What is Engineering Computing?

• Solving Engineering Problems using Computing Tools

• General Classes of Engineering Problems
  – Analysis of Materials or Situations
  – Recording and Organizing Information
  – Calculation
  – Financial Computation

• Specialized Engineering Problems
  – unique, one of a kind, new application, etc.
Engineering Computing Tools

• Spreadsheets
  – Solves the most problems
  – “What if?” analysis
  – Easiest tool to learn

• Mathematical Software
  – Solves problems requiring more mathematics
  – Requires understanding of mathematics and notation
  – Matrix, vector, mathematical equations, physics, etc.

• Computer Programming
  – Solves unique or complex problems
  – Implements algorithmic solution requiring iteration and multiple conditions
  – Most difficult tool to learn
Before We Begin

• IMPORTANT!!!
  – Tools generally do …
    • help make problem solving easier
    • help to make solutions easier to share
    • help to make solutions easier to document and understand
  – Tools do not …
    • replace careful and thoughtful problem solving
    • remove the need to plan ahead
    • remove the need to understand the problem
    • guarantee the correct answers
  – Tools are tailored to solve certain types of problems
Different Kinds of Tools
Different Kinds of Problems

• An Analogy 1 – Tools for Drawing/Writing
  – What are you using right now?
  What’s in your pocket, book bag, etc.?
  What could someone use in a classroom?
  • wooden lead pencil
  • ball point pen
  • mechanical lead pencil
  • Sharpie
  • Magic Marker
  • dry board marker
  • chalk

Different tools for different uses!
  easy to use vs. more sophisticated
  single purpose vs. multipurpose
  temporary vs. permanent
  single use vs. reusable
  media independent/media focused
  cheap vs. more expensive
Different Kinds of Tools
Different Kinds of Problems

• An Analogy 2 – A Carpenter’s Tool Cabinet
  – Tools, fasteners, and materials
  – Do It Yourselfer’s Tools
    • Hand Tools
    • Power Tools
  – Contractor’s Grade Tools
    • Hand Tools
    • Power Tools
    • More Tool Specialization
Exercise #1

• Find another student.

• Brainstorm three lists of things that a person doing carpentry, i.e., working with wood, might use.

• Consider
  – Tools
  – Fasteners
  – Materials
Exercise #2

• Form teams of four students, i.e., two pairs of students should form a team.
• Combine your three lists.
• Now review each list and separate each list into two categories.
  – The first category should contain tools, fasteners, and materials that a Do-It-Yourselfer might use.
  – The second category should contain tools, fasteners, and materials that Professional Carpenter, i.e., someone who does carpentry full-time, might use, but that a Do-It-Yourselfer would probably not use or even know about.
  – You may add to any list now that you have been asked to think about the two categories of carpenters.
Exercise #3

• Exchange your lists of two categories of carpenters’ tools, fasteners, and materials with another team.

1. What differentiates the carpentry needs of a Do-It-Yourselfer from a Professional Carpenter?

2. What differentiates the type of tools, fasteners, and materials each type of carpenter might use?

3. What differentiates among the similar types of tools, e.g., hammering tools, screwing tools, cutting tools, etc.? When would one tool be used instead of another tool?

4. What differentiates among the similar types of fasteners, e.g., nails, staples, screws, glue, dowels, etc.? When would one fastener be used instead of another fastener?

5. What differentiates among the similar types of materials, e.g., natural wood, composite materials, etc.? When would one material be used instead of another material?
Lessons Learned

• Problem solving involves
  – Understanding the problem
  – Understanding tools, information, and materials that could be used to help solve the problem
  – Having the skills to use the tools, information, and materials to help solve the problem
  – Making appropriate choices
Lessons Learned

• Tools don’t solve problems, people do.
• Using an appropriate tool can help solve the problem more easily.
• Using an inappropriate tool can make problem solving more difficult.
Different Kinds of Tools
Different Kinds of Problems

• An Analogy – A Carpenter’s Tool Cabinet
  – Tools, fasteners, and materials
  – Hand Tools
    • Hammer
    • Screwdriver
    • Saw
  – “Weekend” Power Tools
    • Power Screwdriver –or– Electric Drill
    • Circular Saw, Jigsaw, Sabre Saw
Spreadsheets

• Examples
  – MS Excel

• Strengths
  – Organizing data
    • Table/Matrix – rows & columns
    • List/Vector
  – Graphs from Data
  – Widespread Uses

• Notes
Mathematical Software

- **Examples**
  - MATLAB, MathCAD, Maple, Mathematica, MuPAD, Infinity, TK Solver, Origin, O-Matrix, Gauss Mathematical, Derive, LabVIEW, GNU Octave, GNU R, GNU Scientific Library

- **Strengths**
  - Mathematical notation
    (solve standard math, science, and engineering problems)
  - Plotting mathematical functions

- **Notes**
  - Problems must be posed using math
Computer Programming

• Examples
  – Languages: C, C++, Java, Visual BASIC, Perl, PHP, etc.
  – Operating Systems: MS Windows, Unix, Linux, etc.

• Strengths
  – Power to solve unique problems
  – Develops logical thinking

• Weaknesses
  – Difficult to master
  – Extreme detail

• Notes
  – Think ahead.
  – Program in small incremental steps.