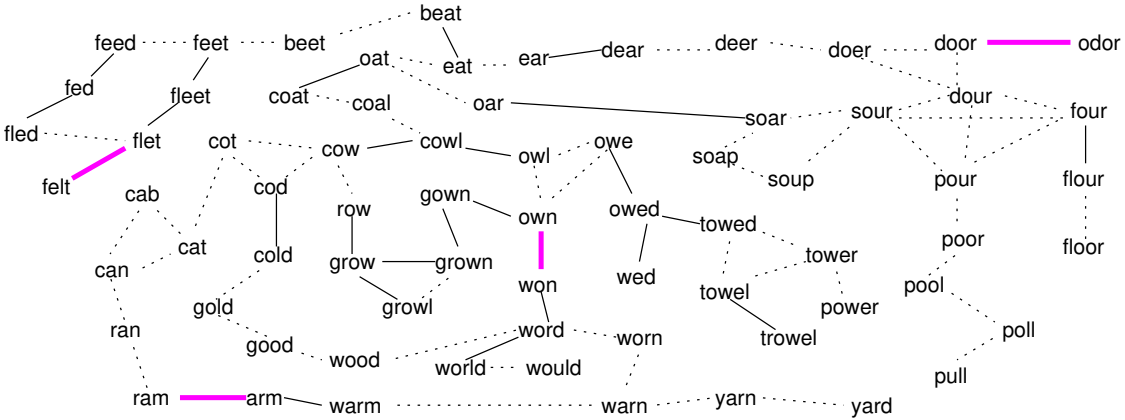
Edit distance and information theory units:

- The edit distance problema nd algorithm (**today**)
- A quick tour of information theory (next week Wednesday)
- Lab: Autoregressive text generation (next week Friday)

Today:

- Follow-up on regex chatbot
- The idea of edit distance
- The minimum edit distance problem
- The minumum edit distance algorithm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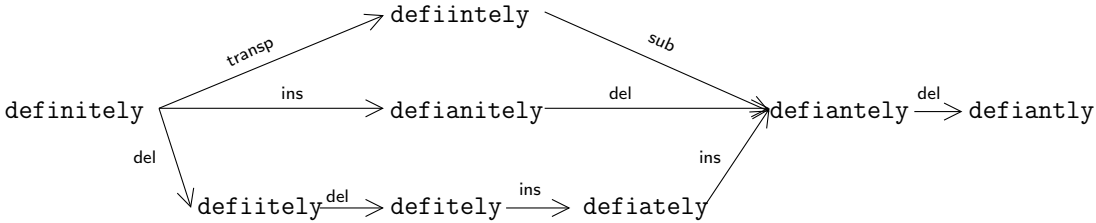
Versions of the minimum edit distance:

- Substitutions only: *Hamming distance*. (Richard Hamming, 1950)
- Insertions and deletions: *Longest common subsequence*.
- Substitutions, insertions, and deletions: *Levenshtein distance.* (Vladimir Levenshtein, 1966)
- Substitutions, insertions, deletions, and transpositions: *Damerau-Levenshtein distance.* (Fred Damerau, 1964)

$$\texttt{recieve} \xrightarrow{\text{del}} \texttt{receve} \xrightarrow{\text{ins}} \texttt{receive} \quad \text{versus} \quad \texttt{recieve} \xrightarrow{\text{transp}} \texttt{receive}$$

$$\texttt{seperate} \xrightarrow{\text{del}} \texttt{seprate} \xrightarrow{\text{ins}} \texttt{separate} \quad \text{versus} \quad \texttt{seperate} \xrightarrow{\text{sub}} \texttt{separate}$$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	␣	c	ca	car	carv	carvi	carvin	carving
5	crave	crave	crave	crave	crave	crave	crave	crave
	␣	c	ca	car	carv	carvi	carvin	carving
4	crav	crav	crav	crav	crav	crav	crav	crav
	␣	c	ca	car	carv	carvi	carvin	carving
3	cra	cra	cra	cra	cra	cra	cra	cra
	␣	c	ca	car	carv	carvi	carvin	carving
2	cr	cr	cr	cr	cr	cr	cr	cr
	␣	c	ca	car	carv	carvi	carvin	carving
1	c	c	c	c	c	c	c	c
	␣	c	ca	car	carv	carvi	carvin	carving
0	␣	␣	␣	␣	␣	␣	␣	␣
	␣	c	ca	car	carv	carvi	carvin	carving
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**

$$
D[i][j] = \begin{cases}
0 & \text{if } i = j = 0 & \text{(Empty prefixes: do nothing)} \\
j \cdot C[0] & \text{if } i = 0 \text{ and } j > 0 & \text{(Empty prefix of } a\text{: insert all the } b \text{ prefix)} \\
i \cdot C[1] & \text{if } i > 0 \text{ and } j = 0 & \text{(Empty prefix of } b\text{: delete all the } a \text{ prefix)} \\
\min \begin{pmatrix}
C[0] + D[i-1][j] & & \text{(insertion)} \\
C[1] + D[i][j-1] & & \text{(deletion)} \\
C[2] + D[i-1][j-1] & & \text{(substitution)} \\
C[3] + D[i-2][j-2] & \text{if } a[i-1] = b[j-2] \text{ and } a[i-2] = b[j-1] & \text{(transposition)} \\
D[i-1][j-1] & \text{if } a[i-1] = b[j-1] & \text{(nop)}
\end{pmatrix} & \text{Otherwise}
\end{cases}
$$

n	6/ins-all	5/ins	4/ins	4/ins	3/ins	3/ins	2/nop	3/del
e	5/ins-all	4/ins	3/ins	3/ins	2/ins	2/sub	3/del	4/del
v	4/ins-all	3/ins	2/ins	2/ins	1/nop	2/del	3/del	4/del
a	3/ins-all	2/ins	1/nop	1/transp	2/del	3/del	4/del	5/del
r	2/ins-all	1/ins	1/sub	1/nop	2/del	3/del	4/del	5/del
c	1/ins-all	0/nop	1/del	2/del	3/del	4/del	5/del	6/del
	0/del-all	1/del-all	2/del-all	3/del-all	4/del-all	5/del-all	6/del-all	7/del-all
		c	a	r	v	i	n	g

c	a	r	v	i	n	g
nop	transp	nop	sub	nop	del	
c	r	a	v	e	n	

Coming up:

- Reading from J&M, Section 2.5 (Fri, Sept 1)
- Regular expressions assignment (Fri, Sept 1)

- Edit distance quiz (Tues, Sept 5)
- Edit distance assignment (Fri, Sept 8)

- Reading from Stone (see Canvas) (Wed, Sept 6)

Next time: A quick tour of information theory