Intro to Software Engineering

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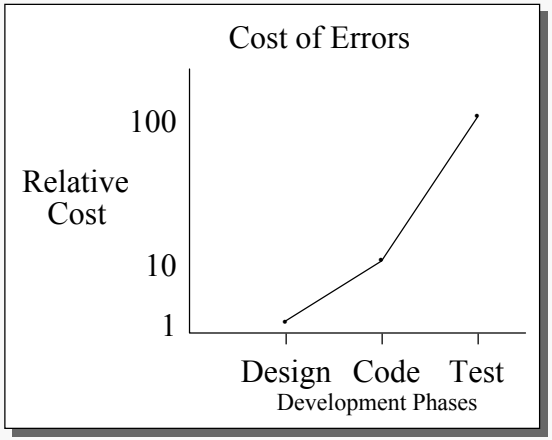
Definitions

Software Systems

- "An integrated whole composed of diverse, interacting, specialized structures and subfunctions." [IEEE]

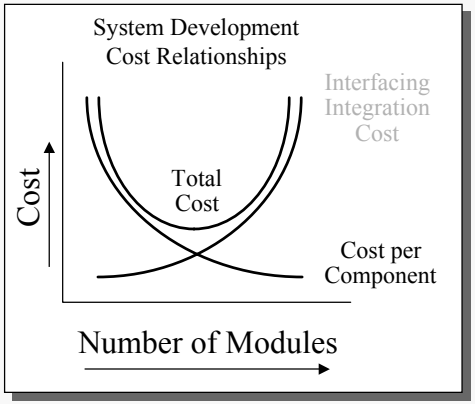
Software Engineering

- Disciplined systematic technological activity for producing and maintaining software products by means of a controlled efficient process.



Large System Development Costs

Cost vs. Number of Modules

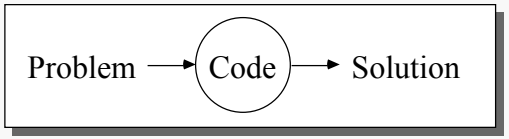


Project	Cost (millions)	Instructions (millions)	Effort (work years)
Apollo Skylab	$209	23	6,000
NASA Satellite Range Monitoring	$ 30	1.25	1,000
FAA Air Traffic Control	$103	1.48	5,000
Safeguard ABM	$120	1.87	3,500

Development Goals

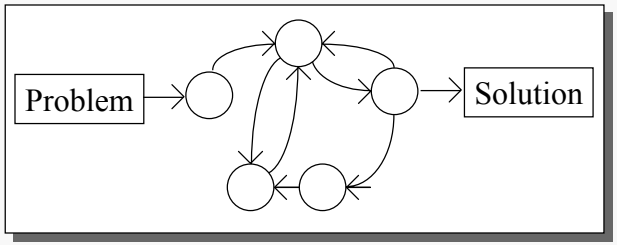
Programming

- Goal: Write Code

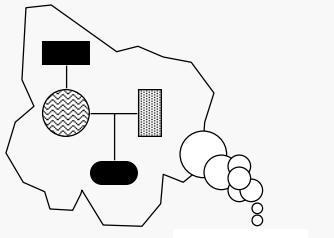


Software Design

- Goals
  - Select components
  - State Functions
  - State Interfaces



Poor Communication



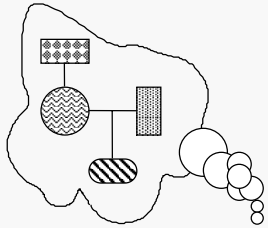
Developer

Code

??

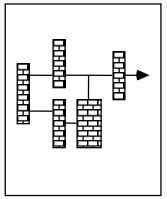
Maintainer / Enhancer

Design Communication



Developer

Idea
(vague)



Design Document

- Concrete and Specific
- Can be analyzed
- Can be compared to implementation
- Traceable through life cycle

Design
Document

Design Elements

A Design should contain
- Components
- Procedures
- Functions

Function of Each Component
- Suggestive names

Interfaces
- Control
  - Calling Hierarchy
- Data
  - Parameters
  - Global Variables
  - Files

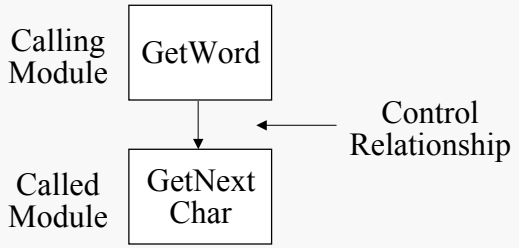
Structure Chart

Structure Chart
- A graphic tool used to hierarchically model the design solution of a problem.

