

17-423/723: Software System Design

Value Sensitive Design

April 8, 2026

Logistics

- M5 released due today; due next Friday (April 17)
- No lectures next week; project work time
- Project presentations will be given on the last day of class (April 22)
- Final exam: Monday, April 27, 8:30-11:30
 - Covers the materials from the entire semester
 - Sample exam to be posted

Learning Goals

- Describe ethical responsibilities of a software engineer
- Identify different types of harms on the society that can be caused by a software system
- Apply heuristics from the Value Sensitive Design approach to design systems that account for stakeholder's values
- Decide whether the benefits of building a software product outweighs its potential harm

Responsible Software Engineering

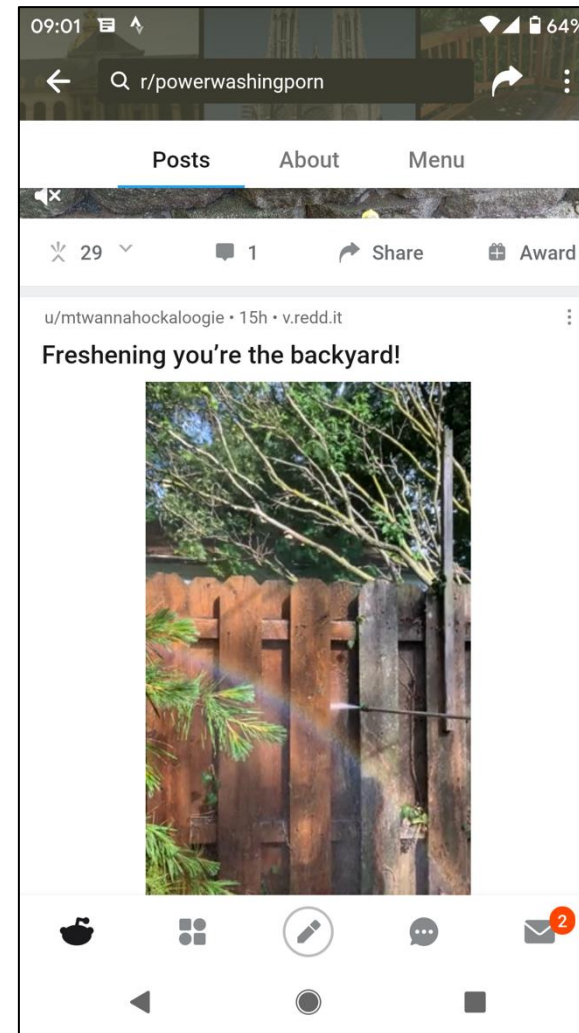
Example: Social Media



- **Q. What is the (real) objective of the organization?**

Optimizing for Organizational Objective

- How do we maximize the user engagement?
- **Examples:**
 - Infinite scroll: Encourage non-stop, continual use
 - Personal recommendations: Suggest news feed to increase engagement
 - Push notifications: Notify disengaged users to return to the app
- **Q. So what? How can social media harm people?**



