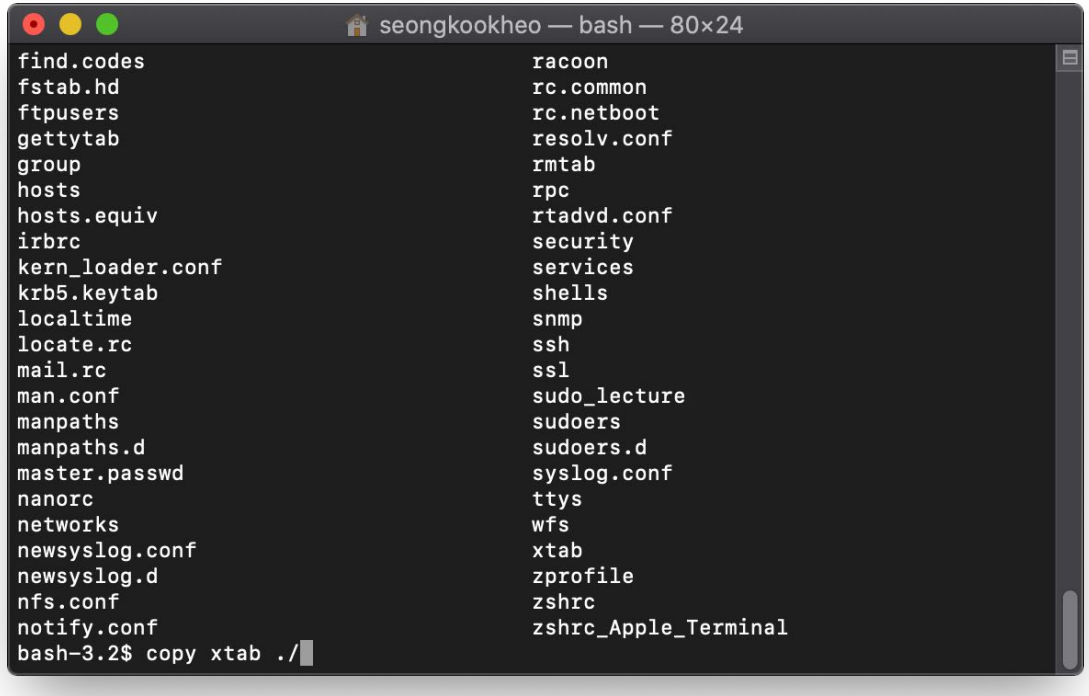
- Learnability: Easy to learn
- Efficiency: Fast once learned
- Memorability: Easy to remember
- Ergonomics: Comfort and fatigue
- Safety: Not having undesirable / dangerous results
- + more

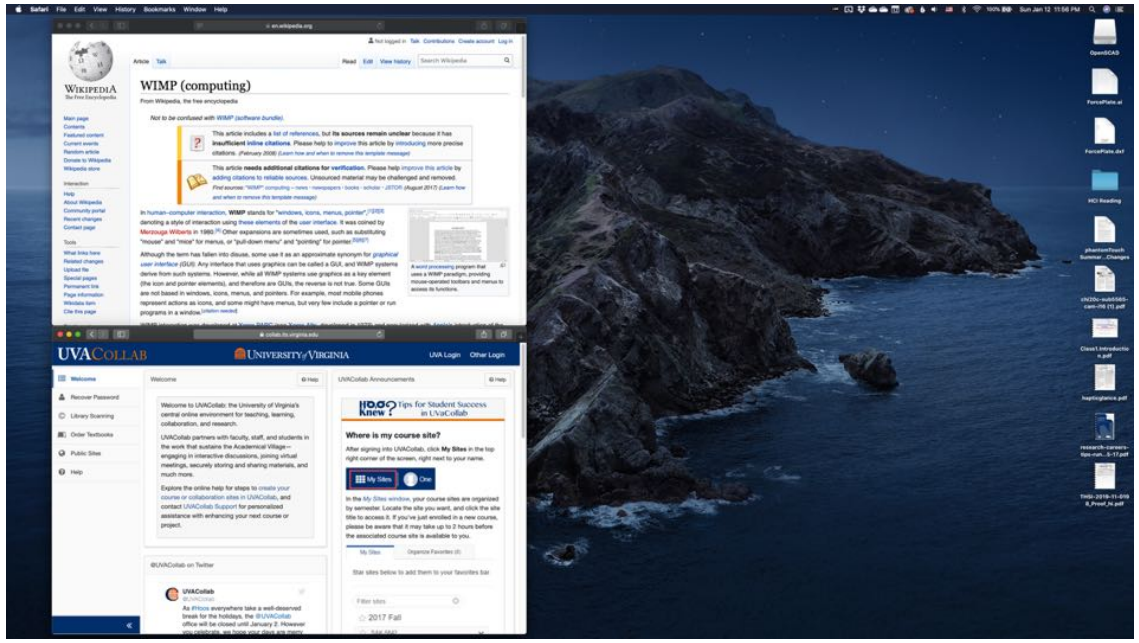
Interaction and Interface are Inseparable



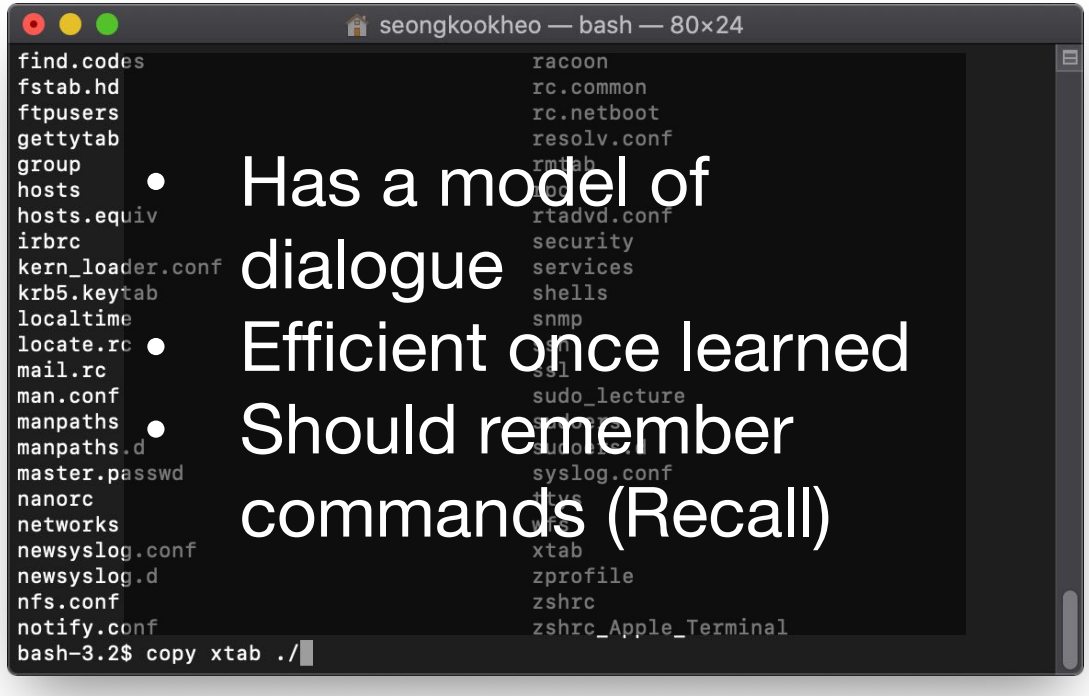
Hornbæk and Oulasvirta, What is Interaction, CHI ‘17
https://dl.acm.org/doi/10.1145/3025453.3025765

