

Usability Engineering

17-313 Spring 2025

Foundations of Software Engineering

<https://cmu-313.github.io>

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Administrivia

- P3B (Final Deliverables) due on Thursday

Smoking Section

- Last full row



Learning Goals

- Identify common examples of bad design, understand why they fail to meet user needs, and learn to critique design choices effectively
- View problems from the user's perspective, understanding their needs, behaviors, and challenges to inform better design decisions
- Learn different methods for assessing usability, including qualitative and quantitative metrics, to gauge the success of a system

What is usability?

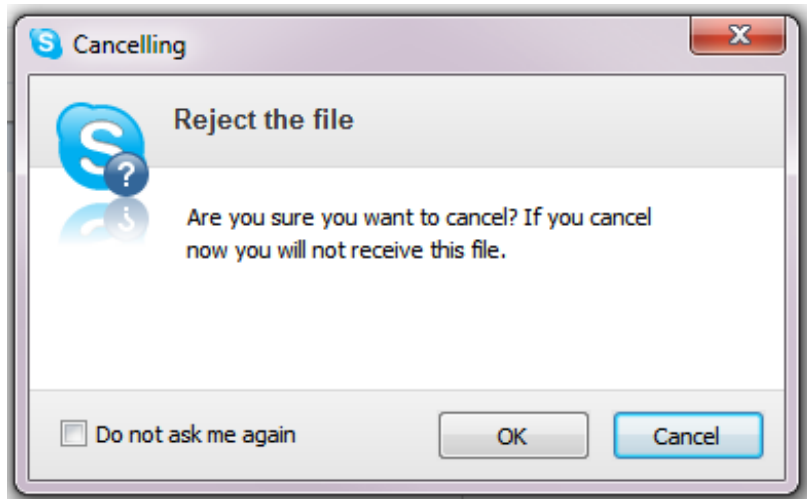
ISO 9241-11: *“the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.”*

*Learnability, Efficiency, Memorability,
Errors, Satisfaction*





- New York overhauled their signs
- Left is before, right is after
- Is it better? Is it good?







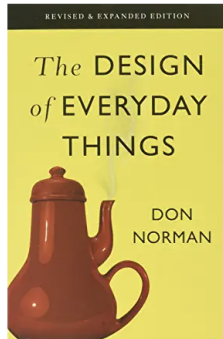




Same handle! Different action?



Best Seller



The Design of Everyday Things: Revised and Expanded Edition

by [Don Norman](#) | Nov 5, 2013

★★★★☆ [1,434](#)

Paperback

\$14⁴⁹

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Available instantly

Great On Kindle: A high quality digital reading

#1 book I would recommend to any student

Ok, innocent enough.
But can anything **bad** happen?



EMERGENCY ALERTS

now

Emergency Alert

BALLISTIC MISSILE THREAT INBOUND TO HAWAII. SEEK IMMEDIATE SHELTER. THIS IS NOT A DRILL.

