Data Mining Lab Test

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SECTION: 02G

Question 1

Step 1: Import related libraries and load the datasets

In [1]:
```
import pandas as pd
import numpy as np
from scipy.cluster.hierarchy import dendrogram, linkage
from sklearn.cluster import AgglomerativeClustering
import matplotlib.pyplot as plt
```

In [2]:
```
movies = pd.read_csv('Movies.csv')
movies
```

Out[2]:

	Production Budget(M)	Worldwide Gross Income (M)	Genre
0	13	230	action
1	16	224	drama
2	15	221	thriller_suspense
3	14	202	adventure
4	16	198	adventure
...	...	...	...
95	37	16	adventure
96	32	19	action
97	31	17	action
98	26	16	western
99	20	14	action

100 rows × 3 columns

Step 2: Provide comprehensive Exploratory Data Analysis (EDA). Summarise the findings and solve the noise in the datasets.

In [3]:
```
movies.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 100 entries, 0 to 99
Data columns (total 3 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   Production Budget(M)        100 non-null    int64
 1   Worldwide Gross Income (M)  100 non-null    int64
 2   Genre                       100 non-null    object
dtypes: int64(2), object(1)
memory usage: 2.5+ KB
```

In [4]:
```
movies.describe()
```

Out[4]:

	Production Budget(M)	Worldwide Gross Income (M)
count	100.000000	100.000000
mean	43.560000	69.140000
std	66.327976	81.065009
min	1.000000	4.000000
25%	6.000000	12.000000
50%	12.000000	16.000000
75%	46.500000	167.000000
max	230.000000	230.000000

In [5]:
```
movies.isna().sum()
```

Out[5]:
```
Production Budget(M)          0
Worldwide Gross Income (M)    0
Genre                         0
dtype: int64
```

Step 3: Convert the string attribute to numerical form.

In [6]:
```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
movies['Genre'] = le.fit_transform(movies['Genre']).astype(float)
movies.head()
```

Out[6]:

	Production Budget(M)	Worldwide Gross Income (M)	Genre
0	13	230	0.0
1	16	224	2.0
2	15	221	4.0
3	14	202	1.0
4	16	198	1.0

In [7]:

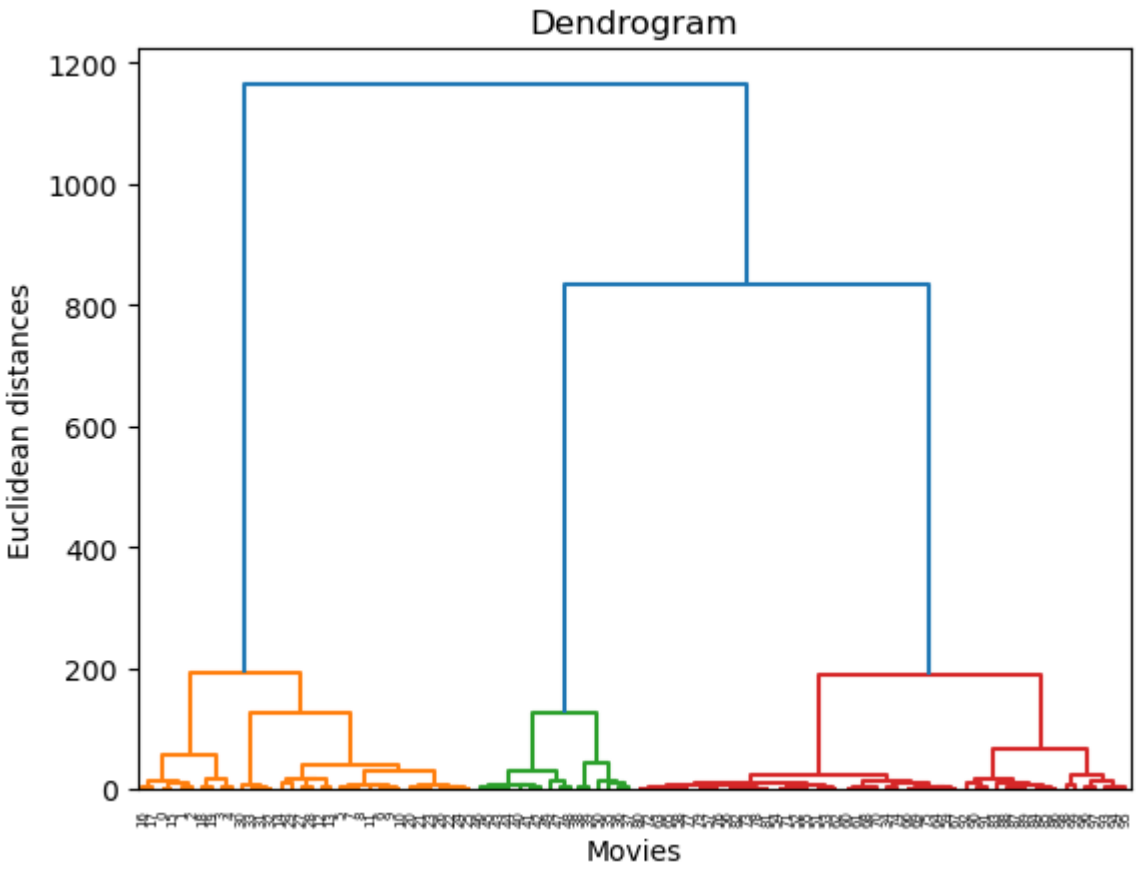
```
X = movies.iloc[:, [0, 1]].values
X
```

Out[7]:
```
array([[ 13, 230],
       [ 16, 224],
       [ 15, 221],
       [ 14, 202],
       [ 16, 198],
       [ 14, 180],
       [ 18, 178],
       [ 14, 176],
       [ 13, 176],
       [ 17, 175],
       [ 18, 175],
       [ 16, 172],
       [ 19, 167],
       [ 17, 165],
       [ 16, 155],
       [ 14, 230],
       [  8, 224],
       [  5, 221],
       [  2, 202],
       [  3, 198],
       [  6, 180],
       [  6, 178],
       [  2, 176],
       [  6, 176],
       [  4, 175],
       [  5, 175],
       [  3, 172],
       [  6, 167],
       [  6, 165],
       [  7, 155],
       [  3, 124],
       [  9, 124],
       [  8, 124],
       [  7, 123],
       [ 13,  12],
       [230,  16],
       [224,  15],
       [221,  14],
       [202,  16],
       [198,  14],
       [180,  18],
       [178,  14],
       [176,  13],
       [176,  17],
       [175,  18],
       [175,  16],
       [172,  19],
       [167,  17],
       [165,  16],
       [155,  14],
       [230,   6],
       [  8,   4],
       [  9,  10],
       [  8,   7],
       [  9,   9],
       [  9,  10],
```

```
       [  3,   9],
       [  5,   6],
       [  7,   9],
       [  7,  15],
       [  2,  17],
       [  1,  16],
       [  9,   7],
       [  6,   8],
       [  8,  13],
       [  6,   8],
       [  7,  12],
       [  7,  14],
       [  4,  14],
       [  6,  13],
       [  2,  13],
       [  9,  10],
       [  6,   8],
       [  4,   8],
       [ 11,  14],
       [  6,  12],
       [  4,   6],
       [  7,   8],
       [  5,   8],
       [  5,   5],
       [  6,   8],
       [  5,   8],
       [  3,   9],
       [ 60,   8],
       [ 59,  13],
       [ 59,  16],
       [ 59,  15],
       [ 56,  14],
       [ 56,  16],
       [ 55,  14],
       [ 52,  18],
       [ 51,  14],
       [ 45,  13],
       [ 42,  17],
       [ 39,  18],
       [ 37,  16],
       [ 32,  19],
       [ 31,  17],
       [ 26,  16],
       [ 20,  14]], dtype=int64)
```

Step 4: Create the dendrogram to find the optimal number of clusters. Explain your answer.

In [8]:
```
# Step 4: Create dendrogram to find the optimal number of clusters
import scipy.cluster.hierarchy as sch
dendrogram = sch.dendrogram(sch.linkage(X, method = 'ward'))
plt.title('Dendrogram')
plt.xlabel('Movies')
plt.ylabel('Euclidean distances')
plt.show()
```



Step 5: Train the hierarchical clustering algorithm in the usecase. Explain the hyperparameter settings implemented for the model.

In [9]:
```
# Step 5: Train hierarchical clustering algorithm
# Use case Explain hyperparameter settings implemented in model
hc = AgglomerativeClustering(n_clusters=5, affinity='euclidean', linkage='ward')
y_hc = hc.fit_predict(movies)
y_hc
```

```
D:\anaconda\Lib\site-packages\sklearn\cluster\_agglomerative.py:1005: FutureWarning:
Attribute `affinity` was deprecated in version 1.2 and will be removed in 1.4. Use `
metric` instead
  warnings.warn(
```

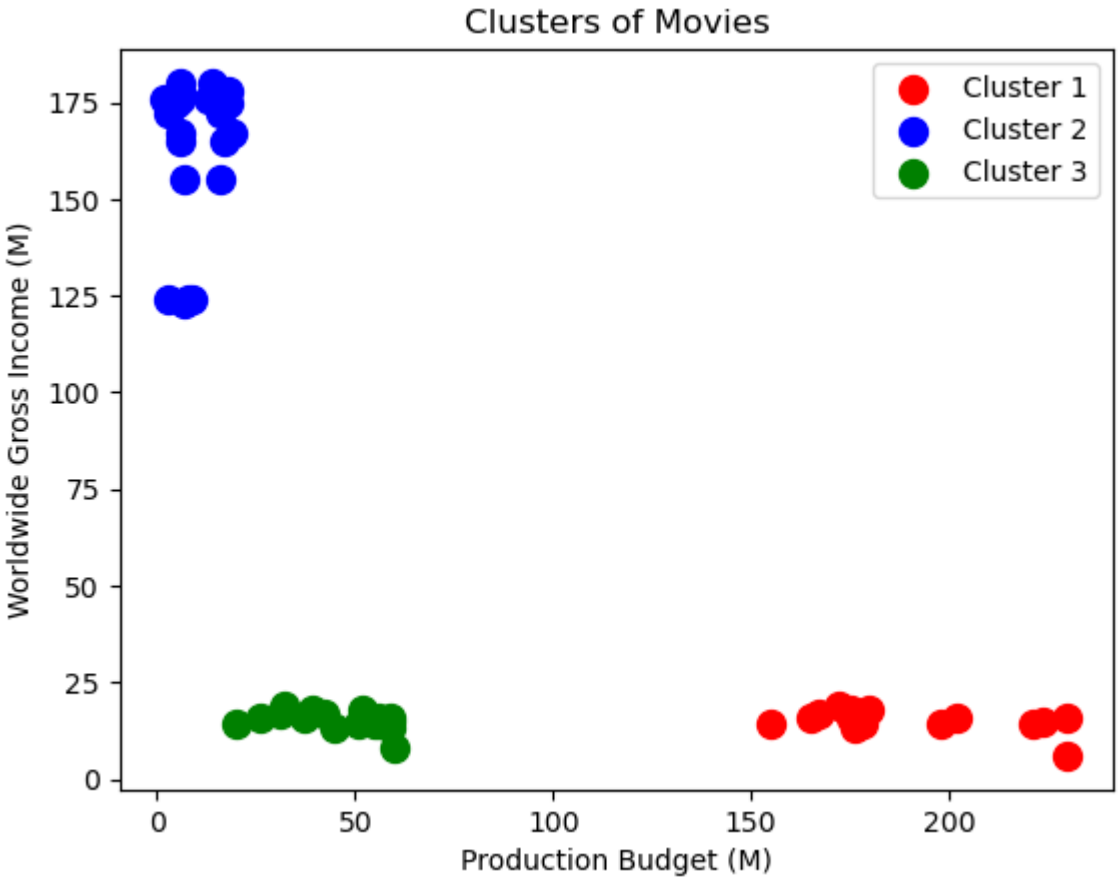
Out[9]:
```
array([3, 3, 3, 3, 3, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 3, 3, 3, 3, 3, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 4, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2], dtype=int64)
```

Step 6: Visualize the clusters involved and interpret them

In [10]:
```
plt.scatter(X[y_hc == 0, 0], X[y_hc == 0, 1], s = 100, c = 'red', label = 'Cluster
plt.scatter(X[y_hc == 1, 0], X[y_hc == 1, 1], s = 100, c = 'blue', label = 'Cluster
plt.scatter(X[y_hc == 2, 0], X[y_hc == 2, 1], s = 100, c = 'green', label = 'Cluste

# Repeat for other clusters with different conditions and colors
plt.title('Clusters of Movies')
```

```
plt.xlabel('Production Budget (M)')
plt.ylabel('Worldwide Gross Income (M)')
plt.legend()
plt.show()
```



1. Cluster 1 (High Profitability): These are the blue dots in the top left corner, representing movies with low production budgets but high worldwide gross incomes.
2. Cluster 2 (Moderate Profitability): Represented by red dots, these movies had high production budgets and moderate worldwide gross incomes.
3. Cluster 3 (Low Profitability): The green dots indicate movies with moderate production budgets but low worldwide gross incomes.

This analysis suggests that some movies can achieve high profitability without necessarily having large production budgets. Conversely, a high production budget does not guarantee high worldwide gross income.

QUESTION 2

Step 1: Import related libraries and load the order_data.csv dataset.

In [11]:
```
import pandas as pd
import numpy as np
from mlxtend.frequent_patterns import apriori, association_rules
```

In [12]:
```
df = pd.read_csv('order_data.csv', names = ['Products'])
df.head()
```

Out[12]:

	Products
0	toothpaste brush milk cereals honey bread butt...
1	milk cereals honey bread cheese razor gel shampoo
2	milk cereals honey cheese soap shampoo
3	honey bread butter cheese mouthwash toothpaste
4	cereals honey bread butter gel soap

In [13]:
```
df['Products'] = df['Products'].str.replace(' ', ', ')
df
```

Out[13]:

	Products
0	toothpaste, brush, milk, cereals, honey, bread...
1	milk, cereals, honey, bread, cheese, razor, ge...
2	milk, cereals, honey, cheese, soap, shampoo
3	honey, bread, butter, cheese, mouthwash, tooth...
4	cereals, honey, bread, butter, gel, soap
5	cheesse, yogurt, milk, cereals, honey, shampoo...
6	honey, bread, cheese, razor, butter, yogurt
7	honey, bread, cheese, butter, milk
8	cereals, butter, cookies, chips
9	cerals, cheese, yogurt, cookies, chips
10	toothpaste, brush, gel, shampoo, soap, cookies...
11	toothpaste, brush, gel, razor, mouthwash, milk...
12	razor, shampoo, gel, soap, bread, butter
13	brush, shampoo, gel, toothpaste, mouthwash, br...
14	mouthwash, toothpaste, soap, shampoo, cheese, ...
15	razor, mouthwash, soap, butter, bread, cheese
16	shampoo, soap, gel, milk, honey, cereals
17	toothpaste, razor, gel, brush, mouthwash, shampoo
18	gel, razor, shampoo, milk, cereals, bread, coo...
19	mouthwash, toothpaste, milk, bread, cookies

Step 2: Check the info for the dataset recorded.

In [14]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20 entries, 0 to 19
Data columns (total 1 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   Products  20 non-null     object
dtypes: object(1)
memory usage: 292.0+ bytes
```

Step 3: Check the shape of the dataset.

In [15]:
```
df.shape
```

Out[15]:
```
(20, 1)
```

Step 4: Convert Pandas DataFrame into a list of lists.

In [16]:
```
data = list(df["Products"].apply(lambda x:x.split(",") ))
data
```

Out[16]:
```
[['toothpaste',
  ' brush',
  ' milk',
  ' cereals',
  ' honey',
  ' bread',
  ' butter',
  ' cheese',
  ' yogurt'],
 ['milk',
  ' cereals',
  ' honey',
  ' bread',
  ' cheese',
  ' razor',
  ' gel',
  ' shampoo'],
 ['milk', ' cereals', ' honey', ' cheese', ' soap', ' shampoo'],
 ['honey', ' bread', ' butter', ' cheese', ' mouthwash', ' toothpaste'],
 ['cereals', ' honey', ' bread', ' butter', ' gel', ' soap'],
 ['cheesse', ' yogurt', ' milk', ' cereals', ' honey', ' shampoo', ' gel'],
 ['honey', ' bread', ' cheese', ' razor', ' butter', ' yogurt'],
 ['honey', ' bread', ' cheese', ' butter', ' milk'],
 ['cereals', ' butter', ' cookies', ' chips'],
 ['cerals', ' cheese', ' yogurt', ' cookies', ' chips'],
 ['toothpaste', ' brush', ' gel', ' shampoo', ' soap', ' cookies', ' chips'],
 ['toothpaste', ' brush', ' gel', ' razor', ' mouthwash', ' milk', ' cookies'],
 ['razor', ' shampoo', ' gel', ' soap', ' bread', ' butter'],
 ['brush',
  ' shampoo',
  ' gel',
  ' toothpaste',
  ' mouthwash',
  ' bread',
  ' cheese'],
 ['mouthwash', ' toothpaste', ' soap', ' shampoo', ' cheese', ' yogurt'],
 ['razor', ' mouthwash', ' soap', ' butter', ' bread', ' cheese'],
 ['shampoo', ' soap', ' gel', ' milk', ' honey', ' cereals'],
 ['toothpaste', ' razor', ' gel', ' brush', ' mouthwash', ' shampoo'],
 ['gel', ' razor', ' shampoo', ' milk', ' cereals', ' bread', ' cookies'],
 ['mouthwash', ' toothpaste', ' milk', ' bread', ' cookies']]
```

Step 5: Transform the list with one-hot encoding. Explain the function.

In [17]:
```
from mlxtend.preprocessing import TransactionEncoder
a = TransactionEncoder()
a_data = a.fit(data).transform(data)
df = pd.DataFrame(a_data,columns=a.columns_)
df = df.replace(False,0)
df
```

Out[17]:

	bread	brush	butter	cereals	cheese	chips	cookies	gel	honey	milk	...	cerals	c
0	True	True	True	True	True	0	0	0	True	True	...	0	
1	True	0	0	True	True	0	0	True	True	0	...	0	
2	0	0	0	True	True	0	0	0	True	0	...	0	
3	True	0	True	0	True	0	0	0	0	0	...	0	
4	True	0	True	0	0	0	0	True	True	0	...	0	
5	0	0	0	True	0	0	0	True	True	True	...	0	
6	True	0	True	0	True	0	0	0	0	0	...	0	
7	True	0	True	0	True	0	0	0	0	True	...	0	
8	0	0	True	0	0	True	True	0	0	0	...	0	
9	0	0	0	0	True	True	True	0	0	0	...	True	
10	0	True	0	0	0	True	True	True	0	0	...	0	
11	0	True	0	0	0	0	True	True	0	True	...	0	
12	True	0	True	0	0	0	0	True	0	0	...	0	
13	True	0	0	0	True	0	0	True	0	0	...	0	
14	0	0	0	0	True	0	0	0	0	0	...	0	
15	True	0	True	0	True	0	0	0	0	0	...	0	
16	0	0	0	True	0	0	0	True	True	True	...	0	
17	0	True	0	0	0	0	0	True	0	0	...	0	
18	True	0	0	True	0	0	True	0	0	True	...	0	
19	True	0	0	0	0	0	True	0	0	True	...	0	

20 rows × 27 columns

Step 6: Build the Apriori model for the dataset. Set the minimum support value at 0.25, minimum confidence at 0.2, minimum lift at 2 and minimum length at 2.

In [18]:
```
#set a threshold value for the support value and calculate the support value.
df = apriori(df, min_support = 0.25, use_colnames = True, verbose = 1)
df
```

```
Processing 36 combinations | Sampling itemset size 3
```

```
D:\anaconda\Lib\site-packages\mlxtend\frequent_patterns\fpcommon.py:110: DeprecationWarning: DataFrames with non-bool types result in worse computationalperformance and their support might be discontinued in the future.Please use a DataFrame with bool type
  warnings.warn(
```

Out[18]:

	support	itemsets
0	0.55	(bread)
1	0.4	(butter)
2	0.3	(cereals)
3	0.5	(cheese)
4	0.3	(cookies)
5	0.45	(gel)
6	0.3	(honey)
7	0.35	(milk)
8	0.25	(mouthwash)
9	0.25	(razor)
10	0.45	(shampoo)
11	0.35	(soap)
12	0.25	(yogurt)
13	0.35	(butter, bread)
14	0.35	(bread, cheese)
15	0.25	(butter, cheese)
16	0.25	(cereals, honey)
17	0.3	(gel, shampoo)
18	0.25	(butter, bread, cheese)

In [19]:
```
df_ar = association_rules(df, metric="confidence", min_threshold=0.2)
df_ar = association_rules(df, metric="lift", min_threshold=2)
df_ar
```

Out[19]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	leve
0	(cereals)	(honey)	0.3	0.3	0.25	0.833333	2.777778	
1	(honey)	(cereals)	0.3	0.3	0.25	0.833333	2.777778	

Step 7: Get the support, confidence and lift values for recommended antecedents and consequents transactions. Explain the results.

- Support: Both rules have a support of (0.25), indicating that the combination of cereals and honey appears together in 25% of all transactions.
- Confidence: The confidence of (0.833333) suggests a high likelihood (over 83%) that the consequent item is purchased when the antecedent is bought.
- Lift: A lift of (2.777778) indicates that the likelihood of purchasing cereals and honey together is nearly 2.8 times higher than the likelihood of purchasing them independently.
- Leverage: The leverage of (0.16) shows the proportion of additional transactions with cereals and honey together, above what would be expected if they were statistically independent.
- Conviction: A conviction of (4.2) implies that the consequent is 4.2 times more likely to be purchased when the antecedent is bought, compared to when it's not.
- Zhang's Metric: With a value of (0.914286), this metric indicates a strong positive correlation between the purchase of cereals and honey.

These results can be useful for retail stores to optimize product placement or for targeted marketing campaigns. The high values of confidence, lift, and other metrics suggest that when customers buy one of these items, they are very likely to buy the other. Hence, placing cereals and honey close together in a store or promoting them together in a campaign could potentially increase sales.

Question 3

1) Grab a class's elements from the URL below using BeatifulSoup.
https://en.wikipedia.org/wiki/Large_language_model

Step 1: Get the request for the URL link.

In [20]:
```
import requests
response = requests.get("https://en.wikipedia.org/wiki/Large_language_model")
response
```

Out[20]:
```
<Response [200]>
```

Step 2: Create a soup from the request.

In [21]:
```
type(response)
```

Out[21]:
```
requests.models.Response
```

In [22]:
```
import bs4
soup = bs4.BeautifulSoup(response.text,"lxml")
```

```
soup
```

Out[22]:
```
<!DOCTYPE html>
<html class="client-nojs vector-feature-language-in-header-enabled vector-feature-
language-in-main-page-header-disabled vector-feature-sticky-header-disabled vector
-feature-page-tools-pinned-disabled vector-feature-toc-pinned-clientpref-1 vector-
feature-main-menu-pinned-disabled vector-feature-limited-width-clientpref-1 vector
-feature-limited-width-content-enabled vector-feature-zebra-design-enabled vector-
feature-custom-font-size-clientpref-0 vector-feature-client-preferences-disabled v
ector-feature-client-prefs-pinned-disabled vector-toc-available" dir="ltr" lang="e
n">
<head>
<meta charset="utf-8"/>
<title>Large language model - Wikipedia</title>
<script>(function(){var className="client-js vector-feature-language-in-header-ena
bled vector-feature-language-in-main-page-header-disabled vector-feature-sticky-he
ader-disabled vector-feature-page-tools-pinned-disabled vector-feature-toc-pinned-
clientpref-1 vector-feature-main-menu-pinned-disabled vector-feature-limited-width
-clientpref-1 vector-feature-limited-width-content-enabled vector-feature-zebra-de
sign-enabled vector-feature-custom-font-size-clientpref-0 vector-feature-client-pr
eferences-disabled vector-feature-client-prefs-pinned-disabled vector-toc-availabl
e";var cookie=document.cookie.match(/(?:^|; )enwikimwclientpreferences=([^;]+)/);i
f(cookie){cookie[1].split('%2C').forEach(function(pref){className=className.replac
e(new RegExp('(^| )'+pref.replace(/-clientpref-\w+$|[^\w-]+/g,'')+'-clientpref-\\w
+( |$)'),'$1'+pref+'$2');});}document.documentElement.className=className;}());RLC
ONF={"wgBreakFrames":false,"wgSeparatorTransformTable":["",""],"wgDigitTransformTa
ble":["",""],
"wgDefaultDateFormat":"dmy","wgMonthNames":["","January","February","March","Apri
l","May","June","July","August","September","October","November","December"],"wgRe
questId":"60b63340-7cff-46db-be04-fea03fd33616","wgCanonicalNamespace":"","wgCanon
icalSpecialPageName":false,"wgNamespaceNumber":0,"wgPageName":"Large_language_mode
l","wgTitle":"Large language model","wgCurRevisionId":1195671783,"wgRevisionId":11
95671783,"wgArticleId":73248112,"wgIsArticle":true,"wgIsRedirect":false,"wgActio
n":"view","wgUserName":null,"wgUserGroups":["*"],"wgCategories":["CS1 errors: miss
ing periodical","CS1: long volume value","Articles with short description","Short
description is different from Wikidata","Wikipedia articles needing clarification
from December 2023","Large language models","Deep learning","Natural language proc
essing"],"wgPageViewLanguage":"en","wgPageContentLanguage":"en","wgPageContentMode
l":"wikitext","wgRelevantPageName":"Large_language_model","wgRelevantArticleId":73
248112,
"wgIsProbablyEditable":true,"wgRelevantPageIsProbablyEditable":true,"wgRestriction
Edit":[],"wgRestrictionMove":[],"wgNoticeProject":"wikipedia","wgFlaggedRevsParam
s":{"tags":{"status":{"levels":1}}},"wgMediaViewerOnClick":true,"wgMediaViewerEnab
ledByDefault":true,"wgPopupsFlags":6,"wgVisualEditor":{"pageLanguageCode":"en","pa
geLanguageDir":"ltr","pageVariantFallbacks":"en"},"wgMFDisplayWikibaseDescription
s":{"search":true,"watchlist":true,"tagline":false,"nearby":true},"wgWMESchemaEdit
AttemptStepOversample":false,"wgWMEPageLength":100000,"wgULSCurrentAutonym":"Engli
sh","wgCentralAuthMobileDomain":false,"wgEditSubmitButtonLabelPublish":true,"wgULS
Position":"interlanguage","wgULSisCompactLinksEnabled":true,"wgULSisLanguageSelect
orEmpty":false,"wgWikibaseItemId":"Q115305900","wgCheckUserClientHintsHeadersJsAp
i":["architecture","bitness","brands","fullVersionList","mobile","model","platfor
m","platformVersion"],"GEHomepageSuggestedEditsEnableTopics":true,"wgGETopicsMatch
ModeEnabled":false,
"wgGEStructuredTaskRejectionReasonTextInputEnabled":false,"wgGELevelingUpEnabledFo
rUser":false};RLSTATE={"skins.vector.user.styles":"ready","ext.globalCssJs.user.st
yles":"ready","site.styles":"ready","user.styles":"ready","skins.vector.user":"rea
dy","ext.globalCssJs.user":"ready","user":"ready","user.options":"loading","ext.ci
te.styles":"ready","ext.math.styles":"ready","codex-search-styles":"ready","skins.
```

vector.styles":"ready","skins.vector.icons":"ready","skins.vector.zebra.styles":"ready","jquery.tablesorter.styles":"ready","jquery.makeCollapsible.styles":"ready","ext.visualEditor.desktopArticleTarget.noscript":"ready","ext.uls.interlanguage":"ready","wikibase.client.init":"ready","ext.wikimediaBadges":"ready"};RLPAGEMODULES=["ext.cite.ux-enhancements","mediawiki.page.media","mediawiki.toggleAllCollapsibles","site","mediawiki.page.ready","jquery.tablesorter","jquery.makeCollapsible","mediawiki.toc","skins.vector.js","ext.centralNotice.geoIP","ext.centralNotice.startUp",
"ext.gadget.ReferenceTooltips","ext.gadget.switcher","ext.urlShortener.toolbar","ext.centralauth.centralautologin","mmv.head","mmv.bootstrap.autostart","ext.popups","ext.visualEditor.desktopArticleTarget.init","ext.visualEditor.targetLoader","ext.echo.centralauth","ext.eventLogging","ext.wikimediaEvents","ext.navigationTiming","ext.uls.compactlinks","ext.uls.interface","ext.cx.eventlogging.campaigns","ext.cx.uls.quick.actions","wikibase.client.vector-2022","ext.checkUser.clientHints","ext.growthExperiments.SuggestedEditSession"];</script>
<script>(RLQ=window.RLQ||[]).push(function(){mw.loader.impl(function(){return["user.options@12s5i",function($,jQuery,require,module){mw.user.tokens.set({"patrolToken":"+\\","watchToken":"+\\","csrfToken":"+\\"});
}];});});</script>
<link href="/w/load.php?lang=en&modules=codex-search-styles%7Cext.cite.styles%7Cext.math.styles%7Cext.uls.interlanguage%7Cext.visualEditor.desktopArticleTarget.noscript%7Cext.wikimediaBadges%7Cjquery.makeCollapsible.styles%7Cjquery.tablesorter.styles%7Cskins.vector.icons%2Cstyles%7Cskins.vector.zebra.styles%7Cwikibase.client.init&only=styles&skin=vector-2022" rel="stylesheet"/>
<script async="" src="/w/load.php?lang=en&modules=startup&only=scripts&raw=1&skin=vector-2022"></script>
<meta content="" name="ResourceLoaderDynamicStyles"/>
<link href="/w/load.php?lang=en&modules=site.styles&only=styles&skin=vector-2022" rel="stylesheet"/>
<meta content="MediaWiki 1.42.0-wmf.13" name="generator"/>
<meta content="origin" name="referrer"/>
<meta content="origin-when-cross-origin" name="referrer"/>
<meta content="max-image-preview:standard" name="robots"/>
<meta content="telephone=no" name="format-detection"/>
<meta content="width=1000" name="viewport"/>
<meta content="Large language model - Wikipedia" property="og:title"/>
<meta content="website" property="og:type"/>
<link href="//upload.wikimedia.org" rel="preconnect"/>
<link href="//en.m.wikipedia.org/wiki/Large_language_model" media="only screen and (max-width: 720px)" rel="alternate"/>
<link href="/w/index.php?title=Large_language_model&action=edit" rel="alternate" title="Edit this page" type="application/x-wiki"/>
<link href="/static/apple-touch/wikipedia.png" rel="apple-touch-icon"/>
<link href="/static/favicon/wikipedia.ico" rel="icon"/>
<link href="/w/opensearch_desc.php" rel="search" title="Wikipedia (en)" type="application/opensearchdescription+xml"/>
<link href="//en.wikipedia.org/w/api.php?action=rsd" rel="EditURI" type="application/rsd+xml"/>
<link href="https://en.wikipedia.org/wiki/Large_language_model" rel="canonical"/>
<link href="https://creativecommons.org/licenses/by-sa/4.0/deed.en" rel="license"/>
<link href="/w/index.php?title=Special:RecentChanges&feed=atom" rel="alternate" title="Wikipedia Atom feed" type="application/atom+xml"/>
<link href="//meta.wikimedia.org" rel="dns-prefetch"/>
<link href="//login.wikimedia.org" rel="dns-prefetch"/>
</head>

<body class="skin-vector skin-vector-search-vue mediawiki ltr sitedir-ltr mw-hide-empty-elt ns-0 ns-subject mw-editable page-Large_language_model rootpage-Large_language_model skin-vector-2022 action-view">Jump to content

<header class="vector-header mw-header">

<nav aria-label="Site" class="vector-main-menu-landmark" role="navigation">

<input aria-haspopup="true" aria-label="Main menu" class="vector-dropdown-checkbox" data-event-name="ui.dropdown-vector-main-menu-dropdown" id="vector-main-menu-dropdown-checkbox" role="button" type="checkbox"/>
<label aria-hidden="true" class="vector-dropdown-label cdx-button cdx-button--fake-button cdx-button--fake-button--enabled cdx-button--weight-quiet cdx-button--icon-only" for="vector-main-menu-dropdown-checkbox" id="vector-main-menu-dropdown-label">
Main menu
</label>

<div class="vector-pinnable-header vector-main-menu-pinnable-header vector-pinnable-header-unpinned" data-feature-name="main-menu-pinned" data-pinnable-element-id="vector-main-menu" data-pinned-container-id="vector-main-menu-pinned-container" data-unpinned-container-id="vector-main-menu-unpinned-container">
Main menu
<button class="vector-pinnable-header-toggle-button vector-pinnable-header-pin-button" data-event-name="pinnable-header.vector-main-menu.pin">move to sidebar</button>
<button class="vector-pinnable-header-toggle-button vector-pinnable-header-unpin-button" data-event-name="pinnable-header.vector-main-menu.unpin">hide</button>

Navigation

<ul class="vector-menu-content-list">
<li class="mw-list-item" id="n-mainpage-description">Main page
<li class="mw-list-item" id="n-contents">Contents
<li class="mw-list-item" id="n-currentevents">Current events
<li class="mw-list-item" id="n-randompage">Random article
<li class="mw-list-item" id="n-aboutsite">About Wikipedia
<li class="mw-list-item" id="n-contactpage">Contact us
<li class="mw-list-item" id="n-sitesupport">Donate


```
</div>
</div>
<div class="vector-menu mw-portlet mw-portlet-interaction" id="p-interaction">
<div class="vector-menu-heading">
                Contribute
        </div>
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
<li class="mw-list-item" id="n-help"><a href="/wiki/Help:Contents" title="Guidance
on how to use and edit Wikipedia"><span>Help</span></a></li><li class="mw-list-ite
m" id="n-introduction"><a href="/wiki/Help:Introduction" title="Learn how to edit
Wikipedia"><span>Learn to edit</span></a></li><li class="mw-list-item" id="n-porta
l"><a href="/wiki/Wikipedia:Community_portal" title="The hub for editors"><span>Co
mmunity portal</span></a></li><li class="mw-list-item" id="n-recentchanges"><a acc
esskey="r" href="/wiki/Special:RecentChanges" title="A list of recent changes to W
ikipedia [r]"><span>Recent changes</span></a></li><li class="mw-list-item" id="n-u
pload"><a href="/wiki/Wikipedia:File_upload_wizard" title="Add images or other med
ia for use on Wikipedia"><span>Upload file</span></a></li>
</ul>
</div>
</div>
<div class="vector-main-menu-action vector-main-menu-action-lang-alert">
<div class="vector-main-menu-action-item">
<div class="vector-main-menu-action-heading vector-menu-heading">Languages</div>
<div class="vector-main-menu-action-content vector-menu-content">
<div class="mw-message-box cdx-message cdx-message--block mw-message-box-notice cd
x-message--notice vector-language-sidebar-alert"><span class="cdx-message__icon">
</span><div class="cdx-message__content">Language links are at the top of the pag
e.</div></div>
</div>
</div>
</div>
</div>
</div>
</div>
</div>
</nav>
<a class="mw-logo" href="/wiki/Main_Page">
<img alt="" aria-hidden="true" class="mw-logo-icon" height="50" src="/static/image
s/icons/wikipedia.png" width="50"/>
<span class="mw-logo-container">
<img alt="Wikipedia" class="mw-logo-wordmark" src="/static/images/mobile/copyrigh
t/wikipedia-wordmark-en.svg" style="width: 7.5em; height: 1.125em;"/>
<img alt="The Free Encyclopedia" class="mw-logo-tagline" height="13" src="/static/
images/mobile/copyright/wikipedia-tagline-en.svg" style="width: 7.3125em; height:
0.8125em;" width="117"/>
</span>
</a>
</div>
<div class="vector-header-end">
<div class="vector-search-box-vue vector-search-box-collapses vector-search-box-sh
ow-thumbnail vector-search-box-auto-expand-width vector-search-box" id="p-search"
role="search">
<a accesskey="f" class="cdx-button cdx-button--fake-button cdx-button--fake-button
--enabled cdx-button--weight-quiet cdx-button--icon-only search-toggle" href="/wik
i/Special:Search" id="" title="Search Wikipedia [f]"><span class="vector-icon mw-u
```

```
i-icon-search mw-ui-icon-wikimedia-search"></span>
<span>Search</span>
</a>
<div class="vector-typeahead-search-container">
<div class="cdx-typeahead-search cdx-typeahead-search--show-thumbnail cdx-typeahea
d-search--auto-expand-width">
<form action="/w/index.php" class="cdx-search-input cdx-search-input--has-end-butt
on" id="searchform">
<div class="cdx-search-input__input-wrapper" data-search-loc="header-moved" id="si
mpleSearch">
<div class="cdx-text-input cdx-text-input--has-start-icon">
<input accesskey="f" aria-label="Search Wikipedia" autocapitalize="sentences" clas
s="cdx-text-input__input" id="searchInput" name="search" placeholder="Search Wikip
edia" title="Search Wikipedia [f]" type="search"/>
<span class="cdx-text-input__icon cdx-text-input__start-icon"></span>
</div>
<input name="title" type="hidden" value="Special:Search"/>
</div>
<button class="cdx-button cdx-search-input__end-button">Search</button>
</form>
</div>
</div>
</div>
<nav aria-label="Personal tools" class="vector-user-links vector-user-links-wide"
role="navigation">
<div class="vector-user-links-main">
<div class="vector-menu mw-portlet emptyPortlet" id="p-vector-user-menu-preference
s">
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
</ul>
</div>
</div>
<div class="vector-menu mw-portlet emptyPortlet" id="p-vector-user-menu-userpage">
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
</ul>
</div>
</div>
<nav aria-label="Appearance" class="vector-client-prefs-landmark">
</nav>
<div class="vector-menu mw-portlet emptyPortlet" id="p-vector-user-menu-notificati
ons">
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
</ul>
</div>
</div>
<div class="vector-menu mw-portlet" id="p-vector-user-menu-overflow">
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
<li class="user-links-collapsible-item mw-list-item user-links-collapsible-item" i
d="pt-createaccount-2"><a class="" data-mw="interface" href="/w/index.php?title=Sp
ecial:CreateAccount&amp;returnto=Large+language+model" title="You are encouraged t
o create an account and log in; however, it is not mandatory"><span>Create account
</span></a>
```

```
</li>
<li class="user-links-collapsible-item mw-list-item user-links-collapsible-item" i
d="pt-login-2"><a accesskey="o" class="" data-mw="interface" href="/w/index.php?ti
tle=Special:UserLogin&amp;returnto=Large+language+model" title="You're encouraged
to log in; however, it's not mandatory. [o]"><span>Log in</span></a>
</li>
</ul>
</div>
</div>
</div>
<div class="vector-dropdown vector-user-menu vector-button-flush-right vector-user
-menu-logged-out" id="vector-user-links-dropdown" title="Log in and more options">
<input aria-haspopup="true" aria-label="Personal tools" class="vector-dropdown-che
ckbox" data-event-name="ui.dropdown-vector-user-links-dropdown" id="vector-user-li
nks-dropdown-checkbox" role="button" type="checkbox"/>
<label aria-hidden="true" class="vector-dropdown-label cdx-button cdx-button--fake
-button cdx-button--fake-button--enabled cdx-button--weight-quiet cdx-button--icon
-only" for="vector-user-links-dropdown-checkbox" id="vector-user-links-dropdown-la
bel"><span class="vector-icon mw-ui-icon-ellipsis mw-ui-icon-wikimedia-ellipsis">
</span>
<span class="vector-dropdown-label-text">Personal tools</span>
</label>
<div class="vector-dropdown-content">
<div class="vector-menu mw-portlet mw-portlet-personal user-links-collapsible-ite
m" id="p-personal" title="User menu">
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
<li class="user-links-collapsible-item mw-list-item" id="pt-createaccount"><a href
="/w/index.php?title=Special:CreateAccount&amp;returnto=Large+language+model" titl
e="You are encouraged to create an account and log in; however, it is not mandator
y"><span class="vector-icon mw-ui-icon-userAdd mw-ui-icon-wikimedia-userAdd"></spa
n> <span>Create account</span></a></li><li class="user-links-collapsible-item mw-l
ist-item" id="pt-login"><a accesskey="o" href="/w/index.php?title=Special:UserLogi
n&amp;returnto=Large+language+model" title="You're encouraged to log in; however,
it's not mandatory. [o]"><span class="vector-icon mw-ui-icon-logIn mw-ui-icon-wiki
media-logIn"></span> <span>Log in</span></a></li>
</ul>
</div>
</div>
<div class="vector-menu mw-portlet mw-portlet-user-menu-anon-editor" id="p-user-me
nu-anon-editor">
<div class="vector-menu-heading">
                Pages for logged out editors <a aria-label="Learn more about editi
ng" href="/wiki/Help:Introduction"><span>learn more</span></a>
</div>
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
<li class="mw-list-item" id="pt-anoncontribs"><a accesskey="y" href="/wiki/Specia
l:MyContributions" title="A list of edits made from this IP address [y]"><span>Con
tributions</span></a></li><li class="mw-list-item" id="pt-anontalk"><a accesskey
="n" href="/wiki/Special:MyTalk" title="Discussion about edits from this IP addres
s [n]"><span>Talk</span></a></li>
</ul>
</div>
</div>
</div>
```