Command-Line Interface vs. GUI

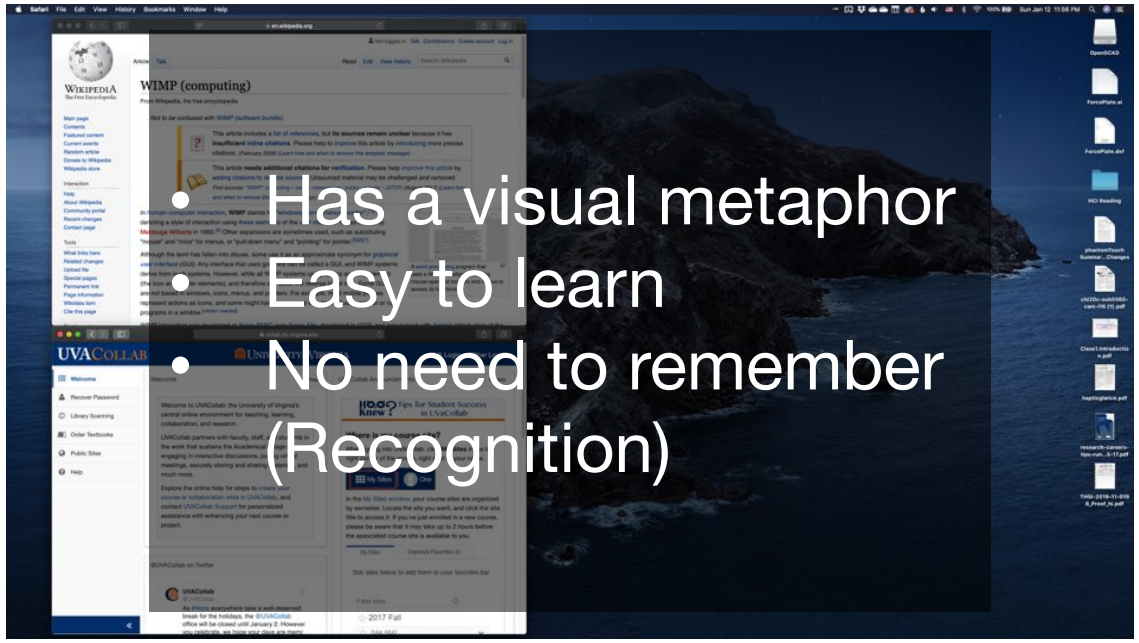




Command-Line Interface vs. GUI



- Has a model of dialogue
- Efficient once learned
- Should remember commands (Recall)



- Has a visual metaphor
- Easy to learn
- No need to remember (Recognition)

Same physical interface, different virtual interface and interaction

How to design a Good User Interface?

User-Centered Design Methods

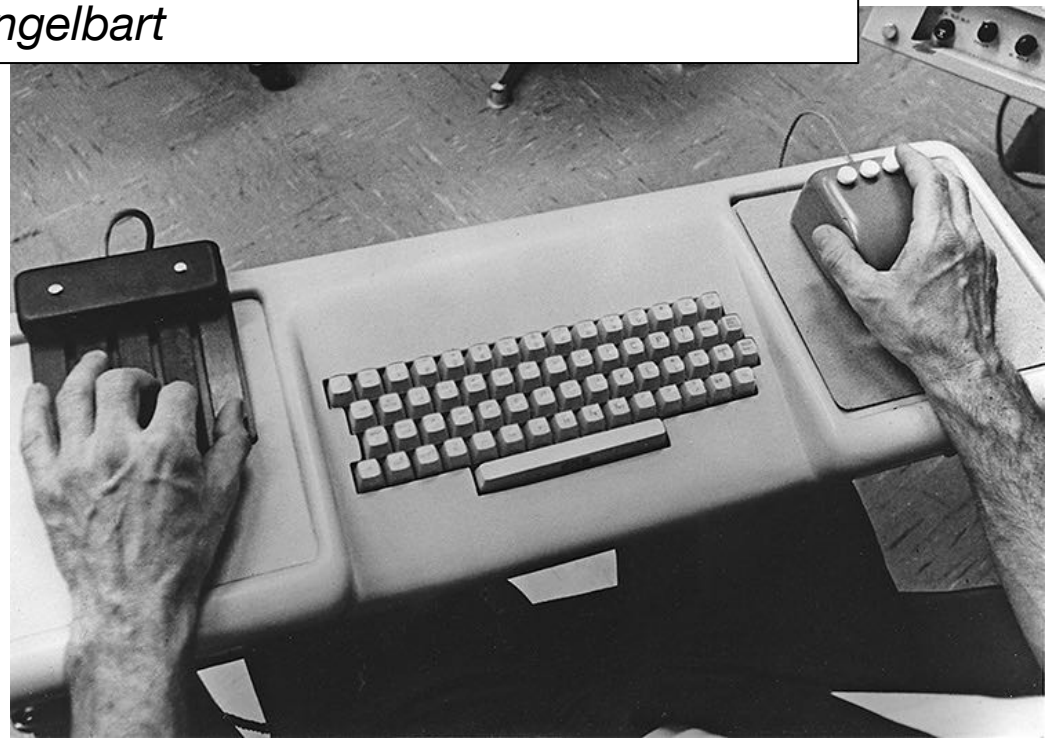
- You probably learned this in CS3205
- Needfinding → Design → Implementation → Evaluation
- Understands users' needs by using various methods, such as
  - Interviews
  - Observations
  - Contextual Inquiries
  - Diary studies, etc.