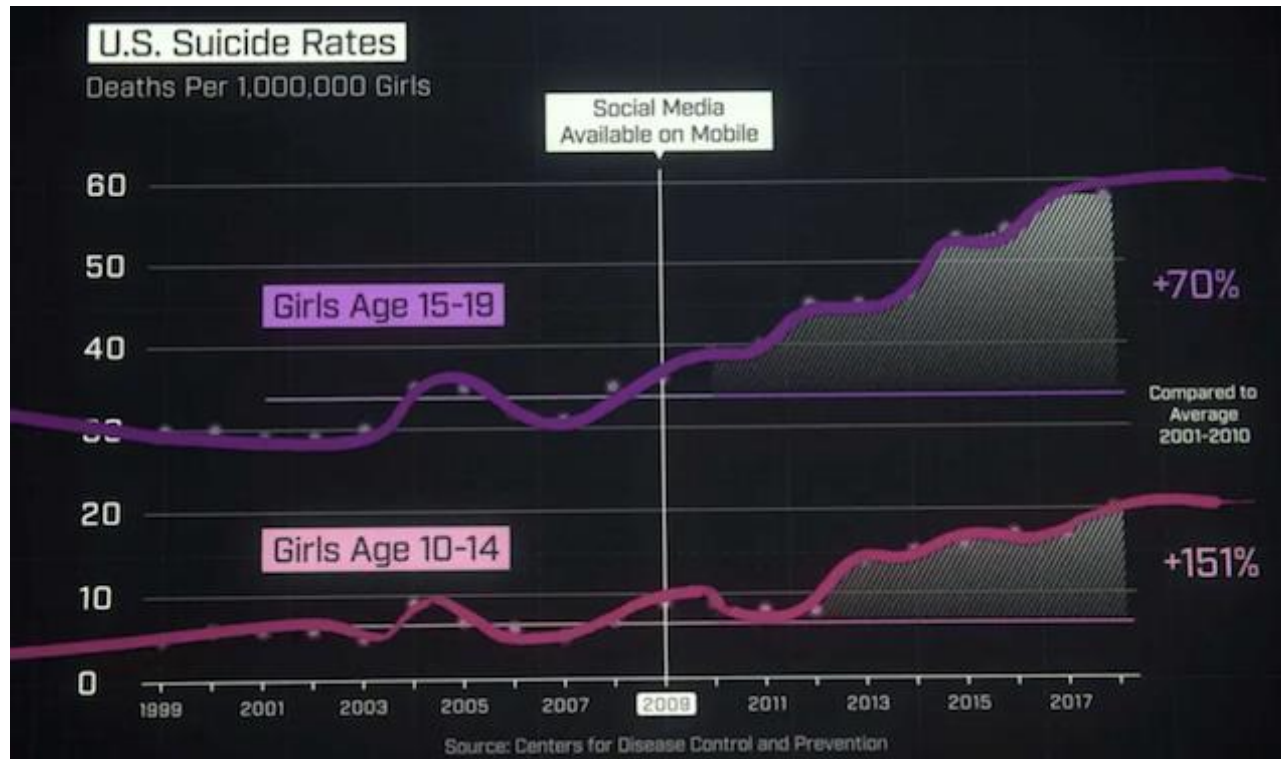
Addiction



- 210M people worldwide addicted to social media
- 71% of Americans sleep next to a mobile device
- ~1000 people injured per day due to distracted driving (US)

Sources: <https://www.flurry.com/blog/mobile-addicts-multiply-across-the-globe>
https://www.cdc.gov/motorvehiclesafety/Distracted_Driving/index.html

Mental Health



- 35% of US teenagers with low social-emotional well-being have been bullied on social media.
- 70% of teens feel excluded when using social media.

Sources: <https://leftronic.com/social-media-addiction-statistics>

Who is to blame?

GOOGLE QUIETLY REMOVES 'DON'T BE EVIL' PREFACE FROM CODE OF CONDUCT

Google employees resigned this month over the company's autonomous weapons project

Anthony Cuthbertson | @ADCuthbertson | Monday 21 May 2018 12:21



**Q. Are these companies intentionally trying to cause harm?
If not, what are the root cause of the problem?**

Challenges

- Misalignment between organizational goals & societal values
 - Financial incentives often dominate other goals ("grow or die")
- Hardly any regulation
 - Little legal consequences for causing negative impact (with some exceptions)
 - Poor understanding of socio-technical systems by policy makers
- Engineering challenges
 - Difficult to clearly define or measure societal/ethical values
 - Difficult to anticipate all possible usage contexts
 - Difficult to prevent malicious actors from abusing the system

Meta and YouTube Found Negligent in Landmark Social Media Addiction Case

A jury found the companies harmed a young user with design features that were addictive and led to her mental health distress.



<https://www.nytimes.com/2026/03/25/technology/social-media-trial-verdict.html>

Responsible Software Engineering Matters!

- We, as software designers, have substantial power in shaping products and outcomes
- Serious individual and societal harms are possible from (a) negligence and (b) malicious designs
 - Safety failures, mental health problems, weapon proliferation
 - Security & privacy violations
 - Manipulation, addiction, surveillance, polarization
 - Job loss, deskilling
 - Discrimination

Dimensions of Responsible Design

- Many quality attributes, when neglected, could result in harm to the stakeholders & environment
 - Robustness, reliability, safety
 - Security, privacy
 - Usability
 - Transparency, accountability
 - Accessibility
 - Fairness & bias
- We should **deliberately consider these qualities and values during the design process**

Value Sensitive Design

Adapted from slides by Arvind Satyanarayan (MIT)

Value Sensitive Design (VSD)

- Designers often focus on the **immediate context of use**:
How will a product be used by the person who purchases it?
- Designers rarely have the time or method to **consider the long-term and indirect effects of their technologies**.
- **VSD**: A set of tools & heuristics to think through design implications more systematically



**VALUE
SENSITIVE
DESIGN**

SHAPING
TECHNOLOGY
WITH MORAL
IMAGINATION

BATYA FRIEDMAN
DAVID G. HENDRY

Value-Sensitive Design: 4 Criteria

Stakeholders

Describes the range of effects both on the people who are in direct contact with the technology, as well as those who might not be direct users, but whose lives are nevertheless affected by various interactions around the technology.

Time

Consider the implications that will only emerge after the technology has moved through initial phases of novelty to later phases of appropriation and integration into society.

Pervasiveness

Systemic interactions that follow from the widespread adoption of an interactive technology.

Values

What do people consider important in life? e.g., autonomy, community, cooperation, democratization, environmental sustainability, fairness, dignity

What do we mean by “values”?

- Some values are **universal** – e.g., safety, justice, human rights, privacy
- But others are **specific to context and stakeholders**
- Consider not only majority values, but also those held by **minority** stakeholders



Human welfare refers to people’s physical, material, and psychological well-being



Accessibility refers to making all people successful users of information technology



Respect refers to treating people with politeness and consideration



Calmness refers to a peaceful and composed psychological state



Freedom from bias refers to systematic unfairness perpetrated on individuals or groups, including pre-existing social bias, technical bias, and emergent social bias

and many others...

