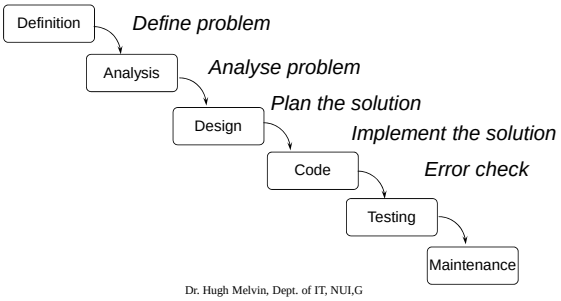
Waterfall Software Development Method (SDM)



Why a structured approach?

- Alternative- just jump in and do it!
  - » leads to round-about solutions
  - » undiscovered errors
  - » takes longer
- The structured approach - plan the right way first
  - » plans to avoid crisis
  - » covers all eventualities
  - » useful for team working
  - » shorter in the end
- Computers need to be told EXACTLY what to do

Defining the problem

- What exactly is required?
- Requirements gathering
- Generate and document a clear problem statement
  - » System Requirements Specification / Document
- Need to talk to all stakeholders
- Most common cause of software system failure traced to poor requirements gathering

Analyse problem - WHAT?

- I-P-O diagram
- What inputs are required?
- What outputs are required?
- Format of input / output

- Eg.
- Program to convert miles to kilometres
- Program to calculate the maximum of 4 temperatures

Design algorithm - HOW?

- Algorithm
  - » an expansion of the processing steps in the I-P-O diagram
  - » step by step set of instructions for solving a specific problem
- The algorithm is key to successful solution
  - » take your time!
- Use *pseudocode* or *flowcharts*
  - » tools to help describe the algorithm

If you don't know how to solve a problem by hand, you can't do it by computer

A good algorithm must...

- ... be sufficiently detailed to describe the transformations necessary to solve the problem
- … always give the same result from the same initial situation
- … give the correct result in all cases
- Use structured programming approach

Algorithm to record TV programmes

1. Insert a DVD
2. If unformatted..format DVD
3. If reqd, set record quality (SP HQ)
3. Repeat steps 4 - 7 for each program
4. Set date
5. Set start time
6. Set stop time
7. Set channel
8. Set DVD player to timed mode

..or use programme code

Structured Programming

- Easy-to-follow logic
- Top-down design…divide and conquer
- Use 3 basic control structures to solve any problem

Control structures

1. ***Sequence*** is a group of instructions followed in order from the first through to the last

4. Set date
5. Set start time
6. Set stop time
7. Set channel

2. ***Selection*** (decision) is used to make logical decisions- to choose between alternate actions depending on certain conditions

2. If reqd, format disk
3. If reqd, set record Quality

3. ***Repetition*** (looping) allows a group of steps to be repeated several times, usually until some condition is satisfied

3. Repeat steps 4 - 7 for each program

Describing your algorithm

- Number of methods
  - » you choose the one with which you are most comfortable!!
- Pseudocode
  - » English-like statements that are almost as specific as code
  - » also called Structured English
- Flowcharts
  - » graphic way to represent thinking
  - » standard symbols and arrows connecting them

Pseudocode

- Accepting input
  - » Read, Get
- Sending output
  - » Print, Write, Put, Display
- Giving a value to something
  - » Set, Initialise, use an assignment statement
- Arithmetic
  - » + - * / ( )
- Selection
  - » If, Else, Endif
- Iteration
  - » Do While, EndDO

Sample pseudocode

Selection (decisions)

```
IF  Balance < Requested Amount
   Display " Insufficient Funds"
ELSE
   Display "Cash on the way"
ENDIF
```

Iteration (loops)

```
DO while numprogs < 5
   Accept starttime
   Accept endtime
   Add 1 to numprogs
ENDDO
```

Problem defined:

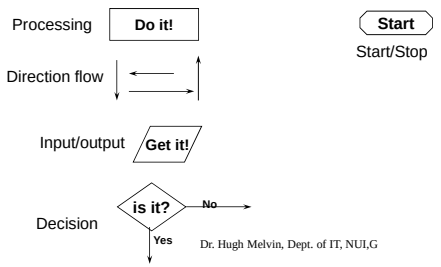
Input two subject results and calculate the total. If the total is greater than or equal to 40, print message to indicate a pass, else print message to indicate fail.

