spelling
grammar
formatting
< merging, splitting, expanding, drawing

CSC104 fall 2012

Why and how of computing

week 5

Danny Heap
heap@cs.toronto.edu
BA4270 (behind elevators)
http://www.cdf.toronto.edu/~heap/104/F12/
416-978-5899

Text: Picturing Programs

Outline

Algorithms

Notes

What to do with computing machines?

Algorithms!

"simple" — without "outside" knowledge.
enough for a much.

should complete in finite time.

simple sequence of feasible steps to solve a problem

deterministic (in this course)

credit Al-Khwarizmi

Examples

- multiplication ?
- PBJ
- Google page rank

Sticky algorithm

pbj

assumption? Sliced bread.

- Get bread, jam, open?
- take knife, place in peanut butter
- take another knife → jam → on top of PB

peanut butter bread jam → PBJ sandwich

could you explain it to a friend

over the phone, who had

never made it?

enjoy

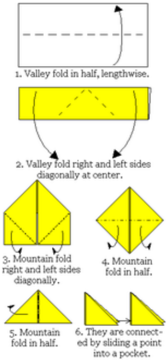
clockwise, counter clockwise? things that don't thread.

which end of knife → goes in PB → spreads.

- which operations are built-in?
- what if conditions change?
- name repeated operations
- does sequence matter?
  - which knife

- which surface get PB, which get jam?

paper folding



(ignore the diagram on the left)
fold over upper surface of paper strip
after one fold, it has a downward crease
fold the once-folded strip again
and it has one upward, two downward
there are good physical reasons you
can't experiment far beyond 6 folds
given the number of folds,
predict the pattern

For more information, and hints, see paper folding problem

2000+ year-old algorithm

GCD(12, 9)   3

Euclid's GCD

$2 \times 2 \times 3$ 3×3

GCD(12, 9) = GCD(9, 3)

⇒ GCD(3, 0)

the largest whole number that divides two non-negative whole numbers is their Greatest Common ~~Denominator~~ Divisor (GCD)

we could find it by sifting through all the divisors, but there's a quicker way

generally this pair is smaller than starting pair.

Euclid noticed that (gcd $n1$ $n2$) = (gcd $n2$ (remainder $n1$ $n2$))

Also, (gcd 0 $n1$) = $n1$. Repeat as needed.

The way we were

grade school multiplication

XXVII

× XXXVIII

non-positional

$$
\begin{array}{r}
{}^{5}\\
38\\
\times\ 27\\
\hline
266\\
76\\
\hline
1026\\
\hline
\end{array}
$$

×	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

We'd memorize, and organize, the algorithm for 27×38

Much better than XXVII × XXXVIII

Notes