Name_____Student No._____

SOFTWARE ENGINEERING 2A04

DAY CLASS Dr. PARNAS / Dr. FARMER
DURATION OF EXAMINATION: 3 HOURS
MCMASTER UNIVERSITY FINAL EXAMINATION December 13, 1999

THIS EXAMINATION PAPER INCLUDES 13 PAGES (INCLUDING COVER SHEET) AND 50 QUESTIONS. YOU ARE RESPONSIBLE FOR ENSURING THAT YOUR COPY OF THE PAPER IS COMPLETE. BRING ANY DISCREPANCY TO THE ATTENTION OF YOUR INVIGILATOR.

Special Instructions:
Candidates may use a standard calculator, notes, & text books. Answers are to be marked on the exam itself as well as on the OMR answer sheet. In case of discrepancies, the OMR answer sheet is considered to be your answer.
Exams and OMR answer sheets are to be collected separately.

OMR EXAMINATION - INSTRUCTIONS
NOTE: IT IS **YOUR** RESPONSIBILITY TO ENSURE THAT THE ANSWER SHEET IS PROPERLY COMPLETED: YOUR EXAMINATION RESULT DEPENDS UPON PROPER ATTENTION TO THESE INSTRUCTIONS.
The scanner, which reads the sheets, senses the shaded areas by their non-reflection of light. A heavy mark must be made, completely filling the circular bubble, with an HB pencil. Marks made with a pen or felt-tip marker will **NOT** be sensed. Erasers must be thorough or the scanner may still sense a mark. Do **NOT** put any unnecessary marks or writing on the sheet.

1. Print your name, student number, course name, section number and the date in the space provided at the top of Side 1 (red side) of the form. Then the sheet **MUST** be signed in the space marked SIGNATURE (See *).
2. Mark your student number in the space provided on the sheet on Side 1 and fill in the corresponding bubbles underneath.
3. Mark only **ONE** choice from the alternatives (A,B,C,D,E) provided for each question. If there is a True/False question, enter response of 1 (or A) as True, and 2 (or B) as False. The question number is to the left of the bubbles. Make sure that the number of the question of the scan sheet is the same as the question number on the test paper.
4. Pay particular attention to the Marking Directions on the form.
5. Begin answering questions using the first set of bubbles, marked "1". Answer all questions.
6. Please circle the correct answer on the exam itself.
7. Pass **both** the exam sheets and exams in at the end of the exam; they should be collected **separately**.

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The questions below are all based on the lectures, the articles in the "coursepack" and on the book, "The Mythical Man Month". Please read the questions carefully. In many cases all of the alternative answers are true statements, but only one responds to the question. Note too that sometimes we are asking you which statement is ***not*** an appropriate answer.

To answer the next 5 questions, you should complete the following tabular description of a finite state machine. The machine should output a "1" if and only if, the most recent 5 characters (including the current input) were "C S C S M". (Current input is "M", the input before that was "S",...)

Minimal CSCSM Recogniser: Initial State is 1

NS	C	M	S	X
1	4	1	1	1
2	4	1		
3	2	1	1	
4	4		3	
5	2		1	1

OUT	C	M	S	X
1				
2		0		0
3		0		0
4		0		0
5	0	1	0	0

(1) State 5 is the state of the machine:
A: whenever the last 5 inputs before the current input were C S C S M
B: whenever the last three inputs before the current input were C S X
C: whenever the last three inputs before the current input were X C S
D: whenever the last 4 Inputs before the current input were C S C S
E: whenever the last two inputs before the current input were C S

(2) If the most recent two inputs before the current input were M X, the state that you would be in is
A: 1
B: 2
C: 3
D: 4
E: 5

(3) If the two previous inputs (other than the current input) were C S, the machine could be in
A: state 1
B: state 1 or state 3
C: state 2 or state 4.
D: state 3 or state 5
E: state 4

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(4) If the three most recent inputs (other than the current input) were C S M, the machine could be in
A: state 1 or state 5
B: state 1
C: state 2
D: state 4
E: state 5

(5) If the two most recent inputs other than the current input were C S, the output could be
A: 1 only
B: 1 or 0
C: 0 only
D: undefined
E: 2 or 4.

The next 5 questions are based on the pseudo-code program below. Assume that A is a global integer array with subscripts 0:N, N is a global integer initially greater than 1 and M is a global integer.