User-Centered Design Methods

- You probably learned this in CS3205
- Needfinding → Design → Implementation → Evaluation
- Understands users' needs by using various methods, such as
  - Interviews
  - Observations
  - Contextual Inquiries
  - Diary studies, etc.

"The mouse we built for the [1968] show was an early prototype that had three buttons. We turned it around so the tail came out the top. We started with it going the other direction, but the cord got tangled when you moved your arm." Doug Engelbart

1963

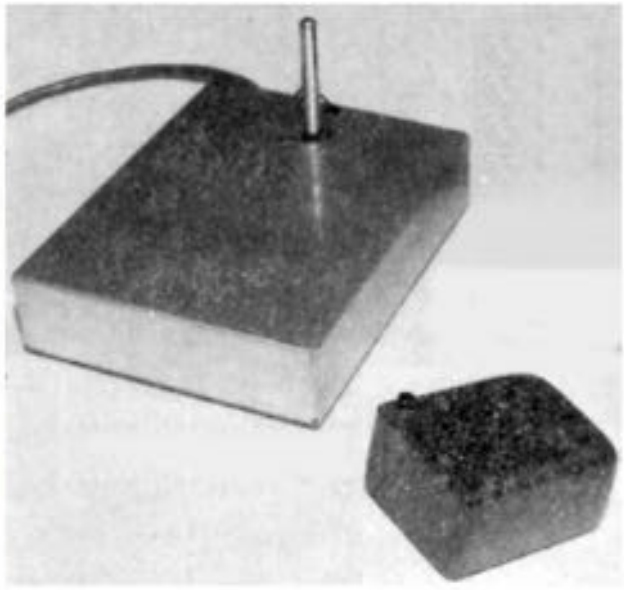


1968

Parallel designs can also be helpful

DEC's gyro-stlye "Grafacon"
(click to enlarge)

A knee-operated pointing device



Joy stick and mouse
(click to enlarge)

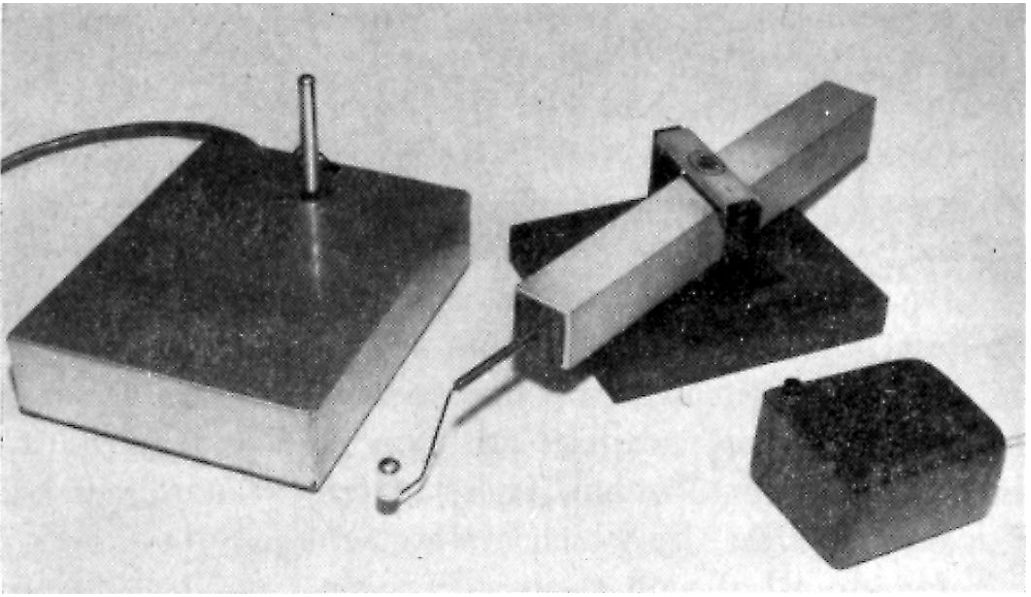
Images from https://www.dougengelbart.org/content/view/162/000/

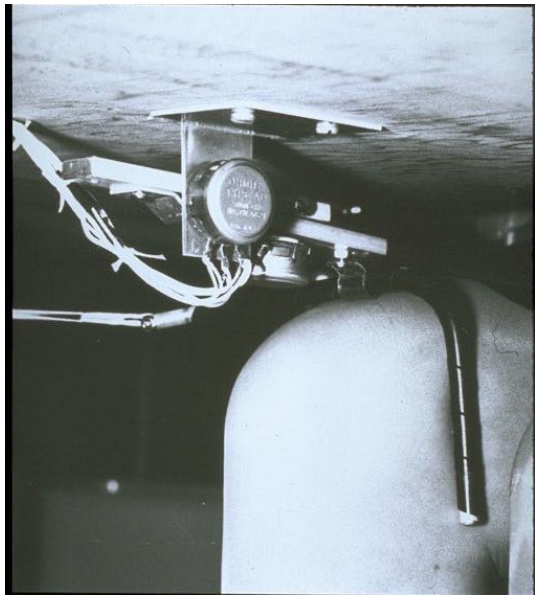
How do you know if it’s good?

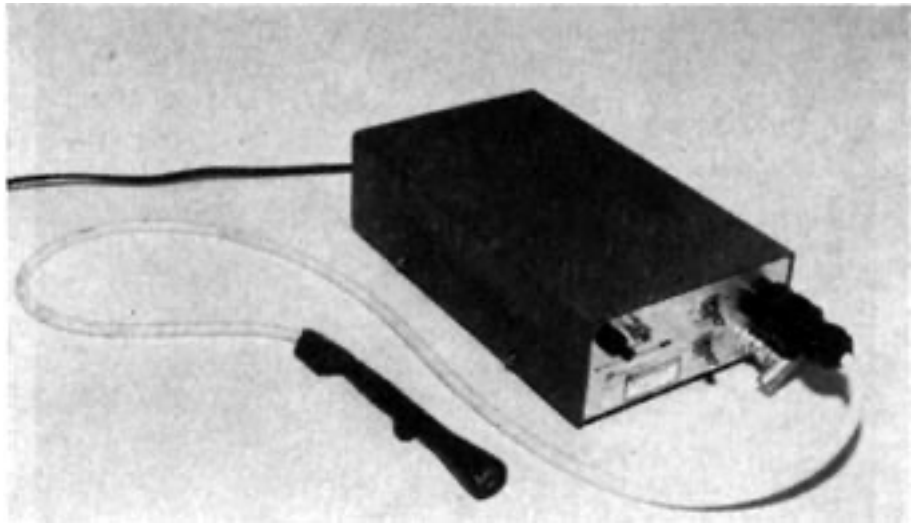
User Interface Evaluation

- **Know your goal ← Very Important!!**
- Conduct experiments that can test if your interface achieves the goal
- Comparison can highlight the differences
  - Yours vs. Others
  - Yours vs. Yours