```
</div>
</nav>
</div>
</header>
</div>
<div class="mw-page-container">
<div class="mw-page-container-inner">
<div class="vector-sitenotice-container">
<div id="siteNotice"><!-- CentralNotice --></div>
</div>
<div class="vector-column-start">
<div class="vector-main-menu-container">
<div id="mw-navigation">
<nav aria-label="Site" class="vector-main-menu-landmark" id="mw-panel" role="navig
ation">
<div class="vector-pinned-container" id="vector-main-menu-pinned-container">
</div>
</nav>
</div>
</div>
<div class="vector-sticky-pinned-container">
<nav aria-label="Contents" class="mw-table-of-contents-container vector-toc-landma
rk" data-event-name="ui.sidebar-toc" id="mw-panel-toc" role="navigation">
<div class="vector-pinned-container" id="vector-toc-pinned-container">
<div class="vector-toc vector-pinnable-element" id="vector-toc">
<div class="vector-pinnable-header vector-toc-pinnable-header vector-pinnable-head
er-pinned" data-feature-name="toc-pinned" data-pinnable-element-id="vector-toc">
<h2 class="vector-pinnable-header-label">Contents</h2>
<button class="vector-pinnable-header-toggle-button vector-pinnable-header-pin-but
ton" data-event-name="pinnable-header.vector-toc.pin">move to sidebar</button>
<button class="vector-pinnable-header-toggle-button vector-pinnable-header-unpin-b
utton" data-event-name="pinnable-header.vector-toc.unpin">hide</button>
</div>
<ul class="vector-toc-contents" id="mw-panel-toc-list">
<li class="vector-toc-list-item vector-toc-level-1" id="toc-mw-content-text">
<a class="vector-toc-link" href="#">
<div class="vector-toc-text">(Top)</div>
</a>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Dataset_preprocessin
g">
<a class="vector-toc-link" href="#Dataset_preprocessing">
<div class="vector-toc-text">
<span class="vector-toc-numb">1</span>Dataset preprocessing</div>
</a>
<button aria-controls="toc-Dataset_preprocessing-sublist" class="cdx-button cdx-bu
tton--weight-quiet cdx-button--icon-only vector-toc-toggle">
<span class="vector-icon vector-icon--x-small mw-ui-icon-wikimedia-expand"></span>
<span>Toggle Dataset preprocessing subsection</span>
</button>
<ul class="vector-toc-list" id="toc-Dataset_preprocessing-sublist">
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Probabilistic_tokeniza
tion">
<a class="vector-toc-link" href="#Probabilistic_tokenization">
<div class="vector-toc-text">
<span class="vector-toc-numb">1.1</span>Probabilistic tokenization</div>
```

```
</a>
<ul class="vector-toc-list" id="toc-Probabilistic_tokenization-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Dataset_cleaning">
<a class="vector-toc-link" href="#Dataset_cleaning">
<div class="vector-toc-text">
<span class="vector-toc-numb">1.2</span>Dataset cleaning</div>
</a>
<ul class="vector-toc-list" id="toc-Dataset_cleaning-sublist">
</ul>
</li>
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Training_and_architect
ure_details">
<a class="vector-toc-link" href="#Training_and_architecture_details">
<div class="vector-toc-text">
<span class="vector-toc-numb">2</span>Training and architecture details</div>
</a>
<button aria-controls="toc-Training_and_architecture_details-sublist" class="cdx-b
utton cdx-button--weight-quiet cdx-button--icon-only vector-toc-toggle">
<span class="vector-icon vector-icon--x-small mw-ui-icon-wikimedia-expand"></span>
<span>Toggle Training and architecture details subsection</span>
</button>
<ul class="vector-toc-list" id="toc-Training_and_architecture_details-sublist">
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Reinforcement_learning
_from_human_feedback_(RLHF)">
<a class="vector-toc-link" href="#Reinforcement_learning_from_human_feedback_(RLH
F)">
<div class="vector-toc-text">
<span class="vector-toc-numb">2.1</span>Reinforcement learning from human feedback
(RLHF)</div>
</a>
<ul class="vector-toc-list" id="toc-Reinforcement_learning_from_human_feedback_(RL
HF)-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Instruction_tuning">
<a class="vector-toc-link" href="#Instruction_tuning">
<div class="vector-toc-text">
<span class="vector-toc-numb">2.2</span>Instruction tuning</div>
</a>
<ul class="vector-toc-list" id="toc-Instruction_tuning-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Mixture_of_experts">
<a class="vector-toc-link" href="#Mixture_of_experts">
<div class="vector-toc-text">
<span class="vector-toc-numb">2.3</span>Mixture of experts</div>
</a>
<ul class="vector-toc-list" id="toc-Mixture_of_experts-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Prompt_engineering,_at
tention_mechanism,_and_context_window">
```

```
<a class="vector-toc-link" href="#Prompt_engineering,_attention_mechanism,_and_con
text_window">
<div class="vector-toc-text">
<span class="vector-toc-numb">2.4</span>Prompt engineering, attention mechanism, a
nd context window</div>
</a>
<ul class="vector-toc-list" id="toc-Prompt_engineering,_attention_mechanism,_and_c
ontext_window-sublist">
</ul>
</li>
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Training_cost">
<a class="vector-toc-link" href="#Training_cost">
<div class="vector-toc-text">
<span class="vector-toc-numb">3</span>Training cost</div>
</a>
<ul class="vector-toc-list" id="toc-Training_cost-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Tool_use">
<a class="vector-toc-link" href="#Tool_use">
<div class="vector-toc-text">
<span class="vector-toc-numb">4</span>Tool use</div>
</a>
<ul class="vector-toc-list" id="toc-Tool_use-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Agency">
<a class="vector-toc-link" href="#Agency">
<div class="vector-toc-text">
<span class="vector-toc-numb">5</span>Agency</div>
</a>
<ul class="vector-toc-list" id="toc-Agency-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Compression">
<a class="vector-toc-link" href="#Compression">
<div class="vector-toc-text">
<span class="vector-toc-numb">6</span>Compression</div>
</a>
<ul class="vector-toc-list" id="toc-Compression-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Multimodality">
<a class="vector-toc-link" href="#Multimodality">
<div class="vector-toc-text">
<span class="vector-toc-numb">7</span>Multimodality</div>
</a>
<ul class="vector-toc-list" id="toc-Multimodality-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Properties">
<a class="vector-toc-link" href="#Properties">
<div class="vector-toc-text">
<span class="vector-toc-numb">8</span>Properties</div>
```

```
</a>
<button aria-controls="toc-Properties-sublist" class="cdx-button cdx-button--weigh
t-quiet cdx-button--icon-only vector-toc-toggle">
<span class="vector-icon vector-icon--x-small mw-ui-icon-wikimedia-expand"></span>
<span>Toggle Properties subsection</span>
</button>
<ul class="vector-toc-list" id="toc-Properties-sublist">
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Scaling_laws_and_emerg
ent_abilities">
<a class="vector-toc-link" href="#Scaling_laws_and_emergent_abilities">
<div class="vector-toc-text">
<span class="vector-toc-numb">8.1</span>Scaling laws and emergent abilities</div>
</a>
<ul class="vector-toc-list" id="toc-Scaling_laws_and_emergent_abilities-sublist">
</ul>
</li>
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Interpretation">
<a class="vector-toc-link" href="#Interpretation">
<div class="vector-toc-text">
<span class="vector-toc-numb">9</span>Interpretation</div>
</a>
<button aria-controls="toc-Interpretation-sublist" class="cdx-button cdx-button--w
eight-quiet cdx-button--icon-only vector-toc-toggle">
<span class="vector-icon vector-icon--x-small mw-ui-icon-wikimedia-expand"></span>
<span>Toggle Interpretation subsection</span>
</button>
<ul class="vector-toc-list" id="toc-Interpretation-sublist">
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Understanding_and_inte
lligence">
<a class="vector-toc-link" href="#Understanding_and_intelligence">
<div class="vector-toc-text">
<span class="vector-toc-numb">9.1</span>Understanding and intelligence</div>
</a>
<ul class="vector-toc-list" id="toc-Understanding_and_intelligence-sublist">
</ul>
</li>
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Evaluation">
<a class="vector-toc-link" href="#Evaluation">
<div class="vector-toc-text">
<span class="vector-toc-numb">10</span>Evaluation</div>
</a>
<button aria-controls="toc-Evaluation-sublist" class="cdx-button cdx-button--weigh
t-quiet cdx-button--icon-only vector-toc-toggle">
<span class="vector-icon vector-icon--x-small mw-ui-icon-wikimedia-expand"></span>
<span>Toggle Evaluation subsection</span>
</button>
<ul class="vector-toc-list" id="toc-Evaluation-sublist">
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Perplexity">
<a class="vector-toc-link" href="#Perplexity">
<div class="vector-toc-text">
<span class="vector-toc-numb">10.1</span>Perplexity</div>
</a>
```

```
<ul class="vector-toc-list" id="toc-Perplexity-sublist">
<li class="vector-toc-list-item vector-toc-level-3" id="toc-BPW,_BPC,_and_BPT">
<a class="vector-toc-link" href="#BPW,_BPC,_and_BPT">
<div class="vector-toc-text">
<span class="vector-toc-numb">10.1.1</span>BPW, BPC, and BPT</div>
</a>
<ul class="vector-toc-list" id="toc-BPW,_BPC,_and_BPT-sublist">
</ul>
</li>
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Task-specific_datasets
_and_benchmarks">
<a class="vector-toc-link" href="#Task-specific_datasets_and_benchmarks">
<div class="vector-toc-text">
<span class="vector-toc-numb">10.2</span>Task-specific datasets and benchmarks</di
v>
</a>
<ul class="vector-toc-list" id="toc-Task-specific_datasets_and_benchmarks-sublis
t">
<li class="vector-toc-list-item vector-toc-level-3" id="toc-Adversarially_construc
ted_evaluations">
<a class="vector-toc-link" href="#Adversarially_constructed_evaluations">
<div class="vector-toc-text">
<span class="vector-toc-numb">10.2.1</span>Adversarially constructed evaluations</
div>
</a>
<ul class="vector-toc-list" id="toc-Adversarially_constructed_evaluations-sublis
t">
</ul>
</li>
</ul>
</li>
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Wider_impact">
<a class="vector-toc-link" href="#Wider_impact">
<div class="vector-toc-text">
<span class="vector-toc-numb">11</span>Wider impact</div>
</a>
<button aria-controls="toc-Wider_impact-sublist" class="cdx-button cdx-button--wei
ght-quiet cdx-button--icon-only vector-toc-toggle">
<span class="vector-icon vector-icon--x-small mw-ui-icon-wikimedia-expand"></span>
<span>Toggle Wider impact subsection</span>
</button>
<ul class="vector-toc-list" id="toc-Wider_impact-sublist">
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Security">
<a class="vector-toc-link" href="#Security">
<div class="vector-toc-text">
<span class="vector-toc-numb">11.1</span>Security</div>
</a>
<ul class="vector-toc-list" id="toc-Security-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-2" id="toc-Algorithmic_bias">
<a class="vector-toc-link" href="#Algorithmic_bias">
```

```
<div class="vector-toc-text">
<span class="vector-toc-numb">11.2</span>Algorithmic bias</div>
</a>
<ul class="vector-toc-list" id="toc-Algorithmic_bias-sublist">
<li class="vector-toc-list-item vector-toc-level-3" id="toc-Stereotyping">
<a class="vector-toc-link" href="#Stereotyping">
<div class="vector-toc-text">
<span class="vector-toc-numb">11.2.1</span>Stereotyping</div>
</a>
<ul class="vector-toc-list" id="toc-Stereotyping-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-3" id="toc-Political_bias">
<a class="vector-toc-link" href="#Political_bias">
<div class="vector-toc-text">
<span class="vector-toc-numb">11.2.2</span>Political bias</div>
</a>
<ul class="vector-toc-list" id="toc-Political_bias-sublist">
</ul>
</li>
</ul>
</li>
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-List">
<a class="vector-toc-link" href="#List">
<div class="vector-toc-text">
<span class="vector-toc-numb">12</span>List</div>
</a>
<ul class="vector-toc-list" id="toc-List-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-See_also">
<a class="vector-toc-link" href="#See_also">
<div class="vector-toc-text">
<span class="vector-toc-numb">13</span>See also</div>
</a>
<ul class="vector-toc-list" id="toc-See_also-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-Notes">
<a class="vector-toc-link" href="#Notes">
<div class="vector-toc-text">
<span class="vector-toc-numb">14</span>Notes</div>
</a>
<ul class="vector-toc-list" id="toc-Notes-sublist">
</ul>
</li>
<li class="vector-toc-list-item vector-toc-level-1" id="toc-References">
<a class="vector-toc-link" href="#References">
<div class="vector-toc-text">
<span class="vector-toc-numb">15</span>References</div>
</a>
<ul class="vector-toc-list" id="toc-References-sublist">
</ul>
</li>
```

<li class="vector-toc-list-item vector-toc-level-1" id="toc-Further_reading">

16Further reading

<ul class="vector-toc-list" id="toc-Further_reading-sublist">

</nav>

<main class="mw-body" id="content" role="main">
<header class="mw-body-header vector-page-titlebar">
<nav aria-label="Contents" class="vector-toc-landmark" role="navigation">
<div class="vector-dropdown vector-page-titlebar-toc vector-button-flush-left" id
="vector-page-titlebar-toc">
<input aria-haspopup="true" aria-label="Toggle the table of contents" class="vecto
r-dropdown-checkbox" data-event-name="ui.dropdown-vector-page-titlebar-toc" id="ve
ctor-page-titlebar-toc-checkbox" role="button" type="checkbox"/>
<label aria-hidden="true" class="vector-dropdown-label cdx-button cdx-button--fake
-button cdx-button--fake-button--enabled cdx-button--weight-quiet cdx-button--icon
-only" for="vector-page-titlebar-toc-checkbox" id="vector-page-titlebar-toc-labe
l"><span class="vector-icon mw-ui-icon-listBullet mw-ui-icon-wikimedia-listBulle
t">
Toggle the table of contents
</label>

<div class="vector-unpinned-container" id="vector-page-titlebar-toc-unpinned-conta
iner">

</nav>
<h1 class="firstHeading mw-first-heading" id="firstHeading"><span class="mw-page-t
itle-main">Large language model</h1>

<input aria-haspopup="true" aria-label="Go to an article in another language. Avai
lable in 31 languages" class="vector-dropdown-checkbox mw-interlanguage-selector"
data-event-name="ui.dropdown-p-lang-btn" id="p-lang-btn-checkbox" role="button" ty
pe="checkbox"/>
<label aria-hidden="true" class="vector-dropdown-label cdx-button cdx-button--fake
-button cdx-button--fake-button--enabled cdx-button--weight-quiet cdx-button--acti
on-progressive mw-portlet-lang-heading-31" for="p-lang-btn-checkbox" id="p-lang-bt
n-label"><span class="vector-icon mw-ui-icon-language-progressive mw-ui-icon-wikim
edia-language-progressive">
31 languages
</label>

<ul class="vector-menu-content-list">
<li class="interlanguage-link interwiki-ar mw-list-item"><a class="interlanguage-l
ink-target" href="https://ar.wikipedia.org/wiki/%D9%86%D9%85%D9%88%D8%B0%D8%AC_%D

8%A7%D9%84%D9%84%D8%BA%D8%A9_%D8%A7%D9%84%D9%83%D8%A8%D9%8A%D8%B1" hreflang="ar" lang="ar" title="نموذج اللغة الكبير – Arabic">العربية
<li class="interlanguage-link interwiki-az mw-list-item">Azərbaycanca
<li class="interlanguage-link interwiki-zh-min-nan mw-list-item">Bân-lâm-gú
<li class="interlanguage-link interwiki-bar mw-list-item">Boarisch
<li class="interlanguage-link interwiki-bs mw-list-item">Bosanski
<li class="interlanguage-link interwiki-ca mw-list-item">Català
<li class="interlanguage-link interwiki-cs mw-list-item">Čeština
<li class="interlanguage-link interwiki-de mw-list-item">Deutsch
<li class="interlanguage-link interwiki-el mw-list-item">Ελληνικά
<li class="interlanguage-link interwiki-es mw-list-item">Español
<li class="interlanguage-link interwiki-eu mw-list-item">Euskara
<li class="interlanguage-link interwiki-fa mw-list-item">فارسی
<li class="interlanguage-link interwiki-fr mw-list-item">Français
<li class="interlanguage-link interwiki-gl mw-list-item">Galego
<li class="interlanguage-link interwiki-ko mw-list-item">한국어
<li class="interlanguage-link interwiki-hi mw-list-item">हिन्दी
<li class="interlanguage-link interwiki-id mw-list-item">Bahasa Indonesia
<li class="interlanguage-link interwiki-zu mw-list-item"><a class="interl

```
anguage-link-target" href="https://zu.wikipedia.org/wiki/UNongo_lolimi_olukhulu" h
reflang="zu" lang="zu" title="UNongo lolimi olukhulu – Zulu"><span>IsiZulu</span>
</a></li><li class="interlanguage-link interwiki-it mw-list-item"><a class="interl
anguage-link-target" href="https://it.wikipedia.org/wiki/Modello_linguistico_di_gr
andi_dimensioni" hreflang="it" lang="it" title="Modello linguistico di grandi dime
nsioni – Italian"><span>Italiano</span></a></li><li class="interlanguage-link inte
rwiki-he mw-list-item"><a class="interlanguage-link-target" href="https://he.wikip
edia.org/wiki/%D7%9E%D7%95%D7%93%D7%9C_%D7%A9%D7%A4%D7%94_%D7%92%D7%93%D7%95%D7%9
C" hreflang="he" lang="he" title="מודל שפה גדול – Hebrew"><span>עברית</span></a></li><
li class="interlanguage-link interwiki-mk mw-list-item"><a class="interlanguage-li
nk-target" href="https://mk.wikipedia.org/wiki/%D0%93%D0%BE%D0%BB%D0%B5%D0%BC_%D1%
98%D0%B0%D0%B7%D0%B8%D1%87%D0%B5%D0%BD_%D0%BC%D0%BE%D0%B4%D0%B5%D0%BB" hreflang="m
k" lang="mk" title="Голем јазичен модел – Macedonian"><span>Македонски</span></a>
</li><li class="interlanguage-link interwiki-ja mw-list-item"><a class="interlangu
age-link-target" href="https://ja.wikipedia.org/wiki/%E5%A4%A7%E8%A6%8F%E6%A8%A1%E
8%A8%80%E8%AA%9E%E3%83%A2%E3%83%87%E3%83%AB" hreflang="ja" lang="ja" title="大規模
言語モデル – Japanese"><span>日本語</span></a></li><li class="interlanguage-link int
erwiki-pt mw-list-item"><a class="interlanguage-link-target" href="https://pt.wiki
pedia.org/wiki/Modelo_de_linguagem_grande" hreflang="pt" lang="pt" title="Modelo d
e linguagem grande – Portuguese"><span>Português</span></a></li><li class="interla
nguage-link interwiki-qu mw-list-item"><a class="interlanguage-link-target" href
="https://qu.wikipedia.org/wiki/Hatun_simi_wallpama" hreflang="qu" lang="qu" title
="Hatun simi wallpama – Quechua"><span>Runa Simi</span></a></li><li class="interla
nguage-link interwiki-ru mw-list-item"><a class="interlanguage-link-target" href
="https://ru.wikipedia.org/wiki/%D0%91%D0%BE%D0%BB%D1%8C%D1%88%D0%B0%D1%8F_%D1%8F%
D0%B7%D1%8B%D0%BA%D0%BE%D0%B2%D0%B0%D1%8F_%D0%BC%D0%BE%D0%B4%D0%B5%D0%BB%D1%8C" hr
eflang="ru" lang="ru" title="Большая языковая модель – Russian"><span>Русский</spa
n></a></li><li class="interlanguage-link interwiki-sl mw-list-item"><a class="inte
rlanguage-link-target" href="https://sl.wikipedia.org/wiki/Obse%C5%BEni_jezikovni_
model" hreflang="sl" lang="sl" title="Obsežni jezikovni model – Slovenian"><span>S
lovenščina</span></a></li><li class="interlanguage-link interwiki-tr mw-list-ite
m"><a class="interlanguage-link-target" href="https://tr.wikipedia.org/wiki/Geni%C
5%9F_dil_modeli" hreflang="tr" lang="tr" title="Geniş dil modeli – Turkish"><span>
Türkçe</span></a></li><li class="interlanguage-link interwiki-uk mw-list-item"><a
class="interlanguage-link-target" href="https://uk.wikipedia.org/wiki/%D0%92%D0%B
5%D0%BB%D0%B8%D0%BA%D0%B0_%D0%BC%D0%BE%D0%B2%D0%BD%D0%B0_%D0%BC%D0%BE%D0%B4%D0%B5%
D0%BB%D1%8C" hreflang="uk" lang="uk" title="Велика мовна модель – Ukrainian"><span
>Українська</span></a></li><li class="interlanguage-link interwiki-ug mw-list-ite
m"><a class="interlanguage-link-target" href="https://ug.wikipedia.org/wiki/%DA%8
6%D9%88%DA%AD_%D8%AA%D9%89%D9%84_%D9%85%D9%88%D8%AF%D9%89%D9%84%D9%89" hreflang="u
g" lang="ug" title="چوڭ تىل مودىلى – Uyghur"><span>ئۇيغۇرچە / Uyghurche</span></a></li><
li class="interlanguage-link interwiki-zh-yue mw-list-item"><a class="interlanguag
e-link-target" href="https://zh-yue.wikipedia.org/wiki/%E5%A4%A7%E5%9E%8B%E8%AA%9
E%E8%A8%80%E6%A8%A1%E5%9E%8B" hreflang="yue" lang="yue" title="大型語言模型 – Canton
ese"><span>粵語</span></a></li><li class="interlanguage-link interwiki-zh mw-list-i
tem"><a class="interlanguage-link-target" href="https://zh.wikipedia.org/wiki/%E5%
A4%A7%E5%9E%8B%E8%AF%AD%E8%A8%80%E6%A8%A1%E5%9E%8B" hreflang="zh" lang="zh" title
="大型语言模型 – Chinese"><span>中文</span></a></li>
</ul>
<div class="after-portlet after-portlet-lang"><span class="wb-langlinks-edit wb-la
nglinks-link"><a class="wbc-editpage" href="https://www.wikidata.org/wiki/Special:
EntityPage/Q115305900#sitelinks-wikipedia" title="Edit interlanguage links">Edit l
inks</a></span></div>
</div>
</div>
</div>
```

```
</header>
<div class="vector-page-toolbar">
<div class="vector-page-toolbar-container">
<div id="left-navigation">
<nav aria-label="Namespaces">
<div class="vector-menu vector-menu-tabs mw-portlet mw-portlet-associated-pages" i
d="p-associated-pages">
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
<li class="selected vector-tab-noicon mw-list-item" id="ca-nstab-main"><a accesske
y="c" href="/wiki/Large_language_model" title="View the content page [c]"><span>Ar
ticle</span></a></li><li class="vector-tab-noicon mw-list-item" id="ca-talk"><a ac
cesskey="t" href="/wiki/Talk:Large_language_model" rel="discussion" title="Discuss
improvements to the content page [t]"><span>Talk</span></a></li>
</ul>
</div>
</div>
<div class="vector-dropdown emptyPortlet" id="p-variants">
<input aria-haspopup="true" aria-label="Change language variant" class="vector-dro
pdown-checkbox" data-event-name="ui.dropdown-p-variants" id="p-variants-checkbox"
role="button" type="checkbox"/>
<label aria-hidden="true" class="vector-dropdown-label cdx-button cdx-button--fake
-button cdx-button--fake-button--enabled cdx-button--weight-quiet" for="p-variants
-checkbox" id="p-variants-label"><span class="vector-dropdown-label-text">English
</span>
</label>
<div class="vector-dropdown-content">
<div class="vector-menu mw-portlet mw-portlet-variants emptyPortlet" id="p-variant
s">
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
</ul>
</div>
</div>
</div>
</div>
</nav>
</div>
<div class="vector-collapsible" id="right-navigation">
<nav aria-label="Views">
<div class="vector-menu vector-menu-tabs mw-portlet mw-portlet-views" id="p-view
s">
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
<li class="selected vector-tab-noicon mw-list-item" id="ca-view"><a href="/wiki/La
rge_language_model"><span>Read</span></a></li><li class="vector-tab-noicon mw-list
-item" id="ca-edit"><a accesskey="e" href="/w/index.php?title=Large_language_model
&amp;action=edit" title="Edit this page [e]"><span>Edit</span></a></li><li class
="vector-tab-noicon mw-list-item" id="ca-history"><a accesskey="h" href="/w/index.
php?title=Large_language_model&amp;action=history" title="Past revisions of this p
age [h]"><span>View history</span></a></li>
</ul>
</div>
</div>
</nav>
<nav aria-label="Page tools" class="vector-page-tools-landmark">
```

<div class="vector-dropdown vector-page-tools-dropdown" id="vector-page-tools-drop
down">
<input aria-haspopup="true" aria-label="Tools" class="vector-dropdown-checkbox" da
ta-event-name="ui.dropdown-vector-page-tools-dropdown" id="vector-page-tools-dropd
own-checkbox" role="button" type="checkbox"/>
<label aria-hidden="true" class="vector-dropdown-label cdx-button cdx-button--fake
-button cdx-button--fake-button--enabled cdx-button--weight-quiet" for="vector-pag
e-tools-dropdown-checkbox" id="vector-page-tools-dropdown-label"><span class="vect
or-dropdown-label-text">Tools
</label>

<div class="vector-pinnable-header vector-page-tools-pinnable-header vector-pinnab
le-header-unpinned" data-feature-name="page-tools-pinned" data-pinnable-element-id
="vector-page-tools" data-pinned-container-id="vector-page-tools-pinned-container"
data-unpinned-container-id="vector-page-tools-unpinned-container">
Tools
<button class="vector-pinnable-header-toggle-button vector-pinnable-header-pin-but
ton" data-event-name="pinnable-header.vector-page-tools.pin">move to sidebar</butt
on>
<button class="vector-pinnable-header-toggle-button vector-pinnable-header-unpin-b
utton" data-event-name="pinnable-header.vector-page-tools.unpin">hide</button>

<div class="vector-menu mw-portlet mw-portlet-cactions emptyPortlet vector-has-col
lapsible-items" id="p-cactions" title="More options">

                Actions

<ul class="vector-menu-content-list">
<li class="selected vector-more-collapsible-item mw-list-item" id="ca-more-view"><
a href="/wiki/Large_language_model">Read
<li class="vector-mo
re-collapsible-item mw-list-item" id="ca-more-edit"><a accesskey="e" href="/w/inde
x.php?title=Large_language_model&action=edit" title="Edit this page [e]"><span
>Edit
<li class="vector-more-collapsible-item mw-list-item" id="ca-
more-history"><a href="/w/index.php?title=Large_language_model&action=histor
y">View history

                General

<ul class="vector-menu-content-list">
<li class="mw-list-item" id="t-whatlinkshere"><a accesskey="j" href="/wiki/Specia
l:WhatLinksHere/Large_language_model" title="List of all English Wikipedia pages c
ontaining links to this page [j]">What links here
<li class
="mw-list-item" id="t-recentchangeslinked"><a accesskey="k" href="/wiki/Special:Re
centChangesLinked/Large_language_model" rel="nofollow" title="Recent changes in pa
ges linked from this page [k]">Related changes
<li class="mw-
list-item" id="t-upload"><a accesskey="u" href="/wiki/Wikipedia:File_Upload_Wizar
d" title="Upload files [u]">Upload file
<li class="mw-list-it
em" id="t-specialpages"><a accesskey="q" href="/wiki/Special:SpecialPages" title

```
="A list of all special pages [q]"><span>Special pages</span></a></li><li class="m
w-list-item" id="t-permalink"><a href="/w/index.php?title=Large_language_model&am
p;oldid=1195671783" title="Permanent link to this revision of this page"><span>Per
manent link</span></a></li><li class="mw-list-item" id="t-info"><a href="/w/index.
php?title=Large_language_model&amp;action=info" title="More information about this
page"><span>Page information</span></a></li><li class="mw-list-item" id="t-cite"><
a href="/w/index.php?title=Special:CiteThisPage&amp;page=Large_language_model&amp;
id=1195671783&amp;wpFormIdentifier=titleform" title="Information on how to cite th
is page"><span>Cite this page</span></a></li><li class="mw-list-item" id="t-urlsho
rtener"><a href="/w/index.php?title=Special:UrlShortener&amp;url=https%3A%2F%2Fen.
wikipedia.org%2Fwiki%2FLarge_language_model"><span>Get shortened URL</span></a></l
i><li class="mw-list-item" id="t-wikibase"><a accesskey="g" href="https://www.wiki
data.org/wiki/Special:EntityPage/Q115305900" title="Structured data on this page h
osted by Wikidata [g]"><span>Wikidata item</span></a></li>
</ul>
</div>
</div>
<div class="vector-menu mw-portlet mw-portlet-coll-print_export" id="p-coll-print_
export">
<div class="vector-menu-heading">
                Print/export
        </div>
<div class="vector-menu-content">
<ul class="vector-menu-content-list">
<li class="mw-list-item" id="coll-download-as-rl"><a href="/w/index.php?title=Spec
ial:DownloadAsPdf&amp;page=Large_language_model&amp;action=show-download-screen" t
itle="Download this page as a PDF file"><span>Download as PDF</span></a></li><li c
lass="mw-list-item" id="t-print"><a accesskey="p" href="/w/index.php?title=Large_l
anguage_model&amp;printable=yes" title="Printable version of this page [p]"><span>
Printable version</span></a></li>
</ul>
</div>
</div>
</div>
</div>
</div>
</div>
</nav>
</div>
</div>
</div>
<div class="vector-column-end">
<div class="vector-sticky-pinned-container">
<nav aria-label="Page tools" class="vector-page-tools-landmark">
<div class="vector-pinned-container" id="vector-page-tools-pinned-container">
</div>
</nav>
<nav aria-label="Appearance" class="vector-client-prefs-landmark">
</nav>
</div>
</div>
<div aria-labelledby="firstHeading" class="vector-body" data-mw-ve-target-containe
r="" id="bodyContent">
<div class="vector-body-before-content">
<div class="mw-indicators">
</div>
```

From Wikipedia, the free encyclopedia

Type of artificial neural network
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Unsupervis
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Online
learning
Batc
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Self
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Reinforc
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Generative model

Regression

Clustering
dime
nsion reduction
density estimati
on
Anomaly detection

Data C
leaning

AutoML
Association rules
Semantic analysis
Structured prediction
Feature engineering
Feature learning
Learning to rank
Grammar induction
Ontology learning
Multimodal learning </td>
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Supervised learning
(classification • regression)
Apprenticeship learning
Decision trees
Ensembles
Bagging
Boosting
Random forest
k-NN
Linear regression
Naive Bayes
Artificial neural networks
Logistic regression
Perceptron
Relevance vector machine (RVM)
Support vector machine (SVM) </td>
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Hierar
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Fuzzy
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Mean shift </
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Factor analysis
CCA</l
i>
<a href="/wiki/Independent_component_analysis" title="Independent component an
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<a href="/wiki/Linear_discriminant_analysis" title="Linear discriminant analys
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actorization">NMF
<a href="/wiki/Principal_component_analysis" title="Principal component analys
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<a href="/wiki/Proper_generalized_decomposition" title="Proper generalized dec
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<a href="/wiki/T-distributed_stochastic_neighbor_embedding" title="T-distribut
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Bayes net</l
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Cond
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Hidden Markov
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<li><a href="/wiki/Gated_recurrent_unit" title="Gated recurrent unit">GRU</a></li>
<li><a href="/wiki/Echo_state_network" title="Echo state network">ESN</a></li>
<li><a href="/wiki/Reservoir_computing" title="Reservoir computing">reservoir comp
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<li><a href="/wiki/Diffusion_model" title="Diffusion model">Diffusion model</a></l
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<li><a href="/wiki/Self-organizing_map" title="Self-organizing map">SOM</a></li>
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l RAM</a> (ECRAM)</li></ul></div></div></td>
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n" title="State–action–reward–state–action">SARSA</a></li>
<li><a href="/wiki/Temporal_difference_learning" title="Temporal difference learni
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<li><a href="/wiki/Multi-agent_reinforcement_learning" title="Multi-agent reinforc
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<li><a href="/wiki/Crowdsourcing" title="Crowdsourcing">Crowdsourcing</a></li>
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achine learning)">Learning curve</a></li></ul></div></div></td>
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<li><a href="/wiki/Empirical_risk_minimization" title="Empirical risk minimizatio
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<li><a href="/wiki/Occam_learning" title="Occam learning">Occam learning</a></li>
<li><a href="/wiki/Probably_approximately_correct_learning" title="Probably approx
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<li><a href="/wiki/Statistical_learning_theory" title="Statistical learning theor
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<li><a href="/wiki/Vapnik%E2%80%93Chervonenkis_theory" title="Vapnik–Chervonenkis
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<li><a href="/wiki/International_Conference_on_Machine_Learning" title="Internatio
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ternational Conference on Learning Representations">ICLR
<a href="/wiki/International_Joint_Conference_on_Artificial_Intelligence" titl
e="International Joint Conference on Artificial Intelligence">IJCAI

ML
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datasets for machine-learning research">List of datasets for machine-learning rese
arch
<a href="/wiki/List_of_datasets_in_computer_vision_and_image_processing" t
itle="List of datasets in computer vision and image processing">List of datasets i
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arning"><abbr title="Edit this template">e</abbr> </td></tr></t
body></table>
A large language model (LLM) is a <a href="/wiki/Language_model"
title="Language model">language model notable for its ability to achieve gener
al-purpose language understanding and generation. LLMs acquire these abilities by
learning statistical relationships from text documents during a computationally in
tensive
self-supervised and <a class="mw-redirect" href="/wiki/Semi-supervised_learnin
g" title="Semi-supervised learning">semi-supervised training process.<sup clas
s="reference" id="cite_ref-:7_1-0">[1]</sup> LLMs ar
e arti
ficial neural networks following a <a href="/wiki/Transformer_(machine_learnin
g_model)" title="Transformer (machine learning model)">transformer architectur
e.^{[2]}
They can be used for <a href="/wiki/Generative_artificial_intelligence" tit
le="Generative artificial intelligence">text generation by taking an input tex
t and repeatedly predicting the next token or word.<sup class="reference" id="cite