(**integer** I; I ⇐ N; M ⇐ A[N];
it (I-1 ≥ 0 → (((A[I-1] < M) → M ⇐ A[I-1] | (M ≤ A[I-1]) → **skip**); I ⇐ I - 1; ☛)
| I-1 < 0 → ●)
ti)

(6) Which of the following is a non-increasing quantity in the loop?
A: only I
B: only M
C: both M and I
D: I - A[I-1]
E: M - I

(7) In this question, if "E" is true, you must choose "E".
Which of the following predicates is invariant in the loop?
A: I+1 ≥ 0
B: A[I] ≥ M
C: (∀ j, I ≤ j ≤ N ⇒ M ≤ A[j])
D: (∀ j, I < j ≤ N ⇒ M ≤ A[j])
E: all of the above

(8) The program above terminates with M equal to:
A: the second smallest value in the array
B: the smallest value in the array
C: A[N] - if A[N] is larger than any other element of the array
D: the initial value of M
E: none of the above

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(9) To show that the above program will terminate we must,
A: show that M will never increase in the loop.
B: show that M will never decrease in the loop.
C: show that I will decrease with each iteration and will be zero on termination.
D: show that I-1 will decrease with each iteration and will be zero on termination.
E: show two of the above.

(10) The program will
A: sometimes do an assignment to M that is not necessary
B: do more additions than necessary
C: do more comparisons than necessary
D: terminate with N = 0
E: none of the above

The next 5 questions are based on the pseudo-code program below. Assume that L, N, and S are global integers, initially N ≥ 0, and A is a global integer array with subscripts 0:N.

(**integer** I; I ⇐ N; L ⇐ 0; S ⇐ L; ***it*** SEESPEC; (I > -1 → ☛ | I ≤ -1 → ●) ***ti***)

SEESPEC is a program that satisfies the following specification

	A['I] > 3	A['I] = 3	A['I] < 3
I'=	'I - 1	'I - 1	'I - 1
L' =	'L + 1	'L	'L
S' =	'S	'S	'S + 1

(11) What is a monotonically decreasing quantity that can be used to confirm termination of the loop?
A: L - I+1
B: I +1
C: A[I]
D: N - I +1
E: N - I

(12) Which of the following best describes the function of SEESPEC
A: Decrement I and Increment L if A[I] is greater than 3.
B: Decrement I and Decrement L if A[I] is greater than 3.
C: Decrement I and Do nothing if A[I] = 3.
D: Decrement I and Decrement S if A[I] is less than 3.
E: Decrement I and Increment L if A[I] is greater than 3 and increment S if A[I] is less than 3.

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(13) Which of the following is invariant in the loop.

A: $L \le S$
B: $S \le L$
C: $L \le I$
D: all of the above
E: none of the above

(14) Which of the following is true if N = 0?

A: The program SEESPEC is never used.
B: The program SEESPEC will abort or give strange results because of an improper array access.
C: The program SEESPEC will be called once.
D: The program SEESPEC will be called twice.
E: None of the above.

(15) In this question, if "E" is true, you must choose "E".
If all elements of the array A have the value 3:

A: The final value of L will be 0.
B: The final value of I will be -1.
C: The final value of S will be 0.
D: SEESPEC will be called N + 1 times.
E: All of the above.

(16) In the OFP (Onboard Flight Program) for the A-7 aircraft, described in the assigned readings, it was proposed that there be three major modules:

A: One used before takeoff, one during flight, and one for landing.
B: One to initialise all variables, one to check inputs, one to calculate outputs.
C: One for navigation, one for weapon impact calculations, and one to control the displays.
D: All of the above.
E: None of the above.

(17) The "mythical man-month effect", as discussed in the assigned readings means:

A: Because different people write code at different speeds, we cannot measure the complexity of a product in man-months.
B: Nobody should work for more than one month on the same module.
C: The product of the number of programmers and the number of months required to develop a product is not constant as the number of programmers varies.
D: It takes much more time to write code than we think it will.
E: It is important to include documentation in your cost estimates.

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Consider the following module specification.

TYPE IMPLEMENTED: <ct>

(1) SYNTAX

OUTPUT VARIABLES:

Variable Name	Type
out	<integer>

ACCESS PROGRAMS:

Program Name	Value	Arg#1
U		
D		
OUT	<integer>	

(2) CANONICAL TRACES

canonical(T) $\leftrightarrow$ T = $[(U)]_{i=1}^{n}$ $\wedge$ (n $\le$ 12)

(3) EQUIVALENCES

T.U ≡

conditions	equivalences
length(T) < 12	T.U
length(T) = 12	–

T.D ≡

conditions	equivalences
length(T) < 1	T
length(T) > 0	T1 where T = T1.U

T.OUT ≡ T

(4) VALUES

V[out](T) =length(T)
Return Values:)

Program Name	Argument No	Value
OUT	Value	out

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(18) In the trace specification just given the number of access programs is:

A: 1
B: 2
C: 3
D: 4
E: none of the above

(19) In the specification given above, which programs change the state of the module:

A: U only
B: D only
C: U and D
D: U and D and OUT
E: OUT only

(20) The number of distinct canonical traces for this module is:

