# CSI 30 LECTURE NOTES (Ojakian)

## Topic 9: Binary and Other Base Numbers

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**OUTLINE**

(References: 4.2, 4.1 (part) )

1. Binary and other base numbers

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1. Number Systems
   (a) Many number systems have base
   (b) Will see application of binary and hexidecimal to computer memory
   (c) Recall meaning of places in decimal
2. Quotient and Remainder (4.1)
   (a) Division Algorithm (Theorem 2, Section 4.1 p. 253)
      i. Quotient and Remainder
      ii. Examples (include negative ones like example 4)
   (b) Quotient: use "//" (like Python)
   (c) Remainder: use "%" (like Python). Book uses: "mod" (confusing with other use of mod). Other books: "rem"
   (d) Examples. Section 4.1: 13, 14.
3. Binary Numbers
   (a) Convert Binary to Decimal
   (b) Convert Decimal to Binary
      i. Divide $N$ by 2 and record the remainder
      ii. Make the quotient the "new $N$" and repeat the division by 2
      iii. Stop when the quotient = 0
4. Any Base Numbers
   Choose base as integer that is 2 or larger.
   (a) Convert Base b to Decimal (like above for binary, but powers of $b$)
   (b) Convert Decimal to Base b (like above for binary but divide by $b$)
5. Adding Any Base Numbers
   (a) Recall for decimal.
   (b) Do the same for other bases.

6. Applications: Computer memory

   (a) A byte in memory takes up 8 bits.

   (b) Each byte has an address: just a number, often in hex.

   (c) Byte addresses are arranged contiguously.

   (d) Exercises

      i. Some data's address is $30A1$ in Hex. What is the address in binary?

      ii. Some byte is at address $E0A8$. What is the address of the next byte? What is the address of the byte after that?

      iii. Some data spans 4 bytes of memory (an "int"), starting at address $F14AE$. What are the addresses of the 4 bytes occupied by this data?

      iv. Some data spans 8 bytes of memory (a "double"), starting at address $10FD$. What is the last address for this data?

7. Exercises

   Section 4.1: 13, 14

   Section 4.2: 1 - 4, 7 - 12,

   Section 4.2: 21 - 24 (just do sums)