Deadline: September 18, 8pm eastern

CS1802 Recitation 1

Fall 2020

September 15-18, 2020

Instructions: The problems in this recitation are based on the course material covered in the CS1800 lecture videos and are meant to prepare you for upcoming homework assignments. You earn full credit for a recitation by using your time well and demonstrating effort on the assignment. Submit your solution on Gradescope by uploading images of hand-written work, or uploading a PDF.

Logistics for Fall 2020: The recitation assignments are designed to be completed within the official 65-minute time. However, we know that schedules are harder to work with this semester, and so the deadline for recitations will officially be on Fridays at 8pm eastern. We recommend submitting your work in real-time at the end of your section, but it's OK if your preference is to submit later as long as you meet that last deadline.

- In-person: If you're able to join in-person, please come to the classroom where instructors will be there to help. Work on the assignment, ask us questions, and submit whatever you have when time is up.
- Synchronous, remote: If you're not able to join in-person but you can remotely join at the designated time, please join the recitation remotely. Work on the assignment, post any questions in the meeting chat, and submit whatever you have when the time is up.
- Asynchronous, remote: If you're both remote and not able to join in real-time, we suggest you register for the asynchronous online section. Dedicate 65 minutes to work on the assignment, and submit your solution by the Friday deadline.

Question 1.

Write down the 4-bit binary numbers from 0 to 15. In decimal, we can tell if a number is even or odd based on the rightmost digit – multiple of 2? Cool, must be even. How about with binary – how can we tell, at a glance, whether a binary number represents an odd or an even number?

Question 2.

Convert the following unsigned numbers to base 10. In other bases, when we run out of digits 0-9, we start using letters of the alphabet, A = 10, B = 11, and so on:

101110010_2
257_8
$2A8_{11}$
$EF2_{16}$

Question 3.

(a) Convert the (unsigned) decimal number 109_{10} to binary.

(b) Convert the (unsigned) decimal number 63_{10} to binary.

Q: Why do computer scientists celebrate Halloween on Christmas?
A: Because oct-31 is the same as dec-25 hahahahaha!!!!!! Is that actualy true ?

Question 4.

Suppose you have 5 bits to represent binary numbers in two's complement format.

(a) What is the highest number you can represent? Answer with a decimal (base 10) number and then express it in 5-bit two's complement.

(b) What is the lowest number you can represent? Answer with a decimal (base 10) number and then express it in 5-bit two's complement.

(c) How many total values can you represent?

Question 5.

Convert each decimal number below to 7-bit two's complement, perform the arithmetic indicated, and tell us the final answer in 7-bit two's complement.

(a) $13_{10} + 10_{10}$

(b) $5_{10} - 28_{10}$

(c) $-8_{10} - 11_{10}$

Question 6.

Prince Humperdinck has been presented with 127 bottles of wine, but one of them has been poisoned(!) with iocane powder. 7 members of the Brute Squad volunteer to sacrifice themselves to find the poisoned bottle. The poison has absolutely no effect on the drinker until exactly 24 hours later, when you instantly drop dead.

In other words, the Prince has 24 hours hours to discover a poison that takes 24 hours to take effect. He doesn't mind if Brute Squad members die. How can he use the 7 to find the poisoned bottle?

★ problems are optional and difficult, to try at home.
Part B ★★ Same problem, but up to 3 bottles might be poisoned - that is, the number of poisoned bottles can be 0, 1, 2, or 3. How many volunteers we need, and how do we assign them to drink from bottles, in order to identify exactly which bottles are poisoned?

Part C ★★★ Same problem as in part B: up to 3 bottles might be poisoned. But now the volunteers die quickly, so the Prince can design an adaptive strategy:
Use first voluneter to drink from a certain set of bottles and wait 5 min to see if he dies;
Depending on result dead/alive for that, same/another volunteer is assigned to a certain set of bottles with result dead/alive in 5 min
and so on.
What is the strategy now, and how many voluneteers are needed to be sure we find the poisoned bottles?