Module Structure

- David Parnas
  - "On the Criteria To Be Used in Decomposing Systems into Modules"
    - *Comm. ACM 15, 12* (Dec. 1972), 1053-1058
- Discusses "modularization"
  - Module = a collection of subroutines and data elements
- Describes two ways to modularize a program that generates KWIC (Key Word in Context) indices.
  - Modularization 1
    - Based on the sequence of steps to perform
  - Modularization 2
    - Based on the principle of "information hiding"

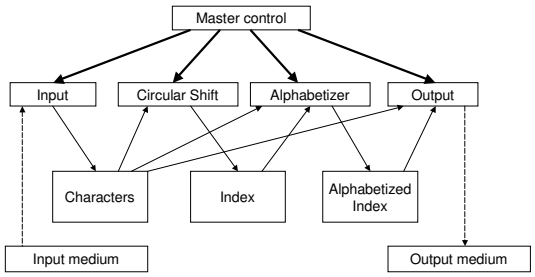
KWIC

- Input

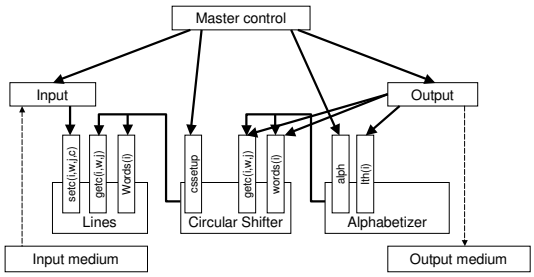
  Designing Software for Ease of Construction
  Figs are Good
- Output

  Designing Software for Ease of Construction
  Software for Ease of Construction Designing
  for Ease of Construction Designing Software
  Ease of Construction Designing Software for
  of Construction Designing Software for Ease
  Construction Designing Software for Ease of
  Figs are Good
  are Good Figs
  Good Figs are

KWIC Modularization 1



KWIC Modularization 2



Crieria for decomposition

- Modularization 1
  - Each major step in the processing was a module
- Modularization 2
  - Information hiding
    - Each module "has a secret"
    - Each module is characterized by its knowledge of a design decision which it hides from all others.

General Comparison

- General
  - Note: both systems might share the same data structures and the same algorithms
  - Differences are in the way they are divided into work assignments
  - Systems are substanitally different even if identical in the runnable representation
    - Possible because the runnable representation is used only for running
    - Other representations are used for
      - Changing
      - Documenting
      - Understanding
      - …

Changeability Comparison

- Design decisions that may change
  - Input format
    - (1, 1)
  - All lines stored in memory
    - (all, 1)
  - Pack characters 4 to a word
    - (all, 1)
  - Make an index for circular shifts rather than store them
    - (3,1)
  - Alphabetize once, rather than either
    - Search for each item as needed
    - Partially alphabetize, partially search
    - (3,1)

Independent Development

- Modularization 1
  - Must design all data structures before parallel work can proceed
  - Complex descriptions needed
- Modularization 2
  - Must design interfaces before parallel work can begin
  - Simple descriptions only
- Comprehensibility
  - Modularization 2 is better
    - Parnas subjective judgment