

A SURVEY OF DIRECTED WORD CHAINS

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The idea of making chains by overlapping words is due to H. E. Dudeney, and is probably a follow-on of Lewis Carroll's word ladders. Dudeney used words of uniform length and constant overlap. Christopher McManus introduced **Word Ways** readers in November 1990 to Ana-Gram-Mar (AGM) chains, ones in which the word length may vary, but there is always single overlap (each letter appears in exactly two words): house-man-slaughter-house, gossypol-yester-morning-tide-water. In the May 1991 **Word Ways**, Ross Eckler called the Dudeney chains directed word chains and introduced notation for word length and degree of overlap. However, it is misleading to restrict the term directed word chains to only those having words of fixed length; AGM chains are directed as well. It is more useful to regard AGM chains as a special case of directed word chains. In three articles beginning in August 1991, I explored AGM chains. I call word parts frags; sometimes frags are words, sometimes not. Most of my work has been with (8,4) chains, such as tops-oils-kins-folk. In this article I consider directed word chains with words of uniform length (some are AGMs).

My database is mostly Websterian. My lists are about one-and-one-half times as long as the Official Scrabble Players Dictionary (my initial source), but short of Web 2 and Web 3. All words are lower case. A nice feature of these chains is that although many include words that are not common today, their meaning is apparent. My lists are restricted to lower case words as a consequence of my start with the OSPD.

Chains were devised by hand, but with the mule work done by computer. I used BASIC programs to create special lists and the standard WORDPERFECT search program to develop chains. A word processor in conjunction with BASIC is a most powerful tool.

Nine-Letter Ana-Gram-Mar Chains

There are different ways to chain words containing an odd number of letters. In the following chains of nine-letter words, frag lengths alternate -4-5-4-5-. My first step in boiling 26,300 nine-letter words down to a useful set was to collect and sort four- and five-letter beginning and ending frags. There were 7400 (4100) different four-letter beginnings (endings), and 13800 (9300) different five-letter beginnings (endings). Later steps selected words in which the left frag of length n was found in the list of right frags of length n , and the right frag of length $9-n$ was found in the list of left frags of length $9-n$. The process was repeated several times to condense the resultant to core words. Two classes of words resulted, splitting 5-4 and 4-5; a few words appeared

in both classes.

In the following chains, note the separate usage of **head** and **heads**, **rain** and **rains**, etc. Note the use of **overtrain** and **down-start**, both divided two ways. No effort was made to find minimum paths between end words.

here-under-draw-downs-tart-woman-head-water-buck-brush-fire-break-down-
start-ling-berry-bush-goats-kins-woman (note ring on woman)
video-disc-overt-rain-water-work-horse-back-cross-over-train-sick-rooms-
tead-ishes

room-stead-fast-backs-trap-light-ship-board-room (a ring)

head-stone-wall-paper-back-stage-hand

rains-torm-enter-mete-yards-tick-birds

loud-mouth-part-ridge-bone-heads

lady-birds-eyes-train		root-stock-pots-hards-hell-hound-fish	
fire-break	ster-coral		
wise-crack down throw		wood-chuck-ling-berry-bush-goats-kins	woma
hand-shake			
test-cross-over	night-wear-isome-tric-homes-tall-grass-----		work

green-head		block-head-skins	boat
grass-fire	heads-tone		eotk
	water-skin	flint-wood--	chuck-full-mouth-pipe-dream
flash-back	tight-wire		land
dream-tide		cocks-wain-scots	time

Nine-Letter Words, One-Letter Overlap

(M,n) chains use words of length m, each of which overlaps the previous by n letters. In the simple case, m and n are chosen so that the third word begins at the end of the first. However, when m is odd and $n = (m+1)/2$, there is one-letter secondary overlap. Eckler exhibits a network of interlocking (3,2) chains in the May 1991 **Word Ways**. Here, I construct (9,5) chains. The set of words useful for this kind of chain (obtained by procedures analogous to the ones described previously) is almost as large as the previous one, but the words are not as well-connected. The following are the longest chains I can make. This type of chain is more appropriate for short words, but nine-letter words make good puzzles.

