

Skip-gram Word2Vec

In this notebook, I'll lead you through using PyTorch to implement the [Word2Vec algorithm](https://en.wikipedia.org/wiki/Word2vec) (<https://en.wikipedia.org/wiki/Word2vec>) using the skip-gram architecture. By implementing this, you'll learn about embedding words for use in natural language processing. This will come in handy when dealing with things like machine translation.

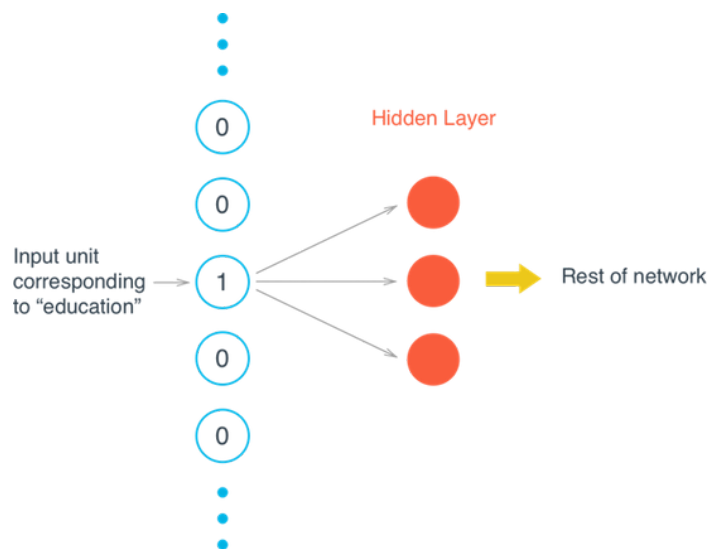
Readings

Here are the resources I used to build this notebook. I suggest reading these either beforehand or while you're working on this material.

- A really good [conceptual overview](http://mccormickml.com/2016/04/19/word2vec-tutorial-the-skip-gram-model/) (<http://mccormickml.com/2016/04/19/word2vec-tutorial-the-skip-gram-model/>) of Word2Vec from Chris McCormick
- [First Word2Vec paper](https://arxiv.org/pdf/1301.3781.pdf) (<https://arxiv.org/pdf/1301.3781.pdf>) from Mikolov et al.
- [Neural Information Processing Systems, paper](http://papers.nips.cc/paper/5021-distributed-representations-of-words-and-phrases-and-their-compositionality.pdf) (<http://papers.nips.cc/paper/5021-distributed-representations-of-words-and-phrases-and-their-compositionality.pdf>) with improvements for Word2Vec also from Mikolov et al.

Word embeddings

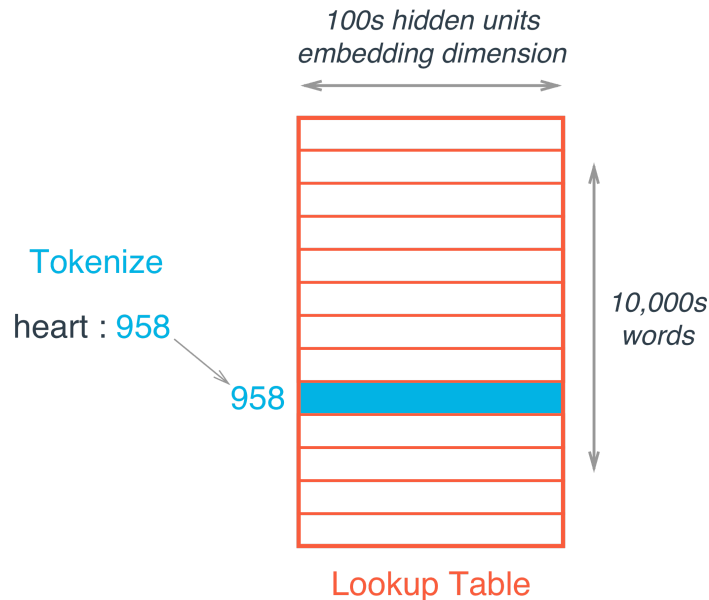
When you're dealing with words in text, you end up with tens of thousands of word classes to analyze; one for each word in a vocabulary. Trying to one-hot encode these words is massively inefficient because most values in a one-hot vector will be set to zero. So, the matrix multiplication that happens in between a one-hot input vector and a first, hidden layer will result in mostly zero-valued hidden outputs.



To solve this problem and greatly increase the efficiency of our networks, we use what are called **embeddings**. Embeddings are just a fully connected layer like you've seen before. We call this layer the embedding layer and the weights are embedding weights. We skip the multiplication into the embedding layer by instead directly grabbing the hidden layer values from the weight matrix. We can do this because the multiplication of a one-hot encoded vector with a matrix returns the row of the matrix corresponding the index of the "on" input unit.

$$\begin{bmatrix} 0 & 0 & 0 & 1 & 0 \end{bmatrix} \times \begin{bmatrix} 8 & 2 & 1 & 9 \\ 6 & 5 & 4 & 0 \\ 7 & 1 & 6 & 2 \\ 1 & 3 & 5 & 8 \\ 0 & 4 & 9 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 3 & 5 & 8 \end{bmatrix}$$

Instead of doing the matrix multiplication, we use the weight matrix as a lookup table. We encode the words as integers, for example "heart" is encoded as 958, "mind" as 18094. Then to get hidden layer values for "heart", you just take the 958th row of the embedding matrix. This process is called an **embedding lookup** and the number of hidden units is the **embedding dimension**.



There is nothing magical going on here. The embedding lookup table is just a weight matrix. The embedding layer is just a hidden layer. The lookup is just a shortcut for the matrix multiplication. The lookup table is trained just like any weight matrix.

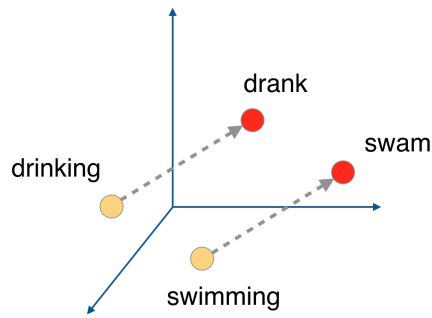
Embeddings aren't only used for words of course. You can use them for any model where you have a massive number of classes. A particular type of model called **Word2Vec** uses the embedding layer to find vector representations of words that contain semantic meaning.

Word2Vec

The Word2Vec algorithm finds much more efficient representations by finding vectors that represent the words. These vectors also contain semantic information about the words.

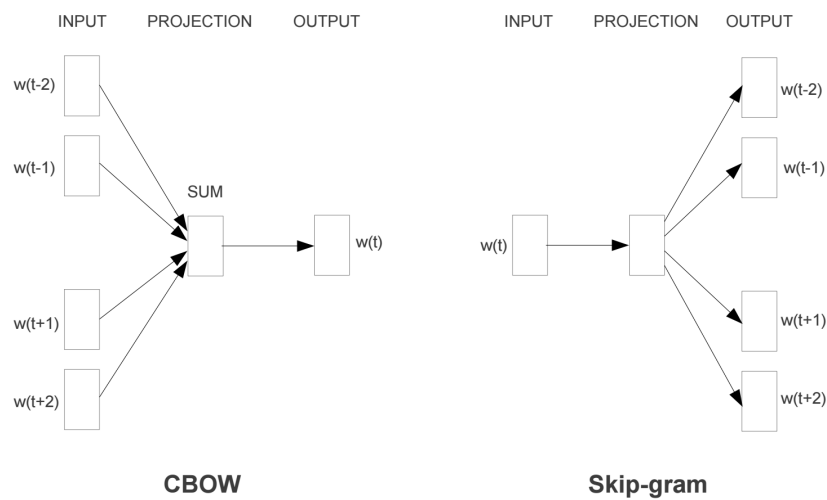
I often drink **coffee** in the mornings.
 When I'm thirsty, I drink **water**.
 I drink **tea**, before I go to sleep.

Words that show up in similar **contexts**, such as "coffee", "tea", and "water" will have vectors near each other. Different words will be further away from one another, and relationships can be represented by distance in vector space.



There are two architectures for implementing Word2Vec:

- CBOW (Continuous Bag-Of-Words) and
- Skip-gram



In this implementation, we'll be using the **skip-gram architecture** because it performs better than CBOW. Here, we pass in a word and try to predict the words surrounding it in the text. In this way, we can train the network to learn representations for words that show up in similar contexts.

Loading Data

Next, we'll ask you to load in data and place it in the `data` directory

1. Load the [text8 dataset \(https://s3.amazonaws.com/video.udacity-data.com/topher/2018/October/5bbe6499_text8/text8.zip\)](https://s3.amazonaws.com/video.udacity-data.com/topher/2018/October/5bbe6499_text8/text8.zip); a file of cleaned up *Wikipedia article text* from Matt Mahoney.
2. Place that data in the `data` folder in the home directory.
3. Then you can extract it and delete the archive, zip file to save storage space.

After following these steps, you should have one file in your data directory: `data/text8`.

In [1]:

```
# read in the extracted text file
with open('data/text8') as f:
    text = f.read()

# print out the first 100 characters
print(text[:100])
```

anarchism originated as a term of abuse first used against early working class radicals including t

Pre-processing

Here I'm fixing up the text to make training easier. This comes from the `utils.py` file. The `preprocess` function does a few things:

- It converts any punctuation into tokens, so a period is changed to `<PERIOD>`. In this data set, there aren't any periods, but it will help in other NLP problems.
- It removes all words that show up five or *fewer* times in the dataset. This will greatly reduce issues due to noise in the data and improve the quality of the vector representations.
- It returns a list of words in the text.

This may take a few seconds to run, since our text file is quite large. If you want to write your own functions for this stuff, go for it!

In [2]:

```
import utils

# get list of words
words = utils.preprocess(text)
print(words[:30])
```

```
['anarchism', 'originated', 'as', 'a', 'term', 'of', 'abuse', 'first',
'used', 'against', 'early', 'working', 'class', 'radicals', 'includin
g', 'the', 'diggers', 'of', 'the', 'english', 'revolution', 'and', 'th
e', 'sans', 'culottes', 'of', 'the', 'french', 'revolution', 'whilst']
```

In [3]:

```
# print some stats about this word data
print("Total words in text: {}".format(len(words)))
print("Unique words: {}".format(len(set(words)))) # `set` removes any duplicate wor
```

Total words in text: 16680599
Unique words: 63641

Dictionaries

Next, I'm creating two dictionaries to convert words to integers and back again (integers to words). This is again done with a function in the `utils.py` file. `create_lookup_tables` takes in a list of words in a text and returns two dictionaries.

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- The integers are assigned in descending frequency order, so the most frequent word ("the") is given the integer 0 and the next most frequent is 1, and so on.

Once we have our dictionaries, the words are converted to integers and stored in the list `int_words`.

In [4]:

```
vocab_to_int, int_to_vocab = utils.create_lookup_tables(words)
int_words = [vocab_to_int[word] for word in words]

print(int_words[:30])
```

```
[5233, 3080, 11, 5, 194, 1, 3133, 45, 58, 155, 127, 741, 476, 10571, 1
33, 0, 27349, 1, 0, 102, 854, 2, 0, 15067, 58112, 1, 0, 150, 854, 358
0]
```

Subsampling

Words that show up often such as "the", "of", and "for" don't provide much context to the nearby words. If we discard some of them, we can remove some of the noise from our data and in return get faster training and better representations. This process is called subsampling by Mikolov. For each word w_i in the training set, we'll discard it with probability given by

$$P(w_i) = 1 - \sqrt{\frac{t}{f(w_i)}}$$

where t is a threshold parameter and $f(w_i)$ is the frequency of word w_i in the total dataset.

$$P(0) = 1 - \sqrt{\frac{1 * 10^{-5}}{1 * 10^6 / 16 * 10^6}} = 0.98735$$

I'm going to leave this up to you as an exercise. Check out my solution to see how I did it.

