The Art of Explaining
“Intuitive Reflections”

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Outline

• introduction
• setting
• strategies
• pitfalls
• exercise
• wrap-up
Settings

Class
» large group
» planned lecture
» spontaneous - response to question

Small Group
» informal gathering

Question and Answer Session
» test imperative

Key distinction - peer pressure associated with large group.
Strategies

Analogy

» examples

» to knowledge base
  • link to specialty - knowledge of audience

» to experience base
  • link to familiar experience - e.g., shower

» scout out familiar framework, then link to this
  • take the time to sense this and prepare - control the pace
Strategies

Spiral

» vulture approach
» circle around, increasing detail progressively

Concept
Application
Outline
Details
Recapitulation
Strategies

Spiral.cont...

Points

» progression of detail
  • informal -> formal
  • abstract -> concrete -> abstract...

» refinement of ideas

» introduction of rigour in measured amounts

» solicit feedback between phases
  • “does this make sense”?

Example - types of process control
Strategies

Images
» visual component to explanation
» reduce degree of abstraction by grounding in visual cue
» Example - notion of a statistic/sampling distribution
  • how variation propagates through a computation

Prepared vs. Spontaneous
» prepared slides - inherently more passive
» spontaneous - images and development evolve during the course of the explanation
» opportunity for “revelation”
Strategies

**Interaction**
- draw students into explanation - induce participation

**Take Your Time**
- take the time to frame your explanation before beginning
- control the pace

**Close the Loop**
- solicit feedback regularly, particularly at reasonable break points
- don’t build on a weak initial understanding
Pitfalls

• **Tangents (!)**
  » relative term
  » class situation - tangent represents time well off the beaten track - remainder of students left hanging
  » small group - excessive detail that obscures the primary concepts
  » reign in
  » defer to an additional session?

• **Please Release Me**
  » temper the need for feedback - avoid stalling because you are waiting for some indication from the class
Pitfalls

- “Talk at” vs. “Discuss with”

- Is the analogy approach patronizing?
  - gauge the reaction
Things to Avoid

• “simple”, “can be easily shown”
  – statements that prejudge the development of understanding
    » each individual has a “difficulty profile”
    » encourage comfort about exchanging ideas - level of trust
Exercise

Choose a topic from your field of specialization, and explain it to your group

» consider strategies

» prepare approach

» present

» review with group
Wrap-up

• use collection of approaches
  » be versatile
• adapt on the run
• close the loop
• watch for tangents
• take chances
Random Samples

Scenario -

» we have an underlying pattern of variability for a process which we would like to characterize -- the population

» we perform a series of experiments on the process in such a way that the results are independent - outcome of one experiment has no influence on any other experiment

» the underlying distribution in place during each experimental run is identical to that of the population

» when we run each experiment, we are collecting a value from the random variable $X_i$ - which has uncertainty

» $X_i$ represents the “i-th” act of sampling - referred to as a sample random variable
Definition - Random Sample

A random sample of size “n” of a population random variable is a collection of random variables $X_1, \ldots, X_n$ such that

» the $X_i$’s are independent

» the $X_i$’s have distributions identical to that of $X$, i.e.,

$$F_{X_i}(x) = F_X(x)$$

Each $X_i$ represents a snapshot of the process. The $X_i$’s are referred to as sample random variables.

What do we do with these sample values?...
Sample Average

- used to estimate the mean
- given “n” samples, \( X_1, \ldots, X_n \), compute
  \[
  \bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i
  \]
- interpretation - a rule for computing the sample average, involving sampling
- \( \bar{X} \) is a random variable
- observed value
  \[
  \bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i
  \]
Statistics

• Sample average is an example of a “statistic”

Definition

A statistic is a function of sample random variables that is used to estimate a value of a parameter, and does not depend on any unknown parameters.

– e.g., sample average estimates mean $\mu$ and doesn’t depend on unknown parameters

$$\bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i$$
Example - Shower
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**Example - Shower**

I want a hot shower

**control algo.**
hotter shower = turn HW tap to right

**setpoint**
I want a hot shower

**sensors**
FI

**final control elements**

Example - Shower

control algo.

I want a hot shower

setpoint

hotter shower = turn HW tap to right

final control elements

feedback loop

sensors

FI

TI