Contains:
- Individual modules
- Data passed to/from modules
- Control Interfaces between modules

Does NOT contain a complete representation of the internal structure of individual modules.

Basic Elements



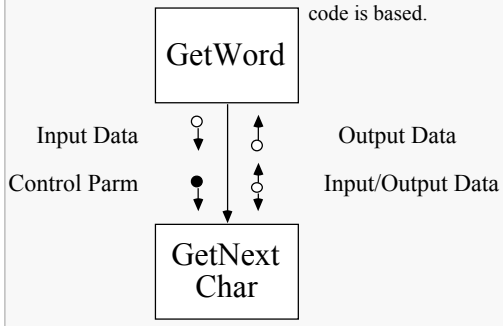
Parameter Notation

Parameter Direction Flow

- 3 Types
  1. Input: Value Parameters & Const Reference Parameters
  2. Output: Reference Parameters (Function changes parameter values independently of parameter's original [passed] value.)
  3. I/O: Reference Parameters (Function changes parameter values dependent upon of parameter's original [passed] value.)

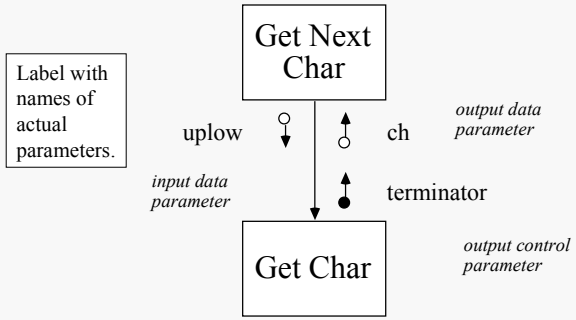
Parameter Classes

- 2 Classes
  1. Data Parameter: Any parameter upon which NO decision in the called module's or calling module's code is based.
  2. Control Parameter: Any parameter upon which a decision in the called module's or calling module's code is based.



Parameter Example


```
void GetNextChar ( . . . ) {
      . . .
    GetChar (ch, uplow, terminator);
    if (terminator) . . .
```

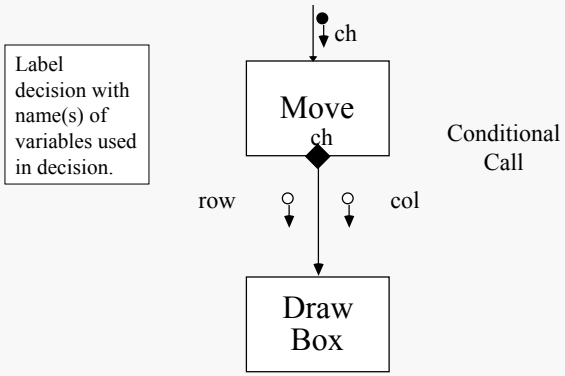



```
void GetChar(char& chact,
             uplowtype uplowCase,
             bool& terminal )
```

Note: Function return values are treated as output parameters (list variable to which they are assigned).

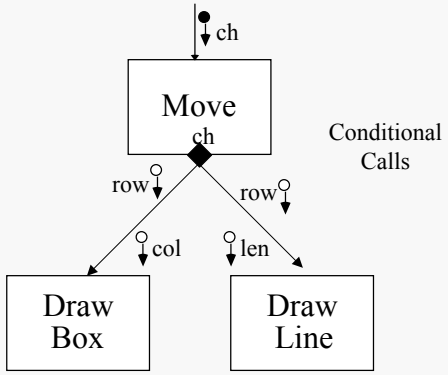
Calls to multiple functions are usually listed left-right in order of execution.


```
void Move(. . . ) {
    ...
    if ( ch == plus )
        DrawBox (row, col);
    ...
```



What does the function header for DrawBox look like?


```
void Move(. . . ) {
    ...
    if ( ch == plus )
        DrawBox (row, col);
    else
        DrawLine (row, len);
        DrawLine (row, len);
    ...
```



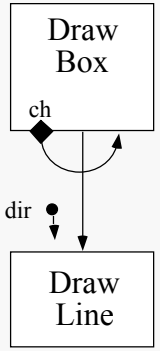
Select statements are diagrammed in a similar manner with multiple calls emanating from the decision diamond.