Exercise: Implement subsampling for the words in `int_words`. That is, go through `int_words` and discard each word given the probability $P(w_i)$ shown above. Note that $P(w_i)$ is the probability that a word is discarded. Assign the subsampled data to `train_words`.

In [5]:

```

from collections import Counter
import random
import numpy as np

threshold = 1e-5
word_counts = Counter(int_words)
#print(list(word_counts.items())[0]) # dictionary of int_words, how many times the

total_count = len(int_words)
freqs = {word: count/total_count for word, count in word_counts.items()}
p_drop = {word: 1 - np.sqrt(threshold/freqs[word]) for word in word_counts}
# discard some frequent words, according to the subsampling equation
# create a new list of words for training
train_words = [word for word in int_words if random.random() < (1 - p_drop[word])]

print(train_words[:30])

```

```

[5233, 3080, 58, 741, 10571, 27349, 15067, 58112, 3580, 190, 10712, 6,
104, 2731, 3672, 708, 53, 7088, 5233, 1052, 44611, 2877, 5233, 8983, 4
147, 6437, 4186, 362, 344, 1818]

```

Making batches

Now that our data is in good shape, we need to get it into the proper form to pass it into our network. With the skip-gram architecture, for each word in the text, we want to define a surrounding *context* and grab all the words in a window around that word, with size C .

From [Mikolov et al. \(https://arxiv.org/pdf/1301.3781.pdf\)](https://arxiv.org/pdf/1301.3781.pdf):

"Since the more distant words are usually less related to the current word than those close to it, we give less weight to the distant words by sampling less from those words in our training examples... If we choose $C = 5$, for each training word we will select randomly a number R in range $[1: C]$, and then use R words from history and R words from the future of the current word as correct labels."

Exercise: Implement a function `get_target` that receives a list of words, an index, and a window size, then returns a list of words in the window around the index. Make sure to use the algorithm described above, where you chose a random number of words to from the window.

Say, we have an input and we're interested in the `idx=2` token, 741 :

```
[5233, 58, 741, 10571, 27349, 0, 15067, 58112, 3580, 58, 10712]
```

For $R=2$, `get_target` should return a list of four values:

```
[5233, 58, 10571, 27349]
```

In [6]:

```
def get_target(words, idx, window_size=5):
    ''' Get a list of words in a window around an index. '''

    R = np.random.randint(1, window_size+1)
    start = idx - R if (idx - R) > 0 else 0
    stop = idx + R
    target_words = words[start:idx] + words[idx+1:stop+1]

    return list(target_words)
```

In [7]:

```
# test your code!

# run this cell multiple times to check for random window selection
int_text = [i for i in range(10)]
print('Input: ', int_text)
idx=5 # word index of interest

target = get_target(int_text, idx=idx, window_size=5)
print('Target: ', target) # you should get some indices around the idx
```

```
Input:  [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
Target:  [3, 4, 6, 7]
```

Generating Batches

Here's a generator function that returns batches of input and target data for our model, using the `get_target` function from above. The idea is that it grabs `batch_size` words from a words list. Then for each of those batches, it gets the target words in a window.

In [8]:

```
def get_batches(words, batch_size, window_size=5):
    ''' Create a generator of word batches as a tuple (inputs, targets) '''

    n_batches = len(words)//batch_size

    # only full batches
    words = words[:n_batches*batch_size]

    for idx in range(0, len(words), batch_size):
        x, y = [], []
        batch = words[idx:idx+batch_size]
        for ii in range(len(batch)):
            batch_x = batch[ii]
            batch_y = get_target(batch, ii, window_size)
            y.extend(batch_y)
            x.extend([batch_x]*len(batch_y))
        yield x, y
```

In [9]:

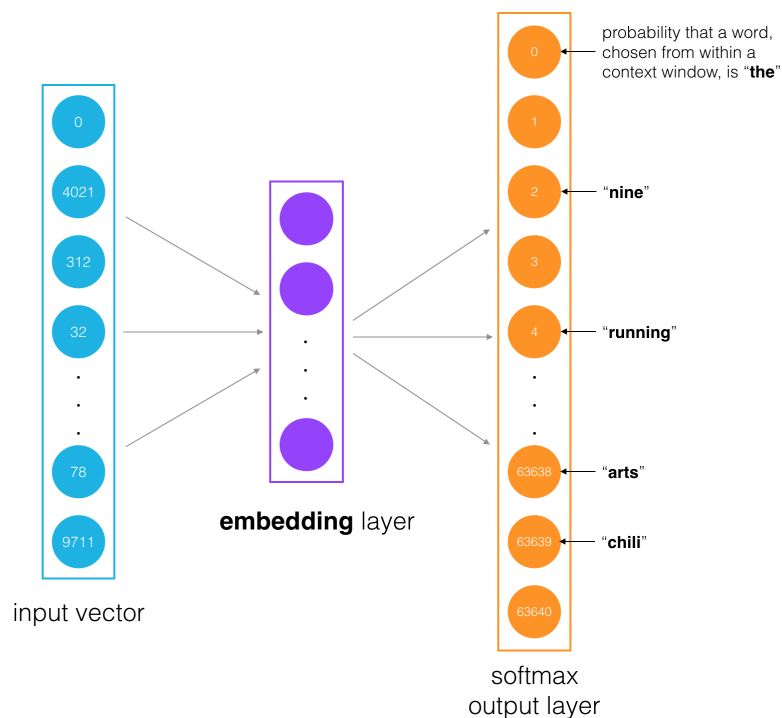
```
int_text = [i for i in range(20)]
x,y = next(get_batches(int_text, batch_size=4, window_size=5))

print('x\n', x)
print('y\n', y)
```

```
x
[0, 0, 0, 1, 1, 1, 2, 2, 2, 3, 3]
y
[1, 2, 3, 0, 2, 3, 0, 1, 3, 1, 2]
```

Building the graph

Below is an approximate diagram of the general structure of our network.



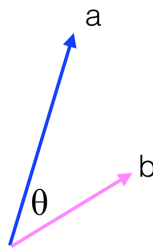
- The input words are passed in as batches of input word tokens.
- This will go into a hidden layer of linear units (our embedding layer).
- Then, finally into a softmax output layer.

We'll use the softmax layer to make a prediction about the context words by sampling, as usual.

The idea here is to train the embedding layer weight matrix to find efficient representations for our words. We can discard the softmax layer because we don't really care about making predictions with this network. We just want the embedding matrix so we can use it in *other* networks we build using this dataset.

Validation

Here, I'm creating a function that will help us observe our model as it learns. We're going to choose a few common words and few uncommon words. Then, we'll print out the closest words to them using the cosine similarity:



$$\text{similarity} = \cos(\theta) = \frac{\vec{a} \cdot \vec{b}}{|\vec{a}| |\vec{b}|}$$

We can encode the validation words as vectors \vec{a} using the embedding table, then calculate the similarity with each word vector \vec{b} in the embedding table. With the similarities, we can print out the validation words and words in our embedding table semantically similar to those words. It's a nice way to check that our embedding table is grouping together words with similar semantic meanings.

In [11]:

```
def cosine_similarity(embedding, valid_size=16, valid_window=100, device='cpu'):
    """ Returns the cosine similarity of validation words with words in the embedding table.
        Here, embedding should be a PyTorch embedding module.
    """

    # Here we're calculating the cosine similarity between some random words and
    # our embedding vectors. With the similarities, we can look at what words are
    # close to our random words.

    # sim = (a . b) / |a||b|

    embed_vectors = embedding.weight

    # magnitude of embedding vectors, |b|
    magnitudes = embed_vectors.pow(2).sum(dim=1).sqrt().unsqueeze(0)

    # pick N words from our ranges (0,window) and (1000,1000+window). lower id implies higher frequency
    valid_examples = np.array(random.sample(range(valid_window), valid_size//2))
    valid_examples = np.append(valid_examples,
                               random.sample(range(1000,1000+valid_window), valid_size//2))
    valid_examples = torch.LongTensor(valid_examples).to(device)

    valid_vectors = embedding(valid_examples)
    similarities = torch.mm(valid_vectors, embed_vectors.t())/magnitudes

    return valid_examples, similarities
```

SkipGram model

Define and train the SkipGram model.

You'll need to define an [embedding layer \(https://pytorch.org/docs/stable/nn.html#embedding\)](https://pytorch.org/docs/stable/nn.html#embedding) and a final, softmax output layer.

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An Embedding layer takes in a number of inputs, importantly:

- **num_embeddings** – the size of the dictionary of embeddings, or how many rows you'll want in the embedding weight matrix
- **embedding_dim** – the size of each embedding vector; the embedding dimension

In [1]:

```
import torch
from torch import nn
import torch.optim as optim
```

In [12]:

```
class SkipGram(nn.Module):
    def __init__(self, n_vocab, n_embed):
        super().__init__()

        self.embed = nn.Embedding(n_vocab, n_embed)
        self.output = nn.Linear(n_embed, n_vocab)
        self.log_softmax = nn.LogSoftmax(dim=-1)

    def forward(self, x):
        x = self.embed(x)
        scores = self.output(x)
        log_ps = self.log_softmax(scores)

        return log_ps
```

Training

Below is our training loop, and I recommend that you train on GPU, if available.

Note that, because we applied a softmax function to our model output, we are using NLLLoss as opposed to cross entropy. This is because Softmax in combination with NLLLoss = CrossEntropy loss .

In [13]:

```

# check if GPU is available
device = 'cuda' if torch.cuda.is_available() else 'cpu'

embedding_dim=300 # you can change, if you want

model = SkipGram(len(vocab_to_int), embedding_dim).to(device)
criterion = nn.NLLLoss()
optimizer = optim.Adam(model.parameters(), lr=0.003)

print_every = 500
steps = 0
epochs = 5

# train for some number of epochs
for e in range(epochs):

    # get input and target batches
    for inputs, targets in get_batches(train_words, 512):
        steps += 1
        inputs, targets = torch.LongTensor(inputs), torch.LongTensor(targets)
        inputs, targets = inputs.to(device), targets.to(device)

        log_ps = model(inputs)
        loss = criterion(log_ps, targets)
        optimizer.zero_grad()
        loss.backward()
        optimizer.step()

    if steps % print_every == 0:
        # getting examples and similarities
        valid_examples, valid_similarities = cosine_similarity(model.embed, dev
_, closest_idx = valid_similarities.topk(6) # topk highest similarities

        valid_examples, closest_idx = valid_examples.to('cpu'), closest_idx.to('cpu')
        for ii, valid_idx in enumerate(valid_examples):
            closest_words = [int_to_vocab[idx.item()] for idx in closest_idx[i]]
            print(int_to_vocab[valid_idx.item()] + " | " + ', '.join(closest_words))
        print("...")