Slide for more

BMD False Alarm

Amber Alert (CAE) - Kauai County Only

Amber Alert (CAE) Statewide

1. TEST Message

PACOM (CDW) - STATE ONLY

Tsunami Warning (CEM) - STATE ONLY

DRILL - PACOM (CDW) - STATE ONLY



S3D

Software and Societa
Systems Department



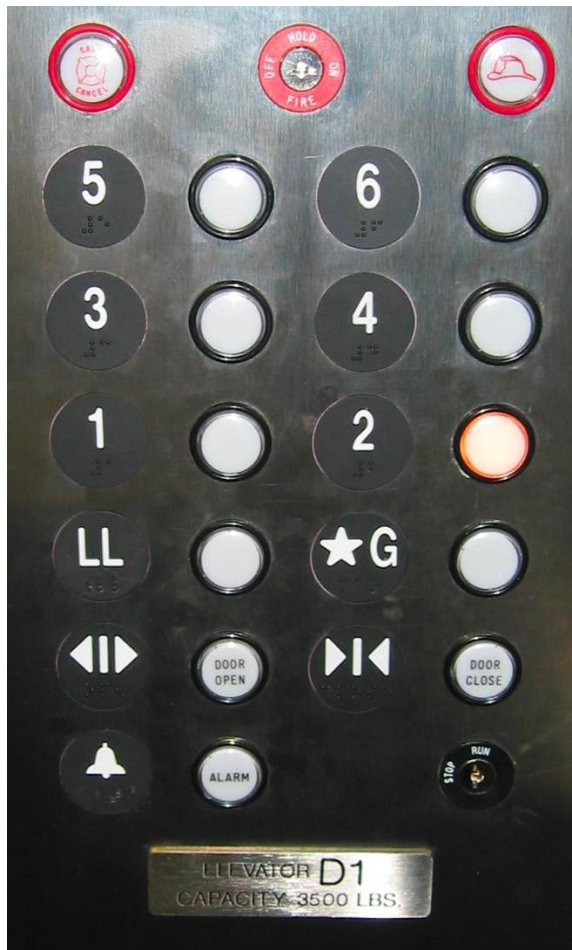
Therac-25

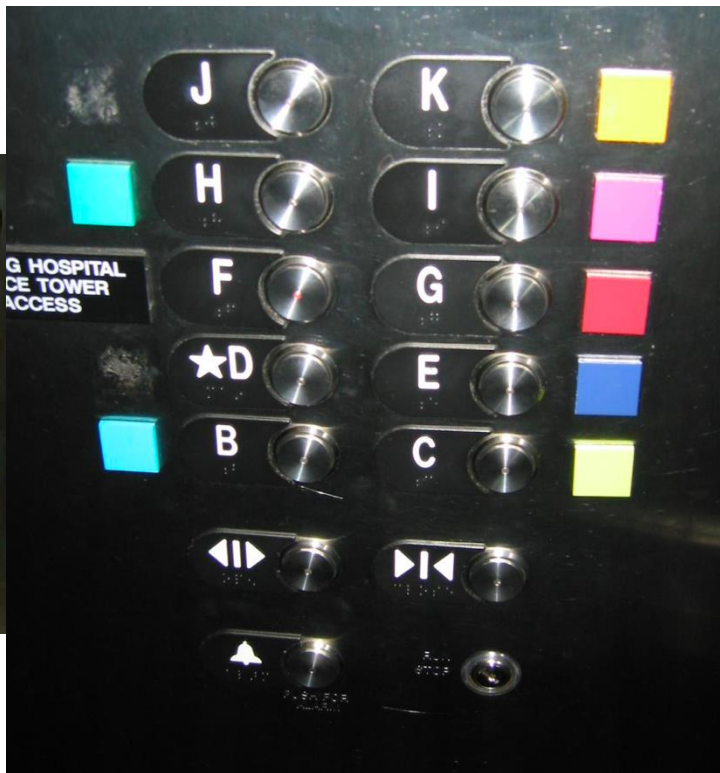
Trump announces all Boeing 737 Max jets are immediately grounded following its 2nd crash in 5 months

Graham Rapier and Benjamin Zhang | Mar. 13, 2019, 2:33 PM

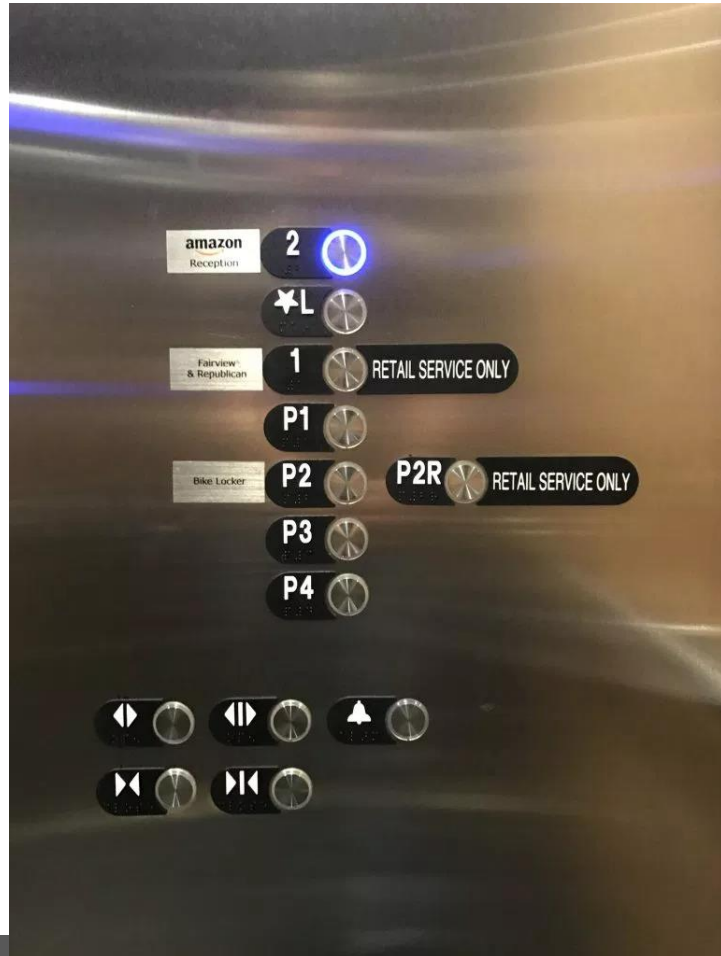


Ever look at elevator button panels?





