Structured Programming

A VERY important Philosophy for Writing Programs

This is supposed to be a refresher only. You are expected to hone your skills by writing programs and reading books on structured programming if you have not mastered structured programming

Bad Programming Habits

- Foggy idea about what is to be done
- Write program with no planning; Start from the beginning and write to the end
- No systematic debugging; Considered it finished if it works on one example

- Undesirable Results !
  - Do not know how to program
  - Programs with numerous bugs that take extremely long time to debug, or even failure to complete
  - Any change of requirement invites rewriting of the entire program again

Benefits of Structured Programming

- Programs that meet the needs of the customer
- Though initially take longer time to generate code, often result in code with runs with no bugs the first time it's run
- Easy to handle change in program specifications in the future

Structured Programming

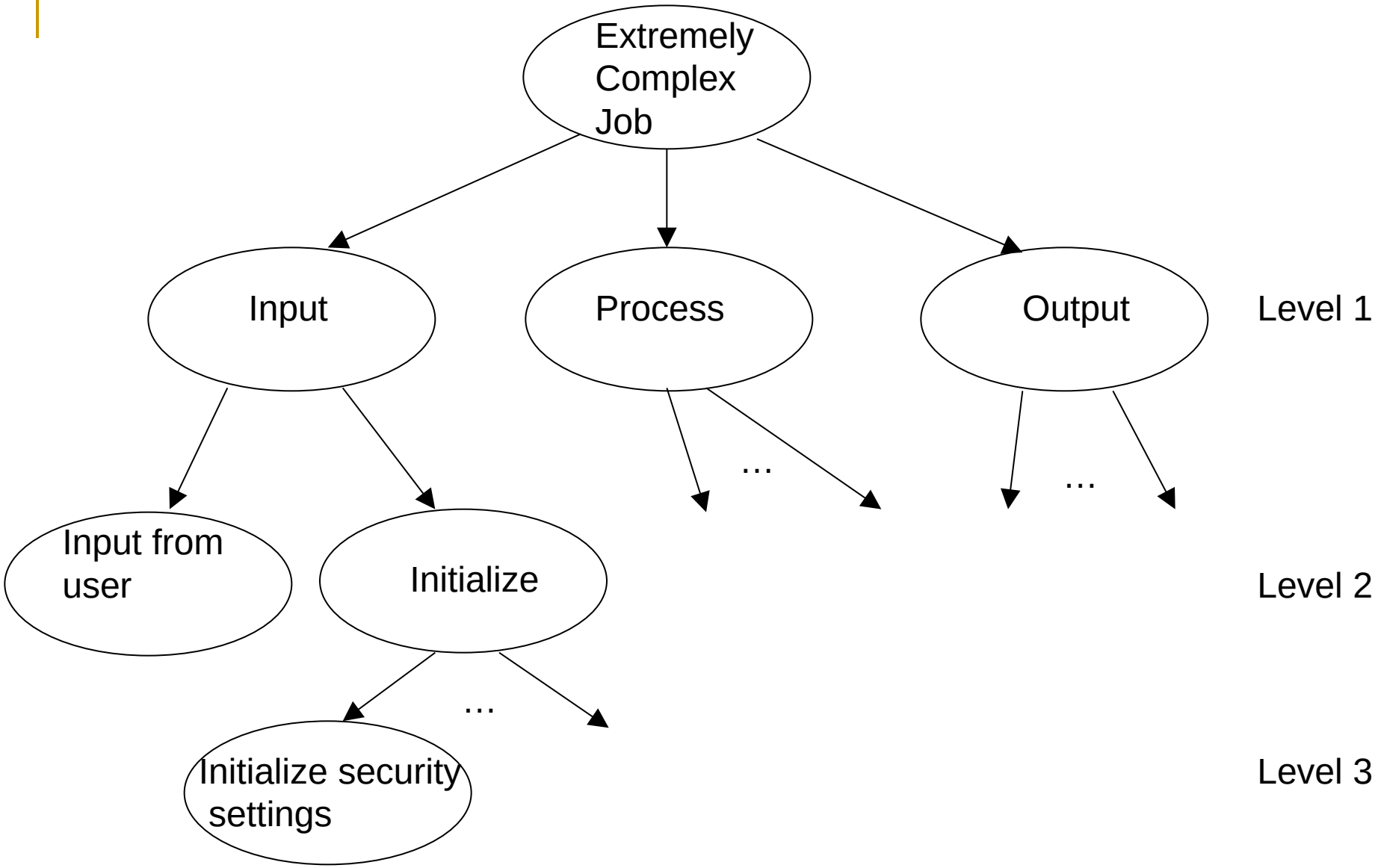
- A tool that becomes popular since the 70's
- Should have been learnt by student that have taken any programming course
- Absolutely essential for handling large programs that involve a team of programmers and huge number of man hours.
- The other popular philosophy is "object oriented programming", but many programmers prefers structured programming

Seven Important Concepts of Structured Programming: 1. Structured Walkthrough

- Before writing any program, the programming team must sit down with the customer and find out the requirement
- Extremely important
- Customer's requirement is often imprecise
- Iterative: several rounds of talks
- Must result in a specifications that is
  - very precise
  - Understandable by programmer in programming terms

2. Stepwise Refinement

- A “DIVIDE and CONQUER” strategy
- When given a large job, divide it into smaller jobs.
- Given any job, it is useful to divide it into
  - Input
  - Process
  - Output
- Draw a tree
- Refine each job level by level (Breadth first)
- Use pseudo code to describe each job
- Decision on data structure is delayed as much as possible


Extremely Complex Job
Input
Process
Output
Level 1
...
...
Input from user
Initialize
Level 2
...
Initialize security settings
Level 3

3. Modular Design

- Each ellipse is a module
- A module is a self contained block:
  - It only receives inputs from its immediate ancestor
  - It only outputs to its immediate ancestor
  - Its computation should only require calling functions that are its immediate children and them only
- The input variables and output variables of each module should be specified when defining the module
- Each module must be “programmable” – no majic block should exist

4. Bottom Up Coding

- When the refinement has reached a simple function, code the simple function
- You can test the simple function independently of the rest of the program
- This gives you achievement and satisfaction, sustaining you through the long project
- Project Manager exercises division of labour here, ask a member to be responsible solely for that function

5. Testing Using Stubs

- A structured Programming project can be field tested before everything finishes
- Stubs - for unfinished modules, use a human being to emulate it, act on the test inputs, she fits in the correct output data by hand
- then other programmers can test their work
- Meanwhile she continues to program her own module (according to MS Project timelines)

6. White Box and Black Box Testing

- For each module and whole program

- White Box
  - Input something for which you know the desired result, it should give your expected output
- Black Box
  - Treat it as a black box, input some data, is the result reasonable?

7. Structured Programming Documents

- A structured programming document is generated along with the program
- When requirement of customer changes, go to the document
- Does not need to rewrite the whole program, just find which modules need to rewrite and rewrite the module and the sub-tree under it
- Programmer usually forgets their code in 2 months; the structured document helps her to refresh her work quickly

Advice

- YOU MUST TRY IT TO LEARN IT

References

- General Philosophy
  - Numerous books about Structured Programming in the library
- A very good structured programming example
  - W. Findlay and D.A. Watt, Pascal: An Introduction to Methodical Programming 1987, Ch. 7 illustrates how to use stepwise refinement to program a complicated task. Try it YOURSELF once, then you would get it