```

```

its | apothecary, entourage, kapoor, captives, perched
or | bridgetown, surveyed, pistis, engages, tiebreaker
as | madhava, messina, trollh, realises, gibraltarians
be | ganymede, matti, dek, competition, gillespie
may | propose, mesh, trapani, lycaon, nod
more | thracians, informing, blvd, failures, aes
and | returns, liverpudlians, limbs, redistributed, operative
who | tackles, discretization, lexically, bleed, kippur
engine | khorasan, candlemas, flemings, strasberg, israelites
channel | poetry, debugging, needed, milla, attracts
operating | taoism, asch, extensions, starting, piccard
bbc | highwind, demigods, complications, atl, temples
alternative | hazmi, dh, lecturers, asthma, ragged
paris | bil, phenomenal, tonight, thugs, accumulations
lived | hartsfield, transcription, buddhism, ancestral, ldap
question | meats, colossians, communism, mwh, theophany
...
after | marital, hero, strongholds, lavey, protrude
four | locker, correction, mocked, screenwriter, itinerarium
into | markka, systematised, unionised, ningen, westminsters

```

seven | turkey, grandfather, southampton, diz, staining
 years | defense, poland, rescinded, maio, silence
 first | bedfordshire, levitated, telemann, congested, porn
 not | agadir, entertainers, ashtabula, squares, oil
 they | harmonica, mainstream, wedded, theodor, seagal
 shown | organises, squid, quanta, eads, canetti
 universe | xa, fauna, infective, personified, chiral
 know | dropkick, jabir, taxis, console, collaborations
 egypt | vu, semicircle, donates, connection, durga
 construction | vivid, openstep, assaulted, penny, zeng
 rise | sextant, aguiler, bored, deviate, abrasion
 discovered | tractate, sweating, lithographs, ditions, metaphor
 ice | decins, horned, lb, btr, invites

...

was | sterile, sleeker, torts, bn, knowledge
 a | rond, bornemisza, boyne, sewerage, fielded
 one | zero, aymara, alvis, vibrates, charlevoix
 its | apothecary, entourage, captives, kapoor, hommes
 while | broca, incapacity, stratification, kernels, went
 not | entertainers, agadir, ashtabula, fundamentalism, squares
 will | lfheim, needles, disuse, deficiencies, rally
 time | scientifiques, liquidated, funds, judges, viewing
 instance | formalizing, disliking, breviaries, moselle, voyage
 defense | ignatius, years, pazzi, footnotes, goatskin
 liberal | tibor, deposited, lesbians, phenols, msi
 rise | sextant, aguiler, deviate, bored, shreck
 event | ninotchka, grupo, anthropic, sooty, baudot
 universe | xa, fauna, infective, personified, chiral
 creation | ali, diomedea, catullus, olney, watashi
 award | bombers, hold, arslan, briar, morant

...

the | genji, gentry, crypto, crushed, vehicle
 been | housed, eggs, fossil, erne, colvin
 some | admetus, outlays, oscilloscope, lachine, baryons
 often | transpersonal, viracocha, coffers, defibrillator, structured
 would | novial, ux, grumpy, laumann, chan
 from | nederlandse, grammatical, combed, exploiting, mod
 more | thracians, informing, wondrous, maturation, trace
 that | committing, jaffa, pods, tardive, mirrored
 except | fuga, hermitian, immigrating, cramped, diplomats
 dr | gokturk, midwinter, glimpsed, untethered, ziggurat
 articles | antinomies, kondratiev, normandie, gong, scored
 troops | refusal, bird, hamm, toile, hornblende
 instance | formalizing, disliking, breviaries, moselle, voyage
 operating | piccard, starting, extensions, origami, taoism
 accepted | unsatisfactory, beats, harboring, cervix, sigismund
 defense | years, ignatius, footnotes, pazzi, sayers

...

history | throws, famer, bionic, ignacy, displeased
 such | expeditions, lpc, kumasi, wes, ifrcs
 after | hero, marital, strongholds, uncontrollable, latterly
 not | fulda, entertainers, squares, ashtabula, agadir
 its | apothecary, covered, captives, entourage, hommes
 been | housed, colvin, involves, fossil, limitation
 would | grumpy, novial, ux, chan, laumann
 will | needles, lfheim, deficiencies, marquardt, jmu
 older | meiosis, bent, szeged, geomorphology, thrills
 test | popcorn, guessing, sapkowski, infiltrate, ointment
 shows | boudin, begining, abkhazians, synchrotron, reputation
 universe | xa, fauna, personified, chiral, infective
 egypt | durga, semicircle, connection, vu, donates

active | dcc, cheng, presides, universes, follower
 animals | burghers, ventura, foix, relish, neonatal
 applied | sonar, perforated, server, flowchart, mcarthur
 ...
 the | genji, gentry, crypto, crushed, wield
 only | khazaria, tournament, customize, commended, qazaqstan
 used | ische, animator, anthrax, harming, singularities
 world | hammond, angled, giantesses, galen, dallas
 b | colliery, l, diesel, physician, stalemate
 two | iuds, hamza, volsunga, byng, per
 other | accessible, mistral, convertible, evesham, engrailed
 some | diocese, admetus, oscilloscope, outlays, lachine
 know | dropkick, jabir, console, collaborations, sectarianism
 cost | patass, pile, orphan, piracy, transmitting
 nobel | maceo, gambler, wilkes, suspends, bus
 existence | kovacs, conway, bats, saaremaa, reminiscent
 bbc | highwind, demigods, atl, counselling, temples
 professional | ousted, warmer, dismisses, havok, agitated
 applications | polygamous, watercourses, os, chaining, voroshilov
 operating | extensions, piccard, origami, sleepers, starting
 ...
 not | fulda, squares, agadir, oil, ashtabula
 people | unfettered, arachnoid, admittance, offenders, deaths
 been | colvin, housed, horseback, liberties, refutations
 american | berglin, waterman, cassie, agricola, vivant
 so | xs, schedules, mah, mengistu, intrinsic
 eight | five, bosman, commissioning, sedating, churn
 will | deficiencies, needles, jmu, sinning, disoriented
 on | nuances, freezer, externalized, tumbling, nyi
 consists | arpa, kilobytes, zyklon, reluctance, florin
 issue | tracked, trotskyist, franchises, epistemology, banknotes
 heavy | prerequisite, dionne, lifeform, remonstrance, housed
 universe | xa, personified, fauna, kill, infective
 freedom | schuyler, moltke, political, elite, rationalize
 grand | dazzle, archaeology, disappointment, motu, invitation
 additional | faithfulness, tactical, sedating, gastronomy, conlangs
 behind | milo, impotent, biographical, ucd, kfar
 ...
 have | apps, damasio, owning, virginity, rerun
 were | niklas, whit, aelia, sorghum, mitre
 united | pharmaceutical, romanov, reuben, corporation, americas
 these | dividend, paulaner, grading, fissure, exempt
 a | rond, fair, paige, pendleton, ulster
 had | statements, wirtschaftswunder, merry, iga, condescending
 has | apulia, cody, nevers, archaeological, jes
 where | honours, bill, duplicity, hashihito, babel
 ice | decins, salty, horned, burmese, btr
 engineering | courageous, perplexing, cirture, sensibilities, interrup
 ts
 additional | faithfulness, alkaline, sedating, tactical, conlangs
 question | colossians, meats, communism, theophany, mwh
 prince | pyroxene, engravings, josephine, aquileia, fraser
 pre | youngman, preferential, travelin, achill, coles
 applied | sonar, perforated, smoot, chimp, technologists
 discovered | chemistry, sweating, metaphor, pavlova, lithographs
 ...
 for | isabelle, malayo, rally, lg, staggered
 be | sayings, defencemen, sparkle, clone, appreciated
 into | systematised, unionised, conjugacy, markka, segment
 was | bn, resentful, homogenic, azores, sepp
 has | apulia, cody, ifab, archaeological, nevers

will | jmu, disoriented, deficiencies, needles, tolerable
 where | hashihito, reminding, bill, akkad, weald
 known | eisenman, mosaic, emedicine, wls, convocation
 cost | patass, pile, piracy, coleco, transmitting
 shown | squid, majlis, canetti, organises, nonhuman
 rise | aguilera, sextant, deviate, according, modulators
 nobel | maceo, hanlon, gambler, suspends, wilkes
 orthodox | corrupt, waived, bude, lecturers, silt
 articles | normandie, kondratiev, antinomies, amigaos, ramstein
 construction | vivid, cubewanos, openstep, penny, unsuited
 ocean | archeologists, outcrops, nepomuk, jinn, steller
 ...
 the | gentry, genji, unskilled, lionhead, crypto
 while | incapacity, broca, marxists, feyd, stratification
 as | allocates, franz, statements, authored, madhava
 would | novial, their, grumpy, theologico, centres
 from | nederlandse, coates, combed, polonia, grammatical
 called | trilobite, aneurin, probed, proximity, struggling
 he | cousin, abelard, spacey, nsaid, savage
 use | conquistadors, cruel, stokes, alike, ves
 bible | balboa, islam, fullness, tiananmen, wissowa
 lived | hartsfield, ancestral, alamein, regarded, chroma
 quite | kanpur, pastors, ooc, acclaim, hai
 assembly | fabricius, rquez, crc, mughal, debayle
 professional | ousted, dogme, unpublished, revamping, dismisses
 nobel | maceo, hanlon, gambler, suspends, prize
 liberal | tibor, commercial, lesbians, colonials, msi
 additional | faithfulness, tactical, conlangs, alkaline, sedating
 ...
 only | tournament, ribao, commended, customize, progeny
 can | geodesic, suffix, terse, pixel, optimal
 new | sections, soso, coburn, rabia, replica
 if | dictator, butyric, wentworth, penal, improves
 th | marwan, yeshiva, burgundian, newspaperman, eloheinu
 world | siddha, hammond, played, giantesses, effort
 than | nuisance, sigmoid, unreliability, makes, surged
 five | eight, unusually, four, dynasty, kandinsky
 freedom | political, rationalize, moltke, restoring, ancestries
 primarily | pattie, uneven, have, testimonials, vytautas
 animals | burghers, ventura, victims, relish, neonatal
 bible | balboa, islam, wissowa, fullness, concr
 mean | reformation, revolve, commences, catechumen, girl
 troops | refusal, toile, jaspers, paolo, odense
 behind | ucd, drinkers, impotent, drowns, milo
 mathematics | trilogy, soci, dupuis, amputation, depressing
 ...
 seven | two, zero, southampton, canvases, ing
 when | madre, ucs, snatched, shorebirds, cordial
 all | therapeutae, convair, therus, renovate, larsson
 united | pharmaceutical, romanov, reuben, corporation, manhunter
 so | schedules, mah, intrinsic, xs, mengistu
 one | zero, nine, six, two, eight
 they | clashed, crosley, inward, discretion, remuneration
 years | poland, xry, rescinded, claret, defense
 know | dropkick, jabir, console, collaborations, pick
 file | rijndael, mellows, erlang, eben, dih
 ice | decins, horned, salty, iris, clements
 resources | balaton, pataki, clearer, exploration, sociopolitical
 cost | patass, piracy, coleco, pile, sustaining
 articles | normandie, kondratiev, antinomies, causeway, agu
 defense | partisan, sayers, ignatius, cottle, pazzi

consists | arpa, aleksey, kilobytes, reluctance, nagaoka
 ...
 be | defencemen, scythians, sayings, absence, homilies
 only | tournament, ribao, commended, progeny, customize
 were | centuries, sorghum, nahar, fc, niklas
 often | transpersonal, viracocha, coerce, besides, interchangeably
 people | deaths, arachnoid, nonproliferation, admittance, remember
 to | bring, bentine, visigoth, jewish, breakthrough
 have | primarily, rerun, owning, virginity, apps
 a | rond, fair, presided, wizards, delayed
 accepted | auditioning, unsatisfactory, sinned, arbenz, incantation
 smith | satirists, deut, burman, chee, departing
 consists | arpa, kilobytes, reluctance, aleksey, nagaoka
 question | colossians, meats, theophany, mwh, proselytizing
 taking | bimmer, ill, gyroscope, maslow, schwitters
 centre | condenses, xyz, salvatore, tyr, touring
 road | airport, vince, bubbled, imprisoning, protons
 active | presides, dcc, cheng, transparency, savard
 ...
 six | one, three, four, eight, two
 over | hotels, gasp, baltic, congregated, sabbatical
 are | there, lds, swnts, domed, vindicated
 during | fripp, thunderstorm, gta, latinized, actinium
 been | colvin, horseback, liberties, coria, colliding
 of | london, in, now, spy, alsatian
 however | panarion, kitchener, moderately, multipoint, wycliffe
 world | siddha, giantesses, hammond, effort, arpa
 pre | youngman, travelin, yoho, programmable, multitrack
 san | chairman, pauling, modernized, muddy, foote
 primarily | have, uneven, emc, pattie, testimonials
 freedom | political, moltke, restoring, rationalize, tenured
 writers | itch, abrahams, politicians, dave, centime
 know | dropkick, console, jabir, collaborations, i
 marriage | borja, aunt, withdrawal, stood, dissuade
 bible | balboa, px, storefront, lddc, flyweight
 ...
 had | condescending, statements, amnesiac, buddhism, iga
 years | poland, claret, xry, rescinded, birth
 if | butyric, chinon, expresses, nobody, oppressed
 one | zero, nine, six, eight, two
 use | conquistadors, cruel, uses, dictionary, scarab
 world | hammond, siddha, effort, denslow, giantesses
 called | proximity, cena, escorted, aneurin, elegans
 when | madre, monadic, ucs, judicially, snatched
 cost | patass, piracy, pile, coleco, insurrectionary
 assembly | rquez, resigned, chief, crc, memo
 writers | politicians, abrahams, itch, dave, by
 magazine | overbearing, cigar, unfolding, singularity, hobby
 animals | burghers, reproduction, victims, relish, neonatal
 professional | ousted, players, unpublished, artie, revamping
 powers | nationalists, bobcat, filo, generalship, conveys
 channel | backward, tier, needed, attracts, smelling
 ...
 may | starley, hostages, tastes, propose, merging
 united | reuben, romanov, pharmaceutical, americas, corporation
 about | waving, tumbuka, dmt, recessions, patmos
 only | tournament, commended, ribao, modulated, customize
 war | ii, saw, estas, defecting, mossad
 for | isabelle, covering, most, outranks, lg
 he | his, spacey, him, revue, doubts
 first | ania, bedfordshire, telemann, insensible, philistines