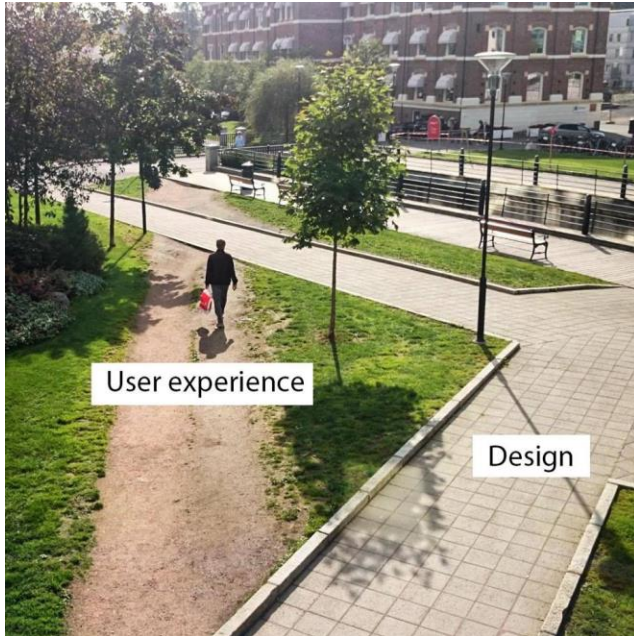


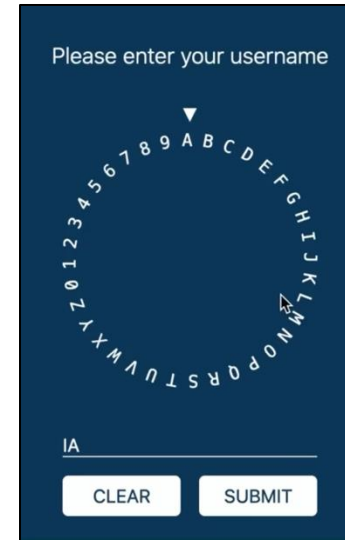


Did you read the instructions?



Design for people





r/BadUIBattles

For more funny examples of bad design...

What usability problems have you seen with software?

How do we test usability?

Intuition?

Test on ourselves?

Copy interface from other apps?

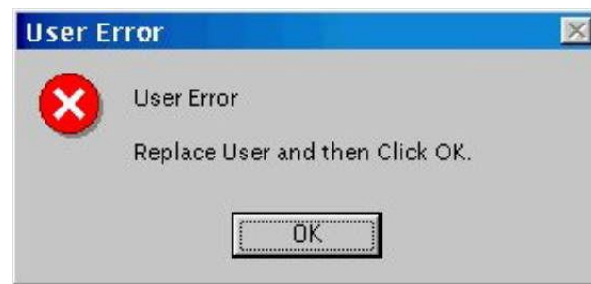
Not worry about it until someone dies?

Activity: How do you test your feature?

- Who do you have test it?
- What do they do with it?
- What do you measure?
- What is the bar for “good”?

Test with actual **USERS**

- Put your app in front of actual people
- Can they figure it out?
- How long does it take them?
- Do they need help?



- **How they behave != how you want them to behave**
 - Don't blame the user!
 - Blame the design and go fix it!

How do you measure usability?

- Imagine your group project...
- How do you measure whether it is usable?
- How do you test it with people?

Low-cost user testing

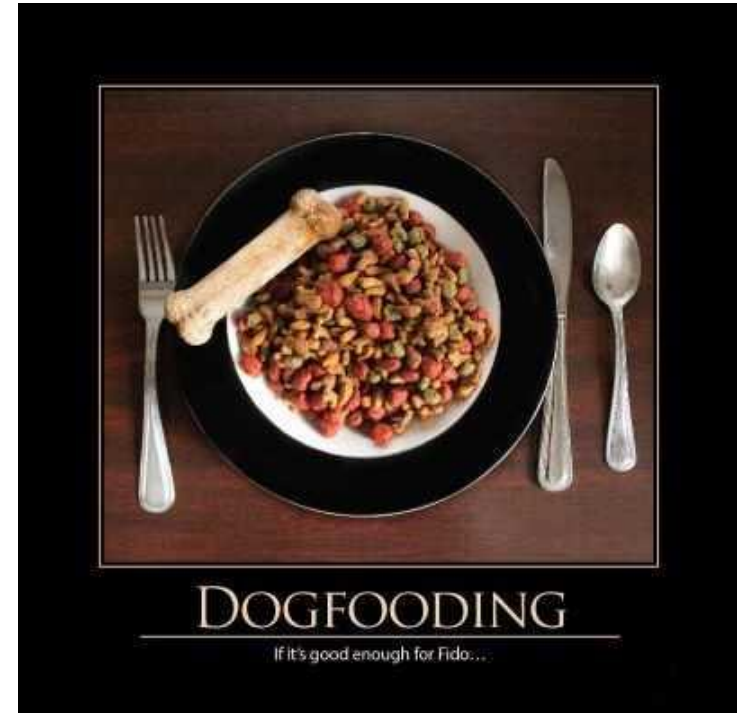
- Ask a few people to try your app every few weeks
- Can they figure it out without help?
- Give them a task with it... do they do it as you expected?



What problems might there be with this method?

“Dogfooding”

- Use your own product.
- Helps close the gap between user and developer.