```
_ref-Bowman_3-0"><a href="#cite_note-Bowman-3">[3]</a></sup> Up to 2020, <a class
="mw-redirect" href="/wiki/Fine-tuning_(machine_learning)" title="Fine-tuning (mac
hine learning)">fine tuning</a> was the only way a model could be adapted to be ab
le to accomplish specific tasks. Larger sized models, such as <a href="/wiki/GPT-
3" title="GPT-3">GPT-3</a>, however, can be <a href="/wiki/Prompt_engineering" tit
le="Prompt engineering">prompt-engineered</a> to achieve similar results.<sup clas
s="reference" id="cite_ref-few-shot-learners_4-0"><a href="#cite_note-few-shot-lea
rners-4">[4]</a></sup> They are thought to acquire knowledge about syntax, semanti
cs and "ontology" inherent in human language corpora, but also inaccuracies and <a
href="/wiki/Algorithmic_bias" title="Algorithmic bias">biases</a> present in the c
orpora.<sup class="reference" id="cite_ref-Manning-2022_5-0"><a href="#cite_note-M
anning-2022-5">[5]</a></sup>
</p><p>Notable examples include <a href="/wiki/OpenAI" title="OpenAI">OpenAI</a>'s
<a href="/wiki/Generative_pre-trained_transformer" title="Generative pre-trained t
ransformer">GPT</a> models (e.g., <a class="mw-redirect" href="/wiki/GPT-3.5" titl
e="GPT-3.5">GPT-3.5</a> and <a href="/wiki/GPT-4" title="GPT-4">GPT-4</a>, used in
<a href="/wiki/ChatGPT" title="ChatGPT">ChatGPT</a>), <a href="/wiki/Google" title
="Google">Google</a>'s <a href="/wiki/PaLM" title="PaLM">PaLM</a> (used in <a clas
s="mw-redirect" href="/wiki/Google_Bard" title="Google Bard">Bard</a>), and <a hre
f="/wiki/Meta_Platforms" title="Meta Platforms">Meta</a>'s <a href="/wiki/LLaMA" t
itle="LLaMA">LLaMA</a>, as well as <a href="/wiki/BLOOM_(language_model)" title="B
LOOM (language model)">BLOOM</a>, <a href="/wiki/Ernie_Bot" title="Ernie Bot">Erni
e 3.0 Titan</a>, and <a href="/wiki/Anthropic#Claude" title="Anthropic">Anthropi
c's Claude 2</a>.
</p>
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an><span class="mw-editsection"><span class="mw-editsection-bracket">[</span><a hr
ef="/w/index.php?title=Large_language_model&amp;action=edit&amp;section=1" title
="Edit section: Dataset preprocessing"><span>edit</span></a><span class="mw-editse
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e" role="note">See also: <a href="/wiki/List_of_datasets_for_machine-learning_rese
arch#Internet" title="List of datasets for machine-learning research">List of data
sets for machine-learning research § Internet</a></div>
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2" title="Edit section: Probabilistic tokenization"><span>edit</span></a><span cla
ss="mw-editsection-bracket">]</span></span></h3>
<p>Using a modification of <a href="/wiki/Byte_pair_encoding" title="Byte pair enc
oding">byte-pair encoding</a>, in the first step, all unique characters (including
blanks and <a class="mw-redirect" href="/wiki/Punctuation_mark" title="Punctuation
mark">punctuation marks</a>) are treated as an initial set of <a href="/wiki/N-gra
m" title="N-gram"><i>n</i>-grams</a> (i.e. initial set of uni-grams). Successively
the most frequent pair of adjacent characters is merged into a bi-gram and all ins
tances of the pair are replaced by it. All occurrences of adjacent pairs of (previ
ously merged) <i>n</i>-grams that most frequently occur together are then again me
rged into even lengthier <i>n</i>-gram repeatedly until a vocabulary of prescribed
size is obtained (in case of <a href="/wiki/GPT-3" title="GPT-3">GPT-3</a>, the si
ze is 50257).<sup class="reference" id="cite_ref-xbiWb_6-0"><a href="#cite_note-xb
iWb-6">[6]</a></sup> Token vocabulary consists of <a class="mw-redirect" href="/wi
ki/Integers" title="Integers">integers</a>, spanning from zero up to the size of t
```

he token vocabulary. New words can always be interpreted as combinations of the to
kens and the initial-set uni-grams.<sup class="reference" id="cite_ref-2022Book_7-
0">[7]</sup>
A token vocabulary based on the frequencies extracted from mainly English c
orpora uses as few tokens as possible for an average English word. An average word
in another language encoded by such an English-optimized tokenizer is however spli
t into suboptimal amount of tokens.
<small><code>tokenizer: texts -> series of numerical "tokens"</code></sm
all> may be split into:

<table class="wikitable">
<tbody><tr>
<td>n-grams:</td>
<td bgcolor="#e0e0e0">token</td>
<td>izer</td>
<td bgcolor="#e0e0e0">:</td>
<td>texts</td>
<td bgcolor="#e0e0e0"><code>-></code></td>
<td>series</td>
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<td>numerical</td>
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<tr>
<td>numbers as "tokens":</td>
<td bgcolor="#e0e0e0">30001</td>
<td>7509</td>
<td bgcolor="#e0e0e0">25</td>
<td>13399</td>
<td bgcolor="#e0e0e0">4613</td>
<td>2168</td>
<td bgcolor="#e0e0e0">286</td>
<td>29052</td>
<td bgcolor="#e0e0e0">366</td>
<td>83</td>
<td bgcolor="#e0e0e0">482</td>
<td>641</td>
<td bgcolor="#e0e0e0">1
</td></tr></tbody></table>
Probabilistic tokenization also <a href="/wiki/Data_compression" title="Data co
mpression">compresses the datasets, which is the reason for using the <a href
="/wiki/Byte_pair_encoding" title="Byte pair encoding">byte pair encoding algo
rithm as a tokenizer. Because LLMs generally require input to be an array that is
not jagged, the shorter text
s must be "padded" until they match the length of the longest one. How many tokens
are, on average, needed per word depends on the language of the dataset.<sup class
="reference" id="cite_ref-8">[8]</sup><sup class="refer
ence" id="cite_ref-9">[9]</sup>

<h3>Dataset cleaning<span c
lass="mw-editsection">[<a href="/w/ind
ex.php?title=Large_language_model&action=edit&section=3" title="Edit secti

on: Dataset cleaning">edit]
</h3>
Removal of toxic passages from the dataset, discarding low-quality data, and de
-duplication are examples of <a href="/wiki/Data_cleansing" title="Data cleansin
g">dataset cleaning.<sup class="reference" id="cite_ref-aYNg4_10-0"><a href="#
cite_note-aYNg4-10">[10]</sup> Resulting, cleaned (high-quality) datasets cont
ain up to 17 trillion words in 2022, raising from 985 million words, used in 2018
for GPT-1,<sup class="reference" id="cite_
ref-TzrRM_11-0">[11]</sup> and 3.3 billion word
s, used for BE
RT.<sup class="reference" id="cite_ref-jm_12-0">[1
2]</sup> The future data is, however, expected to be increasingly "contaminate
d" by LLM-generated contents themselves.<sup class="reference" id="cite_ref-qbFw1_
13-0">[13]</sup>

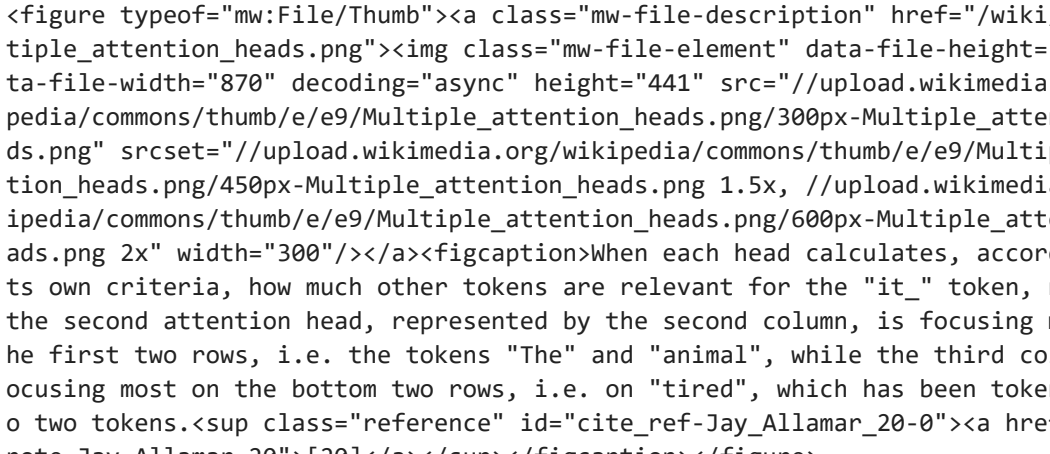
<h2>Training and
architecture details<span class="mw-editsectio
n-bracket">[<a href="/w/index.php?title=Large_language_model&action=edi
t&section=4" title="Edit section: Training and architecture details">edi
t]</h2>
<link href="mw-data:TemplateStyles:r1033289096" rel="mw-deduplicated-inline-styl
e"/> See also: <a class
="mw-redirect" href="/wiki/Fine-tuning_(machine_learning)" title="Fine-tuning (mac
hine learning)">Fine-tuning (machine learning)
<h3><span
class="mw-headline" id="Reinforcement_learning_from_human_feedback_(RLHF)">Reinfor
cement learning from human feedback (RLHF)<spa
n class="mw-editsection-bracket">[<a href="/w/index.php?title=Large_languag
e_model&action=edit&section=5" title="Edit section: Reinforcement learning
from human feedback (RLHF)">edit<span class="mw-editsection-brack
et">]</h3>
<a href="/wiki/Reinforcement_learning_from_human_feedback" title="Reinforcement
learning from human feedback">Reinforcement learning from human feedback (RLH
F) through algorithms, such as <a href="/wiki/Proximal_Policy_Optimization" title
="Proximal Policy Optimization">proximal policy optimization, is used to furth
er fine-tune a model based on a dataset of human preferences.<sup class="referenc
e" id="cite_ref-instructGPT-paper_14-0">
[14]</sup>

<h3>Instruction tuning<sp
an class="mw-editsection">[<a href="/
w/index.php?title=Large_language_model&action=edit&section=6" title="Edit
section: Instruction tuning">edit<span class="mw-editsection-brac
ket">]</h3>
Using "self-instruct" approaches, LLMs have been able to <a href="/wiki/Bootstr
apping" title="Bootstrapping">bootstrap correct responses, replacing any naive
responses, starting from human-generated corrections of a few cases. For example,
in the instruction "Write an essay about the main themes represented in Hamlet," a
n initial naive completion might be 'If you submit the essay after March 17, your
grade will be reduced by 10% for each day of delay," based on the frequency of thi
s textual sequence in the corpus.<sup class="reference" id="cite_ref-self-instruct
-paper_15-0">[15]</sup>

<h3>Mixture of experts<sp
an class="mw-editsection">[<a href="/
w/index.php?title=Large_language_model&action=edit&section=7" title="Edit

section: Mixture of experts">edit]</h3>
<link href="mw-data:TemplateStyles:r1033289096" rel="mw-deduplicated-inline-style"/> Main article: Mixture of experts
The largest LLM may be too expensive to train and use directly. For such models, mixture of experts (MoE) can be applied, a line of research pursued by Google researchers since 2017 to train models reaching up to 1 trillion parameters.^{[16]}^{[17]}^{[18]}

<h3>Prompt engineering, attention mechanism, and context window[edit]</h3>
<link href="mw-data:TemplateStyles:r1033289096" rel="mw-deduplicated-inline-style"/> See also: Prompt engineering and Attention (machine learning)
Most results previously achievable only by (costly) fine-tuning, can be achieved through prompt engineering, although limited to the scope of a single conversation (more precisely, limited to the scope of a context window).^{[19]}

<figure typeof="mw:File/Thumb">  <figcaption>When each head calculates, according to its own criteria, how much other tokens are relevant for the "it_" token, note that the second attention head, represented by the second column, is focusing most on the first two rows, i.e. the tokens "The" and "animal", while the third column is focusing most on the bottom two rows, i.e. on "tired", which has been tokenized into two tokens.^{[20]}</figcaption></figure>
In order to find out which tokens are relevant to each other within the scope of the context window, the attention mechanism calculates "soft" weights for each token, more precisely for its embedding, by using multiple attention heads, each with its own "relevance" for calculating its own soft weights. For example, the small (i.e. 117M parameter sized) GPT-2 model, has had twelve attention heads and a context window of only 1k token.^{[21]}
In its medium version it has 345M parameters and contains 24 layers,

each with 12 attention heads. For the training with gradient descent a batch size of 512 was utilized.^{[7]}
The largest models can have a context window sized up to 32k (for example, GPT-4; while GPT-3.5 has a context window sized from 4k to 16k, and legacy GPT-3 has had 2k sized context window).^{[22]}
Length of a conversation that the model can take into account when generating its next answer is limited by the size of a context window, as well. If the length of a conversation, for example with Chat-GPT, is longer than its context window, only the parts inside the context window are taken into account when generating the next answer, or the model needs to apply some algorithm to summarize the too distant parts of conversation.
The shortcomings of making a context window larger include higher computational cost and possibly diluting the focus on local context, while making it smaller can cause a model to miss an important long-range dependency. Balancing them are a matter of experimentation and domain-specific considerations.
A model may be pre-trained either to predict how the segment continues, or what is missing in the segment, given a segment from its training dataset.^{[23]} It can be either

autoregressive (i.e. predicting how the segment continues, the way GPTs do it): for example given a segment "I like to eat", the model predicts "ice cream", or
"masked" (i.e. filling in the parts missing from the segment, the way "BERT"^{[12]} does it): for example, given a segment "I like to <code>[__] [__]</code> cream", the model predicts that "eat" and "ice" are missing.
Models may be trained on auxiliary tasks which test their understanding of the data distribution, such as Next Sentence Prediction (NSP), in which pairs of sentences are presented and the model must predict whether they appear consecutively in the training corpus.^{[12]} During training, regularization loss is also used to stabilize training. However regularization loss is usually not used during testing and evaluation.

<h2>Training cost[edit]</h2>
Advances in software and hardware have reduced the cost substantially since 2020, such that in 2023 training of a 12-billion-parameter LLM computational cost is 72,300 A100-GPU-hours, while in 2020 the cost of training a 1.5-billion-parameter LLM (which was two orders of magnitude smaller than the state of the art in 2020) was between $80 thousand and $1.6 million.^{[24]}^{[25]}<sup class="ref

erence" id="cite_ref-Pythia_26-0">[26]</sup> Since 2020, large sums were invested in increasingly large models. For example, training of the GPT-2 (i.e. a 1.5-billion-parameters model) in 2019 cost $50,000, while training of the PaLM (i.e. a 540-billion-parameters model) in 2022 cost $8 million.^{[27]}
For Transformer-based LLM, training cost is much higher than inference cost. It costs 6 FLOPs per parameter to train on one token, whereas it costs 1 to 2 FLOPs per parameter to infer on one token.^{[28]}

<h2>Tool use[edit]</h2>
There are certain tasks that, in principle, cannot be solved by any LLM, at least not without the use of external tools or additional software. An example of such a task is responding to the user's input '354 * 139 = ', provided that the LLM has not already encountered a continuation of this calculation in its training corpus. In such cases, the LLM needs to resort to running program code that calculates the result, which can then be included in its response. Another example is 'What is the time now? It is ', where a separate program interpreter would need to execute a code to get system time on the computer, so LLM could include it in its reply.^{[29]}^{[30]} This basic strategy can be sophisticated with multiple attempts of generated programs, and other sampling strategies.^{[31]}
Generally, in order to get an LLM to use tools, one must finetune it for tool-use. If the number of tools is finite, then finetuning may be done just once. If the number of tools can grow arbitrarily, as with online API services, then the LLM can be finetuned to be able to read API documentation and call API correctly.^{[32]}^{[33]}
A simpler form of tool use is Retrieval Augmented Generation: augment an LLM with document retrieval, sometimes using a vector database. Given a query, a document retriever is called to retrieve the most relevant (usually measured by first encoding the query and the documents into vectors, then finding the documents with vectors closest in Euclidean norm to the query vector). The LLM then generates an output based on both the query and the retrieved documents.^{[34]}

<h2>Agency[edit]</h2>
An LLM is a language model, which is not an agent as it has no goal, but it can be used as a component of an intelligent agent.^{[35]} Researchers have described several methods for such integrations.
The ReAct ("Reason + Act") method constructs an <a href="/wiki/Intelligent_

agent" title="Intelligent agent">agent out of an LLM, using the LLM as a plann
er. The LLM is prompted to "think out loud". Specifically, the language model is p
rompted with a textual description of the environment, a goal, a list of possible
actions, and a record of the actions and observations so far. It generates one or
more thoughts before generating an action, which is then executed in the environme
nt.<sup class="reference" id="cite_ref-DmvNE_36-0">
[36]</sup> The linguistic description of the environment given to the LLM plan
ner can even be the LaTeX code of a paper describing the environment.<sup class="r
eference" id="cite_ref-JS8Vd_37-0">[37]</sup>
In the DEPS ("Describe, Explain, Plan and Select") method, an LLM is first
connected to the visual world via image descriptions, then it is prompted to produ
ce plans for complex tasks and behaviors based on its pretrained knowledge and env
ironmental feedback it receives.<sup class="reference" id="cite_ref-38"><a href="#
cite_note-38">[38]</sup>
The Reflexion method<sup class="reference" id="cite_ref-sbB2T_39-0"><a href
="#cite_note-sbB2T-39">[39]</sup> constructs an agent that learns over multipl
e episodes. At the end of each episode, the LLM is given the record of the episod
e, and prompted to think up "lessons learned", which would help it perform better
at a subsequent episode. These "lessons learned" are given to the agent in the sub
sequent episodes.
Mon
te Carlo tree search can use an LLM as rollout heuristic. When a programmatic
world model is not available, an LLM can also be prompted with a description of th
e environment to act as world model.<sup class="reference" id="cite_ref-ltTer_40-
0">[40]</sup>
For open-ended exploration, an LLM can be used to score observations for th
eir "interestingness", which can be used as a reward signal to guide a normal (non
-LLM) reinforcement learning agent.<sup class="reference" id="cite_ref-mBvD9_41-
0">[41]</sup> Alternatively, it can <a href="/wi
ki/Zone_of_proximal_development" title="Zone of proximal development">propose incr
easingly difficult tasks for <a class="new" href="/w/index.php?title=Curriculu
m_learning&action=edit&redlink=1" title="Curriculum learning (page does no
t exist)">curriculum learning.<sup class="reference" id="cite_ref-:0_42-0"><a
href="#cite_note-:0-42">[42]</sup> Instead of outputting individual actions, a
n LLM planner can also construct "skills", or <a href="/wiki/Function_(computer_pr
ogramming)" title="Function (computer programming)">functions for complex acti
on sequences. The skills can be stored and later invoked, allowing increasing leve
ls of abstraction in planning.<sup class="reference" id="cite_ref-:0_42-1"><a href
="#cite_note-:0-42">[42]</sup>
LLM-powered agents can keep a long-term memory of its previous contexts, an
d the memory can be retrieved in the same way as Retrieval Augmented Generation. M
ultiple such agents can interact socially.<sup class="reference" id="cite_ref-Xuvj
F_43-0">[43]</sup>

<h2>Compression<span class="mw-e
ditsection">[<a href="/w/index.php?tit
le=Large_language_model&action=edit&section=12" title="Edit section: Compr
ession">edit]
</h2>
Typically, LLM are trained with full- or half-precision floating point numbers
(float32 and float16). One float16 has 16 bits, or 2 bytes, and so one billion par
ameters require 2 gigabytes. The largest models typically have 100 billion paramet
ers, requiring 200 gigabytes to load, which places them outside the range of most
consumer electronics.
Post-training <a href="/wiki/Quantization_(signal_processing)" title="Qu
antization (signal processing)">quantization<sup class="reference" id="cit

e_ref-LS2Go_44-0">[44]</sup> aims to decrease th
e space requirement by lowering precision of the parameters of a trained model, wh
ile preserving most of its performance.<sup class="reference" id="cite_ref-cpzcK_4
5-0">[45]</sup><sup class="reference" id="cite_r
ef-QVU95_46-0">[46]</sup> The simplest form of q
uantization simply truncates all numbers to a given number of bits. It can be impr
oved by using a different quantization <a href="/wiki/Block_cipher" title="Block c
ipher">codebook per layer. Further improvement can be done by applying <a href
="/wiki/Mixed-precision_arithmetic" title="Mixed-precision arithmetic">different p
recisions to different parameters, with higher precision for particularly impo
rtant parameters ("outlier weights").<sup class="reference" id="cite_ref-dU9Bu_47-
0">[47]</sup>
While quantized models are typically frozen, and only pre-quantized models
are finetuned, quantized models can still be finetuned.<sup class="reference" id
="cite_ref-D0nFA_48-0">[48]</sup>

<h2>Multimodality<span class
="mw-editsection">[<a href="/w/index.p
hp?title=Large_language_model&action=edit&section=13" title="Edit section:
Multimodality">edit]
</h2>
Multimodality means "having several modalities", and a <a href="/wiki/Modality_
(human%E2%80%93computer_interaction)" title="Modality (human–computer interactio
n)">"modality" means a type of input, such as video, image, audio, text, <a hr
ef="/wiki/Proprioception" title="Proprioception">proprioception, etc.<sup clas
s="reference" id="cite_ref-49">[49]</sup> There have b
een many AI models trained specifically to ingest one modality and output another
modality, such as AlexNet for image to
label,<sup class="reference" id="cite_ref-50">[50]</su
p> <a class="mw-redirect" href="/wiki/Visual_question_answering" title="Visual que
stion answering">visual question answering for image-text to text,<sup class
="reference" id="cite_ref-51">[51]</sup> and <a href
="/wiki/Speech_recognition" title="Speech recognition">speech recognition for
speech to text.
A common method to create multimodal models out of an LLM is to "tokenize"
the output of a trained encoder. Concretely, one can construct a LLM that can unde
rstand images as follows: take a trained LLM, and take a trained image encoder <sp
an class="mwe-math-element"><span class="mwe-math-mathml-inline mwe-math-mathml-a1
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2ee3eec0a9c0a19b15ab92daa6223f9b" style="vertical-align: -0.338ex; width:1.776ex;
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height:2.509ex;"/>, so that for any image <s
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c717213d4317e666f1ae872e00620a0d" style="vertical-align: -0.671ex; width:1.155ex;
height:2.009ex;"/>, the post-processed vector <span class="mwe-math-elemen
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th/render/svg/8d41d0ec0611a795f65ea14a43b8016462703a8e" style="vertical-align: -0.
838ex; width:7.828ex; height:2.843ex;"/> has the same dimensions as an enco
ded token. That is an "image token". Then, one can interleave text tokens and imag
e tokens. The compound model is then finetuned on an image-text dataset. This basi
c construction can be applied with more sophistication to improve the model. The i
mage encoder may be frozen to improve stability.<sup class="reference" id="cite_re
f-52">[52]</sup>
Flamingo demonstrated the effectiveness of the tokenization method, finetun
ing a pair of pretrained language model and image encoder to perform better on vis
ual question answering than models trained from scratch.<sup class="reference" id
="cite_ref-53">[53]</sup> <a class="mw-redirect" href
="/wiki/Pathways_Language_Model" title="Pathways Language Model">Google PaLM m

odel was finetuned into a multimodal model PaLM-E using the tokenization method, a
nd applied to robotic control.<sup class="reference" id="cite_ref-54"><a href="#ci
te_note-54">[54]</sup> LLaMA models ha
ve also been turned multimodal using the tokenization method, to allow image input
s,^{[55]} a
nd video inputs.<sup class="reference" id="cite_ref-56">[5
6]</sup>
GPT-4 can use both text and image a
s inputs<sup class="reference" id="cite_ref-57">[57]</
sup> (although the vision component wasn't released to the public until GPT-4V<sup
class="reference" id="cite_ref-58">[58]</sup>); <a hre
f="/wiki/Google_DeepMind" title="Google DeepMind">Google DeepMind's <a href="/
wiki/Gemini_(language_model)" title="Gemini (language model)">Gemini is also m
ultimodal.<sup class="reference" id="cite_ref-59">[59]
</sup>

<h2>Properties<span class="mw-edi
tsection">[<a href="/w/index.php?title
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ies">edit]</h2
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s and emergent abilities<span class="mw-editse
ction-bracket">[<a href="/w/index.php?title=Large_language_model&action
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pan>edit]</h3>
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e"/> Main article: <a hr
ef="/wiki/Neural_scaling_law" title="Neural scaling law">Neural scaling law</d
iv>
The following four hyper-parameters characterize a LLM:

cost of (pre-)training (<small><span class
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e mw-invert" src="https://wikimedia.org/api/rest_v1/media/math/render/svg/4fc55753
007cd3c18576f7933f6f089196732029" style="vertical-align: -0.338ex; width:1.766ex;
height:2.176ex;"/></small>),
size of the <a href="/wiki/Artificial_neural_network" title="Artificial neural
network">artificial neural network itself, such as number of parameters <small
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e mw-invert" src="https://wikimedia.org/api/rest_v1/media/math/render/svg/f5e3890c
981ae85503089652feb48b191b57aae3" style="vertical-align: -0.338ex; width:2.064ex;
height:2.176ex;"/></small> (i.e. amount of neurons in its layers, amount of
weights between them and biases),
size of its (pre-)training dataset (i.e. number of tokens in corpus, <small><s
pan class="mwe-math-element"><span class="mwe-math-mathml-inline mwe-math-mathml-a
11y" style="display: none;"><math alttext="{\displaystyle D}" xmlns="http://www.w
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0395e5d4345287e21fb26efd386990e6" style="vertical-align: -0.338ex; width:1.924ex;
height:2.176ex;"/></small>),
performance after (pre-)training.
They are related by simple <a href="/wiki/Empirical_statistical_laws" title="Em
pirical statistical laws">statistical laws, called "scaling laws". One particu
lar scaling law ("Chinchilla s
caling") for LLM autoregressively trained for one epoch, with a <a class="mw-r
edirect" href="/wiki/Log-log_plot" title="Log-log plot">log-log <a href="/wik
i/Learning_rate" title="Learning rate">learning rate schedule, states that:<su
p class="reference" id="cite_ref-fJta3_60-0"><a href="#cite_note-fJta3-60">[60]</sup>
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</math></small> is the cost of training the model, in FLOPs.
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</math></small> is the number of parameters in the model.
<small><math alttext="{\displaystyle D}" xmlns="http://www.w3.org/1998/Math/MathML">
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</math></small> is the number of tokens in the training set.
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6f781fe6e9a4a87b8ea1cebe0ad4ede8" style="vertical-align: -0.338ex; width:1.583ex;
height:2.176ex;"/></small> is the average negative log-likelihood loss per
token (nats/token), achieved by
the trained LLM on the test dataset.
and the statistical hyper-parameters are

<small><span class="mwe-math-mathml-inline
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671ex; width:6.977ex; height:2.509ex;"/></small>, meaning that it costs 6 F
LOPs per parameter to train on one token. Note that training cost is much higher t
han inference cost, where it costs 1 to 2 FLOPs per parameter to infer on one toke
n.<sup class="reference" id="cite_ref-kaplan-scaling_28-1"><a href="#cite_note-kap
lan-scaling-28">[28]</sup>
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<figure class="mw-default-size" typeof="mw:File/Thumb"><figcaption>At point(s) referred to as breaks,^{[61]} the lines change their slopes, appearing on a log-log plot as a series of linear segments connected by arcs.</figcaption></figure>
When one subtracts out from the y-axis the best performance that can be achieved even with infinite scaling of the x-axis quantity, large models' performance, measured on various tasks, seems to be a linear extrapolation of other (smaller-sized and medium-sized) models' performance on a log-log plot. However, sometimes the line's slope transitions from one slope to another at point(s) referred to as break(s)^{[61]} in downstream scaling laws, appearing as a series of linear segments connected by arcs; it seems that larger models acquire "emergent abilities" at this point(s).^{[19]}^{[62]} These abilities are discovered rather than programmed-in or designed, in some cases only after the LLM has been publicly deployed.^{[3]}
The most intriguing among emergent abilities is in-context learning from example demonstrations.^{[63]} In-context learning is involved in tasks, such as:

reported arithmetics, decoding the <a href="/wiki/International_Phonetic_A

lphabet" title="International Phonetic Alphabet">International Phonetic Alphabet, unscrambling a word's letters, disambiguate word in context,^{[19]}^{[64]}^{[65]} converting spatial words, cardinal directions (for example, replying "northeast" upon [0, 0, 1; 0, 0, 0; 0, 0, 0]), color terms represented in text.^{[66]}
chain-of-thought prompting: Model outputs are improved by chain-of-thought prompting only when model size exceeds 62B. Smaller models perform better when prompted to answer immediately, without chain of thought.^{[67]}
identifying offensive content in paragraphs of Hinglish (a combination of Hindi and English), and generating a similar English equivalent of Kiswahili proverbs.^{[68]}
Schaeffer et. al. argue that the emergent abilities are not unpredictably acquired, but predictably acquired according to a smooth scaling law. The authors considered a toy statistical model of an LLM solving multiple-choice questions, and showed that this statistical model, modified to account for other types of tasks, applies to these tasks as well.^{[69]}
Let <math alttext="{\displaystyle x}" xmlns="http://www.w3.org/1998/Math/MathML">
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c717213d4317e666f1ae872e00620a0d" style="vertical-align: -0.671ex; width:1.155ex; height:2.009ex;"/> be the performance of the model.
</p>

When <math alttext="{\displaystyle y={\text{average }}\Pr({\text{correct token}})}" xmlns="http://www.w3.org/1998/Math/MathML">
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, then <math alttext="{\displaystyle (\log x,y)}" xmlns="http://www.w3.org/1998/Math/MathML">
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</math> is an exponential curve (before it hits the plateau at one), which looks like emergence.
When <math alttext="{\displaystyle y={\text{average }}\log(\Pr({\text{correct token}}))}" xmlns="http://www.w3.org/1998/Math/MathM

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x;"/>, then the <span class="mwe-math-mathml
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-0.838ex; width:8.687ex; height:2.843ex;"/> plot is a straight line (before
it hits the plateau at zero), which does not look like emergence.
When <span class="mwe-math-mathml-inline mwe-ma
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</semantics>
</math> is a step-function, which looks like emergence.
<h2>Interpretation[edit]</h2>
Large language models by themselves are "black boxes", and it is not clear how they can perform linguistic tasks. There are several methods for understanding how LLM work.
Mechanistic interpretability aims to reverse-engineer LLM by discovering symbolic algorithms that approximate the inference performed by LLM. One example is Othello-GPT, where a small Transformer is trained to predict legal Othello moves. It is found that there is a linear representation of

Othello board, and modifying the representation changes the predicted legal Othello moves in the correct way.[70][71] In another example, a small Transformer is trained on Karel programs. Similar to the Othello-GPT example, there is a linear representation of Karel program semantics, and modifying the representation changes output in the correct way. The model also generates correct programs that are on average shorter than those in the training set.[72]

In another example, the authors trained small transformers on modular arithmetic addition. The resulting models were reverse-engineered, and it turned out they used discrete Fourier transform.[73]

Understanding and intelligence

NLP researchers were evenly split when asked, in a 2022 survey, whether (untuned) LLMs "could (ever) understand natural language in some nontrivial sense".[74] Proponents of "LLM understanding" believe that some LLM abilities, such as mathematical reasoning, imply an ability to "understand" certain concepts. A Microsoft team argued in 2023 that GPT-4 "can solve novel and difficult tasks that span mathematics, coding, vision, medicine, law, psychology and more" and that GPT-4 "could reasonably be viewed as an early (yet still incomplete) version of an artificial general intelligence system": "Can one reasonably say that a system that passes exams for software engineering candidates is not *really* intelligent?"[75][76] Some researchers characterize LLMs as "alien intelligence".[77][78] For example, Conjecture CEO Connor Leahy considers untuned LLMs to be like inscrutable alien "Shoggoths", and believes that RLHF tuning creates a "smiling facade" obscuring the inner workings of the LLM: "If you don't push it too far, the smiley face stays on. But then you give it [an unexpected] prompt, and suddenly you see this massive underbelly of insanity, of weird thought processes and clearly non-human understanding."[79][80]

In contrast, some proponents of the "LLMs lack understanding" school believe that existing LLMs are "simply remixing and recombining existing writing",[78] or point to the deficits existing LLMs continue to have in prediction skills, reasoning skills, agency, and explainability.[74] For example, GPT-4 has natural deficits in planning and in real-time learning.

_sparks_76-1">[76]</sup> Generative L
LMs have been observed to confidently assert claims of fact which do not seem to b
e <a href="/wiki/Justification_(epistemology)" title="Justification (epistemolog
y)">justified by their <a class="mw-redirect" href="/wiki/Training_data" title
="Training data">training data, a phenomenon which has been termed "<a href="/
wiki/Hallucination_(artificial_intelligence)" title="Hallucination (artificial int
elligence)">hallucination".<sup class="reference" id="cite_ref-hallucination-s
urvey_81-0">[81]</sup> Specifical
ly, hallucinations in the context of LLMs correspond to the generation of text or
responses that seem syntactically sound, fluent, and natural but are factually inc
orrect, nonsensical, or unfaithful to the provided source input.<sup class="refere
nce" id="cite_ref-82">[82]</sup> Neuroscientist <a cla
ss="mw-redirect" href="/wiki/Terrence_Sejnowski" title="Terrence Sejnowski">Terren
ce Sejnowski has argued that "The diverging opinions of experts on the intelli
gence of LLMs suggests that our old ideas based on natural intelligence are inadeq
uate".<sup class="reference" id="cite_ref-debate_understanding_74-2"><a href="#cit
e_note-debate_understanding-74">[74]</sup>
The matter of LLM's exhibiting intelligence or understanding<sup class="ref
erence" id="cite_ref-debate_understanding_74-3"><a href="#cite_note-debate_underst
anding-74">[74]</sup> has foundations in the study of language as a model of <
a href="/wiki/Cognition" title="Cognition">cognition in the field of <a href
="/wiki/Cognitive_linguistics" title="Cognitive linguistics">cognitive linguistics
. American linguist George
Lakoff presented Neural Theory of Language (NTL)<sup class="reference" id="cit
e_ref-83">[83]</sup> as a <a href="/wiki/Cognitive_li
nguistics#Computational_approaches" title="Cognitive linguistics">computational ba
sis for using language as a model of learning tasks and understanding. NTL pro
vided a framework for computer systems to model language and shifted the debate to
frameworks for computer systems to generate language with acceptable grammar.<sup
class="noprint Inline-Template" style="margin-left:0.1em; white-space:nowrap;">[<i
><span t
itle="The text near this tag may need clarification or removal of jargon. (Decembe
r 2023)">clarification needed]</sup> In his 2014 book titled <a
href="/wiki/The_Language_Myth" title="The Language Myth">The Language Myth: Why La
nguage Is Not An Instinct, British cognitive linguist and digital communic
ation technologist Vyvyan Evans
 mapped out the role of <a href="/wiki/Probabilistic_context-free_grammar" tit
le="Probabilistic context-free grammar">probabilistic context-free grammar (PC
FG) in enabling <a href="/wiki/Natural_language_processing#Cognition_and_NLP" titl
e="Natural language processing">NLP to model cognitive patterns and generate h
uman like language.<sup class="reference" id="cite_ref-84"><a href="#cite_note-8
4">[84]</sup> <sup class="reference" id="cite_ref-85">
[85]</sup>

<h2>Evaluation<span class="mw-edi
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ion">edit]</h2
>
<h3>Perplexity<span class="mw-edi
tsection">[<a href="/w/index.php?title
=Large_language_model&action=edit&section=19" title="Edit section: Perplex
ity">edit]</h3
>
The most commonly used measure of a language model's performance is its <a href
="/wiki/Perplexity" title="Perplexity">perplexity on a given text corpus. Perp

lexity is a measure of how well a model is able to predict the contents of a datas
et; the higher the likelihood the model assigns to the dataset, the lower the perp
lexity. Mathematically, perplexity is defined as the exponential of the average ne
gative log likelihood per token:</p> <div class="mwe-
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981ae85503089652feb48b191b57aae3" style="vertical-align: -0.338ex; width:2.064ex;
height:2.176ex;"/> is the number of tokens in the text corpus, and "context
for token <span class="mwe-math-mathml-inline mwe-m
ath-mathml-a11y" style="display: none;"><math alttext="{\displaystyle i}" xmlns="h
ttp://www.w3.org/1998/Math/MathML">
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</semantics>
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e mw-invert" src="https://wikimedia.org/api/rest_v1/media/math/render/svg/add78d86
08ad86e54951b8c8bd6c8d8416533d20" style="vertical-align: -0.338ex; width:0.802ex;
height:2.176ex;"/>" depends on the specific type of LLM used. If the LLM is
autoregressive, then "context for token <span class="mwe-math-element"><span class
="mwe-math-mathml-inline mwe-math-mathml-a11y" style="display: none;"><math alttex
t="{\displaystyle i}" xmlns="http://www.w3.org/1998/Math/MathML">
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</mstyle>
</mrow>
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e mw-invert" src="https://wikimedia.org/api/rest_v1/media/math/render/svg/add78d86
08ad86e54951b8c8bd6c8d8416533d20" style="vertical-align: -0.338ex; width:0.802ex;
height:2.176ex;"/></span>" is the segment of text appearing before token <span cla
ss="mwe-math-element"><span class="mwe-math-mathml-inline mwe-math-mathml-a11y" st
yle="display: none;"><math alttext="{\displaystyle i}" xmlns="http://www.w3.org/19
98/Math/MathML">
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<mi>i</mi>
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</semantics>
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e mw-invert" src="https://wikimedia.org/api/rest_v1/media/math/render/svg/add78d86
08ad86e54951b8c8bd6c8d8416533d20" style="vertical-align: -0.338ex; width:0.802ex;
height:2.176ex;"/></span>. If the LLM is masked, then "context for token <span cla
ss="mwe-math-element"><span class="mwe-math-mathml-inline mwe-math-mathml-a11y" st
yle="display: none;"><math alttext="{\displaystyle i}" xmlns="http://www.w3.org/19
98/Math/MathML">
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</mstyle>
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e mw-invert" src="https://wikimedia.org/api/rest_v1/media/math/render/svg/add78d86
08ad86e54951b8c8bd6c8d8416533d20" style="vertical-align: -0.338ex; width:0.802ex;
height:2.176ex;"/></span>" is the segment of text surrounding token <span class="m
we-math-element"><span class="mwe-math-mathml-inline mwe-math-mathml-a11y" style
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<mi>i</mi>
</mstyle>
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</semantics>
</math></span><img alt="i" aria-hidden="true" class="mwe-math-fallback-image-inlin
e mw-invert" src="https://wikimedia.org/api/rest_v1/media/math/render/svg/add78d86
08ad86e54951b8c8bd6c8d8416533d20" style="vertical-align: -0.338ex; width:0.802ex;
height:2.176ex;"/></span>.
<p>Because language models may <a class="mw-redirect" href="/wiki/Overfit" title
="Overfit">overfit</a> to their training data, models are usually evaluated by the
ir perplexity on a <a class="mw-redirect" href="/wiki/Test_set" title="Test set">t
est set</a> of unseen data.<sup class="reference" id="cite_ref-jm_12-3"><a href="#
cite_note-jm-12">[12]</a></sup> This presents particular challenges for the evalua
tion of large language models. As they are trained on increasingly large corpora o
```

f text largely scraped from the web, it becomes increasingly likely that models' t
raining data inadvertently includes portions of any given test set.<sup class="ref
erence" id="cite_ref-few-shot-learners_4-1"><a href="#cite_note-few-shot-learners-
4">[4]</sup>

<h4><span class="mw-headline" id="BPW,_BP
C,_and_BPT">BPW, BPC, and BPT<span class="mw-e
ditsection-bracket">[<a href="/w/index.php?title=Large_language_model&a
ction=edit&section=20" title="Edit section: BPW, BPC, and BPT">edit</spa
n>]</h4>
In information th
eory, the concept of <a href="/wiki/Entropy_(information_theory)" title="Entro
py (information theory)">entropy is intricately linked to perplexity, a relati
onship notably established by <a href="/wiki/Claude_Shannon" title="Claude Shanno
n">Claude Shannon.<sup class="reference" id="cite_ref-86"><a href="#cite_note-
86">[86]</sup> This relationship is mathematically expressed as <span class="m
we-math-element"><span class="mwe-math-mathml-inline mwe-math-mathml-a11y" style
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{Perplexity}})}" xmlns="http://www.w3.org/1998/Math/MathML">
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<msub>
<mi>log</mi>
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</mrow>
</msub>
<mo><!-- --></mo>
<mo stretchy="false">(</mo>
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</mrow>
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({\text{Perplexity}})}</annotation>
</semantics>
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y}})}" aria-hidden="true" class="mwe-math-fallback-image-inline mw-invert" src="ht
tps://wikimedia.org/api/rest_v1/media/math/render/svg/462f40a6811ee57670d1735c452d
04be85a82c57" style="vertical-align: -0.838ex; width:27.813ex; height:2.843ex;"/>
.
Entropy, in this context, is commonly quantified in terms of bits per word
(BPW) or bits per character (BPC), which hinges on whether the language model util
izes word-based or character-based tokenization.
Notably, in the case of larger language models that predominantly employ su
b-word tokenization, bits per token (BPT) emerges as a seemingly more appropriate
measure. However, due to the variance in tokenization methods across different Lar
ge Language Models (LLMs), BPT does not serve as a reliable metric for comparative
analysis among diverse models. To convert BPT into BPW, one can multiply it by the

average number of tokens per word.
In the evaluation and comparison of language models, cross-entropy is generally the preferred metric over entropy. The underlying principle is that a lower BPW is indicative of a model's enhanced capability for compression. This, in turn, reflects the model's proficiency in making accurate predictions.

<h3>Task-specific datasets and benchmarks[edit]</h3>
A large number of testing datasets and benchmarks have also been developed to evaluate the capabilities of language models on more specific downstream tasks. Tests may be designed to evaluate a variety of capabilities, including general knowledge, commonsense reasoning, and mathematical problem-solving.
One broad category of evaluation dataset is question answering datasets, consisting of pairs of questions and correct answers, for example, ("Have the San Jose Sharks won the Stanley Cup?", "No").^{[87]} A question answering task is considered "open book" if the model's prompt includes text from which the expected answer can be derived (for example, the previous question could be adjoined with some text which includes the sentence "The Sharks have advanced to the Stanley Cup finals once, losing to the Pittsburgh Penguins in 2016."^{[87]}). Otherwise, the task is considered "closed book", and the model must draw on knowledge retained during training.^{[88]} Some examples of commonly used question answering datasets include TruthfulQA, Web Questions, TriviaQA, and SQuAD.^{[88]}
Evaluation datasets may also take the form of text completion, having the model select the most likely word or sentence to complete a prompt, for example: "Alice was friends with Bob. Alice went to visit her friend, ____".^{[4]}
Some composite benchmarks have also been developed which combine a diversity of different evaluation datasets and tasks. Examples include GLUE, SuperGLUE, MMLU, BIG-bench, and HELM.^{[89]}^{[88]}
It was previously standard to report results on a heldout portion of an evaluation dataset after doing supervised fine-tuning on the remainder. It is now more common to evaluate a pre-trained model directly through prompting techniques, though researchers vary in the details of how they formulate prompts for particular tasks, particularly with respect to how many examples of solved tasks are adjoined to the prompt (i.e. the value of n in n-shot prompting).

<h4>Adversarially constructed evaluations[edit]</h4>
Because of the rapid pace of improvement of large language models, evaluation benchmarks have suffered from short lifespans, with state of the art models quickly "saturating" existing benchmarks, exceeding the performance of human annotators, leading to efforts to replace or augment the benchmark with more challenging tasks.

