ESE

Lecture #12 – User Interface
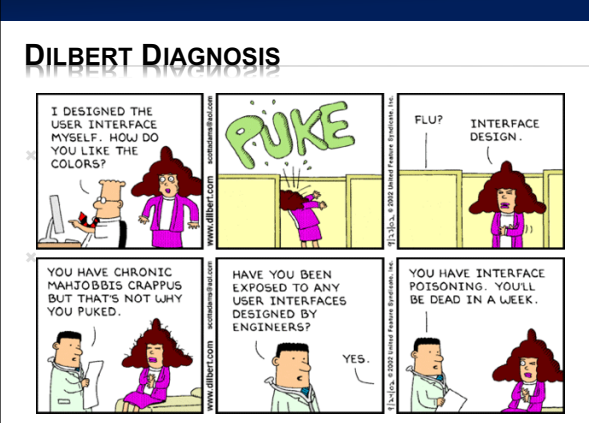
ESE 150 – DIGITAL AUDIO BASICS

Some contributions © 2018--2020 DeHon
Based on slides © 2009--2017 Badler

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USER INTERFACE

- **When a user sees a product**
  - See the interface
  - Not the underlying design
    - ….and that's the way it should be
- **Interface determines if the user can get job done**
  - …or will walk away frustrated
- **Successful interface**
  - Make it easy, pleasant to use
  - Hide all the complexity that makes it work

2

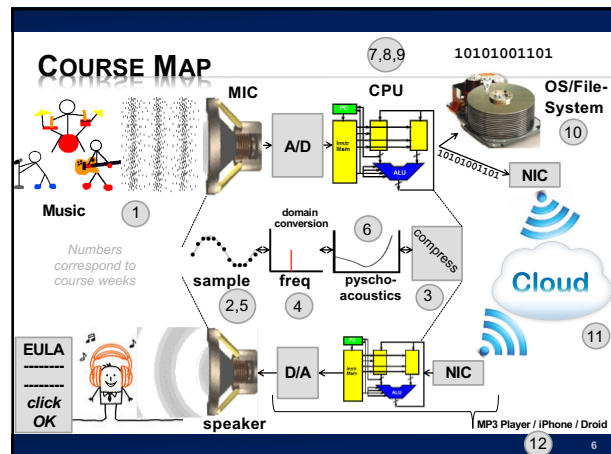---

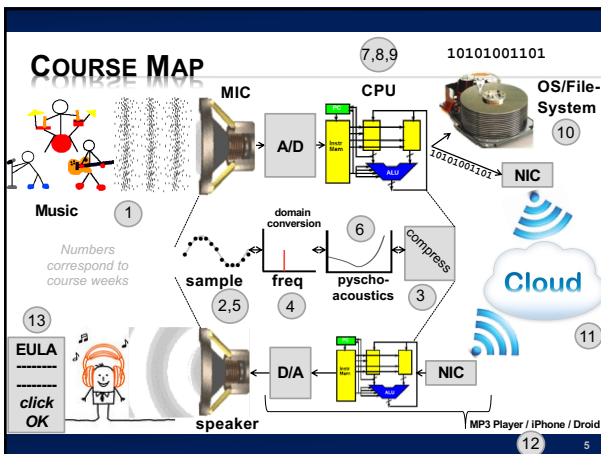## DILBERT DIAGNOSIS

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LECTURE TOPICS

- **Where are we on course map?**
- **User Interface**
  - Motivation
  - Issues and Principals
  - Developer vs. User
  - Design Choices
  - Approaches and Prototyping
  - Advancing/Enabling Technology

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COURSE MAP

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COURSE MAP

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DILBERT DIAGNOSIS

SELF AWARENESS

- **I'm an Engineer**
- **I have a different perspective and understanding of technology than lay public**
- **My view of what's obvious/non-obvious probably not representative of intended user base**
- **…how do I (or team I'm in) compensate for that?**
- **This lecture, I'm talking about my weakness**
  - And need for help
  - Not my strength
  - Won't do justice with solution…but maybe in raising issues, need for help
- **Nonetheless, I am frustrated by bad design from others as much as anyone else…**
  - Want "us" to do better.

