Lecture 04

Design

- Design
  1. System design
  2. Program / Module design
- Properties of modules
  1. Module Coupling
  2. Module Strength / Cohesion
- Module Coupling : Describe the nature, direction and quantity of parameter(s) passed between modules
- Module Strength / Cohesion :How system function coded into modules

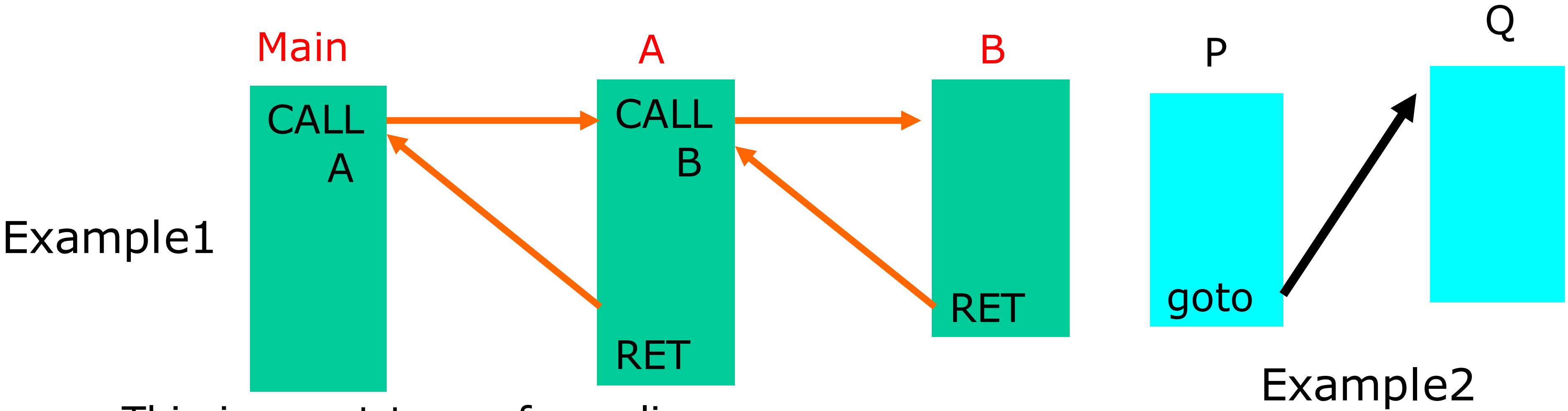
Module Coupling

1. Content Coupling (Worst)
2. Common Coupling
3. External Coupling
4. Control Coupling
5. Stamp Coupling
6. Data Coupling
7. Zero Coupling (Best)

Content Coupling

- If one module makes a direct reference to the contents of another module

- One module to branch into another module



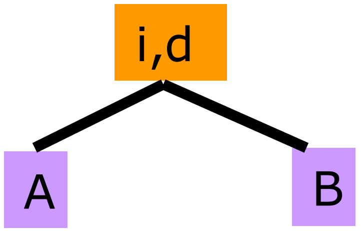
- This is worst type of coupling

- Potentially dengerous situation, always avoid it.

- There is no information hiding (i.e. called module become open to calling module)

Common Coupling

- If two or more modules refers to the same data structure or data element in a common environment
- Global variables
- Include common areas in user program or shared files
- Heterogeneous global data



```
Example1: Struct { int i,j,k;
                     double d;
                      char *s1,*s2;
                      } var1, var2;
```

Common Coupling (Cont.)

- Example 2

  -
    ```
    COMMON A, B, C
              X, Y, Z
    ```

Example 3

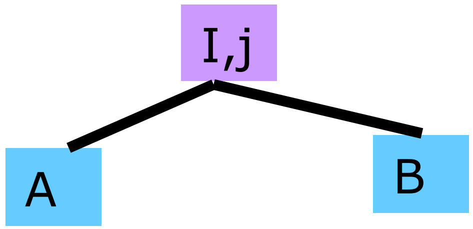
```
PERFORM P1 THRU P8

