CS 5/7350
Quiz #2 Due Feb 22 for Completion Grade

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1. [1.5 pts]Determine a Huffman encoding for each symbol in a message that contains: 11
   20 As,
   10 20 Bs,
   011 7 Ds,
   010 7 Es,
   0011 3 Fs,
   0010 3 Gs,
   0010 2 Hs,
   0000 2 Ks,

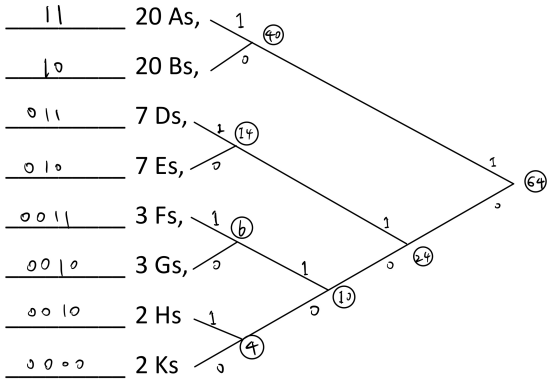
   How many bits are in the entire message if each symbol is encoded with 3 bits?

   Solution:

$$(20 + 20 + 7 + 7 + 3 + 3 + 2 + 2) \times 3 = 64 \times 3 = 192\ bits$$

   How many bits are in the entire Huffman coded message?

   Solution:



$$(20 + 20) \times 2 + (7 + 7) \times 3 + (3 + 3 + 2 + 2) \times 4 = 80 + 42 + 40 = 162\ bits$$

2. [2 pts] You run different programs for various value of "n" and create 4 tables of the run-times. Given the Asymptoitc bounds that each of the tables support?

a. n	time(ms)	b. n	time(ms)	c. n	time(ms)	d. n	time(ms)
1000	2120	1000	58913	100	21564	52	20
2000	4120	2000	60913	200	81564	53	60
3000	6120	4000	62913	300	181564	54	180
4000	8120	8000	64913	400	321564	55	540
5000	10120	16000	66913	500	501564	56	1620
6000	12120	32000	68913	600	721564	57	4860
7000	14120	64000	70913	700	981564	58	14580
8000	16120	128000	72913	800	1281564	59	43740
9000	18120	256000	74913	900	1621564	60	131220
10000	20120	512000	76913	1000	2001564	61	393660

Solution:

(a) $\Theta(n)$.
$\frac{10000}{1000} = 10, \frac{f(10000)}{f(1000)} = \frac{20120\ ms}{2120\ ms} = 9.49056603773585 \approx 9.5 \approx 10$

(b) $\Theta(log(n))$
$\frac{f(512000)}{f(12800)} = \frac{76913\ ms}{72913\ ms} = 1.0548599015264768 \approx 1.1 \approx \frac{\log_2(512000)}{\log_2(128000)} = \frac{18.96578428}{16.96578428} = 1.1$

(c) $\Theta(n^2)$
$\frac{1000}{100} = 10, \frac{f(1000)}{f(100)} = \frac{2001564\ ms}{21564\ ms} = 92.81969949916528 \approx 9.59^2 \approx 10^2$
$\frac{900}{300} = 3, \frac{f(900)}{f(300)} = \frac{1621564}{181564} = 8.931087660549448 \approx 9 = 3^2$

(d) $\Theta(3^n)$
$61 - 60 = 1 \frac{f(61)}{f(60)} = \frac{393660}{131220} = 3.0000685871056243 \approx 3^1$
$60 - 58 = 2 \frac{f(60)}{f(58)} = \frac{131220}{14580} = 9 = 3^2$

3. [1 pts] What is $(-\frac{1}{4})$ *modulo* 7?

Solution:

$ab \bmod 7$ (a \ b)	0	1	2	3	4	5	6
0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6
2	0	2	4	6	1	3	5
3	0	3	6	2	5	1	4
4	0	4	1	5	2	6	3
5	0	5	3	1	6	1	2
6	0	6	5	4	3	2	1

$$\because (4 \times (-\frac{1}{4}))\%7 = -1\%7 = 6, (4 \times 5)\%7 = 6$$
$$\therefore (-\frac{1}{4})\%7 = 5$$

4. [1 pts] Two people need to establish a secret key for encrypting communications. They agree to use a Diffie-Hellman key exchange with a modulus of 11 and decide on 2 as the base. Person A chooses a random value performs the appropriate computations and sends the value 6 to person B. Person B chooses a random value of 3 and performs the appropriate computations:

(a) What is the value Person B sends to Person A

Solution:

$$B \rightarrow A : 2^3 \bmod 11 = 8 \bmod 11 = 8$$

(b) What is the shared secret key between Person A and Person B

Solution:

$$(A\ sends\ to\ Person\ B)^3 \bmod 11 = 6^3 \bmod 11 = 216 \bmod 11 = 7$$