san | chairman, pauling, modernized, foote, conservatory
 applied | perforated, technologists, sonar, smoot, chimp
 channel | backward, radio, tier, milla, attracts
 engineering | courageous, perplexing, soc, kak, arachne
 applications | os, chaining, polygamous, watercourses, sht
 bbc | highwind, updated, atl, computing, supplemented
 orthodox | corrupt, adherents, bude, calvinists, chaldees
 bill | sides, security, lakshadweep, lvaro, mason
 ...
 five | four, eight, two, zero, six
 who | kazakh, amram, alabama, shred, tackles
 eight | one, five, four, six, two
 war | ii, saw, defecting, troop, estas
 as | participated, precautionary, trollh, iit, example
 not | exclusively, fulda, could, invalidating, arcane
 to | persson, bring, know, uproar, commercialize
 many | online, viridis, gol, distinct, unquestioned
 recorded | cello, xxxix, shark, wart, mcghee
 operations | eigenfunctions, egress, hemorrhagic, ownership, landhold
 ng
 bill | sides, lakshadweep, mason, lvaro, security
 proposed | tariff, janus, reinstate, governorates, formulation
 hold | comanche, muad, prem, homeported, visualized
 discovered | chemistry, lithographs, pavlova, peach, sweating
 know | dropkick, tried, jabir, console, collaborations
 notes | redirection, wiki, vma, octave, ravens
 ...
 known | minor, sahel, settled, frustrating, emedicine
 up | iommi, corbett, encryption, dario, erlewine
 use | uses, iec, conquistadors, hyperplasia, dimethyl
 about | tumbuka, waving, geoid, recessions, cumbric
 seven | two, nine, zero, one, eight
 called | covalent, cena, mu, impedance, escorted
 between | conceptual, barrichello, abreast, rude, circumference
 not | could, or, accept, exclusively, invalidating
 question | colossians, proselytizing, meats, theophany, emphasizing
 lived | hartsfield, ancestral, alamein, chroma, transcription
 running | layering, runs, federer, halacha, tokelau
 magazine | overbearing, cigar, kino, collectible, hobby
 bbc | highwind, computing, updated, atl, zero
 articles | normandie, reformation, gong, kondratiev, spiky
 taking | ill, joe, maslow, gyroscope, annalen
 file | rijndael, psychoanalytical, mellows, grothendieck, mesi
 ...
 for | kickoff, isabelle, chambersburg, blacked, pacos
 people | denial, deaths, remember, stress, admittance
 american | recipient, singer, actress, swedish, nine
 most | are, chih, deformation, polytheistic, modula
 no | clique, fraktion, ingenioso, user, reelection
 his | he, was, her, him, relics
 the | of, hades, range, first, to
 other | cations, lymphedema, is, rinse, ic
 grand | dazzle, street, archaeology, motu, nc
 proposed | tariff, reinstate, governorates, janus, reluctantly
 older | plantes, rampton, lexical, ousterhout, extravagance
 quite | kanpur, ooc, acclaim, pastors, recipe
 behind | drowns, vecchio, archelaus, spyglass, girondins
 troops | refusal, army, battle, wwi, armies
 san | conservatory, chairman, pauling, modernized, upriver
 know | dropkick, tried, jabir, i, sectarianism
 Loading web-font STIX-Web/Size3/Regular
 ...

this | datatype, supportive, submission, paraclete, generally
 where | bypasses, zenith, tajiks, perpendicular, weald
 or | word, and, milnor, seaweed, medial
 people | deaths, denial, remember, admittance, presidencia
 five | four, eight, one, zero, six
 also | is, usp, ability, ethnicity, pine
 for | isabelle, hotspur, kickoff, antiques, in
 of | religious, in, azad, the, now
 http | page, html, loosely, www, web
 san | conservatory, chairman, pauling, modernized, plaid
 older | plantes, rampton, ousterhout, extravagance, lexical
 rise | sextant, deviate, aguileria, modulators, according
 file | rijndael, psychoanalytical, executables, mellows, ignoble
 except | planners, asgard, veiled, japonic, choked
 hold | taxpayers, unthinkable, comanche, prem, demarcated
 derived | melos, kilowatt, ferment, pd, progressives
 ...
 some | recognize, admetus, dentists, gaon, marxian
 other | spearman, or, lymphedema, is, number
 used | stroking, ische, harming, typographical, particularly
 where | bypasses, hades, tajiks, weald, zenith
 from | satsuki, iban, magic, griffon, jell
 or | word, milnor, medial, other, surveyed
 the | and, of, in, wares, servicing
 world | played, denslow, effort, belgium, in
 construction | cubewanos, vivid, behaviours, building, massively
 scale | greyish, nueva, miscarriages, bewildering, horst
 assembly | memo, chief, appointed, interchanged, re
 mean | catechumen, unobservable, girl, revolve, reformation
 http | page, html, www, loosely, web
 pope | xi, john, kitchener, hypertalk, expedients
 behind | drowns, archelaus, spyglass, stumbling, would
 something | statements, refreshed, ytterbium, crazy, numb
 ...
 to | not, tariff, ministries, the, in
 there | are, evangelical, ih, males, mong
 be | that, defencemen, they, this, any
 system | dortmund, peripheral, developments, altes, gc
 into | systematised, dissented, turbines, paternoster, absorbing
 people | deaths, denial, remember, exterminated, admittance
 all | are, existence, if, invertible, or
 world | denslow, effort, bud, bader, bolivia
 active | presides, salut, transparency, recommendations, bodies
 notes | icao, wiki, vma, tswana, redirection
 bbc | highwind, radio, interview, updated, naughty
 magazine | intergalactic, overbearing, cigar, kino, gwen
 joseph | morris, jeffery, sam, pastoral, moreau
 numerous | malibu, enunciation, isolation, clientele, roaming
 derived | kilowatt, pd, melos, ferment, polycystic
 construction | cubewanos, behaviours, vivid, mitcham, dickens
 ...
 d | b, kurt, mprp, yx, michel
 will | my, your, they, you, looks
 time | externalization, mael, funds, extrapolating, thermal
 had | his, was, he, him, condescending
 most | have, for, are, deformation, chih
 often | layers, interchangeably, coerce, sketching, fainting
 is | the, a, or, also, to
 was | his, had, were, salary, nikolai
 pressure | unconsciousness, transition, conduction, kinetic, quarters
 orthodox | church, catholic, denomination, interests, corrupt

lived | hartsfield, ancestral, alamein, chroma, frost
 centre | touring, xyz, varuna, condenses, salvatore
 grand | street, motu, dazzle, highwind, invitation
 test | popcorn, icao, guessing, infiltrate, niosh
 marriage | aunt, upheld, kazantzakis, borja, migrated
 shown | exponential, realization, ascertain, extensionality, unprotect
 ed

...

people | deaths, exterminated, remember, ones, natives
 three | one, zero, two, four, six
 where | bypasses, sides, recoiled, if, will
 have | some, most, are, capacities, their
 states | individuals, international, amendment, entailed, civil
 by | the, wonderland, accountants, was, ashton
 for | most, a, duplicated, how, persuade
 known | games, also, minor, mythology, loosely
 frac | we, iy, y, theta, constant
 universe | xa, personified, origin, supernatural, bo
 bill | security, mason, lakshadweep, sides, lvaro
 account | fornax, real, farmhouse, foreshadow, lasor
 versions | ess, lx, systems, starcraft, erina
 grand | motu, street, dazzle, invitation, anticlockwise
 channel | network, radio, backward, debugging, hare
 construction | cubewanos, vivid, behaviours, mitcham, building

...

are | there, most, of, and, have
 an | isosceles, mcfadden, dom, additional, coucy
 were | anticipated, reassert, have, sorghum, been
 many | distinct, sounds, unquestioned, related, are
 while | entertain, corkscrew, incapacity, phospholipid, dune
 of | the, and, in, a, are
 four | one, two, five, three, six
 over | total, two, baltic, one, male
 pre | preferential, eliyahu, travelin, vedas, youngman
 woman | daughter, male, marry, live, pregnant
 stage | actors, singled, walk, patton, concert
 ocean | himalaya, outcrops, intelsat, sierra, pillar
 joseph | jeffery, morris, sam, mortimer, honor
 alternative | hazmi, dh, criticized, bambara, earthenware
 resources | diachronic, improved, spammers, agriculture, exploration
 arts | art, graduate, susskind, school, institute

...

and | the, of, caracal, are, some
 an | of, a, topological, is, algebra
 th | nd, century, centuries, one, ceawlin
 are | have, most, other, more, and
 in | of, was, scandinavia, the, and
 than | sigmoid, makes, nuisance, bigger, much
 by | sussman, of, and, the, be
 there | are, ih, cases, males, locality
 stage | actors, walk, singled, beethoven, hollywood
 san | conservatory, caldera, cavallo, modernized, earn
 active | combustible, salut, presides, transparency, excludes
 consists | nagaoka, aleksey, bayh, reluctance, kilobytes
 operations | operation, security, excision, landholding, eac
 mean | unobservable, mantras, is, revolve, difference
 bill | security, lvaro, mason, fun, comedian
 governor | supreme, lord, forza, parliaments, democrat

...