A: 12
B: 13
C: 11
D: 2^{12}
E: 2^{13}

(21) For the module described above, the trace U.U.U.D is

A: not possible
B: not legal
C: not canonical
D: all of the above
E: none of the above

(22) For the module described above, the trace U.U.U.D.U is equivalent to

A: the empty trace
B: U.U.U
C: U. U. D.U.U.U
D: U.U.U.D
E: none of the above

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(23) In this question, if "E" is true, you must choose "E".
For the module described above, the trace U.U.U.D.U is equivalent to

A: U.U.U
B: D.U.U.U
C: U.D.U.U.U
D: U. U. D.U.U
E: all of the above

(24) What is the highest possible value that can be returned by OUT

A: 11
B: 12
C: 13
D: 2^{11}
E: 2^{12}

(25) Which of the following statements about modules was ***not*** stressed in this course?

A: It is important that modules have interfaces that are unlikely to change.
B: It is important that modules can be tested separately before integration.
C: It is important that each module can be written by someone who does not know the code of the other modules.
D: It is important that modules that satisfy the same specification be interchangeable.
E: It is important that modules can be compiled separately.

(26) Software seems to age. Which of the following is ***not*** one of the reasons given in your reading assignments?

A: Requirements change.
B: Alterations to software often violate the initial assumptions.
C: Documentation is not kept up to date when changes are made.
D: Magnetic media degrade.
E: Changes may introduce inconsistencies.

(27) Which of the following statements is a true statement about module structure?

A: Modules must always fit on one page.
B: Modules should have only one entry point.
C: Two programs should be in the same module whenever you would not use one without the other being present.
D: Modules should never terminate abnormally.
E: Two programs should be in the same module if they share design decisions that are likely to change.

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(28) Which of the following statements is ***not*** true of the second modularisation of the KWIC index problem given in "On the Criteria to be used in Decomposing Systems into Modules"?

A: It would be possible to implement the Alphabetiser module in such a way that ITH is a very slow program.
B: It would be possible to implement the Alphabetizer module in such a way that ALPH is a slow program.
C: All superficial changes in the format of the input could be accommodated by changing only the INPUT module.
D: It would be possible to build the original system without using DELINE and DELWRD from the Line Storage module.
E: One could use a symbol table module within the Line Storage module but only if you make a change to at least one other module.

(29) Which of the following positions ***is*** taken in the readings on modularisation?

A: It is important to make sure that all programmers memorise the formats used in files or other "persistent" data structures.
B: If A and B are programs and A always calls B, A and B should be in the same module.
C: Programs that change the values in a data structure should be in a different module from those that return values derived from the data structure.
D: If two programs are identical, they should be kept separate but part of the same module.
E: None of the above.

(30) Which of the following is ***not*** one of the reasons given (in your readings) to design programs that can be easily extended and contracted?

A: Programs designed for extension and contraction are easier to test during development.
B: We want to be able to squeeze a system into a small memory so we can sell it to people with older or cheaper computers.
C: We want it to be easy to add features to keep ahead of the competition.
D: We want to help the economy by selling upgrades that will force customers to buy newer, bigger and faster computers.
E: We want to have a subset that we can deliver to a customer when we said we would deliver.

(31) Building software as layers of virtual machines is a good idea because:

A: virtual machines are cheaper than real ones.
B: virtual machines use less power than real ones.
C: virtual machines are more convenient than real ones because they abstract from certain details.
D: middle layers can be removed just by renumbering the levels.
E: none of the above.

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(32) If we have two programs A and B, which of the following is ***not*** required if A is to be allowed to use B?

A: A should be simplified because it uses B.
B: There should be a useful subset with B and without A.
C: B should not be more complex because it cannot use A.
D: There should be no useful subsets having A and not B.
E: B should be more usable than A.

(33) In the major example in "Designing Software for Extension and Contraction", OUTADSEL is a level above INAD because:

A: outputs are more important than inputs in requirements analysis.
B: OUTADSEL uses OUTAD and INAD uses nothing.
C: you cannot output data unless you have read it in first.
D: the address output module is placed at a higher level than address input.
E: OUTAD has to use the address storage module.

(34) In this question, if "E" is true, you must choose "E".
Which of the following is ***not*** a good guideline for module design?

A: It should be possible to change one module without changing others.
B: Modules should not have nested loops.
C: Design decisions that are highly likely to change should be "known" to only one module.
D: None of the above.
E: All of the above (except D).

(35) Which of the following statements is true?

A: If you have a module guide, you don't need module specifications.
B: The module guide reveals the implementation decisions for each module.
C: The module guide sketches the interfaces for each module.
D: The module guide should contain precise interface specifications for all of the modules.
E: None of the above.