PERFORM P4 THRU P10
```

External Coupling

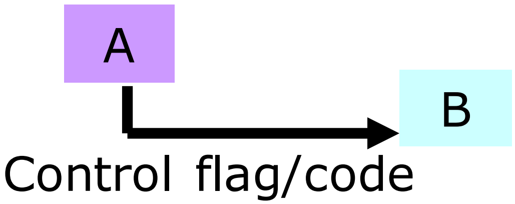
- Special case of common coupling
- Homogeneous global data (variables are same types)
- Example struct { int i, j, k, l;

```
char s1, s2; }
```



Control Coupling

- Two module one of which would pass a control flag to another



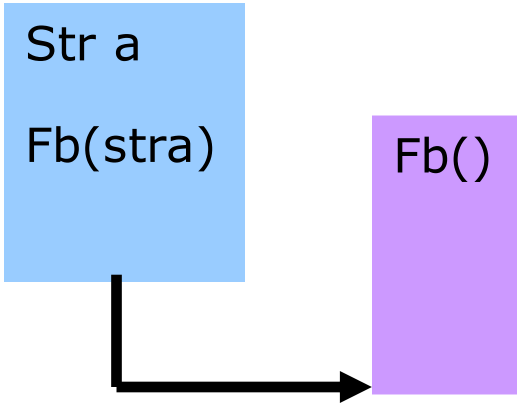
- Violates the principle of information hiding
- Calling module must know the method of operation of the called module

Stamp Coupling

- It involves passing of heterogeneous local data which passes through the parameters
- Needed few elements of the

  entire structure or can stamp

  the entire structure
- Problem of overhead



Data Coupling

- Pass values of data and return the result
- Practically best coupling

Zero Coupling

- Means no coupling between two module
- Practically this is impossible
- All physical module must have some coupling however week is

Module Strength / Cohesion

- Internal activity of a single module

- In general one module should perform one single task

- Module which try to perform many task – validate input, process data, output results – are difficult to define and maintain

- By their very nature, their complexity will leads to coupling problems

- Hence, good coupling should help enforce for good cohesion

Module Strength / Cohesion

1. Coincidental Strength / Cohesion (Worst)
2. Logical Strength / Cohesion
3. Classical / Temporal Strength / Cohesion
4. Procedural Strength / Cohesion
5. Communicational Strength / Cohesion
6. Functional Strength / Cohesion
7. Informational Strength / Cohesion (Best)

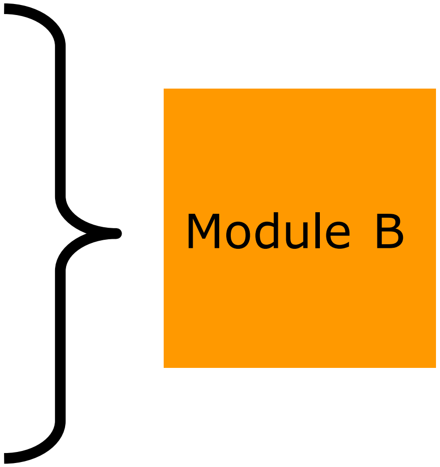
Coincidental Strength / Cohesion

- No strength at all
- Multiple task, completely unrelated
- Only one way to describe module task is by describing its logic step-by-step
- Sequence of commands, replacing these sequence by modules
- This is very difficult to create in practice (only arbitrary random grouping of the lines of the program code could perhaps result in such strength)