Input	*Process*	*Output*

res1
res2
	Prompt for res1 , res2
	Get res1,res2
	total = res1+res2
	If total > =40
	  Print "Congrats..you passed"
	Else
	  Print "Sorry, you failed "
	Endif
	End
		Printed verdict

Flowchart symbols

- Graphic way to represent thinking
- Standard symbols and arrows connecting them



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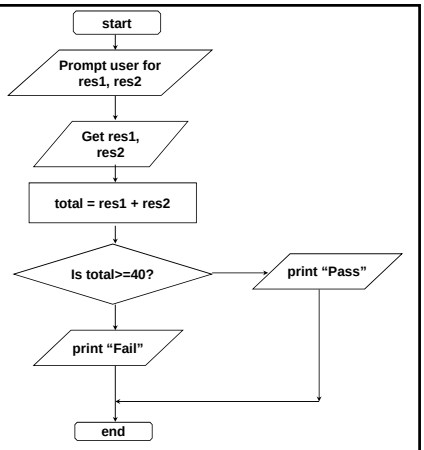


Pseudocode or flowchart?

	Advantages	Disadvantages
Pseudocode	. Can be done easily on word processor . Implements structured design elements well	. Not visual . No standard
Flowcharting	. Standardised . visual	. Difficult to modify . Need special software to do on computer .

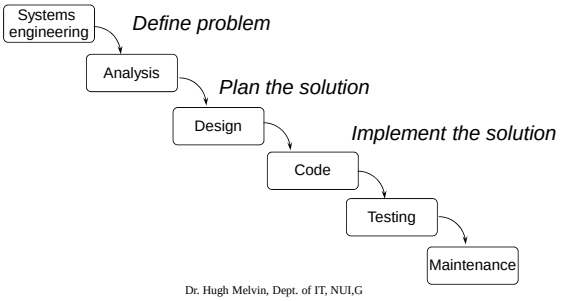
Write the solution in computer code

- Algorithm is in general terms - it may be applied to any computer language
- Before entering code into computer, desk-check it for logic errors or for syntax errors
- Use plenty of comments to explain code …documentation
- cf. Next section on programming languages

Testing and debugging

- Test with variety of data
- Test all limits for correctness
  - » >= vs <
  - » Eg. Fail if res < 40 , Pass if res > 40 ➔ what happens when res = 40?
    - »Common logic error
  - » ATM machine, safety-critical systems : Testing critical
- Debugging: locating and correcting errors
  - » Syntax error eg. IF(a < (b / c) .. Missing closing bracket
  - » Run-time error eg. Divide by zero
  - » Logic error eg. Flaw in algorithm
- Programming packages usually have debugger software to help programmer

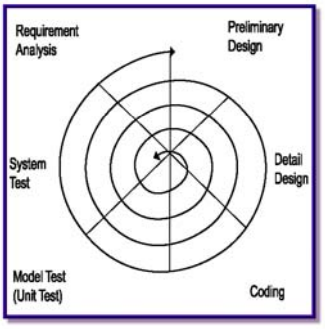
Waterfall Approach



Waterfall Approach

- Sequential
- Each phase completed before moving to next
- Requires a precisely defined requirements spec and analysis before **any** development
- Little or No flexibility
- Doesn't facilitate change process
  - » Can result in spectacular failures
  - » Unrealistic?

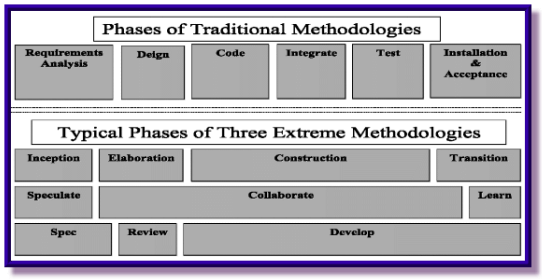
Spiral Approach



Spiral Approach

- Iterative approach
- Allows for greater flexibility
  - » Requirements may be added
  - » Requirements may be changed
- Product is increasingly refined with each cycle of the spiral
- Problems can be identified & rectified earlier in cycle

Extreme Programming Approach (XP)



Extreme Programming Approach (XP)

- Rapid iterations of product development
- Full functionality is achieved over time, while partial functionality is achieved quickly
- An acceptance that change is inevitable
- More likely to deliver a useful system
- Small & Focused Development Teams
  - »**Pair Programming** concept
- Otherwise not really that *extreme*
  - » *Still requires Requirements gathering / Planning/ Tracking/ Quality Assurance*
- *Scrum programming is latest evolution*