Finishing Up: Quantitative Methods
P-Value Hacking (Don't Do It)

• Suppose: are there ANY differences in effects between these two drugs?

• Proposal:
  
  • Measure everything you can think of (say 10 things)

  • Do 10 hypothesis tests. Use $\alpha = 0.05$

  • $P(\text{Type I error}) = 1 - (1 - 0.05)^{10} \approx 0.4$
Cognitive Dimensions of Notation

Expert Methods

• Recall: expert methods do not require any users

• Pros:
  • Low-cost (don't have to design studies, recruit participants)
  • Applicable at early stages of design

• Cons:
  • Results depend on expert's analytic skills and methods
  • Cognitive dimensions serve as one analytic method.
Cognitive Dimensions as Vocabulary

• Programming depends on notation

• What vocabulary can we use to describe properties of notation?

• If we can describe properties, we can analyze tradeoffs

  • Every notation highlights some kinds of information at the expense of obscuring other kinds.

  • When seeking information, there must be a cognitive fit between the mental representations and the external representation.
Visual Programming Languages

- Programming is not just text
  - Spreadsheets
  - LabVIEW
  - Scratch
  - IDEs…
- Approaches to analyze notation should generalize to VPLs too
Example Task

• The rocket program computes the vertical and horizontal trajectory of a rocket on which the only forces acting are its thrust and gravity. At time zero the rocket stands stationary and vertical on level ground, with a mass of 104 pounds. Its engine develops a thrust of $4 \times 10^5$ foot-pounds, using up a mass of 50 pounds of fuel per second, until the fuel is exhausted after 100 seconds. It rises vertically for 10 seconds after which it adopts and retains an angle of 0.3941 radians (22.5 degrees) to the vertical. The downwards acceleration of gravity is 32 feet sec$^{-2}$. 
Example Solutions (MS BASIC, LabVIEW)

Mass = 10000
Fuel = 50
Force = 400000
Gravity = 32

WHILE Vdist >= 0
    IF Tim = 11 THEN Angle = .3941
    IF Tim > 100 THEN Force=0 ELSE Mass=Mass - Fuel
    Vaccel = Force*COS(Angle)/Mass - Gravity
    Vveloc = Vveloc + Vaccel
    Vdist = Vdist + Vveloc
    Haccel = Force*SIN(Angle)/Mass
    Hveloc = Hveloc + Haccel
    Hdist = Hdist + Hveloc

    PRINT TIM, Vdist, Holst
    Tim = Tim + 1
WEND
STOP
Dimensions Examples

- Viscosity: how hard is it to make changes?
- Which changes?
- Structured editors typically have high viscosity (vs. text editors)
Hidden Dependencies

- Spreadsheets tend to hide dependencies
- Textual languages partially hide dependencies
- Dataflow languages expose dependencies
Contrast: Nielsen's Heuristics

- 10 heuristics
- Example: Match between system and the real world
- Applicable to UIs in general, not just PLs

https://www.nngroup.com/articles/ten-usability-heuristics/
Nielsen's Heuristics

• Recognition rather than recall
  • "What’s the capital of Portugal?"
  • "Is Lisbon the capital of Portugal?"
• The latter is much easier for most people!
• GUIs vs. command line
Group Activity

• Analyze (using CDs):
  • Flowcharts
  • Assembly programs
  • Paper/pencil mathematics
  • To-dos on sticky notes
  • Word processor styles
  • Musical notation

• Compare (using CDs): spreadsheets vs. databases
  • Identify examples in real life:
    • Premature commitment
    • Viscosity
    • Hidden dependencies
    • Abstraction gradient
    • Closeness of mapping