Continuously Assessed Questions (06-11582)

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10 September 2010

Each question is worth 10%. Marks will be awarded for correctness, elegance and efficiency. You have to submit your answers by noon on Tuesday, the 23rd of November 2010. You have to submit both (a) a hardcopy of your answers to the receptionist with an appropriate covering sheet and also (b) an electronic version of your answers to me at either `ard` or `A.R.Diller@cs.bham.ac.uk` as a text file.

(1) A *partition* of a positive integer n is a representation of n as the sum of any number of positive integers. For example, there are seven partitions of 5, namely $1+1+1+1+1$, $1+1+1+2$, $1+1+3$, $1+2+2$, $1+4$, $2+3$ and 5. There are five partitions of 4, namely $1+1+1+1$, $1+1+2$, $1+3$, $2+2$ and 4. Define a function `parts` which returns the list of distinct partitions of n as lists. Thus, for example:

$$\texttt{parts}\ 5 = [[1,1,1,1,1],[1,1,1,2],[1,1,3],[1,2,2],[1,4],[2,3],[5]],$$
$$\texttt{parts}\ 4 = [[1,1,1,1],[1,1,2],[1,3],[2,2],[4]].$$

(2) The RATS (Reverse Add Then Sort) sequence is generated as follows: To obtain the $(n+1)$st member from the nth, reverse the nth element digit by digit, thus 145 would become 541, then add the nth element to its 'reversed' version, then treat this sum as a list of digits and sort it into non-decreasing order and then turn it into a decimal number. For example, the seventh RATS number is 145, therefore the eighth is 668. The Reverse Add step is $145 + 541 = 686$. The Sort step then gives the result 668. Define an infinite list `ratlist` in Haskell which contains all the RATS numbers. The first RATS number is 1, thus the first few elements of `ratlist` are: 1, 2, 4, 8, 16.