Why do you needed to develop problem solving skills?

- One definition of programming is it is applied problem solving
  - You have a problem (E.g. Need a program to calculate the area of the circle).
  - What needs to be done?
  - What inputs and outputs are needed?
  - How does what is entered produce the right output?

"...many students have almost no mathematical background and some even arrive with a built-in phobia against anything involving formulae or syntax.” Carter (2004)
"Programming is a complex activity.... Problem Solving is not trivial and requires component skills including relativity; decision making; identification of the central issues; recognition of relationships, familiar situations and patterns; development of an algorithm and the translation of the algorithm into executable code." Beaumont and Fox (2003)


Mistakes

- An expert is a man who has made all the mistakes which can be made in a very narrow field.
  
  **Niels Bohr**
Mistakes

Anyone who has never made a mistake has never tried anything new.
Albert Einstein

Simplicity

- Any intelligent fool can make things bigger and more complex... It takes a touch of genius - and a lot of courage to move in the opposite direction.
Albert Einstein

- Everything should be made as simple as possible, but not simpler.
Albert Einstein

How do this course split

- Weeks 1-8
  - Problem Solving
- Weeks 9-24
  - Java Programming

Stepwise refinement

- Take the problem and break it down into smaller and smaller chunks that are now manageable.

Basics

- Problem statement
- Analysis
- Design
- Implementation
- Testing
Analysis – Sample thoughts

- What does it have to do?
- What does it need?
- What rules/algorithms are needed?
- When testing what does it take to prove it works?
- Can I break this down further?

Things to remember

- There is often more than one solution to a problem.
  - You can often solve a problem in many different ways, that each have advantages and disadvantages.
- Two heads are better than one
  - Part of some problem solving techniques can be as simple as discussing issues.
  - For example: Why did you do that?

Problem 1.1

- Write a routine to calculate the area of the circle.
  - First pass
    - Input
    - Calculation
    - Display
- **Second pass**
  - **Input**
    - Input radius of the circle
  - **Calculation**
    - Area = \( \pi \times \text{radius} \times \text{radius} \)
  - **Display**
    - Display area on the screen

- **Third pass**
  - Put a message of the screen telling the user to enter the radius of the circle.
  - Read in from the keyboard what the radius of the circle is
  - Calculation Area = \( \pi \times \text{radius} \times \text{radius} \)
  - Display the following message on the screen “The area of the circle is ” and display the result of the calculation on the screen

**Problem 1.2:**
- In groups of 2-3 write a routine for calculating the area of a rectangular room.
- **First pass**
  - **Input**
  - **Calculation**
  - **Display**
What assumptions did you make?

- Did you assume that the measurements of the room were already taken?
- What units of measurement did you use?
- What does area of the room mean?
  - Area of the floor?
  - Area of the floor and area of all the walls?

Problem 1.3


- Goal: Is to get to a bowl of sugar in the opposite diagonal corner on the floor. What is the shortest route?
- Restrictions: It can’t fly or be blown across the room

Hints

- The key to this problem is to re-arrange the problem.
- Try flattening the walls.
Five steps in problem solving

- Understand and isolate the problem
- Brainstorm for ideas to solve the problem
- Design a solution that might work
- Test your solution to see if it will work
- Assess whether the solution is good enough to do it

See http://cda.mrs.umn.edu/~fauxr/computing/problemsolve.html

Understand and isolate the problem

- What does it take to succeed with a particular problem?
- What is the vital information?

- Identify the parts of the problems – analysis.
  - What are the inputs and outputs?
  - What are the limitations?
  - What are the rules?
Brainstorm for ideas to solve the problem
- Note down all the solutions
  - Have solutions been used in similar way before?
  - Keep solutions that have common features.
  - Two heads are better than one.
- When all the solutions have been found weed-out less reasonable ones.
- Can be solo or group activity.

Design a solution that might work
- The design of a solution can be created using diagrams, algorithms and other models. The main purposes of creating a design that can be viewed by others is to communicate the solution. Providing a diagram or algorithm of what you THINK is going on and is needed will provide others a chance to see what your thinking is.

Test your solution to see if it will work
- Take the time to trace through your design with some test information.
- Try more than one scenario.
- Try to find information that tests the borders.
- Choose some information that isn't supposed to work and be certain that the design handles it.
- Give your algorithm or diagram to another person.
Assess whether the solution is good enough to do it

- Is this solution really worth doing?
- Would another solution be better for this situation?

Problem 1.4

- Write a routine that lets the user convert pounds Stirling into the Northampton dollar and display the results

- What information do you need?
- What does the routine need to do?