Coincidental Strength / Cohesion (Cont.)

Example

- Calculate Tax deduction
- Print National Insurance
- Calculate Number
- Calculate Union Dues



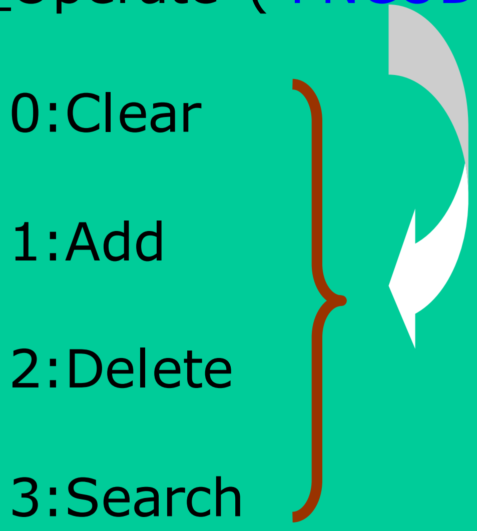
Module B

Logical Strength / Cohesion

- A module that perform similar tasks, which are related logically is called Logical Cohesiveness
  - i.e. All editing, produces all output regardless of type
  - Similar edit check may be made on more than one data item i.e. date of transaction
- A better way is to construct a DATE_CHECK module and call this module whenever a date check is necessary
- Characterized
  - Single function
  - uniform function interface
  - Information hiding

Logical Strength / Cohesion (Cont.)

- Example Table_Operate (FNCODE, ARG1, ARG2,ARG3)



0:Clear

1:Add

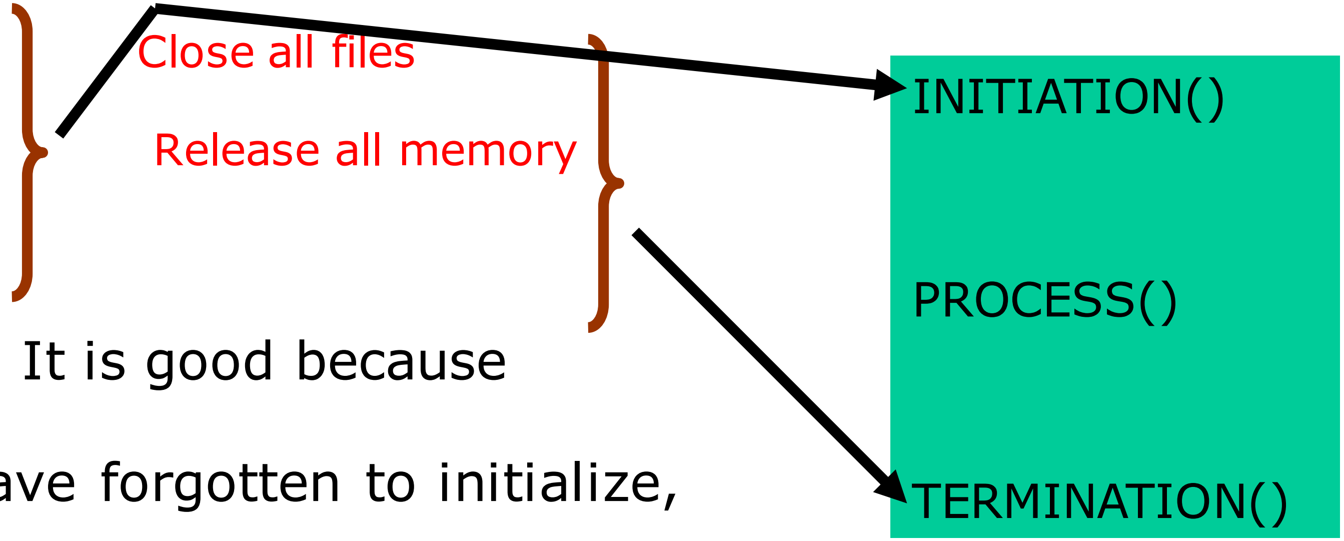
2:Delete

3:Search

- Disadvantage
  - To add some extra feature, we have to add some extra argument
  - A single change, would require a number of changes inside the module which is very costly

Classical/Temporal Strength / Cohesion

- Very similar to logical strength
- All functions related to time are grouped into one module
- A better way is to construct a DATE_CHECK module and call this module whenever a date check is necessary



Zeroes all variables

Procure all memory

Open all Files

Close all files

Release all memory

INITIATION()

PROCESS()

TERMINATION()

- Advantage → It is good because

suppose if we have forgotten to initialize,

we have only to scan process part

Classical/Temporal Strength / Cohesion (Cont.)

- Disadvantage → Addition of a new file we have to be change all the functions

Procedural Strength / Cohesion

- When a flowchart (we define system functions) structure is divided into a number of section and each section is represent one module

- It is some time problem specific and domain specific

- Example

A branching application problem :

```
if (tx_code ==5)
{  read_next_tx();

         print_E15();

         update_bal();

         Clear_buffer();