THE PROBLEM IS THAT HUMANS ARE HALF OF THE USER INTERFACE

http://www.nevtron.si/borderline/archive2/intuiti.gif

AND EVEN IF INTUITIVE AND CLEAR, USER INTERFACE MIGHT NOT BE SO GOOD.

http://www.nevtron.si/borderline/delete.gif

AND IT'S NOT JUST ABOUT OUR WORKSTATION INTERFACES…

http://www.uselog.com/2008/11/users-fix-parking-ticket-machine-ui.html

WHO'S TO BLAME FOR USABILITY FAILURES?

- **Most Returned Products Work Fine:** Study Says Only 5 percent of returned products are genuinely defective: Yardena Arar, *PC World*, June 2, 2008 4:00 pm
- **Only 5 percent of consumer electronics products returned to retailers are malfunctioning --**yet many people who return working products think they are broken, a new study indicates.
- The report by technology consulting and outsourcing firm Accenture pegs the costs of consumer electronics returns in 2007 at **$13.8 billion** in the United States alone, *with return rates ranging from 11 percent to 20 percent*, depending on the type of product.
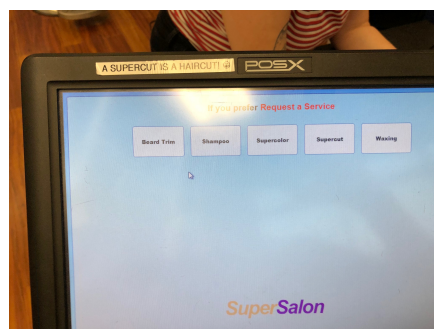
http://www.pcworld.com/article/146576/most_returned_products_work_fine_study_says.html

UI EXAMPLES: BAD

× **Examples of infuriating / bad UIs?**

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LOCAL EXAMPLE

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UI EXAMPLES: GOOD

× **Examples of pleasant/good UIs?**

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PHONE

× **How is a cell-phone dialing interface better than a conventional POTS phone?**

× **…and how often do you dial on a cell phone?**
  + Alternative? Better?

× **How cell phone interface worse?**

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PRECLASS 2

× **Which interface easier? Why?**
  + Limit to vend $20, $300/day

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HOT/COLD WATER INTERFACE

× Old: two knobs
  + Hot
  + Cold

× Newer: one knob
  + Tune heat
  + (maybe also volume)

Why built this way?

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Make common case fast

× **…not buried deep in menus**
  + Minimize mouse clicks?

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Power Point: Add Equation

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Hawaii Missle Warning January 2018

⚠ EMERGENCY ALERTS   ×

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

Settings

https://commons.wikimedia.org/wiki/File:2018_Hawaii_missile_alert.jpg   21

Hawaii Missle Warning False Alarm

BMD False Alarm   Added after incident
Amber Alert (CAE) - Kauai County Only
Amber Alert (CAE) Statewide
1. TEST Message
PACOM (CDW) - STATE ONLY   What selected
Tsunami Warning (CEM) - STATE ONLY
DRILL - PACOM (CDW) - STATE ONLY   What intended
Landslide - Hana Road Closure
Amber Alert DEMO TEST
High Surf Warning North Shores

https://www.theverge.com/2018/1/16/16896368/hawaii-false-missile-alert-system-confusing-interface-poor-design   22

Issues to be concerned with?