User study methods

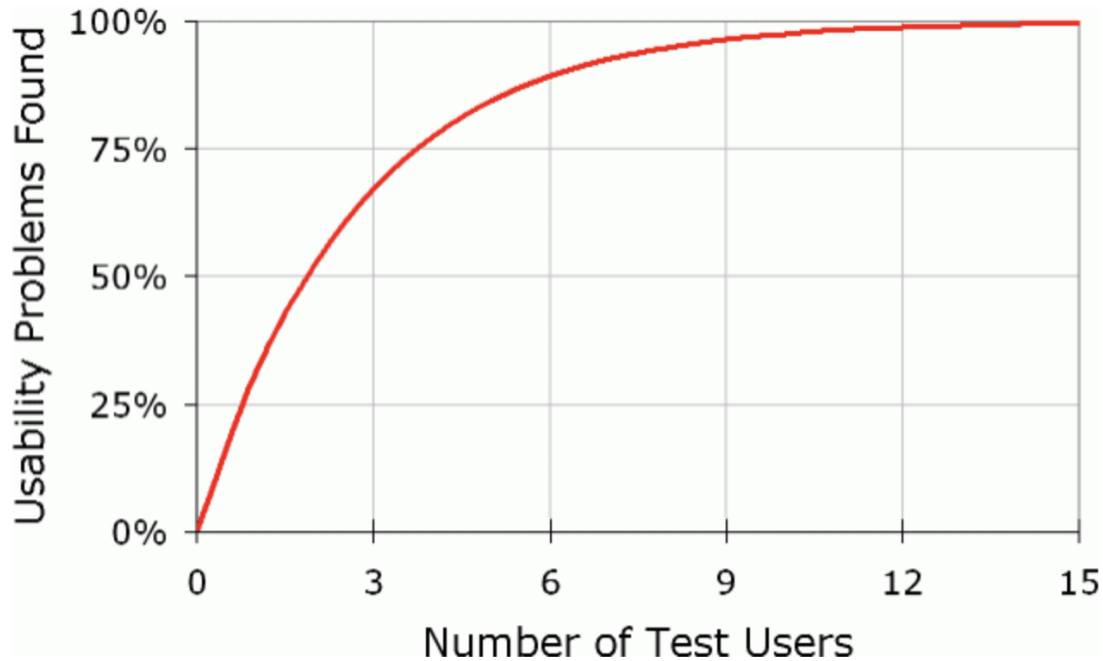
- Interviews
 - Surveys
 - Shadowing
 - Lab study
 - Field study
 - Wizard of Oz
 - Focus group
 - Retrospective study
 - Diary study
 - A/B testing
- Pros/cons of each
 - Each answers different questions
 - Often use multiple

Lab study

- Controlled setting with complete control over tasks
- Common to record the participant and the screen
- Can be formal or informal
- Many possibly tasks
 - Based on your user stories
 - Ask them to complete the same task using two different apps
- Metrics: task time, correctness, mistakes, opinions
- Beware of reactivity effects
- Do they use the app as you expected?



Revealing usability concerns



A/B testing



A/B Testing

- Compare two variations of a design
- Often used for web pages with a call to action

- Randomly show a user design A or B
- Does design A or B lead to more sales/signups/clicks?

- Requires many users
- Is there a *statistically significant difference*?
- Doesn't tell you *why*

Shadowing

- “Fly on the wall”
- Observe people in their own setting... often work
- Rich qualitative data

- Expensive!
- Time consuming
- Difficult to get access



Interview & Survey

- Open-ended questions show the users perspective
- Users will surprise you
- Don't ask leading questions
 - *"How much do you love my app?"*
- Responses don't always match behavior
- Scalable

- *"Do you want this feature?" "YES!"*

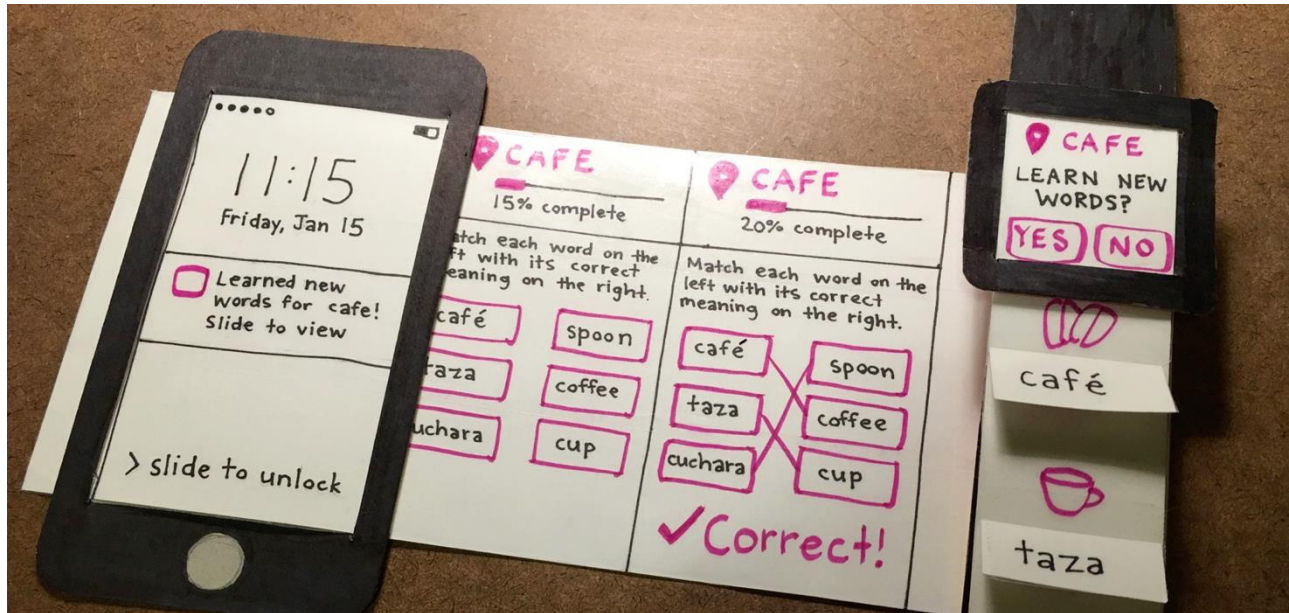


Prototyping

- Implementing a full feature/product is expensive
- Prototype to gather requirements first