}
```

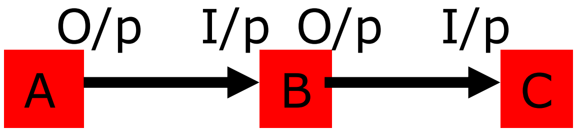
4 functions are
unrelated they are

application specific

Communicational Strength / Cohesion (Cont.)

- When the processes are communicate with each other, are included in the same module

- Concerned with a data structure / file
  - Module read the file, process it and write output back to the file



Functional Strength / Cohesion

- Practically best strength/cohesion
- When a module perform a single unambiguous task
- If we are able to conclude at a single statement describing about the activity of the module, then we have achieved functional strength

Informational Strength / Cohesion

- Practically not possible to implement
- Multiple functions related by the same data structure
- Multiple entry points corresponding to different functions
- No jump between different entry points
- Advantage → Information Hiding

Program Design

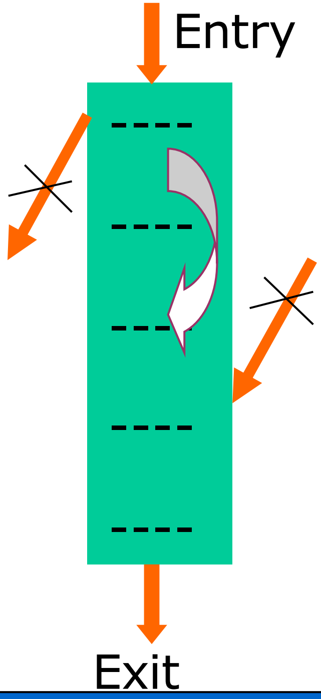
Modular / Structured program design

- No goto
- Structure program uses structured control structures to improve program clarity and maintenance
- Top_down development

- There are three basic control structure
  - Sequence
  - Decision/Selection
  - Iteration/Looping

