Some quotes….

I really hate this damned machine
I wish that they would sell it.
It never does quite what I want
But only what I tell it.

~Anon

These machines have no common sense; they have not yet learned to *think*, and they do exactly as they are told, no more and no less. This fact is the hardest concept to grasp when one first tries to use a computer.

~Donald Knuth
Announcements

- Ian King returns on Friday
- History of Computing, Part 2
What's The Plan?
Algorithmic Thinking

Step-by-step directions for whatever someone, or the computer, needs to do
Algorithm

- A precise, systematic method for producing a specified result
- In real life we do this all the time:
● Algorithms
  ● http://uweoconnect.extn.washington.edu/algoithmsdslfit7/
What is an algorithm?

- **Algorithm** is a procedure and sequence of actions to accomplish some task. The concept of an algorithm is often illustrated by the example of a recipe, although many algorithms are much more complex; algorithms often have steps that repeat (iterate) or require decisions (such as logic or comparison). In most higher level programs, algorithms act in complex patterns, each using smaller and smaller sub-methods which are built up to the program as a whole.

Source: Computer User's online dictionary
Algorithms in our everyday lives

- Directions to our home, workplace, or the shopping mall to meet friends
- Recipes
- Patterns
  - For sewing clothes or soft furnishings
  - For knitting or crochet
- Plans for building furniture
- Owners’ manuals
Algorithms in our everyday lives

- Each algorithm
  - Solves a problem
  - Can be repeated over and over
    - With the same results
Algorithm example
Algorithms in our everyday lives

- Always consider the audience
  - Is your friend familiar with North Seattle?
  - How much experience with baking does your friend have?
  - If you’re going to add RAM to your laptop yourself, you’re probably fairly technically competent
Language in Algorithms

- **Natural language**
  - For people, we use a natural language like English
  - Ambiguity is common in natural language

- **Programming Language**
  - Formal languages designed to express algorithms
  - Precisely defined; no ambiguity
How are algorithms organized?

Awesome Oat Cake with Broiled Topping

- 1 1/4 cups boiling water
- 1 cup quick or old fashioned oats
- 1 3/4 cups all-purpose flour
- 1 teaspoon baking soda
- 1 teaspoon ground cinnamon
- 1/4 teaspoon ground nutmeg
- 1/4 teaspoon salt
- 5 tablespoons butter, softened
- 1 cup granulated sugar
- 1 cup brown sugar, firmly packed
- 1 large egg
- 1 teaspoon vanilla extract

Broiled Coconut Topping:
- 1/2 cup sweetened shredded coconut
- 1/2 cup brown sugar, firmly packed
- 1/2 cup quick or old fashioned oats
- 3 tablespoons milk
- 2 tablespoons butter, melted

1. Heat oven to 350°F (175°C). Lightly grease and flour 9-inch square baking pan.
2. For Cake: In a medium bowl, pour boiling water over oats and mix well; set aside.
3. Combine flour, baking soda, cinnamon, nutmeg and salt in a medium bowl; set aside.
4. In large bowl, beat butter and sugars until light and fluffy. Add egg and vanilla and beat well. Stir in reserved oat mixture and flour mixture.
5. Pour batter into pan.
6. Bake 50 to 60 minutes or until wooden pick inserted in center comes out clean. Transfer cake in pan to wire rack.
7. For Broiled Coconut Topping: In a small bowl combine all ingredients and mix well. Spread evenly over top of warm cake.
8. Broil about 4-inches from heat 1 to 2 minutes or until topping is bubbly. Watch closely; topping burns easily.
9. Cool cake in pan on wire rack.

Makes 12 servings.
How are algorithms organized?

Awesome Oat Cake with Broiled Topping

Ingredients:
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- 3/4 cups all-purpose flour
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- 1/4 teaspoon ground nutmeg
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**Steps**

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Makes 12 servings.
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- 1 1/4 cups boiling water
- 1 cup quick or old fashioned oats
- 1 3/4 cups all-purpose flour
- 1 teaspoon baking soda
- 1 teaspoon ground cinnamon
- 1/4 teaspoon ground nutmeg
- 1/4 teaspoon salt
- 6 tablespoons butter, softened
- 1 cup granulated sugar
- 1 cup brown sugar, firmly packed
- 1 large egg
- 1 teaspoon vanilla extract

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Makes 12 servings.
How are algorithms organized?

- Title
- Ingredients
- Steps
- Exceptions
- Servings

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Makes 12 servings.
How are algorithms organized?

- Title
- Ingredients
- Steps
  - Exceptions
  - When to stop
- Servings

**Awesome Oat Cake with Broiled Topping**

1. 1/4 cups boiling water
2. 1 cup quick or old fashioned oats
3. 3/4 cup all-purpose flour
4. 1 teaspoon baking soda
5. 1 teaspoon ground cinnamon
6. 1/4 teaspoon salt
7. 2 tablespoons ground nutmeg
8. 1/4 teaspoon ground nutmeg
9. 5 tablespoons butter, softened
10. 1 cup granulated sugar
11. 1 cup brown sugar, firmly packed
12. 1 large egg
13. 1 tablespoon vanilla extract

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Makes 12 servings.
The Five Essential Properties of Algorithms

1. Input specified
   - Data to be transformed during the computation to produce the output
   - Must specify type, amount, and form of data

2. Output specified
   - Data resulting from the computation—intended result
   - It is possible to have no output
3. Definiteness
   - Specify the sequence of events
   - Details of each step, including how to handle errors

4. Effectiveness
   - The operations are do-able

5. Finiteness
   - Must eventually stop
Context matters—sorting names

- Program can fulfill five properties of an algorithm, be unambiguous, and still not work right because it is executed in the wrong context
  - e.g., last name in Western countries means family name; in Asian countries it may mean given name
Driving instructions
"From 45th go to University Avenue and turn right."

- Assumes you are traveling in a specific direction. If you are not, the directions will fail.

Diagram of approaching a street (the Ave) from different directions, giving the "turn right" instruction different meanings.
Baking bread....

- The final baking step depends on the type of oven

Source: http://www.leftoverqueen.com
Context Matters—electric ovens
Context Matters—brick ovens
Context matters—bread machine
A program is an algorithm that has been customized to solve a specific task under a specific set of circumstances using a specific language.

Algorithm is *general*

Program is *specific*
A practice algorithm…

- Grab a piece of paper
- In the next few slides, I’ll name the property of an algorithm and you can fill in the blanks for making a salad.
Algorithm: Input specified

- Algorithm for preparing a salad
  1. Input specified
Algorithm for preparing a salad

2. Output specified
Algorithm—
Definiteness & Effectiveness

- Algorithm for preparing a salad
  3. Definiteness
  4. Effectiveness
• Algorithm for preparing a salad

5. Finiteness
CD or DVD sorting in a rack

- Exchange sort algorithm
The Alphabetize CDs example illustrates the standard *Exchange Sort* algorithm.

- The idea of comparing pairs of items chosen in a particular way, exchanging them if they are out of order, and continuing to sweep through the items.

- We could use the same algorithm to sort on a different principle.
Friday

- Learn the vocabulary on GoPost