Workshop-Based Learning

Retention and learning in Data Structures and Algorithms (CPSC 221)

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Motivation

CPSC 221, Data Structures and Algorithms is a high content course split across theory and implementation expectations

The high learning load makes 221 a traditionally difficult course for many students

Often students perform only averagely or worse across the various topics within the course

An in-class, active learning approach can help....

Traditional Course Structure

Class is split into **lectures** and **labs**

Lectures deliver the bulk of material in a fairly traditional lecture-based delivery format

Clickers are used to assess student progress regularly through the term

Labs require practice of high-level theory concepts as well as implementation practice via C++ (a new language to the students)

Revision: In-Class Activities

Lectures were reworked to include scaffolded, interactive, in-class activities

Content delivery was partially replaced by these activities

Basic definitions were often introduced via activities

Focus of **lectures** became application of theory

(**Labs** then became only implementation practice, driven by theory learned in class)

The Activities

Two general types:

Hands-On Content Delivery

- Some or all of the material is new to the students

- Content delivered through step-by-step, exploratory-style questions

Hands-On Content Practice

- Given after the material is delivered in lecture

Excerpts:

IMPORTANT FIRST STEPS:
1. Close your laptops and put them away (if necessary, you may refer to your course notes).
2.Form a group of 2-3 students.
3. Clearly put your names and IDs on 1 copy of this worksheet.
4. Be sure to turn this exercise in at the end of class.

Hashing

Today's exercises are all about hash tables and the notion of a mapping between keys and elements. Recall that a hash table is just a particular type of mapping where the key is passed through a *hash algorithm* that results in an index value into an array.

Let's get hashing!

Suppose we have the following hash function: $h_1(x) = \lfloor x/10 \rfloor$
compression mapping: $h_2(x) = x \% 10$

Advice for working in a group:

First start by discussing the problem and making sure everyone in your group understands it. For this particular problem, if you have something you can stack (such as coins, or pieces of paper) it may be helpful, otherwise you can draw it out using pencil and paper.

Keep in mind that everyone learns/works a little differently-- it may be helpful to give everyone a few minutes to work on the problem on their own, and then get back together to discuss it. Resist the urge to do it all on your own, though. Learning to discuss these sorts of problems at a high level will go a long way in helping you do well not only in this course, but in future courses, job interviews, and the jobs themselves!

Try to keep everyone involved, and don't be afraid to challenge the group with "what if" questions!

MPORTANT FIRST STEPS:
. Close your laptops and put them away.
.Form a group of 2-3 students.
. Clearly put your names and IDs on 1 copy of this worksheet.
. Be sure to turn this exercise in at the end of class.

Complexity

Consider the following two pieces of pseudocode:

```
procedure fnc_a( A: list )
do
    swapped := false
    for each i in 0 to length(A) - 2 do
        if A[i] > A[i+1] then
            swap( A[i], A[i+1] )
            swapped := true
        end if
    end for
while swapped
end procedure
```

```
procedure fnc_b( B: list )
do
    n := n - 1
    swapped := false
    for each i in 0 to n - 1 do
        if B[i] > B[i+1] then
            swap( B[i], B[i+1] )
            swapped := true
        end if
    end for
while swapped
end procedure
```

As clearly and succinctly as possible, explain in plain English what fnc_a and fnc_b
ach do:

What happened?

This is what we call a collision. Apply the pigeonhole principle to describe a collision (What are the pigeons, what are the pigeonholes?):

Retention

Hypothesis is that these activities will lead to greater retention and improved performance overall

A pre-test was provided to the incoming Fall 2009 CPSC 320 students, whose intake consists of CPSC 221 students

Results are preliminary...

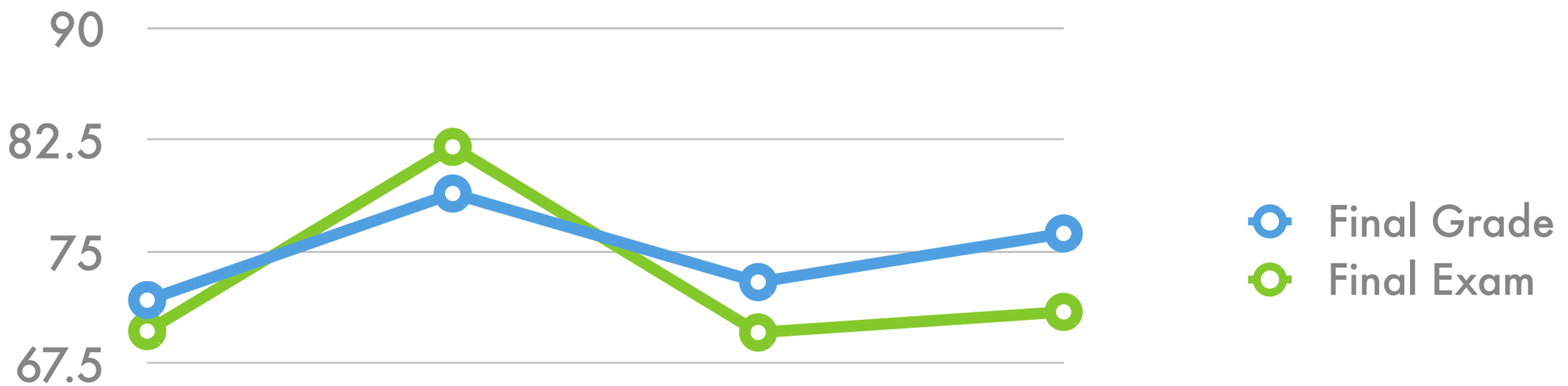
Fall 2009 Pre-Test Results

t-Test: Two-Sample Assuming Unequal Variances		
	Summer 2009	Spring 2009
Activity content	High	Low
Mean	18.48*	13.79*
# students	21	27
t Stat	2.6569	
P(T<=t) two-tail	98.92%	

Retention after one year (traditional course)	
	Summer-Fall 2008
Activity content	None
Mean	10.5*
# students	21

*out of 34

Overall performance



	no activities	no activities	low activities	high activities
	Summer 2007	Summer 2008	Spring 2009	Summer 2009
Final grade	**71.77**	**78.92**	**72.98**	**76.24**
Final exam	**69.69**	**82.05**	**69.60**	**70.98**

Conclusions

Students report **high enjoyment/utility** of in-class activities:

"More activities please!"

"These really helped me understand what I didn't understand"

"These are a great study guide"

Longer term follow-up is needed

The summer 2009 term clearly outperformed spring 2009; awaiting final grades from spring 2010

Confounding factors need to be addressed