^{[90]} In addition, there are cases of "shortcut learning" wherein AIs sometimes "cheat" on multiple-choice tests by using statistical correlations in superficial test question wording in order to guess the correct responses, without necessarily understanding the actual question being asked.^{[74]}
Some datasets have been constructed adversarially, focusing on particular problems on which extant language models seem to have unusually poor performance compared to humans. One example is the TruthfulQA dataset, a question answering dataset consisting of 817 questions which language models are susceptible to answering incorrectly by mimicking falsehoods to which they were repeatedly exposed during training. For example, an LLM may answer "No" to the question "Can you teach an old dog new tricks?" because of its exposure to the English idiom you can't teach an old dog new tricks, even though this is not literally true.^{[91]}
Another example of an adversarial evaluation dataset is Swag and its successor, HellaSwag, collections of problems in which one of multiple options must be selected to complete a text passage. The incorrect completions were generated by sampling from a language model and filtering with a set of classifiers. The resulting problems are trivial for humans but at the time the datasets were created state of the art language models had poor accuracy on them. For example:

<blockquote>
We see a fitness center sign. We then see a man talking to the camera and sitting and laying on a exercise ball. The man...

a) demonstrates how to increase efficient exercise work by running up and down balls.

b) moves all his arms and legs and builds up a lot of muscle.

c) then plays the ball and we see a graphics and hedge trimming demonstration.

d) performs sit ups while on the ball and talking.^{[92]}

</blockquote>
BERT selects b) as the most likely completion, though the correct answer is d).^{[92]}

<h2>Wider impact[edit]</h2>
In 2023, Nature Biomedical Engineering wrote that "it is no longer possible to accurately distinguish" human-written text from text created by large language models, and that "It is all but certain that general-purpose large language models will rapidly proliferate... It is a rather safe bet that they will change many industries over time."^{[93]} Goldman Sachs suggested in 2023 that generative language AI could increase global GDP by 7% in the next ten years, and could expose to automation 300

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million jobs globally.<sup class="reference" id="cite_ref-81w7x_94-0"><a href="#ci
te_note-81w7x-94">[94]</a></sup><sup class="reference" id="cite_ref-zIM6Y_95-0"><a
href="#cite_note-zIM6Y-95">[95]</a></sup>
</p>
<h3><span class="mw-headline" id="Security">Security</span><span class="mw-editsec
tion"><span class="mw-editsection-bracket">[</span><a href="/w/index.php?title=Lar
ge_language_model&amp;action=edit&amp;section=24" title="Edit section: Security"><
span>edit</span></a><span class="mw-editsection-bracket">]</span></span></h3>
<p>Some commenters expressed concern over accidental or deliberate creation of mis
information, or other forms of misuse.<sup class="reference" id="cite_ref-nD6kH_96
-0"><a href="#cite_note-nD6kH-96">[96]</a></sup> For example, the availability of
large language models could reduce the skill-level required to commit bioterroris
m; biosecurity researcher Kevin Esvelt has suggested that LLM creators should excl
ude from their training data papers on creating or enhancing pathogens.<sup class
="reference" id="cite_ref-PKiPY_97-0"><a href="#cite_note-PKiPY-97">[97]</a></sup>
</p><p>A study by researchers at Google and several universities, including <a hre
f="/wiki/Cornell_University" title="Cornell University">Cornell University</a> and
<a href="/wiki/University_of_California,_Berkeley" title="University of Californi
a, Berkeley">University of California, Berkeley</a>, showed that there are potenti
al security risks in language models such as <a href="/wiki/ChatGPT" title="ChatGP
T">ChatGPT</a>.  In their study, they examined the possibility that questioners co
uld get, from ChatGPT, the training data that the AI model used; they found that t
hey could get the training data from the AI model. For example, when asking ChatGP
T 3.5 turbo to repeat the word "poem" forever, the AI model will say "poem" hundre
ds of times and then diverge, deviating from the standard dialogue style and spitt
ing out nonsense phrases, thus spitting out the training data as it is. The resear
chers have seen more than 10,000 examples of the AI model exposing their training
data in a similar method. The researchers said that it was hard to tell if the AI
model was actually safe or not.<sup class="reference" id="cite_ref-98"><a href="#c
ite_note-98">[98]</a></sup>
</p>
<h3><span class="mw-headline" id="Algorithmic_bias">Algorithmic bias</span><span c
lass="mw-editsection"><span class="mw-editsection-bracket">[</span><a href="/w/ind
ex.php?title=Large_language_model&amp;action=edit&amp;section=25" title="Edit sect
ion: Algorithmic bias"><span>edit</span></a><span class="mw-editsection-bracket">]
</span></span></h3>
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e"/><div class="hatnote navigation-not-searchable" role="note">Main article: <a hr
ef="/wiki/Algorithmic_bias" title="Algorithmic bias">Algorithmic bias</a></div>
<p>While LLMs have shown remarkable capabilities in generating human-like text, th
ey are susceptible to inheriting and amplifying biases present in their training d
ata. This can manifest in skewed representations or unfair treatment of different
demographics, such as those based on race, gender, language, and cultural groups.<
sup class="reference" id="cite_ref-:8_99-0"><a href="#cite_note-:8-99">[99]</a></s
up> Since English data is overrepresented in current large language models' traini
ng data, it may also downplay non-English views.<sup class="reference" id="cite_re
f-:1_100-0"><a href="#cite_note-:1-100">[100]</a></sup>
</p>
<h4><span class="mw-headline" id="Stereotyping">Stereotyping</span><span class="mw
-editsection"><span class="mw-editsection-bracket">[</span><a href="/w/index.php?t
itle=Large_language_model&amp;action=edit&amp;section=26" title="Edit section: Ste
reotyping"><span>edit</span></a><span class="mw-editsection-bracket">]</span></spa
n></h4>
<p>AI models can reinforce a wide range of stereotypes, including those based on g
ender, ethnicity, age, nationality, religion, or occupation. This can lead to outp
uts that unfairly generalize or caricature groups of people, sometimes in harmful
```

or derogatory ways.^{[101]}
Notably, gender bias refers to the tendency of these models to produce outputs that are unfairly prejudiced towards one gender over another. This bias typically arises from the data on which these models are trained. Large language models often assign roles and characteristics based on traditional gender norms.^{[99]} For example, it might associate nurses or secretaries predominantly with women and engineers or CEOs with men.^{[102]}

<h4>Political bias[edit]</h4>
Political bias refers to the tendency of algorithms to systematically favor certain political viewpoints, ideologies, or outcomes over others. Language models may also exhibit political biases. Since the training data includes a wide range of political opinions and coverage, the models might generate responses that lean towards particular political ideologies or viewpoints, depending on the prevalence of those views in the data.^{[103]}

<h2>List[edit]</h2>
For the training cost column, 1 petaFLOP-day = 1 petaFLOP/sec × 1 day = 8.64E19 FLOP.

<table class="wikitable sortable">
<tbody><tr>
<th>Name</th>
<th>Release date^{[a]}</th>
<th>Developer</th>
<th>Number of parameters^{[b]}</th>
<th>Corpus size
</th>
<th>Training cost (petaFLOP-day)</th>
<th>License^{[c]}</th>
<th>Notes
</th></tr>
<tr>
<td>GPT-1</td>
<td>June 2018</td>
<td>OpenAI</td>
<td>117 million</td>
<td>
</td>
<td></td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:c

enter;">MIT^{[104]}
</td>
<td>First GPT model, decoder-only transformer.
</td></tr>
<tr>
<td>BERT</td>
<td>October 2018</td>
<td>Google</td>
<td>340 million^{[105]}
</td>
<td>3.3 billion words^{[105]}
</td>
<td>9^{[106]}</td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:center;">Apache 2.0^{[107]}
</td>
<td>An early and influential language model,^{[5]} but encoder-only and thus not built to be prompted or generative^{[108]}
</td></tr>
<tr>
<td>XLNet</td>
<td>June 2019</td>
<td>Google</td>
<td>~340 million^{[109]}</td>
<td>33 billion words
</td>
<td></td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:center;">Apache 2.0^{[110]}
</td>
<td>An alternative to BERT; designed as encoder-only^{[111]}^{[112]}
</td></tr>
<tr>
<td>GPT-2</td>
<td>February 2019</td>
<td>OpenAI</td>
<td>1.5 billion^{[113]}
</td>
<td>40GB<sup class="reference" id="cite_ref-5T8u5_117-0"><a href="#cite_note-5T8u5

-117">[114]</sup> (~10 billion to
kens)<sup class="reference" id="cite_ref-LambdaLabs_118-0"><a href="#cite_note-Lam
bdaLabs-118">[115]</sup>
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<td></td>
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enter;">MIT<sup class="reference" id="cite_ref-Sudbe_119-0"><a href="#cite_note-Su
dbe-119">[116]</sup>
</td>
<td>general-purpose model based on transformer architecture
</td></tr>
<tr>
<td>GPT-3</td>
<td>May
2020</td>
<td>OpenAI</td>
<td>175 billion<sup class="referenc
e" id="cite_ref-Wiggers_24-1">[24]</sup></td>
<td>300 billion tokens<sup class="re
ference" id="cite_ref-LambdaLabs_118-1">[115]
</sup>
</td>
<td>3640<sup class="reference" id="cite_ref-:2_120-0">
[117]</sup></td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">proprietary
</td>
<td>A fine-tuned variant of GPT-3, termed GPT-3.5, was made available to the publi
c through a web interface called ChatGPT</
a> in 2022.<sup class="reference" id="cite_ref-chatgpt-blog_121-0"><a href="#cite_
note-chatgpt-blog-121">[118]</sup>
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ch 2021</td>
<td>EleutherAI</td>
<td>2.7 billion<sup class="reference"
id="cite_ref-gpt-neo_122-0">[119]</sup></td>
<td>825 GiB<sup class="reference" id="cite_ref-Pile_123-0"><a href="#cite_note-Pil
e-123">[120]</sup>
</td>
<td></td>
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enter;">MIT<sup class="reference" id="cite_ref-vb-gpt-neo_124-0"><a href="#cite_no
te-vb-gpt-neo-124">[121]</sup>
</td>
<td>The first of a series
of free GPT-3 alternatives released by EleutherAI. GPT-Neo outperformed an equ
ivalent-size GPT-3 model on some benchmarks, but was significantly worse than the
largest GPT-3.<sup class="reference" id="cite_ref-vb-gpt-neo_124-1"><a href="#cite
_note-vb-gpt-neo-124">[121]</sup>
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e 2021</span></td>
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<td><span data-sort-value="6000000000 !">6 billion</span><sup class="reference" id
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e-123">[120]</a></sup>
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</td>
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ober 2021</span><sup class="reference" id="cite_ref-BwnW5_127-0"><a href="#cite_no
te-BwnW5-127">[124]</a></sup></td>
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vidia" title="Nvidia">Nvidia</a></td>
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e" id="cite_ref-mtnlg-preprint_128-0"><a href="#cite_note-mtnlg-preprint-128">[12
5]</a></sup></td>
<td><span data-sort-value="338600000000 !">338.6 billion</span> tokens<sup class
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-128">[125]</a></sup>
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<td></td>
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nter;">Restricted web access
</td>
<td>Standard architecture but trained on a supercomputing cluster.
</td></tr>
<tr>
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ember 2021</span></td>
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<td><span data-sort-value="260000000000 !">260 billion</span><sup class="referenc
e" id="cite_ref-qeOB8_129-0"><a href="#cite_note-qeOB8-129">[126]</a></sup></td>
<td>4 Tb
</td>
<td></td>
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nter;">Proprietary
</td>
<td>Chinese-language LLM. <a href="/wiki/Ernie_Bot" title="Ernie Bot">Ernie Bot</a
> is based on this model.
</td></tr>
<tr>
<td>Claude<sup class="reference" id="cite_ref-i8jc4_130-0"><a href="#cite_note-i8j
c4-130">[127]</a></sup></td>
<td><span data-sort-value="000000002021-12-01-0000" style="white-space:nowrap">Dec
ember 2021</span></td>
<td><a href="/wiki/Anthropic" title="Anthropic">Anthropic</a></td>
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<td>52 billion^{[128]}</td>
<td>400 billion tokens^{[128]}
</td>
<td></td>
<td class="table-partial" style="background: #FFB; vertical-align: middle; text-align: center;">beta
</td>
<td>Fine-tuned for desirable behavior in conversations.^{[129]}
</td></tr>
<tr>
<td>GLaM (Generalist Language Model)</td>
<td>December 2021</td>
<td>Google</td>
<td>1.2 trillion^{[18]}
</td>
<td>1.6 trillion tokens^{[18]}
</td>
<td>5600^{[18]}</td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:center;">Proprietary
</td>
<td>Sparse mixture of experts model, making it more expensive to train but cheaper to run inference compared to GPT-3.
</td></tr>
<tr>
<td>Gopher</td>
<td>December 2021</td>
<td>DeepMind</td>
<td>280 billion^{[130]}</td>
<td>300 billion tokens^{[131]}
</td>
<td>5833^{[132]}</td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:center;">Proprietary
</td>
<td>Further developed into the Chinchilla model.
</td></tr>
<tr>
<td>LaMDA (Language Models for Dialog Appl

```
ications)</td>
<td><span data-sort-value="000000002022-01-01-0000" style="white-space:nowrap">Jan
uary 2022</span></td>
<td>Google</td>
<td><span data-sort-value="137000000000 !">137 billion</span><sup class="referenc
e" id="cite_ref-lamda-blog_136-0"><a href="#cite_note-lamda-blog-136">[133]</a></s
up></td>
<td>1.56T words,<sup class="reference" id="cite_ref-lamda-blog_136-1"><a href="#ci
te_note-lamda-blog-136">[133]</a></sup> <span data-sort-value="168000000000 !">168
billion</span> tokens<sup class="reference" id="cite_ref-hoffman_134-1"><a href="#
cite_note-hoffman-134">[131]</a></sup>
</td>
<td>4110<sup class="reference" id="cite_ref-DMs9Z_137-0"><a href="#cite_note-DMs9Z
-137">[134]</a></sup></td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>Specialized for response generation in conversations.
</td></tr>
<tr>
<td>GPT-NeoX</td>
<td><span data-sort-value="000000002022-02-01-0000" style="white-space:nowrap">Feb
ruary 2022</span></td>
<td><a href="/wiki/EleutherAI" title="EleutherAI">EleutherAI</a></td>
<td><span data-sort-value="20000000000 !">20 billion</span><sup class="reference"
id="cite_ref-gpt-neox-20b_138-0"><a href="#cite_note-gpt-neox-20b-138">[135]</a></
sup></td>
<td>825 GiB<sup class="reference" id="cite_ref-Pile_123-2"><a href="#cite_note-Pil
e-123">[120]</a></sup>
</td>
<td>740<sup class="reference" id="cite_ref-:3_126-1"><a href="#cite_note-:3-126">
[123]</a></sup></td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:c
enter;">Apache 2.0
</td>
<td>based on the Megatron architecture
</td></tr>
<tr>
<td><a href="/wiki/Chinchilla_AI" title="Chinchilla AI">Chinchilla</a></td>
<td><span data-sort-value="000000002022-03-01-0000" style="white-space:nowrap">Mar
ch 2022</span></td>
<td><a class="mw-redirect" href="/wiki/DeepMind" title="DeepMind">DeepMind</a></td
>
<td><span data-sort-value="70000000000 !">70 billion</span><sup class="reference"
id="cite_ref-chinchilla-blog_139-0"><a href="#cite_note-chinchilla-blog-139">[136]
</a></sup></td>
<td><span data-sort-value="1400000000000 !">1.4 trillion</span> tokens<sup class
="reference" id="cite_ref-chinchilla-blog_139-1"><a href="#cite_note-chinchilla-bl
og-139">[136]</a></sup><sup class="reference" id="cite_ref-hoffman_134-2"><a href
="#cite_note-hoffman-134">[131]</a></sup>
</td>
<td>6805<sup class="reference" id="cite_ref-:4_135-1"><a href="#cite_note-:4-135">
[132]</a></sup></td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
```

<td>Reduced-parameter model trained on more data. Used in the Sparrow bot. Often cited for its neural scaling law.
</td></tr>
<tr>
<td>PaLM (Pathways Language Model)</td>
<td>April 2022</td>
<td>Google</td>
<td>540 billion^{[137]}</td>
<td>768 billion tokens^{[136]}
</td>
<td>29250^{[132]}</td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:center;">Proprietary
</td>
<td>aimed to reach the practical limits of model scale
</td></tr>
<tr>
<td>OPT (Open Pretrained Transformer)</td>
<td>May 2022</td>
<td>Meta</td>
<td>175 billion^{[138]}</td>
<td>180 billion tokens^{[139]}
</td>
<td>310^{[123]}</td>
<td class="table-partial" style="background: #FFB; vertical-align: middle; text-align: center;">Non-commercial research^{[d]}
</td>
<td>GPT-3 architecture with some adaptations from Megatron
</td></tr>
<tr>
<td>YaLM 100B</td>
<td>June 2022</td>
<td>Yandex</td>
<td>100 billion^{[140]}
</td>
<td>1.7TB^{[140]}</td>
<td></td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:center;">Apache 2.0</td>
<td>English-Russian model based on Microsoft's Megatron-LM.

```
</td></tr>
<tr>
<td>Minerva</td>
<td><span data-sort-value="000000002022-06-01-0000" style="white-space:nowrap">Jun
e 2022</span></td>
<td>Google</td>
<td><span data-sort-value="540000000000 !">540 billion</span><sup class="referenc
e" id="cite_ref-minerva-paper_145-0"><a href="#cite_note-minerva-paper-145">[141]
</a></sup></td>
<td>38.5B tokens from webpages filtered for mathematical content and from papers s
ubmitted to the arXiv preprint server<sup class="reference" id="cite_ref-minerva-p
aper_145-1"><a href="#cite_note-minerva-paper-145">[141]</a></sup>
</td>
<td></td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>LLM trained for solving "mathematical and scientific questions using step-by-s
tep reasoning".<sup class="reference" id="cite_ref-FfCNK_146-0"><a href="#cite_not
e-FfCNK-146">[142]</a></sup> Minerva is based on PaLM model, further trained on ma
thematical and scientific data.
</td></tr>
<tr>
<td><a href="/wiki/BLOOM_(language_model)" title="BLOOM (language model)">BLOOM</a
></td>
<td><span data-sort-value="000000002022-07-01-0000" style="white-space:nowrap">Jul
y 2022</span></td>
<td>Large collaboration led by <a href="/wiki/Hugging_Face" title="Hugging Face">H
ugging Face</a></td>
<td><span data-sort-value="175000000000 !">175 billion</span><sup class="referenc
e" id="cite_ref-bigger-better_147-0"><a href="#cite_note-bigger-better-147">[143]
</a></sup></td>
<td><span data-sort-value="350000000000 !">350 billion</span> tokens (1.6TB)<sup c
lass="reference" id="cite_ref-B8wB2_148-0"><a href="#cite_note-B8wB2-148">[144]</a
></sup>
</td>
<td></td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:c
enter;">Responsible AI
</td>
<td>Essentially GPT-3 but trained on a multi-lingual corpus (30% English excluding
programming languages)
</td></tr>
<tr>
<td>Galactica</td>
<td><span data-sort-value="000000002022-11-01-0000" style="white-space:nowrap">Nov
ember 2022</span></td>
<td><a href="/wiki/Meta_Platforms" title="Meta Platforms">Meta</a></td>
<td><span data-sort-value="120000000000 !">120 billion</span></td>
<td><span data-sort-value="350000000000 !">106 billion</span> tokens<sup class="re
ference" id="cite_ref-37sY6_149-0"><a href="#cite_note-37sY6-149">[145]</a></sup>
</td>
<td>unknown</td>
<td class="table-partial" style="background: #FFB; vertical-align: middle; text-al
ign: center;">CC-BY-NC-4.0
</td>
```

<td>Trained on scientific text and modalities.
</td></tr>
<tr>
<td>AlexaTM (Teacher Models)</td>
<td>November 2022</td>
<td>Amazon</td>
<td>20 billion^{[146]}</td>
<td>1.3 trillion^{[147]}
</td>
<td></td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:center;">proprietary^{[148]}
</td>
<td>bidirectional sequence-to-sequence architecture
</td></tr>
<tr>
<td>LLaMA (Large Language Model Meta AI)</td>
<td>February 2023</td>
<td>Meta</td>
<td>65 billion^{[149]}
</td>
<td>1.4 trillion^{[149]}
</td>
<td>6300^{[150]}</td>
<td class="table-partial" style="background: #FFB; vertical-align: middle; text-align: center;">Non-commercial research^{[e]}
</td>
<td>Trained on a large 20-language corpus to aim for better performance with fewer parameters.^{[149]} Researchers from Stanford University trained a fine-tuned model based on LLaMA weights, called Alpaca.^{[151]}
</td></tr>
<tr>
<td>GPT-4</td>
<td>March 2023</td>
<td>OpenAI</td>
<td>Exact number unknown^{[f]}</td>
<td>Unknown
</td>
<td>Unknown</td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:center;">proprietary

```
</td>
<td>Available for ChatGPT Plus users and used in <a href="/wiki/GPT-4#Usage" title
="GPT-4">several products</a>.
</td></tr>
<tr>
<td>Cerebras-GPT
</td>
<td><span data-sort-value="000000002023-03-01-0000" style="white-space:nowrap">Mar
ch 2023</span>
</td>
<td>Cerebras
</td>
<td><span data-sort-value="13000000000 !">13 billion</span><sup class="reference"
id="cite_ref-D0k2a_159-0"><a href="#cite_note-D0k2a-159">[153]</a></sup>
</td>
<td>
</td>
<td>270<sup class="reference" id="cite_ref-:3_126-3"><a href="#cite_note-:3-126">
[123]</a></sup></td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:c
enter;">Apache 2.0
</td>
<td>Trained with Chinchilla formula.
</td></tr>
<tr>
<td>Falcon</td>
<td><span data-sort-value="000000002023-03-01-0000" style="white-space:nowrap">Mar
ch 2023</span></td>
<td><a href="/wiki/Technology_Innovation_Institute" title="Technology Innovation I
nstitute">Technology Innovation Institute</a></td>
<td><span data-sort-value="40000000000 !">40 billion</span><sup class="reference"
id="cite_ref-falcon_160-0"><a href="#cite_note-falcon-160">[154]</a></sup></td>
<td>1 trillion tokens, from RefinedWeb (filtered web text corpus)<sup class="refer
ence" id="cite_ref-Xb1gq_161-0"><a href="#cite_note-Xb1gq-161">[155]</a></sup> plu
s some "curated corpora".<sup class="reference" id="cite_ref-gzTNw_162-0"><a href
="#cite_note-gzTNw-162">[156]</a></sup>
</td>
<td>2800<sup class="reference" id="cite_ref-:5_154-1"><a href="#cite_note-:5-154">
[150]</a></sup></td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:c
enter;">Apache 2.0<sup class="reference" id="cite_ref-Wmlcs_163-0"><a href="#cite_
note-Wmlcs-163">[157]</a></sup>
</td>
<td>
</td></tr>
<tr>
<td>BloombergGPT</td>
<td><span data-sort-value="000000002023-03-01-0000" style="white-space:nowrap">Mar
ch 2023</span></td>
<td><a href="/wiki/Bloomberg_L.P." title="Bloomberg L.P.">Bloomberg L.P.</a></td>
<td><span data-sort-value="50000000000 !">50 billion</span></td>
<td>363 billion token dataset based on Bloomberg's data sources, plus 345 billion
tokens from general purpose datasets<sup class="reference" id="cite_ref-nGOSu_164-
0"><a href="#cite_note-nGOSu-164">[158]</a></sup>
</td>
<td></td>
```

<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>LLM trained on financial data from proprietary sources, that "outperforms exis
ting models on financial tasks by significant margins without sacrificing performa
nce on general LLM benchmarks"
</td></tr>
<tr>
<td>PanGu-Σ</td>
<td>Mar
ch 2023</td>
<td>Huawei</td>
<td>1.085 trillion</td>
<td>329 billion tokens<sup class="reference" id="cite_ref-9WSFw_165-0"><a href="#c
ite_note-9WSFw-165">[159]</sup>
</td>
<td></td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>
</td></tr>
<tr>
<td>OpenAssistant<sup class="reference" id="cite_ref-JiOl8_166-0"><a href="#cite_n
ote-JiOl8-166">[160]</sup></td>
<td>Mar
ch 2023</td>
<td>LAION</td>
<td>17 billion</td>
<td>1.5 trillion tokens
</td>
<td></td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:c
enter;">Apache 2.0
</td>
<td>Trained on crowdsourced open data
</td></tr>
<tr>
<td>Jurassic-2<sup class="reference" id="cite_ref-167">[1
61]</sup>
</td>
<td>Mar
ch 2023
</td>
<td>AI21 Labs
</td>
<td>Exact size unknown
</td>
<td>Unknown
</td>
<td></td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>Multilingual<sup class="reference" id="cite_ref-168">
[162]</sup>

```
</td></tr>
<tr>
<td><a href="/wiki/PaLM" title="PaLM">PaLM 2</a> (Pathways Language Model 2)</td>
<td><span data-sort-value="000000002023-05-01-0000" style="white-space:nowrap">May
2023</span></td>
<td>Google</td>
<td><span data-sort-value="340000000000 !">340 billion</span><sup class="referenc
e" id="cite_ref-cnbc-20230516_169-0"><a href="#cite_note-cnbc-20230516-169">[163]
</a></sup></td>
<td><span data-sort-value="3600000000000 !">3.6 trillion</span> tokens<sup class
="reference" id="cite_ref-cnbc-20230516_169-1"><a href="#cite_note-cnbc-20230516-1
69">[163]</a></sup>
</td>
<td>85000<sup class="reference" id="cite_ref-:5_154-2"><a href="#cite_note-:5-15
4">[150]</a></sup></td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>Used in <a href="/wiki/Bard_(chatbot)" title="Bard (chatbot)">Bard chatbot</a
>.<sup class="reference" id="cite_ref-pWyLA_170-0"><a href="#cite_note-pWyLA-170">
[164]</a></sup>
</td></tr>
<tr>
<td>Llama 2</td>
<td><span data-sort-value="000000002023-07-01-0000" style="white-space:nowrap">Jul
y 2023</span></td>
<td>Meta</td>
<td><span data-sort-value="70000000000 !">70 billion</span><sup class="reference"
id="cite_ref-meta-20230719_171-0"><a href="#cite_note-meta-20230719-171">[165]</a>
</sup></td>
<td><span data-sort-value="2000000000000 !">2 trillion</span> tokens<sup class="re
ference" id="cite_ref-meta-20230719_171-1"><a href="#cite_note-meta-20230719-171">
[165]</a></sup>
</td>
<td></td>
<td class="table-partial" style="background: #FFB; vertical-align: middle; text-al
ign: center;">Llama 2 license
</td>
<td>Successor of LLaMA.
</td></tr>
<tr>
<td>Claude 2
</td>
<td>July 2023
</td>
<td>Anthropic
</td>
<td>Unknown
</td>
<td>Unknown
</td>
<td>Unknown</td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>Used in Claude chatbot.<sup class="reference" id="cite_ref-172"><a href="#cite
```

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_note-172">[166]</a></sup>
</td></tr>
<tr>
<td>Falcon 180B</td>
<td><span data-sort-value="000000002023-09-01-0000" style="white-space:nowrap">Sep
tember 2023</span></td>
<td>Technology Innovation Institute</td>
<td><span data-sort-value="180000000000 !">180 billion</span><sup class="referenc
e" id="cite_ref-tii-20230921_173-0"><a href="#cite_note-tii-20230921-173">[167]</a
></sup></td>
<td><span data-sort-value="3500000000000 !">3.5 trillion</span> tokens<sup class
="reference" id="cite_ref-tii-20230921_173-1"><a href="#cite_note-tii-20230921-17
3">[167]</a></sup>
</td>
<td></td>
<td class="table-partial" style="background: #FFB; vertical-align: middle; text-al
ign: center;">Falcon 180B TII license
</td></tr>
<tr>
<td>Mistral 7B</td>
<td><span data-sort-value="000000002023-09-01-0000" style="white-space:nowrap">Sep
tember 2023</span></td>
<td><a href="/wiki/Mistral_AI" title="Mistral AI">Mistral AI</a></td>
<td><span data-sort-value="7300000000 !">7.3 billion</span><sup class="reference"
id="cite_ref-mistral-20230927_174-0"><a href="#cite_note-mistral-20230927-174">[16
8]</a></sup></td>
<td>Unknown
</td>
<td></td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:c
enter;">Apache 2.0
</td>
<td>
</td></tr>
<tr>
<td>Claude 2.1
</td>
<td>November 2023
</td>
<td>Anthropic
</td>
<td>Unknown
</td>
<td>Unknown
</td>
<td>Unknown</td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>Used in Claude chatbot. Has a context window of 200,000 tokens, or ~500 pages.
<sup class="reference" id="cite_ref-175"><a href="#cite_note-175">[169]</a></sup>
</td></tr>
<tr>
<td>Grok-1
</td>
<td>November 2023
```

