IMPORTANT NOTICE TO STUDENTS

These slides are **NOT** to be used as a replacement for student notes.
These **slides** are sometimes **vague and incomplete on purpose** to spark a class discussion

KWIC Case Study

CS 446/646 ECE452
May 20th, 2011

WATERLOO
CHERITON SCHOOL OF COMPUTER SCIENCE

KWIC-Index

Intent

- alphabetical list of keywords
- keywords are displayed with context
  - context = surrounding words
- also known as “permuted index”

KWIC Example

Clouds are white
Ottawa is beautiful

Input is a set of titles

are white Clouds
beautiful Ottawa is
Clouds are white
is beautiful Ottawa
Ottawa is beautiful
white Clouds are

Output is permuted index where each keyword is surrounded by the context in which it was used

Architectural Concerns

Parnas – 1972

- changes in the processing algorithm
  - sequential, batch, and lazy (on-demand) line shifting
- changes in data representation

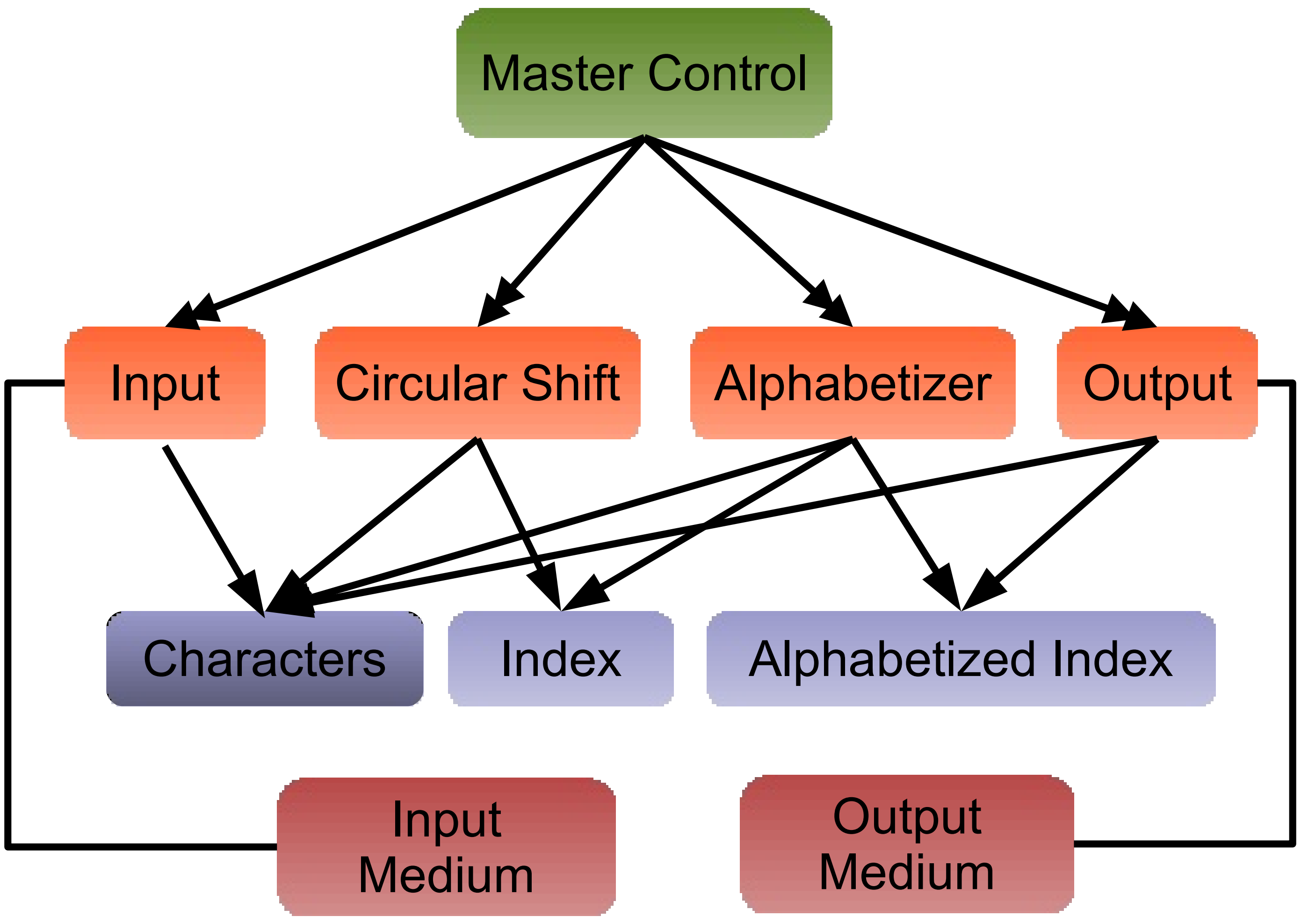
Garlan, Kaiser 7 Notkin – 1992

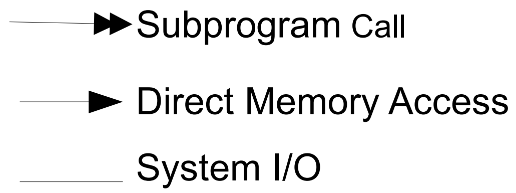
- enhancement to system function
  - user interaction, noise words
- performance
- reuse

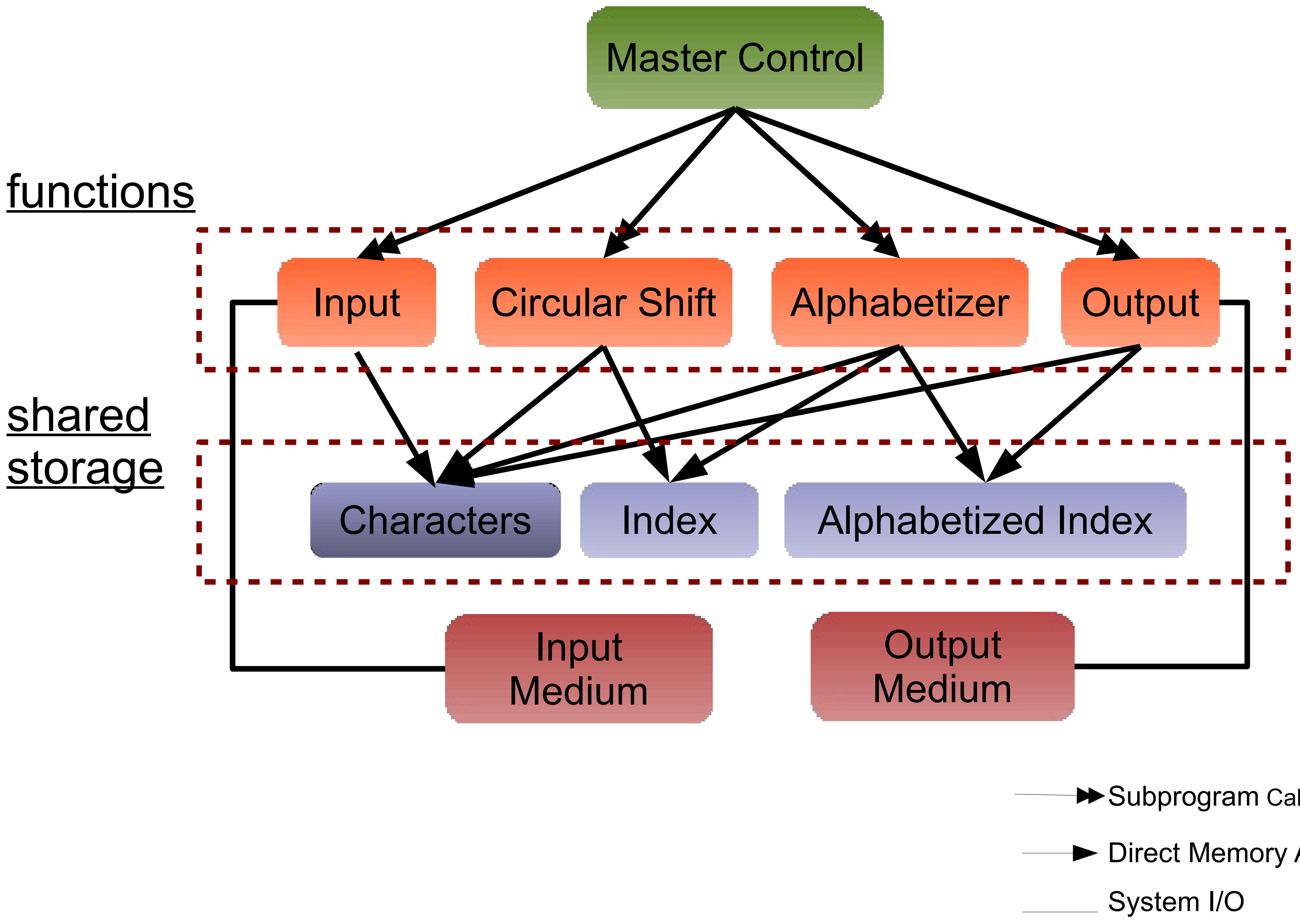
Solution 1 (Parnas)