Flow Control: Loop


```
void Drawbox ( . . . ) {
    ...
    while (ch != plus)
    {
       ...
       DrawLine ( dir );
       ...
    }
    ...
```

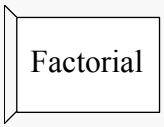
Label with name(s) of variables used in decision.

Conditional Loop

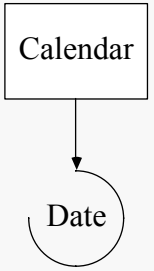


Misc. Routine Calls

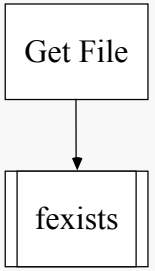
Recursive Routines:
- Routines that call themselves



Operating System Calls:

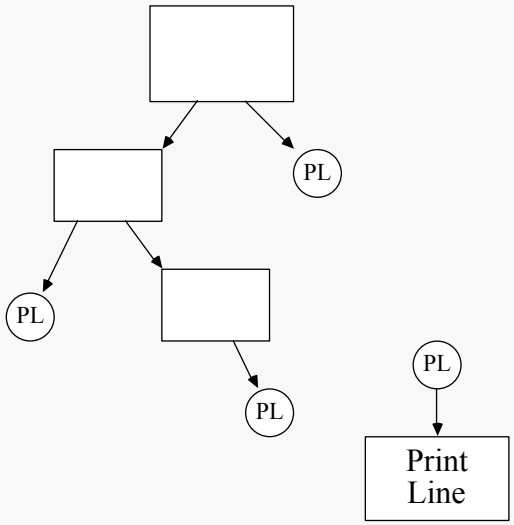


Predefined Module:
- (library routines)

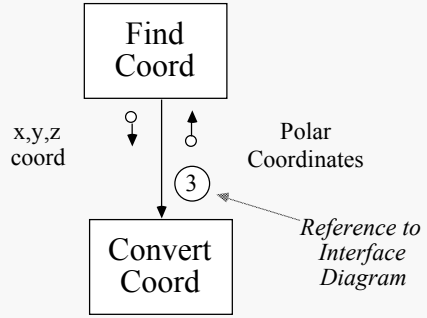


Connector Symbol

Large designs span many pages



Interface Diagram



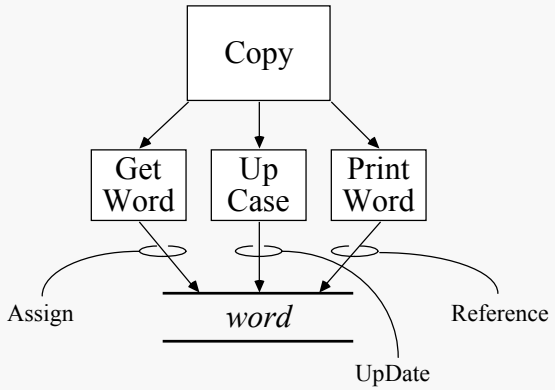
Interface Diagram #3

Parameter	Type	Dir	Description
x	data	in	Cartesian coords
y	data	in	of point
z	data	in	
scale	data	in	scale of axis
angrad	cont	in	angle degrees (rad)
angle	data	out	polar coords
dist	data	out	of point

Global Data

Global Data (extern)

- Must be highly justifiable (semi-global)
  - separately compiled, module scope
- Operation
  - Assign
  - Update
  - Reference



Global X-Reference Charts

Global Variables introduce complexities that must be mapped and traceable.

Global Structures

Procedures	•••	Form	Setting	Date	•••
⋮					
GetNext		R	U		
Advance		U	A	R	
PutNext		A	R		
Reset			A	A	
⋮					

U : Update A : Assign R : Reference