Michael Kohn
CS 570: HW1

1a Binary addition

```
  1 1
  1100110
+ 1010111
----------
 10111101
```

binary addition table

0 + 0 = 0
0 + 1 = 1
1 + 1 = 10
1 + 1 + 1 = 11

Check
$1100110 = 2^6 \times 1 + 2^5 \times 1 + 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 102$
$1010111 = 2^6 \times 1 + 2^5 \times 0 + 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = 87$
$10111101 = 1 \times 2^7 + 0 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 189$

check passes!!

1b binary division

```
  00111110   R=01
11|10111101
 -11
  101
  -11
   101
    11
   100
   -11
     11
     11
     01
```

check:
$1 \times 2^7 + 0 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = 187$

```
  62 R1
3|187
 18
 --
 07
  6
  -
  1
```

$1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 62$
$1 \times 2^1 + 1 \times 2^0 = 3$
$R\ 01 = 1$

check passes!!

answer:

```
  00111110   R=01
11|10111101
```

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2 A test document is 15 pages long. Each page contains approximately 200 words with an average word length of 5 characters. Assume one blank space between words and no punctuation. How many bytes will it take to store this document in memory or on disk using ASCII?

ASCII = 1 byte per character

Get total characters and multiply by byte per character

total characters

$$15 \text{ pages} \left(200 \frac{\text{words}}{\text{page}}\right)\left(5 \frac{\text{chars}}{\text{word}}\right) = 15{,}000 \text{ chars}$$

200 words/page means 199 spaces/page

$$15 \text{ pages} \left(199 \frac{\text{spaces}}{\text{page}}\right) = 2985 \text{ spaces}$$

Spaces are ASCII characters, so 2985 spaces = 2985 chars

total characters = 15,000 + 2985 = 17,985

$$17{,}985 \text{ chars} \left(1 \frac{\text{byte}}{\text{char}}\right) = 17{,}985 \text{ bytes}$$

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3 Create the truth table for:

$(P \wedge \neg Q) \vee (P \vee Q)$ $A_1 = P \wedge \neg Q$ $A_2 = P \vee Q$

truth table A_1

P	Q	$\neg Q$	P	$\neg Q$	$P \wedge \neg Q$
F	F	T	F	T	F
T	F	T	T	T	T
F	T	F	F	F	F
T	T	F	T	F	F

truth table A_2

P	Q	$P \vee Q$
F	F	F
T	F	T
F	T	T
T	T	T

$A_1 \vee A_2$: Final truth table

F	F	F
T	T	T
F	T	T
F	T	T

4 Create truth table for the formula:
$(\neg P \vee \neg Q) \wedge ((R \wedge Q) \vee (P \wedge \neg R))$

$A_1 = \neg P \vee \neg Q$ $A_2 = R \wedge Q$ $A_3 = (P \wedge \neg R)$
$A_4 = A_2 \vee A_3$

	P	Q	R	$\neg P$	$\neg Q$	$\neg R$
1	F	F	F	T	T	T
2	T	F	F	F	T	T
3	F	T	F	T	F	T
4	F	F	T	T	T	F
5	T	T	F	F	F	T
6	T	F	T	F	T	F
7	F	T	T	T	F	F
8	T	T	T	F	F	F

	A_1			A_2			A_3		
	$\neg P$	$\neg Q$		R	Q		P	$\neg R$	
1	T	T	1	F	F	1	F	T	
2	F	F	2	F	F	2	T	T	
3	T	F	3	F	F	3	F	T	
4	T	F	4	T	F	4	F	F	
5	F	F	5	F	T	5	T	T	
6	F	T	6	T	F	6	T	F	
7	T	F	7	T	T	7	F	F	
8	F	F	8	T	T	8	T	F	

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CS 570 : HW 2

4 continued

A_1 $\neg P$	$\neg Q$	$\neg P \vee \neg Q$
T	T	T
F	T	T
T	F	T
T	T	T
F	F	F
F	T	T
T	F	T
F	F	F

A_2 R	Q	R A Q
F	F	F
F	F	F
F	T	F
T	F	F
F	T	F
T	F	F
T	T	T
T	T	T

A_3 P	$\neg R$	P A $\neg R$
F	T	F
T	T	T
F	T	F
F	F	F
T	T	T
T	F	F
F	F	F
T	F	F

A_4 A_2	A_3	$A_2 \vee A_3$
F	F	F
F	T	T
F	F	F
F	F	F
F	T	T
F	F	F
T	F	T
T	F	T

answer = $A_1 \wedge A_4$ final truth table

A_1	A_4	$A_1 \wedge A_4$
T	F	F
T	T	T
T	F	F
T	F	F
F	T	F
T	F	F
T	T	T
F	T	F