Value-Sensitive Design: 4 Criteria

Stakeholders

Direct Stakeholders ■ Indirect Stakeholders ■ Non-targeted Use ■ Children ■ Variation in Abilities ■ Changing Hands ■ One Person, Many Roles

Time

The Long Now ■ Long-Term Health & Well-Being ■ Sustained Friendships ■ Work of the Future ■ Adaptation ■ Non-Use ■ Obsolescence ■ Reappropriation

Pervasiveness

Widespread Use ■ Diverse Geographies ■ Crossing National Boundaries ■ Accounting for Culture ■ Political Realities

Values

Elicit Stakeholder Values ■ Consider Key Values at Stake ■ Choose Desired Values ■ Evaluate User Experience of Values ■ Value Tensions ■ Perceptions of a Value

Value-Sensitive Design: 4 Criteria



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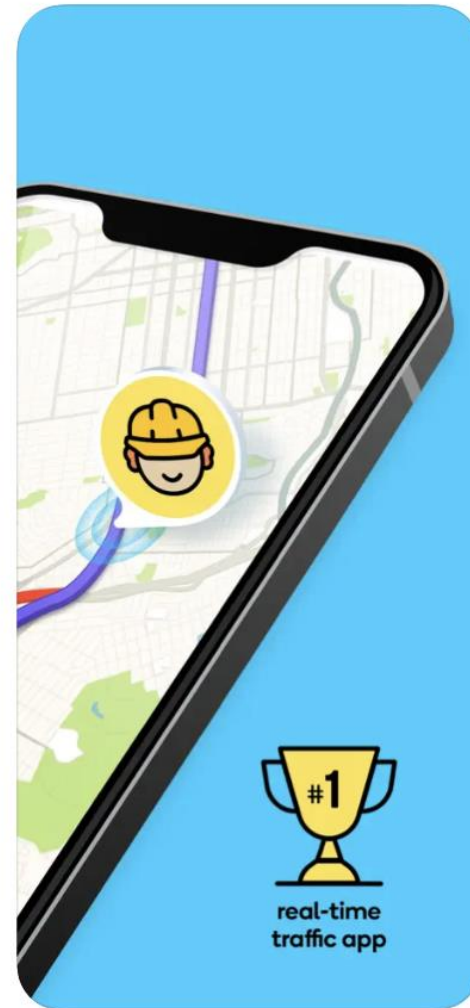
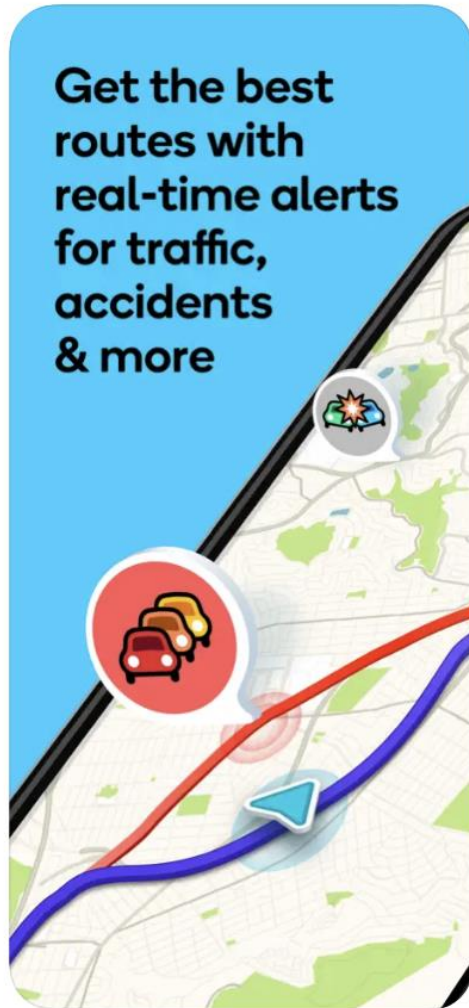
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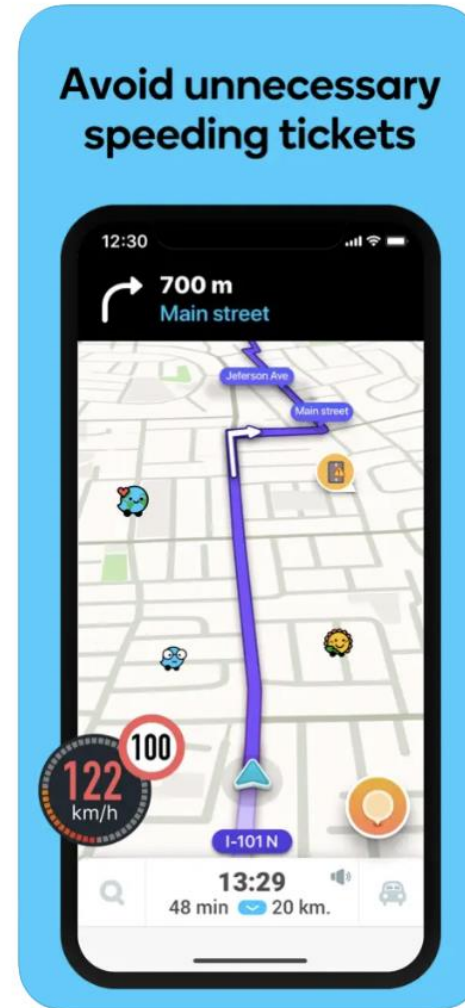
Indirect Stakeholders: The Waze Effect

