Final Exam Study Guide

Logistics

Review Tips

In order to have a successful exam, the student should do the following:

- Review lecture slides and class notes [by Prof. Mohan] in google drive folder and the student’s class notes.
- Clear browser cache and get new slides before the exam. There might be some changes that will not show if you do not clear cache and download a new copy of the slides.
- Go through the reading assignments at the end of each slide, and read the textbook chapters. You can skip topics that were not discussed in class.
- Go over the Class activity exercises
- Go over the Lab assignments
- Go over the Quizzes

Exam Format

- Paper based
- Questions will be aimed at basic understanding of concepts and the ability to apply them in concrete examples.
- Question types may include one or more from the following:
  1. Short answer (may require writing programming statements, draw circuit diagrams, analyze circuit design, and/or boolean algebra simplifications and theorem proving, and writing descriptive answers through diagram illustration.)
  2. True/false
  3. Multiple choice
  4. Fill in the blanks
- You will not be asked to write whole programs; however, you have been exposed to a number of concepts through C programming language. There might be questions that would ask you to write part of the program, such as developing new functions.).

Additional Details

- Exam is on: 12/13/2018 7:00 PM - 10:00 PM at Alden 109. The submissions after 10:00pm will be penalized for lateness (unless you have special arrangements). If you plan to be late to the exam starting time, you must let me know in advance.
There would be three booklets given to you during the exam. The first is a question booklet, that contains the list of questions in the exam. The second is an answer booklet, where the students are expected to write their answers to the questions given in the exam. The third is an outline document, that provides an outline to the attributes of right answers. At the end of the exam, it is the responsibility of the student, to combine all the three sections of the student’s exam using a paper clip provided and return back the exam to Prof. Mohan. After grading completion, the graded answer booklets would be returned back to the student.

The exam will be closed [notes, lecture slides, textbook, other teaching materials, and NO internet].

However, you may use one 8 1/2 by 11 sheet of paper with any information on it you wish. You need to include your resource sheet with your exam as part of the submission. You may not use a microscope or microform reader to read your one sheet of paper. A basic calculator may be used during the exam.

I highly recommend you use a black pen (preferably Pilot G-2) for writing your answers during the exam. Please note, it is very difficult for me to read the pencil writing and hence there might be a chance for inaccuracy while grading.

It is better to give part of an answer than to leave a question blank. No partial credit can be given for wrong answers if there is no accompanying work. If you leave a question blank, then there will be no points awarded to the question.

Add necessary justification to your answer, if your understanding of the question deviate from the actual question. This rule also applies to multiple choice questions. I may give you partial credit or even full credit, based on how good you have justified your answer.

I recommend preparing well for the final exam, as this is going to be 20% of your final grade as per our course syllabus.

I would strongly encourage you to make use of my office hours, to discuss and/or clarify any topic related to the course.

**Topics covered**

The exam will cover all material discussed in this semester, up through Datapath’s. The main topics covered so far are:

- Introduction to C
  
  **KR: Chapter 01 → 1.1 - 1.5**

- Performance Assessment
  
  **PH: Chapter 01 → 1.1 - 1.5**

- Arrays in C
  
  **KR: Chapter 01 → 1.6**

- Functions in C
  
  **KR: Chapter 01 → 1.7; Chapter 04 → 4.1 - 4.3, 4.5, 4.9 - 4.10**

- Revisiting Performance
  
  **PH: Chapter 01 → 1.10**

- Internal representation of Data
  
  **PH: Chapter 02 → 2.4; Chapter 03 → 3.1 - 3.4**
• Pointers and Structs in C
  
  KR: Chapter 05 → 5.1 - 5.2; 5.6 - 5.9; 5.11; 6.1 - 6.4

• Basic Gates
  
  Principles of Computer Hardware by Alan Clements Chapter 02 → 2.1 to 2.3

• Boolean Algebra
  
  Principles of Computer Hardware by Alan Clements Chapter 02 → 2.5

• KMaps
  
  KMaps rules external document provided in the lecture 15 folder. This can be accessed through the course webpage, by clicking on 11/01/2018 google drive folder.