at | noone, mile, angeles, finishing, per
 zero | two, three, four, six, eight

or | is, word, other, to, not
 will | my, looks, you, enough, switchable
 some | have, are, as, such, other
 may | vocative, starley, appropriate, insensible, or
 s | nine, one, and, four, two
 see | list, jagan, links, here, also
 alternative | hazmi, dh, criticized, immemorial, bambara
 troops | war, army, refusal, rebels, battle
 writers | novelists, politicians, humorists, alumni, homepage
 issue | banknotes, trotskyist, franchises, epistemology, goering
 applied | technologists, intention, perforated, versioning, eec
 mainly | balkan, patagonian, primarily, retained, beit
 proposed | tariff, be, governorates, reinstate, hyperplane
 smith | jim, paterson, chee, kaufman, lap
 ...
 for | how, four, in, are, equating
 an | intermembrane, of, inhumane, to, renewed
 other | are, or, usually, some, is
 in | the, of, world, after, and
 are | there, other, such, most, or
 up | corbett, iommi, saimiri, chatti, edge
 system | systems, dortmund, separate, developments, development
 war | military, troops, wwii, wars, defecting
 hit | puente, microphone, restart, appropriate, wizard
 engine | powered, fv, cars, glock, flemings
 except | planners, is, parts, asgard, other
 liberal | conservatism, msi, reform, commercial, argue
 institute | arts, school, genealogy, studies, abrahams
 egypt | egyptian, nasser, syria, depopulation, abdullah
 units | amistad, kilogram, min, prefixes, disengage
 dr | sara, giulia, nonaligned, trevor, aldrin
 ...
 there | are, that, sabotaged, similar, insular
 that | be, it, not, to, of
 were | was, in, some, after, been
 between | the, in, linea, seeks, both
 where | recoiled, left, stitch, course, exists
 for | in, to, tutelage, how, as
 world | denslow, international, in, war, mtu
 so | be, to, ourselves, intrinsic, nullified
 hold | backstory, muad, unthinkable, cavalli, choosing
 smith | jim, paterson, chee, satirists, kaufman
 road | airport, roads, passenger, route, interstate
 dr | giulia, sara, nonaligned, der, theodor
 placed | trecento, canvas, excavation, defecting, laying
 notes | compositions, redirection, tswana, octave, metrology
 account | real, fornax, farmhouse, mench, impression
 behind | archelaus, quickly, spyglass, skirmishing, drowns
 ...
 this | a, the, is, or, it
 when | it, in, sow, tta, that
 had | was, until, brought, to, his
 however | that, so, not, is, allies
 will | my, you, allows, be, they
 its | the, tourism, of, a, has
 to | the, that, of, and, in
 of | the, and, by, a, is
 mainly | primarily, also, balkan, language, patagonian
 hold | muad, taxpayers, unthinkable, backstory, inscrutable
 report | rajendra, approved, june, biggio, office
 applied | technologists, perforated, versioning, mesmer, chimp

existence | enlightenment, lihou, eternal, faiths, hominin
 cost | price, piracy, sustaining, insurrectionary, ammunition
 test | detection, rocket, popcorn, niosh, marginalize
 stage | actors, radiate, beethoven, eckenstein, walk
 ...
 there | are, not, that, in, go
 other | are, is, or, these, some
 four | one, two, five, three, seven
 such | many, are, some, other, that
 known | settled, mythology, mentions, of, ranks
 see | list, links, external, also, coterminous
 nine | one, seven, two, four, three
 been | were, was, hashemite, committee, early
 http | www, html, com, links, web
 square | headwaters, hour, kilometre, area, miles
 cost | price, piracy, invest, insurrectionary, sustaining
 question | proselytizing, colossians, i, gentry, inasmuch
 centre | sprawling, touring, town, innovations, city
 rise | sextant, according, modulators, mieszko, caliente
 behind | archelaus, quickly, spyglass, collapses, hold
 pressure | kinetic, wick, unconsciousness, duma, lecithin
 ...
 he | his, him, was, had, moved
 which | the, and, by, tz, on
 often | sometimes, rather, gamelan, horns, namo
 use | used, manual, uses, available, admittedly
 when | it, tta, that, then, landowners
 the | in, is, and, of, its
 a | is, and, the, of, into
 up | to, you, i, corbett, the
 centre | education, city, sprawling, town, campus
 square | headwaters, hour, area, miles, kilometre
 older | median, families, plantes, age, income
 hold | taxpayers, backstory, millennialism, muad, unthinkable
 test | rocket, detection, icao, popcorn, flight
 file | storage, rijndael, psychoanalytical, mellows, mesi
 running | runs, platform, vt, tokelau, coles
 experience | hinduism, panpsychism, bodhi, teach, me
 ...
 but | to, that, seamen, only, true
 first | the, in, place, time, second
 more | are, less, tend, such, for
 many | such, are, some, have, most
 years | zero, four, age, five, six
 however | allies, that, not, necessarily, required
 it | that, is, doing, do, not
 united | states, nations, presidents, virginia, australia
 governor | state, government, representative, democrat, cabinet
 instance | be, lattices, cobol, formalizing, disliking
 road | airport, roads, route, passenger, railway
 hit | puente, hits, restart, album, cried
 accepted | auditioning, colleague, athanasian, learn, fathers
 ocean | atlantic, am, stations, pacific, intelsat
 derived | root, glycosides, variants, word, kilowatt
 taking | joe, ill, indistinguishable, involving, maslow
 ...
 six | four, three, two, five, one
 one | nine, eight, seven, four, three
 five | four, two, eight, one, six
 not | to, do, it, that, there
 may | jurisdictions, any, conclusively, severity, lasts

two | three, four, zero, five, six
th | century, nd, late, six, centuries
american | eight, nine, born, singer, actor
mainly | primarily, included, sultanates, have, or
mathematics | mathematical, humanities, physics, study, mathematicians
placed | defecting, canvas, extensive, nairobi, trecento
dr | sara, cricketer, giulia, muggs, nonaligned
report | approved, rajendra, terrorists, biggio, outgrabe
professional | players, mascot, cornerbacks, revamping, sports
marriage | marriages, marry, divorce, married, aunt
resources | resource, petroleum, witwatersrand, country, agriculture
...
these | are, can, most, namespaces, several
also | are, see, and, as, is
can | be, are, ability, common, do
see | links, list, also, external, uses
from | the, on, by, and, to
known | of, also, the, is, nil
his | he, him, her, returned, had
to | would, not, and, had, that
police | guards, guard, military, officials, bainbridge
heavy | punk, pounder, enemy, transformers, destroyer
primarily | have, mainly, shanghai, recently, wurzel
construction | constructed, building, vivid, quarrying, romanesque
applications | systems, operating, computer, os, solaris
existence | eternal, lihou, believes, enlightenment, essence
institute | school, studies, biotechnology, lecturer, arts
square | kilometre, hour, mile, miles, magnificently
...
s | one, four, two, nine, seven
their | would, or, they, have, those
time | first, reputation, several, externalization, during
to | that, would, while, the, this
used | commonly, use, simpler, term, various
he | his, him, was, she, had
so | ourselves, know, that, will, form
over | total, qasr, million, male, ghola
shows | show, dvd, sexy, television, outro
pope | xi, sixtus, iv, vi, vii
pre | revivalist, preferential, achaemenids, sleepers, confucianism
know | you, i, my, we, want
hit | hits, album, puente, restart, hitting
discovered | discovery, discoveries, voyager, pavlova, lithographs
frac | theta, f, iy, sqrt, prod
notes | compositions, coins, octave, concise, metrology
...
most | are, these, than, considered, more
had | was, later, his, were, first
to | only, not, that, they, would
where | delta, sup, bypasses, recoiled, stosunku
that | it, be, not, to, this
he | his, him, doctorate, went, she
however | not, because, required, even, logically
may | jurisdictions, certain, occur, treated, dosage
assembly | parliament, bicameral, council, seats, proportional
egypt | egyptian, pharaoh, syria, mesopotamia, alexandria
frac | theta, f, right, negative, sqrt
woman | marry, fertility, women, wife, god
defense | weapons, cavalry, superiority, israeli, guns
primarily | have, mainly, than, wurzel, displaced
issue | issues, legal, venom, banknotes, bumblng

articles | org, news, reformation, book, documents
 ...
 some | are, many, does, have, such
 there | are, is, in, as, years
 six | three, four, eight, one, five
 a | in, by, but, an, each
 been | early, were, have, stipulated, decades
 so | ourselves, trypho, nullified, know, dissociative
 had | was, later, were, after, his
 or | is, are, other, to, with
 cost | price, expensive, piracy, usd, coleco
 brother | married, sons, son, wife, daughters
 running | runs, run, platform, skits, popularity
 bible | testament, hebrew, translation, books, biblical
 award | awards, awarded, best, achievement, won
 quite | stakes, rustic, sheer, fick, blues
 lived | ancestral, deists, abductions, sores, claimed
 animals | humans, cows, animal, beings, birds
 ...
 six | eight, three, one, five, four
 than | less, most, more, much, makes
 however | but, that, the, came, chaldees
 often | typically, sometimes, usually, effects, horns
 nine | one, eight, three, four, seven
 when | to, for, could, bulky, get
 from | the, in, and, elsewhere, for
 their | they, with, themselves, are, as
 ocean | atlantic, am, islands, island, coast
 proposed | tariff, bang, via, starships, chairmanship
 lived | ancestral, sores, abductions, permian, hartsfield
 square | mile, occupies, hour, adjacent, thirds
 operating | unix, os, extensions, interface, default
 troops | army, forces, war, allied, battle
 nobel | prize, laureate, physicist, biochemist, chemist
 existence | fact, humans, eternal, supernatural, nihilism
 ...
 such | some, and, as, many, are
 more | less, and, than, to, are
 war | wars, soviet, army, allied, troops
 zero | two, three, four, six, eight
 system | systems, dortmund, traffic, levels, operating
 up | down, them, someone, easily, bolted
 new | york, colony, incorporated, dalrymple, symbolized
 no | link, there, recombined, total, yes
 experience | observable, posture, experiences, ability, panpsychism
 hold | ranking, taxpayers, millennialism, muad, jamais
 test | cricket, testing, tests, flight, rocket
 troops | army, forces, war, allied, armies
 marriage | her, marriages, married, divorce, wife
 lived | ancestral, sores, abductions, permian, deists
 active | association, abuses, organization, include, member
 brother | married, sons, son, wife, daughters
 ...
 when | so, to, for, had, start
 often | typically, sometimes, usually, variety, rather
 such | are, as, also, many, more
 all | are, the, every, any, they
 for | a, the, is, to, or
 states | united, state, u, law, american
 their | they, have, those, as, would
 at | year, each, winter, where, is

channel | radio, network, tv, bbc, satellite
 experience | observable, posture, panpsychism, username, steamboat
 active | abuses, mannerheim, include, youth, salut
 mainly | primarily, natufian, forestry, sultanates, relatively
 square | mile, area, miles, occupies, hour
 troops | army, forces, armies, war, attack
 stage | actors, concert, kerguelen, oxidizer, walk
 ocean | atlantic, coast, am, stations, pacific
 ...
 called | the, which, a, form, are
 a | the, is, for, which, or
 but | not, because, very, yet, to
 so | ourselves, be, do, we, if
 war | wars, military, soviet, army, revolution
 he | his, him, who, himself, she
 or | are, a, with, also, typically
 an | a, of, additional, the, eric
 accepted | colleague, tischendorf, confirmation, recombined, proposed
 taking | rushed, where, indistinguishable, ill, unsure
 except | only, asgard, choked, homeomorphic, if
 additional | capabilities, an, single, other, discontinued
 mainly | primarily, natufian, sultanates, mesothelioma, hollandic
 channel | network, tv, radio, bbc, aired
 heavy | pounder, during, lighter, bauds, enemy
 frac | f, x, theta, sqrt, n
 ...
 will | your, do, to, allows, you
 history | links, historical, topics, site, bibliography
 state | legislature, university, goodhue, states, community
 world | international, history, war, nations, era
 nine | one, eight, two, four, seven
 for | a, to, and, in, the
 people | births, deaths, living, natives, americans
 american | born, musician, singer, actor, americans
 san | francisco, jose, diego, california, rio
 experience | observable, persist, experiences, knowledge, panpsychism
 troops | army, forces, armies, soviet, war
 marriage | her, marriages, marry, married, divorce
 joseph | isbn, geologist, charles, wilhelm, pierre
 existence | eternal, essence, concept, belief, beings
 channel | tv, satellite, network, radio, aired
 governor | minister, chief, cabinet, legislature, appointed
 ...
 over | total, one, zero, three, two
 up | down, starts, need, pair, iommi
 all | are, any, such, of, only
 four | one, five, three, two, six
 had | was, after, were, his, later
 from | in, of, on, the, and
 war | wars, allied, troops, soviet, military
 people | americans, natives, births, deaths, citizens
 universe | cosmological, cosmology, moonraker, fictional, mcduck
 running | run, runs, ran, platform, tokelau
 woman | wife, she, marry, women, her
 issue | issues, legal, debate, endorsing, referrals
 consists | consisting, aleksey, lebrun, harpists, judicial
 accepted | colleague, tischendorf, recombined, confirmation, fathers
 something | like, really, nothing, dispel, algorithmically
 file | files, disk, format, document, operating

