

# Using Tablet PCs for Active Learning in the CS Classroom

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## Schedule for the workshop

### Time Activity

- 7:00** Workshop Objectives
- 7:05** Installation of software
- 7:20** Technology
- 7:50** Break – Bio/Stretch
- 7:55** Basic Techniques
- 8:50** Break - Refreshments
- 9:00** Participant Activities
- 9:15** Advanced Techniques
- 9:45** Insider tips
- 9:50** Wrap up

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## WORKSHOP OBJECTIVES

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## Objectives of the Workshop

- Introduce classroom management technologies:
  - what are they
  - what can they do
- Introduce basic pedagogical methods (enhancing slide based pedagogy)
  - Delivering lecture material
  - Getting feedback
- Introduce advanced pedagogical methods (real time activities)
  - Running demonstrations in class
- Review research results

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## Five most important points

- Active learning increases interaction during lecture in meaningful ways, but interaction must be natural.
- Excellent technology support is essential, without it, disaster looms
- Students will need to adapt to different lecture and note-taking techniques, be prepared for some pushback
- Faculty will need to rethink lectures, be prepared for some pushback
- The technology helps tremendously, but it isn't a golden bullet

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## TECHNOLOGY

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## Computer Technology

- Reliable Tablet PCs or Pen Input Devices
- Tier 1 Vendor - Reliability
- What to look for in a Tablet PC
  - Processing Power
  - Battery Life
  - Screen Size
  - Reliability and durability
- Campus support mechanisms
  - Collaborate with IT
  - Helpdesk, repair shop, etc.
- Network Infrastructure
  - Capacity
  - Reliable/Robust

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## Classroom Technology

- Classroom design
  - Pen Enabled Classrooms
    - 1:1 or shared Tablet PCs
    - Integrated classroom stations (Lab type setting)
  - LCD/DLP Projectors
  - Smartboards
  - Network Connections (wired or wireless)
  - Power Connections
  - Usable Workspace
    - Configurable and non-configurable

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## Networking Technology Details

- DyKnow
  - Client/Server Based System
  - Client connects via http or https to Microsoft IIS/SQL server
  - Standalone or integrated authentication
  - Has supported up to 300 students in one class
  - Supports both local and distance learning
- Classroom Presenter (CP3)
  - Student machines make TCP/IP connections to instructor machine
  - Practical limit of about 30 student machines
  - Initial slide broadcast a potential bottleneck
  - Multicast used to advertise presentation
    - If Multicast is not available, students enter instructor's IP Address

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## Description of Classroom Presenter

- Tablet PC based presentation and interaction system
- CP3 a complete rewrite of CP2
  - Biggest change: a different approach to networking
- Integrate electronic slides with digital ink
- Students connect to instructor machine
  - No external server
- Students slides synchronized with instructor's machine
  - Students communicate with instructor by submitting ink on slides
- Free download  
<http://classroompresenter.cs.washington.edu>
- BSD License

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## Description of DyKnow

- Integrated system that instantly transmit prepared or extemporaneous content to student screens.
  - Progressive disclosure of content.
  - Content can be freehand, PowerPoint, web, etc.
- Collaborative note taking.
- Interactive activities
  - Student response tools - Polls
  - Shared Workspace - Groups
- Content replay and notes review.
- Collect, grade and return student work.
- Computer monitoring
  - Keyboard lock, screen blanking, URL filtering, application blocking.
- Client is a free download from <http://www.dyknow.com>

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## Exercise 0: Who are you?

- Who are you:
- Where are you from:
- Draw a picture of something from your home town



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Student submission

## BASIC TECHNIQUES

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## Basic Techniques

### Objectives

- Learn how to deliver content using digital ink
- Interaction with students
  - Writing on slides
  - Collecting slides from students
  - Polling
- Pedagogical issues
  - When to interact (planned and opportunistic)
  - What types of interaction to expect from students
- Examples
  - Algorithms, Games, Introductory Data Structures

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## Lecturing with Digital Ink

- Integration of slide content and ink
  - What are the benefits of prepared slides?
  - What are the benefits of a whiteboard?
- Annotation for emphasis
- Spontaneous examples
- Planned derivations
- Structured examples
- Didn't finish writing slides

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## What are the pitfalls of lecturing with digital ink?

