Using Algorithms

- Algorithm? What’s an Algorithm?
- An **algorithm** is a procedure for solving a problem.
- An algorithm need not be complex
  - Recipe
  - Directions
  - Even heating a TV dinner has instructions
- So, an algorithm is a step-by-step set of instructions, that if carried out exactly, solves the problem.
Algorithms

- Making a plan is designing an algorithm
- In many situations we do this unconsciously
- In other situations we cannot let our unconscious work on its own.
  - Grocery shop
  - Plan a party
  - Write a 20 page research paper
- In each of the cases above what do we do first?
  - Grab a piece of paper
  - Make of list of tasks
Algorithms

- A large complex task, like planning a large party, or writing a 20 page paper is unmanageable if attacked as a whole.
- Top-down analysis – break it down into its basic parts.
- This is not a computer technique, it is a life skill
- Let’s look at the research paper
Algorithms – A Research Paper

What is the topic of the paper?

Every paper starts with three basic parts
- Introduction
- Paper
- Conclusion

Tell them, tell them what you are going to tell them, tell them what you told them

In 20 pages, intro should be 2-3 page, conclusion should be 3-4 pages, this leaves 14 pages to make our case.

Now break down these 14 pages into smaller parts
- Background, current theories, future research
An Algorithm
I've been asked to reduce headcount.

To be fair about it I created a scientific algorithm to decide who goes.

I thought you were firing the people with the highest salaries.

Okay, maybe "algorithm" is an overstatement.

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An Algorithm

Utility Lantern

To connect contact wire
1. Turn head counterclockwise and remove. (A)
2. Slide battery in halfway and insert contact (on wire end) between the coils of the positive (+) spring, pushing until contact snaps onto spring. (B)
3. Remove plastic cap from negative (-) spring.
4. Slide battery fully in and replace lantern head.
An Algorithm
An Algorithm

NANCY

HOW TO LEARN TO RIDE A BIKE
1. Get on bike
2. Fall off
3. Repeat

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An Algorithm
Using Algorithms

- The key is the step-by-step instructions.
- A computer is a machine designed to follow specific instructions very rapidly;
  BUT
- The computer does only and exactly what it is told.
- Computers cannot think!
- Computers cannot make assumptions
Algorithms

- An algorithm written so that it can be carried out by a computer is called a **program**.
- To be understood by a computer, the program or algorithm must be written in a programming language.
Algorithms – Problem Solving Steps

People naturally think at a level of abstraction far too complex for even the most abstract and futuristic computer. Get simple, get “stupid”, make NO assumptions.

1. Define the problem
2. Define the output
3. Define the input
4. Define the initial algorithm
5. Refine the algorithm
6. Define the program

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Algorithms

There are three large classes of programming languages:

- **Machine Language**
  - Code used to communicate with a particular computer
  - Instructions are coded as groups of 1’s and 0’s
  - Can be thought of as the computer’s “native” language
  - Language is *machine-dependent*, each type of computer has its own code
  - Every statement in machine language contains an instruction and the data or the location of the data that the instruction will use.
  - Very difficult for humans to use
Algorithms

- Assembly Language:
  - Instead of long series of 1’s and 0’s uses abbreviations of mnemonics
    - Ex. SUB for subtract, CLR for clear, or MOV for move
  - Data is represented directly as numeric quantities or variables.
  - Compared to machine language, much easier for people to use and understand
  - Machine dependent, different computers require different assembly languages
  - Must be translated into machine language for the computer to understand program
Algorithms

- High Level Language:
  - Structure more like natural language (Ex. English) with a limited set of rules
  - Must be translated into machine language for the computer to understand program
  - One statement may translate into many machine language statements
  - Largely *machine independent*
  - Easier to use by people