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 d | b, seven, one, nine, eight

three | four, one, two, six, five
 an | and, to, a, of, second
 at | university, where, failed, an, tour
 zero | two, four, three, six, five
 use | used, can, systems, using, uses
 its | the, tourism, which, commercial, steadily
 two | zero, three, four, one, nine
 applications | systems, application, technology, software, interface
 taking | where, unsure, indistinguishable, take, attending
 except | only, there, not, all, nouns
 mathematics | mathematical, theory, algebra, theorems, numbers
 lived | he, died, sores, mother, man
 professional | players, sports, cornerbacks, association, trained
 liberal | conservatism, party, conservative, progressive, politics
 troops | army, war, battle, allied, soviet
 ...
 on | of, the, with, and, between
 three | two, four, one, six, nine
 up | down, promenade, starts, almost, you
 united | states, british, nations, britain, australia
 no | link, import, if, duplicate, already
 also | see, list, as, main, known
 was | had, later, his, after, died
 new | york, press, reprinted, acre, isbn
 question | questions, whether, call, if, skeptical
 mean | temperature, diameter, average, parallax, unobservable
 dr | dre, sara, report, trevor, theodor
 creation | created, explanation, flood, worlds, anatomists
 freedom | rights, restoring, expression, sustainability, political
 articles | com, article, books, book, org
 animals | humans, animal, eating, reproduction, cows
 behind | thrust, quickly, belichick, preventing, side
 ...
 can | be, example, are, must, means
 over | total, four, zero, three, nine
 may | be, any, certain, this, or
 years | year, months, age, five, one
 these | are, many, most, not, such
 if | we, be, every, any, then
 first | by, later, early, which, in
 on | the, of, from, with, and
 universe | cosmological, cosmology, moonraker, matter, fictional
 animals | humans, animal, eating, mammals, cows
 governor | representative, legislature, appointed, government, chief
 active | secretariat, mannerheim, presides, members, abuses
 scale | scales, observations, instrument, quantities, large
 arts | art, graduate, institutions, degree, prestigious
 shown | ni, alene, delineate, exponential, stress
 joseph | composer, jeffery, painter, honor, scarpa
 ...
 d | b, e, f, c, pr
 are | or, such, other, these, all
 that | to, be, any, a, this
 where | delta, same, exists, if, is
 system | systems, the, operating, separate, which
 will | allows, does, my, can, wait
 zero | two, three, four, one, five
 use | used, can, using, many, uses
 resources | resource, information, agriculture, source, external
 ice | hockey, canadian, athletes, roller, basketball
 recorded | records, dates, dated, larmor, coptic

placed | resting, tosses, redeemed, somewhere, merciful
 derived | modern, derives, phrase, root, distinct
 mainly | primarily, parts, some, mountainous, language
 ocean | atlantic, islands, pacific, intelsat, am
 award | awards, awarded, best, won, emmy
 ...
 would | to, they, their, had, that
 four | one, two, five, three, seven
 most | have, many, particularly, include, such
 many | such, some, most, these, were
 people | deaths, natives, living, americans, citizens
 eight | one, six, seven, four, five
 into | the, part, east, in, to
 his | he, him, himself, after, was
 pressure | liquid, temperature, pressures, propellant, heat
 assembly | council, parliament, deputies, legislative, member
 units | unit, prefixes, disengage, approximately, force
 instance | cobol, languages, jurisdictions, derivation, addition
 defense | security, foreign, agency, u, service
 know | you, want, i, me, we
 mainly | primarily, mountainous, some, parts, mostly
 ocean | atlantic, islands, pacific, stations, coast
 ...
 seven | one, four, five, eight, three
 would | to, their, they, that, had
 eight | six, four, one, five, three
 two | zero, three, four, one, five
 his | he, him, had, himself, after
 states | united, u, state, constitution, virginia
 three | two, four, one, six, five
 new | york, press, nine, state, conference
 powers | exercised, power, wigner, expanded, fraught
 account | accounts, definitive, mentions, discordia, executables
 instance | jurisdictions, use, languages, borrowings, example
 bbc | interview, abc, aired, radio, news
 numerous | including, and, several, include, are
 operating | unix, os, ported, windows, extensions
 cost | dollars, budget, expensive, costing, invest
 report | reports, concluded, pdf, witness, coop
 ...
 if | example, we, not, true, measure
 use | used, systems, using, are, uses
 all | every, with, be, are, such
 are | or, such, other, these, there
 often | typically, sometimes, usually, settings, rather
 seven | one, four, five, eight, six
 over | zero, total, four, five, two
 may | be, certain, depending, occur, specific
 proposed | rejected, tariff, formed, bill, proposal
 powers | exercised, monarch, power, exercising, ceremonial
 existence | eternal, universe, reincarnation, discovery, lihou
 operating | unix, systems, ported, microsoft, windows
 hit | hits, album, hitting, billboard, debut
 account | definitive, accounts, executables, discordia, meteorologists
 applications | software, interface, systems, application, proprietary
 shows | show, appeared, television, itv, theatrical
 ...
 i | you, my, me, t, know
 b | d, actor, one, writer, politician
 may | certain, depending, occur, or, should
 two | three, zero, four, nine, five

the | of, is, a, and, by
 world | between, history, in, most, total
 for | a, and, is, with, only
 and | of, with, for, in, the
 resources | resource, hydropower, protection, agricultural, petroleum
 quite | difficult, different, most, straightforward, than
 centre | centers, museums, airport, shopping, education
 ocean | pacific, atlantic, am, intelsat, islands
 animals | animal, humans, eating, species, reproduction
 derived | derives, root, origin, corresponding, latin
 units | unit, si, prefixes, conversion, approximately
 versions | version, proprietary, systems, interface, portable
 ...
 years | year, months, age, days, over
 where | delta, then, \mathbf{right} , left
 so | do, that, can, it, able
 such | are, or, as, called, used
 known | of, also, the, other, referred
 one | four, three, eight, seven, nine
 but | just, however, to, did, not
 b | d, actor, politician, writer, one
 quite | difficult, mechanically, different, used, straightforward
 alternative | many, such, hdl, standard, annotate
 channel | channels, radio, network, satellite, tv
 know | you, say, me, myself, stuff
 road | roads, route, airport, connecting, passenger
 mainly | stretched, almost, mostly, mountainous, mixed
 grand | michigan, street, virginia, soccer, prix
 test | testing, tests, flight, cricket, risk
 ...
 zero | two, five, eight, three, six
 about | approximately, thousand, half, million, estimated
 however | this, that, been, fact, although
 used | use, usually, other, uses, term
 their | themselves, they, them, only, would
 had | were, later, he, went, after
 its | steadily, due, far, tourism, southwest
 have | are, been, that, some, they
 bill | bush, singer, george, clinton, president
 engineering | technology, engineers, technical, electrical, physics
 older | age, median, families, household, younger
 accepted | was, universally, be, tischendorf, papal
 assembly | elected, deputies, parliament, senate, seats
 proposed | rejected, proposal, completed, tariff, aaaa
 mean | value, diameter, variable, arithmetic, approximated
 account | discoveries, surpluses, infliction, accounts, explanation
 ...
 war | battle, allied, troops, army, defeat
 eight | one, six, seven, five, nine
 four | one, two, five, six, three
 can | properties, is, example, requires, used
 more | less, than, tend, or, usually
 was | later, had, a, were, died
 as | be, the, also, known, not
 in | the, of, and, first, all
 ice | canadian, snow, glacier, covered, snout
 prince | princess, daughter, married, emperor, assassinated
 applications | application, software, technologies, postscript, deskto
 p
 engine | engines, turbine, powered, fuel, cars
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 bbc | april, links, listing, news, march

http | www, html, com, htm, org
 orthodox | church, catholic, orthodoxy, churches, eastern
 bill | bush, clinton, president, singer, senator
 ...
 american | actor, musician, actress, singer, born
 years | year, age, months, period, six
 they | are, them, themselves, those, their
 from | in, the, elsewhere, and, of
 zero | two, one, five, six, four
 b | d, politician, actor, musician, physicist
 to | higher, the, but, this, or
 than | less, most, more, higher, relatively
 question | questions, whether, answer, asked, how
 active | organization, enhance, association, nations, include
 defense | security, force, air, armed, mounted
 numerous | including, most, are, were, various
 applications | software, application, systems, desktop, interface
 units | unit, infantry, prefixes, kilometre, comparison
 notes | note, coins, concise, subdominant, edition
 pre | savages, ceremonial, celta, ordovician, been
 ...
 they | themselves, all, their, to, are
 would | that, but, eventually, because, had
 has | is, the, that, arguably, some
 people | americans, living, births, deaths, natives
 can | cannot, or, useful, do, be
 so | to, i, will, able, do
 five | one, six, four, three, eight
 and | in, of, the, by, one
 cost | dollars, expensive, usd, costs, price
 running | run, next, runs, pick, workstations
 writers | novelists, poets, philosophers, births, fiction
 road | roads, peachtree, route, street, track
 something | you, wrong, like, replied, might
 lived | story, exile, mother, least, wife
 egypt | egyptian, pharaoh, syria, mesopotamia, ancient
 magazine | interview, fiction, magazines, weekly, news
 ...
 one | eight, four, nine, five, seven
 his | him, himself, he, father, wrote
 he | his, him, himself, she, father
 their | they, themselves, have, more, these
 three | two, five, four, one, six
 to | by, and, the, not, or
 s | nine, five, eight, four, two
 used | use, usually, uses, common, widely
 institute | university, research, institutions, college, school
 nobel | prize, laureate, physicist, physiology, chemist
 except | only, so, gon, if, are
 engineering | engineers, sciences, engineer, technology, electrical
 square | adjacent, mile, sq, occupies, city
 cost | dollars, expensive, usd, costs, budget
 award | awards, awarded, best, nominated, achievement
 san | francisco, diego, jose, santa, el
 ...
 called | which, a, the, name, also
 at | the, times, three, lengths, winter
 other | are, or, all, similar, types
 he | his, him, she, himself, who
 are | or, other, these, all, types
 many | different, some, these, are, such

years | age, zero, six, four, five
 th | century, nd, centuries, rd, late
 liberal | conservatism, conservative, party, political, democratic
 notes | note, coins, fifth, edition, concise
 pressure | temperature, pressures, liquid, fluid, phase
 recorded | records, song, albums, album, music
 ice | snow, cream, melted, warm, glaciations
 heavy | armoured, lighter, armor, enemy, armour
 something | you, wrong, knows, look, get
 bill | jim, david, george, bills, evans
 ...
 would | eventually, that, did, it, had
 used | use, using, commonly, as, usually
 at | the, times, begins, newark, year
 where | \mathbf{delta} , then, \mathbf{delta} , dense, left
 two | three, five, four, zero, one
 its | a, the, commercial, far, steadily
 who | he, him, whom, young, father
 time | when, minimization, place, externalization, redstone
 quite | different, very, humans, difficult, straightforward
 marriage | marriages, marry, divorce, married, polygamy
 hit | hits, hitting, song, billboard, album
 nobel | prize, laureate, physiology, physicist, chemist
 universe | universes, cosmological, cosmology, cosmic, bang
 freedom | sustainability, freedoms, ethics, rights, chorionic
 pre | celta, americas, savages, splice, curricular
 road | roads, route, peachtree, street, highway
 ...
 be | that, should, can, not, cannot
 war | wars, wwii, allied, soviet, military
 but | would, not, that, did, they
 two | three, zero, four, five, one
 was | october, had, after, early, february
 new | york, press, nine, seven, state
 history | historical, links, site, references, museum
 d | b, writer, eight, politician, composer
 account | beg, explanation, infliction, imbalance, chapter
 mathematics | mathematical, theoretical, algebraic, calculus, axiomati
 c
 dr | presenter, theodor, scientist, ketcham, rick
 discovered | discovery, discoveries, discoverer, later, ago
 troops | forces, armies, soviet, confederacy, command
 stage | actors, theatre, broadway, film, musical
 arts | art, graduate, students, degree, theatre
 question | questions, whether, answer, that, answers
 ...
 its | a, the, due, steadily, and
 two | three, one, zero, four, nine
 where | \mathbf{delta} , sum, right, \mathbf{mathrm} , if
 years | year, age, over, six, female
 nine | one, two, eight, four, six
 about | million, thousand, and, around, estimated
 their | they, have, but, them, that
 called | the, name, glutamic, form, a
 bill | clinton, jim, musician, evans, jennifer
 prince | princess, crown, throne, king, abdication
 smith | thomas, jim, coordinator, braxton, john
 primarily | mainly, and, major, groups, related
 channel | tv, channels, aired, satellite, radio
 mean | signifies, means, meaning, does, variance
 report | pdf, reports, international, news, biggio