Student submission

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## Active learning model

- Activity proposed
- Student work period
- Collection of results
- Discussion of results
- Two different approaches
  - Individual artifacts
    - Students submissions or panel submissions
  - Aggregated data
    - Quick polls or clickers

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## Instructional and pedagogical goals

- Activities must have pedagogical goals
- Articulating lesson goals is an extremely good practice
- Students recognize when activities are used just for the sake of having activities
- Examples of pedagogical goals
  - Engagement
  - Collective Brainstorm
  - Identify Misconceptions
  - Classroom Assessment
  - Problem Introduction
  - Discovery
  - Challenge problems
  - Discussion Artifact

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## Activity examples

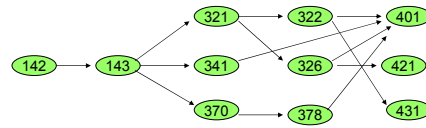
- Engagement
  - Draw a picture of your home town
- Collective Brainstorm
  - Pitfalls of lecturing with digital ink
- Discovery
  - Topological Sort
- Classroom Assessment
  - Americans Before Columbus
- Problem introduction
  - Longest Common Subsequence

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## Topological Sort

- Given a set of tasks with precedence constraints, find a linear order of the tasks

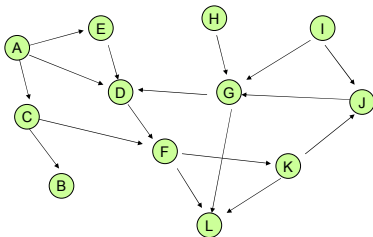


- Label vertices with integers  $1, 2, \dots, n$ 
  - If  $v$  precedes  $w$ , then  $l(v) < l(w)$

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Find a topological order for the following graph



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How many people lived in North America in 1491?



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Determine the Longest Common Subsequence for following strings

BARTHOLEMEWSIMPSON

KRUSTYTHECLOWN

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Additional activities from an algorithms course

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## Polynomial vs. Exponential Complexity

- Suppose you have an algorithm which takes  $n!$  steps on a problem of size  $n$
- If the algorithm takes one second for a problem of size 10, estimate the run time for the following problems sizes:

12          14          16          18          20

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## Who was Dijkstra?

- What were his major contributions?

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## Classify the following recurrences (Increasing, Decreasing, Balanced)

- $T(n) = n + 5T(n/8)$
- $T(n) = n + 9T(n/8)$
- $T(n) = n^2 + 4T(n/2)$
- $T(n) = n^3 + 7T(n/2)$
- $T(n) = n^{1/2} + 3T(n/4)$

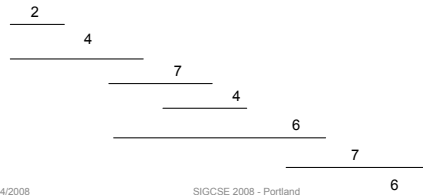
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## Fill in the array with the Opt values

$$\text{Opt}[j] = \max(\text{Opt}[j-1], w_j + \text{Opt}[p[j]])$$



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## Find a satisfying truth assignment

$(x \parallel y \parallel z) \&\& (\neg x \parallel \neg y \parallel \neg z) \&\& (\neg x \parallel y) \&\& (x \parallel \neg y) \&\& (y \parallel \neg z) \&\& (\neg y \parallel z)$

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## Polling

How much experience do you have with computer supported active learning?

- A) Use it regularly in my courses
- B) Have experimented with or used it a few times in class
- C) Have seen demos, but never tried it
- D) This is the first I've heard of it

- Quick polling is under development in CP3. Will be available in 3.1 release.

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## Exercise 1: Prepare and deliver a lecture

- Create a brief lecture (2 minutes)
  - Use of PowerPoint as baseline optional
- Incorporate some interaction
  - Collect slide
  - Poll
- Present to workshop

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## Feedback 1

- In what way would you use the techniques from this section of the workshop?
  