- Mockups/wireframes
- Paper prototype
- Wizard of Oz

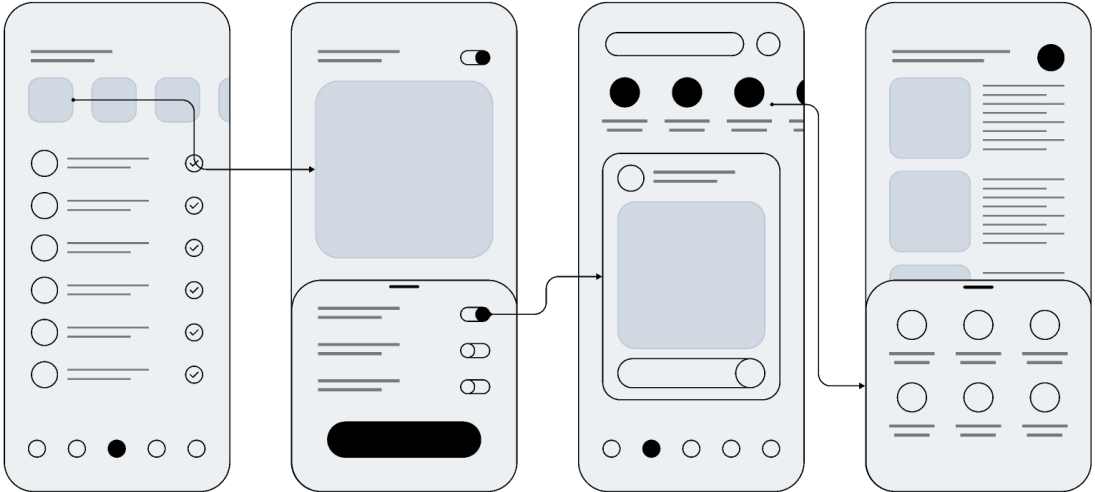
Paper prototype



Wizard of Oz



Wireframes



Aspects of Usability

Learnability



Efficiency



Satisfaction



Memorability



Errors



Learnability

- Can users learn to correctly use it?
 - Can unfamiliar users pick it up?
 - Can power users learn to become experts with it?
- How to provide the right guidance to help users?
- They won't read instruction books!
- Wizards?
- Visible & labeled buttons



Word

Sign in

New

Home Resume

Resume for internal co...

Functional resume (Min... →)

Employment and salary...

Resume (Origin theme)

Resume (Essential design)

Resume (Black Tie design)

Resume (Origin theme)

Resume (Equity theme)

Category

| | |
|-------------------|----|
| Industry | 32 |
| Human Resources | 31 |
| Business | 30 |
| Resume | 30 |
| Hiring | 26 |
| Personal | 19 |
| Design Sets | 13 |
| Basic | 11 |
| Chronological | 11 |
| Individual | 7 |
| Professional | 5 |
| Small Business | 5 |
| Blue | 3 |
| Employee | 3 |
| Functional | 3 |
| Sales | 3 |
| Application | 2 |
| Borders | 2 |
| Equity Design Set | 2 |
| Orange | 2 |

Screencast-O-Matic.com

Design constraint:

- Don't overwhelm the user
- Make it easy to find features



How could we measure learnability?