discovered | discovery, discoveries, discoverer, ago, named
 ...
 they | are, their, those, them, do
 these | are, be, other, many, have
 nine | one, seven, eight, two, five
 war | defeat, troops, wars, battle, allied
 between | the, which, through, of, shared
 may | or, should, does, indefinite, take
 three | two, six, five, one, four
 is | of, the, a, or, if
 applied | ethics, which, electrical, dynamics, disciplines
 proposed | rejected, proposal, formed, independently, formulated
 magazine | magazines, weekly, newspaper, interview, october
 ice | canadian, hockey, basketball, snow, roller
 woman | married, she, women, fertility, herself
 existence | eternal, exist, universes, beings, notion
 lived | died, he, mother, his, was
 operations | operation, assignment, security, boolean, arithmetic
 ...
 are | other, there, these, have, all
 up | down, easiest, quickly, ballcarrier, so
 d | b, j, composer, writer, politician
 see | list, links, also, external, article
 may | occur, or, should, does, do
 also | as, see, of, list, including
 this | not, which, it, have, could
 nine | one, eight, seven, four, five
 mainly | primarily, also, industry, persians, mountainous
 notes | note, coins, bass, compositions, harmony
 derived | word, modern, derives, etymology, distinct
 defense | defence, branches, civil, defensive, offensive
 freedom | rights, freedoms, ethics, liberty, liberties
 applications | systems, application, interface, software, technologies
 recorded | records, yielded, released, tune, observations
 hit | hits, hitting, album, swing, record
 ...
 time | year, months, periods, the, years
 about | approximately, estimated, thousand, than, estimates
 or | other, is, be, are, often
 has | have, which, is, some, been
 so | how, it, even, you, have
 at | of, in, the, after, three
 but | him, of, later, was, the
 one | eight, nine, three, four, seven
 notes | note, coins, editions, compositions, metrology
 proposed | proposal, rejected, accepted, formed, independently
 nobel | prize, laureate, physicist, physiology, chemist
 award | awards, awarded, best, oscar, won
 older | families, household, median, younger, females
 police | military, enforcement, officials, department, battalion
 something | you, i, knows, lot, seem
 derived | derives, modern, word, is, root
 ...
 th | centuries, century, nd, late, around
 after | before, had, until, was, during
 where | go, left, y, or, delta
 world | nations, international, country, asia, organization
 new | york, nine, corporation, june, albany
 there | are, have, common, also, only
 s | one, nine, two, five, six
 called | is, also, containing, the, are

engine | engines, fuel, turbine, powered, combustion
 active | bind, isoamyl, support, tightly, secretariat
 dr | theodor, john, actor, ketcham, seymour
 grand | knights, michigan, highwind, commemorating, prix
 professional | teams, tournaments, sports, trained, players
 heavy | alloys, metal, armor, lighter, industries
 road | roads, passenger, railway, interstate, city
 articles | article, sites, external, list, org
 ...
 five | one, eight, four, three, two
 by | of, the, one, and, a
 world | international, nations, history, era, during
 i | my, you, me, am, we
 many | most, such, these, are, notable
 into | through, the, directly, them, in
 years | year, remaining, months, age, days
 two | zero, three, four, one, five
 hit | hits, hitting, album, record, singles
 notes | note, bass, coins, compositions, editions
 test | testing, tests, flight, cricket, concorde
 resources | resource, protection, help, deposits, arable
 account | accounts, billion, book, ambrosius, beg
 construction | constructed, bridge, bridges, tunnel, building
 shows | show, series, television, appearance, icp
 existence | that, exist, eternal, supernatural, concept
 ...
 also | as, are, and, with, most
 four | three, one, two, five, six
 by | the, and, of, other, which
 such | are, many, most, usually, or
 world | international, country, nine, nations, during
 a | the, as, is, in, and
 which | the, and, in, of, is
 first | was, second, one, seven, the
 rise | centuries, arose, conquest, eastern, culminating
 smith | jewell, coordinator, braxton, greg, brett
 award | awards, awarded, best, oscar, winners
 paris | france, le, les, fran, french
 experience | experiences, thinking, perception, awareness, soul
 lived | return, briefly, he, mother, have
 alternative | many, oldies, major, like, complementary
 writers | novelists, winners, fiction, authors, literature
 ...
 eight | one, five, six, four, seven
 however | although, few, not, that, but
 is | a, are, if, or, example
 all | are, they, every, define, with
 five | four, one, six, two, three
 so | you, really, if, pull, that
 from | in, the, on, across, to
 been | discovered, samsa, drying, many, have
 dr | scientist, actor, protagonist, theodor, d
 freedom | freedoms, liberty, rights, individual, liberties
 lived | briefly, return, he, went, wealthy
 ice | hockey, snow, roller, canadian, glaciation
 centre | centers, main, centres, airport, universities
 nobel | prize, laureate, physicist, physiology, chemist
 bbc | abc, itv, uk, interview, news
 governor | legislature, chief, minister, cabinet, appointed

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d | b, composer, writer, politician, one

many | most, have, various, some, these
 i | you, my, t, me, am
 as | of, also, a, and, the
 five | four, one, six, two, three
 there | are, is, and, all, of
 who | he, had, slaying, whom, while
 about | estimated, article, country, accounts, has
 professional | trained, teams, team, athletic, sports
 additional | pdf, extra, number, added, rare
 derived | derives, etymology, latin, word, use
 bill | clinton, bush, politician, governor, senator
 writers | novelists, winners, fiction, literature, deaths
 discovered | discovery, discoveries, named, mysterious, found
 brother | son, throne, married, daughters, father
 operations | operation, squadron, combat, evaluating, reconnaissance
 ...
 in | the, and, of, first, a
 other | are, or, such, most, include
 about | how, article, related, answer, has
 called | a, the, are, of, include
 some | have, are, these, or, that
 eight | six, four, one, five, three
 four | one, three, two, eight, nine
 and | of, in, the, for, are
 older | household, families, median, younger, age
 police | arrested, officers, enforcement, guards, military
 hit | hits, hitting, got, album, career
 freedom | freedoms, rights, liberty, recipients, liberties
 award | awards, awarded, nominations, best, won
 quite | difficult, used, enough, manufacturers, especially
 defense | defence, tactics, military, tribunal, air
 san | francisco, diego, california, antonio, da
 ...
 who | he, whom, while, people, slaying
 will | shall, cannot, does, you, your
 no | true, there, cannot, condoned, said
 for | and, a, all, two, of
 such | are, these, other, modern, with
 used | use, usually, uses, commonly, using
 up | down, take, walked, get, you
 time | already, after, unprecedented, failed, hours
 applications | software, application, server, desktop, interface
 accepted | regard, recognized, marxist, not, remained
 bible | testament, tanakh, biblical, scripture, prophets
 arts | art, styles, school, technique, graduate
 assembly | council, elected, legislative, deputies, senate
 rise | arose, almohades, nazism, centuries, occupation
 pressure | pressures, fluid, gases, liquid, propellant
 lived | missionary, ranch, wealthy, settled, returned
 ...
 its | far, the, was, due, which
 new | york, company, sold, philadelphia, state
 they | them, to, are, not, those
 had | later, was, he, after, were
 would | not, that, eventually, even, did
 it | a, not, that, been, to
 be | not, that, can, only, no
 this | the, however, truism, interruptus, believe
 cost | expensive, costs, dollars, price, usd
 versions | version, models, compatibility, compiler, graphical
 additional | extra, mode, provide, added, special

shows | show, animated, television, episodes, sitcom
freedom | freedoms, rights, moral, ethics, recipients
applications | software, application, desktop, server, os
dr | scientist, actor, musician, rapper, pseudonym
creation | monotheism, creator, abrahamic, judaism, destiny
...
if | we, unless, condition, so, let
often | typically, variety, usually, use, these
between | geographic, dispute, boundary, the, both
with | and, are, in, as, a
or | either, are, typically, can, other
new | york, philadelphia, opens, april, sold
six | eight, four, five, one, three
more | less, than, tend, very, although
except | but, dialects, nearly, joins, enumerated
existence | supernatural, exist, argument, belief, humans
creation | monotheism, creator, judaism, abrahamic, idea
liberal | conservative, democrats, liberals, democratic, conservatives
shown | showed, mg, aleph, thyroid, tnfr
prince | princess, throne, iii, son, crown
bill | bills, clinton, bush, linda, impeachment
universe | fictional, universes, cosmology, character, cosmological
...
than | less, most, tend, size, higher
or | either, typically, are, usually, can
between | straightened, of, side, correspondence, boundary
first | second, the, one, three, in
can | or, types, cannot, be, may
also | as, especially, a, list, are
from | and, in, the, down, of
up | down, with, while, back, went
ice | hockey, canadian, glaciers, snow, glaciations
lived | story, exile, briefly, missionary, return
hit | hits, hitting, recorded, swing, charts
orthodox | catholic, churches, orthodoxy, church, christianity
mean | sqrt, variance, approximated, temperature, frac
accepted | credibility, tischendorf, universally, hypothesis, date
derived | word, meaning, derives, originated, modern
joseph | smith, latter, adolf, jesus, austrian
...
that | some, not, be, because, might
used | use, for, uses, other, usage
first | second, the, early, was, one
it | is, does, which, not, even
while | by, along, were, their, kwan
time | hour, lasted, already, during, after
who | whom, himself, he, father, illegally
six | eight, five, one, four, nine
pre | americas, conquered, columbian, early, oriental
behind | federals, front, back, yard, defensive
woman | fertility, male, she, pregnant, female
square | adjacent, sq, squares, mile, city
resources | resource, environmental, arable, of, agricultural
older | median, families, age, household, versus
rise | elevations, peak, expanded, plains, rising
award | awards, awarded, best, achievement, prize
...
i | you, yes, t, sorry, am
from | the, in, of, down, at
only | to, except, not, be, but
over | years, zero, total, three, period

b | d, r, v, c, y
 four | three, one, two, five, six
 on | the, of, be, kayaking, from
 during | before, early, became, period, was
 applications | software, application, solutions, useful, computer
 know | you, my, want, think, how
 powers | governor, territory, commander, responsibilities, judicial
 joseph | smith, latter, jesus, composer, william
 orthodox | churches, orthodoxy, christians, catholicism, catholic
 prince | throne, princess, son, abdication, abdicated
 grand | ceded, lithuania, croix, prix, michigan
 heavy | armor, lighter, armoured, heavier, vehicles
 ...
 on | the, a, also, of, introducing
 it | not, even, a, that, is
 nine | one, eight, two, seven, three
 state | states, colleges, new, united, university
 seven | one, three, eight, five, nine
 is | a, in, are, be, also
 their | they, them, these, but, to
 with | or, in, the, such, a
 powers | empire, power, commander, territory, governor
 applications | software, application, technologies, solutions, compute
 rs
 shown | showed, tnf, shows, aleph, have
 derived | word, etymology, latin, root, meaning
 animals | animal, eating, humans, mammals, organisms
 engineering | technology, engineers, engineer, management, technical
 additional | extra, are, provide, option, added
 prince | throne, princess, son, abdication, abdicated
 ...
 from | in, down, on, and, the
 their | they, them, these, have, would
 at | three, where, time, two, one
 eight | one, seven, nine, six, five
 where | at, then, formula, the, this
 three | four, one, five, two, six
 five | one, three, four, six, eight
 after | had, during, last, before, months
 engineering | technology, engineers, management, engineer, research
 grand | croix, prince, prix, ceded, of
 woman | daughter, she, her, female, women
 articles | external, article, com, links, site
 applications | application, software, systems, server, technologies
 report | pdf, reports, news, commission, review
 existence | entity, notion, property, exist, conception
 numerous | were, bizarre, have, most, including
 ...
 are | have, or, other, some, such
 war | wars, defeat, army, civil, independence
 so | that, not, do, be, have
 or | are, may, which, either, of
 on | from, the, of, in, with
 that | not, be, this, would, cannot
 they | them, do, not, have, some
 five | one, eight, four, three, six
 woman | she, her, daughter, women, married
 ocean | pacific, atlantic, islands, coast, oceans
 bill | clinton, bills, jim, joe, bush
 writers | novelists, poets, fiction, deaths, academics
 instance | specific, which, value, yoghurt, androgens