Main Program/Subroutine with Shared Data

- functional decomposition
  - components are subroutines
- shared memory


Master Control
Input
Circular Shift
Alphabetizer
Output
Characters
Index
Alphabetized Index
Input Medium
Output Medium


Subprogram Call
Direct Memory Access
System I/O



functions
shared storage
Master Control
Input
Circular Shift
Alphabetizer
Output
Characters
Index
Alphabetized Index
Input Medium
Output Medium
Subprogram Call
Direct Memory Access
System I/O

Solution 1 (Parnas)

Strengths

- centralized data
  - efficient representation of data
- modular decomposition
  - easy to add new components
- performance

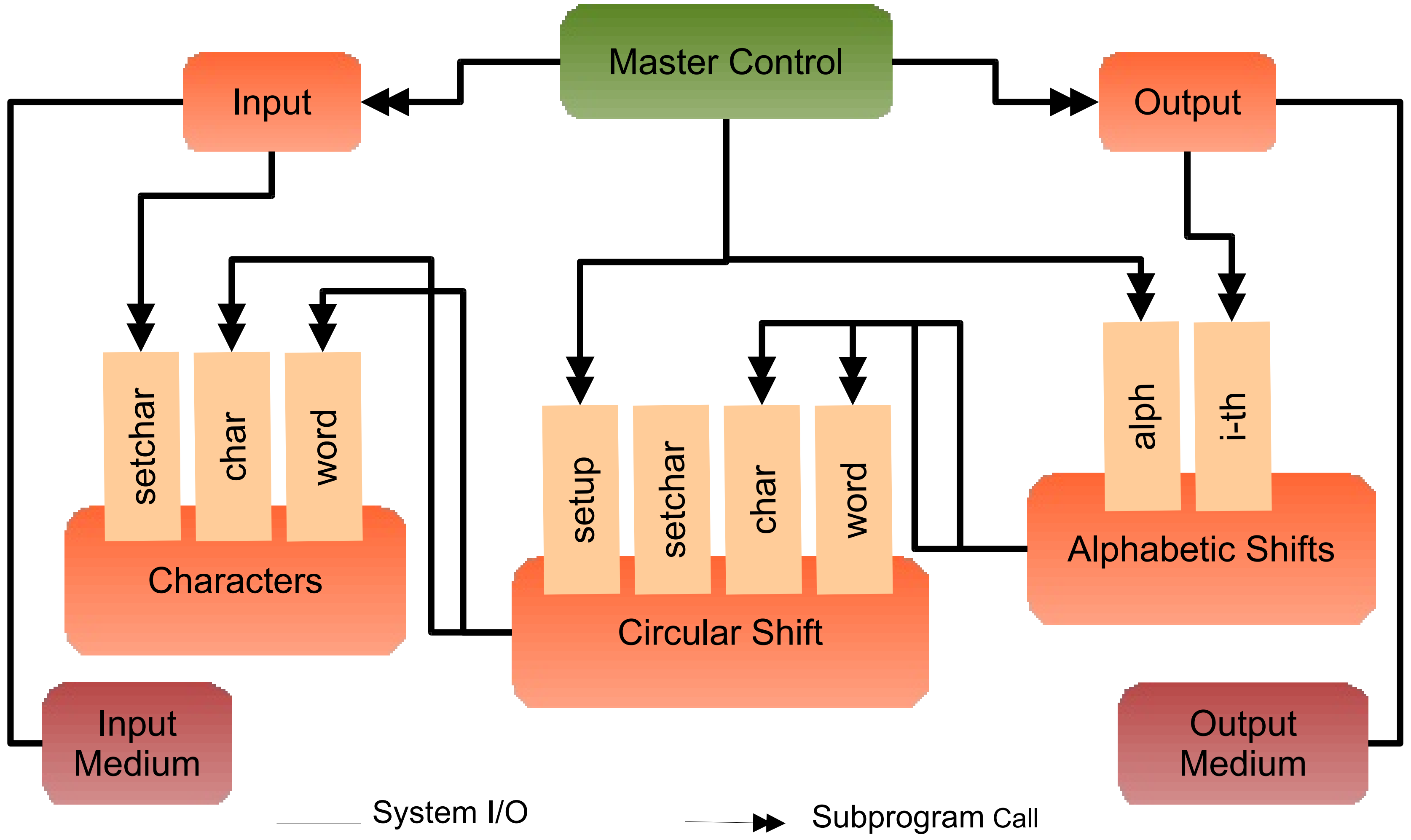
Weaknesses

- resistant to change
  - consider the impact of data storage format
  - difficult to enhance the overall functionality
  - reuse of component is difficult