User Interface Evaluation

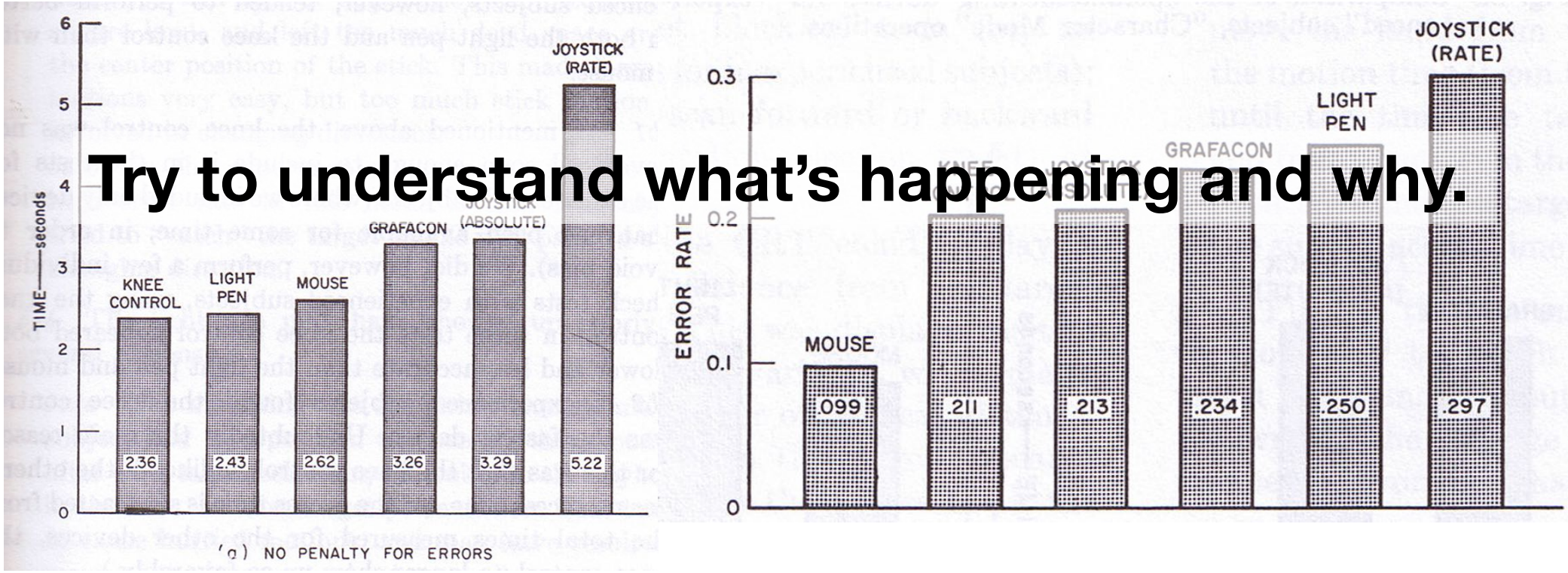






English, Engelbart, and Berman, IEEE Transactions on Human Factors in Electronics, March 1967, Vol. HFE-8, No. 1, pp. 5-15

User Interface Evaluation



Try to understand what's happening and why.

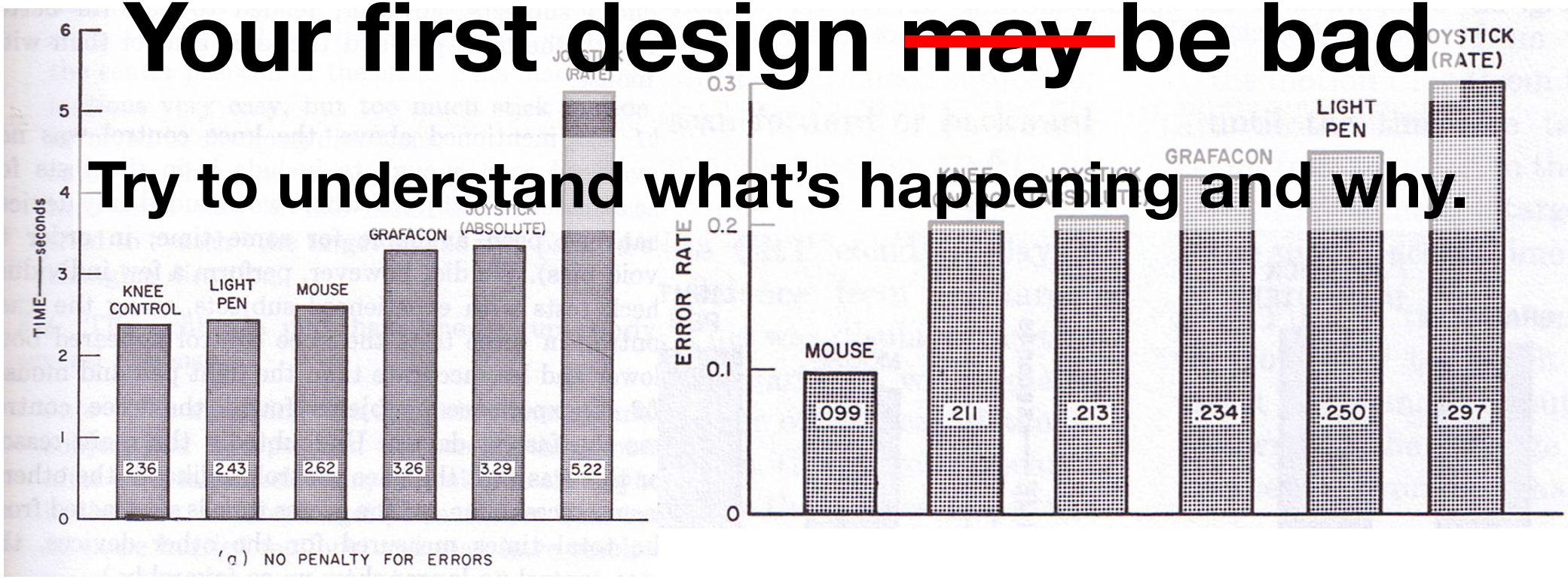
English, Engelbart, and Berman, IEEE Transactions on Human Factors in Electronics, March 1967, Vol. HFE-8, No. 1, pp. 5-15

User Interface Evaluation

will

Your first design ~~may~~ be bad

Try to understand what's happening and why.