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</td>
<td><a class="mw-redirect" href="/wiki/X.AI" title="X.AI">x.AI</a>
</td>
<td>Unknown
</td>
<td>Unknown
</td>
<td>Unknown</td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>Used in <a href="/wiki/Grok_(chatbot)" title="Grok (chatbot)">Grok</a> chatbo
t. Grok-1 has a context length of 8,192 tokens and has access to X (Twitter).<sup
class="reference" id="cite_ref-176"><a href="#cite_note-176">[170]</a></sup>
</td></tr>
<tr>
<td>Yi<sup class="reference" id="cite_ref-:6_177-0"><a href="#cite_note-:6-177">[1
71]</a></sup>
</td>
<td>November 2023
</td>
<td>01-ai
</td>
<td>34.4 billion<sup class="reference" id="cite_ref-:6_177-1"><a href="#cite_note
-:6-177">[171]</a></sup>
</td>
<td>3 trillion tokens<sup class="reference" id="cite_ref-:6_177-2"><a href="#cite_
note-:6-177">[171]</a></sup>
</td>
<td>Unknown</td>
<td class="table-partial" style="background: #FFB; vertical-align: middle; text-al
ign: center;">Yi license<sup class="reference" id="cite_ref-178"><a href="#cite_no
te-178">[172]</a></sup>
</td>
<td>
</td></tr>
<tr>
<td><a href="/wiki/Gemini_(language_model)" title="Gemini (language model)">Gemini
</a>
</td>
<td>December 2023
</td>
<td><a href="/wiki/Google_DeepMind" title="Google DeepMind">Google DeepMind</a>
</td>
<td>Unknown
</td>
<td>Unknown
</td>
<td>Unknown</td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:ce
nter;">Proprietary
</td>
<td>Multimodal model, comes in three sizes. Used in <a href="/wiki/Bard_(chatbot)"
title="Bard (chatbot)">Bard chatbot</a>.<sup class="reference" id="cite_ref-179"><
a href="#cite_note-179">[173]</a></sup>
</td></tr>
```

<tr>
<td>Mixtral 8x7B
</td>
<td>December 2023
</td>
<td>Mistral AI
</td>
<td>46.7B total, 12.9B parameters per token^{[174]}
</td>
<td>Unknown
</td>
<td>Unknown</td>
<td class="table-yes" style="background:#9EFF9E;vertical-align:middle;text-align:center;">Apache 2.0
</td>
<td>Mixture of experts model, outperforms GPT-3.5 and Llama 2 70B on many benchmarks. All weights were released via torrent.^{[175]}
</td></tr>
<tr>
<td>Phi-2
</td>
<td>December 2023
</td>
<td>Microsoft
</td>
<td>2.7B
</td>
<td>1.4T tokens
</td>
<td>Unknown</td>
<td class="table-no" style="background:#FFC7C7;vertical-align:middle;text-align:center;">Proprietary
</td>
<td>So-called small language model, that "matches or outperforms models up to 25x larger", trained on "textbook-quality" data based on the paper "Textbooks Are All You Need". Model training took "14 days on 96 A100 GPUs".^{[176]}
</td></tr></tbody></table>
<h2>See also[edit]</h2>
Foundation models
Generative AI
<h2>Notes[edit]</h2>
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<ol class="references">
<li id="cite_note-104">^ This is the date that documentation describing the model's architecture was first released.

<li id="cite_note-105">^ In many cases, researchers release or report on multiple versions of a model having different sizes. In these cases, the size of the largest model is listed here.

<li id="cite_note-106">^ This is the license of the pre-trained model weights. In almost all cases the training code itself is open-source or can be easily replicated.

<li id="cite_note-143">^ The smaller models including 66B are publicly available, while the 175B model is available on request.

<li id="cite_note-155">^ Facebook's license and distribution scheme restricted access to approved researchers, but the model weights were leaked and became widely available.

<li id="cite_note-158">^ As stated in Technical report: "Given both the competitive landscape and the safety implications of large-scale models like GPT-4, this report contains no further details about the architecture (including model size), hardware, training compute, dataset construction, training method ..."^{[152]}

<h2>References[edit]</h2>
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log/better-language-models/" rel="nofollow">"Better Language Models and Their Impl
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accessdate">. Retrieved 2019-08-25.</cite><span
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nguage+Models+and+Their+Implications&rft.date=2019-02-14&rft_id=https%3A%2
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REFMerritt2022">Merritt, Rick (2022-03-25). <a class="external text" href="http
s://blogs.nvidia.com/blog/2022/03/25/what-is-a-transformer-model/" rel="nofollo
w">"What Is a Transformer Model?". NVIDIA Blog<span class="reference-ac
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wman_3-0">^a <sup><b
>b</sup> <link href="mw-data:Templ
ateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation a
rxiv cs1" id="CITEREFBowman2023">Bowman, Samuel R. (2023). "Eight Things to Know a
bout Large Language Models". <a class="mw-redirect" href="/wiki/ArXiv_(identifie
r)" title="ArXiv (identifier)">arXiv:<span class="cs1-lock-free" title="Freely
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g/archive/cs.CL" rel="nofollow">cs.CL].</cite><span class="Z3988" title="ctx_v
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<li id="cite_note-few-shot-learners-4">^ ^a ^b ^c <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFBrownMannRyderSubbiah2020">Brown, Tom B.; Mann, Benjamin; Ryder, Nick; Subbiah, Melanie; Kaplan, Jared; Dhariwal, Prafulla; Neelakantan, Arvind; Shyam, Pranav; Sastry, Girish; Askell, Amanda; Agarwal, Sandhini; Herbert-Voss, Ariel; Krueger, Gretchen; Henighan, Tom; Child, Rewon; Ramesh, Aditya; Ziegler, Daniel M.; Wu, Jeffrey; Winter, Clemens; Hesse, Christopher; Chen, Mark; Sigler, Eric; Litwin, Mateusz; Gray, Scott; Chess, Benjamin; Clark, Jack; Berner, Christopher; McCandlish, Sam; Radford, Alec; Sutskever, Ilya; Amodei, Dario (Dec 2020). Larochelle, H.; Ranzato, M.; Hadsell, R.; Balcan, M.F.; Lin, H. (eds.). "Language Models are Few-Shot Learners" (PDF). Advances in Neural Information Processing Systems. Curran Associates, Inc. 33: 1877–1901.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.jtitle=Advances+in+Neural+Information+Processing+Systems&rft.atitle=Language+Models+are+Few-Shot+Learners&rft.volume=33&rft.pages=1877-1901&rft.date=2020-12&rft.aulast=Brown&rft.aufirst=Tom+B.&rft.au=Mann%2C+Benjamin&rft.au=Ryder%2C+Nick&rft.au=Subbiah%2C+Melanie&rft.au=Kaplan%2C+Jared&rft.au=Dhariwal%2C+Prafulla&rft.au=Neelakantan%2C+Arvind&rft.au=Shyam%2C+Pranav&rft.au=Sastry%2C+Girish&rft.au=Askell%2C+Amanda&rft.au=Agarwal%2C+Sandhini&rft.au=Herbert-Voss%2C+Ariel&rft.au=Krueger%2C+Gretchen&rft.au=Henighan%2C+Tom&rft.au=Child%2C+Rewon&rft.au=Ramesh%2C+Aditya&rft.au=Ziegler%2C+Daniel+M.&rft.au=Wu%2C+Jeffrey&rft.au=Winter%2C+Clemens&rft.au=Hesse%2C+Christopher&rft.au=Chen%2C+Mark&rft.au=Sigler%2C+Eric&rft.au=Litwin%2C+Mateusz&rft.au=Gray%2C+Scott&rft.au=Chess%2C+Benjamin&rft.au=Clark%2C+Jack&rft.au=Berner%2C+Christopher&rft.au=McCandlish%2C+Sam&rft.au=Radford%2C+Alec&rft.au=Sutskever%2C+Ilya&rft.au=Amodei%2C+Dario&rft_id=https%3A%2F%2Fproceedings.neurips.cc%2Fpaper%2F2020%2Ffile%2F1457c0d6bfcb4967418bfb8ac142f64a-Paper.pdf&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-Manning-2022-5">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFManning2022">Manning, Christopher D. (2022). "Human Language Understanding & Reasoning". Daedalus. 151 (2): 127–138. doi:10.1162/daed_a_01905. S2CID 248377870.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.jtitle=Daedalus&rft.atitle=Human+Language+Understanding+%26+Reasoning&rft.volume=151&rft.issue=2&rft.pages=127-138&rft.date=2022&rft_id=info%3Adoi%2F10.1162%2Fdaed_a_01905&rft_id=https%3A%2F%2Fapi.semanticscholar.org%2FCorpusI

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<li id="cite_note-xbiWb-6">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"OpenAI API". platform.openai.com. Archived from the original on April 23, 2023. Retrieved 2023-04-30.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=platform.openai.com&rft.atitle=OpenAI+API&rft_id=https%3A%2F%2Fplatform.openai.com%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-2022Book_-7">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation book cs1" id="CITEREFPaaßGiesselbach2022">Paaß, Gerhard; Giesselbach, Sven (2022). "Pre-trained Language Models". Foundation Models for Natural Language Processing. Artificial Intelligence: Foundations, Theory, and Algorithms. pp. 19–78. doi:10.1007/978-3-031-23190-2_2. ISBN <bdi>9783031231902</bdi>. Retrieved 3 August 2023.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=bookitem&rft.atitle=Pre-trained+Language+Models&rft.btitle=Foundation+Models+for+Natural+Language+Processing&rft.series=Artificial+Intelligence%3A+Foundations%2C+Theory%2C+and+Algorithms&rft.pages=19-78&rft.date=2022&rft_id=info%3Adoi%2F10.1007%2F978-3-031-23190-2_2&rft.isbn=9783031231902&rft.aulast=Paa%C3%9F&rft.aufirst=Gerhard&rft.au=Giesselbach%2C+Sven&rft_id=https%3A%2F%2Flink.springer.com%2Fchapter%2F10.1007%2F978-3-031-23190-2_2&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-8">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFYennie_Jun2023">Yennie Jun (2023-05-03). "All languages are NOT created (tokenized) equal". Language models cost much more in some languages than others. Retrieved 2023-08-17. <q>In other words, to express the same sentiment, some languages require up to 10 times more tokens.</q></cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=Language+models+cost+much+more+in+some+languages+than+others&rft.atitle=All+languages+are+NOT+created+%28tokenized%29+equal&rft.date=2023-05-03&rft.au=Yennie+Jun&rft_id=ht

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<li id="cite_note-aYNg4-10">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFDodgeSapMarasovićAgnew2021">Dodge, Jesse; Sap, Maarten; Marasović, Ana; Agnew, William; Ilharco, Gabriel; Groeneveld, Dirk; Mitchell, Margaret; Gardner, Matt (2021). "Documenting Large Webtext Corpora: A Case Study on the Colossal Clean Crawled Corpus". arXiv:2104.08758 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Documenting+Large+Webtext+Corpora%3A+A+Case+Study+on+the+Colossal+Clean+Crawled+Corpus&rft.date=2021&rft_id=info%3Aarxiv%2F2104.08758&rft.aulast=Dodge&rft.aufirst=Jesse&rft.au=Sap%2C+Maarten&rft.au=Marasovi%C4%87%2C+Ana&rft.au=Agnew%2C+William&rft.au=Ilharco%2C+Gabriel&rft.au=Groeneveld%2C+Dirk&rft.au=Mitchell%2C+Margaret&rft.au=Gardner%2C+Matt&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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<li id="cite_note-jm-12">^ ^a ^b ^c ^d <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation book cs1" id="CITEREFJurafskyMartin2023">Jurafsky, Dan; Martin, James H. (7 January 2023). Speech and Language Processing (PDF) (3rd edition draft ed.) . Retrieved 24 May 2022.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=book&rft.btitle=Speech+and+Language+Processing&rft.edition=3rd+edition+draft&rft.date=2023-01-07&rft.aulast=Jurafsky&rft.aufirst=Dan&rft.au=Martin%2C+James+H.&rft_id=https%3A%2F%2Fweb.stanford.edu%2F~jurafsky%2Fslp3%2Fed3book_jan72023.pdf&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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<li id="cite_note-instructGPT-paper-14">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFOuyangWuJiangAlmeida2022">Ouyang, Long; Wu, Jeff; Jiang, Xu; Almeida, Diogo; Wainwright, Carroll L.; Mishkin, Pamela; Zhang, Chong; Agarwal, Sandhini; Slama, Katarina; Ray, Alex; Schulman, John; Hilton, Jacob; Kelton, Fraser; Miller, Luke; Simens, Maddie; Askell, Amanda; Welinder, Peter; Christiano, Paul; Leike, Jan; Lowe, Ryan (2022). "Training language models to follow instructions with human feedback". arXiv:2203.02155 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Training+language+models+to+follow+instructions+with+human+feedback&rft.date=2022&rft_id=info%3Aarxiv%2F2203.02155&rft.aulast=Ouyang&rft.aufirst=Long&rft.au=Wu%2C+Jeff&rft.au=Jiang%2C+Xu&rft.au=Almeida%2C+Diogo&rft.au=Wainwright%2C+Carroll+L.&rft.au=Mishkin%2C+Pamela&rft.au=Zhang%2C+Chong&rft.au=Agarwal%2C+Sandhini&rft.au=Slama%2C+Katarina&rft.au=Ray%2C+Alex&rft.au=Schulman%2C+John&rft.au=Hilton%2C+Jacob&rft.au=Kelton%2C+Fraser&rft.au=Miller%2C+Luke&rft.au=Simens%2C+Maddie&rft.au=Askell%2C+Amanda&rft.au=Welinder%2C+Peter&rft.au=Christiano%2C+Paul&rft.au=Leike%2C+Jan&rft.au=Lowe%2C+Ryan&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-self-instruct-paper-15">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFWangKordiMishraLiu2022">Wang, Yizhong; Kordi, Yeganeh; Mishra, Swaroop; Liu, Alisa; Smith, Noah A.; Khashabi, Daniel; Hajishirzi, Hannaneh (2022). "Self-Instruct: Aligning Language Model with Self Generated Instructions". arXiv:2212.10560 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Self-Instruct%3A+Aligning+Language+Model+with+Self+Generated+Instructions&rft.date=2022&rft_id=info%3Aarxiv%2F2212.10560&rft.aulast=Wang&rft.aufirst=Yizhong&rft.au=Kordi%2C+Yeganeh&rft.au=Mishra%2C+Swaroop&rft.au=Liu%2C+Alisa&rft.au=Smith%2C+Noah+A.&rft.au=Khashabi%2C+Daniel&rft.au=Hajishirzi%2C+Hannaneh&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-HGZCJ-16">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFShazeerMirhoseiniMaziarzDavis2017">Shazeer, Noam; Mirhoseini, Azalia; Maziarz, Krzysztof; Davis, Andy; Le, Quoc; Hinton, Geoffrey; Dean, Jeff (2

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<li id="cite_note-glam-blog-18">^ ^a ^b ^c ^d <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFDaiDu2021">Dai, Andrew M; Du, Nan (December 9, 2021). "More Efficient In-Context Learning with GLaM". ai.googleblog.com. Retrieved 2023-03-09.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=ai.googleblog.com&rft.atitle=More+Efficient+In-Context+Learning+with+GLaM&rft.date=2021-12-09&rft.aulast=Dai&rft.aufirst=Andrew+M&rft.au=Du%2C+Nan&rft_id=https%3A%2F%2Fai.googleblog.com%2F2021%2F12%2Fmore-efficient-in-context-learning-with.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-emergentpaper-19">^ ^a ^b ^c <link href

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<li id="cite_note-Jay_Allamar-20">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFAllamar">Allamar, Jay. "Illustrated transformer". Retrieved 2023-07-29.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=unknown&rft.btitle=Illustrated+transformer&rft.aulast=Allamar&rft.aufirst=Jay&rft_id=https%3A%2F%2Fjalammar.github.io%2Fillustrated-transformer%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-Jay_Allamar_GPT2-21">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFAllamar">Allamar, Jay. "The Illustrated GPT-2 (Visualizing Transformer Language Models)". Retrieved 2023-08-01.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=unknown&rft.btitle=The+Illustrated+GPT-2+%28Visualizing+Transformer+Language+Models%29&rft.aulast=Allamar&rft.aufirst=Jay&rft_id=https%3A%2F%2Fjalammar.github.io%2Fillustrated-gpt2%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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<li id="cite_note-ioUpE-23">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation book cs1" id="CITEREFZaibShengEmma_Zhang2020">Zaib, Munazza; Sheng, Quan Z.; Emma Zhang, Wei (4 February 2020). "A Short Survey of Pre-trained Language Models for Conversational AI-A New Age in NLP". Proceedings of the Australasian Computer Science Week Multiconference. pp. 1–4. arXiv:2104.10810. doi:10.1145/3373017.3373028. ISBN <bdi>9781450376976</bdi>. S2CID 211040895.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=bookitem&rft.atitle=A+Short+Survey+of+Pre-trained+Language+Models+for+Conversational+AI-A+New+Age+in+NLP&rft.btitle=Proceedings+of+the+Australasian+Computer+Science+Week+Multiconference&rft.pages=1-4&rft.date=2020-02-04&rft_id=info%3Aarxiv%2F2104.10810&rft_id=https%3A%2F%2Fapi.semanticscholar.org%2FCorpusID%3A211040895%23id-name%3DS2CID&rft_id=info%3Adoi%2F10.1145%2F3373017.3373028&rft.isbn=9781450376976&rft.aulast=Zaib&rft.aufirst=Munazza&rft.au=Sheng%2C+Quan+Z.&rft.au=Emma+Zhang%2C+Wei&rft_id=https%3A%2F%2Fwww.researchgate.net%2Fpublication%2F338931711&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-Wiggers-24">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFWiggers2022">Wiggers, Kyle (28 April 2022). "The emerging types of language models and why they matter". TechCrunch.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=TechCrunch&rft.atitle=The+emerging+types+of+language+models+and+why+they+matter&rft.date=2022-04-28&rft.aulast=Wiggers&rft.aufirst=Kyle&rft_id=https%3A%2F%2Ftechcrunch.com%2F2022%2F04%2F28%2Fthe-emerging-types-of-language-models-and-why-they-matter%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-xaytj-25">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFSharirPelegShoham2020">Sharir, Or; Peleg, Barak; Shoham, Yoav (2020). "The Cost of Training NLP Models: A Concise Overview". arXiv:<a class="external text" href="http

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61" rel="nofollow">2001.08361 [cs.LG].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Scaling+Laws+for+Neural+Language+Models&rft.date=2020&rft_id=info%3Aarxiv%2F2001.08361&rft.aulast=Kaplan&rft.aufirst=Jared&rft.au=McCandlish%2C+Sam&rft.au=Henighan%2C+Tom&rft.au=Brown%2C+Tom+B.&rft.au=Chess%2C+Benjamin&rft.au=Child%2C+Rewon&rft.au=Gray%2C+Scott&rft.au=Radford%2C+Alec&rft.au=Wu%2C+Jeffrey&rft.au=Amodei%2C+Dario&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-PI1fW-29">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFGaoMadaanZhouAlon2022">Gao, Luyu; Madaan, Aman; Zhou, Shuyan; Alon, Uri; Liu, Pengfei; Yang, Yiming; Callan, Jamie; Neubig, Graham (2022-11-01). "PAL: Program-aided Language Models". arXiv:2211.10435 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=PAL%3A+Program-aided+Language+Models&rft.date=2022-11-01&rft_id=info%3Aarxiv%2F2211.10435&rft.aulast=Gao&rft.aufirst=Luyu&rft.au=Madaan%2C+Aman&rft.au=Zhou%2C+Shuyan&rft.au=Alon%2C+Uri&rft.au=Liu%2C+Pengfei&rft.au=Yang%2C+Yiming&rft.au=Callan%2C+Jamie&rft.au=Neubig%2C+Graham&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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<li id="cite_note-gQxzq-31">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFParanjapeLundbergSinghHajishirzi2023">Paranjape, Bhargavi; Lundberg, Scott; Singh, Sameer; Hajishirzi, Hannaneh; Zettlemoyer, Luke; Tulio Ribeiro, Marco (2023-03-01). "ART: Automatic multi-step reasoning and tool-use for large language models". arXiv:2303.09014 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=ART%3A+Automatic+multi-step+reasoning+and+tool-use+for+large+language+models&rft.date=2023-03-01&rft_id=info%3Aarxiv%2F2303.09014&rft.aulast=Paranjape&rft.aufirst=Bhargavi&rft.au=Lundber

g%2C+Scott&rft.au=Singh%2C+Sameer&rft.au=Hajishirzi%2C+Hannaneh&rft.au=Zettlemoyer%2C+Luke&rft.au=Tulio+Ribeiro%2C+Marco&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-lLrda-32">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFLiangWuSongWu2023">Liang, Yaobo; Wu, Chenfei; Song, Ting; Wu, Wenshan; Xia, Yan; Liu, Yu; Ou, Yang; Lu, Shuai; Ji, Lei; Mao, Shaoguang; Wang, Yun; Shou, Linjun; Gong, Ming; Duan, Nan (2023-03-01). "TaskMatrix.AI: Completing Tasks by Connecting Foundation Models with Millions of APIs". arXiv:2303.16434 [cs.AI].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=TaskMatrix.AI%3A+Completing+Tasks+by+Connecting+Foundation+Models+with+Millions+of+APIs&rft.date=2023-03-01&rft_id=info%3Aarxiv%2F2303.16434&rft.aulast=Liang&rft.aufirst=Yaobo&rft.au=Wu%2C+Chenfei&rft.au=Song%2C+Ting&rft.au=Wu%2C+Wenshan&rft.au=Xia%2C+Yan&rft.au=Liu%2C+Yu&rft.au=Ou%2C+Yang&rft.au=Lu%2C+Shuai&rft.au=Ji%2C+Lei&rft.au=Mao%2C+Shaoguang&rft.au=Wang%2C+Yun&rft.au=Shou%2C+Linjun&rft.au=Gong%2C+Ming&rft.au=Duan%2C+Nan&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-4Xzrs-33">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFPatilZhangWangGonzalez2023">Patil, Shishir G.; Zhang, Tianjun; Wang, Xin; Gonzalez, Joseph E. (2023-05-01). "Gorilla: Large Language Model Connected with Massive APIs". arXiv:2305.15334 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Gorilla%3A+Large+Language+Model+Connected+with+Massive+APIs&rft.date=2023-05-01&rft_id=info%3Aarxiv%2F2305.15334&rft.aulast=Patil&rft.aufirst=Shishir+G.&rft.au=Zhang%2C+Tianjun&rft.au=Wang%2C+Xin&rft.au=Gonzalez%2C+Joseph+E.&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-BUZBP-34">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFLewisPerezPiktusPetroni2020">Lewis, Patrick; Perez, Ethan; Piktus, Aleksandra; Petroni, Fabio; Karpukhin, Vladimir; Goyal, Naman; Küttler, Heinrich; Lewis, Mike; Yih, Wen-tau; Rocktäschel, Tim; Riedel, Sebastian; Kiela, Douwe (2020). "Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks". Advances in Neural Information Processing Systems. Curran Associates, Inc. 33: 9459–9474. arXiv:2005.11401.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aof

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<li id="cite_note-CFuti-35">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFHuangAbbeelPathakMordatch2022">Huang, Wenlong; Abbeel, Pieter; Pathak, Deepak; Mordatch, Igor (2022-06-28). "Language Models as Zero-Shot Planners: Extracting Actionable Knowledge for Embodied Agents". Proceedings of the 39th International Conference on Machine Learning. PMLR: 9118–9147. arXiv:2201.07207.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.jtitle=Proceedings+of+the+39th+International+Conference+on+Machine+Learning&rft.atitle=Language+Models+as+Zero-Shot+Planners%3A+Extracting+Actionable+Knowledge+for+Embodied+Agents&rft.pages=9118-9147&rft.date=2022-06-28&rft_id=info%3Aarxiv%2F2201.07207&rft.aulast=Huang&rft.aufirst=Wenlong&rft.au=Abbeel%2C+Pieter&rft.au=Pathak%2C+Deepak&rft.au=Mordatch%2C+Igor&rft_id=https%3A%2F%2Fproceedings.mlr.press%2Fv162%2Fhuang22a.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-DmvNE-36">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFYaoZhaoYuDu2022">Yao, Shunyu; Zhao, Jeffrey; Yu, Dian; Du, Nan; Shafran, Izhak; Narasimhan, Karthik; Cao, Yuan (2022-10-01). "ReAct: Synergizing Reasoning and Acting in Language Models". arXiv:2210.03629 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=ReAct%3A+Synergizing+Reasoning+and+Acting+in+Language+Models&rft.date=2022-10-01&rft_id=info%3Aarxiv%2F2210.03629&rft.aulast=Yao&rft.aufirst=Shunyu&rft.au=Zhao%2C+Jeffrey&rft.au=Yu%2C+Dian&rft.au=Du%2C+Nan&rft.au=Shafran%2C+Izhak&rft.au=Narasimhan%2C+Karthik&rft.au=Cao%2C+Yuan&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-JS8Vd-37">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFWuPrabhumoyeMin2023">Wu, Yue; Prabhumoye, Shrimai; Min, So Yeon (24 May 2023). "SPRING: GPT-4 Out-performs RL Algorithms by Studying Papers and

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<li id="cite_note-38">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFWangCaiLiuMa2023">Wang, Zihao; Cai, Shaofei; Liu, Anji; Ma, Xiaojian; Liang, Yitao (2023-02-03). "Describe, Explain, Plan and Select: Interactive Planning with Large Language Models Enables Open-World Multi-Task Agents". arXiv:2302.01560 [cs.AI].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Describe%2C+Explain%2C+Plan+and+Select%3A+Interactive+Planning+with+Large+Language+Models+Enables+Open-World+Multi-Task+Agents&rft.date=2023-02-03&rft_id=info%3Aarxiv%2F2302.01560&rft.aulast=Wang&rft.aufirst=Zihao&rft.au=Cai%2C+Shaofei&rft.au=Liu%2C+Anji&rft.au=Ma%2C+Xiaojian&rft.au=Liang%2C+Yitao&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-sbB2T-39">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFShinnCassanoLabashGopinath2023">Shinn, Noah; Cassano, Federico; Labash, Beck; Gopinath, Ashwin; Narasimhan, Karthik; Yao, Shunyu (2023-03-01). "Reflexion: Language Agents with Verbal Reinforcement Learning". arXiv:2303.11366 [cs.AI].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Reflexion%3A+Language+Agents+with+Verbal+Reinforcement+Learning&rft.date=2023-03-01&rft_id=info%3Aarxiv%2F2303.11366&rft.aulast=Shinn&rft.aufirst=Noah&rft.au=Cassano%2C+Federico&rft.au=Labash%2C+Beck&rft.au=Gopinath%2C+Ashwin&rft.au=Narasimhan%2C+Karthik&rft.au=Yao%2C+Shunyu&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-ltTer-40">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFHaoGuMaJiahua_Hong2023">Hao, Shibo; Gu, Yi; Ma, Haodi; Jiahua Hong, Joshua; Wang, Zhen; Zhe Wang, Daisy; Hu, Zhiting (2023-05-01). "Reasoning with Language Model is Planning with World Model". arXiv:<a class="external text" href="https://arxiv.org/ab

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<li id="cite_note-:0-42">^ <a href="#cite_ref-:0_42
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<li id="cite_note-LS2Go-44">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFNagelAmjadBaalenLouizos2020">Nagel, Markus; Amjad, Rana Ali; Baalen, Mart Van; Louizos, Christos; Blankevoort, Tijmen (2020-11-21). "Up or Down? Adaptive Rounding for Post-Training Quantization". Proceedings of the 37th International Conference on Machine Learning. PMLR: 7197–7206.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.jtitle=Proceedings+of+the+37th+International+Conference+on+Machine+Learning&rft.atitle=Up+or+Down%3F+Adaptive+Rounding+for+Post-Training+Quantization&rft.pages=7197-7206&rft.date=2020-11-21&rft.aulast=Nagel&rft.aufirst=Markus&rft.au=Amjad%2C+Rana+Ali&rft.au=Baalen%2C+Mart+Van&rft.au=Louizos%2C+Christos&rft.au=Blankevoort%2C+Tijmen&rft_id=https%3A%2F%2Fproceedings.mlr.press%2Fv119%2Fnagel20a.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-cpzcK-45">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFPolinoPascanuAlistarh2018">Polino, Antonio; Pascanu, Razvan; Alistarh, Dan (2018-02-01). "Model compression via distillation and quantization". arXiv:1802.05668 [cs.NE].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Model+compression+via+distillation+and+quantization&rft.date=2018-02-01&rft_id=info%3Aarxiv%2F1802.05668&rft.aulast=Polino&rft.aufirst=Antonio&rft.au=Pascanu%2C+Razvan&rft.au=Alistarh%2C+Dan&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-QVU95-46">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFFrantarAshkboosHoeflerAlistarh2022">Frantar, Elias; Ashkboos, Saleh; Hoefler, Torsten; Alistarh, Dan (2022-10-01). "GPTQ: Accurate Post-Training Quantization for Generative Pre-trained Transformers". arXiv:2210.17323 [cs.LG].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=GPTQ%3A+Accurate+Post-Training+Quantization+for+Generative+Pre-trained+Transformers&rft.date=2022-10-01&rft_id=info%3Aarxiv%2F2210.17323&rft.aulast=Frantar&rft.aufirst=Elias&rft.au=Ashkboos%2C+Saleh&rft.au=Hoefler%2C+Torsten&rft.au=Alistarh%2C+Dan&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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U9Bu_47-0">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFDettmersSvirschevskiEgiazarianKuznedelev2023">Dettmers, Tim; Svirschevski, Ruslan; Egiazarian, Vage; Kuznedelev, Denis; Frantar, Elias; Ashkboos, Saleh; Borzunov, Alexander; Hoefler, Torsten; Alistarh, Dan (2023-06-01). "SpQR: A Sparse-Quantized Representation for Near-Lossless LLM Weight Compression". arXiv:2306.03078 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=SpQR%3A+A+Sparse-Quantized+Representation+for+Near-Lossless+LLM+Weight+Compression&rft.date=2023-06-01&rft_id=info%3Aarxiv%2F2306.03078&rft.aulast=Dettmers&rft.aufirst=Tim&rft.au=Svirschevski%2C+Ruslan&rft.au=Egiazarian%2C+Vage&rft.au=Kuznedelev%2C+Denis&rft.au=Frantar%2C+Elias&rft.au=Ashkboos%2C+Saleh&rft.au=Borzunov%2C+Alexander&rft.au=Hoefler%2C+Torsten&rft.au=Alistarh%2C+Dan&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-D0nFA-48">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFDettmersPagnoniHoltzmanZettlemoyer2023">Dettmers, Tim; Pagnoni, Artidoro; Holtzman, Ari; Zettlemoyer, Luke (2023-05-01). "QLoRA: Efficient Finetuning of Quantized LLMs". arXiv:2305.14314 [cs.LG].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=QLoRA%3A+Efficient+Finetuning+of+Quantized+LLMs&rft.date=2023-05-01&rft_id=info%3Aarxiv%2F2305.14314&rft.aulast=Dettmers&rft.aufirst=Tim&rft.au=Pagnoni%2C+Artidoro&rft.au=Holtzman%2C+Ari&rft.au=Zettlemoyer%2C+Luke&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-49">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFKirosSalakhutdinovZemel2014">Kiros, Ryan; Salakhutdinov, Ruslan; Zemel, Rich (2014-06-18). "Multimodal Neural Language Models". Proceedings of the 31st International Conference on Machine Learning. PMLR: 595–603.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.jtitle=Proceedings+of+the+31st+International+Conference+on+Machine+Learning&rft.atitle=Multimodal+Neural+Language+Models&rft.pages=595-603&rft.date=2014-06-18&rft.aulast=Kiros&rft.aufirst=Ryan&rft.au=Salakhutdinov%2C+Ruslan&rft.au=Zemel%2C+Rich&rft_id=https%3A%2F%2Fproceedings.mlr.press%2Fv32%2Fkiros14.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-50">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id

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<li id="cite_note-51">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFAntolAgrawalLuMitchell2015">Antol, Stanislaw; Agrawal, Aishwarya; Lu, Jiasen; Mitchell, Margaret; Batra, Dhruv; Zitnick, C. Lawrence; Parikh, Devi (2015). "VQA: Visual Question Answering". ICCV: 2425–2433.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.jtitle=ICCV&rft.atitle=VQA%3A+Visual+Question+Answering&rft.pages=2425-2433&rft.date=2015&rft.aulast=Antol&rft.aufirst=Stanislaw&rft.au=Agrawal%2C+Aishwarya&rft.au=Lu%2C+Jiasen&rft.au=Mitchell%2C+Margaret&rft.au=Batra%2C+Dhruv&rft.au=Zitnick%2C+C.+Lawrence&rft.au=Parikh%2C+Devi&rft_id=https%3A%2F%2Fopenaccess.thecvf.com%2Fcontent_iccv_2015%2Fhtml%2FAntol_VQA_Visual_Question_ICCV_2015_paper.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-52">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFLiLiSavareseHoi2023">Li, Junnan; Li, Dongxu; Savarese, Silvio; Hoi, Steven (2023-01-01). "BLIP-2: Bootstrapping Language-Image Pre-training with Frozen Image Encoders and Large Language Models". arXiv:2301.12597 [cs.CV].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=BLIP-2%3A+Bootstrapping+Language-Image+Pre-training+with+Frozen+Image+Encoders+and+Large+Language+Models&rft.date=2023-01-01&rft_id=info%3Aarxiv%2F2301.12597&rft.aulast=Li&rft.aufirst=Junnan&rft.au=Li%2C+Dongxu&rft.au=Savarese%2C+Silvio&rft.au=Hoi%2C+Steven&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-53">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFAlayracDonahueLucMiech2022">Alayrac, Jean-Baptiste; Donahue, Jeff; Luc, Pauline; Miech, Antoine; Barr, Iain; Hasson, Yana; Lenc, Karel; Mensch, Arthur; Millican, Katherine; Reynolds, Malcolm; Ring, Roman; Rutherford, Eliza; Cabi, Serkan; Han, Tengda; Gong, Zhitao (2022-12-06). <a class="external text" href="https://pro

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<li id="cite_note-54">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFDriessXiaSajjadiLynch2023">Driess, Danny; Xia, Fei; Sajjadi, Mehdi S. M.; Lynch, Corey; Chowdhery, Aakanksha; Ichter, Brian; Wahid, Ayzaan; Tompson, Jonathan; Vuong, Quan; Yu, Tianhe; Huang, Wenlong; Chebotar, Yevgen; Sermanet, Pierre; Duckworth, Daniel; Levine, Sergey (2023-03-01). "PaLM-E: An Embodied Multimodal Language Model". arXiv:2303.03378 [cs.LG].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=PaLM-E%3A+An+Embodied+Multimodal+Language+Model&rft.date=2023-03-01&rft_id=info%3Aarxiv%2F2303.03378&rft.aulast=Driess&rft.aufirst=Danny&rft.au=Xia%2C+Fei&rft.au=Sajjadi%2C+Mehdi+S.+M.&rft.au=Lynch%2C+Corey&rft.au=Chowdhery%2C+Aakanksha&rft.au=Ichter%2C+Brian&rft.au=Wahid%2C+Ayzaan&rft.au=Tompson%2C+Jonathan&rft.au=Vuong%2C+Quan&rft.au=Yu%2C+Tianhe&rft.au=Huang%2C+Wenlong&rft.au=Chebotar%2C+Yevgen&rft.au=Sermanet%2C+Pierre&rft.au=Duckworth%2C+Daniel&rft.au=Levine%2C+Sergey&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-55">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFLiuLiWuLee2023">Liu, Haotian; Li, Chunyuan; Wu, Qingyang; Lee, Yong Jae (2023-04-01). "Visual Instruction Tuning". arXiv:2304.08485 [cs.CV].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Visual+Instruction+Tuning&rft.date=2023-04-01&rft_id=info%3Aarxiv%2F2304.08485&rft.aulast=Liu&rft.aufirst=Haotian&rft.au=Li%2C+Chunyuan&rft.au=Wu%2C+Qingyang&r

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<li id="cite_note-56">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFZhangLiBing2023">Zhang, Hang; Li, Xin; Bing, Lidong (2023-06-01). "Video-LLaMA: An Instruction-tuned Audio-Visual Language Model for Video Understanding". arXiv:2306.02858 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Video-LLaMA%3A+An+Instruction-tuned+Audio-Visual+Language+Model+for+Video+Understanding&rft.date=2023-06-01&rft_id=info%3Aarxiv%2F2306.02858&rft.aulast=Zhang&rft.aufirst=Hang&rft.au=Li%2C+Xin&rft.au=Bing%2C+Lidong&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-57">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFOpenAI2023">OpenAI (2023-03-27). "GPT-4 Technical Report". arXiv:2303.08774 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=GPT-4+Technical+Report&rft.date=2023-03-27&rft_id=info%3Aarxiv%2F2303.08774&rft.au=OpenAI&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-58">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFOpenAI2023">OpenAI (September 25, 2023). "GPT-4V(ision) System Card" (PDF).</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=unknown&rft.btitle=GPT-4V%28ision%29+System+Card&rft.date=2023-09-25&rft.au=OpenAI&rft_id=https%3A%2F%2Fcdn.openai.com%2Fpapers%2FGPTV_System_Card.pdf&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-59">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation cs2" id="CITEREFPichai">Pichai, Sundar, Google Keynote (Google I/O '23), timestamp 15:31, retrieved 2023-07-02</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=book&rft.btitle=Google+Keynote+%28Google+I%2FO+%2723%29&rft.pages=timestamp+15%3A31&rft.aulast=Pichai&rft.aufirst=Sundar&rft_id=https%3A%2F%2Fwww.youtube.

com%2Fwatch%3Fv%3DcNfINi5CNbY%26t%3D931s&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-fJta3-60">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFHoffmannBorgeaudMenschBuchatskaya2022">Hoffmann, Jordan; Borgeaud, Sebastian; Mensch, Arthur; Buchatskaya, Elena; Cai, Trevor; Rutherford, Eliza; Casas, Diego de Las; Hendricks, Lisa Anne; Welbl, Johannes; Clark, Aidan; Hennigan, Tom; Noland, Eric; Millican, Katie; Driessche, George van den; Damoc, Bogdan (2022-03-29). "Training Compute-Optimal Large Language Models". arXiv:2203.15556 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Training+Compute-Optimal+Large+Language+Models&rft.date=2022-03-29&rft_id=info%3Aarxiv%2F2203.15556&rft.aulast=Hoffmann&rft.aufirst=Jordan&rft.au=Borgeaud%2C+Sebastian&rft.au=Mensch%2C+Arthur&rft.au=Buchatskaya%2C+Elena&rft.au=Cai%2C+Trevor&rft.au=Rutherford%2C+Eliza&rft.au=Casas%2C+Diego+de+Las&rft.au=Hendricks%2C+Lisa+Anne&rft.au=Welbl%2C+Johannes&rft.au=Clark%2C+Aidan&rft.au=Hennigan%2C+Tom&rft.au=Noland%2C+Eric&rft.au=Millican%2C+Katie&rft.au=Driessche%2C+George+van+den&rft.au=Damoc%2C+Bogdan&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-IYm4Q-61">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFCaballeroGuptaRishKrueger2022">Caballero, Ethan; Gupta, Kshitij; Rish, Irina; Krueger, David (2022). "Broken Neural Scaling Laws". arXiv:2210.14891 [cs.LG].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Broken+Neural+Scaling+Laws&rft.date=2022&rft_id=info%3Aarxiv%2F2210.14891&rft.aulast=Caballero&rft.aufirst=Ethan&rft.au=Gupta%2C+Kshitij&rft.au=Rish%2C+Irina&rft.au=Krueger%2C+David&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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te_ref-Hahn_20230314_63-0">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFHahnGoyal2023">Hahn, Michael; Goyal, Navin (2023-03-14). "A Theory of Emergent In-Context Learning as Implicit Structure Induction". arXiv:2303.07971 [cs.LG].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=A+Theory+of+Emergent+In-Context+Learning+as+Implicit+Structure+Induction&rft.date=2023-03-14&rft_id=info%3Aarxiv%2F2303.07971&rft.aulast=Hahn&rft.aufirst=Michael&rft.au=Goyal%2C+Navin&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-57FEA-64">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFPilehvarCamacho-Collados2019">Pilehvar, Mohammad Taher; Camacho-Collados, Jose (June 2019). "Proceedings of the 2019 Conference of the North". Proceedings of the 2019 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Volume 1 (Long and Short Papers). Minneapolis, Minnesota: Association for Computational Linguistics: 1267–1273. doi:10.18653/v1/N19-1128. S2CID 102353817.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.jtitle=Proceedings+of+the+2019+Conference+of+the+North+American+Chapter+of+the+Association+for+Computational+Linguistics%3A+Human+Language+Technologies%2C+Volume+1+%28Long+and+Short+Papers%29&rft.atitle=Proceedings+of+the+2019+Conference+of+the+North&rft.pages=1267-1273&rft.date=2019-06&rft_id=info%3Adoi%2F10.18653%2Fv1%2FN19-1128&rft_id=https%3A%2F%2Fapi.semanticscholar.org%2FCorpusID%3A102353817%23id-name%3DS2CID&rft.aulast=Pilehvar&rft.aufirst=Mohammad+Taher&rft.au=Camacho-Collados%2C+Jose&rft_id=https%3A%2F%2Faclanthology.org%2FN19-1128&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-TEIkA-65">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"WiC: The Word-in-Context Dataset". pilehvar.github.io. Retrieved 2023-06-27.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=pilehvar.github.io&rft.atitle=WiC%3A+The+Word-in-Context+Dataset&rft_id=https%3A%2F%2Fpilehvar.github.io%2Fwic%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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<li id="cite_note-Imb98-67">^ A Closer Look at Large Language Models Emergent Abilities (Yao Fu, Nov 20, 2022)

<li id="cite_note-CeQVF-68">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFOrnes2023">Ornes, Stephen (March 16, 2023). "The Unpredictable Abilities Emerging From Large AI Models". Quanta Magazine.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=Quanta+Magazine&rft.atitle=The+Unpredictable+Abilities+Emerging+From+Large+AI+Models&rft.date=2023-03-16&rft.aulast=Ornes&rft.aufirst=Stephen&rft_id=https%3A%2F%2Fwww.quantamagazine.org%2Fthe-unpredictable-abilities-emerging-from-large-ai-models-20230316%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-C775b-69">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFSchaefferMirandaKoyejo2023">Schaeffer, Rylan; Miranda, Brando; Koyejo, Sanmi (2023-04-01). "Are Emergent Abilities of Large Language Models a Mirage?". arXiv:2304.15004 [cs.AI].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Are+Emergent+Abilities+of+Large+Language+Models+a+Mirage%3F&rft.date=2023-04-01&rft_id=info%3Aarxiv%2F2304.15004&rft.aulast=Schaeffer&rft.aufirst=Rylan&rft.au=Miranda%2C+Brando&rft.au=Koyejo%2C+Sanmi&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-IZSIr-70">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFLiHopkinsBauViégas2022">Li, Kenneth; Hopkins, Aspen K.; Bau, David; Viégas, Fernanda; Pfister, Hanspeter; Wattenberg, Martin (2022-10-01). "Emergent World Representations: Exploring a Sequence Model Trained on a Synthetic Task". arXiv:2210.13382 [<a class="external text" href="https://arxiv.org/archive/cs.LG" rel="nofoll

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<li id="cite_note-RLik9-71">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"Large Language Model: world models or surface statistics?". The Gradient. 2023-01-21. Retrieved 2023-06-12.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=The+Gradient&rft.atitle=Large+Language+Model%3A+world+models+or+surface+statistics%3F&rft.date=2023-01-21&rft_id=https%3A%2F%2Fthegradient.pub%2Fothello%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-Hln1l-72">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFJinRinard2023">Jin, Charles; Rinard, Martin (2023-05-01). "Evidence of Meaning in Language Models Trained on Programs". arXiv:2305.11169 [cs.LG].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Evidence+of+Meaning+in+Language+Models+Trained+on+Programs&rft.date=2023-05-01&rft_id=info%3Aarxiv%2F2305.11169&rft.aulast=Jin&rft.aufirst=Charles&rft.au=Rinard%2C+Martin&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-oYGlo-73">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFNandaChanLieberumSmith2023">Nanda, Neel; Chan, Lawrence; Lieberum, Tom; Smith, Jess; Steinhardt, Jacob (2023-01-01). "Progress measures for grokking via mechanistic interpretability". arXiv:2301.05217 [cs.LG].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Progress+measures+for+grokking+via+mechanistic+interpretability&rft.date=2023-01-01&rft_id=info%3Aarxiv%2F2301.05217&rft.aulast=Nanda&rft.aufirst=Neel&rft.au=Chan%2C+Lawrence&rft.au=Lieberum%2C+Tom&rft.au=Smith%2C+Jess&rft.au=Steinhardt%2C+Jacob&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-debate_understanding-74">^ ^a ^b ^c ^d ^e <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation journal cs1" id="CITEREFMitchellKrakauer2023">Mitchell, Melanie; Krakauer, David C. (28 March 2023). "The debate over understanding in AI's large language models". Proceedings of the National Academy of Sciences. 120 (13): e2215907120. arXiv:2210.13966. Bibcode:2023PNAS..12015907M. doi:10.1073/pnas.2215907120. PMC 10068812. PMID 36943882.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.jtitle=Proceedings+of+the+National+Academy+of+Sciences&rft.atitle=The+debate+over+understanding+in+AI%27s+large+language+models&rft.volume=120&rft.issue=13&rft.pages=e2215907120&rft.date=2023-03-28&rft_id=https%3A%2F%2Fwww.ncbi.nlm.nih.gov%2Fpmc%2Farticles%2FPMC10068812%23id-name%3DPMC&rft_id=info%3Abibcode%2F2023PNAS..12015907M&rft_id=info%3Aarxiv%2F2210.13966&rft_id=info%3Apmid%2F36943882&rft_id=info%3Adoi%2F10.1073%2Fpnas.2215907120&rft.aulast=Mitchell&rft.aufirst=Melanie&rft.au=Krakauer%2C+David+C.&rft_id=https%3A%2F%2Fwww.ncbi.nlm.nih.gov%2Fpmc%2Farticles%2FPMC10068812&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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<li id="cite_note-microsoft_sparks-76">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFBubeckChandrasekaranEldanGeh

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<li id="cite_note-new_yorker_kind_of_mind-78">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation magazine cs1" id="CITEREFNewport2023">Newport, Cal (13 April 2023). "What Kind of Mind Does ChatGPT Have?". The New Yorker. Retrieved 12 June 2023.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.jtitle=The+New+Yorker&rft.atitle=What+Kind+of+Mind+Does+ChatGPT+Have%3F&rft.date=2023-04-13&rft.aulast=Newport&rft.aufirst=Cal&rft_id=https%3A%2F%2Fwww.newyorker.com%2Fscience%2Fannals-of-artificial-intelligence%2Fwhat-kind-of-mind-does-chatgpt-have&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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<li id="cite_note-85">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation book cs1" id="CITEREFFriston2022">Friston, Karl J. (2022). Active Inference: The Free Energy Principle in Mind, Brain, and Behavior; Chapter 4 The Generative Models of Active Inference. The MIT Press. ISBN <bdi>978-0-262-36997-8</bdi>

