Algorithms

Algorithms are a familiar idea. Our goal is to learn to specify them right so someone or something else does the work.

Previous Algorithms

Algorithm, a precise, systematic method to produce a specified result

- We have seen algorithms already...
- Placeholder technique is an algorithm with an easy specification:
  \[ \text{longStringWithShortStringInIt} \leftarrow \text{placeholder} \]
  \[ \text{ShortString} \leftarrow \varepsilon \]
  \[ \text{placeholder} \leftarrow \text{longStringWithShortStringInIt} \]

Not every process is an algorithm — debugging

Properties of Algorithms

For an algorithm to be well specified it must have
- Inputs specified
- Outputs specified
- Definiteness
- Effectiveness
- Finiteness

Programs vs Algorithms

A program is an algorithm specialized to a particular situation

- Algorithm:
  \[ \text{longStringWithShortStringInIt} \leftarrow \text{placeholder} \]
  \[ \text{ShortString} \leftarrow \varepsilon \]
  \[ \text{placeholder} \leftarrow \text{longStringWithShortStringInIt} \]

- Program:
  \[ \text{\#} \leftarrow \text{\#} \]
  \[ \text{\#} \leftarrow \varepsilon \]
  \[ \varepsilon \leftarrow \text{\#} \]

Alphabetize CDs

1. Set \text{Artist}_\text{Of} to refer to the group name
2. Pick \text{Alpha}! Decide which end of rack is to be start of alphabetic sequence, and call the first slot \text{alpha}
3. Pick \text{Beta}! Call the slot next to \text{alpha}, \text{beta}
4. Exchange \text{Alpha} of the CD in the \text{alpha} slot and the \text{Beta} of the CD in the \text{beta} slot, interchange this CD; otherwise continue on
5. More \text{Betass}?! If a slot follows \text{beta} slot, begin calling it the \text{beta} slot and go to step 4; otherwise continue on
6. More \text{Alphas}?! If two slots follow the \text{alpha} slot, begin calling the next one the \text{alpha} slot and the one following it the \text{beta} slot; go to step 5; otherwise stop

Alphabetize CDs Flow Chart

- Start
  - Set \text{Artist}_\text{Of} to refer to the group name
  - Pick \text{Alpha}!
  - Pick \text{Beta}!
  - Exchange \text{Alpha} of the CD in the \text{alpha} slot and the \text{Beta} of the CD in the \text{beta} slot, interchange this CD; otherwise continue on
  - More \text{Betass}?! If a slot follows \text{beta} slot, begin calling it the \text{beta} slot and go to step 4; otherwise continue on
  - More \text{Alphas}?! If two slots follow the \text{alpha} slot, begin calling the next one the \text{alpha} slot and the one following it the \text{beta} slot; go to step 5; otherwise stop

Wynette

Beethoven

Spoon

Hampton

Pearl Jam
Abstraction means removing an idea or process from a situation.

**Beta sweep**—while alpha points to a fixed slot, beta sweeps through slots following alpha, interchanging as necessary. The beta sweep is a concept removed based on our understanding of the operation of the algorithm.

Abstraction

**Alpha sweep**—Process of sweeping through all of the CDs (but the last) performing the beta sweep:

- Exhaustive—considers all but last CD
- Non-redundant—a slot is alpha only once
- Progressive—when beta sweep completes the alphabetically next CD in alpha
- Complete—when last beta sweep is done the last slot’s CD is later than next to last slot
- Effective—the alpha sweep alphabetizes CDs

**Summary**

We figure out most algorithms on our own, abstracting from specific cases. Also we abstract parts of an algorithm or program to understand them.

Thinking about how the program works and reasoning about its properties allows us to know why an algorithm works... and then we can let the computer do it.
In Sunday’s Paper...

Google Bombing: To sabotage Google’s page-rank system

Ask Google for ‘miserable failure’

George W. Bush?

The most highly ranked Web page for words ‘miserable failure’ is George Bush?

Sample Query

What’s Happening?

Many pages make their anchor text ‘miserable failure’ and make the anchor link to the Bush biography

Google trusts anchor text in the page rank calculation