English, Engelbart, and Berman, IEEE Transactions on Human Factors in Electronics, March 1967, Vol. HFE-8, No. 1, pp. 5-15

So I’m ready to build a good user interface

Where to start?

1. Know the problem

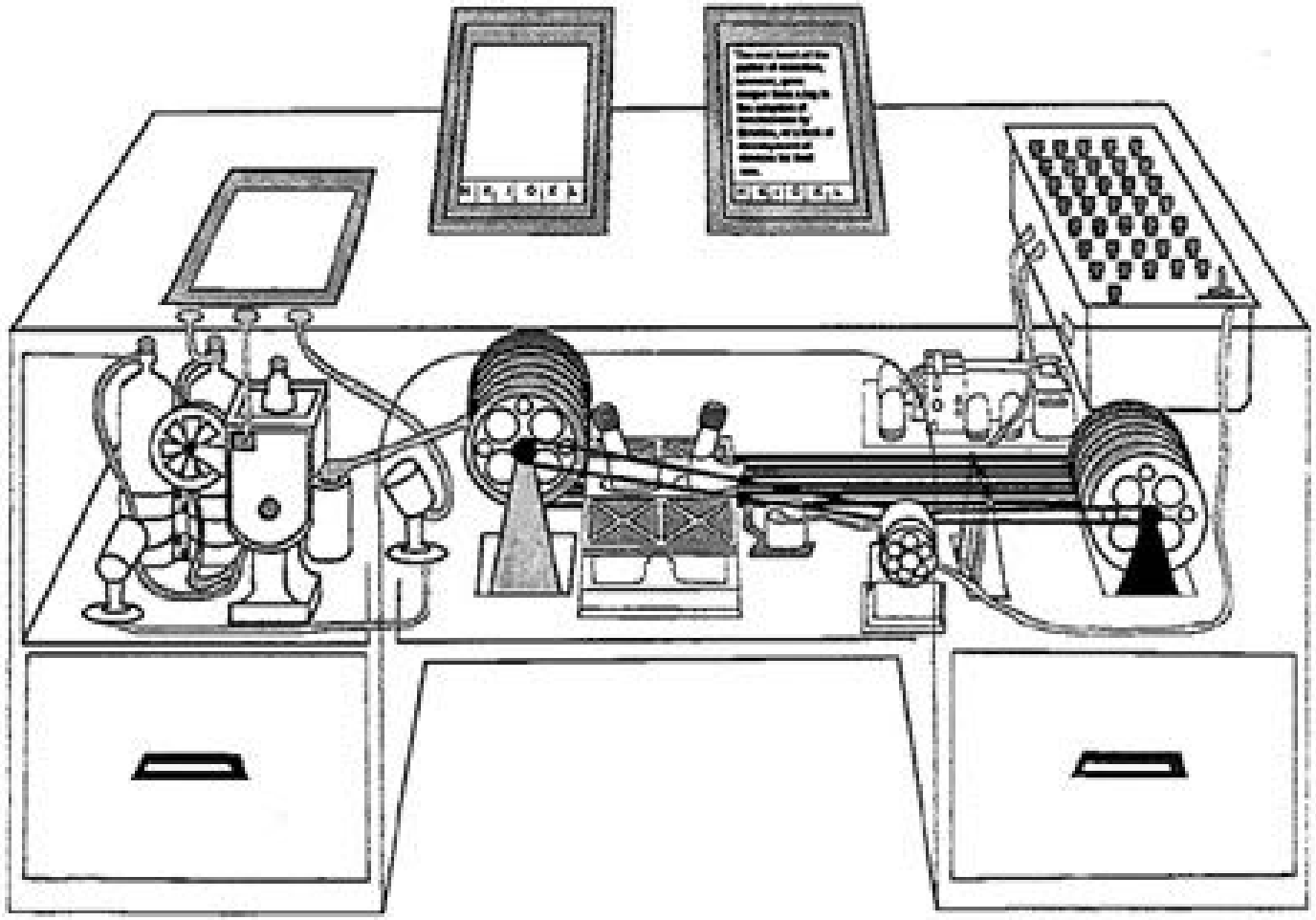
- Find the problem that people are experiencing
- Understand what is the “main” problem that is causing the problem
- Is there something that you want to make it better?
- Or, imagine the future and think the problems that people in that future will experience

2. Find the solution

- **Understand the characteristics of the problem**
- Find the solution that can help with the characteristics
- Know other interfaces and see what property of it is causing problems and what is solving them.

What’s the future you want to live in?

“As We May Think”, Vannevar Bush (1945)