railroads	trichomes	thousands	eleganter
roadstead	homestall	sandsoaps	anterooms
steadying	stallions	soapstone	roomstead
dyingness	lionships	stoneface	stadiest
	shipshape		diestrous
	shapeless		trousered

Eight-Letter Words, Secondary Overlap

With (m,n) chains, if m is even and $n = 1+(m/2)$, we have two-letter secondary overlap. There is not much in the way of length in the following (8,5) chains, but these also make good puzzles.

displace subhuman madwoman citharas confines
 placemen humanest womanise harasses finespun
 cementer anestic aniseed assessor espundia
 entering stricter seedsman essorant undialed
 chasuble eringoes icterode
 sublease erodents accoutre madoquas
 leaseman profiles outreach oquassas
 semantic filespec reaching assassin
 anticked especial chingmas assinego

Seven-Letter Words, Secondary Overlap

Here is an introduction to the (7,4) chain. Now the game gets interesting!

rusalka isotach
 alkalis unscrew tachist
 alismas crewels histrio
smasher welsher trionym antonym
 fiurama sheriff onymous onymize
 marabou ruffles mousing
 aboulic flesher singing
 ulicons sherroot bundist gingham gingeli
 constat roother disturb gelidly
 descent statant thereto turbeth
centric tantric retours bethumb carcass
 tricorn tricars ourself humbugs cassava
 cornett carsick selfish bugshas savanna
 netting sicking fishing shastra annatta
 tingled kinging hinging strains attains
 gledged gingall ainsell
 galloot sellout
looting louting
 tinging

Six-Letter Words, Secondary Overlap

Here are (6,4) chains. Six seems to be the best length for this. These are well-enough connected to allow branching, but I have not found closed loops or enough joins to identify a core (it's close). Analysis of a slightly-larger database should prove useful.

maniac albata
 niacin batata brenne
 acinar tatami incubi ennewe
 inarch tamise cubist newest
 archil misere bistro westar
 replan chilli serene stroke stares
 planch illite renest rokete areste
 anchor litera nester ketene esteem
 choral teraph steric tenere teemer
 orally raphae ericas nereis emerald
 allyic phaenic icasms reises erodes

Chaining Words of Mixed Length

Neither eight- nor nine-letter words produced long chains with secondary overlap, so here are chains using eight- and nine-letter

words together. My rule is that every word must overlap the previous one by five letters. In the future, I will show what including ten-letter words allows.

executer	schmucks		
cuterebra	muckswheat		
rebranch	sweatweed		
ranchero	tweediest		
cheroots	diestrous		
rootstock	trousseau		
prolonge	stockings		
longears	kingships	calamari	
gearshift	shipsides	amarillo	
shiftable	sideslips	rillocks	
tableman	slipslops	locksmith	
lemanite	slopshops	smithing	
	shopsters	thingiest	

Puzzle 1

Fill the blank with one word so as to make two more nonoverlapping words (i.e., a four-link AGM chain). The filler may be of any length - the longer, the better.

- | | | | |
|------------|---------|------------|----------|
| 1. cock- | -fatter | 7. ship- | -worm |
| 2. brain- | -power | 8. show- | -pieces |
| 3. ship- | -craft | 9. cross- | -talk |
| 4. trans- | -dress | 10. sheep- | -breeder |
| 5. papers- | -eller | 11. corn- | -picker |
| 6. ball- | -head | 12. hand- | -spring |

Puzzle 2

Provide extensions in both directions from the following so as to produce two overlapping words. The longer the overlap, and the longer the words, the better. For example, -ignoratio- is answered by monsignor and rationale, which overlap at R; -hatcheck- is answered by nuthatch and checkout, which overlap at CH. These are neither AGM chains nor directed word chains, but a more general case.

-blastular-	-pediatric-	-semester-
-wheatears-	-podiatric-	-spacemen-
-downswing-	-damascene-	-turnover-
-frontally-	-sighthole-	-rillocks-
-desisting-	-sovereign-	-clothing-
-novelette-	-archenemy-	-commando-
-majorette-	-outreach-	-billions-
-temptress-	-mentally-	

Answers can be found in Answers and Solutions at the end of this issue.