Solution 2 (Parnas)

Abstract Data Types

- data encapsulation within objects
  - data is shared via *'interface methods'*
  - data access via component interface invocation
  - no direct data access


Master Control
Input
Output
setchar
char
word
Characters
setup
setchar
char
word
Circular Shift
alph
i-th
Alphabetic Shifts
Input Medium
Output Medium
System I/O
Subprogram Call

Solution 2 (Parnas)

Advantages

- data model can change with minimal impact
- handles **individual** component design changes well
  - algorithm and data are encapsulated in individual modules
- reuse as modules interact via defined interfaces

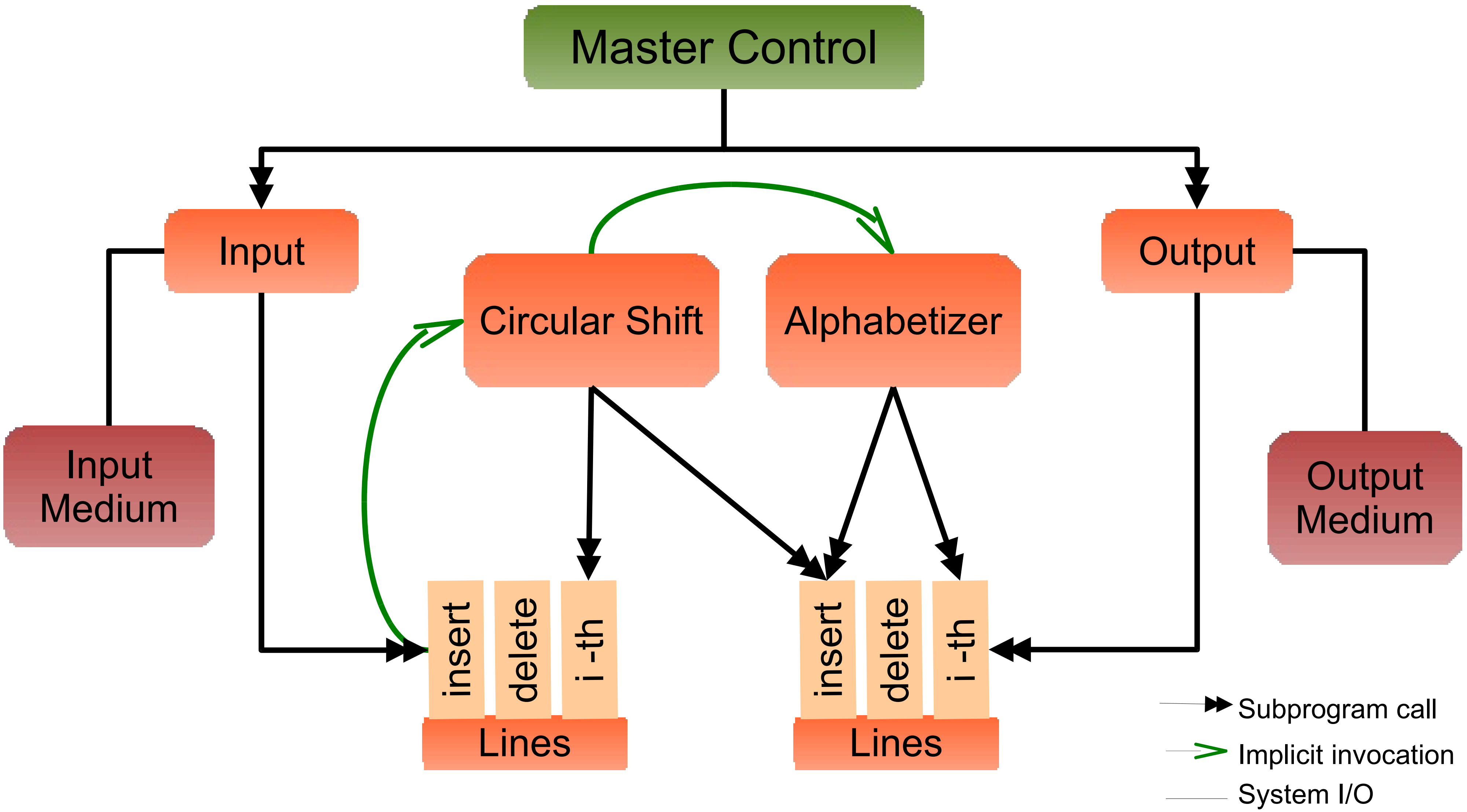
Disadvantages

- system evolution still a problem
  - to add new or change existing features may require
    - changes to existing components
    - addition of new components