Get the best routes with real-time alerts for traffic, accidents & more

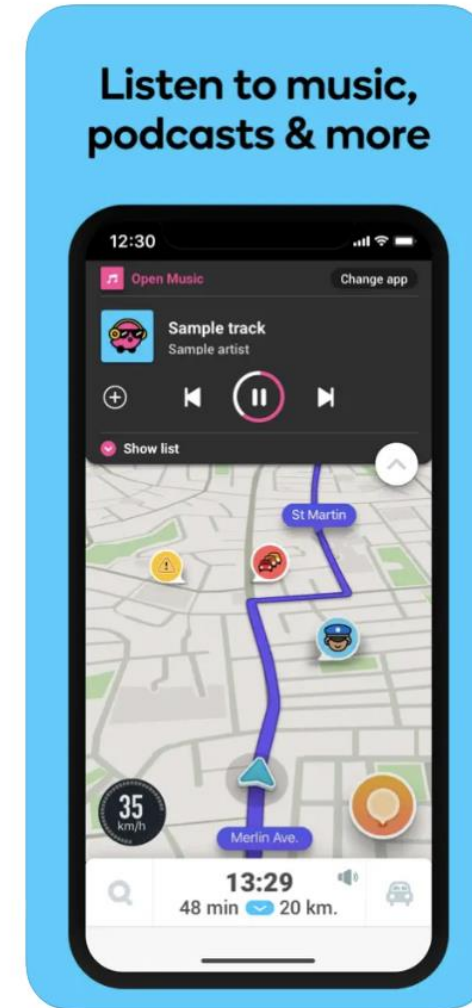


#1
real-time traffic app

Avoid unnecessary speeding tickets



Listen to music, podcasts & more





BOROUGH
of
LEONIA
settled
1668

 **CBS THIS
MORNING**

WAZED AND CONFUSED

NJ TOWN TARGETS CONGESTION FROM NAVIGATION APPS



Indirect Stakeholders: The Waze Effect



Gail Barry of Medford says navigation apps have **completely changed her neighborhood**.

"The cars go whiz, whiz, whiz. It's like we are living on a highway. It's horrible."

Q. What are values that are important to the indirect stakeholders of Waze?



...en worse every year over

le-maps-traffic-navigation-apps-

street in Takoma Park, MD.
every two seconds on a

street with a single lane available between parked cars.

One morning, neighbors **awoke to a cacophony of honks** and went out to find a **backup dozens of cars deep**, two drivers in the middle **about to come to blows**.

https://www.washingtonpost.com/local/traffic-weary-homeowners-and-waze-are-at-war-again-guess-whos-winning/2016/06/05/c466df46-299d-11e6-b989-4e5479715b54_story.html

Stakeholders Strike Back



DAVID E. RYU
COUNCILMEMBER, FOURTH DISTRICT

April 17, 2018

City Attorney Mike Feuer
Office of the Los Angeles City Attorney
James K. Hahn City Hall East
200 North Main Street, 8th Floor
Los Angeles, CA 90012

Dear City Attorney,

I am writing you today to urge your office to explore filing suit against Waze, owned by Google LLC, a subsidiary of Alphabet, for creating a dangerous condition in the public right of way. After numerous attempts to reach a resolution with Waze for the threats to public safety and infrastructure caused by their mobile technology, it has become clear that any and all legal options should be considered.

Wayfinding technology such as Waze has grown increasingly popular with drivers. In 2015, Waze reported that it had about 2 million users in Greater Los Angeles, one of the app's most popular locations. This new kind of wayfinding technology promises users a faster commute by giving real-time traffic updates and alternate routes to traditional arteries. To achieve this, it can wreak undue havoc on traffic plans, residential communities, and the safety of the residents of Los Angeles. Ironically, many of these "short cuts", end up causing more traffic in a race-to-the-bottom effort to cut travel times by using small cut-through streets, leading drivers to make unsafe turns and often unpermitted traffic directions.

Responsibility of the Product Designer?



"All roads are the public domain and therefore the right of everyone to use [...] In that sense, Waze redistributes traffic to create a better traffic situation for everyone."

– Uri Levine, Waze Co-Founder

Indirect Stakeholders: Discussion

- **Q. Should Waze update its design to account for its indirect stakeholders?**
 - If so, what are some potential design solutions?
 - If not, what is your argument against doing so?

Activity: Food Rescue System

- **Discussion in groups (7~8 minutes):**
 - Who are some potential indirect stakeholders?
 - What are values that are important/relevant to those stakeholders?
 - What are ways in which those values can be affected negatively by the system?
 - How would you (re)design the system to mitigate those effects?