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Issues

× **Time to learn**
× **Easy to figure out how to use**
× **Clarity of what happened**
  + Why something didn't happen
× **Safety**
× **Time to perform task**
× **Ease of recovery**
× **User stress**

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DONALD NORMAN: UI GURU

Referring to Norman's book: *Design of Everyday Things*

- **Visibility –** visible functions aid user awareness; invisible functions are more difficult to find and know how to use.
- **Feedback –** return information about what action has been done and what has been accomplished.
- **Constraints –** restricting the kind of user interaction that can take place at a given moment.
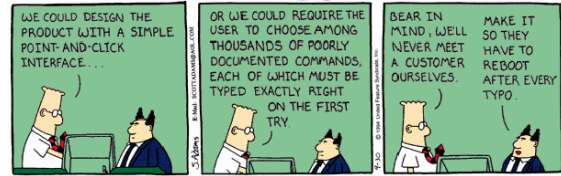- **Mapping –** the (functional, geometric, appearance) relationship between controls and their effects in the world.
- **Consistency –** use similar operations and use similar elements for achieving similar tasks.
- **Affordance –** an attribute of an object that allows people to know how to use it.

Add: **Tolerance** – reducing cost of mistakes, allowing recovery.

http://twobenches.wordpress.com/2008/06/05/don-normans-design-principles/ 25

INTERFACE DESIGN

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INTERACTION STYLES

Style	Main Advantages	Main Disadvantages	Applications
Direct manipulation	Fast and intuitive interaction; easy to learn	Only suitable where there is a visual metaphor for tasks and objects	Video games; CAD systems
Menu selection	Avoids user error; little typing required	Slow for experienced user; can become complex if many menu options	Most general purpose systems
Form fill-in	Simple data entry; easy to learn; checkable	Takes up much screen space; causes problems where user options do not match the form fields	Ordering
Command language	Powerful and flexible	Hard to learn; poor error management	Operating systems, command and control systems
Natural language	Accessible to casual user; easily extended	Requires typing; NL understanding systems may be unreliable	Information retrieval and Q/A systems

Ian Sommerville: Software Engineering, 7th Ed., 2004 28

IMPLEMENTER VS. USER

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USER VS. IMPLEMENTER

- **Thesis:** Engineer who implements something is seldom the right person to judge the goodness of the user interface
  - Knows how should work
  - Has a mental model of inner workings
  - Motivated to reduce implementation complexity
- Contrast user
  - Doesn't know how works – shouldn't have to?
  - Benefit from reduced use complexity
    - Reduced cognitive load

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FOOLPROOF QUOTE

- **You cannot make something foolproof, because fools are so ingenious!**
  - George Cox

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EXAMPLE (FOOLPROOF)

× *Coders: The Making of a New Tribe and the Remaking of the World*
  + Clive Thompson

  +
  "It turns out a user had made a mistake. Someone out there had used the service to find their balance, as is normal. But instead of inputting their ~~card~~ [phone] number—which is what they were supposed to do—the user had accidentally sent in the number of the phonebot service itself. So the software got stuck in a loop. "The service was texting itself back and forth, back and forth, back and forth," Guarino says. It was, he admits, ultimately his mistake, a flaw in how he'd written the code for the textbot. He could have easily written a rule checking to make sure that someone didn't accidentally text the bot its own phone number. But it never occurred to him that a real live person would ever do that. "Users," he says ruefully, "will find a way." You might think you've stamped out your bugs, but they find new ones."

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ISSUE

× **Hard to put aside what you know and see how it will look to an uninitiated user**
× **How could anyone not know?**
  + When program crashes, it leaves a lock file around that needs to be cleaned up…
    × Happens to ESE150 students in Detkin!
  + Naming a variable "foo-bar" might be interpreted as subtraction
  + "NC" means not connected
    × (user named their next state variables NA NB NC ND)
× **Why would anyone**
  + Put a ' in a name?

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WHY WOULD ANYONE

× **https://xkcd.com/327/**

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APPROACH

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DONALD NORMAN: UI GURU

Referring to Norman's book: *Design of Everyday Things*
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http://twobenches.wordpress.com/2008/06/05/don-normans-design-principles/

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HOW USE PRINCIPLES AND GOALS?