Aspects of Usability

Learnability



Efficiency



Satisfaction



Memorability

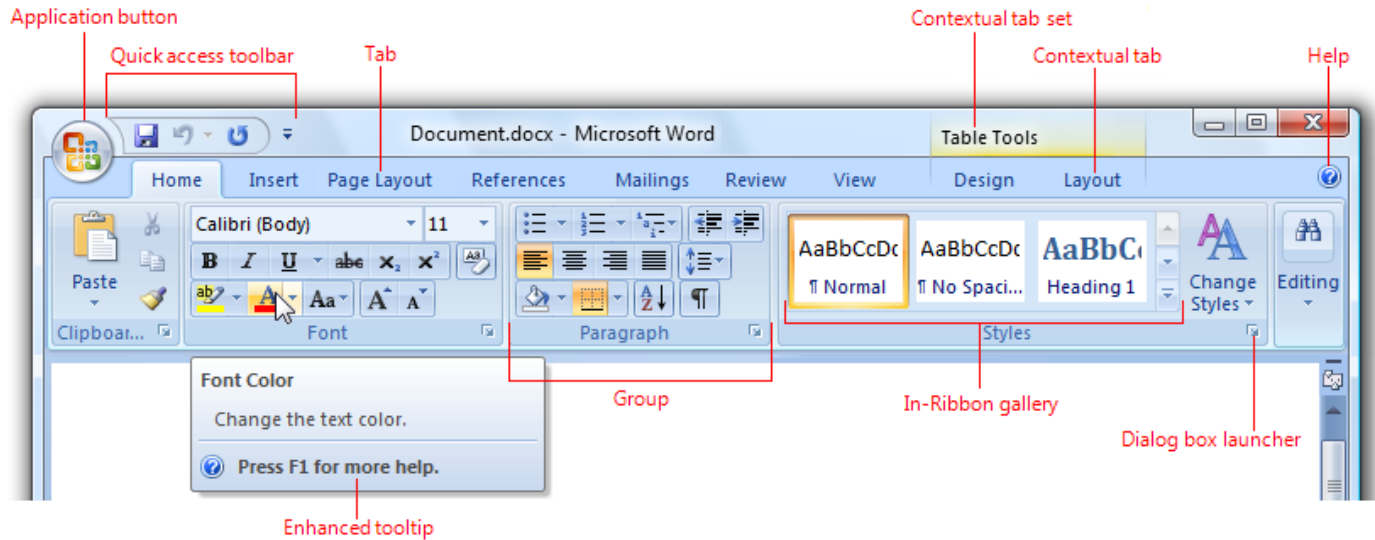


Errors



Efficiency

- How fast can users perform the correct interaction?
- How do you design interfaces for faster interactions?



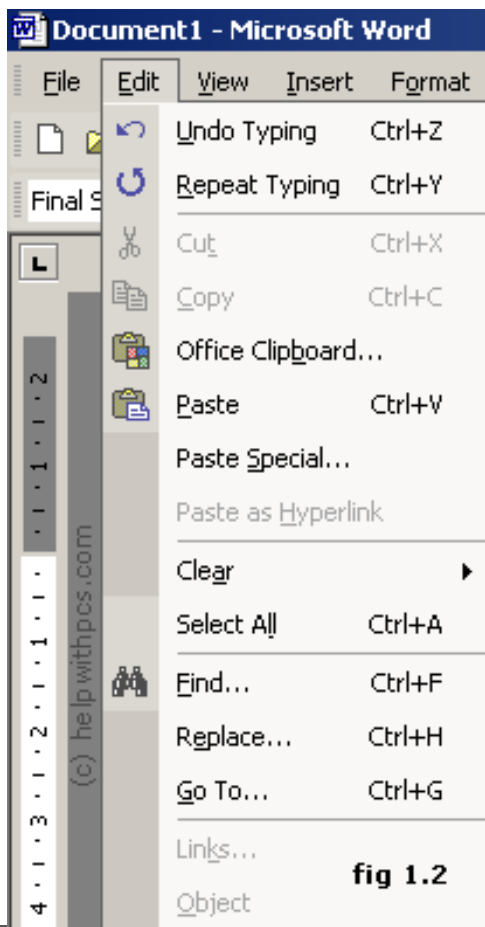


fig 1.2

```
write --zsh -- 80x24
drwxr-xr-x  59 azh  staff  1.8K Jan 21 12:56 src
drwxr-xr-x  53 azh  staff  1.7K Jan 21 12:56 test
drwxr-xr-x   3 azh  staff   96B Jan 21 12:56 types
-rw-r--r--   1 azh  staff  1.9K Jan 21 12:56 webpack.common.js
-rw-r--r--   1 azh  staff  195B Jan 21 12:56 webpack.dev.js
-rw-r--r--   1 azh  staff  397B Jan 21 12:56 webpack.installer.js
-rw-r--r--   1 azh  staff  472B Jan 21 12:56 webpack.prod.js
[~/Coding/NodeBB] λ cd src/routes/write
[~/Coding/NodeBB/src/routes/write] λ ll
total 120
-rw-r--r--   1 azh  staff  1.5K Jan 21 12:56 admin.js
-rw-r--r--   1 azh  staff  2.2K Jan 21 12:56 categories.js
-rw-r--r--   1 azh  staff  4.4K Jan 21 12:56 chats.js
-rw-r--r--   1 azh  staff  993B Jan 21 12:56 files.js
-rw-r--r--   1 azh  staff  1.2K Jan 21 12:56 flags.js
-rw-r--r--   1 azh  staff  2.4K Jan 21 12:56 groups.js
-rw-r--r--   1 azh  staff  2.4K Jan 21 12:56 index.js
-rw-r--r--   1 azh  staff  2.8K Jan 21 12:56 posts.js
-rw-r--r--   1 azh  staff  967B Jan 21 12:56 search.js
-rw-r--r--   1 azh  staff  542B Jan 21 12:56 tags.js
-rw-r--r--   1 azh  staff  3.8K Jan 21 12:56 topics.js
-rw-r--r--   1 azh  staff  4.7K Jan 21 12:56 users.js
-rw-r--r--   1 azh  staff  557B Jan 21 12:56 utilities.js
[~/Coding/NodeBB/src/routes/write] λ
```


Book Search for tools, help, and more (Option + Q) AH

File Home Insert Share Page Layout Formulas Data Review View Help Draw

Comments Editing Share

Arial 10 B Currency \$€ ¥ .0 .00 ∑ 21

| | A | Font Name | C | D | E |
|----|-------------|-----------------|---------------------|------------------|--------------------|
| 1 | 0 | Actual Jan 2023 | Projected July 2023 | Actual July 2023 | Projected Jan 2024 |
| 2 | 401k 1 | \$33.00 | \$44.00 | \$71.00 | \$59.00 |
| 3 | 401k 2 | \$48.00 | \$52.00 | \$53.00 | \$48.00 |
| 4 | 403b | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| 5 | Roth IRA | \$67.00 | \$73.00 | \$99.00 | \$79.00 |
| 6 | RSU/ESPP | \$89.00 | \$105.00 | \$123.00 | \$42.00 |
| 7 | Brokerage | \$42.00 | \$54.00 | \$75.00 | \$86.00 |
| 8 | HYSAs | \$23.00 | \$23.00 | \$10.00 | \$23.00 |
| 9 | CD | \$0.00 | \$0.00 | \$10.00 | \$0.00 |
| 10 | Checking | \$34.00 | \$34.00 | \$48.00 | \$34.00 |
| 11 | Brokerage 2 | \$79.00 | \$90.00 | \$0.00 | \$79.00 |
| 12 | HSA | \$32.00 | \$35.00 | \$79.00 | \$10.00 |
| 13 | 0 | 0 | 0 | 0 | 0 |
| 14 | TOTAL | \$830.00 | \$950.00 | \$980.00 | \$999.00 |
| 15 | LIQUID | \$83.00 | \$110.00 | \$130.00 | \$163.00 |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20 | | | | | |
| 21 | | | | | |

Copilot

Can you add another projection column and calculate each row based on prior years data?

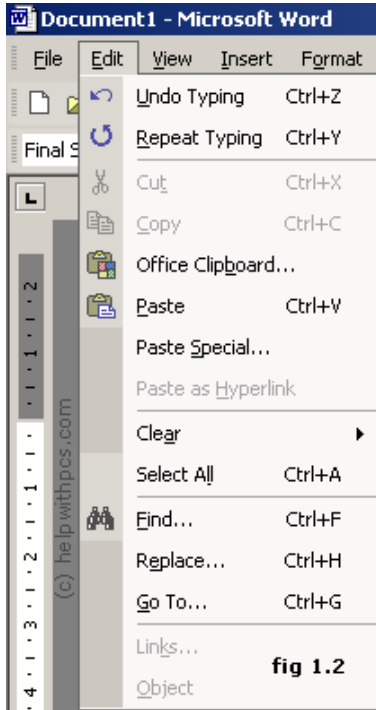
The headers in data range A1:L21 should be in columns, as a single row on top of the data. Ask me how to use the TRANSPOSE() function to switch the format from columns to rows.

AI-generated content may be incorrect

Please add another projection column

The headers in data range A1:L21 should be in columns, as a single row on top of the data. Ask me how to use the TRANSPOSE() function to switch the format from columns to rows.

AI-generated content may be incorrect



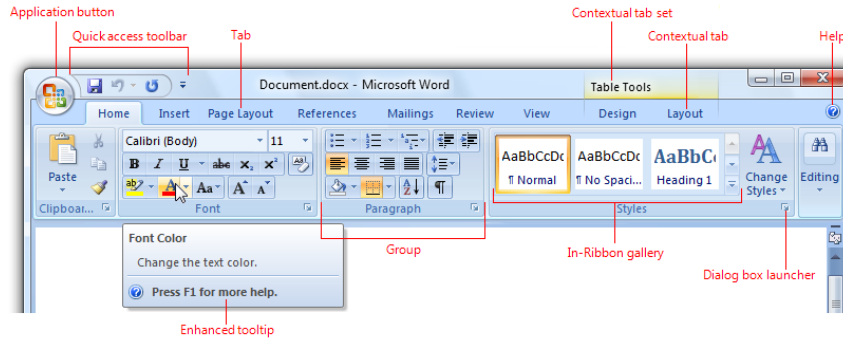
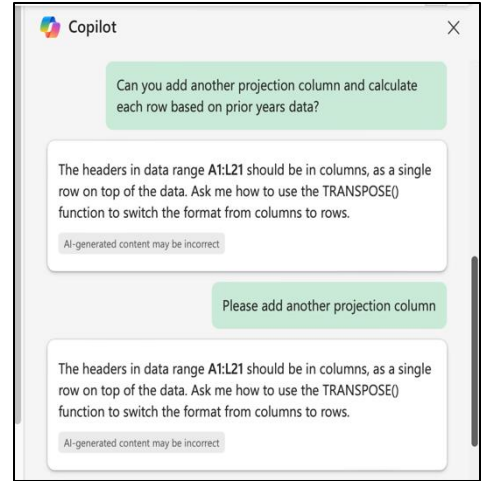
```

write -- zsh -- 80x24
drwxr-xr-x 59 azh staff 1.8K Jan 21 12:56 src
drwxr-xr-x 53 azh staff 1.7K Jan 21 12:56 test
drwxr-xr-x 3 azh staff 96B Jan 21 12:56 types
-rw-r--r-- 1 azh staff 1.9K Jan 21 12:56 webpack.common.js
-rw-r--r-- 1 azh staff 195B Jan 21 12:56 webpack.dev.js
-rw-r--r-- 1 azh staff 397B Jan 21 12:56 webpack.installer.js
-rw-r--r-- 1 azh staff 472B Jan 21 12:56 webpack.prod.js

[~/Coding/NodeBB] λ cd src/routes/write
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total 120
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-rw-r--r-- 1 azh staff 2.2K Jan 21 12:56 categories.js
-rw-r--r-- 1 azh staff 4.4K Jan 21 12:56 chats.js
-rw-r--r-- 1 azh staff 993B Jan 21 12:56 files.js
-rw-r--r-- 1 azh staff 1.2K Jan 21 12:56 flags.js
-rw-r--r-- 1 azh staff 2.4K Jan 21 12:56 groups.js
-rw-r--r-- 1 azh staff 2.4K Jan 21 12:56 index.js
-rw-r--r-- 1 azh staff 2.8K Jan 21 12:56 posts.js
-rw-r--r-- 1 azh staff 967B Jan 21 12:56 search.js
-rw-r--r-- 1 azh staff 542B Jan 21 12:56 tags.js
-rw-r--r-- 1 azh staff 3.8K Jan 21 12:56 topics.js
-rw-r--r-- 1 azh staff 4.7K Jan 21 12:56 users.js
-rw-r--r-- 1 azh staff 557B Jan 21 12:56 utilities.js

[~/Coding/NodeBB/src/routes/write] λ

```



Design constraint:

- Let experts be fast
- Let novices learn



How could we measure efficiency?

Errors

- Is it unlikely that users will make errors?
- Is it easy to recover from errors?



Make it hard to make mistakes

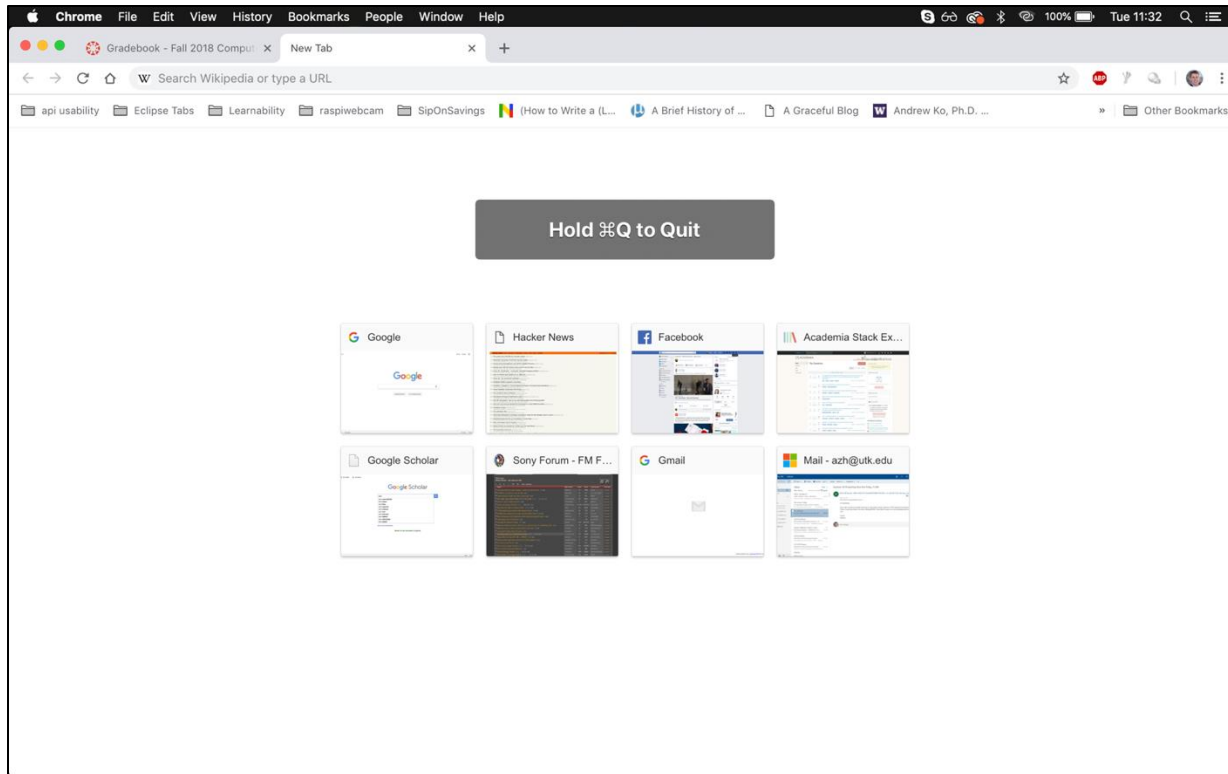
- Unambiguous buttons
- Clear descriptions
- No surprises!
- Every action should be revertible*

Revertible!

- Ever close a tab on accident?
 - Reopen tab
- Ever close all your tabs?
 - Reopen all
- Ever close Chrome?
 - Recent update made it harder
- Delete a file?
 - Trash
- Changed a file?
 - Undo
- Clicked the Next button?
 - Previous



For permanent things...
Ask if they are sure.
Consider a delay.



How could we measure errors?

Aspects of Usability

Learnability



Efficiency



Satisfaction



Memorability



Errors



Activity: How do you test your feature?

- Who do you have test it?
- How do they test it?
- What do you measure?
- What is the bar for “good”?