- Question?

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## ADVANCED TECHNIQUES

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## Advanced Techniques

### Objectives

- Capturing screen input from demonstrations
- Allowing students to control the lecture
- Classroom management
  - How to manage demonstrations
- Pedagogical issues
  - Why capture demonstrations (archive and expand)
  - How to keep students engaged during
- Examples
  - Programming examples from Games and Introductory Data Structures

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## Demonstrations

- Many activities in lecture work best via demonstration
  - Web pages
  - Videos
  - Programming
  - Proofs
- Problem: How do you capture for later student use?
  - Showing the completed product is not as helpful as showing the steps along the way
  - Student often understand the final artifact, but can't figure out steps along the way
- Programming
  - Showing parts of the program under construction
  - Highlighting important parts of the finished program

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## Demonstration Mode

- Capture salient screenshots along the way
  - Notate
  - Allow students to ask question, make comments
- Demonstrations
  - Introductory programming: capturing the design
    - How to start
    - Specific concepts introduced
  - Advanced programming: notating the design
    - Students understand theory and programming
    - Keep specific instruction on statement and program organization

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## Demonstration: Web Programming

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## Demonstration: Game Programming

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## Demonstration: Student giving a demo

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## Discussion

- When to use demonstration mode
  - Steps are important, not just the final artifact
  - Student to do code/proof walkthroughs
  - Particularly tricky technical detail (e.g., how to the linker)
    - Pictures are much more useful than a procedure
- Problems
  - Switching between screens is annoying
  - Students can become disengaged
  - Performance: screen is update infrequently
- Remedies
  - Have student drive the demonstration
  - Have students markup the captured screen

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## Discussion

- Useful archive
  - Information available to students as they need
  - Simplifies office hours
    - “I showed you how to set up the linker, look at Friday’s lecture.”
- Immediate exercise of concepts
  - Particularly useful for advanced classes

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## Exercise 2: Capture a demonstration

- Create a demonstration (2 minutes)
  - Programming example, or
  - Website, or
  - Whatever you’d like
- Present to workshop

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## Feedback 2

- In what way would you use the techniques from this section of the workshop?
- Questions?

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## OBSERVATIONS

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## Student Comments

- "When it comes down to it, I'm old school, I prefer a pen and paper. I also find it easier to learn and understand material if I see it in my own handwriting. My prof uses fill in the blank so only parts of my notes are in my own handwriting. I like how it encourages us to be more interactive in class. The chat feature and the feature that allows the professor to grab our slides after we've answered a question is very beneficial."
- "When all I have to do is fill in a couple of blanks, not process information and put it into my own words, I don't pay attention."

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## Student Comments

- "It's nice to be able to think about the topics as they're being written on your screen instead of spending the time writing as he's talking. Also, being able to complete an example problem and then have him review it right away helps to fix any misunderstandings about the material. Being able to save the lectures and access them from anywhere on campus since they're on the network is a HUGE advantage. DyKnow is great."
- "DyKnow allows me to zone out and not pay attention in class. The teacher gives me all the important notes so I have the opportunity to stare off into space while he lectures. Using DyKnow is a tremendous disadvantage as I never pay attention to my teacher when the software is being utilized."

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## Faculty Comments

- "DyKnow is a very effective tool for teaching Mathematics because it combines the spontaneity of a blackboard lecture with the structure and reproducibility of a PowerPoint lecture. Also, the time-consuming, embarrassing, and inefficient practice of having students work at the blackboard in front of their peers is replaced by an (optionally anonymous) efficient process in which students work individually and the instructor can choose which solution to critique."
- "DyKnow allows the ability to teach using a multitude of techniques all in one product. The main idea is not to do everything for the student but help them grasp the information."

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## Faculty Comments

- "Polling and panel management are GREAT! I miss animations that PowerPoint support."
- "DyKnow was great for marking up code segments and explaining what the code accomplished, in some cases line-by-line."
- "The many components of DyKnow would have been more useful if all the students had tablet computers."
- "I did not require the students to use DyKnow. About 1/4 to 1/3 of the students chose to use the program."

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