1 Functions/Options Learned

`Rule (->)`	`ReplaceAll (/.)`	`ReplaceRepeated (//.)`	`MaxIterations`	`Quiet`	`MatchQ`
`Cases`	`ReplaceList`	`Permutations`	`IntegerExponent`	`Module`	`Short`

2 Problems

From electronic text

1. Problem 8.1
2. Exercise 8.1
3. Problem 8.2
4. Problem 9.1
5. Exercise 9.1
6. Problem 9.2
7. Exercise 9.2
8. Problem 9.3
9. Problem 9.4
10. Exercise 9.3
11. Problem 9.5
12. Problem 9.6 (The 6-th input/output pair demonstrated in the book for this problem is not correct. The problem also shows up on page 111. The function `f` is supposed to take an odd number as an input and the book has clearly input an even number, so `f[2^5*3*5*7]` should remain unevaluated. I figured that they accidentally plugged $3n+1$ into `f` instead of n. However, this also couldn't be the case as `2^5*3*5*7` does not equal $3n+1$ for any integer n. I would just completely ignore these two lines. Everything else is correct.)
13. Problem 10.1
14. Problem 10.2
15. Problem 10.3 (The function `Subscript` creates subscripted symbols. Check it out.)
16. Problem 10.4

17. Demonstrate how many "perfect shuffles" (Faro shuffles) you must execute on a standard deck of cards before it returns to its original ordering? See `http://en.wikipedia.org/wiki/Faro_shuffle`.
(Hint: Check out the function ***`Riffle`*** *or* ***`Permute`****.)*

18. Let $[n]$ denote the set $\{1, 2, \ldots, n\}$. Write a function which takes a positive integer n as an input and returns how many permutations of $[n]$ do not have a subsequence abc with $a < c < b$? For example, the permutation `{1,4,8,2,5,6,3,7}` has many such subsequences (e.g. 142 and 263) whereas the permutation `{8,7,6,5,4,3,2,1}` has none. Use the functions `Permutations`, `Cases`, along with `Condition (/;)` to compute the number of permutations which **do** have such a subsequence and subtract this number from $n!$ to obtain the number which don't.

    (a) How many permutations of [8] do not have such a subsequence?

    (b) Produce a random permutation of [8] which does not have such a subsequence. *(Hint: Check out* ***`RandomChoice`****.)*

    (c) Map your function across all integers from 1 to 9 to obtain a list of numbers whose i-th element is the number of permutations of $[i]$ having no such subsequences. What numbers are these? I suspect that many of you will not recognize these numbers, so enter the sequence into the on-line encyclopedia of integer sequences `http://oeis.org/` to find out.

19. Write a function called `Antiderivative` (using multiple definitions) that can find an antiderivative of expressions that are sums of constant multiples of either powers of x or exponential functions with positive base. The function should take two inputs, the first being the function you wish to find an antiderivative for and the second being the variable that you are integrating with respect to. Of course Mathematica contains a built-in function `Integrate` (check it out) which does this already, but that is not the point of this exercise. Test your function on the following examples to make sure they work with the variable x.

    (a) x^2

    (b) 3^x

    (c) $x^2 + 3^x$

    (d) $112 + 4x + 12x^5 + 7^x + 3 * 5^x$

    (e) x^π

    (f) $x^{-1} + x^{-2} + x^{-3}$

    Also verify that the following remain unevaluated.

    (a) x^x

    (b) x^t

    (c) $(-5)^x$

    (d) `Antiderivative[x,2]`