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IT Challenges

1. Circular primes

A circular prime is a prime number which remains prime on any cyclic rotation of its digits. For example, 1193 is a circular prime, as 1931, 9311 and 3119 are also primes. 337 is another one. Write a function to find the number of circular primes less than any given number. (For example, there are 8 circular primes less than 40 (2, 3, 5, 7, 11, 13, 17, 37 - counting only the smallest in each circle)

2. Simple SQL

Consider the following table, representing the results of a survey asking people their age, gender and education (table name: survey_responses, see the attachment)

id	ageband	gender	education
1	3	6	7
2	1	6	7
3	2	5	7
4	3	6	10
5	2	5	10
6	3	6	9
etc	etc	Etc	etc

And here's the key to the codes used (table name: survey_key.txt, see the attachment)

lookup	descr
1	20-29
2	30-39
3	40-49
4	50-59
5	male
6	female
7	none
8	primary
9	secondary
10	tertiary

Write an SQL statement that produces the following summary results (for ageband)

ageband	count	id's
20-29	18	2,11,36,42, ...
30-39	24	3,5,10,12, ...
40-49	26	1,4,6,9,13, ...
50-59	32	7,8,15,16, ...

Similarly, give the SQL statement for gender and education. Ensure your solution wouldn't change much if the survey had many more questions.

3. Simple webpage

Produce a very simple webpage where the user can drag a number things from one box to another, and back again.

4. Cancelling fractions

The fraction $^{49}/_{98}$ has the property that the 9's can be "cancelled out", leaving $^{4}/_{8}$ which leaves its value unchanged. List all fractions less than one of this type, containing two digits in the numerator and denominator. Ignore trivial cases where zero's are cancelled out.

5. Triangular words

The triangular numbers are of the form $t_n = ½ \cdot n \cdot (n+1)$, the first 10 are 1, 3, 6, 10, 15, 21, 28, 36, 45, 55. Each word can be converted into a word value by adding the numbers corresponding to its letters, using A=1, B=2, … , Z=26. Find the number of words with a word value equal to a triangular number. Use the dictionary.txt file (attached) for your universe of words.

6. Coin flipping

At the annual Eighty20 Coin Flipping event each member of staff spent the whole day flipping coins, recording the result of each flip. The attached text file shows the combined results of all the coin flips. Using primarily SQL, find out for each employee what their longest unbroken run of heads was. Assume that the number of employees, and the number of flips could in theory be in the millions (so Excel is out)

7. Prime proportions

Starting with 1 in the centre, and counting in an anti clockwise fashion, you can generate a table of numbers, as shown below:

37	36	35	34	33	32	31
38	17	16	15	14	13	30
39	18	5	4	3	12	29
40	19	6	1	2	11	28
41	20	7	8	9	10	27
42	21	22	23	24	25	26
43	44	45	46	47	48	49

Using Excel (incl. VBA), generate such a table, highlighting the prime numbers in red (as in the table above). In addition, generate a summary table showing the proportion of primes falling on the diagonals, for each size of the table, as the table grows. For example, the first few entries of the summary table are:

Table size	Primes as a proportion of diagonals	Comment
1x1	0%	(the table is just "1". No primes there)
3x3	60%	(3 out of 5. The primes are 5, 3, 7)
5x5	55.6%	(5 out of 9 ...)
7x7	61.5%	(8 out of 13, as per the table above)
etc.		

Note: only square tables are relevant, i.e. after each complete loop.

Stop once the number falls below a given proportion, given by the user at the outset.

8. Linux

Suppose we need to perform a back-up of files that get produced by particular system on a daily basis. The files for each day are put into a folder with that day's date, as follows:

```
$ ls -l
total 302
dr-xr-xr-x 1 root root 0 Nov  5 14:42 2014-06-04
dr-xr-xr-x 1 root root 0 Nov  5 14:42 2014-06-05
dr-xr-xr-x 1 root root 0 Nov  5 14:42 2014-06-06
dr-xr-xr-x 1 root root 0 Nov  5 14:42 2014-06-09
dr-xr-xr-x 1 root root 0 Nov  5 14:42 2014-06-10
```

… etc.

Using only standard Linux tools and commands, write a script which produces a listing of all files which are to be backed up, as follows:

- 14 days' worth of files, up to and including the date in the system variable $THEDATE
- All files from the most recent month 15th of the month on or before $THEDATE

The script should also produce a neat summary of the size of all the files listed, by folder and in total.