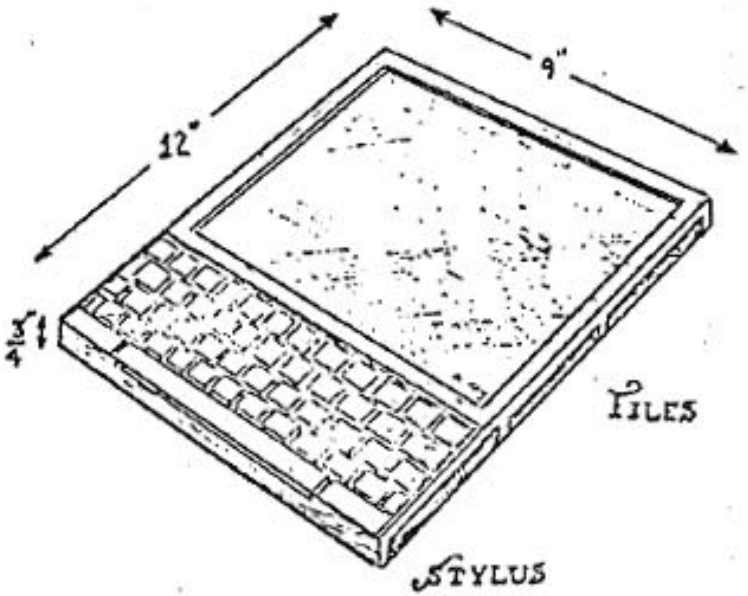


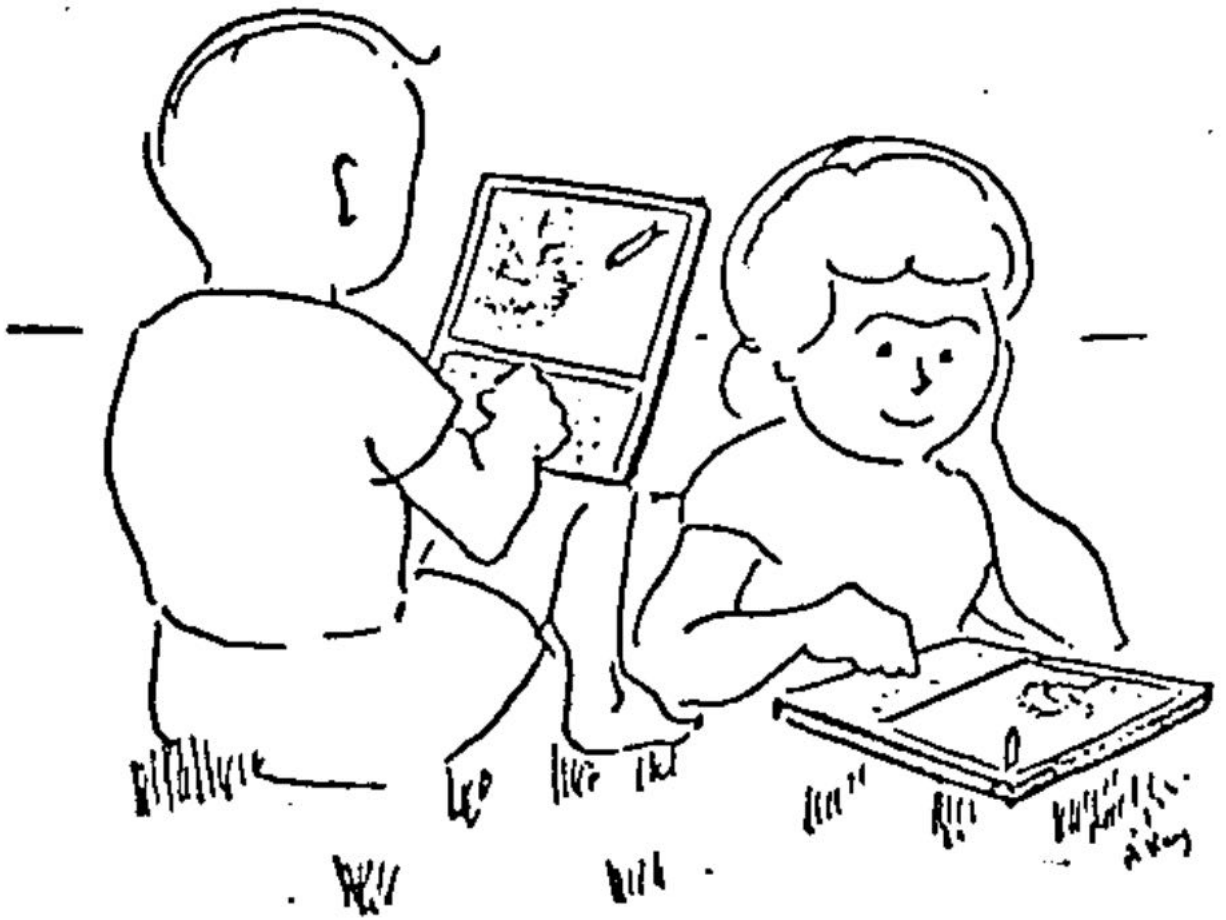
https://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/

“Augmenting Human Intellect”, Douglas Engelbart (1962)

https://www.dougengelbart.org/content/view/138/

A Personal Computer for Children of All Ages, Alan Kay (1972)





https://history-computer.com/Library/Kay72.pdf

A Personal Computer for Children of All Ages, Alan Kay (1972)

If we want children to learn any particular area, then it is clearly up to us to provide them with something real and enjoyable to "do" on their way to perfection of both the art and the skill. Painting can be frustrating, yet practice is fun because a finished picture is a subgoal which can be accomplished without needing total mastery of the subject.

Playing musical instruments and gaining musical thinking is unfortunately much further removed. Most modern keyboard and orchestral instruments do not provide subgoals which are satisfying to the child or adult for many months, nor do they really give any insight into what music is or how to "do" it on one's own. It is usually much more analogous to "drill and skill" in painting a billboard "by the numbers", and not even getting to use your own numbers or paint!

The study of arithmetic and mathematics is, in general, an even worse situation. What can a child "do" with multiplication? The usual answer is work problems in the math book! A typical establishment reaction to this is that "some things just have to be learned by drill". (Fortunately kids don't have to learn their native tongue under those circumstances.) Papert's kids need to use multiplication to make

https://history-computer.com/Library/Kay72.pdf

Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms, Hiroshi Ishii and Brygg Ullmer (1997)

BITS & ATOMS

We live between two realms: our physical environment and cyberspace. Despite our dual citizenship, the absence of seamless couplings between these parallel existences leaves a great divide between the worlds of bits and atoms. At the present, we are torn between these parallel but disjoint spaces.

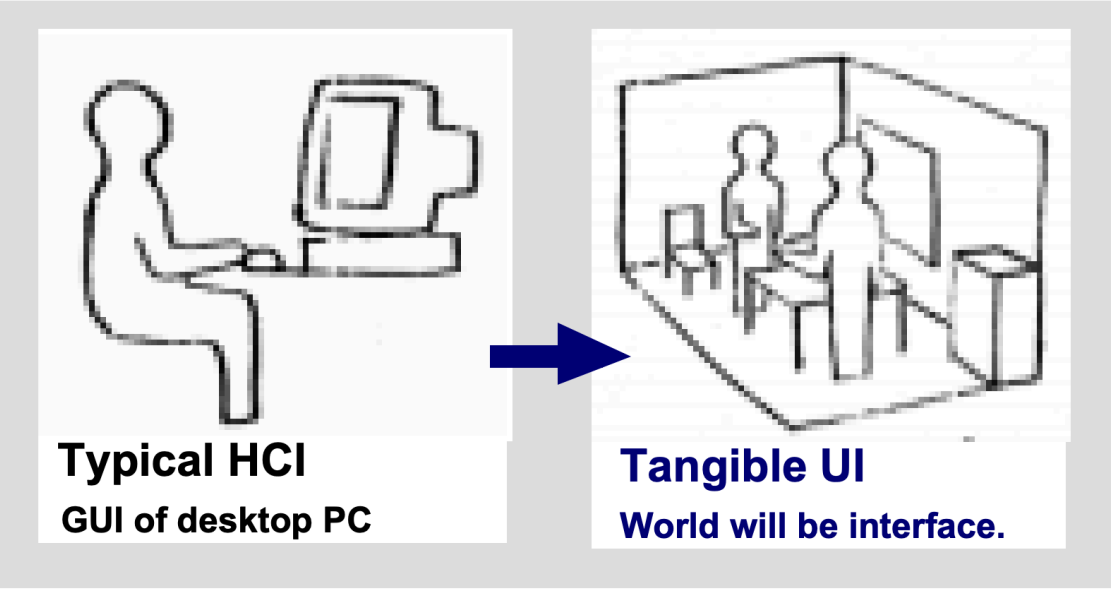


Figure 2 From GUI to Tangible User Interfaces

See his research group: http://tangible.media.mit.edu/projects/

https://trackr-media.tangiblemedia.org/publishedmedia/Papers/331-Tangible%20Bits%20Towards%20Seamless/Published/PDF