Program Design (Cont.)

- Properties of Structured programming
  - Single entry point and single exit point
  - Program have no. jumps from outside to inside except at the beginning
  - Program have no. jumps from inside to outside except at the end
  - Jump inside should be avoided



- Ways of removing goto’s from program

  (Use Loops i.e. While, do_while, Repeat Until)

- Convert Unstructured programming to equivalent structured programming

Program Design (Cont.)

- Methods
  1. Formal
  2. Informal

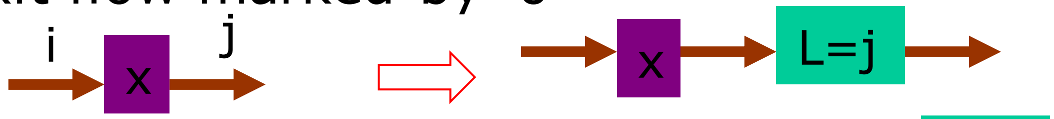
- Informal method consist of two techniques
  1. Use of code duplication
  2. Use of Boolean flag(s)

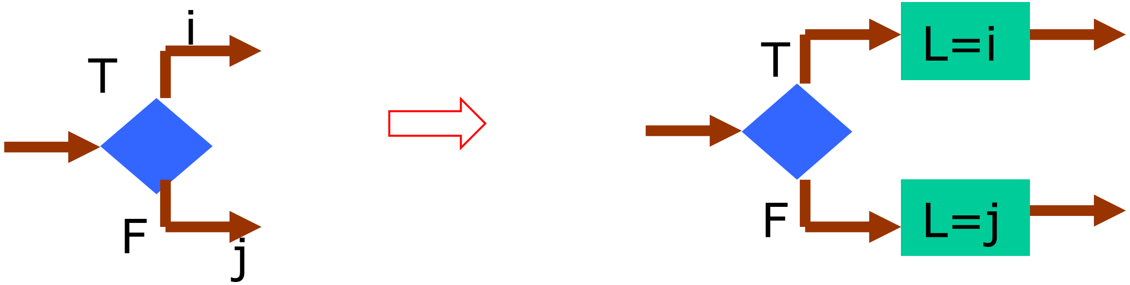
- Formal Method
  – Use Mill’s theorem

Program Design (Cont.)

- Mill’s theorem
  - There exists a corresponding equivalent structured programming given by number of nodes and flow for a proper unstructured programming with n nodes (process and decision)

- Rules

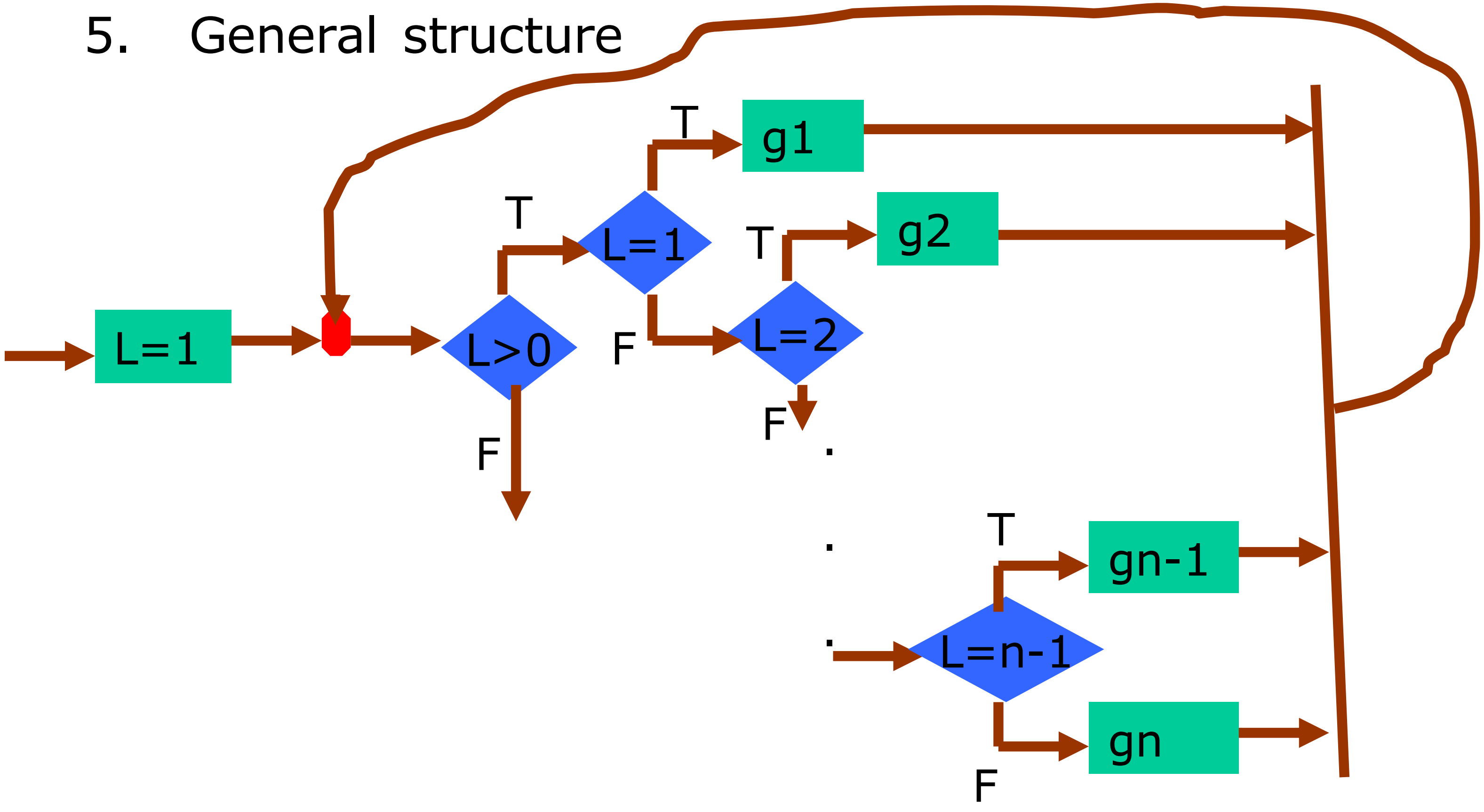
1. Entry node/flow marked by ‘1’
2. Exit flow marked by ‘0’
3. 

4. 

Program Design (Cont.)

- Rules

5. General structure


L=1
L>0
T
F
L=1
T
F
g1
L=2
T
F
g2
.
.
.
L=n-1
T
F
gn-1
gn