Principles are generally:

× **Descriptive, comparative and analytical (i.e., how alternatives compare; test and refine paradigm)**
  + Give us some idea how to evaluate a UI
× **Not constructive (i.e., do not define the process of developing user interface design)**
  + No automated (good) interface design tools exist (e.g., that could have predicted the iPod user interface design)
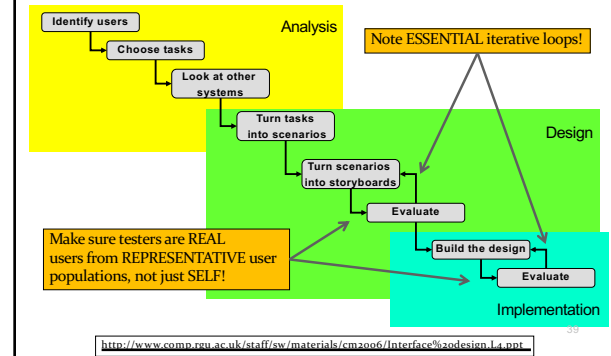
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PRINCIPLES MUST BE CONSIDERED IN THE CONTEXT OF USER POPULATION

- Principles define an optimization problem where the (target) user population is not uniform in skill, cognitive ability, needs, experience, learning style, or motivation.

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TASK-CENTERED DESIGN

Note ESSENTIAL iterative loops!

Make sure testers are REAL users from REPRESENTATIVE user populations, not just SELF!

http://www.comp.rgu.ac.uk/staff/sw/materials/cm2006/Interface%20design.L4.ppt

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ANALYSIS TECHNIQUES

- **Task analysis**
  + Models the steps involved in completing a task.
- **Interviewing and questionnaires**
  + Asks the users about the work they do.
- **Ethnography**
  + Observes the user at work.

Ian Sommerville: Software Engineering, 7th Ed., 2004

41
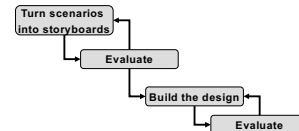
PROTOTYPING

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USER INTERFACE PROTOTYPING

- **Aim:** allow users to experience the interface.
- **Without such direct experience,**
  + it is impossible to judge the usability of an interface.
- **Prototyping often a two-stage process:**
  + Early: paper prototypes
  + Refine to increasingly sophisticated automated prototypes

Ian Sommerville: Software Engineering, 7th Ed., 2004

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PAPER PROTOTYPING

- **Work through scenarios using sketches of the interface.**
- **Use a *storyboard* to present a series of interactions with the system.**
- **Paper prototyping to get user reactions to a design proposal.**

Ian Sommerville: Software Engineering, 7th Ed., 2004

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4/21/20

Slide 51

STORYBOARD

CREATE NEW COLLECTION   SELECT DATA FILES

"ORGANIZE" HOME SCREEN   SELECT FACE TO SORT BY   EDIT LAYOUT OF COLLECTION

From Microsoft Hilo Chapter 4:
https://msdn.microsoft.com/en-us/library/windows/desktop/ff800706.aspx

Slide 52

STORYBOARD

USER FLOW EXAMPLE
CREATE AND VIEW POSTS

× Arctouch arctouch.com

Slide 53

PROTOTYPING TECHNIQUES

× **Use PowerPoint as a substitute for an editable script.**
  + Can include links to different slides/displays
× **Script-driven prototyping**
  + Develop a set of scripts and screens using a UI design tool. When the user interacts with these, the screen changes to the next display.
× **Internet-based prototyping**
  + Use a web browser and associated scripts.
× **Visual programming**
  + Language designed for rapid development such as Visual Basic.
  + Python+GTK (will use in lab)

Ian Sommerville: Software Engineering, 7th Ed., 2004

Slide 55

USER TESTING

Slide 56

SAMPLE USABILITY ATTRIBUTES

Attribute	Description
Learnability	How long does it take a new user to become productive with the system?
Speed of Operation (use)	How well does the system response match the user's work practice and task requirements?
Robustness	How tolerant is the system of user error?
Recoverability	How good is the system at recovering from user errors?
Adaptability	How closely is the system tied to a single model of work?