The best way to predict the future is to invent it.
- Alan Kay

About this course

In this course, you will learn

- Fundamentals
  - How these interactive technologies work

- Practices
  - How to use these technologies to create a new user interface

- Research
  - Foundational as well as state-of art research on interactive technologies

In this course, you will learn

- Fundamentals
  - How these interactive technologies work
  - Sensors
  - Signal Processing
  - Actuators
  - Fabrication Methods

In this course, you will learn

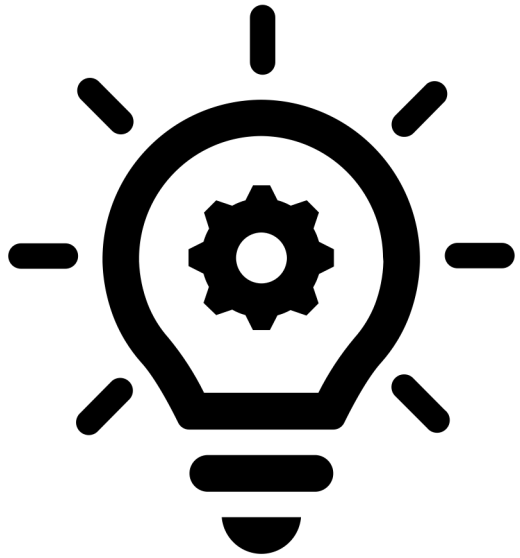
- Practices
  - How to use these technologies to create a new user interface
  - Basic electronics
  - Using Arduino
  - Connecting sensors, actuators, etc.
  - 3D printing

In this course, you will learn

- Research
  - Foundational as well as state-of art research on interactive technologies
  - You'll be exposed to cutting-edge research papers

In this course, you will build

an amazing user interface



This course will *not* cover

- Basic concepts of HCI
  - If you're new to HCI, I recommend taking a short online course (https://www.coursera.org/learn/human-computer-interaction)

- Programming
  - You should be able to comfortably code in at least one program language to be successfully complete assignments and projects

Course Information

TAs

- Md Aashikur Rahman Azim (ma6zp@virginia.edu)
- 2nd year Ph. D. Student in Computer Science

- Zhanhong Tian (zt9yz@virginia.edu)
- 1st year Master's Student in Computer Science

In this course, you will (CS6501)

- Learn the fundamentals of interactive technologies
  - Midterm (25%)
- Practice building interactive systems
  - Lab reports (5%), assignments (20%)
- Build a new user interface
  - Project (40%)
- Learn from research papers
  - Weekly reading responses (10%)

Reading responses (CS6501 only, by 1/22)

- Read the weekly paper and write a 300-word response, that may include
  - what you liked/disliked about the paper
  - what you think about the method used
  - what you think could’ve done better
  - what you think can be done from there

Course Policies

- Students must fully comply with all the provisions of the University's Honor Code. All lab reports, assignments, exams, and project must be pledged.
- No phone/laptop use during lecture classes
- Bring a laptop on lab classes

Course Policies

- All reports/assignments due 11:59pm
- You may submit reports until 3 days after the deadline, with 10%, 20%, and 40% penalty.

Assignment #1: Good UI, Bad UI (1/24)

- Find two **Good User Interfaces**
- Find two **Bad User Interfaces**
- Explain **why you think they're good or bad**
- Find **those that aren't traditional ones** (non keyboard/mouse)
- Best ones will be introduced in the class
- 5 / 20 points

Seongkook Heo,
CS6501– Engineering Interactive Technologies
HW 1
1/15/2019

Good UI #1: XXX

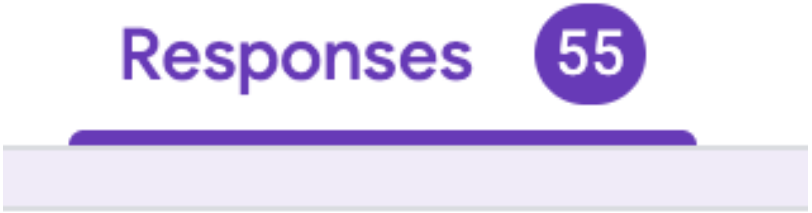
This is good because Lorem ipsum dolor sit amet, conse ctetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor

Good UI #2: XXX

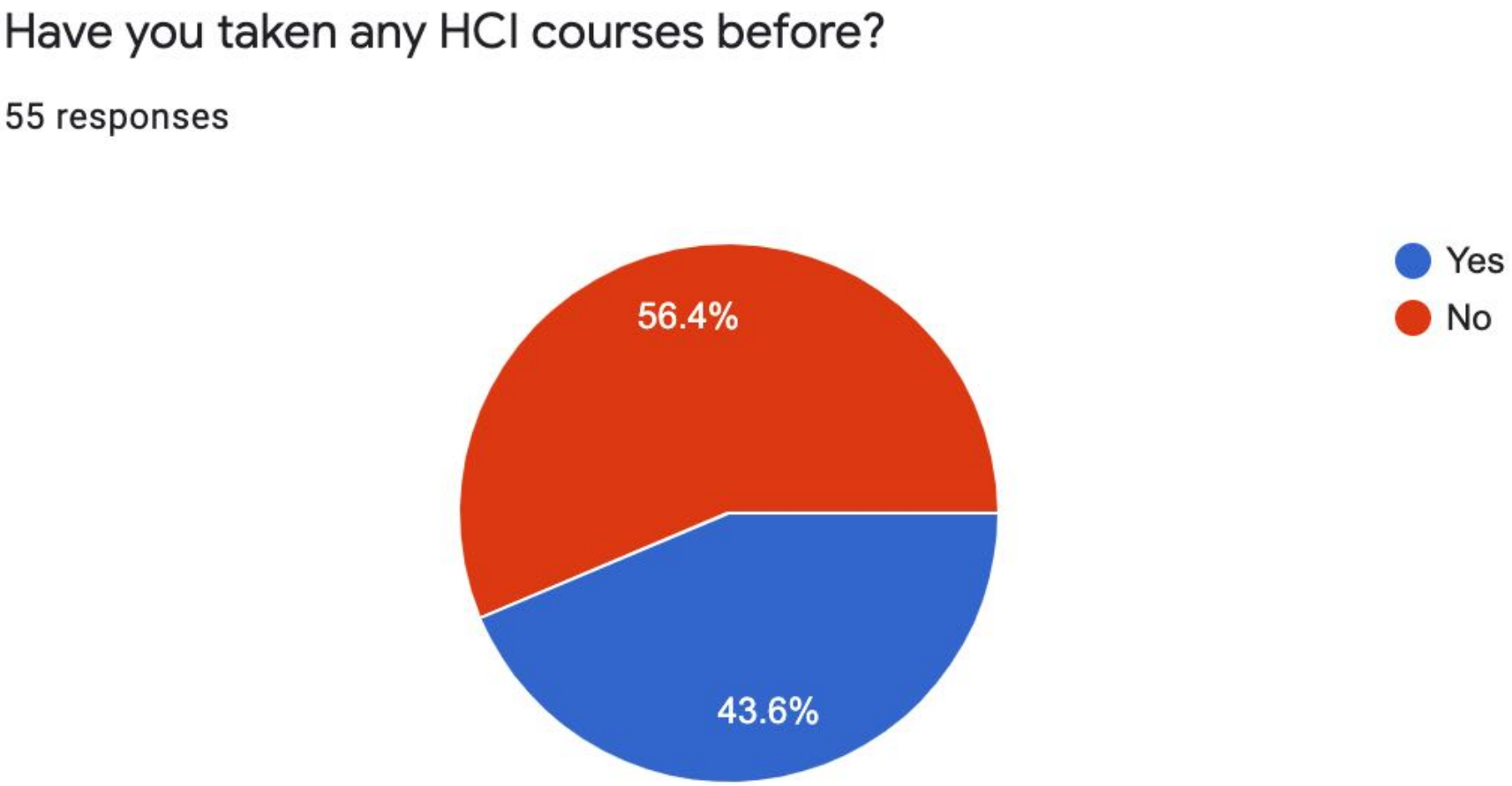
This is good because Lorem ipsum dolor sit amet, conse ctetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor

http://web.media.mit.edu/~monster/blendie/

Assignment #0



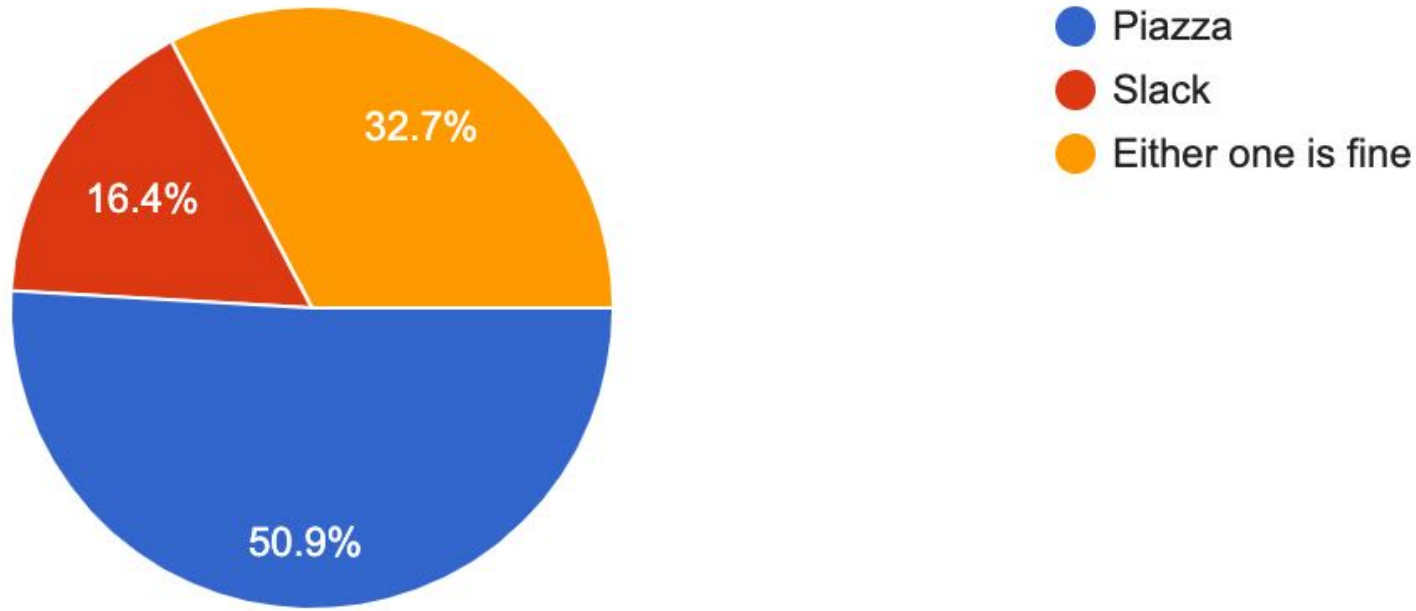
Thank you!



Take this course by Scott Klemmer, it’s short and very good (https://www.coursera.org/learn/human-computer-interaction)

Which platform do you prefer for discussions?

55 responses



Anything you'd like to ask the instructor?

Can we go over hardware integrated with virtual reality applications?

I have no experience with HCI before. Will I be fine?

iOS or Android?

What will the labs entail? What is the criteria for the lab reports?

Will we be allowed to take notes on a laptop? Or can you post the slides after class as review, please!

No

So would you say that by the end of this course, we'll have a fully functional project to be proud of? :)

Will 4501 students have access to the readings assigned to 6501?

What's your favorite Korean food

Anything you'd like to ask the instructor?

How many assignments will we have? And how many people of a group for the project?

Do you want to share something about your personal life?

Some more information regarding examinations

Why did you choose to teach this class?

A more detailed elaboration of the Project - User Interface. If the project is individual or team based?

What is the most interesting interface you know of in recent memory?

Project

- 5 students / team
- You'll find topics / problems you want to solve, and find teammates who have similar interest
- You'll build an interactive system, and evaluate it
- There will be sessions to help your project
- You can ask for sensors, actuators, and devices

So would you say that by the end of this course, we'll have a fully functional project to be proud of? :)

Yes

If you want to learn more,

- ACM CHI and UIST are the top conferences in User Interface
- See UIST Conference Proceedings
  - https://dl.acm.org/conference/uist/proceedings

you'll find very interesting ones

Thank you!