FURTHER CRACKS IN THE PI-CODE

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In "Cracking the Pi-Code" in the November 1999 issue of Word Ways, David Morice discussed the recreation of looking for words in the decimal digits of pi (3.14159265358979...) with the 10 digits replaced by some set of 10 different letters, as in a substitution cipher.

The longest word he found was PALINDROME (actually, any 10-letter isogram), which can be made using the digits that appear starting at the 61st after the decimal point (5923078164). In fact, if we want a 10-letter isogram we can move back one digit, since 4592307816 (starting at digit 60) is the earliest 10-digit isogram in pi. But in fact we can do quite a bit better than 10-letter words.

We exhaustively searched the first five million digits of pi using a computer, and found words up to 15 letters in length (but no 16-letter ones). The first (earliest in pi) Web3 Unabridged words of various lengths are given in the table below. The third column gives the position of the starting digit, the fourth column gives the pi digits, and the fifth column gives the letter code that generates the word:

10	unorthodox	2	4159265358	NTDUOH-XR-
11	cellularity	22	64338327950	-ALETCRUIY
12	turneraceous	46	375105820974	NCTSR-UAOE
13	metamerically	729	8159813629774	ECRYTILMA-
14	subtransparent	7047	59381465741268	REBASNPTU-
15	cystoflagellate	36222	326187940599415	TYCAESFOLG

Using some reasonable formations, we can find words even closer to the beginning of pi. We find the 13-letter TYRANNOPHOBIA (fear of tyrants, or perhaps dinosaurs?) at digit 90, the 12-letter UNDISSOLUBLE at digit 30, and the 11-letter WRETCHEDEST starting at just the second digit after the decimal point (that is, 3.1WRETCHEDEST...). Even better, we can make the reasonable 10-letter coinage DESERTWARD starting with the very first digit of pi, using the code EWDSRA--T-.

The reason it's relatively easy to make long words is that we have a lot of flexibility in choosing the pi code, and we can be "greedy" in our choice, trying to form one long word at the expense of many shorter ones. Two other problems Morice poses are not so easy: to find codes that produce long strings of overlapping words, or a high percentage of letters embedded in words within a given window of pi digits. To attack this we used a heuristic, rather than exhaustive, search due to the large size of the search space.

Within the first 301 digits of pi, the longest string of overlapping words reported by Morice using Web 3 Unabridged was 49 letters. Staying within the same 301-digit window, but trying many different codes, the longest string of overlapping words we found has 72 letters, derived from the code RSEABOMTKI. Here are the first 301 digits of pi in this code:

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E RARbkSOBEb tkmkESETAO SOAEeTESmk BISTTARKMR OKEkKEMBRI
  BtSIkMAKAA BkSEImtROA IOSTOSITkk TOSTIEATSB EASrrMIOMk

  tsRATITObR ESTSEIOOAM IKETAAOIkb BIBtsSERms BEbKAITrST
  ATrrrMABIS TARISMIRKE TbsrRIBbbK OAAOSSKATk BAKEIEtrKO

  AASTTRIkmB OOBkeEAAOR STAMBOATSE EMTOMTEROB SMRSIRKIKR
  ABOATBOOKS EAOIEATORI ABAESOOATS REEKEOImSO ISAKRARsME
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The 72-letter string starts on the next-to-last line and is comprised of the Web3 words EA, A, OR, ST, AM, BOATS, SEEM, TOM, ER, ROBS, MRS, IRK, I, KRA, BOAT, BOOKS, EA, O, I, EA, TORI, ABA, AE, SO, OATS, REEK, EKE, O, I. Note that some of these are somewhat "inferior" words such as the abbreviations ST and MRS, but all are boldface entries in Web3. The number of relatively long words in this string is noteworthy.

Using a different code, we were able to construct a 51-letter string that starts right at the beginning of pi. The code IEAPNMHLOB produces

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A IPINOEMNAN LOHOAEALPM EMPAALAEHO NBELLPIOHI MOAOOAHNIB
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which is comprised of the words A, I, PI, NO, EM, NAN, LO, OH, O, AE, ALP, ME, EM, PA, AL, AE, HO, ON, BELL, PI, OH, HIM, O, A, O, O, AH, NIB, and includes two occurrences of PI itself. Note that this one contains no abbreviations.

Clearly the way to success in this particular task is to have a good stockpile of short words available, so dictionaries biased in this direction (such as the Official Scrabble Players Dictionary) would probably yield larger runs. Indeed, if ten letters can be found such that all 100 bigrams formed from those letters can be found in some dictionary (or in some other way justified as being words), then we can claim that the whole number pi (indeed, any number!) consists entirely of words--and they wouldn't even overlap. Do 100 such bigrams exist? The most difficult part would be ensuring that all the consonant pairs (of which there will be many, including doubled ones like TT) qualify as words.

Finally, we consider the following problem posed by Morice: which assignment of digits to letters gives the highest percentage of word-worthy letters? It seems clear that three of the letters should be A, I, O, so that these one-letter words can be taken advantage of, and it's obvious one of them should be E, but there are many possibilities for the remaining six. As before, we just concentrated on the first 301

digits and tried to find the most word-rich code for that window. The best we were able to achieve is 275 letters out of 301 (about 91 per cent) using the code AEHITDMRON.

H AIATOEDTHt ROMOHEHRID EDIhhRHEMO TNERRIAOMA DOHOOHMTAN
TRENOMIOII TOEHnMRADI NDERDENROO RDERNHIRET HIEAAMndMO

REAIRnrdTA HEREHndDIM NOHrIIDNOT tnTREEHAME THTOINRAER
IRAAAMITNE RIANEMNAOH rTEAANTtTO DIIDEEOIRO TIOHnhRAOD

IIERRANOMT DdTOHHIIDA ERIMTDIREH hMRdMRHADT EMAENAONOA
ITDIRTDDOE HIDnHIrDAN ITIHEDDIRE AHHOHdnMED NEIOAIAEMh

Mathematicians conjecture that pi is normal. If this is true (everyone believes it is), then arbitrarily long sequences of valid words occur in pi. Undoubtedly, further searching would yield yet more improvements to the results presented here.

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Barmecide feast (a banquet without food)
down the rabbit hole (into a bizarre or surreal situation)
grok (to understand intuitively or empathically)
MacGuffin (a catalyst that sets of the action in a story)
mojo (a magic spell)
whip the offending Adam (to punish someone and leave him virtuous)
Zuzu's petals (restored contact with reality)

Edited by Elizabeth Webber and Mike Feinsilber, the book was published in paperback (ISBN 0-87779-628-9) by the Merriam-Webster Company for $14.95.