(36) In the A-7 structure described in your notes:

A: the Hardware Hiding Module hides the information to be displayed.
B: the Behaviour Hiding Module hides the behaviour of special purpose devices.
C: the Software Decision Module hides the algorithms used in physical models.
D: the Behaviour Hiding Module hides key facts about human behaviour.
E: none of the above.

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(37) In the A-7 software, the interface to Extended Computer Module would be changed if:

A: the computer was extended by adding a floating point co-processor.
B: the computer was replaced by a clone with faster circuitry.
C: it was decided to use a double precision variable to represent altitude instead of a normal precision variable.
D: it was decided to replace the Air Data Computer.
E: none of the above.

(38) In the A-7 software, mode definition tables are "shared" because:

A: mode definitions affect more than one function driver.
B: mode transition programs are very frequently used.
C: mode definitions must be known to both pilots and programmers.
D: modes affect many device interface modules.
E: none of the above.

(39) In the A-7 software, the Physical Model module:

A: calculates the trigonometric functions to use in navigation.
B: calculates altitude given the air pressure.
C: simulates wind tunnel behaviour.
D: would have to be changed if the U.S. Navy had more women pilots.
E: none of the above

(40) In the A-7 software, if the HUD (Head Up Display) device was replaced with one that permitted the symbols to be shown in four colours, exploiting this might require changes in:
(note: If D is true you must pick D.)

A: the HUD Device Interface Module.
B: the HUD Function Driver Module.
C: the Human Factors Module.
D: all of the above.
E: none of the above.

(41) In the THE Multiprogramming System:

A: deadlock was prevented by operator intervention.
B: semaphores could be created when needed and deleted when not needed.
C: the semaphores could be paged in and out like all other data.
D: level 2 could not be used if the drum had broken down.
E: none of the above.

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(42) In "The Mythical Man Month", Fred Brooks states that:

A: more projects have gone awry for lack of calendar time than all for other causes combined.
B: you must be unusually optimistic to be a good programmer.
C: when you partition tasks, do so in such a way that there need be no information shared between the programmers.
D: dividing a program into parts to be constructed separately will increase costs.
E: software is best written by a lonely individual without interference.

(43) In the early part of his book, Brooks suggests that you should plan to build a prototype and then discard it and start over. Later he concludes that this advice (given 20 years earlier) was wrong. The reason that he gives is:

A: your boss or customer will not let you throw it away.
B: if you build a system with the intent of discarding it, you learn how to build systems that should be discarded.
C: it is better to use an incremental building technique with each new extension tested before you add to it.
D: the second system might be worse than the first.
E: none of the above.

(44) When well designed software projects run out of time, the best thing to do is:

A: ask for a small extension in time.
B: skip testing.
C: hire someone new to write the documentation.
D: eliminate programs that are low in the uses hierarchy from the first release.
E: eliminate programs that are high in the uses hierarchy from the first release.

(45) The "ideal" software design process is one in which the design is derived from a clear statement of requirements. Which of the following is ***not*** one of the reasons for the fact that this process is seldom followed in real software developments?

A: It is difficult to find out all of the requirements at the start of a project.
B: The developers think the requirements are obvious and don't write them down.
C: People want to reuse or extend previously written software that may not be ideal for the new requirements.
D: People find it easier to write code than to describe requirements precisely.
E: None of the above.

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(46) Which of the following would be a secret of a hardware hiding module designed to make it easier to replace terminals in a computer system with newer hardware.

A: Whether the messages are displayed in English or French.
B: The space between the buttons on the keyboard.
C: Whether or not windows are allowed to overlap
D: How to display an “8” at a given point on the screen.
E: Where to display an “8” on the screen.

(47) Which of the following would Fred Brooks now agree with:

A: Information Hiding is a recipe for disaster.
B: When you add new functions to a system, you will increase its complexity.
C: A conceptually integrated system will be slower to build but faster to test.
D: Interface design and implementation can proceed in parallel.
E: None of the above.

(48) In this question, if D is true, choose D.
A well-structured telephone system offers its operators a choice of messages in English and French. Because of foreign sales, they want to add Chinese using both traditional and simplified characters. This might affect:

A: the Device Interface Module for the operator terminals.
B: the Function Driver Module.for the operator terminals.
C: the amount of storage needed.
D: all of the above.
E: none of the above.

(49) In “The Mythical Man Month”, Fred Brooks states that:

A: Dividing a program into modules will increase costs.
B: You must be unusually pessimistic to be a good tester.
C: The “architect” should specify programs and then instruct the programmer about how to implement the specification.
D: It is impossible to accurately estimate the time and effort that a software project will require.
E: None of the above.

(50) When he says “plan to throw one away” Brooks means that:

A: you will always fail the first design review; count on it.
B: your first attempt at a product may turn out to be the prototype for the product you sell.
C: you won’t get it right the first time so don’t try.
D: most of the documentation will not be used and can be discarded.
E: none of the above.

THE END