Recitation 4

Measurement

Measurement

- Measurement is the empirical, **objective assignment of numbers**, according to a rule derived from a model or theory, to attributes of objects or events with the intent of describing them. – Craner, Bond, "Software Engineering Metrics: What Do They Measure and How Do We Know?"
- A quantitatively expressed **reduction of uncertainty** based on one or more observations. – Hubbard, "How to Measure Anything ..."
- Measure: Variable to which a value is assigned as a result of a measurement
- Why are we learning about this?
    a. You will need to come up with measures for an individual assignment

Why is this better?

- If we incorrectly think that measurement means meeting some nearly unachievable standard of certainty, then few things will seem measurable
- The fact that **some amount of error is unavoidable** but can still be an improvement on prior knowledge is central to experiments, surveys etc.
- “Uncertainty reduction” is what is critical to business. Major decisions (worth millions) made under a state of uncertainty can be made better, even if just slightly, by reducing uncertainty.

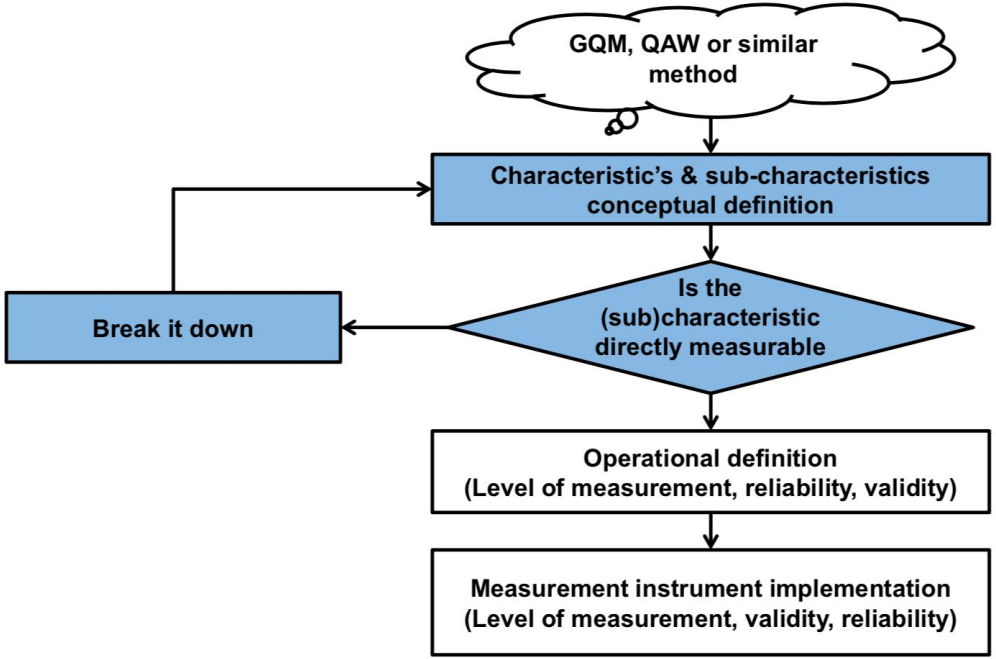
Everything is measurable

- If X is something that we care about, then X, by definition, should be **detectable**
- If X is detectable, then it must be **detectable in some amount**
  - If you can observe a thing at all, then you can observe more of it, or less of it
- If we can observe it in some amount, then, it must be **measurable**

Usability of Software

- Goal -> Question -> Metric
- Goal: Software should be usable
- Users should be able to learn to use the software quickly.
  - What does it mean to have a small learning curve?
    - Change in average duration to perform a task over time
- What indicates that a software is hard to use?
  - If the user is making mistakes, how do you determine if the system is leading to user mistakes?
    - Percentage of user mistakes per task undertaken

Measurement Development Process



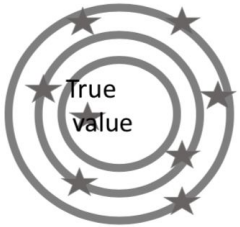
Scales of Measurement

- Nominal (ex: is the fruit an apple or an orange)
- Ordinal (ex: t-shirt sizes - small, medium, large)
- Interval (the number 0 doesn't correspond to absence of the quantity measured)
- Ratio (has an absolute 0 point, ex: cost, time elapsed)

Example: Sustainability - Open Source Projects

- What does this mean to you? Why do you want to measure sustainability?
- What data do you need to compare the sustainability of two projects?
  - What attributes of a project will you look for?
- What is the metric? How will you measure this? (operationalization)
- What is the scale for this metric?
- Can measurement be automated, or will human involvement be needed?
- Is the measurement repeatable? How precise, and accurate would the measure be?
- Did the measure reduce at least some level of uncertainty?

Precision & Accuracy of Measures



Low accuracy, low precision

Low accuracy, high precision

High accuracy, low precision

High accuracy, high precision

Construct Validity

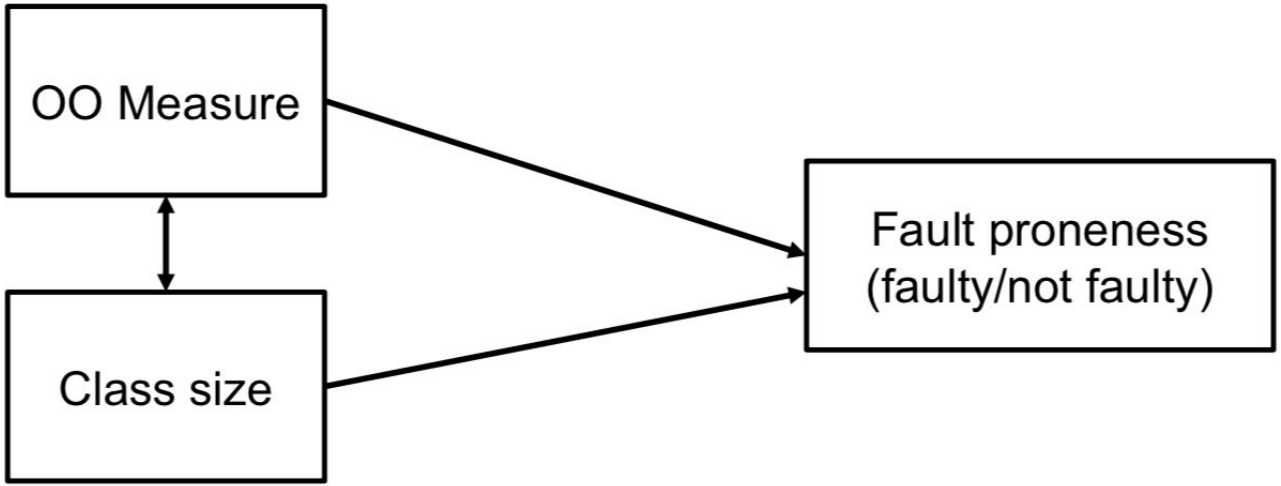
A retrospective analysis of the faults found in each module yields the following counts:

- Module A, 2 faults
- Module B, 5 faults
- Module C, 1 fault
- Module D, 3 faults

Based on the above data, the team concluded that B is the most error-prone, and C/E are less error-prone, ie. fault counts measure error proneness

Is this correct? Are we measuring what we intended to measure?

Confounding Variables



Final Note

- Often times, we measure things that are easy to measure, but don't get any real benefit
- So, it's important to derive measures that makes sense for the goal you want to achieve
- Try to automate as much as possible

Thank You!