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 prejudice 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
Teaching Questions

ORGANIZING A LECTURE

• How to develop a good introduction
• What would be a good conclusion
• How much is too much - too little?
• How to make it flow (I’m told I’m hard to follow and skip around)
• Techniques to properly prepare for class
• How to go from making a point in 10 minutes to lecturing for 1.5 - 3 hours
Teaching Questions

GETTING THE TIMING RIGHT
• How to slow down
• Pacing

DEVELOPING CONFIDANCE
• How to become less nervous
• How not to let your nervousness show
Teaching Questions

USING DIFFERENT STRATEGIES

• How to use 1.5 hours for lecture (I plan to leave the second hour for tutorial perhaps?)
• What are strategies for filling 3 hours because I can’t lecture the entire time and still I’m not sure
• How to introduce learning strategies to students in a way which will help them learn
• Learning Styles - so I can incorporate them in my teaching (as well as improving my approach)
Teaching Questions

- How to respond in a practical way to differences in student learning
- How to deal with different levels of learning
- Info re: asking good questions
- How to give some responsibility to the class
Teaching Questions

MAINTAINING INTEREST

• How to keep everyone interested in a large class
• How to lecture without making people fall asleep or bored
• How to maintain interest throughout the required time
• How do you avoid boring students?
• Motivation (How to?)
Teaching Questions

MONITORING STUDENT UNDERSTANDING

• How should I monitor the class understanding as I lecture (within one session)
• How do I decide when to go back and cover something again (if one student is confused or if ¼ of them are)
• Knowing how to find the level to present to (is this so obvious it’s silly or way above their heads)
• Info re: handling students’ questions
• (?)Use of interface in teaching
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

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

*Lower case is used to denote observed values of the sample random variables and average.*
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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control algo.

hotter shower = turn HW tap to right

I want a hot shower

setpoint

sensors

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