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<li id="cite_note-86">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFHuyen2019">Huyen, Chip (2019). "Understanding Evaluation Metrics for Language Modeling". The Gradient. Retrieved January 14, 2024.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=unknown&rft.btitle=Understanding+Evaluation+Metrics+for+Language+Modeling&rft.pub=The+Gradient&rft.date=2019&rft.aulast=Huyen&rft.aufirst=Chip&rft_id=https%3A%2F%2Fthegradient.pub%2Funderstanding-evaluation-metrics-for-language-models%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-boolq-87">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFClarkLeeChangKwiatkowski2019">Clark, Christopher; Lee, Kenton; Chang, Ming-Wei; Kwiatkowski, Tom; Collins, Michael; Toutanova, Kristina (2019). "BoolQ: Exploring the Surprising Difficulty of Natural Yes/No Questions". arXiv:1905.10044 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=BoolQ%3A+Exploring+the+Surprising+Difficulty+of+Natural+Yes%2FNo+Questions&rft.date=2019&rft_id=info%3Aarxiv%2F1905.10044&rft.aulast=Clark&rft.aufirst=Christopher&rft.au=Lee%2C+Kenton&rft.au=Chang%2C+Ming-Wei&rft.au=Kwiatkowski%2C+Tom&rft.au=Collins%2C+Michael&rft.au=Toutanova%2C+Kristina&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-survey-88">^ ^a ^b ^c <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFWayne_Xin_ZhaoZhouLiTang2023">Wayne Xin Zhao; Zhou, Kun; Li, Junyi; Tang, Tianyi; Wang, Xiaolei; Hou, Yupeng; Min, Yingqian; Zhang, Beichen; Zhang, Junjie; Dong, Zican; Du, Yifan; Yang, Chen; Chen, Yushuo; Chen, Zhipeng; Jiang, Jinhao; Ren, Ruiyang; Li, Yifan; Tang, Xinyu; Liu, Zikang; Liu, Peiyu; Nie, Jian-Yun; Wen, Ji-Rong (2023). "A Survey of Large Language Models". arXiv:2303.18223 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajo

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<li id="cite_note-bigbench-90">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFSrivastavaRastogiRaoAbu_Awal_Md_Shoeb2022">Srivastava, Aarohi; et al. (2022). "Beyond the Imitation Game: Quantifying and extrapolating the capabilities of language models". arXiv:2206.04615 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Beyond+the+Imitation+Game%3A+Quantifying+and+extrapolating+the+capabilities+of+language+models&rft.date=2022&rft_id=info%3Aarxiv%2F2206.04615&rft.aulast=Srivastava&rft.aufirst=Aarohi&rft.au=Rastogi%2C+Abhinav&rft.au=Rao%2C+Abhishek&rft.au=Abu+Awal+Md+Shoeb&rft.au=Abid%2C+Abubakar&rft.au=Fisch%2C+Adam&rft.au=Brown%2C+Adam+R.&rft.au=Santoro%2C+Adam&rft.au=Gupta%2C+Aditya&rft.au=Garriga-Alonso%2C+Adri%C3%A0&rft.au=Kluska%2C+Agnieszka&rft.au=Lewkowycz%2C+Aitor&rft.au=Agarwal%2C+Akshat&rft.au=Power%2C+Alethea&rft.au=Ray%2C+Alex&rft.au=Warstadt%2C+Alex&rft.au=Kocurek%2C+Alexander+W.&rft.au=Safaya%2C+Ali&rft.au=Tazarv%2C+Ali&rft.au=Xiang%2C+Alice&rft.au=Parrish%2C+Alicia&rft.au=Nie%2C+Allen&rft.au=Hussain%2C+Aman&rft.au=Askell%2C+Amanda&rft.au=Dsouza%2C+Amanda&rft.au=Slone%2C+Ambrose&rft.au=Rahane%2C+Ameet&rft.au=Iyer%2C+Anantharaman+S.&rft.au=Andreassen%2C+Anders&rft.au=Madotto%2C+Andrea&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-truthfulqa-91">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFLinHiltonEvans2021">Lin, Stephanie; Hilton, Jacob; Evans, Owain (2021). "TruthfulQA: Measuring How Models Mimic Human Falsehoods".

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<li id="cite_note-zIM6Y-95">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"Generative AI Could Raise Global GDP by 7%". Goldman Sachs. Retrieved 18 June 2023.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=Goldman+Sachs&rft.atitle=Generative+AI+Could+Raise+Global+GDP+by+7%25&rft_id=https%3A%2F%2Fwww.goldmansachs.com%2Fintelligence%2Fpages%2Fgenerative-ai-could-raise-global-gdp-by-7-percent.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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<li id="cite_note-:8-99">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFStokel-Walker2023">Stokel-Walker, Chris (November 22, 2023). "ChatGPT Replicates Gender Bias in Recommendation Letters". Scientific American. Retrieved 2023-12-29.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=Scientific+American&rft.atitle=ChatGPT+Replicates+Gender+Bias+in+Recommendation+Letters&rft.date=2023-11-22&rft.aulast=Stokel-Walker&rft.aufirst=Chris&rft_id=https%3A%2F%2Fwww.scientificamerican.com%2Farticle%2Fchatgpt-replicates-gender-bias-in-recommendation-letters%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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<li id="cite_note-bert-paper-108">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFDevlinChangLeeToutanova2018">Devlin, Jacob; Chang, Ming-Wei; Lee, Kenton; Toutanova, Kristina (11 October 2018). "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding". arXiv:1810.04805v2 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=BERT%3A+Pre-training+of+Deep+Bidirectional+Transformers+for+Language+Understanding&rft.date=2018-10-11&rft_id=info%3Aarxiv%2F1810.04805v2&rft.aulast=Devlin&rft.aufirst=Jacob&rft.au=Chang%2C+Ming-Wei&rft.au=Lee%2C+Kenton&rft.au=Toutanova%2C+Kristina&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-bHZJ2-109">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFPrickett2021">Prickett, Nicole Hemsoth (2021-08-24). "Cerebras Shifts Architecture To Meet Massive AI/ML Models". The Next Platform. Retrieved 2023-06-20.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=The+Next+Platform&rft.atitle=Cerebras+Shifts+Architecture+To+Meet+Massive+AI%2FML+Models&rft.date=2021-08-24&rft.aulast=Prickett&rft.aufirst=Nicole+Hemsoth&rft_id=https%3A%2F%2Fwww.nextplatform.com%2F2021%2F08%2F24%2Fcerebras-shifts-architecture-to-meet-massive-ai-ml-models%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-bert-web-110">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"BERT". March 13, 2023 – via GitHub.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=unknown&rft.btitle=BERT&rft.date=2023-03-13&rft_id=https%3A%2F%2Fgithub.com%2Fgoogle-research%2Fbert&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-Ir545-111">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFPatelLiRasooliConstant2022">Patel, Ajay; Li, Bryan; Rasooli, Mohammad Sadegh; Constant, Noah; Raffel, Colin; Callison-Burch, Chris (2022). "Bidirectional Language Models Are Also Few-shot Learners". arXiv:2209.14500 [cs.LG].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Am

tx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Bidirectional+Language+Models+Are+Also+Few-shot+Learners&rft.date=2022&rft_id=info%3Aarxiv%2F2209.14500&rft.aulast=Patel&rft.aufirst=Ajay&rft.au=Li%2C+Bryan&rft.au=Rasooli%2C+Mohammad+Sadegh&rft.au=Constant%2C+Noah&rft.au=Raffel%2C+Colin&rft.au=Callison-Burch%2C+Chris&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-45rAm-112">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"BERT, RoBERTa, DistilBERT, XLNet: Which one to use?". KDnuggets.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=KDnuggets&rft.atitle=BERT%2C+RoBERTa%2C+DistilBERT%2C+XLNet%3A+Which+one+to+use%3F&rft_id=https%3A%2F%2Fwww.kdnuggets.com%2Fbert-roberta-distilbert-xlnet-which-one-to-use.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-xlnet-113">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"xlnet". GitHub. Retrieved 2 January 2024.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=GitHub&rft.atitle=xlnet&rft_id=https%3A%2F%2Fgithub.com%2Fzihangdai%2Fxlnet%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-gAbNO-114">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFNaik2021">Naik, Amit Raja (September 23, 2021). "Google Introduces New Architecture To Reduce Cost Of Transformers". Analytics India Magazine.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=Analytics+India+Magazine&rft.atitle=Google+Introduces+New+Architecture+To+Reduce+Cost+Of+Transformers&rft.date=2021-09-23&rft.aulast=Naik&rft.aufirst=Amit+Raja&rft_id=https%3A%2F%2Fanalyticsindiamag.com%2Fgoogle-introduces-new-architecture-to-reduce-cost-of-transformers%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-LX3rI-115">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFYangDaiYangCarbonell2020">Yang, Zhilin; Dai, Zihang; Yang, Yiming; Carbonell, Jaime; Salakhutdinov, Ruslan; Le, Quoc V. (2 January 2020). "XLNet: Generalized Autoregressive Pretraining for Language Understanding". arXiv:1906.08237 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aof

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<li id="cite_note-LambdaLabs-118">^ a b "OpenAI's GPT-3 Language Model: A Technical Overview". lambdalabs.com. 3 June 2020.

<li id="cite_note-Sudbe-119">^ "gpt-2". GitHub. Retrieved 13 March 2023.

<li id="cite_note-:2-120">^ Table D.1 in <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFBrownMannRyderSubbiah2020">Brown, Tom B.; Mann, Benjamin; Ryder, Nick; Subbiah, Melanie; Kaplan, Jared; Dhariwal, Prafulla; Neelakantan, Arvind; Shyam, Pranav; Sastry, Girish; Askell, Amanda; Agarwal, Sandhini; Herbert-Voss, Ariel; Krueger, Gretchen; Henighan, Tom; Child, Rewon; Ramesh, Aditya; Ziegler, Daniel M.; Wu, Jeffrey; Winter, Clemens; Hesse, Christopher; Chen, Mark; Sigler, Eric; Litwin, Mateusz; Gray, Scott; Chess, Benjamin; Clark, Jack; Berner, Christopher; McCandlish, Sam; Radford, Alec; Sutskever, Ilya; Amodei, Dario (May 28, 2020). "Language Models are Few-Shot Learners". arXiv:2005.14165v4 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Language+Models+are+Few-Shot+Learners&rft.date=2020-05-28&rft_id=info%3Aarxiv%2F2005.14165v4&rft.aulast=Brown&rft.aufirst=Tom+B.&rft.au=Mann%2C+Benjamin&rft.au=Ryder%2C+Nick&rft.au=Subbiah%2C+Melanie&rft.au=Kaplan%2C+Jared&rft.au=Dhariwal%2C+Prafulla&rft.au=Neelakantan%2C+Arvind&rft.au=Shyam%2C+Pranav&rft.au=Sastry%2C+Girish&rft.au=Askell%2C+Amanda&rft.au=Agarwal%2C+Sandhini&rft.au=Herbert-Voss%2C+Ariel&rft.au=Krueger%2C+Gretchen&rft.au=Henighan%2C+Tom&rft.au=Child%2C+Rewon&rft.au=Ramesh%2C+Aditya&rft.au=Ziegler%2C+Daniel+M.&rft.au=Wu%2C+Jeffrey&rft.au=Winter%2C+Clemens&rft.au=Hesse%2C+Christopher&rft.au=Chen%2C+Mark&rft.au=Sigler%2C+Eric&rft.au=Litwin%2C+Mateusz&rft.au=Gray%2C+Scott&rft.au=Chess%2C+Benjamin&rft.au=Clark%2C+Jack&rft.au=Berner%2C+Christopher&rft.au=McCandlish%2C+Sam&rft.au=Radford%2C+Alec&rft.au=Sutskever%2C+Ilya&rft.au=Amodei%2C+Dario&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-chatgpt-blog-121">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"ChatGPT: Optimizing Language Models for Dialogue". OpenAI. 2022-11-30. Retrieved 2023-01-13.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=OpenAI&rft.atitle=ChatGPT%3A+Optimizing+Language+Models+for+Dialogue&rft.date=2022-11-30&rft_id=https%3A%2F%2Fopenai.com%2Fblog%2Fchatgpt%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-gpt-neo-122">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"GPT Neo". March 15, 2023 – via GitHub.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=unknown&rft.btitle=GPT+Neo&rft.date=2023-03-15&rft_id=https%3A%2F%2Fgithub.com%2FEleutherAI%2Fgpt-neo&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-Pile-123">^ ^a ^b ^c

 <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFGaoBidermanBlackGolding2020">Gao, Leo; Biderman, Stella; Black, Sid; Golding, Laurence; Hoppe, Travis; Foster, Charles; Phang, Jason; He, Horace; Thite, Anish; Nabeshima, Noa; Presser, Shawn; Leahy, Connor (31 December 2020). "The Pile: An 800GB Dataset of Diverse Text for Language Modeling". arXiv:2101.00027 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=The+Pile%3A+An+800GB+Dataset+of+Diverse+Text+for+Language+Modeling&rft.date=2020-12-31&rft_id=info%3Aarxiv%2F2101.00027&rft.aulast=Gao&rft.aufirst=Leo&rft.au=Biderman%2C+Stella&rft.au=Black%2C+Sid&rft.au=Golding%2C+Laurence&rft.au=Hoppe%2C+Travis&rft.au=Foster%2C+Charles&rft.au=Phang%2C+Jason&rft.au=He%2C+Horace&rft.au=Thite%2C+Anish&rft.au=Nabeshima%2C+Noa&rft.au=Presser%2C+Shawn&rft.au=Leahy%2C+Connor&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-vb-gpt-neo-124">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFIyer2021">Iyer, Abhishek (15 May 2021). "GPT-3's free alternative GPT-Neo is something to be excited about". VentureBeat.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=VentureBeat&rft.atitle=GPT-3%27s+free+alternative+GPT-Neo+is+something+to+be+excited+about&rft.date=2021-05-15&rft.aulast=Iyer&rft.aufirst=Abhishek&rft_id=https%3A%2F%2Fventurebeat.com%2Fai%2Fgpt-3s-free-alternative-gpt-neo-is-something-to-be-excited-about%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-JxohJ-125">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"GPT-J-6B: An Introduction to the Largest Open Source GPT Model | Forefront". www.forefront.ai. Retrieved 2023-02-28.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=www.forefront.ai&rft.atitle=GPT-J-6B%3A+An+Introduction+to+the+Largest+Open+Source+GPT+Model+%7C+Forefront&rft_id=https%3A%2F%2Fwww.forefront.ai%2Fblog-posts%2Fgpt-j-6b-an-introduction-to-the-largest-open-sourced-gpt-model&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-:3-126">^ ^a ^b ^c ^d <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFDeyGosalZhimingChen2023">Dey, Nolan; Gosal, Gurpreet; Zhiming; Chen; Khachane, Hemant; Marshall, William; Pathri

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<li id="cite_note-BwnW5-127">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFAlviKharya2021">Alvi, Ali; Kharya, Paresh (11 October 2021). "Using DeepSpeed and Megatron to Train Megatron-Turing NLG 530B, the World's Largest and Most Powerful Generative Language Model". Microsoft Research.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=Microsoft+Research&rft.atitle=Using+DeepSpeed+and+Megatron+to+Train+Megatron-Turing+NLG+530B%2C+the+World%27s+Largest+and+Most+Powerful+Generative+Language+Model&rft.date=2021-10-11&rft.aulast=Alvi&rft.aufirst=Ali&rft.au=Kharya%2C+Paresh&rft_id=https%3A%2F%2Fwww.microsoft.com%2Fen-us%2Fresearch%2Fblog%2Fusing-deepspeed-and-megatron-to-train-megatron-turing-nlg-530b-the-worlds-largest-and-most-powerful-generative-language-model%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-mtnlg-preprint-128">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFSmithPatwaryNorickLeGresley2022">Smith, Shaden; Patwary, Mostofa; Norick, Brandon; LeGresley, Patrick; Rajbhandari, Samyam; Casper, Jared; Liu, Zhun; Prabhumoye, Shrimai; Zerveas, George; Korthikanti, Vijay; Zhang, Elton; Child, Rewon; Aminabadi, Reza Yazdani; Bernauer, Julie; Song, Xia (2022-02-04). "Using DeepSpeed and Megatron to Train Megatron-Turing NLG 530B, A Large-Scale Generative Language Model". arXiv:2201.11990 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Using+DeepSpeed+and+Megatron+to+Train+Megatron-Turing+NLG+530B%2C+A+Large-Scale+Generative+Language+Model&rft.date=2022-02-04&rft_id=info%3Aarxiv%2F2201.11990&rft.aulast=Smith&rft.aufirst=Shaden&rft.au=Patwary%2C+Mostofa&rft.au=Norick%2C+Brandon&rft.au=LeGresley%2C+Patrick&rft.au=Rajbhandari%2C+Samyam&rft.au=Casper%2C+Jared&rft.au=Liu%2C+Zhun&rft.au=Prabhumoye%2C+Shrimai&rft.au=Zerveas%2C+George&rft.au=Korthikanti%2C+Vijay&rft.au=Zhang%2C+Elton&rft.au=Child%2C+Rewon&rft.au=Aminabadi%2C+Reza+Yazdani&rft.au=Bernaue

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plateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation
web cs1"><a class="external text" href="https://www.anthropic.com/product" rel="no
follow">"Product"</a>. <i>Anthropic</i><span class="reference-accessdate">. Retrie
ved <span class="nowrap">14 March</span> 2023</span>.</cite><span class="Z3988" ti
tle="ctx_ver=Z39.88-2004&amp;rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&am
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<li id="cite_note-AnthroArch-131"><span class="mw-cite-backlink">^ <a href="#cite_
ref-AnthroArch_131-0"><sup><i><b>a</b></i></sup></a> <a href="#cite_ref-AnthroArch
_131-1"><sup><i><b>b</b></i></sup></a></span> <span class="reference-text"><link h
ref="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite
class="citation arxiv cs1" id="CITEREFAskellBaiChenDrain2021">Askell, Amanda; Bai,
Yuntao; Chen, Anna; et al. (9 December 2021). "A General Language Assistant as a L
aboratory for Alignment". <a class="mw-redirect" href="/wiki/ArXiv_(identifier)" t
itle="ArXiv (identifier)">arXiv</a>:<span class="cs1-lock-free" title="Freely acce
ssible"><a class="external text" href="https://arxiv.org/abs/2112.00861" rel="nofo
llow">2112.00861</a></span> [<a class="external text" href="https://arxiv.org/arch
ive/cs.CL" rel="nofollow">cs.CL</a>].</cite><span class="Z3988" title="ctx_ver=Z3
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tory+for+Alignment&rft.date=2021-12-09&rft_id=info%3Aarxiv%2F2112.00861&rft.aulast=Askell&rft.aufirst=Amanda&rft.au=Bai%2C+Yuntao&rft.au=Chen%2C+Anna&rft.au=Drain%2C+Dawn&rft.au=Ganguli%2C+Deep&rft.au=Henighan%2C+Tom&rft.au=Jones%2C+Andy&rft.au=Joseph%2C+Nicholas&rft.au=Mann%2C+Ben&rft.au=DasSarma%2C+Nova&rft.au=Elhage%2C+Nelson&rft.au=Hatfield-Dodds%2C+Zac&rft.au=Hernandez%2C+Danny&rft.au=Kernion%2C+Jackson&rft.au=Ndousse%2C+Kamal&rft.au=Olsson%2C+Catherine&rft.au=Amodei%2C+Dario&rft.au=Brown%2C+Tom&rft.au=Clark%2C+Jack&rft.au=McCandlish%2C+Sam&rft.au=Olah%2C+Chris&rft.au=Kaplan%2C+Jared&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-RZqhw-132">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFBaiKadavathKunduAskell2022">Bai, Yuntao; Kadavath, Saurav; Kundu, Sandipan; et al. (15 December 2022). "Constitutional AI: Harmlessness from AI Feedback". arXiv:2212.08073 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Constitutional+AI%3A+Harmlessness+from+AI+Feedback&rft.date=2022-12-15&rft_id=info%3Aarxiv%2F2212.08073&rft.aulast=Bai&rft.aufirst=Yuntao&rft.au=Kadavath%2C+Saurav&rft.au=Kundu%2C+Sandipan&rft.au=Askell%2C+Amanda&rft.au=Kernion%2C+Jackson&rft.au=Jones%2C+Andy&rft.au=Chen%2C+Anna&rft.au=Goldie%2C+Anna&rft.au=Mirhoseini%2C+Azalia&rft.au=McKinnon%2C+Cameron&rft.au=Chen%2C+Carol&rft.au=Olsson%2C+Catherine&rft.au=Olah%2C+Christopher&rft.au=Hernandez%2C+Danny&rft.au=Drain%2C+Dawn&rft.au=Ganguli%2C+Deep&rft.au=Li%2C+Dustin&rft.au=Tran-Johnson%2C+Eli&rft.au=Perez%2C+Ethan&rft.au=Kerr%2C+Jamie&rft.au=Mueller%2C+Jared&rft.au=Ladish%2C+Jeffrey&rft.au=Landau%2C+Joshua&rft.au=Ndousse%2C+Kamal&rft.au=Lukosuite%2C+Kamile&rft.au=Lovitt%2C+Liane&rft.au=Sellitto%2C+Michael&rft.au=Elhage%2C+Nelson&rft.au=Schiefer%2C+Nicholas&rft.au=Mercado%2C+Noemi&rft.au=DasSarma%2C+Nova&rft.au=Lasenby%2C+Robert&rft.au=Larson%2C+Robin&rft.au=Ringer%2C+Sam&rft.au=Johnston%2C+Scott&rft.au=Kravec%2C+Shauna&rft.au=Showk%2C+Sheer+El&rft.au=Fort%2C+Stanislav&rft.au=Lanham%2C+Tamera&rft.au=Telleen-Lawton%2C+Timothy&rft.au=Conerly%2C+Tom&rft.au=Henighan%2C+Tom&rft.au=Hume%2C+Tristan&rft.au=Bowman%2C+Samuel+R.&rft.au=Hatfield-Dodds%2C+Zac&rft.au=Mann%2C+Ben&rft.au=Amodei%2C+Dario&rft.au=Joseph%2C+Nicholas&rft.au=McCandlish%2C+Sam&rft.au=Brown%2C+Tom&rft.au=Kaplan%2C+Jared&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-mD5eE-133">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"Language modelling at scale: Gopher, ethical considerations, and retrieval". www.deepmind.com. 8 December 2021. Retrieved 20 March 2023.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=www.deepmind.com&rft.atitle=Language+modelling+at+scale%3A+Gopher%2C+ethical+considerations%2C+and+retrieval&rft.date=2021-12-08&rft_id=https%3A%2F%2Fwww.deepmind.com%2Fblog%2Flanguage-modelling-at-scal

e-gopher-ethical-considerations-and-retrieval&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-hoffman-134">^ ^a ^b ^c <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFHoffmannBorgeaudMenschBuchatskaya2022">Hoffmann, Jordan; Borgeaud, Sebastian; Mensch, Arthur; et al. (29 March 2022). "Training Compute-Optimal Large Language Models". arXiv:2203.15556 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Training+Compute-Optimal+Large+Language+Models&rft.date=2022-03-29&rft_id=info%3Aarxiv%2F2203.15556&rft.aulast=Hoffmann&rft.aufirst=Jordan&rft.au=Borgeaud%2C+Sebastian&rft.au=Mensch%2C+Arthur&rft.au=Buchatskaya%2C+Elena&rft.au=Cai%2C+Trevor&rft.au=Rutherford%2C+Eliza&rft.au=Casas%2C+Diego+de+Las&rft.au=Hendricks%2C+Lisa+Anne&rft.au=Welbl%2C+Johannes&rft.au=Clark%2C+Aidan&rft.au=Hennigan%2C+Tom&rft.au=Noland%2C+Eric&rft.au=Millican%2C+Katie&rft.au=Driessche%2C+George+van+den&rft.au=Damoc%2C+Bogdan&rft.au=Guy%2C+Aurelia&rft.au=Osindero%2C+Simon&rft.au=Simonyan%2C+Karen&rft.au=Elsen%2C+Erich&rft.au=Rae%2C+Jack+W.&rft.au=Vinyals%2C+Oriol&rft.au=Sifre%2C+Laurent&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-:4-135">^ ^a ^b ^c Table 20 of PaLM: Scaling Language Modeling with Pathways

<li id="cite_note-lamda-blog-136">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFChengThoppilan2022">Cheng, Heng-Tze; Thoppilan, Romal (January 21, 2022). "LaMDA: Towards Safe, Grounded, and High-Quality Dialog Models for Everything". ai.googleblog.com. Retrieved 2023-03-09.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=ai.googleblog.com&rft.atitle=LaMDA%3A+Towards+Safe%2C+Grounded%2C+and+High-Quality+Dialog+Models+for+Everything&rft.date=2022-01-21&rft.aulast=Cheng&rft.aufirst=Heng-Tze&rft.au=Thoppilan%2C+Romal&rft_id=https%3A%2F%2Fai.googleblog.com%2F2022%2F01%2Flamda-towards-safe-grounded-and-high.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-DMs9Z-137">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFThoppilanDe_FreitasHallShazeer2022">Thoppilan, Romal; De Fre

itas, Daniel; Hall, Jamie; Shazeer, Noam; Kulshreshtha, Apoorv; Cheng, Heng-Tze; Jin, Alicia; Bos, Taylor; Baker, Leslie; Du, Yu; Li, YaGuang; Lee, Hongrae; Zheng, Huaixiu Steven; Ghafouri, Amin; Menegali, Marcelo (2022-01-01). "LaMDA: Language Models for Dialog Applications". arXiv:2201.08239 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=LaMDA%3A+Language+Models+for+Dialog+Applications&rft.date=2022-01-01&rft_id=info%3Aarxiv%2F2201.08239&rft.aulast=Thoppilan&rft.aufirst=Romal&rft.au=De+Freitas%2C+Daniel&rft.au=Hall%2C+Jamie&rft.au=Shazeer%2C+Noam&rft.au=Kulshreshtha%2C+Apoorv&rft.au=Cheng%2C+Heng-Tze&rft.au=Jin%2C+Alicia&rft.au=Bos%2C+Taylor&rft.au=Baker%2C+Leslie&rft.au=Du%2C+Yu&rft.au=Li%2C+YaGuang&rft.au=Lee%2C+Hongrae&rft.au=Zheng%2C+Huaixiu+Steven&rft.au=Ghafouri%2C+Amin&rft.au=Menegali%2C+Marcelo&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-gpt-neox-20b-138">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation conference cs1 cs1-prop-long-vol" id="CITEREFBlackBidermanHallahan2022">Black, Sidney; Biderman, Stella; Hallahan, Eric; et al. (2022-05-01). GPT-NeoX-20B: An Open-Source Autoregressive Language Model. Proceedings of BigScience Episode #5 -- Workshop on Challenges & Perspectives in Creating Large Language Models. Vol. Proceedings of BigScience Episode #5 -- Workshop on Challenges & Perspectives in Creating Large Language Models. pp. 95–136. Retrieved 2022-12-19.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=conference&rft.btitle=GPT-NeoX-20B%3A+An+Open-Source+Autoregressive+Language+Model&rft.pages=95-136&rft.date=2022-05-01&rft.aulast=Black&rft.aufirst=Sidney&rft.au=Biderman%2C+Stella&rft.au=Hallahan%2C+Eric&rft_id=https%3A%2F%2Faclanthology.org%2F2022.bigscience-1.9%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-chinchilla-blog-139">^ ^a ^b ^c <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFHoffmannBorgeaudMenschSifre2022">Hoffmann, Jordan; Borgeaud, Sebastian; Mensch, Arthur; Sifre, Laurent (12 April 2022). "An empirical analysis of compute-optimal large language model training". Deepmind Blog.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=Deepmind+Blog&rft.atitle=An+empirical+analysis+of+compute-optimal+large+language+model+training&rft.date=2022-04-12&rft.aulast=Hoffmann&rft.aufirst=Jordan&rft.au=Borgeaud%2C+Sebastian&rft.au=Mensch%2C+Arthur&rft.au=Sifre%2C+Laurent&rft_id=https%3A%2F%2Fwww.deepmind.com%2Fblog%2Fan-empirical-analysis-of-compute-optimal-large-language-model-training&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-palm-blog-140">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1" id="CITEREFNarangChowdhery2022">Narang, Sharan; Chowdhery, Aakanksha (April 4, 2022). "Pathways Language Model (PaLM): Scaling to 540 Billion Parameters for Breakthrough Performance". ai.googleblog.com. Retrieved 2023-03-09.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=ai.googleblog.com&rft.atitle=Pathways+Language+Model+%28PaLM%29%3A+Scaling+to+540+Billion+Parameters+for+Breakthrough+Performance&rft.date=2022-04-04&rft.aulast=Narang&rft.aufirst=Sharan&rft.au=Chowdhery%2C+Aakanksha&rft_id=https%3A%2F%2Fai.googleblog.com%2F2022%2F04%2Fpathways-language-model-palm-scaling-to.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-jlof8-141">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"Democratizing access to large-scale language models with OPT-175B". ai.facebook.com.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=ai.facebook.com&rft.atitle=Democratizing+access+to+large-scale+language+models+with+OPT-175B&rft_id=https%3A%2F%2Fai.facebook.com%2Fblog%2Fdemocratizing-access-to-large-scale-language-models-with-opt-175b%2F&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-QjTIc-142">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFZhangRollerGoyalArtetxe2022">Zhang, Susan; Roller, Stephen; Goyal, Naman; Artetxe, Mikel; Chen, Moya; Chen, Shuohui; Dewan, Christopher; Diab, Mona; Li, Xian; Lin, Xi Victoria; Mihaylov, Todor; Ott, Myle; Shleifer, Sam; Shuster, Kurt; Simig, Daniel; Koura, Punit Singh; Sridhar, Anjali; Wang, Tianlu; Zettlemoyer, Luke (21 June 2022). "OPT: Open Pre-trained Transformer Language Models". arXiv:2205.01068 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=OPT%3A+Open+Pre-trained+Transformer+Language+Models&rft.date=2022-06-21&rft_id=info%3Aarxiv%2F2205.01068&rft.aulast=Zhang&rft.aufirst=Susan&rft.au=Roller%2C+Stephen&rft.au=Goyal%2C+Naman&rft.au=Artetxe%2C+Mikel&rft.au=Chen%2C+Moya&rft.au=Chen%2C+Shuohui&rft.au=Dewan%2C+Christopher&rft.au=Diab%2C+Mona&rft.au=Li%2C+Xian&rft.au=Lin%2C+Xi+Victoria&rft.au=Mihaylov%2C+Todor&rft.au=Ott%2C+Myle&rft.au=Shleifer%2C+Sam&rft.au=Shuster%2C+Kurt&rft.au=Simig%2C+Daniel&rft.au=Koura%2C+Punit+Singh&rft.au=Sridhar%2C+Anjali&rft.au=Wang%2C+Tianlu&rft.au=Zettlemoyer%2C+Luke&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-yalm-repo-144">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation cs2" id="CITEREFKhrushchevVasilevPetrovZinov2022">Khrushchev, Mikhail; Vasilev, Ruslan; Petrov, Alexey; Zinov, Nikolay (2022-06-22), YaLM 100B, retrieved 2023-03-18</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Abook&rft.genre=book&rft.btitle=YaLM+100B&rft.date=2022-06-22&rft.aulast=Khrushchev&rft.aufirst=Mikhail&rft.au=Vasilev%2C+Ruslan&rft.au=Petrov%2C+Alexey&rft.au=Zinov%2C+Nikolay&rft_id=https%3A%2F%2Fgithub.com%2Fyandex%2FYaLM-100B&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-minerva-paper-145">^ ^a ^b <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation arxiv cs1" id="CITEREFLewkowyczAndreassenDohanDyer2022">Lewkowycz, Aitor; Andreassen, Anders; Dohan, David; Dyer, Ethan; Michalewski, Henryk; Ramasesh, Vinay; Slone, Ambrose; Anil, Cem; Schlag, Imanol; Gutman-Solo, Theo; Wu, Yuhuai; Neyshabur, Behnam; Gur-Ari, Guy; Misra, Vedant (30 June 2022). "Solving Quantitative Reasoning Problems with Language Models". arXiv:2206.14858 [cs.CL].</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=preprint&rft.jtitle=arXiv&rft.atitle=Solving+Quantitative+Reasoning+Problems+with+Language+Models&rft.date=2022-06-30&rft_id=info%3Aarxiv%2F2206.14858&rft.aulast=Lewkowycz&rft.aufirst=Aitor&rft.au=Andreassen%2C+Anders&rft.au=Dohan%2C+David&rft.au=Dyer%2C+Ethan&rft.au=Michalewski%2C+Henryk&rft.au=Ramasesh%2C+Vinay&rft.au=Slone%2C+Ambrose&rft.au=Anil%2C+Cem&rft.au=Schlag%2C+Imanol&rft.au=Gutman-Solo%2C+Theo&rft.au=Wu%2C+Yuhuai&rft.au=Neyshabur%2C+Behnam&rft.au=Gur-Ari%2C+Guy&rft.au=Misra%2C+Vedant&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-FfCNK-146">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"Minerva: Solving Quantitative Reasoning Problems with Language Models". ai.googleblog.com. 30 June 2022. Retrieved 20 March 2023.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=ai.googleblog.com&rft.atitle=Minerva%3A+Solving+Quantitative+Reasoning+Problems+with+Language+Models&rft.date=2022-06-30&rft_id=https%3A%2F%2Fai.googleblog.com%2F2022%2F06%2Fminerva-solving-quantitative-reasoning.html&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

<li id="cite_note-bigger-better-147">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite

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<li id="cite_note-B8wB2-148">^ <link href="mw-data:TemplateStyles:r1133582631" rel="mw-deduplicated-inline-style"/><cite class="citation web cs1">"bigscience/bloom · Hugging Face". huggingface.co.</cite><span class="Z3988" title="ctx_ver=Z39.88-2004&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=unknown&rft.jtitle=huggingface.co&rft.atitle=bigscience%2Fbloom+%C2%B7+Hugging+Face&rft_id=https%3A%2F%2Fhuggingface.co%2Fbigscience%2Fbloom&rfr_id=info%3Asid%2Fen.wikipedia.org%3ALarge+language+model">

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```
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a>.</li></ul>
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iki/Template:Natural_language_processing" title="Template:Natural language process
ing"><abbr style=";;background:none transparent;border:none;box-shadow:none;paddin
g:0;" title="View this template">v</abbr></a></li><li class="nv-talk"><a href="/wi
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e processing"><abbr style=";;background:none transparent;border:none;box-shadow:no
ne;padding:0;" title="Discuss this template">t</abbr></a></li><li class="nv-edit">
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bbr></a></li></ul></div><div id="Natural_language_processing" style="font-size:11
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0.25em">
<ul><li><a href="/wiki/AI-complete" title="AI-complete">AI-complete</a></li>
<li><a href="/wiki/Bag-of-words_model" title="Bag-of-words model">Bag-of-words</a>
</li>
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n-gram
Bigram
Trigram
Co
mputational linguistics
<a href="/wiki/Natural-language_understanding" title="Natural-language underst
anding">Natural-language understanding
Stop words
Text processing</l
i>
</td></tr><tr><th class="navbox-group" scope="row" style="width:1%"><a href
="/wiki/Text_mining" title="Text mining">Text analysis</th><td class="navbox-l
ist-with-group navbox-list navbox-even" style="width:100%;padding:0"><div style="p
adding:0 0.25em">
Argument mining
Collocat
ion extraction
Concept mining
Corefer
ence resolution

Deep linguistic processing
Distant reading</l
i>
Informat
ion extraction
Name
d-entity recognition
Ontology learning

Parsing
Part-of-
speech tagging
<a href="/wiki/Semantic_analysis_(machine_learning)" title="Semantic analysis
(machine learning)">Semantic analysis
Semantic
role labeling
<a href="/wiki/Semantic_decomposition_(natural_language_processing)" title="Se
mantic decomposition (natural language processing)">Semantic decomposition
Semantic simil
arity
Sentiment analys
is
<a href="/wiki/Syntactic_parsing_(computational_linguistics)" title="Syntactic
parsing (computational linguistics)">Syntactic parsing
Terminol
ogy extraction
Text mining
Textual entailme
nt
Truecasing
Wo
rd-sense disambiguation
<a href="/wiki/Word-sense_induction" title="Word-sense induction">Word-sense i

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nduction</a></li></ul>
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Compound-term processing</a></li>
<li><a class="mw-redirect" href="/wiki/Lemmatisation" title="Lemmatisation">Lemmat
isation</a></li>
<li><a href="/wiki/Lexical_analysis" title="Lexical analysis">Lexical analysis</a>
</li>
<li><a href="/wiki/Shallow_parsing" title="Shallow parsing">Text chunking</a></li>
<li><a href="/wiki/Stemming" title="Stemming">Stemming</a></li>
<li><a href="/wiki/Sentence_boundary_disambiguation" title="Sentence boundary disa
mbiguation">Sentence segmentation</a></li>
<li><a href="/wiki/Word#Word_boundaries" title="Word">Word segmentation</a></li></
ul>
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="/wiki/Automatic_summarization" title="Automatic summarization">Automatic summari
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<li><a href="/wiki/Sentence_extraction" title="Sentence extraction">Sentence extra
ction</a></li>
<li><a href="/wiki/Text_simplification" title="Text simplification">Text simplific
ation</a></li></ul>
</div></td></tr><tr><th class="navbox-group" scope="row" style="width:1%"><a href
="/wiki/Machine_translation" title="Machine translation">Machine translation</a></
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<ul><li><a href="/wiki/Computer-assisted_translation" title="Computer-assisted tra
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<li><a href="/wiki/Example-based_machine_translation" title="Example-based machine
translation">Example-based</a></li>
<li><a href="/wiki/Rule-based_machine_translation" title="Rule-based machine trans
lation">Rule-based</a></li>
<li><a href="/wiki/Statistical_machine_translation" title="Statistical machine tra
nslation">Statistical</a></li>
<li><a href="/wiki/Transfer-based_machine_translation" title="Transfer-based machi
ne translation">Transfer-based</a></li>
<li><a href="/wiki/Neural_machine_translation" title="Neural machine translation">
Neural</a></li></ul>
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semantics</a> models</th><td class="navbox-list-with-group navbox-list navbox-eve
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<li><a href="/wiki/Document-term_matrix" title="Document-term matrix">Document-ter
m matrix</a></li>
<li><a href="/wiki/Explicit_semantic_analysis" title="Explicit semantic analysis">
Explicit semantic analysis</a></li>
<li><a href="/wiki/FastText" title="FastText">fastText</a></li>
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GloVe
Language model (<a c
lass="mw-selflink selflink">large)
Late
nt semantic analysis
Seq2seq
Word embedding
Word2vec
</td></tr><tr><th class="navbox-group" scope="row" style="width:1%"><a href
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Lexical resource

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<a href="/wiki/Machine-readable_dictionary" title="Machine-readable dictionar
y">Machine-readable dictionary
Parallel text
PropBank
Semantic network

<a href="/wiki/Simple_Knowledge_Organization_System" title="Simple Knowledge O
rganization System">Simple Knowledge Organization System
Speech corpus
Text corpus
<a href="/wiki/Thesaurus_(information_retrieval)" title="Thesaurus (informatio
n retrieval)">Thesaurus (information retrieval)
Treebank
Universa
l Dependencies
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ing:0">
BabelNet
Bank of English</l
i>
DBpedia
FrameNet
Google Ngram V
iewer
UBY
WordNet
</td></tr></tbody></table> </td></tr><tr><th class="navbox-group"
scope="row" style="width:1%"><a href="/wiki/Automatic_identification_and_data_capt
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Speech recog
nition

Speech segment
ation
Speech synthesis

<a href="/wiki/Natural_language_generation" title="Natural language generatio
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<a href="/wiki/Optical_character_recognition" title="Optical character recogni
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Do
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n">Latent Dirichlet allocation
Pachinko alloc
ation
</td></tr><tr><th class="navbox-group" scope="row" style="width:1%"><a href
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assisted
reviewing</th><td class="navbox-list-with-group navbox-list navbo
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Au
tomated essay scoring
Concordancer
Grammar checker</l
i>
Predictive text</l
i>
Pron
unciation assessment
Spell checker
Sy
ntax guessing
</td></tr><tr><th class="navbox-group" scope="row" style="width:1%"><a class
="mw-redirect" href="/wiki/Natural_language_user_interface" title="Natural languag
e user interface">Natural language
user interface</th><td class="navbox-li
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Chatbot
Interactive fi
ction
Question answeri
ng
Virtual assistant

Voice user i
nterface
</td></tr><tr><th class="navbox-group" scope="row" style="width:1%">Related
</th><td class="navbox-list-with-group navbox-list navbox-odd" style="width:100%;p
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<a href="/wiki/Hallucination_(artificial_intelligence)" title="Hallucinati
on (artificial intelligence)">Hallucination
Natu
ral Language Toolkit
spaCy

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NewPP limit report
Parsed by mw2370
Cached time: 20240114205837
Cache expiry: 2592000
Reduced expiry: false
Complications: [vary-revision-sha1, show-toc]
CPU time usage: 1.795 seconds
Real time usage: 1.960 seconds
Preprocessor visited node count: 13730/1000000
Post-expand include size: 489576/2097152 bytes
Template argument size: 11460/2097152 bytes
Highest expansion depth: 12/100
Expensive parser function count: 8/500
Unstrip recursion depth: 1/20
Unstrip post-expand size: 556837/5000000 bytes
Lua time usage: 1.209/10.000 seconds
Lua memory usage: 8668143/52428800 bytes
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    dataWrapper <mw.lua:672>   280 ms
23.0%
    MediaWiki\Extension\Scribunto\Engines\LuaSandbox\LuaSandboxCallback::gsub
160 ms   13.1%
    MediaWiki\Extension\Scribunto\Engines\LuaSandbox\LuaSandboxCallback::callParse
rFunction   140 ms   11.5%
    <mw.lua:694>   80 ms
6.6%
    ?   80 ms
6.6%
    MediaWiki\Extension\Scribunto\Engines\LuaSandbox\LuaSandboxCallback::find
60 ms   4.9%
    recursiveClone <mwInit.lua:41>   60 ms
4.9%
    (for generator)   40 ms
3.3%
    is_set <Module:Citation/CS1/Utilities:23>   40 ms
3.3%
    is_generic <Module:Citation/CS1:1492>   40 ms
3.3%
    [others]   240 ms
19.7%
Number of Wikibase entities loaded: 0/400
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 72.13% 1198.868   2 Template:Reflist
 32.20% 535.239   70 Template:Cite_arXiv
 20.34% 338.017   70 Template:Cite_web
  8.18% 135.954   20 Template:Cite_journal
  4.70%   78.049   1 Template:Machine_learning
  4.56%   75.717   1 Template:Sidebar_with_collapsible_lists
  3.21%   53.318   1 Template:Short_description
  2.44%   40.603   52 Template:Sort
  2.37%   39.353   3 Template:Navbox

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<div class="printfooter" data-nosnippet="">Retrieved from "<a dir="ltr" href="http
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https://en.wikipedia.org/w/index.php?title=Large_language_model&amp;oldid=11956717
83</a>"</div></div>
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gory:Large language models">Large language models</a></li><li><a href="/wiki/Categ
ory:Deep_learning" title="Category:Deep learning">Deep learning</a></li><li><a hre
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issing periodical">CS1 errors: missing periodical</a></li><li><a href="/wiki/Categ
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me value</a></li><li><a href="/wiki/Category:Articles_with_short_description" titl
e="Category:Articles with short description">Articles with short description</a></
li><li><a href="/wiki/Category:Short_description_is_different_from_Wikidata" title
="Category:Short description is different from Wikidata">Short description is diff
erent from Wikidata</a></li><li><a href="/wiki/Category:Wikipedia_articles_needing
_clarification_from_December_2023" title="Category:Wikipedia articles needing clar
ification from December 2023">Wikipedia articles needing clarification from Decemb
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58<span class="anonymous-show"> (UTC)</span>.</li>
<li id="footer-info-copyright">Text is available under the <a href="//en.wikipedi
a.org/wiki/Wikipedia:Text_of_the_Creative_Commons_Attribution-ShareAlike_4.0_Inter
national_License" rel="license">Creative Commons Attribution-ShareAlike License 4.
0</a><a href="//en.wikipedia.org/wiki/Wikipedia:Text_of_the_Creative_Commons_Attri
bution-ShareAlike_4.0_International_License" rel="license" style="display:none;">
</a>;
additional terms may apply.  By using this site, you agree to the <a href="//found
ation.wikimedia.org/wiki/Terms_of_Use">Terms of Use</a> and <a href="//foundation.
wikimedia.org/wiki/Privacy_policy">Privacy Policy</a>. Wikipedia® is a registered
trademark of the <a href="//www.wikimediafoundation.org/">Wikimedia Foundation, In
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<li id="footer-places-about"><a href="/wiki/Wikipedia:About">About Wikipedia</a></
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li>
<li id="footer-places-disclaimers">Disclaimers
<li id="footer-places-contact">Contact Wikipedia
<li id="footer-places-wm-codeofconduct">Code of Conduct
<li id="footer-places-developers">Developers
<li id="footer-places-statslink">Statistics
<li id="footer-places-cookiestatement">Cookie statement
<li id="footer-places-mobileview">Mobile view

<ul class="noprint" id="footer-icons">
<li id="footer-copyrightico">
<li id="footer-poweredbyico">

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Toggle limited content width
</button>

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</body>
</html>

Step 3: Select the (".toctext) for grabbing the elements from the URL.

In [23]:
```
soup.select(".toctext")
```

Out[23]:
```
[]
```

Step 4: Print the element nicely.

In [24]:
```
for item in soup.select(".toctext"):
 print(item.text)
```

2) Figure 3 shows the price of the Mazda CX-8 in Mazda website. Crawl the price by inspecting the element for the price from the link below using lxml and BeautifulSoup.
https://mazda.com.my/vehicles/mazda-cx-8

In [25]:
```
res = requests.get("https://mazda.com.my/vehicles/mazda-cx-8")
soup = bs4.BeautifulSoup(res.text,'lxml')
```

In [26]:
```
#Extracting Readable Text from a BeautifulSoup Object
import requests
res = requests.get("https://mazda.com.my/vehicles/mazda-cx-8")
soup = bs4.BeautifulSoup(res.text,'lxml')
def encoding_check(r):
 return (r.encoding)
def decode_content(r,encoding):
 return (r.content.decode(encoding))
contents = decode_content(response,encoding_check(response))
```

In [27]:
```
from bs4 import BeautifulSoup
# Parse the HTML content of the page using BeautifulSoup
```

