

CS 2200 Spring 2021 HW 01

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Due 2021-02-02 at 11:59 PM

Submit your assignment as a single PDF file with that includes all the answers to the individual questions, all pictures, all code, all code output, and anything else that you need to include to support your answers. This should all be well-organized and attractively laid out.

If you need a program that helps you put PDF files together into a single PDF file, try <http://www.pdfsam.org/>. The program there is open source and available for free.

1. (30 points) Read the handout about the Abacus and Roman Numerals that is in the HW01 folder on Canvas. It comes from <http://ds-wordpress.haverford.edu/bitbybit/wp-content/uploads/2012/07/Abacus-and-Roman-Numerals.pdf>. Please do not search for answers on the Internet. Read the handout and try to work out the answers. You can certainly do this. Use this as an opportunity to stretch your brain and understand the difficulties that your ancestors went through to build the world that you live in.

Write a program that adds decimal numbers using the abacus. The program should not just simply convert everything to decimal and use the decimal addition capabilities of the computer. It should do addition in a way that mimics how a person would use an abacus. Here are more details about the program you are to write.

- (a) The program should be well commented.
- (b) The abacus should have 13 columns like the abacus pictured in the handout.
- (c) The program should take two numbers written in standard decimal notation having up to 12 digits each and load them onto the abacus.
- (d) For each number you should “draw” pictures of the abacus using ASCII art, i.e., blanks, small “o”, and the - character. For example the arrangement below represents the number 17. Your figures should display the full 13 columns of the abacus.

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o  o  o
o  o

```

```

      o
-----
o  o
o

```

```

o
o  o
o  o  o
o  o  o
o  o  o

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- (e) When adding on an abacus, it is easiest to go left to right rather than right to left as you are taught in school. For more examples and information on how to add with an abacus see wikihow.com/Use-an-Abacus.
 - (f) The addition should use the stones in the top and bottom of the abacus and handle carries correctly.
2. (10 points) Carry out the following additions using your abacus simulator. Be sure to display the abacus view of each input number and the output number.
 - (a) (2 points) $54321 + 90678$
 - (b) (4 points) $559876543210 + 27623428724$
 - (c) (4 points) $127002343627 + 23412876241$

3. (20 points) Read the handout about the Abacus and Roman Numerals that is in the HW01 folder on Canvas. It comes from <http://ds-wordpress.haverford.edu/bitbybit/wp-content/uploads/2012/07/Abacus-and-Roman-Numerals.pdf>. Please do not search for answers on the Internet. Read the handout and try to work out the answers. You can certainly do this. Use this as an opportunity to stretch your brain and understand the difficulties that your ancestors went through to build the world that you live in.

Write a well-commented program that adds and subtracts numbers directly in Roman Numerals. Here are more details.

- (a) The program should accept inputs as Roman numerals.
- (b) Nowhere in your program are you allowed to convert from Roman numerals to integers.
- (c) The output should be correctly written in Roman numerals.
- (d) The program should be able to spot incorrectly written Roman numerals and output an error message if given an incorrectly formatted Roman numeral.

- (e) The program should be able to subtract any Roman numeral from any larger Roman numeral. Since the Romans did not have 0, there is no way to represent the result of subtracting a number from itself.
 - (f) There is no way to represent negative numbers so the program must give an error message if you try to subtract a larger number from a smaller number.
4. (10 points) Run the following problems using your Roman numeral program.
- (a) (2 points) $CXCV + XXXI + LXXXVIII$
 - (b) (2 point) $(CCCXCV - CXV) - LXX$
 - (c) (2 point) $CCMCCCII + MLCLCIII$
 - (d) (4 points) Suppose you wanted to multiply $MMDXLVII$ by $CMCLVII$ using only Roman numeral operations. Explain how you would approach the problem and whether you could efficiently solve it. Speculate on whether the Romans could have had the Scientific Revolution happen in their country given their ability to compute.
5. (10 points) Read the Wikipedia article on the slide rule. Print a copy of the semilog paper that is included in the HW01 Folder. Label the right edge and cut a strip off the right side of the paper. Put the cut-off piece next to the remainder and use it as a slide rule. The photos in Figures 1 and 2 below show how to compute the product of 2.5 and 4.5 which is 11.25