Ian Sommerville: Software Engineering, 7th Ed., 2004

Slide 57

TECHNOLOGY CHANGE

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PRECLASS 3

- **How many instructions should we be willing to execute to save a second of human time?**
  - Cost of second of human time?
    - Assume $300K/yr., 250 days/yr, 8 hours/day
  - Given Energy cost:
    - 10^{-15} cents per instruction
  - Number of instructions cost same as human-second?

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IMPACT

- **Can afford to spend computation to bridge between natural user view (interaction) and underlying implementation view**

- **Energy/op has reduced over time**
  - Increasing this ratio

- Can afford to spend **more** computation now than in past

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RISE OF VOICE CONTROL

- **Siri**
- **Ok Google**
- **Alexa**
- **Voice Remote**

- **Locally recognize "wake words"**
  - Ship off to server farm for bulk speech recognition

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PRECLASS 4

- **How GPS data ease data lookup for bus stop, schedule?**

- **Compared to what must do without GPS data?**

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CONTEXT AWARENESS

- **Sense context**
  - Can reduce information need to explicitly gather from user
  - Prioritize/reorder data presented
    - Know more about likely common case
- **Other context examples?**

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SENSORS

- **Open up new input modes and interaction possibilities**

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NATURAL(?) INPUT

- Audio processing
- Vision, Radar
- Motion (e.g. fitbit, iWatch)
- Biometrics
- Coupled with signal processing, cheap computation
- Opportunity to take input from natural interactions

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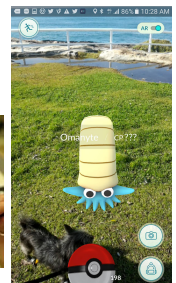## AUGMENTED REALITY WITH PORTABLE DEVICES (SMARTPHONE)

https://mashable.com/2016/07/10/john-hanke-pokemon-go/#edHFGDBS1kql

- Use the embedded camera and overlap synthesized images and animation.
- Pokemon Go
- Need real-time feature tracking for registration.

"Invisible Train": Schmalstieg and Reitmayr, 2004

Overlaid Directions

http://www.youtube.com/watch?v=zOS5Mbk_luc

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AUGMENTED REALITY

(Doctor Who fans: search for augmented reality tardis)

https://blippar.com/en/resources/blog/2017/11/06/welcome-ar-city-future-maps-and-navigation/ 66

EVOLUTION

- Dedicated Buttons and Knobs
- Keyboard
  - With character display
- Mouse, graphics
- Touch Screens
- Accelerometers
- Audio, video, …
- Augmented Reality

Platforms shrinking
- Rooms and Racks
- Desktops
- Laptops
- Tablets/phones
  - No physical keyboard
- Watch
- Glasses?

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BIG IDEAS

- User Interface essential
  - And worth designing carefully and deliberately
- View should match user goals, not internal design
  - Spend computing cycles to bridge
  - Make simple, safe, intuitive
- Implementer seldom a good judge of interface goodness
  - Knows too much about how should work
  - Conflict of goals
- Important to test and get representative user feedback

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NEXT LAB

- Develop and analyze User Interface(s) for internet-connected devices
  - Networking to control
  - Develop GUI
- Need to install software

- *Remember feedback*

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FINAL

- **Monday May 11**
  - Registrar scheduled 3—5pm
  - Will give as Canvas Quiz
    - 2 hour time limit
    - …but can take any time in 24 hr. period of May 11th Eastern time
  - Open text, notes, calculators
  - Must work alone; no getting help from anyone else
  - No communication about test during 24 hour period
    - (even not in class or believe to have finished exam)
  - Subject to Penn Code of Academic Integrity

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READING

- *The Design of Everyday Things*, Donald Norman -- a classic book on design for usability (broader than just hardware and software)
- *The Inmates are Running the Asylum*, Alan Cooper -- a manifesto calling out computer/software industry for poor design
- *Set Phasers on Stun: And Other True Tales of Design, Technology, and Human Error*, Steven M. Casey -- a series of anecdotes (case-studies) on how bad design and interfaces can go wrong, perhaps even killing people.

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LEARN MORE @ PENN

- **Courses**
  - ESE543 – Human Factors Engineering

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