Solution 3

Implicit Invocation

- similar to solution 1
- shared data via abstract interfaces (set, list etc.)
- with some main differences
  - components are invoked implicitly
    - e.g. when a line is added
  - interaction is based on *'active data model'*



calls to circular shift and alphabetizer are implicit, and are the result of inserting lines

Solution 3

Advantages

- strong evolution path
  - functional enhancements are easy
  - new components can be attached and removed
- minimal component coupling/dependency
  - data events are the source of all interactions

Solution 3

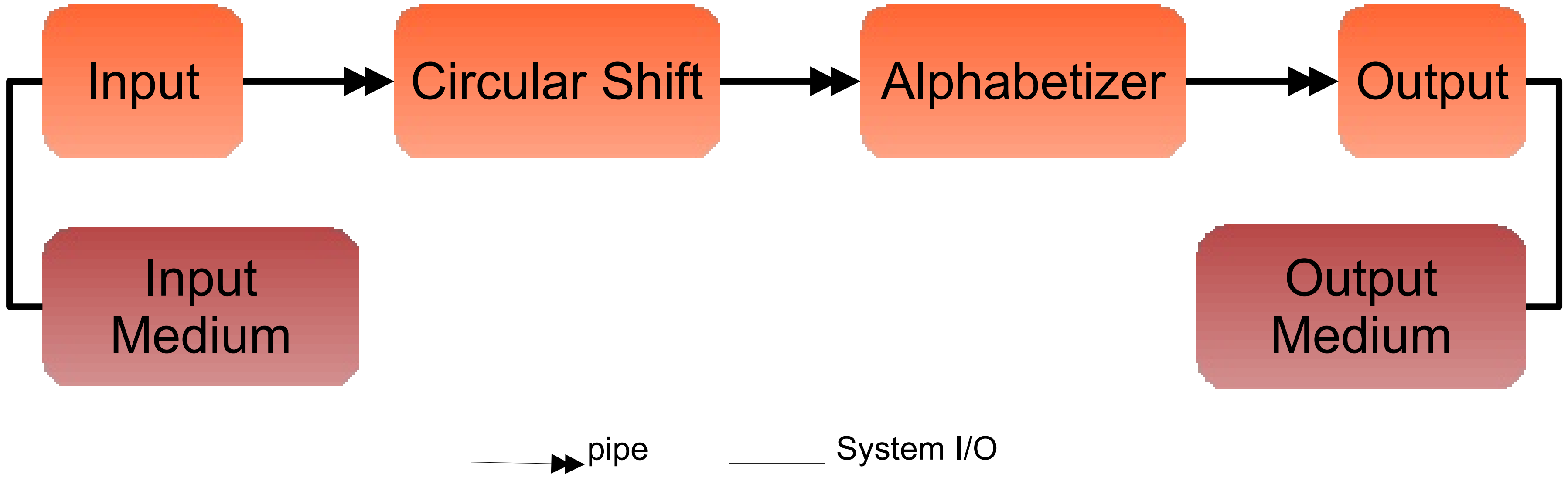
Disadvantages

- shared data model → resistant to change
- difficult to control the ordering of processing
- poor reuse since system is based on the data model
  - components can not be reused without data model
- requires more storage capacity
  - **Why?**
  - **IS THIS REALLY A DISADVANTAGE?**

Solution 4

Pipes & Filters

- four filters
  - input, shift, alphabetize, output
  - data sharing is restricted by pipes



Solution 4

Advantages

- intuitive flow of processing
- reuse
- evolution
  - new filters can be easily added
  - easy to modify

Solution 4

Disadvantage

- virtually impossible to support an interactive system
- **Is this a true pipes & filters?**
  - consider the data flow
- difficult to change the data model
  - what is the LCD data unit?
- performance may suffer
  - since each filter will have to ___________

Comparison

	Shared Memory	ADT	Implicit Invocation	Pipe & Filter
change in algorithm	✗	✗	✓	✓
change in data representation	✗	✓	✗	✗
change in functionality	✓	✗	✓	✓
performance	✓	✓	✗	✗
reuse	✗	✓	✗	✓

change in algorithm == change in overall system processing mechanism

change in functionality == change in components structure