Midterm Test

March 6, 1997

Conditions: Closed book  Duration: 70 minutes

Name: {Please underline last name}

Student Number: ________________________________

1. __________ /20

2. __________ /20

3. __________ /20

4. __________ /20

5. __________ /20

Total __________ /100
1. [20 marks]

For each of the following ten statements, indicate whether it is true (mark T) or false (mark F).
(No penalty for a wrong answer)

___ T. This is the mid-term test for CS6362.

___ 1. All compilers run in a batch mode as this mode is good for conceptual simplicity and
adaptability.

___ 2. The correctness of a filter is independent of the correctness of its predecessor filters.

___ 3. A software architecture serves as an (abstract) skeleton which can be used to expose the
ability of a system to meet its gross system requirements.

___ 4. Programming-in-the-small focuses on building evolvable software systems, while programming-
in-the-large focuses on building efficient data structures and algorithms.

___ 5. Classical module interconnection languages (MILs) are powerful enough to describe a
variety of architectural styles, such as pipe-and-filter and implicit invocation.

___ 6. The single primary role of non-functional requirements during software architectural
design should be in selecting among software architectural alternatives after they have
been produced by software architects.

___ 7. In the style of implicit invocation, modules communicate indirectly with each other by
directly accessing shared data.

___ 8. In a batch sequential architecture, data flows through a sequence of discrete processing
steps where update modules can run concurrently with each other.

___ 9. An essential part of any software architectural design should be design rationale, since
design rationale explains why the particular architecture is chosen from the (possibly
ininitely) large design space.

___ 10. A semi-formal approach to designing a software architecture is often considered bad
concerning defects but good concerning understandability.
2. [20 marks]

Consider the following four architectures for the KWIC problem.

**Architecture 1: Shared Data**

**Architecture 2: Abstract Data Type**

**Architecture 3: Implicit Invocation**

**Architecture 4: Pipe and Filter**
2. [continued]

Consider Architecture 1. Describe briefly what and where modification is needed to efficiently “omit” indices starting with a noise word (e.g., the, a, an, to, and, or, etc.).

Consider Architecture 1 and Architecture 2. Compare them with respect to reusability and space performance.

Consider Architecture 3. Suppose the Output module is to be implicitly invoked, instead of being explicitly invoked by the Master Control module. What kind of data should be generated, and by which module and when?

Consider Architecture 1 and Architecture 4. Describe briefly the major disadvantage(s) of Architecture 4 when run in a batch mode, when compared to Architecture 1.
Consider the following module declaration:

```plaintext
module M
  provides: a, b, c, d, e;
  requires: v, w, x, y, z;
  consist-of: module M1, module M2, module M3
module M1
  provides: a;
  requires: v;
  string a, real v
end M1

module M2
  provides: b, c, d;
  requires: w, x, y;
  has-access-to: module M1
  consist-of: module M21, module M22, module M23
module M21
  provides: b;
  requires: w;
  boolean b, integer w
end M21

module M22
  provides: c;
  requires: x;
  has-access-to: module M21
  integer c, real x
end M22

module M23
  provides: d;
  requires: y;
  has-access-to: module M22
  boolean d, string y
end M23

end M2

module M3
  provides: e;
  requires: z;
  has-access-to: module M2
  integer e, z
end M3

end M
```
1. List the set of (both internal and external) variables that module M1 has access to.

2. List the set of (both internal and external) variables that module M21 has access to.

3. List the set of (both internal and external) variables that module M22 has access to.

4. List the set of (both internal and external) variables that module M23 has access to.

5. List the set of (both internal and external) variables that module M3 has access to.
4. [20 marks]

Consider the following declaration of stack:

Stack (E, C): trait /* E(e.g., integer, string) is an element of C, a stack */
introduces
    new: -> C
    push: C, E -> C
top: C -> E    exempting top(new)
pop: C -> C    exempting pop(new)
isEmpty: C -> Bool

asserts
C generated by new, push
forall stk: C, e: E
    top (push(stk, e)) == e
    pop (push(stk, e)) == stk
    isEmpty(new)
    ~ isEmpty(push(stk, e))
implies
LinearContainer (push for insert, top for first, pop for rest)

1. What is the value of \text{pop} (\text{top} (\text{stk})) for any \text{stk}: C?

2. What is the value of \text{top} (\text{push} (\text{new}, e)) for any e: E?

3. What is the value of \text{pop} (\text{push} (\text{new}, e)) for any e: E?

4. What is the value of \text{isEmpty} (\text{pop} (\text{push} (\text{new}, e))) for any e: E?

5. What is the value of \text{pop} (\text{push} (\text{push} (\text{new}, e), e'))) for any e, e': E?

6. What is the value of \text{isEmpty} (\text{pop} (\text{push} (\text{push} (\text{new}, e), e'))) for any e, e': E?

7. What is the value of \text{top} (\text{pop} (\text{push} (\text{push} (\text{new}, e), e'))) for any e, e': E?

8. What is the value of \text{top} (\text{pop} (\text{push} (\text{push} (\text{new}, e), e'))) for any e, e': E?

9. What is the value of \text{rest} (\text{rest} (\text{insert} (\text{new}, e))) for any e: E, assuming that \text{LinearContainer} has access to \text{Stack}?

10. What is the value of \text{first} (\text{rest} (\text{insert} (\text{new}, e)), e')) for any e, e': E, assuming that \text{LinearContainer} has access to \text{Stack}?
5. [20 marks]

Consider the following two architectures for an oscilloscope, as discussed in class:

![Architecture 1](image1)

![Architecture 2](image2)


2. [8 marks] What kind of mechanism would be needed to display Measurement on the screen?

3. [4 marks] Pictorially depict a 2-layer architecture which can be obtained from Architecture 2.