Problem Solving Skills

Steven Castellucci

Why Attend University?

- To learn how to learn
- To learn how to think
- To learn how to problem solve

Problem Solving

- Impossible to learn a solution to every possible problem
- Important skills in programming and in life
- Learn methods to
  - Analyze the situation
  - Attempt a solution
  - Evaluate the result

Give a man a fish and you feed him for a day;
teach a man to fish and you feed him for a lifetime.

Identify Important Information

- Very important:
  - Read **entire** problem or task description
  - Understand the requirements
- Identify:
  - Required input (e.g., prompts, data types, valid ranges)
  - Expected output (e.g., calculated values, formatting)
  - Available resources (e.g., input files, existing code, provided classes/methods)

Use Previous Experience

- Different programs often share similar characteristics (e.g., performing input validation, reading from a file)
- Try to remember (or look-up) your solution to similar problems
  - How similar are the two programming tasks?
  - How are the tasks different?
- Identify which parts can be used and which have to be changed

Draw a Diagram

- Often benefits visual learners
- For example:
  - Given a square and the Cartesian coordinates of two opposite points (x_1,y_1) and (x_2,y_2), determine the coordinates of the other two points

Make a Table

- Visually organizing inputs/outputs can also be beneficial
- For example:
  - Given input *n*, output a right-aligned, upside down triangle made of *n* lines of *'s

Input: 5

Output:

```
*****
 ****
  ***
   **
    *
```

Line	Spaces	Stars
1	0	5
2	1	4
3	2	3
4	3	2
5	4	1

Find a Pattern

- When one draws a diagram or makes a table, patterns might become more apparent
- Using the previous example ($n = 5$):
  - #spaces = line# – 1
  - #stars = n – line# + 1

Input: 5

Output:

```
*****
 ****
  ***
   **
    *
```

Line	Spaces	Stars
1	0	5
2	1	4
3	2	3
4	3	2
5	4	1

Solve a Smaller Problem

- Programs often have many parts, e.g.:
  - Prompt user
  - Validate input
  - Calculate answer
  - Format output
- Identify a single part and try to solve it
- Solve the problem for a smaller subset of input
  (e.g., solve for an input of 0 or 1, then work backwards to solve for an input of *n*)

Implement, Check, and Repeat

- Code your solution
- Run tests
- Compare actual output to the expected output

- Identify differences
- Refine solution or try a different approach
- Repeat tests

Observation Tips

- Take your time
- Look for subtle differences
- Discard preconceptions
- Avoid assumptions
- Practice exercises:
  - http://www.spotthedifference.com/
  - http://sciencenotebooking.blogspot.ca/2010/08/fun-observation-exercises.html

Observation Exercise 1

```
Enter the number to square: 5
The square of that number is 25
```

```
Enter the number to square:
5
The square of that number is 25
```

Observation Exercise 2

```
The numbers are as
follows:
  2
 10
  5
  8
 26
 80
```

```
The numbers are as
follows:
 2
 10
 5
 8
 26
 80
```

Observation Exercise 3

```
Enter the initial speed (m/s): 10.0
Enter the initial angle (deg): 60.0
The trajectory's range is 8.83 metres.
```

```
Enter the initial Speed (m/s): 10.0
Enter the initial angle (deg):60.00
The trajectory's range is  8.83 meters
```

Thank You