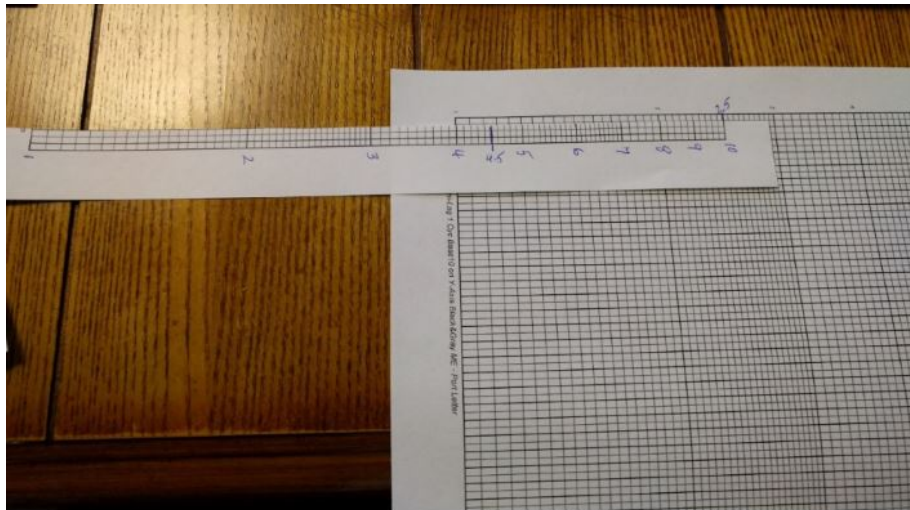


Figure 1: A Simple Paper Slide Rule

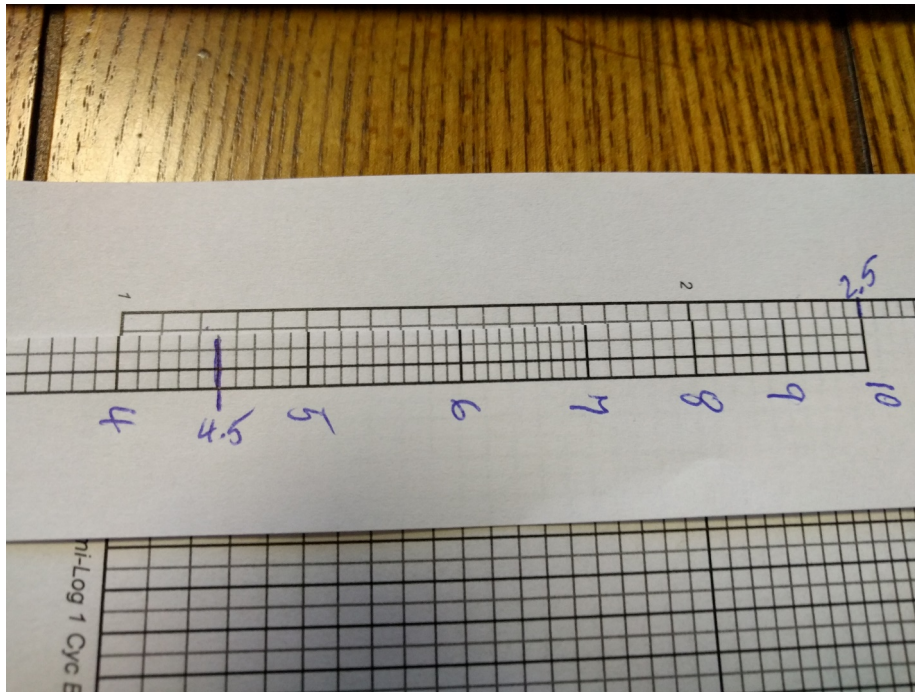


Figure 2: A Closeup of the Simple Paper Slide Rule

Use your slide rule to compute the product of 44.98 and 3127 as accurately as you can. Include a photo of your slide rule that looks like the photo above. Also, make sure to write your name on the slide rule so it is visible in the picture.

6. (10 points) Read the Wikipedia article on Napier's Bones. Create a set of Bones using cardboard or paper. Show how to compute the product of 9×2435 and produce a photo of your version of Napier's Bones with the correct result shown in the picture. Make sure that your name is visible in the photo.
7. (10 points) Read the handout called "50 Years of Army Computing" and answer the following questions:
 - (a) (2 points) In what sense was ENIAC a personal computer?
 - (b) (2 points) How much memory did ENIAC have?
 - (c) (2 points) How common were subroutines in ENIAC programming?
 - (d) (2 points) What does BRL stand for?
 - (e) (2 points) Why do punched cards need to be used in air conditioned areas?