• Combinational Logic
  
  Principles of Computer Hardware by Alan Clements Chapter 02 → 2.6; PH: Appendix B → B.3

• Sequential Logic
  
  Principles of Computer Hardware by Alan Clements Chapter 03

• MIPS Instruction Set Architecture
  
  PH: Chapter 02

• Processor Datapath
  
  PH: Chapter 04 → 4.1 - 4.3

Exam Prep Guide

Here are examples of the *kinds of questions* that might be asked. This is not intended to be a sample exam; the topics covered below are not intended to be an exhaustive review. In particular, knowing the answers to all the questions below will not guarantee a good grade on the exam! The page numbers provided below, refers to the page number shown in the footer of each slides.

1. Explain different stages of compilation that a C Program goes through? A diagram illustration may be required to show the data flow from step to another.

2. Define Amdhal’s law

3. Define Moore’s law and state how can one reduce the impact of the outcome of this law?

4. Given some performance metrics of a CPU, such as CPI, no of instructions, and the execution time, determine the clock rate of the CPU in GHz. Note: GHz is giga Hz, which is $1 \times 10^9$ Hz.

   Look at other performance problems in our lecture slides, and lab assignment. For example Exercise 1.7 on page 56 (Lab 02 part 1 question).

5. Let us assume that we are trying to speedup the execution time of the CPU, with a list of metrics defined in the problem. Applying amdhal’s law, determine the new execution time. Look at the problems discussed in our lecture 07 lecture slides [Page 9 -11]. It is important you spend some time on performance problems. There are at least two questions in the exam that would ask you to evaluate performance metrics.

6. Given a number in one format, apply the [number conversion procedures] to find the equivalent number in another format. For example:

HANDED OUT ON Dec 6th, 2018
(a) Binary to Decimal
(b) Decimal to Binary
(c) Binary to Hexadecimal
(d) Hexadecimal to Binary
(e) Decimal to Hexadecimal
(f) Hexadecimal to Decimal
(g) Fraction binary to decimal
(h) Fraction decimal to binary

All of these conversion procedures, will be tested in some level or the other during the exam. So in order to be successful, I would recommend including the procedure outlines in your 8 1/2 by 11 resource sheet. In this way, you don’t need to fully rely on your memory power.

7. Given a set of numbers apply binary operations using addition and/or subtraction.

I recommend highly to look the rules of binary subtraction document uploaded to our lecture 08 folder. Practice the examples discussed in class. For example, [Page 07 of lecture 08 slides] and the in-class activity. Refer to other students solutions posted in Slack, to do a self analysis of whether your result is correct. Again, I discussed the cross validation technique, that would make sure your binary result is equivalent to the decimal equivalent. The cross validation approach discussed in class is available through my lecture notes. Always try to look at my lecture notes if you are stuck and need any additional clarifications.

8. Given a set of numbers apply binary operations using multiplication. I am not going to ask you to include the manual multiplication results in the exam. That is not to the best interest of this CS200. What we would want to know is how machines do the multiplication? Look at the flowchart on Page 13 on lecture 08 folder slides. Additionally look at the examples discussed in class, for example the solution in page 13 and page 15 of lecture 08 folder slides. However, it is also true that as a cross validation, you may use the manual approach to check if your final output is correct. But there will be no points given for the manual solution, it just make sure that your final answer is 100% correct and assure that you would get the full points for the question.

Try out the in-class exercise given in class Page 16 of lecture 08 folder slides. In the exam you would typically have a table where you would fill out the **Multiplicand**, **Multiplier**, and **Product**.

Look at the theory of binary multiplication Page 17 of lecture 08 folder. Similar to the quiz there might be question asking you to verify if the given `X` bit register, will be sufficient to hold the product of two `X` bit numbers.

9. Given a positive number, how do you best represent them as a negative number. For example, there are techniques such as 1’s complement, 2’s complement, and Signed magnitude that could be used to represent a negative number in binary.

Do all the try out exercises given on page 23 of the lecture 08 slides.

10. Given an existing program with function calls implemented in C, analyze the code and say if the code works or not. For example, I recommend looking back at the in-class exercise on swapping three numbers and implementing basic sort technique. Practicing the same using a function and more specifically with the notion of a caller and a called function would be helpful.

11. C program to implement a function that converts either a lowercase to uppercase or vice versa.

12. Given two array of strings (character array’s), analyze the data and find interesting patterns of correlation between the data items in the array. For example, in lab 02 and lab 03 assignment, the requirement was to implement a palindrome checker. This will check if both strings are equal after reversing the strings. And in Lab 03, this was done using recursion. I recommend highly to look at your lab work, the lecture slides, and the lecture notes to learn how arrays are implemented in C.
13. Explain difference between a Struct and an Array?

14. Explain difference between a variable length array and a dynamic array in C?

15. State some examples of creating a dynamic 2d array in C with the use of malloc keyword?

16. C program to implement a function that uses pointers and dynamic arrays to implement a dynamic data structure such as a matrix, and find max and min in each row and/or column.

17. Laws of boolean algebra:
   - State Demorgan’s law with an example?
   - State Associative law with an example?
   - State Distributive law with an example?
   - State Commutative law with an example?

18. Boolean Algebra:
   - What are the different ways that we had discussed, to represent a boolean logic?
   - Given a boolean algebra theorem, prove it by applying the axioms, laws, identity, and negation rules.
   - Given a boolean algebra expression, simplify it by applying the axioms, laws, identity, and negation rules.
   - Given a boolean expression, simplify it using Karnaugh Maps. There will be atleast one question on Karnaugh Maps, so I recommend highly to review the lecture notes, KMaps rules reference document, and to look at class examples.

19. State an application of XOR gate, by providing the proper circuit diagram.
   You may be asked to analyze a circuit and say what it is supposed to do!

20. Combination Logic:
   - Show the visual representation of a half adder, by drawing the circuit diagram along with clearly providing the truth table.
   - Show the visual representation of a full adder, by drawing the circuit diagram along with clearly providing the truth table.
   - Show the visual representation of a 4-bit full adder, by drawing the circuit diagram.
   - State the difference between a multiplexer and a demultiplexer. What are some of the applications? you may be asked to draw the circuit diagram for mux (multiplexer) and demux (demultiplexer).

21. Sequential Logic
   - What is a Latch?
   - What is a register?
   - How is a clocked flip flop different from a latch?
   - Show the visual representation of a RS flip flop, by drawing the circuit diagram along with clearly providing the characteristics table.
     You may be asked to analyze the flip flop and identify the outputs for the different input combinations and show the derivation.
   - Show the visual representation of a Clocked RS flip flop, by drawing the circuit diagram along with clearly providing the truth table.
     You may be asked to analyze the flip flop and identify the outputs for the different input combinations and show the derivation.
   - Design JK flip flop with the circuit diagram and the characteristics table. What are some of the limitations of RS flip flop that is addressed by JK flip flop?
• Design Master Slave flip flop with the circuit diagram and the characteristics table. Derive the characteristics table. What are some of the limitations of JK flip flop that is addressed by Master Slave flip flop?

22. Assembly language programming

• Why should one do Assembly language programming?
• What are the different types of instruction in MIPS? **R-format, I-format, J-format**
• Given MIPS code snippet, analyze the code and tell what the code is trying to do?
• How does Arrays work in MIPS? Review the MIPS array code discussed in class;
• Printing a list of elements in an array? Review class activity solution uploaded in lecture 19/coding03 folder.
• How to do you reverse a string and print in MIPS? Review your lab solution.
• Realization of processor data path; Given a MIPS instruction such as:
  add $t1, $t2, $t3
  Identify the processor data path by listing the various steps taken during the path.
The topics listed in the Topics Covered section covers all the material covered in the Finals. However, the above listed items is not a full review! (For example, I will ask at least one question on binary division.) Given two numbers, apply the binary division operation on those numbers and show the quotient and remainder result. For example, let us say you are trying to divide $12/5$, this leads to $1100/0101$ in binary. The typical result of this binary division operation, will include a quotient $[0010]$ and a remainder $[0010]$. Again, I am not going to ask you to include the manual division results in the exam. That is not to the best interest of this CS200. What we would want to know is how machines do the division? Look at the flowchart on Page 11 on lecture 09 folder slides. Additionally look at the examples discussed in class and posted in the lecture 09 folder. There are two examples that was discussed in class and the solution for both of them is uploaded to the lecture 09 folder slides. In the exam you would typically have a table where you would fill out the Operation Type, A, Q, M, and Count. You may also include your calculations which was used to fill the table at each phase. I recommend practicing exercise problem, on page 13 on lecture 09 folder. Please come to Tuesday’s class prepared to ask questions.