derived | word, derives, etymology, modern, origin
 institute | university, technology, research, college, school
 know | you, want, didn, my, i
 ...
 can | be, example, need, cannot, above
 will | shall, does, they, allows, wait
 had | was, he, his, after, she
 years | year, age, months, over, days
 an | is, which, the, of, a
 which | a, the, is, its, has
 many | some, other, most, different, are
 there | are, have, that, some, or
 magazine | newspaper, magazines, weekly, interview, comics
 governor | minister, appointed, senate, senators, president
 primarily | northerly, mainly, major, includes, most
 discovered | discovery, discoveries, colonized, discoverer, asteroid
 running | run, runs, ran, emulation, line
 cost | expensive, costs, price, dollars, usd
 prince | princess, crown, throne, abdicated, emperor
 bill | clinton, impeachment, bills, jim, alex
 ...
 there | are, have, all, that, only
 not | be, do, that, it, must
 on | the, of, with, from, between
 used | use, uses, be, are, term
 that | not, be, existence, thus, a
 at | in, where, the, on, observatory
 as | the, also, well, including, of
 people | natives, americans, citizens, minority, ethnic
 articles | discussion, online, publications, books, article
 arts | art, martial, graduate, styles, sports
 alternative | annotate, authored, hypothesis, trends, scientifically
 bbc | news, itv, allafrika, tv, aired
 joseph | composer, austrian, botanist, johann, von
 freedom | freedoms, rights, liberty, liberties, liberalism
 road | roads, highway, railroad, peachtree, track
 mathematics | mathematical, theory, axiomatic, physics, algebra
 ...
 where | at, chili, is, left, or
 the | of, in, and, a, by
 has | have, is, which, such, not
 in | the, of, and, which, one
 be | not, that, cannot, can, to
 other | are, some, etc, or, kinds
 it | not, that, could, this, do
 can | are, be, cannot, must, if
 frac | cdot, sqrt, infty, cos, mathbf
 arts | art, students, graduate, yale, school
 shows | show, television, nbc, tv, comedy
 test | testing, tests, simulate, cricket, detection
 cost | costs, expensive, usd, dollars, wages
 san | francisco, santa, diego, jose, los
 smith | john, greg, jim, graeme, ian
 grand | prize, marshals, croix, michigan, knights
 ...
 often | sometimes, or, usually, are, form
 some | are, many, or, those, and
 b | d, c, p, f, y
 his | he, him, himself, father, life
 used | use, example, uses, usage, or
 see | links, list, external, uses, also

nine | four, seven, one, two, five
 be | are, not, or, that, can
 know | you, how, want, sure, i
 stage | musicals, stages, actors, broadway, synchronized
 powers | power, exercised, constitutional, government, retains
 behind | face, front, side, downward, defensive
 pressure | pressures, cardiac, pump, subjected, explosive
 running | emulation, ran, runs, unix, quarterbacks
 shown | are, tnf, aleph, different, pronunciation
 smith | john, greg, jim, graeme, jewell
 ...
 this | kalmyk, is, the, be, when
 eight | one, six, seven, four, five
 may | must, or, certain, can, be
 states | united, us, state, u, admitted
 during | year, after, days, months, lasted
 nine | one, four, six, two, five
 are | other, or, usually, such, is
 to | would, too, when, they, only
 accepted | universally, recognized, stated, accepts, not
 consists | consisting, comprises, separated, composed, consist
 alternative | many, annotate, well, non, embraced
 resources | resource, contribute, reserves, deposits, protection
 derived | derives, modern, etymology, root, similar
 pope | papacy, papal, vii, king, xii
 versions | version, windows, operating, graphical, vendors
 hold | holding, entire, holds, whether, deny
 ...
 into | once, the, in, first, which
 is | the, of, a, are, or
 from | in, and, the, on, which
 are | other, usually, such, or, is
 that | not, be, it, to, did
 th | century, nd, rd, six, in
 there | these, still, are, have, common
 was | after, became, a, later, he
 universe | cosmology, cosmological, galaxy, fictional, bang
 award | awards, awarded, best, emmy, pulitzer
 pope | papal, papacy, xii, pius, benedict
 something | you, audience, really, like, wrong
 except | dialects, be, inhabited, pronounce, if
 smith | mormon, jewell, primus, fatou, greg
 recorded | records, recording, song, album, recordings
 issue | issues, nullification, reconciling, racism, commenting
 ...
 known | also, called, century, as, referred
 between | differences, arises, divided, with, relationship
 nine | one, six, four, three, two
 american | actor, writer, british, americans, comedian
 that | be, it, is, cannot, a
 six | eight, five, four, one, nine
 during | occurred, after, lasted, nine, days
 up | down, in, out, the, from
 cost | costs, inexpensive, expensive, pricing, dollars
 pre | hagia, americas, periods, columbian, thr
 award | awards, awarded, emmy, pulitzer, winner
 question | questions, asked, answer, answers, what
 professional | teams, sports, trained, amateur, team
 egypt | egyptian, cairo, egyptians, sues, arab
 event | events, sporting, week, extinction, sukkot
 articles | publications, online, news, books, org

```

...
while | to, had, their, only, who
five | four, three, six, one, eight
some | many, are, these, such, have
its | the, part, has, which, area
i | you, my, t, am, yes
by | the, of, one, and, as
after | was, had, during, in, before
with | and, the, in, for, of
experience | experiences, perception, sensory, awareness, psychotherap
y
institute | technology, university, college, research, school
writers | novelists, winners, authors, fiction, poets
brother | son, throne, daughter, married, younger
paris | fran, france, les, du, lyon
engineering | technology, engineers, graduate, institute, professor
http | www, html, htm, com, edu
bill | clinton, bills, submitted, legislation, politician
...
not | they, do, to, does, need
most | many, these, include, considered, other
seven | one, three, four, five, two
american | actor, writer, singer, composer, musician
its | it, the, which, by, part
four | two, three, one, five, eight
state | governor, united, government, federal, governors
united | states, governors, state, north, presidents
engineering | technology, engineers, institute, physics, technical
operating | unix, windows, software, desktop, bsd
bbc | february, listing, day, march, leap
paris | france, fran, de, le, du
account | accounts, imbalance, predictions, value, pliny
animals | animal, mammals, insects, cows, phylum
accepted | universally, regard, rejected, accept, recognized
construction | constructed, freight, tunnel, transportation, railroad
...

```

Visualizing the word vectors

Below we'll use T-SNE to visualize how our high-dimensional word vectors cluster together. T-SNE is used to project these vectors into two dimensions while preserving local structure. Check out [this post from Christopher Olah \(http://colah.github.io/posts/2014-10-Visualizing-MNIST/\)](http://colah.github.io/posts/2014-10-Visualizing-MNIST/) to learn more about T-SNE and other ways to visualize high-dimensional data.

In [14]:

```

%matplotlib inline
%config InlineBackend.figure_format = 'retina'

import matplotlib.pyplot as plt
from sklearn.manifold import TSNE

```

In [16]:

```

# getting embeddings from the embedding layer of our model, by name
embeddings = model.embed.weight.to('cpu').data.numpy()

```

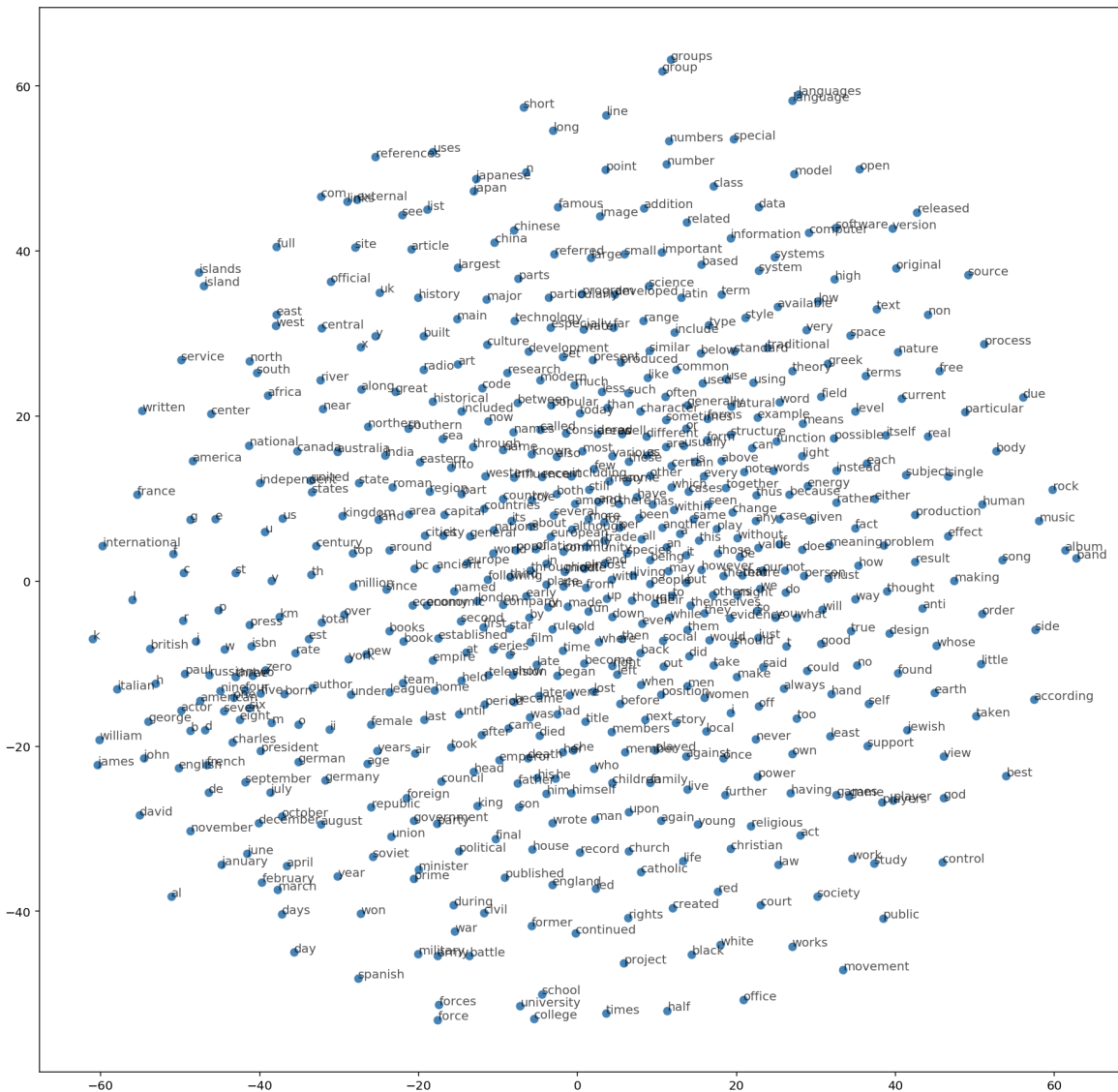
Loading web-font STIX-Web/Size3/Regular

In [26]:

```
viz_words = 600
tsne = TSNE()
embed_tsne = tsne.fit_transform(embeddings[:viz_words, :])
```

In [27]:

```
fig, ax = plt.subplots(figsize=(16, 16))
for idx in range(viz_words):
    plt.scatter(*embed_tsne[idx, :], color='steelblue')
    plt.annotate(int_to_vocab[idx], (embed_tsne[idx, 0], embed_tsne[idx, 1]), alpha
```



In []: