Algorithms

Part 2: Measuring Time

Notes for CSC 100 - The Beauty and Joy of Computing
The University of North Carolina at Greensboro

Reminders

Blown to Bits:
Chapter 3 on-line discussion over the next week

Lab:
Check on Thursday for Lab 6 Pre-Lab Reading (might not be any this week)

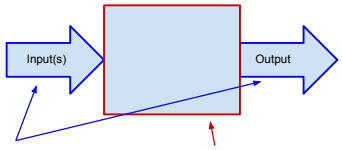
Homework:
Homework 2 due in one week: Wed., Oct. 1

On the horizon: Midterm Wednesday, Oct. 8

Last Time We Saw...

Problems are defined by input/output relation, with no reference to how they are solved (*focus is on what*)

Algorithms are well-defined computational procedures that solve problems (*focus is on how*)



Problem specifier worries about input and outputs

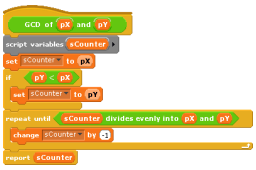
Implementer / algorithm designer worries about the computational process

In BYOB

Problem Focus

With a well-chosen name, that may define the problem well enough for the user!

Algorithm Focus



This is an over-simplification: Sometimes the user wants to know some properties of the block implementation.

Question: What kinds of properties?

Algorithm Characteristics

- Does the algorithm work correctly (does it solve the problem)?
- Is the answer provided precise?
- How confident are you in the correctness of the algorithm and implementation (simpler algorithms are easier to verify)?
- How much memory does the algorithm require?
- How fast is the algorithm?

Algorithm Characteristics

- Does the algorithm work correctly (does it solve the problem)?
- Is the answer provided precise?
- How confident are you in the correctness of the algorithm and implementation (simpler algorithms are easier to verify)?
- How much memory does the algorithm require?
- How fast is the algorithm?

Assume no problems with correctness or precision for now.

Memory is a problem for some algorithms, but not as common a limiting factor as...

Time is usually the most interesting and limiting characteristic, whether talking about running a big computation for a week, or calculating a new graphics frame in 1/30 of a second.

What is "time" for an Algorithm?

Time is time, right?

But...

- Does time depend on things other than the algorithm?
- If run many times (on the same input), is time always the same?
- If QuickSort runs in 20 seconds on my old IBM PC, and SelectionSort runs in 0.5 seconds on my current computer, is SelectionSort a faster algorithm?
- Can we give clock time without implementing the algorithm?

Correcting for vagueness of timing

Wall-clock times depend on:

- Speed of computer that it's run on
- What else is happening on the computer
- ... and a few other things we'll address later

But... these are not differences in algorithms!

Solution: Algorithms are sequences of steps, so count steps!

Question: We discussed steps earlier - so what's a step?

BYOB blocks and "steps"

Which of these should not be treated as "one step"?

a) 

b) 

c) 

d) 

e) 

Experimenting with timing BYOB scripts

Timer is available to help test things out

- Reset timer to start it at zero

- Save current timer value into a variable for "lap timer"

- Watch variable shows limited precision - for more use "say

- Tip: surround only what you're interested in timing with reset/set blocks (not initializations)

Summary

Time is one of the most important algorithm characteristics

An “algorithm” should be independent of what runs it
→ So measure time in steps, not seconds

But - when you want time in seconds for a specific implementation, BYOB gives you tools to measure that.