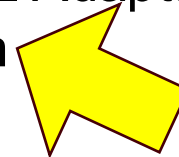
Value-Sensitive Design: 4 Criteria

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Pervasiveness

Widespread Use ■ Diverse Geographies ■ Crossing National Boundaries ■ Accounting for Culture ■ Political Realities

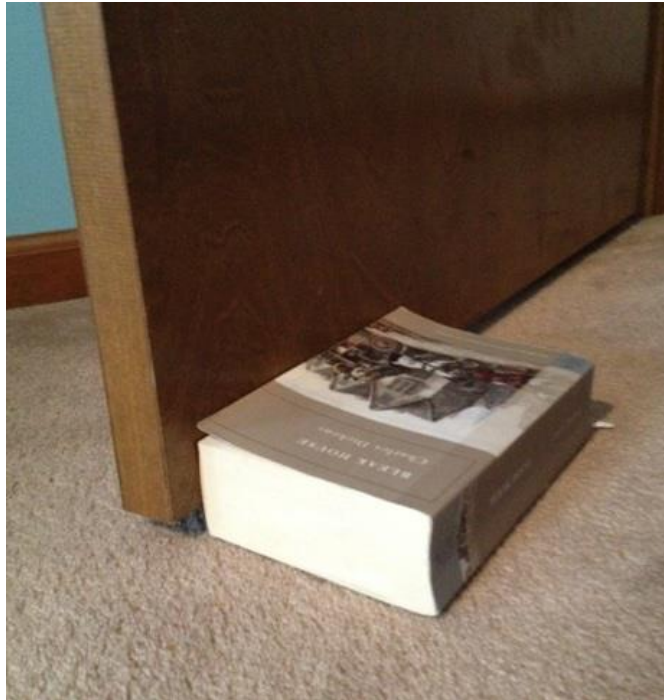
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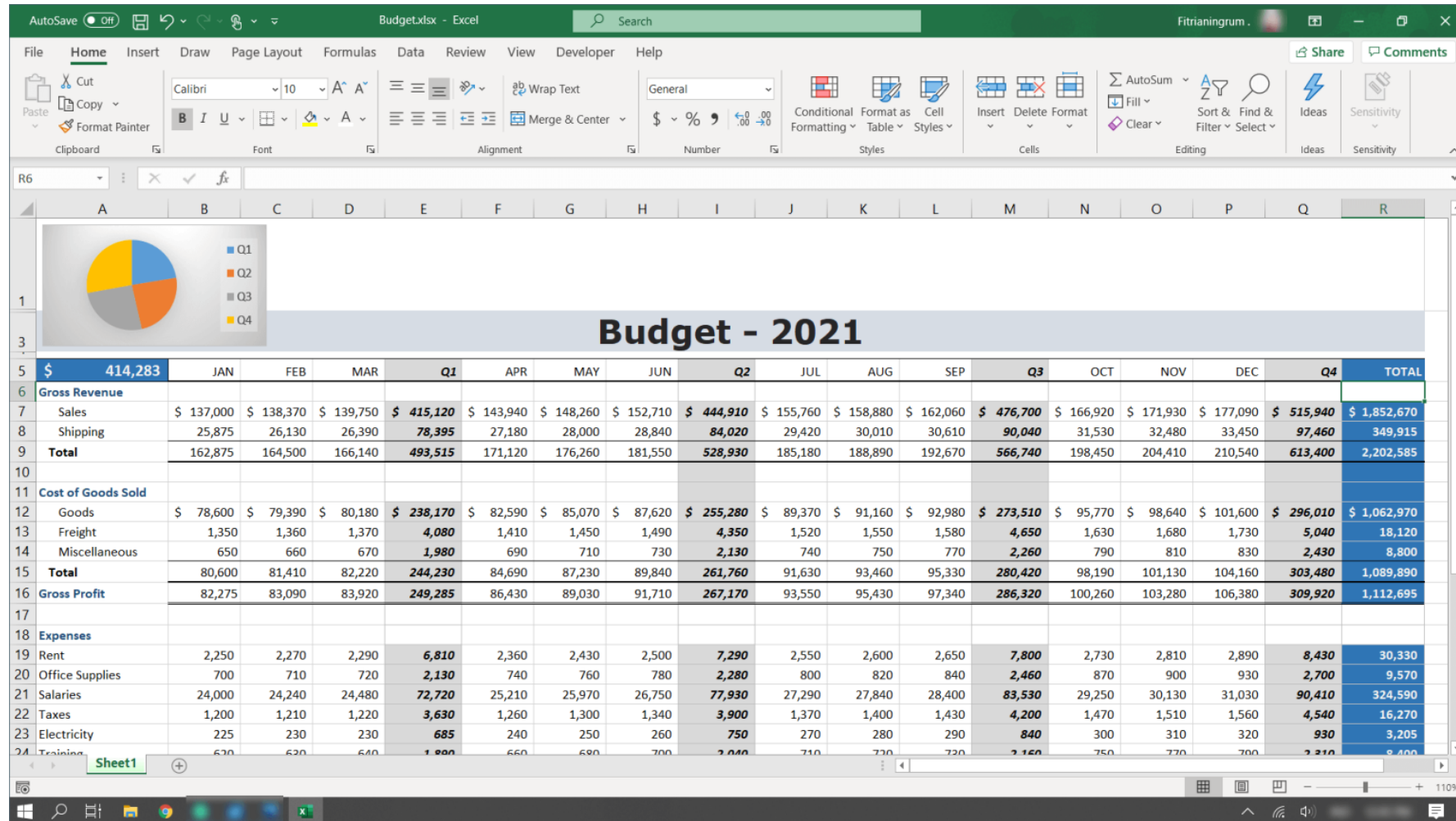
Reappropriation



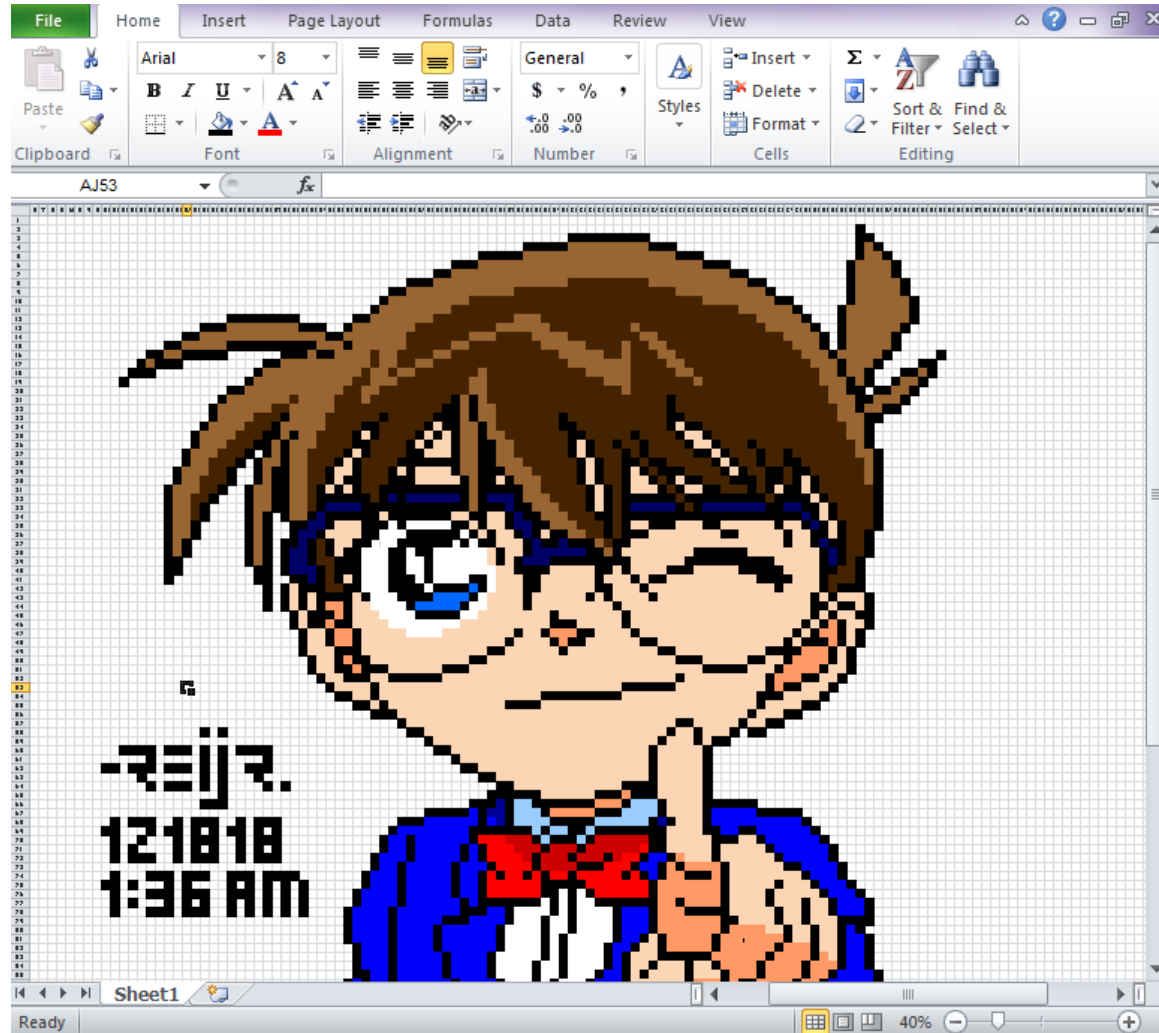
Photo by Clément Gault



Reappropriation: Malleable Software

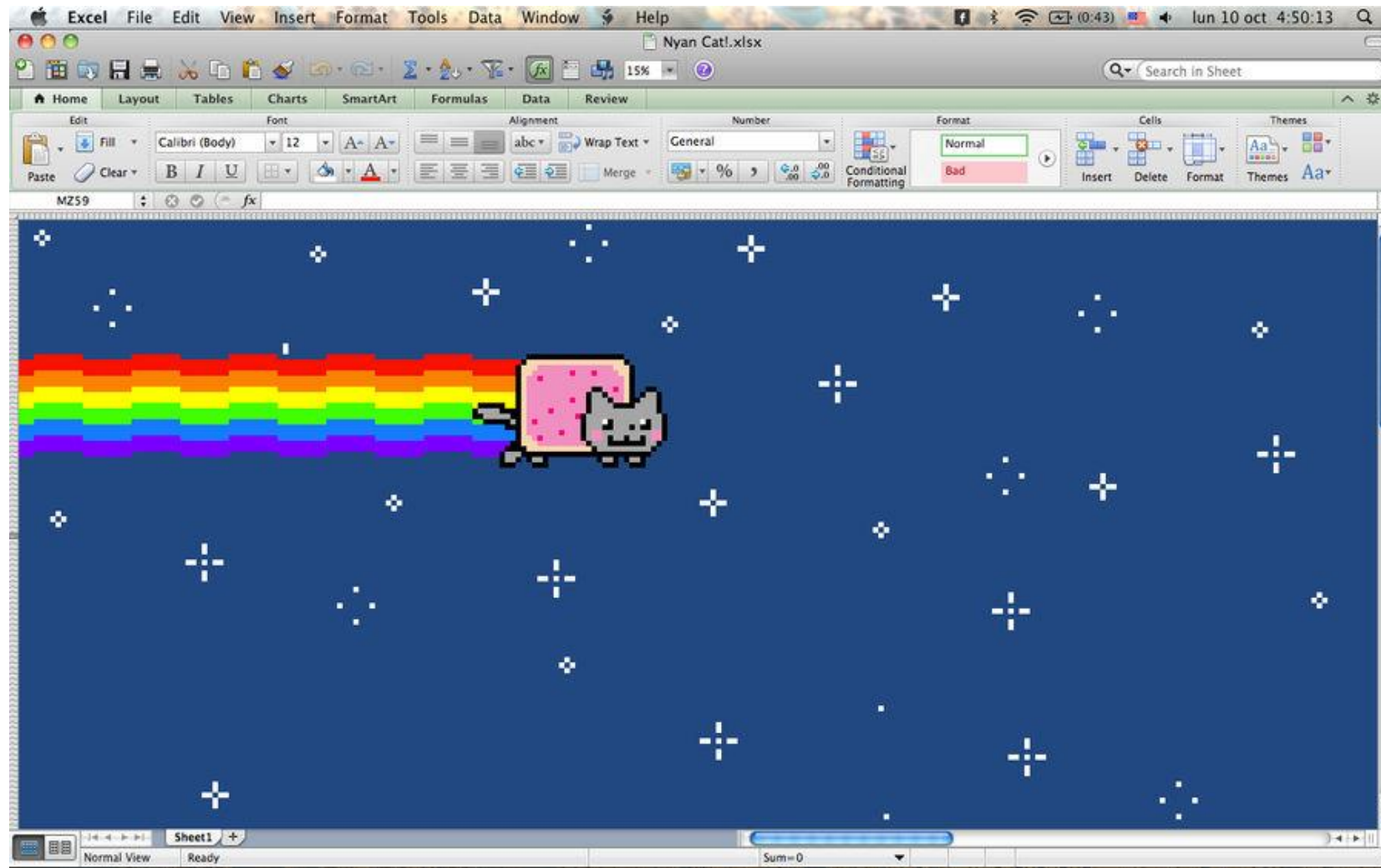


Reappropriation: Malleable Software



Pixel art by [reijr.](#)
Curated by [Maggie Appleton](#)

Reappropriation: Malleable Software



Reappropriation: Malleable Software

The screenshot displays the XIStudio software interface. At the top, the title 'XIStudio v1 by Dylan Tallchief' is shown with a 'Click Here!' link. Below this is a control panel with a BPM of 169, Device 1, Legato Off, and Swing 0. A 'Play' button is highlighted in yellow. To the right are 'Add Track' (green), 'Remove Track' (orange), and 'Export' (blue) buttons. The main area shows a music score with tracks for Drums, Synth, Bass, Slow Strings, Lead, Lead 2, and Strings 2. The score is divided into sections: Intro, Hook, and Verse 1. The Drums track shows a sequence of notes: 1 . 2 . 1 . 2 . 1 . 3 . 5 . 7 . 5 . 7 . 5 . 7 . 5 . 7 . 5 . 7 . 5 . 12 . The Synth track shows notes: 10 . . . 14 . . . The Bass track shows notes: 11 . . . 13 . . . 13 . . . 13 . 13 . 18 . . . 18 . . . 21 . . . The Slow Strings track shows notes: 12 . . . The Lead track shows notes: 15 . . . 15 . . . 17 . . . The Lead 2 track shows notes: 15 . . . 15 . . . 17 . . . The Strings 2 track shows notes: 16 . . . 16 . . . 16 . 16 . . . 32 33 .

Reappropriation

- A piece of technology or product used in ways that are originally unintended by the creator
- Given its malleability, software products tend to be more easily reappropriated (compared to physical products)
- Reappropriation can **empower** users to adapt/use a product in novel ways that are beneficial to them
- **BUT**: Software products can also be reappropriated/**misused** to cause deliberate or inadvertent **harms** to other direct/**indirect** stakeholders

AirTag

**What was lost
is now sound.**



CANADA

N.B. woman finds Apple AirTag in purse after night out: 'I was so shocked'



By **Alex Cooke & Anna Mandin** • Global News

Posted March 25, 2024 5:19 pm · Updated March 25, 2024 6:13 pm · 5 min read



<https://globalnews.ca/news/10382664/nb-canada-woman-apple-airtag-bar-club/>

Reappropriation

- **Q. Other examples of harmful reappropriation of software products?**

Reappropriation

- Software products can also be reappropriated/**misused** to cause deliberate or inadvertent **harms** to other stakeholders
- As a designer, we can't predict all possible ways in which a product can be misused
 - But this doesn't mean we should simply give up trying!
- Systematically consider not just *“who will use this?”* but also *“who could misuse it, and against whom?”*
 - Involves **adversarial thinking!** (recall: assurance case & threat modeling)
- Develop plans to continually monitor and improve the product during its entire lifecycle (beyond design & implementation)
 - Periodic audits, channels for user feedback, product recall & repair, etc.,

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Public Safety vs. Privacy



4 in 5 Americans are at least somewhat concerned about government surveillance, and almost 9 in 10 believe surveillance will be taken too far or already has been. ([Source](#))

South Korea > Law & Crime

Enhanced CCTV surveillance bolsters crime prevention across Seoul



88.9% of respondents 'believe' that public CCTVs are effective in preventing crime, while only 5% are negative on it and 6.1% said they are not sure about it.

*Furthermore, 46.5% of the respondents assess that CCTVs in public places are more effective in preventing crime than police.
([source](#))*

Value Tension

- Conflicting values across stakeholders from different communities, ages, gender, backgrounds, cultures, experiences, etc.,
 - Also common between individuals vs. groups (e.g., government)
- Not always a trade-off! Sometimes, innovative design can mitigate the tension by addressing both needs; e.g.,
 - Blur faces by default unless a legal trigger occurs (e.g., crime report)
 - Homomorphic encryption (query w/o decrypting data)
- But often, the tension must be **reconciled** by:
 - Following legal mandates
 - Prioritizing basic core values that cannot be compromised
 - Choosing the option that minimizes harms to vulnerable stakeholders
- One of the most difficult decisions to make as a system designer!



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Always question: Should we build it?

- If the amount of potential harm to the society is greater than the benefits of a product, should we build it?
- At the beginning, ask yourself:
 - What makes you think the problem can be satisfactorily addressed by software?
 - What makes you think the problem *should* be addressed by software?
 - What are possible social, political, and moral contexts in which the system will be used?
 - What will happen when a user, whom you might not have imagined, uses your system in a way that you didn't expect?

Deepfake AI Generator

Generate a deepswap video using AI in minutes

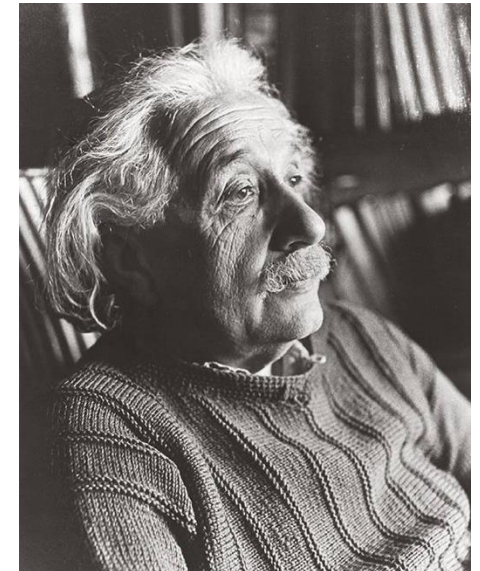
Make a Deepfake Video →

Always question: Should we build it?

- If the amount of potential harm to the society is greater than the benefits of a product, should we build it?

“Had I known that the Germans would not succeed in developing an atomic bomb, I would have done nothing.”

- Albert Einstein, reflecting on his letter to Roosevelt



Takeaways

- As software engineers, we have a significant amount of influence over how our products are shaped
- Remember that your system likely interacts with different groups of users from diverse backgrounds
- Even if unintended, the system may be used in ways that cause harms to users, the environment, and our society

Software is not neutral!

Developing software involves a series of **design choices** and **tradeoffs**, large and small. Each design decision is implicitly encoding your **values** and **priorities**. Through adoption, those values are then applied at **scale**. Those design choices then begin to shape our **values**.

Summary

- Exit ticket!
- Have a fun Spring Carnival!