CONCATENATING LETTER RANKS

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This note is inspired by Numbo-Carrean, which was introduced in Ross Eckler's *Word Recreations* [1] in the chapter called "Ten Logotopian Lingos." This lingo uses words with the following property: when each letter is replaced by its letter rank (or alphabetic position number), the resulting number is a perfect square. That is, *a* is replaced by 1, *b* by 2, *c* by 3, and so forth, and these numbers are concatenated. For example, *have* becomes 81225, which is the square of 285. However, if the restriction of being a square is dropped, then all words can be mapped to numbers. This note examines the cases where one number stands for more than one word. For instance, *able* and *lay* are both 12125.

Since these numbers can be ambiguous, we use parentheses to surround the alphabetic position numbers. For example, 12125 is (1)(2)(12)(5) for *able*, but (12)(1)(25) for *lay*. The ambiguity is always due to the numerals 1 and 2, for instance, 12 can be the letter *l* or the two letters *ab*, but 6554 must be *feed*, and although 25 can be either *y* or *be*, this is due to the digit 2, not the digit 5.

Generating examples using a computer and a word list is straightforward to do. For each word on the list, convert it to its associated number. Then change this number to a string, and store the original word using this string as an index (that is, use an associative array). This was done for all the words from Crosswd.txt, which is part of Grady Ward's *Moby Word Lists*. These lists are in the public domain and are available from Project Gutenberg [2].

In practice, the number of different ways to group digits into singletons and pairs is limited by the number of 1s and 2s. But counting the number of ways to place the parentheses around digits (ignoring whether or not words are made) gives an upper bound to the most words possible for one number. This bound turns out to be F_n for $n-1$ digits, where F_n is the nth Fibonacci number. This is not hard to show: see the Appendix. Although F_n grows exponentially as a function of n, only four cases where three words have the same number were found, and no cases of four (or more) words with the same number. So the number of words sharing a number is much smaller than the mathematical upper bound unless the words are very short.

The example of *able* and *lay*, where all letters change, is rare. Most of the time the two words are like *unburied* and *unvaried* (both 211422118954), where the change occurs only for at 221, which goes from *bu* to *va*, (or (2)(21) to (22)(1)) and all the rest of the letters are common to both words. Let us call 221 (with or without parentheses) the *locus of change*. Table 1 is compiled from a computer search, and it is a type collection of loci of change. Note that some of these entries have two loci, for example, *assai* and *kiss*. Also note the table does not contain (17), but this stands for the letter *q*, hence this is not surprising. Finally, here are the four examples of three words having the same number: 1225 for *abbe, aby, ave*; 1415 for *ado, nae, no*; 191254 for *ailed, sabed, sled*; 211419 for *bans, unai, uns*.

(1)(1)(12), (11)(1)(2)	aal, kab
(1)(11)(5), (11)(15)	akela, kola
(1)(11), (11)(1)	weak, weka
(1)(12)(1), (11)(21)	alae, kue
(1)(12)(2), (11)(22)	albas, kvas
(1)(12)(5), (11)(25)	sale, sky
(1)(18)(11)(19), (11)(8)(1)(11)(9)	arks, khaki
(1)(19)(19)(1)(9), (11)(9)(19)(19)	assai, kiss
(1)(19), (11)(9)	sass, skis
(1)(2)(12)(21), (12)(1)(22)(1)	ablution, lavation
(1)(2)(12)(25), (12)(1)(22)(5)	ably, lave
(1)(2)(12)(5), (12)(1)(25)	parable, parlay
(1)(2)(19), (12)(1)(9)	abscise, laicise
(1)(2)(2)(1), (12)(21)	sabbat, slut
(1)(2), (12)	above, love
(1)(21), (12)(1)	gauze, glaze
(1)(22)(1), (12)(21)	avast, lust
(1)(22)(15), (12)(21)(5)	avos, lues
(1)(22)(25), (12)(22)(5)	heavy, helve
(1)(22)(5), (12)(25)	repave, reply
(1)(24), (12)(4)	hoax, hold
(1)(25), (12)(5)	midday, middle
(1)(3)(13), (13)(1)(3)	acme, mace
(1)(3)(14), (13)(1)(4)	acne, made
(1)(3)(18)(15)(2)(1), (13)(1)(8)(15)(21)	acrobat, mahout
(1)(3), (13)	deacon, demon
(1)(4)(15), (14)(1)(5)	ado, nae
(1)(4), (14)	head, hen
(1)(5)(14), (15)(1)(4)	gaen, goad
(1)(5), (15)	faecal, focal
(1)(6), (16)	afore, pore
(1)(8)(15)(25), (18)(15)(2)(5)	ahoy, robe
(1)(8), (18)	ahead, read
(1)(9)(12), (19)(1)(2)	ail, sab
(1)(9)(13), (19)(1)(3)	aim, sac
(1)(9)(14), (19)(1)(4)	ain, sad
(1)(9)(19), (19)(1)(9)	aisled, sailed
(1)(9), (19)	ailing, sling
(2)(1)(14)(19), (21)(14)(1)(9)	bans, unai
(2)(1)(18)(19), (21)(18)(1)(9)	sambars, samurai
(2)(1), (21)	barn, urn
(2)(2), (22)	crabbed, craved
(2)(21)(12)(2)(21), (22)(1)(12)(22)(1)	bulbul, valval
(2)(21), (22)(1)	burnish, varnish
(2)(25), (22)(5)	bye, vee
(2)(5)(1)(22), (25)(1)(2)(2)	beaver, yabber
(2)(5)(5)(18), (25)(5)(1)(8)	beer, yeah
(2)(5), (25)	beak, yak

Table 1. Distinct loci of changes found, each with one example.

Perl code is available from the author upon request.

Appendix

Claim. The number of ways to group n digits into singletons and pairs is F_{n+1}, where F_n is the nth Fibonacci number.

Proof. Let F_{n+1} be the solution for n digits. For one digit there is only one way: (d), so $F_2 = 1$. For two digits there are two ways: (dd) and (d)(d), so $F_3 = 2$. Now consider the general case of $n+1$ digits. The last digit is either a singleton or part of a pair. In the former case, there are F_{n+1} ways to group the first n digits, and in the latter case there are F_n to group the first $n-1$ digits. So the total number of ways is $F_{n+2} = F_{n+1} + F_n$. Given the first two values, it is well known that this relationship defines the Fibonacci numbers. QED

References

[1] A. Ross Eckler. *Word Recreations: Games and Diversions from Word Ways.* Dover Publications, New York, New York, 1979.

[2] Grady Ward. *Moby Word Lists.* Number 3201 in Project Gutenberg Releases. Project Gutenberg, 2002. URL: http://www.gutenberg.org/.