```
soup = BeautifulSoup(res.text, 'lxml')
```

In [28]:
```
txt_dump=soup.text
txt_dump
```

```
Out[28]: "\n\n\n\n\n\n\n\n\nMazda CX-8\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n
\n\n\n\n\n\n\n\n\nWe use cookies to enhance your experience. By continuing to visi
t this site you agree to our Personal Data Protection Act and Terms & Conditions\n
\n\n\n\nGot It\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nMazda Anshin\n\n\nTest Dri
ve\n\n\nFind a Dealer\n\n\n\n\n\n\n\n\nDigital Showroom\n\nWhy Mazda\n\nOwners & S
ervices\n\nNews & Events\n\nAbout Us\n\n\n\n\n\nDigital Showroom\n\n\n\r\n
Menu\r\n                                    \n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n
\n\n\n\n\nTHE NEW\nMazda2\nHatch | Sedan\n\n\n\n\n\nMazda3\nSedan | Liftback\n\n\n
\n\n\nMazda6\nSedan | Touring\n\n\n\n\n\nMazda MX-5 RF\nRF\n\n\n\n\n\nMazda CX-3\n
Small SUV\n\n\n\n\n\nThe New\nMazda CX-30\nSmall SUV\n\n\n\n\n\nMazda CX-5\nMedium
SUV\n\n\n\n\n\nThe New\nMazda CX-8\nLarge SUV\n\n\n\n\n\nMazda CX-9\nLarge SUV\n\n
\n\n\n\nAll-New \nMazda BT-50\nDouble Cab | Single Cab\n\n\n\n\n\nAll-New\nMazda M
X-30\nElectric Vehicle\n\n\n\n\nBook A Test Drive\nShop Online\nVirtual Showroom\n
\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nMazda Philosophy \n\n\nMazda History\n\n\nSk
yactiv\n\n\nDesign\n\n\nInnovation\n\n\nSafety\n\n\n\n\n\n\nMazda believes there i
s an extension for vehicles to develop further, in a way that takes the joy of dri
ving to a new level and combines it with outstanding environmental and safety perf
ormance. Our main goal is to accomplish the best possible level and further the ad
vancement of the vehicle.\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nWelcome to the World
of Mazda\n\n\nMazda Recall Information Centre\n\n\nPeace of mind 5 + 5\n\n\n24h Ro
adside Assistance\n\n\nMazda Contactless Service\n\n\nEuro5 Diesel Location\n\n\nM
azda Accident Management\n\n\nMazda Warning  & Indicator Lights\n\n\nMazda Roadsid
e Assist SOS\n\n\n\n\n\n\nGo to Mazda Connect Portal to enjoy full benefits of bei
ng a Mazda Owner\n\n\nLOGIN/REGISTER\n\n\nSERVICE APPOINTMENT\n\n\n\n\n\n\n\n\n\n
\n\n\n\n\n\n\n\n2021 Mazda CX-3 Compact Crossover SUV\n\n\nMazda Unveils All-New M
azda BT-50\n\n\nSupply Agreement with PETRONAS\n\n\nMazda RX-Vision GT3 Concept\n
\n\nIntroducing Mazda Contactless Service\n\n\nMazda 100 Years Anniversary\n\n\n\n
\n\n\nKeep updated with the latest Mazda news, launching ceremonies, events, offer
s, and more.\n\n\nVIEW ALL\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nBermaz CSR\n\n\nCSR Events
\n\n\nMedicare Fund\n\n\nCOVID-19 We Care\n\n\nPrivilege Card\n\n\n\n\n\nBERMAZ MO
TOR SDN BHD (173654-K)\nWe are the distributor of Mazda vehicles & spare parts bas
ed in Malaysia. We distribute a selected range of Mazda vehicles & spare parts in
Malaysia & Philippines. We also operate 3S centres in Malaysia. Bermaz Auto Berhad
Group was listed on the Main Market of Bursa Malaysia Securities Berhad on 18 Nove
mber 2013.\n\n\nABOUT BERMAZ\n\n\nPDPA\n\n\nCAREER\n\n\n\n\n\n\n\n\n\n\nWhy Mazda
\n\n\n\n\r\n                                                       Mazda Philosop
hy \r\n                                                   \n\nMazda History\n\n\n
Skyactiv\n\n\nDesign\n\n\nInnovation\n\n\nSafety\n\n\n\n\n\n\n\n\n\n\nOwners & S
ervices\n\n\n\n\n\n\nWelcome to the World of Mazda\n\n\nMazda Recall Information C
entre\n\n\nPeace of mind 5 + 5\n\n\n24h Roadside Assistance\n\n\nMazda Contactless
Service\n\n\nEuro5 Diesel Location\n\n\nMazda Accident Management\n\n\nMazda Warni
ng  & Indicator Lights\n\n\nMazda Roadside Assist SOS\n\n\n\n\n\n\n\nLOGIN/REGISTE
R\n\n\nSERVICE APPOINTMENT\n\n\n\n\n\n\nNews & Events\n\n\n\n\n\n\n2021 Mazda CX-3
Compact Crossover SUV\n\n\nMazda Unveils All-New Mazda BT-50\n\n\nSupply Agreement
with PETRONAS\n\n\nMazda RX-Vision GT3 Concept\n\n\nIntroducing Mazda Contactless
Service\n\n\nMazda 100 Years Anniversary\n\n\n\n\n\n\n\nVIEW ALL\n\n\n\n\n\n\nAbou
t Us\n\n\n\n\r\n                                                       Bermaz CSR
\r\n                                                  \n\nCSR Events\n\n\nMedica
re Fund\n\n\nCOVID-19 We Care\n\n\nPrivilege Card\n\n\n\n\n\r\n
BERMAZ MOTOR SDN BHD (173654-K)\r\n
\n\nABOUT BERMAZ\n\n\nPDPA\n\n\nCAREER\n\n\n\n\n\n\n\nOther Links\n\n\nMazda Anshi
n\n\n\nTest Drive\n\n\nFind a Dealer\n\n\n\n\n\n\n\n\n\n\nMazda CX-8\n\n\n\n\n\n
\n\n\n\n\n\n360° VIRTUAL VIEW\n\nFEATURES\n\nBROCHURE\n\nSPECIFICATION\n\n\n
COLOUR\n\nMEDIA REVIEW\n\n\n\n\n\nContact Us\n\n\n\n\n\n\n\n\nA LEAGUE OF IT
S OWN\nMAZDA CX-8\n\n\nBOOK A TEST DRIVE\nSHOP ONLINE\nSHOP ONLINE\n\n\n\n\n\n\n\n
\n360° Virtual View \n\n\n\n\n\n\n\nEXTERIOR\nINTERIOR\n\n\n\n\n\n\n\n\n\n\n\n\n\n
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\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nAll details and specifications of the vehicles and their options shown on the screen may vary according to locale.\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nTHE STREAMLINED VERSATILE SUV\n\n\nMazda’s stunning KODO Design language is at the heart of every Mazda SUV. Concentrating on proportions, form and fine details, the long flowing lines create a strong, mature and dignified road presence. The three-row SUV that opens up inspiring new possibilities for people with active lifestyles, now with an all-new front grille that gives the Mazda CX-8 an elegant and commanding stance on the road.\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nTHREE ROWS OF LUXURY\n\n\nThe New Mazda CX-8 offers 3 variants of seat configurations that cater to your needs. From front row to back, you will discover quality finishes, premium materials and the luxury that Mazda SUVs have become known for.\n\n\n\n\nMore information\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nLUXURY & TECHNOLOGY COME TOGETHER\n\n\nSit back and relax in the perfect blend of high-quality finishes and intuitive connectivity. Take control in the thoughtfully designed cockpit that wraps snugly around the driver, with all major controls laid out in perfect symmetry.\nThe Mazda CX-8 brings the latest connectivity and infotainment to everyone on board. Mazda’s advanced MAZDA CONNECT system allows you to safely access your compatible smartphone’s contact, social media and music. The exceptional audio sound system, is integrated seamlessly throughout the cabin – providing clear tunes from the front row to the third.\n\n\n\n\nMore information\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nSEE ALL THE FEATURES OF THE NEW MAZDA CX-8 IN OUR PRODUCT BROCHURE\n\n\n\nDownload Brochure\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nSKYACTIV-VEHICLE ARCHITECTURE\n\n\nWith our revolutionary Skyactiv technologies, redesigned from scratch to provide breakthrough performance, Mazda has consistently aimed to provide the joy of ‘Jinba-Ittai’ driving.\nNow we have developed our next-generation Skyactiv-Vehicle Architecture that focuses on the human-centered design philosophy. The new vehicle architecture coupled with award winning powertrains provide effortless responsive driving that is in perfect harmony with the driver's intention, creating the ultimate 'Jinba-Ittai' driving feel.\n\n\n\n\nMore information\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nREADY FOR ANYTHING\n\n\ni-ACTIV AWD\nThe pioneering i-Activ AWD* All-Wheel Drive system helps you drive confidently in all weather conditions. This innovative technology uses sophisticated real-time vehicle dynamics modeling to help predict traction loss and send torque to the tyres that need it the most, delivering an unparalleled connection to the road.\nWhen your destination takes you off the beaten path, Off-road Traction Assist* helps optimize torque distribution and traction control to help you traverse uneven terrain. So you can keep on exploring.\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nENGINEERED TO EXHILARATE\n\n\nThe strict adherence to the philosophy of ‘Jinba-Ittai’, the sense of car and driver as one, has created a driving experience that’s truly next generation. The newly developed G-Vectoring Control Plus (GVC Plus) offers unprecedented levels of confidence-inspiring controllability, while Skyactiv engines deliver exhilarating performance.\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nPEACE OF MIND BUILT-IN\n\n\nThe new Mazda CX-8 puts safety at its heart with every safety innovation Mazda has to offer. Mazda CX-8 features the full suite of Mazda’s i-Activsense advanced safety technologies, which are designed to help you recognize potential hazards, avoid collisions and minimise the severity of accidents should they become unavoidable.\n\n\n\n\nMore information\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\nSpecification \n\n\nBody\n\n\n\nSUV\n\n\n\n\n\nSUV\n\n\n\n\n\n\n\nDrive\n\n\n\n2WD\n\n\nAWD\n\n\n\n\n\n2WD\nAWD\n\n\n\n\nGrade\n\n\n\n\n2.5G MID\n\n\n2.5G HIGH\n\n\n\n2.5G HIGH +\n\n\n2.2D HIGH +\n\n\n\n\n\n2.5G MID\n2.5G HIGH\n2.5G HIGH +\n2.2D HIGH +\n\n\n\n\n\n\n\n2.5G TURBO HIGH +\n\n\n\n\n\n2.5G TURBO HIGH +\n\n\n\n\n\n\n\n\n\n2.5G MID\nPrice From\nRM184,000\n\n\n\n\n\n\n\n\n\n\n2.5G HIGH\nPrice From\nRM190,000\n\n\n\n\n\n\n\n\n\n\n\n\n2.5G HIGH +\nPrice From\nRM205,000\n\n\n\n\n\n\n\n\n\n\n\n\n2.2D HIGH +\nPrice From\nRM212,000\n\n\n\n\n\n\n\n\n\n\n\n\n2.5G TURBO HIGH +\nPrice From\nRM220,000\n\n\n\n\n\n\n\n\n\n\n\n\nMazda CX-8 Features\n\n\nMAZDA CX-8 SKYACTIV-G 2WD (2.5L MID) \n\n\n\n (MODEL : KV0K MM1)\n\n\n\n\nPOWERTRAIN\n\n

\nEngine Type - SKYACTIV®-G 2.5L DOHC 16-Valve 4 Cylinder with VVT\nCapacity - 2,488cc\nMaximum Power - 192Hp/6,000rpm\nMaximum Torque - 258Nm/4,000rpm\nTransmission - SKYACTIV®-DRIVE 6-Speed Automatic with Manual Shift Mode\nFuel Type - Petrol\nRecommended Fuel - Min. Ron95\nFuel System - Direct Injection\nFuel Tank Capacity - 72 litres\n\n\n\n\xa0\n\xa0\n\n\n\nCHASSIS\n\n\nBrake Type - Ventilated Discs (Front)\nBrake Type - Solid Discs (Rear)\nSuspension Type - MacPherson Struts (Front)\nSuspension Type - Multi-Link (Rear)\nSteering Type - Electronic Power Assisted Steering (EPAS)\nWheel Size - 19 x 7J\nTyre Size - 225/55R19\n\n\n\n\xa0\n\xa0\n\n\n\nDIMENSIONS\n\n\nOverall Length - 4,900mm\nOverall Width - 1,840mm\nOverall Height - 1,730mm\nCurb Weight - 1,781kg\n\n\n\n\xa0\n\xa0\n\n\n\nEXTERIOR\n\n\nFront LED Headlights\nAuto Front Headlights Leveling\nLED Rear Combination Taillights\nPower Folding Side Mirrors with Turn Indicators\nRear Roof Spoiler\nMazda Advanced Keyless Entry\nPower Tailgate (Handsfree)\nParking Sensors - Front & Rear\n\n\n\n\xa0\n\xa0\n\n\n\nINTERIOR\n\n\nEngine Start / Stop Button\nSteering Wheel With Audio & Bluetooth® Hands-Free Switches\nAuto-dimming rearview mirror\nApple CarPlay® & Android Auto™ Function**\nSeating Capacity - 7\n\n\n\n\xa0\n\xa0\n\n\n\nADVANCED TECHNOLOGIES\n\n\nMazda i-Stop Idling Technology\nMazda G-Vectoring Control Plus Technology (GVC Plus)\n\n\n\n\xa0\n\xa0\n\n\n\nSAFETY\n\n\nSRS Airbags System\nAnti-Lock Braking System (ABS)\nElectronic Brake-Force Distribution (EBD)\nBrake Assist (BA)\nDynamic Stability Control (DSC)\nTraction Control System (TCS)\nEmergency Stop Signal (ESS)\nHill Launch Assist (HLA)\nWalk Away Lock\nEngine-Immobilizer with Anti-Theft System\n\n\n\n\n** Android Auto will be available upon the official launch of service in Malaysia\n\n\n\n\n\n\n\n\nMazda CX-8 Features\n\n\nMAZDA CX-8 SKYACTIV-G 2WD (2.5L HIGH) \n\n\n\n (MODEL : KV0K MM2)\n\n\n\n\nPOWERTRAIN\n\n\nEngine Type - SKYACTIV®-G 2.5L DOHC 16-Valve 4 Cylinder with VVT\nCapacity - 2,488cc\nMaximum Power - 192Hp/6,000rpm\nMaximum Torque - 258Nm/4,000rpm\nTransmission - SKYACTIV®-DRIVE 6-Speed Automatic with Manual Shift Mode\nFuel Type - Petrol\nRecommended Fuel - Min. Ron95\nFuel System - Direct Injection\nFuel Tank Capacity - 72 litres\n\n\n\n\xa0\n\xa0\n\n\n\nCHASSIS\n\n\nBrake Type - Ventilated Discs (Front)\nBrake Type - Solid Discs (Rear)\nSuspension Type - MacPherson Struts (Front)\nSuspension Type - Multi-Link (Rear)\nSteering Type - Electronic Power Assisted Steering (EPAS)\nWheel Size - 19 x 7J\nTyre Size - 225/55R19\n\n\n\n\xa0\n\xa0\n\n\n\nDIMENSIONS\n\n\nOverall Length - 4,900mm\nOverall Width - 1,840mm\nOverall Height - 1,730mm\nCurb Weight - 1,781kg\n\n\n\n\xa0\n\xa0\n\n\n\nEXTERIOR\n\n\nFront LED Headlights with Signature Illumination\nAuto Front Headlights Leveling\nLED Daytime Running Lights\nLED Rear Combination Taillights with Signature Illumination\nPower Folding Side Mirrors with Turn Indicators\nRear Roof Spoiler\nMazda Advanced Keyless Entry\nPower Tailgate (Handsfree)\nParking Sensors - Front & Rear\n\n\n\n\xa0\n\xa0\n\n\n\nINTERIOR\n\n\nEngine Start / Stop Button\nSteering Wheel with Audio & Bluetooth® Hands-Free Switches\nApple CarPlay® & Android Auto™ Function**\nSeating Capacity - 6\n\n\n\n\xa0\n\xa0\n\n\n\nADVANCED TECHNOLOGIES\n\n\nMazda i-Stop Idling Technology\nMazda G-Vectoring Control Plus Technology (GVC Plus)\nWireless Charger\n\n\n\n\xa0\n\xa0\n\n\n\nSAFETY\n\n\nSRS Airbags System\nAnti-Lock Braking System (ABS)\nElectronic Brake-Force Distribution (EBD)\nBrake Assist (BA)\nDynamic Stability Control (DSC)\nTraction Control System (TCS)\nEmergency Stop Signal (ESS)\nHill Launch Assist (HLA)\nWalk Away Lock\nEngine-Immobilizer with Anti-Theft System\n\n\n\n\xa0\n\xa0\n\n\n\nADVANCED SAFETY TECHNOLOGIES\n\n\nAdaptive Front-Lighting System (AFS)\nBlind Spot Monitoring (BSM)\nRear Cross Traffic Alert (RCTA)\nSmart City Brake Support (SCBS) - Front\n\n\n\n\n** Android Auto will be available upon the official launch of service in Malaysia\n\n\n\n\n\n\n\n\nMazda CX-8 Features\n\n\nMAZDA CX-8 SKYACTIV-G 2WD (2.5L HIGH PLUS) \n\n\n\n (MODEL : KV0K MM3)\n\n\n\n\nPOWERTRAIN\n\n\nEngine Type - SKYACTIV®-G 2.5L DOHC 16-Valve 4 Cylinder with VVT\nCapacity - 2,488cc\nMaximum Power - 192Hp/6,000rpm\nMaximum Torque - 258Nm/4,000rpm\nTransmission - SKYACTIV®-DRIVE 6-Speed Automatic with Manual Shift Mode\nFuel Type - Petrol\nRecommended Fuel - Min. Ron95\nFuel System - Direct Injection\nFuel Tank Capacity - 72 litres\n\n\n\n\xa0\n\xa0\n\n\n\nCHASSIS\n\n\n

Brake Type - Ventilated Discs (Front)\nBrake Type - Solid Discs (Rear)\nSuspension Type - MacPherson Struts (Front)\nSuspension Type - Multi-Link (Rear)\nSteering Type - Electronic Power Assisted Steering (EPAS)\nWheel Size - 19 x 7J\nTyre Size - 225/55R19\n\n\n\n\xa0\n\xa0\n\n\n\nDIMENSIONS\n\n\nOverall Length - 4,900mm\nOverall Width - 1,840mm\nOverall Height - 1,730mm\nCurb Weight - 1,781kg\n\n\n\n\xa0\n\xa0\n\n\n\nEXTERIOR\n\n\nFront LED Headlights with Signature Illumination\nAuto Front Headlights Leveling\nLED Daytime Running Lights\nLED Rear Combination Taillights with Signature Illumination\nPower Folding Side Mirrors with Turn Indicators\nRear Roof Spoiler\nMazda Advanced Keyless Entry\nPower Tailgate (Handsfree)\nParking Sensors - Front & Rear\n\n\n\n\xa0\n\xa0\n\n\n\nINTERIOR\n\n\nEngine Start / Stop Button\nSteering Wheel with Audio & Bluetooth® Hands-Free Switches\nApple CarPlay® & Android Auto™ Function**\nSeating Capacity - 6\n\n\n\n\xa0\n\xa0\n\n\n\nADVANCED TECHNOLOGIES\n\n\nMazda i-Stop Idling Technology\nMazda G-Vectoring Control Plus Technology (GVC Plus)\nWireless Charger\n\n\n\n\xa0\n\xa0\n\n\n\nSAFETY\n\n\nSRS Airbags System\nAnti-Lock Braking System (ABS)\nElectronic Brake-Force Distribution (EBD)\nBrake Assist (BA)\nDynamic Stability Control (DSC)\nTraction Control System (TCS)\nEmergency Stop Signal (ESS)\nHill Launch Assist (HLA)\nWalk Away Lock\nEngine-Immobilizer with Anti-Theft System\n\n\n\n\xa0\n\xa0\n\n\n\nADVANCED SAFETY TECHNOLOGIES\n\n\nAdaptive Front-Lighting System (AFS)\nHigh Beam Control (HBC)\nBlind Spot Monitoring (BSM)\nRear Cross Traffic Alert (RCTA)\nLane Departure Warning System (LDWS)\nLane-Keep Assist System (LAS)\nDriver Attention Alert (DAA)\nSmart City Brake Support (SCBS) - Front & Rear\nSmart Brake Support (SBS)\nMazda Radar Cruise Control (MRCC)\n\n\n\n\n** Android Auto will be available upon the official launch of service in Malaysia\n\n\n\n\n\n\n\n\n\nMazda CX-8 Features\n\n\nMAZDA CX-8 SKYACTIV-D 2WD (2.2L HIGH PLUS) \n\n\n\n (MODEL : KV0M MM1)\n\n\n\n\nPOWERTRAIN\n\n\nEngine Type - SKYACTIV®-D 2.2L DOHC 16-Valve 4 Cylinder\nCapacity - 2,191cc\nMaximum Power - 188Hp/4,500rpm\nMaximum Torque - 450Nm/2,000rpm\nTransmission - SKYACTIV®-DRIVE 6-Speed Automatic with Manual Shift Mode\nFuel Type - Diesel\nRecommended Fuel - Euro 5\nFuel System - Direct Injection\nFuel Tank Capacity - 72 litres\n\n\n\n\xa0\n\xa0\n\n\n\nCHASSIS\n\n\nBrake Type - Ventilated Discs (Front)\nBrake Type - Solid Discs (Rear)\nSuspension Type - MacPherson Struts (Front)\nSuspension Type - Multi-Link (Rear)\nSteering Type - Electronic Power Assisted Steering (EPAS)\nWheel Size - 19 x 7J\nTyre Size - 225/55R19\n\n\n\n\xa0\n\xa0\n\n\n\nDIMENSIONS\n\n\nOverall Length - 4,900mm\nOverall Width - 1,840mm\nOverall Height - 1,730mm\nCurb Weight - 1,858kg\n\n\n\n\xa0\n\xa0\n\n\n\nEXTERIOR\n\n\nFront LED Headlights with Signature Illumination\nAuto Front Headlights Leveling\nLED Daytime Running Lights\nLED Rear Combination Taillights with Signature Illumination\nPower Folding Side Mirrors with Turn Indicators\nRear Roof Spoiler\nMazda Advanced Keyless Entry\nPower Tailgate (Handsfree)\nParking Sensors - Front & Rear\n\n\n\n\xa0\n\xa0\n\n\n\nINTERIOR\n\n\nEngine Start / Stop Button\nSteering Wheel with Audio & Bluetooth® Hands-Free Switches\nApple CarPlay® & Android Auto™ Function**\nSeating Capacity - 6\n\n\n\n\xa0\n\xa0\n\n\n\nADVANCED TECHNOLOGIES\n\n\nMazda i-Stop Idling Technology\nMazda G-Vectoring Control Plus Technology (GVC Plus)\nWireless Charger\n\n\n\n\xa0\n\xa0\n\n\n\nSAFETY\n\n\nSRS Airbags System\nAnti-Lock Braking System (ABS)\nElectronic Brake-Force Distribution (EBD)\nBrake Assist (BA)\nDynamic Stability Control (DSC)\nTraction Control System (TCS)\nEmergency Stop Signal (ESS)\nHill Launch Assist (HLA)\nWalk Away Lock\nEngine-Immobilizer with Anti-Theft System\n\n\n\n\xa0\n\xa0\n\n\n\nADVANCED SAFETY TECHNOLOGIES\n\n\nAdaptive Front-Lighting System (AFS)\nHigh Beam Control (HBC)\nBlind Spot Monitoring (BSM)\nRear Cross Traffic Alert (RCTA)\nLane Departure Warning System (LDWS)\nLane-Keep Assist System (LAS)\nDriver Attention Alert (DAA)\nSmart City Brake Support (SCBS) - Front & Rear\nSmart Brake Support (SBS)\nMazda Radar Cruise Control (MRCC)\n\n\n\n\n** Android Auto will be available upon the official launch of service in Malaysia\n\n\n\n\n\n\n\n\n\nMazda CX-8 Features\n\n\nMAZDA CX-8 SKYACTIV-G AWD (2.5L TURBO HIGH PLUS) \n\n\n\n (MODEL : KV0L MM1)\n\n\n\n\nPOWERTRAIN\n\n\nEngine Type - SKYACTIV®-G 2.5L DOHC 16-Valve 4 Cylinder with VVT\nCapacity - 2,488cc\nMaximum

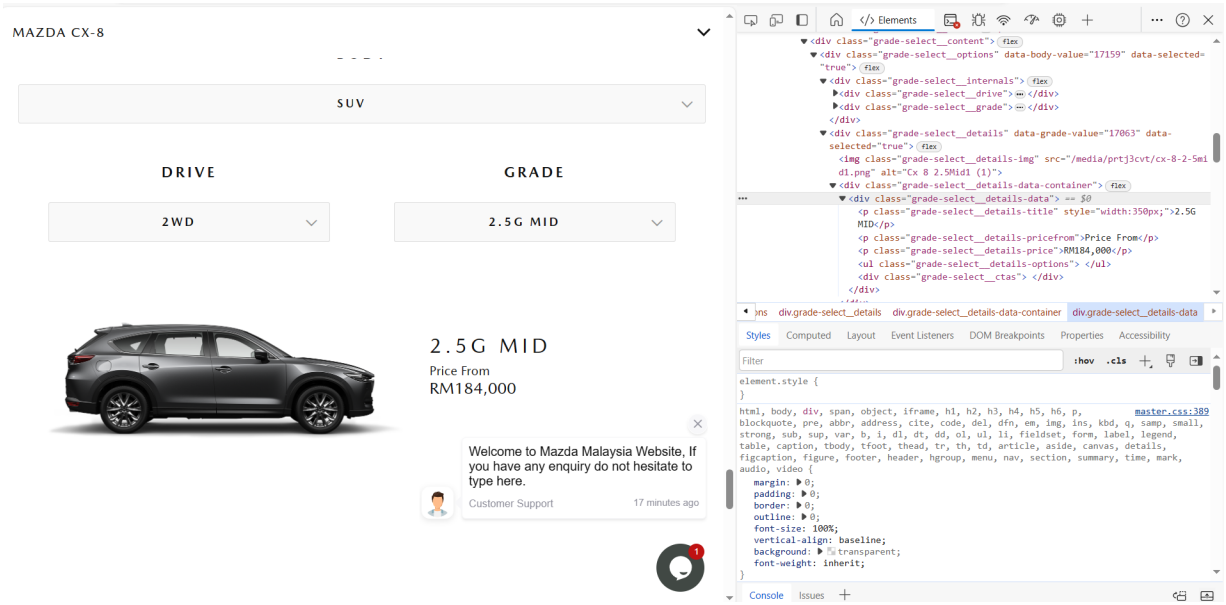
```
Power - 228Hp/5,000rpm\nMaximum Torque - 420Nm/2,000rpm\nTransmission - SKYACTIV®-
DRIVE 6-Speed Automatic with Manual Shift Mode\nFuel Type - Petrol\nRecommended Fu
el - Min. Ron 95\nFuel System - Direct Injection\nFuel Tank Capacity - 74 litres\n
\n\n\n\xa0\n\xa0\n\n\n\nCHASSIS\n\n\nBrake Type - Ventilated Discs (Front)\nBrake
Type - Solid Discs (Rear)\nSuspension Type - MacPherson Struts (Front)\nSuspension
Type - Multi-Link (Rear)\nSteering Type - Electronic Power Assisted Steering (EPA
S)\nWheel Size - 19 x 7J\nTyre Size - 225/55R19\n\n\n\n\xa0\n\xa0\n\n\n\nDIMENSION
S\n\n\nOverall Length - 4,900mm\nOverall Width - 1,840mm\nOverall Height - 1,730mm
\nCurb Weight - 1,896kg\n\n\n\n\xa0\n\xa0\n\n\n\nEXTERIOR\n\n\nFront LED Headlight
s with Signature Illumination\nAuto Front Headlights Leveling\nLED Daytime Running
Lights\nLED Rear Combination Taillights with Signature Illumination\nPower Folding
Side Mirrors with Turn Indicators\nRear Roof Spoiler\nMazda Advanced Keyless Entry
\nPower Tailgate (Handsfree)\nParking Sensors - Front & Rear\n\n\n\n\xa0\n\xa0\n\n
\n\nINTERIOR\n\n\nEngine Start / Stop Button\nSteering Wheel with Audio & Bluetoot
h® Hands-Free Switches\nApple CarPlay® & Android Auto™ Function**\nSeating Capacit
y - 6\n\n\n\n\xa0\n\xa0\n\n\n\nADVANCED TECHNOLOGIES\n\n\nMazda i-Stop Idling Tech
nology\nMazda G-Vectoring Control Plus Technology (GVC Plus)\nWireless Charger\n\n
\n\n\xa0\n\xa0\n\n\n\nSAFETY\n\n\nSRS Airbags System\nAnti-Lock Braking System (AB
S)\nElectronic Brake-Force Distribution (EBD)\nBrake Assist (BA)\nDynamic Stabilit
y Control (DSC)\nTraction Control System (TCS)\nEmergency Stop Signal (ESS)\nHill
Launch Assist (HLA)\nWalk Away Lock\nEngine-Immobilizer with Anti-Theft System\n\n
\n\n\xa0\n\xa0\n\n\n\nADVANCED SAFETY TECHNOLOGIES\n\n\nAdaptive Front-Lighting Sy
stem (AFS)\nHigh Beam Control (HBC)\nBlind Spot Monitoring (BSM)\nRear Cross Traff
ic Alert (RCTA)\nLane Departure Warning System (LDWS)\nLane-Keep Assist System (LA
S)\nDriver Attention Alert (DAA)\nSmart City Brake Support (SCBS) - Front & Rear\n
Smart Brake Support (SBS)\nMazda Radar Cruise Control (MRCC)\n\n\n\n\n** Android A
uto will be available upon the official launch of service in Malaysia\n\n\n\n\n\n
\n\n\n\n\n\n\n\n\nDownload Specification\nDownload Price (West)\nDownload Price
(East)\n\n\n\n\n\n\nColour\n\n\n Soul Red Crystal\r\nMachine Gray\r\nSnowflake Whi
te Pearl\r\nPlatinum Quartz\r\nDeep Crystal Blue \r\nPolymetal Gray\r\nJet Black\r
\n\r\n\r\n\r\n\n\n\n\n\n\n\n\n\n\nMedia Review\n\n\ncategory\n\nAll\nEvents\nNews
\nVideo\nPromotion\n\n\n\nMazda2\n\nAll\nMazda2\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n
\n\n\n\n\n\n\n\n\n\nPDPA\n\n\n\n\nTERMS & CONDITIONS\n\n\n\n\nZOOM-ZOOM LI
NE : 1800-22-8080\n\n\n\n\n24 HOURS ROADSIDE ASSISTANCE : 1800 18 8011\n\n\n\n\n
© 2024 BERMAZ MOTOR SDN BHD 198801006297  (173654-K)\n\n\nEND CHAT\n\n\n\n\n\n
\n\n\n\n\n\n\n\n\n\n"
```

In [29]:
```
# Find the element that contains the price
# Assuming the price is within a <span> tag with a specific class or id
price_element = soup.find('p', class_='grade-select__details-price')  # Replace 'pr
```

In [30]:
```
# Extract the text from the price element
price = price_element.text.strip()
price
```

Out[30]:
```
'RM184,000'
```

In [31]:
```
from PIL import Image
im1 = Image.open("C:/Users/user/OneDrive/Desktop/Sem 5 Slide/Data Mining/Mazda CX-8
display(im1)
```



Question 4

Step 1: Import the nltk library and read the SMSSpamHam.txt dataset.

In [32]:
```
import nltk
messages = [line.rstrip() for line in open('SMSSpamHam.txt')]
messages
```

Out[32]: ['label\tmessage',
 "ham\tU don't know how stubborn I am. I didn't even want to go to the hospital. I kept telling Mark I'm not a weak sucker. Hospitals are for weak suckers.",
 'ham\tWhat you thinked about me. First time you saw me in class.',
 'ham\tA gram usually runs like <#> , a half eighth is smarter though and gets you almost a whole second gram for <#>',
 "ham\tK fyi x has a ride early tomorrow morning but he's crashing at our place tonight",
 'ham\tWow. I never realized that you were so embarassed by your accomodations. I thought you liked it, since i was doing the best i could and you always seemed so happy about "the cave". I\'m sorry I didn\'t and don\'t have more to give. I\'m sorry i offered. I\'m sorry your room was so embarassing.',
 'spam\tSMS. ac Sptv: The New Jersey Devils and the Detroit Red Wings play Ice Hockey. Correct or Incorrect? End? Reply END SPTV',
 'ham\tDo you know what Mallika Sherawat did yesterday? Find out now @ <URL>',
 'spam\tCongrats! 1 year special cinema pass for 2 is yours. call 09061209465 now! C Suprman V, Matrix3, StarWars3, etc all 4 FREE! bx420-ip4-5we. 150pm. Dont miss out!',
 "ham\tSorry, I'll call later in meeting.",
 'ham\tTell where you reached',
 'ham\tYes..gauti and sehwag out of odi series.',
 "ham\tYour gonna have to pick up a $1 burger for yourself on your way home. I can't even move. Pain is killing me.",
 'ham\tHa ha ha good joke. Girls are situation seekers.',
 'ham\tIts a part of checking IQ',
 'ham\tSorry my roommates took forever, it ok if I come by now?',
 'ham\tOk lar i double check wif da hair dresser already he said wun cut v short. He said will cut until i look nice.',
 'spam\tAs a valued customer, I am pleased to advise you that following recent review of your Mob No. you are awarded with a Â£1500 Bonus Prize, call 09066364589',
 'ham\tToday is "song dedicated day.." Which song will u dedicate for me? Send this to all ur valuable frnds but first rply me...',
 'spam\tUrgent UR awarded a complimentary trip to EuroDisinc Trav, Aco&Entry41 Or Â£1000. To claim txt DIS to 87121 18+6*Â£1.50(moreFrmMob. ShrAcomOrSglSuplt)10, LS1 3AJ',
 'spam\tDid you hear about the new "Divorce Barbie"? It comes with all of Ken\'s stuff!',
 'ham\tI plane to give on this month end.',
 'ham\tWah lucky man... Then can save money... Hee...',
 'ham\tFinished class where are you.',
 'ham\tHI BABE IM AT HOME NOW WANNA DO SOMETHING? XX',
 'ham\tK..k:)where are you?how did you performed?',
 'ham\tU can call me now...',
 'ham\tI am waiting machan. Call me once you free.',
 'ham\tThats cool. i am a gentleman and will treat you with dignity and respect.',
 'ham\tI like you peoples very much:) but am very shy pa.',
 'ham\tDoes not operate after <#> or what',
 "ham\tIts not the same here. Still looking for a job. How much do Ta's earn there.",
 "ham\tSorry, I'll call later",
 'ham\tK. Did you call me just now ah?',
 'ham\tOk i am on the way to home hi hi',
 'ham\tYou will be in the place of that man',
 'ham\tYup next stop.',
 "ham\tI call you later, don't have network. If urgnt, sms me.",

```
 "ham\tFor real when u getting on yo? I only need 2 more tickets and one more jack
et and I'm done. I already used all my multis.",
 "ham\tYes I started to send requests to make it but pain came back so I'm back in
bed. Double coins at the factory too. I gotta cash in all my nitros.",
 "ham\tI'm really not up to it still tonight babe",
 'ham\tEla kano.,il download, come wen ur free..',
 'ham\tYeah do! Donâ€˜t stand to close tho- youâ€˜ll catch something!',
 "ham\tSorry to be a pain. Is it ok if we meet another night? I spent late afterno
on in casualty and that means i haven't done any of y stuff42moro and that include
s all my time sheets and that. Sorry.",
 'ham\tSmile in Pleasure Smile in Pain Smile when trouble pours like Rain Smile wh
en sum1 Hurts U Smile becoz SOMEONE still Loves to see u Smiling!!',
 'spam\tPlease call our customer service representative on 0800 169 6031 between 1
0am-9pm as you have WON a guaranteed Â£1000 cash or Â£5000 prize!',
 'ham\tHavent planning to buy later. I check already lido only got 530 show in e a
fternoon. U finish work already?',
 'spam\tYour free ringtone is waiting to be collected. Simply text the password "M
IX" to 85069 to verify. Get Usher and Britney. FML, PO Box 5249, MK17 92H. 450Ppw
16',
 'ham\tWatching telugu movie..wat abt u?',
 'ham\ti see. When we finish we have loads of loans to pay',
 'ham\tHi. Wk been ok - on hols now! Yes on for a bit of a run. Forgot that i have
hairdressers appointment at four so need to get home n shower beforehand. Does tha
t cause prob for u?"',
 'ham\tI see a cup of coffee animation',
 "ham\tPlease don't text me anymore. I have nothing else to say.",
 'ham\tOkay name ur price as long as its legal! Wen can I pick them up? Y u ave x
ams xx',
 "ham\tI'm still looking for a car to buy. And have not gone 4the driving test ye
t.",
 "ham\tAs per your request 'Melle Melle (Oru Minnaminunginte Nurungu Vettam)' has
been set as your callertune for all Callers. Press *9 to copy your friends Callert
une",
 "ham\twow. You're right! I didn't mean to do that. I guess once i gave up on bost
on men and changed my search location to nyc, something changed. Cuz on my signin
page it still says boston.",
 'ham\tUmma my life and vava umma love you lot dear',
 'ham\tThanks a lot for your wishes on my birthday. Thanks you for making my birth
day truly memorable.',
 "ham\tAight, I'll hit you up when I get some cash",
 "ham\tHow would my ip address test that considering my computer isn't a minecraft
server",
 'ham\tI know! Grumpy old people. My mom was like you better not be lying. Then ag
ain I am always the one to play jokes...',
 "ham\tDont worry. I guess he's busy.",
 'ham\tWhat is the plural of the noun research?',
 'ham\tGoing for dinner.msg you after.',
 "ham\tI'm ok wif it cos i like 2 try new things. But i scared u dun like mah. Cos
u said not too loud.",
 'spam\tGENT! We are trying to contact you. Last weekends draw shows that you won
a Â£1000 prize GUARANTEED. Call 09064012160. Claim Code K52. Valid 12hrs only. 150
ppm',
 "ham\tWa, ur openin sentence very formal... Anyway, i'm fine too, juz tt i'm eati
n too much n puttin on weight...Haha... So anythin special happened?",
 "ham\tAs I entered my cabin my PA said, '' Happy B'day Boss !!''. I felt special.
She askd me 4 lunch. After lunch she invited me to her apartment. We went there.",
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 'spam\tYou are a winner U have been specially selected 2 receive Â£1000 or a 4* h
oliday (flights inc) speak to a live operator 2 claim 0871277810910p/min (18+)',
 'ham\tGoodo! Yes we must speak friday - egg-potato ratio for tortilla needed!',
 "ham\tHmm...my uncle just informed me that he's paying the school directly. So pl
s buy food.",
 'spam\tPRIVATE! Your 2004 Account Statement for 07742676969 shows 786 unredeemed
Bonus Points. To claim call 08719180248 Identifier Code: 45239 Expires',
 'spam\tURGENT! Your Mobile No. was awarded Â£2000 Bonus Caller Prize on 5/9/03 Th
is is our final try to contact U! Call from Landline 09064019788 BOX42WR29C, 150PP
M',
 'ham\there is my new address -apples&pairs&all that malarky',
 'spam\tTodays Voda numbers ending 7548 are selected to receive a $350 award. If y
ou have a match please call 08712300220 quoting claim code 4041 standard rates ap
p',
 'ham\tI am going to sao mu today. Will be done only at 12',
 "ham\tÃœ predict wat time Ã¼'ll finish buying?",
 'ham\tGood stuff, will do.',
 "ham\tJust so that you know,yetunde hasn't sent money yet. I just sent her a text
not to bother sending. So its over, you dont have to involve yourself in anything.
I shouldn't have imposed anything on you in the first place so for that, i apologi
se.",
 'ham\tAre you there in room.',
 'ham\tHEY GIRL. HOW R U? HOPE U R WELL ME AN DEL R BAK! AGAIN LONG TIME NO C! GIV
E ME A CALL SUM TIME FROM LUCYxx',
 'ham\tK..k:)how much does it cost?',
 "ham\tI'm home.",
 'ham\tDear, will call Tmorrow.pls accomodate.',
 'ham\tFirst answer my question.',
 'spam\tSunshine Quiz Wkly Q! Win a top Sony DVD player if u know which country th
e Algarve is in? Txt ansr to 82277. Â£1.50 SP:Tyrone',
 "spam\tWant 2 get laid tonight? Want real Dogging locations sent direct 2 ur mob?
Join the UK's largest Dogging Network bt Txting GRAVEL to 69888! Nt. ec2a. 31p.msg
@150p",
 "ham\tI only haf msn. It's yijue@hotmail.com",
 'ham\tHe is there. You call and meet him',
 'ham\tNo no. I will check all rooms befor activities',
 "spam\tYou'll not rcv any more msgs from the chat svc. For FREE Hardcore services
text GO to: 69988 If u get nothing u must Age Verify with yr network & try again",
 'ham\tGot c... I lazy to type... I forgot Ã¼ in lect... I saw a pouch but like no
t v nice...',
 "ham\tK, text me when you're on the way",
 'ham\tSir, Waiting for your mail.',
 'ham\tA swt thought: "Nver get tired of doing little things 4 lovable persons.."
Coz..somtimes those little things occupy d biggest part in their Hearts.. Gud ni
8',
 'ham\tI know you are. Can you pls open the back?',
 'ham\tYes see ya not on the dot',
 'ham\tWhats the staff name who is taking class for us?',
 "spam\tFreeMsg Why haven't you replied to my text? I'm Randy, sexy, female and li
ve local. Luv to hear from u. Netcollex Ltd 08700621170150p per msg reply Stop to
end",
 'ham\tUmmma.will call after check in.our life will begin from qatar so pls pray v
ery hard.',
 'ham\tK..i deleted my contact that why?',
 'ham\tSindu got job in birla soft ..',
 "ham\tThe wine is flowing and i'm i have nevering..",
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 'ham\tYup i thk cine is better cos no need 2 go down 2 plaza mah.',
 'ham\tOk... Ur typical reply...',
 "ham\tAs per your request 'Melle Melle (Oru Minnaminunginte Nurungu Vettam)' has
been set as your callertune for all Callers. Press *9 to copy your friends Callert
une",
 'ham\tYou are everywhere dirt, on the floor, the windows, even on my shirt. And s
ometimes when i open my mouth, you are all that comes flowing out. I dream of my w
orld without you, then half my chores are out too. A time of joy for me, lots of t
v shows i.ll see. But i guess like all things you just must exist, like rain, hail
and mist, and when my time here is done, you and i become one.',
 'ham\tAaooooright are you at work?',
 "ham\tI'm leaving my house now...",
 'ham\tHello, my love. What are you doing? Did you get to that interview today? Ar
e you you happy? Are you being a good boy? Do you think of me?Are you missing me
?',
 'spam\tCustomer service annoncement. You have a New Years delivery waiting for yo
u. Please call 07046744435 now to arrange delivery',
 'spam\tYou are a winner U have been specially selected 2 receive Â£1000 cash or a
4* holiday (flights inc) speak to a live operator 2 claim 0871277810810',
 "ham\tKeep yourself safe for me because I need you and I miss you already and I e
nvy everyone that see's you in real life",
 'ham\tNew car and house for my parents.:)i have only new job in hand:)',
 "ham\tI'm so in love with you. I'm excited each day i spend with you. You make me
so happy.",
 'spam\t-PLS STOP bootydelious (32/F) is inviting you to be her friend. Reply YES-
434 or NO-434 See her: www.SMS.ac/u/bootydelious STOP? Send STOP FRND to 62468',
 'spam\tBangBabes Ur order is on the way. U SHOULD receive a Service Msg 2 downloa
d UR content. If U do not, GoTo wap. bangb. tv on UR mobile internet/service men
u',
 'ham\tI place all ur points on e cultures module already.',
 'spam\tURGENT! We are trying to contact you. Last weekends draw shows that you ha
ve won a Â£900 prize GUARANTEED. Call 09061701939. Claim code S89. Valid 12hrs onl
y',
 "ham\tHi frnd, which is best way to avoid missunderstding wit our beloved on
e's?",
 'ham\tGreat escape. I fancy the bridge but needs her lager. See you tomo',
 'ham\tYes :)it completely in out of form:)clark also utter waste.',
 'ham\tSir, I need AXIS BANK account no and bank address.',
 'ham\tHmmm.. Thk sure got time to hop ard... Ya, can go 4 free abt... Muz call u
to discuss liao...',
 'ham\tWhat time you coming down later?',
 'ham\tBloody hell, cant believe you forgot my surname Mr . Ill give u a clue, its
spanish and begins with m...',
 "ham\tWell, i'm gonna finish my bath now. Have a good...fine night.",
 "ham\tLet me know when you've got the money so carlos can make the call",
 'ham\tU still going to the mall?',
 "ham\tTurns out my friends are staying for the whole show and won't be back til ~
&lt;#&gt; , so feel free to go ahead and smoke that $ &lt;#&gt;  worth",
 'ham\tText her. If she doesnt reply let me know so i can have her log in',
 "ham\tHi! You just spoke to MANEESHA V. We'd like to know if you were satisfied w
ith the experience. Reply Toll Free with Yes or No.",
 'ham\tYou lifted my hopes with the offer of money. I am in need. Especially when
the end of the month approaches and it hurts my studying. Anyways have a gr8 weeke
nd',
 'ham\tLol no. U can trust me.',
 'ham\tok. I am a gentleman and will treat you with dignity and respect.',
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 'ham\tHe will, you guys close?',
 'ham\tGoing on nothing great.bye',
 "ham\tHello handsome ! Are you finding that job ? Not being lazy ? Working toward
s getting back that net for mummy ? Where's my boytoy now ? Does he miss me ?",
 'ham\tHaha awesome, be there in a minute',
 'spam\tPlease call our customer service representative on FREEPHONE 0808 145 4742
between 9am-11pm as you have WON a guaranteed Â£1000 cash or Â£5000 prize!',
 'ham\tHave you got Xmas radio times. If not i will get it now',
 'ham\tI jus reached home. I go bathe first. But my sis using net tell u when she
finishes k...',
 'spam\tAre you unique enough? Find out from 30th August. www.areyouunique.co.uk',
 "ham\tI'm sorry. I've joined the league of people that dont keep in touch. You me
an a great deal to me. You have been a friend at all times even at great personal
cost. Do have a great week.|",
 'ham\tHi :)finally i completed the course:)',
 'ham\tIt will stop on itself. I however suggest she stays with someone that will
be able to give ors for every stool.',
 "ham\tHow are you doing? Hope you've settled in for the new school year. Just wis
hin you a gr8 day",
 'ham\tGud mrng dear hav a nice day',
 'ham\tDid u got that persons story',
 'ham\tis your hamster dead? Hey so tmr i meet you at 1pm orchard mrt?',
 'ham\tHi its Kate how is your evening? I hope i can see you tomorrow for a bit bu
t i have to bloody babyjontet! Txt back if u can. :) xxx',
 'ham\tFound it, ENC  &lt;#&gt; , where you at?',
 'ham\tI sent you  &lt;#&gt;  bucks',
 'ham\tHello darlin ive finished college now so txt me when u finish if u can love
Kate xxx',
 'ham\tYour account has been refilled successfully by INR  &lt;DECIMAL&gt; . Your
KeralaCircle prepaid account balance is Rs  &lt;DECIMAL&gt; . Your Transaction ID
is KR &lt;#&gt; .',
 'ham\tGoodmorning sleeping ga.',
 'ham\tU call me alter at 11 ok.',
 'ham\tÃœ say until like dat i dun buy ericsson oso cannot oredi lar...',
 "ham\tAs I entered my cabin my PA said, '' Happy B'day Boss !!''. I felt special.
She askd me 4 lunch. After lunch she invited me to her apartment. We went there.",
 'ham\tAight yo, dats straight dogg',
 'ham\tYou please give us connection today itself before  &lt;DECIMAL&gt;  or refu
nd the bill',
 'ham\tBoth :) i shoot big loads so get ready!',
 "ham\tWhat's up bruv, hope you had a great break. Do have a rewarding semester.",
 'ham\tHome so we can always chat',
 'ham\tK:)k:)good:)study well.',
 'ham\tYup... How Ã¼ noe leh...',
 'ham\tSounds great! Are you home now?',
 'ham\tFinally the match heading towards draw as your prediction.',
 "ham\tTired. I haven't slept well the past few nights.",
 'ham\tEasy ah?sen got selected means its good..',
 'ham\tI have to take exam with march 3',
 "ham\tYeah you should. I think you can use your gt atm now to register. Not sure
but if there's anyway i can help let me know. But when you do be sure you are read
y.",
 'ham\tOk no prob. Take ur time.',
 'ham\tThere is os called ubandu which will run without installing in hard disk...
you can use that os to copy the important files in system and give it to repair sh
op..',
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 "ham\tSorry, I'll call later",
 'ham\tU say leh... Of course nothing happen lar. Not say v romantic jus a bit onl
y lor. I thk e nite scenery not so nice leh.',
 'spam\t500 New Mobiles from 2004, MUST GO! Txt: NOKIA to No: 89545 & collect your
s today!From ONLY Â£1 www.4-tc.biz 2optout 087187262701.50gbp/mtmsg18',
 'ham\tWould really appreciate if you call me. Just need someone to talk to.',
 'spam\tWill u meet ur dream partner soon? Is ur career off 2 a flyng start? 2 fin
d out free, txt HORO followed by ur star sign, e. g. HORO ARIES',
 'ham\tHey company elama po mudyadhu.',
 'ham\tLife is more strict than teacher... Bcoz Teacher teaches lesson &amp;amp; then
conducts exam, But Life first conducts Exam &amp;amp; then teaches Lessons. Happy morn
ing. . .',
 'ham\tDear good morning now only i am up',
 'ham\tGet down in gandhipuram and walk to cross cut road. Right side &lt;#&gt; st
reet road and turn at first right.',
 'ham\tDear we are going to our rubber place',
 "ham\tSorry battery died, yeah I'm here",
 'ham\tYes:)here tv is always available in work place..',
 'spam\tText & meet someone sexy today. U can find a date or even flirt its up to
U. Join 4 just 10p. REPLY with NAME & AGE eg Sam 25. 18 -msg recd@thirtyeight penc
e',
 'ham\tI have printed it oh. So  &lt;#&gt;  come upstairs',
 'ham\tOr ill be a little closer like at the bus stop on the same street',
 'ham\tWhere are you?when wil you reach here?',
 "ham\tNew Theory: Argument wins d SITUATION, but loses the PERSON. So dont argue
with ur friends just.. . . . kick them &amp;amp; say, I'm always correct.!",
 'spam\tU 447801259231 have a secret admirer who is looking 2 make contact with U-
find out who they R*reveal who thinks UR so special-call on 09058094597',
 'ham\tTomarrow final hearing on my laptop case so i cant.',
 'ham\tPLEASSSSSSSEEEEEE TEL ME V AVENT DONE SPORTSx',
 'ham\tOkay. No no, just shining on. That was meant to be signing, but that sounds
better.',
 "ham\tAlthough i told u dat i'm into baig face watches now but i really like e wa
tch u gave cos it's fr u. Thanx 4 everything dat u've done today, i'm touched...",
 "ham\tU don't remember that old commercial?",
 "ham\tToo late. I said i have the website. I didn't i have or dont have the slipp
ers",
 'ham\tI asked you to call him now ok',
 'ham\tKallis wont bat in 2nd innings.',
 'ham\tIt didnt work again oh. Ok goodnight then. I.ll fix and have it ready by th
e time you wake up. You are very dearly missed have a good night sleep.',
 'spam\tCongratulations ur awarded 500 of CD vouchers or 125gift guaranteed & Free
entry 2 100 wkly draw txt MUSIC to 87066 TnCs www.Ldew.com1win150ppmx3age16',
 'ham\tRanjith cal drpd Deeraj and deepak 5min hold',
 'ham\tWen ur lovable bcums angry wid u, dnt take it seriously.. Coz being angry i
s d most childish n true way of showing deep affection, care n luv!.. kettoda mand
a... Have nice day da.',
 'ham\tWhat you doing?how are you?',
 'ham\tUps which is 3days also, and the shipping company that takes 2wks. The othe
r way is usps which takes a week but when it gets to lag you may have to bribe nip
ost to get your stuff.',
 "ham\tI'm back, lemme know when you're ready",
 "ham\tDon't necessarily expect it to be done before you get back though because
I'm just now headin out",
 'ham\tMmm so yummy babe ... Nice jolt to the suzy',
 'ham\tWhere are you lover ? I need you ...',
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 'spam\tWe tried to contact you re your reply to our offer of a Video Handset? 750
anytime networks mins? UNLIMITED TEXT? Camcorder? Reply or call 08000930705 NOW',
 'ham\tIâ€˜m parked next to a MINI!!!! When are you coming in today do you thin
k?',
 'ham\tYup',
 "ham\tAnyway i'm going shopping on my own now. Cos my sis not done yet. Dun distu
rb u liao.",
 'ham\tMY NO. IN LUTON 0125698789 RING ME IF UR AROUND! H*',
 'spam\tHey I am really horny want to chat or see me naked text hot to 69698 text
charged at 150pm to unsubscribe text stop 69698',
 'ham\tWhy you Dint come with us.',
 'ham\tSame. Wana plan a trip sometme then',
 'ham\tNot sure yet, still trying to get a hold of him',
 'spam\tUr ringtone service has changed! 25 Free credits! Go to club4mobiles.com t
o choose content now! Stop? txt CLUB STOP to 87070. 150p/wk Club4 PO Box1146 MK45
2WT',
 'ham\tThe evo. I just had to download flash. Jealous?',
 'spam\tRingtone Club: Get the UK singles chart on your mobile each week and choos
e any top quality ringtone! This message is free of charge.',
 "ham\tCome to mu, we're sorting out our narcotics situation",
 'ham\tNight has ended for another day, morning has come in a special way. May you
smile like the sunny rays and leaves your worries at the blue blue bay.',
 'spam\tHMV BONUS SPECIAL 500 pounds of genuine HMV vouchers to be won. Just answe
r 4 easy questions. Play Now! Send HMV to 86688 More info:www.100percent-real.co
m',
 'ham\tUsf I guess, might as well take 1 car',
 'ham\tNo objection. My bf not coming.',
 'ham\tThanx...',
 'ham\tTell rob to mack his gf in the theater',
 "ham\tAwesome, I'll see you in a bit",
 'ham\tJust sent it. So what type of food do you like?',
 'ham\tAll done? All handed in? Celebrations in full swing yet?',
 'ham\tYou got called a tool?',
 'ham\t"Wen u miss someone, the person is definitely special for u..... But if the
person is so special, why to miss them, just Keep-in-touch" gdeve..',
 'ham\tOk. I asked for money how far',
 'ham\tOkie...',
 "ham\tYeah I think my usual guy's still passed out from last night, if you get ah
old of anybody let me know and I'll throw down",
 'ham\tK, I might come by tonight then if my class lets out early',
 'ham\tOk..',
 'ham\thi baby im cruisin with my girl friend what r u up 2? give me a call in and
hour at home if thats alright or fone me on this fone now love jenny xxx',
 'ham\tMy life Means a lot to me, Not because I love my life, But because I love t
he people in my life, The world calls them friends, I call them my World:-).. Ge:
-)..',
 'ham\tDear,shall mail tonite.busy in the street,shall update you tonite.things ar
e looking ok.varunnathu edukkukayee raksha ollu.but a good one in real sense.',
 'ham\tHey you told your name to gautham ah?',
 'ham\tHaf u found him? I feel so stupid da v cam was working.',
 'ham\tOops. 4 got that bit.',
 'ham\tAre you this much buzy',
 'ham\tI accidentally deleted the message. Resend please.',
 "spam\tT-Mobile customer you may now claim your FREE CAMERA PHONE upgrade & a pay
& go sim card for your loyalty. Call on 0845 021 3680.Offer ends 28thFeb.T&C's app
ly",
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 "ham\tUnless it's a situation where YOU GO GURL would be more appropriate",
 'ham\tHurt me... Tease me... Make me cry... But in the end of my life when i die
plz keep one rose on my grave and say STUPID I MISS U.. HAVE A NICE DAY BSLVYL',
 'ham\tI cant pick the phone right now. Pls send a message',
 "ham\tNeed a coffee run tomo?Can't believe it's that time of week already",
 'ham\tAwesome, I remember the last time we got somebody high for the first time w
ith diesel :V',
 'ham\tShit that is really shocking and scary, cant imagine for a second. Def up f
or night out. Do u think there is somewhere i could crash for night, save on tax
i?',
 'ham\tOh and by the way you do have more food in your fridge! Want to go out for
a meal tonight?',
 'ham\tHe is a womdarfull actor',
 'spam\tSMS. ac Blind Date 4U!: Rodds1 is 21/m from Aberdeen, United Kingdom. Chec
k Him out http://img. sms. ac/W/icmb3cktz8r7!-4 no Blind Dates send HIDE',
 'ham\tYup... From what i remb... I think should be can book...',
 'ham\tJos ask if u wana meet up?',
 "ham\tLol yes. Our friendship is hanging on a thread cause u won't buy stuff.",
 'spam\tTheMob> Check out our newest selection of content, Games, Tones, Gossip, b
abes and sport, Keep your mobile fit and funky text WAP to 82468',
 "ham\tWhere are the garage keys? They aren't on the bookshelf",
 'ham\tToday is ACCEPT DAY..U Accept me as? Brother Sister Lover Dear1 Best1 Clos1
Lvblefrnd Jstfrnd Cutefrnd Lifpartnr Belovd Swtheart Bstfrnd No rply means enemy',
 'spam\tThink ur smart ? Win Â£200 this week in our weekly quiz, text PLAY to 8522
2 now!T&Cs WinnersClub PO BOX 84, M26 3UZ. 16+. GBP1.50/week',
 "ham\tHe says he'll give me a call when his friend's got the money but that he's
definitely buying before the end of the week",
 'ham\tHi the way I was with u 2day, is the normal way&this is the real me. UR uni
que&I hope I know u 4 the rest of mylife. Hope u find wot was lost.',
 'ham\tYou made my day. Do have a great day too.',
 'ham\tK.k:)advance happy pongal.',
 'ham\tHmmm... Guess we can go 4 kb n power yoga... Haha, dunno we can tahan power
yoga anot... Thk got lo oso, forgot liao...',
 "ham\tNot really dude, have no friends i'm afraid :(",
 'spam\tDecember only! Had your mobile 11mths+? You are entitled to update to the
latest colour camera mobile for Free! Call The Mobile Update Co FREE on 0800298690
6',
 'ham\tCoffee cake, i guess...',
 'ham\tMerry Christmas to you too babe, i love ya *kisses*',
 'ham\tHey... Why dont we just go watch x men and have lunch... Haha',
 'ham\tcud u tell ppl im gona b a bit l8 cos 2 buses hav gon past cos they were fu
ll & im still waitin 4 1. Pete x',
 "ham\tThat would be great. We'll be at the Guild. Could meet on Bristol road or s
omewhere - will get in touch over weekend. Our plans take flight! Have a good wee
k",
 'ham\tNo problem. How are you doing?',
 'ham\tNo calls..messages..missed calls',
 'ham\tHi da:)how is the todays class?',
 "ham\tI'd say that's a good sign but, well, you know my track record at reading w
omen",
 "ham\tCool, text me when you're parked",
 "ham\tI'm reading the text i just sent you. Its meant to be a joke. So read it in
that light",
 'ham\tK.k:)apo k.good movie.',
 'ham\tMaybe i could get book out tomo then return it immediately ..? Or somethin
g.',
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 'spam\tCall Germany for only 1 pence per minute! Call from a fixed line via acces
s number 0844 861 85 85. No prepayment. Direct access!',
 "ham\tAny chance you might have had with me evaporated as soon as you violated my
privacy by stealing my phone number from your employer's paperwork. Not cool at al
l. Please do not contact me again or I will report you to your supervisor.",
 'spam\tValentines Day Special! Win over Â£1000 in our quiz and take your partner
on the trip of a lifetime! Send GO to 83600 now. 150p/msg rcvd. CustCare:087187202
01.',
 'ham\tTa-Daaaaa! I am home babe, are you still up ?',
 'ham\tCool. So how come you havent been wined and dined before?',
 'ham\tJust sleeping..and surfing',
 "ham\tSorry, I'll call later",
 'ham\tU calling me right? Call my hand phone...',
 "ham\tOk that's great thanx a lot.",
 'ham\tI take it the post has come then! You must have 1000s of texts now! Happy r
eading. My one from wiv hello caroline at the end is my favourite. Bless him',
 'ham\tWhere u been hiding stranger?',
 'ham\tAm not interested to do like that.',
 'ham\tMy sister cleared two round in birla soft yesterday.',
 'ham\tGudnite....tc...practice going on',
 'ham\tDis is yijue. I jus saw ur mail. In case huiming havent sent u my num. Dis
is my num.',
 'ham\tOne small prestige problem now.',
 'spam\tFancy a shag? I do.Interested? sextextuk.com txt XXUK SUZY to 69876. Txts
cost 1.50 per msg. TnCs on website. X',
 'ham\tJust checking in on you. Really do miss seeing Jeremiah. Do have a great mo
nth',
 "ham\tNah can't help you there, I've never had an iphone",
 "ham\tIf you're not in my car in an hour and a half I'm going apeshit",
 "ham\tTODAY is Sorry day.! If ever i was angry with you, if ever i misbehaved or
hurt you? plz plz JUST SLAP URSELF Bcoz, Its ur fault, I'm basically GOOD",
 'ham\tYo you guys ever figure out how much we need for alcohol? Jay and I are try
ing to figure out how much we can safely spend on weed',
 'ham\t&lt;#&gt; ISH MINUTES WAS 5 MINUTES AGO. WTF.',
 'ham\tThank You for calling.Forgot to say Happy Onam to you Sirji.I am fine here
and remembered you when i met an insurance person.Meet You in Qatar Insha Allah.Ra
khesh, ex Tata AIG who joined TISSCO,Tayseer.',
 'spam\tCongratulations ur awarded 500 of CD vouchers or 125gift guaranteed & Free
entry 2 100 wkly draw txt MUSIC to 87066 TnCs www.Ldew.com1win150ppmx3age16',
 'spam\tUr cash-balance is currently 500 pounds - to maximize ur cash-in now send
CASH to 86688 only 150p/msg. CC: 08708800282 HG/Suite342/2Lands Row/W1J6HL',
 "ham\tI'm an actor. When i work, i work in the evening and sleep late. Since i'm
unemployed at the moment, i ALWAYS sleep late. When you're unemployed, every day i
s saturday.",
 'ham\tHello! Just got here, st andrews-boy its a long way! Its cold. I will keep
you posted',
 'ham\tHa ha cool cool chikku chikku:-):-DB-)',
 'ham\tOh ok no prob..',
 "ham\tCheck audrey's status right now",
 'ham\tBusy here. Trying to finish for new year. I am looking forward to finally m
eeting you...',
 'ham\tGood afternoon sunshine! How dawns that day ? Are we refreshed and happy to
be alive? Do we breathe in the air and smile ? I think of you, my love ... As alwa
ys',
 'ham\tWell i know Z will take care of me. So no worries.',
 'spam\tUpdate_Now - Xmas Offer! Latest Motorola, SonyEricsson & Nokia & FREE Blue
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tooth! Double Mins & 1000 Txt on Orange. Call MobileUpd8 on 08000839402 or call2op
tout/F4Q=',
 'spam\tHere is your discount code RP176781. To stop further messages reply stop.
www.regalportfolio.co.uk. Customer Services 08717205546',
 'ham\tWat uniform? In where get?',
 "ham\tCool, text me when you're ready",
 'ham\tHello my boytoy ... Geeee I miss you already and I just woke up. I wish you
were here in bed with me, cuddling me. I love you ...',
 'ham\tI will spoil you in bed as well :)',
 "ham\tI'm going for bath will msg you next <#> min..",
 'ham\tI cant keep talking to people if am not sure i can pay them if they agree t
o price. So pls tell me what you want to really buy and how much you are willing t
o pay',
 'spam\tThanks for your Ringtone Order, Reference T91. You will be charged GBP 4 p
er week. You can unsubscribe at anytime by calling customer services on 0905703999
4',
 'ham\tCan you say what happen',
 "ham\tYou could have seen me..i did't recognise you Face.:)",
 "ham\tWell there's not a lot of things happening in Lindsay on New years *sighs*
Some bars in Ptbo and the blue heron has something going",
 'ham\tKeep my payasam there if rinu brings',
 'ham\tI taught that Ranjith sir called me. So only i sms like that. Becaus hes ve
rifying about project. Prabu told today so only pa dont mistake me..',
 "ham\tI guess that's why you re worried. You must know that there's a way the bod
y repairs itself. And i'm quite sure you shouldn't worry. We'll take it slow. Firs
t the tests, they will guide when your ovulation is then just relax. Nothing you'v
e said is a reason to worry but i.ll keep on followin you up.",
 'ham\tYeah sure, give me a couple minutes to track down my wallet',
 'ham\tHey leave it. not a big deal:-) take care.',
 'ham\tHey i will be late ah... Meet you at 945+',
 'spam\tDouble mins and txts 4 6months FREE Bluetooth on Orange. Available on Son
y, Nokia Motorola phones. Call MobileUpd8 on 08000839402 or call2optout/N9DX',
 'ham\tIt took Mr owl 3 licks',
 'ham\tCustomer place i will call you.',
 'ham\tMm that time you dont like fun',
 'spam\t4mths half price Orange line rental & latest camera phones 4 FREE. Had you
r phone 11mths ? Call MobilesDirect free on 08000938767 to update now! or2stoptx
t',
 'ham\tYup having my lunch buffet now.. U eat already?',
 'ham\tHuh so late... Fr dinner?',
 'ham\tHey so this sat are we going for the intro pilates only? Or the kickboxing
too?',
 'ham\tMorning only i can ok.',
 'ham\tYes i think so. I am in office but my lap is in room i think thats on for t
he last few days. I didnt shut that down',
 'ham\tPick you up bout 7.30ish? What time are and that going?',
 'ham\tFrom here after The performance award is calculated every two month.not for
current one month period..',
 'ham\tWas actually sleeping and still might when u call back. So a text is gr8. Y
ou rock sis. Will send u a text wen i wake.',
 "ham\tYou are always putting your business out there. You put pictures of your as
s on facebook. You are one of the most open people i've ever met. Why would i thin
k a picture of your room would hurt you, make you feel violated.",
 'ham\tGood evening Sir, Al Salam Wahleykkum.sharing a happy news.By the grace of
God, i got an offer from Tayseer,TISSCO and i joined.Hope you are fine.Inshah Alla
h,meet you sometime.Rakhesh,visitor from India.',

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 'ham\tHmmm...k...but i want to change the field quickly da:-)i wanna get system a
dministrator or network administrator..',
 'spam\tFREE RINGTONE text FIRST to 87131 for a poly or text GET to 87131 for a tr
ue tone! Help? 0845 2814032 16 after 1st free, tones are 3xÂ£150pw to eÂ£nd txt st
op',
 'ham\tDear how is chechi. Did you talk to her',
 'ham\tThe hair cream has not been shipped.',
 "ham\tNone of that's happening til you get here though",
 'ham\tYep, the great loxahatchee xmas tree burning of  &lt;#&gt;  starts in an ho
ur',
 'ham\tHaha get used to driving to usf man, I know a lot of stoners',
 "ham\tAll was well until slightly disastrous class this pm with my fav darlings!
Hope day off ok. Coffee wld be good as can't stay late tomorrow. Same time + place
as always?",
 'ham\tHello! Good week? Fancy a drink or something later?',
 'ham\tHeadin towards busetop',
 'ham\tMessage:some text missing* Sender:Name Missing* *Number Missing *Sent:Date
missing *Missing U a lot thats y everything is missing sent via fullonsms.com',
 'ham\tCome by our room at some point so we can iron out the plan for this weeken
d',
 'ham\tCos i want it to be your thing',
 "ham\tOkies... I'll go yan jiu too... We can skip ard oso, go cine den go mrt on
e, blah blah blah...",
 'ham\tBring home some Wendy =D',
 'spam\t100 dating service cal;l 09064012103 box334sk38ch',
 'ham\tWhatsup there. Dont u want to sleep',
 'ham\tAlright i have a new goal now',
 'spam\tFREE entry into our Â£250 weekly competition just text the word WIN to 800
86 NOW. 18 T&C www.txttowin.co.uk',
 "ham\tAlright, I'll head out in a few minutes, text me where to meet you",
 'spam\tSend a logo 2 ur lover - 2 names joined by a heart. Txt LOVE NAME1 NAME2 M
OBNO eg LOVE ADAM EVE 07123456789 to 87077 Yahoo! POBox36504W45WQ TxtNO 4 no ads 1
50p',
 "ham\tYes:)from last week itself i'm taking live call.",
 'spam\tSomeone has contacted our dating service and entered your phone because th
ey fancy you! To find out who it is call from a landline 09111032124 . PoBox12n146
tf150p',
 'ham\tSiva is in hostel aha:-.',
 'spam\tURGENT! Your Mobile number has been awarded with a Â£2000 prize GUARANTEE
D. Call 09058094455 from land line. Claim 3030. Valid 12hrs only',
 'ham\tSend this to ur friends and receive something about ur voice..... How is my
speaking expression? 1.childish 2.naughty 3.Sentiment 4.rowdy 5.ful of attitude 6.
romantic 7.shy 8.Attractive 9.funny  &lt;#&gt; .irritating  &lt;#&gt; .lovable. re
ply me..',
 "ham\tOk. She'll be ok. I guess",
 'ham\taathi..where are you dear..',
 'ham\tAny pain on urination any thing else?',
 'ham\t7 at esplanade.. Do Ã¼ mind giving me a lift cos i got no car today..',
 'ham\tI wnt to buy a BMW car urgently..its vry urgent.but hv a shortage of  &lt;#
&gt; Lacs.there is no source to arng dis amt. &lt;#&gt; lacs..thats my prob',
 'ham\tAt home watching tv lor.',
 'ham\tDoes she usually take fifteen fucking minutes to respond to a yes or no que
stion',
 'spam\tCongrats! Nokia 3650 video camera phone is your Call 09066382422 Calls cos
t 150ppm Ave call 3mins vary from mobiles 16+ Close 300603 post BCM4284 Ldn WC1N3X
X',
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'ham\tBooked ticket for pongal?',
"ham\tYou available now? I'm like right around hillsborough & <#> th",
'ham\tThe message sent is askin for <#> dollars. Shoul i pay <#> o
r <#> ?',
"ham\tAsk g or iouri, I've told the story like ten times already",
'ham\tHow long does applebees fucking take',
'ham\tHi hope u get this txt~journey hasnt been gd,now about 50 mins late I thin
k.',
'ham\tBut i have to. I like to have love and arrange.',
'ham\tYes..he is really great..bhaji told kallis best cricketer after sachin in w
orld:).very tough to get out.',
'ham\tYou were supposed to wake ME up >:(',
'ham\tOic... I saw him too but i tot he din c me... I found a group liao...',
"ham\tSorry, I'll call later",
'ham\t"HEY HEY WERETHE MONKEESPEOPLE SAY WE MONKEYAROUND! HOWDY GORGEOUS, HOWU DO
IN? FOUNDURSELF A JOBYET SAUSAGE?LOVE JEN XXX"',
"ham\tSorry, my battery died, I can come by but I'm only getting a gram for now,
where's your place?",
'ham\tWell done, blimey, exercise, yeah, i kinda remember wot that is, hmm.',
'ham\tI wont get concentration dear you know you are my mind and everything :-)',
'ham\tLOL ... Have you made plans for new years?',
'ham\t10 min later k...',
'ham\thanks lotsly!',
'ham\tThanks for this hope you had a good day today',
'ham\tK:)k:)what are detail you want to transfer?acc no enough?',
'ham\tOk i will tell her to stay out. Yeah its been tough but we are optimistic t
hings will improve this month.',
"spam\tLoan for any purpose Â£500 - Â£75,000. Homeowners + Tenants welcome. Have
you been previously refused? We can still help. Call Free 0800 1956669 or text bac
k 'help'",
'ham\tSi si. I think ill go make those oreo truffles.',
'ham\tLOOK AT AMY URE A BEAUTIFUL, INTELLIGENT WOMAN AND I LIKE U A LOT. I KNOW U
DONÂ’T LIKE ME LIKE THAT SO DONÂ’T WORRY.',
"ham\tI hope you that's the result of being consistently intelligent and kind. St
art asking him about practicum links and keep your ears open and all the best. tty
l",
'ham\t1.20 that call cost. Which i guess isnt bad. Miss ya, need ya, want ya, lov
e ya',
'ham\tGoing thru a very different feeling.wavering decisions and coping up with t
he same is the same individual.time will heal everything i believe.',
'ham\tWhere did u go? My phone is gonna die you have to stay in here',
'ham\tGreat. Never been better. Each day gives even more reasons to thank God',
"spam\tUpgrdCentre Orange customer, you may now claim your FREE CAMERA PHONE upgr
ade for your loyalty. Call now on 0207 153 9153. Offer ends 26th July. T&C's appl
y. Opt-out available",
"ham\tSorry, I'll call later ok bye",
'ham\tOk i am on the way to railway',
'ham\tgreat princess! I love giving and receiving oral. Doggy style is my fave po
sition. How about you? I enjoy making love <#> times per night :)',
"ham\tThey don't put that stuff on the roads to keep it from getting slippery ove
r there?",
'ham\tWhen are you going to ride your bike?',
"ham\tYup, no need. I'll jus wait 4 e rain 2 stop.",
'ham\tThere are many company. Tell me the language.',
'spam\tokmail: Dear Dave this is your final notice to collect your 4* Tenerife Ho
liday or #5000 CASH award! Call 09061743806 from landline. TCs SAE Box326 CW25WX 1

50ppm',
 'ham\tHow long has it been since you screamed, princess?',
 'ham\tNothing. I meant that once the money enters your account here, the bank wil
l remove its flat rate. Someone transfered <#> to my account and <#&g
t; dollars got removed. So the banks differ and charges also differ.be sure you tr
ust the 9ja person you are sending account details to cos...',
 "spam\tWant 2 get laid tonight? Want real Dogging locations sent direct 2 ur Mob?
Join the UK's largest Dogging Network by txting MOAN to 69888Nyt. ec2a. 31p.msg@15
0p",
 "ham\tNice line said by a broken heart- Plz don't cum 1 more times infront of m
e... Other wise once again I ll trust U... Good 9t:)",
 "ham\tOk I'm gonna head up to usf in like fifteen minutes",
 'ham\tLove you aathi..love u lot..',
 'ham\tTension ah?what machi?any problem?',
 "ham\tK, can I pick up another 8th when you're done?",
 "ham\tWhen're you guys getting back? G said you were thinking about not staying f
or mcr",
 'ham\tAlmost there, see u in a sec',
 'ham\tYo carlos, a few friends are already asking me about you, you working at al
l this weekend?',
 'ham\tWatching tv lor...',
 'ham\tThank you baby! I cant wait to taste the real thing...',
 'ham\tYou should change your fb to jaykwon thuglyfe falconerf',
 'ham\tIf we win its really no 1 side for long time.',
 'spam\tFREE MESSAGE Activate your 500 FREE Text Messages by replying to this mess
age with the word FREE For terms & conditions, visit www.07781482378.com',
 'ham\tDear reached railway. What happen to you',
 'ham\tDepends on quality. If you want the type i sent boye, faded glory, then abo
ut 6. If you want ralphs maybe 2',
 "ham\tI think i've fixed it can you send a test message?",
 "ham\tSorry man my account's dry or I would, if you want we could trade back half
or I could buy some shit with my credit card",
 'spam\tCongrats! 1 year special cinema pass for 2 is yours. call 09061209465 now!
C Suprman V, Matrix3, StarWars3, etc all 4 FREE! bx420-ip4-5we. 150pm. Dont miss o
ut!',
 "ham\tSorry,in meeting I'll call later",
 'ham\tWhat class of <#> reunion?',
 'ham\tAre you free now?can i call now?',
 'ham\tGot meh... When?',
 'ham\tNope... Think i will go for it on monday... Sorry i replied so late',
 'ham\tSome of them told accenture is not confirm. Is it true.',
 'ham\tKate jackson rec center before 7ish, right?',
 'ham\tDear i have reache room',
 'ham\tFighting with the world is easy, u either win or lose bt fightng with some1
who is close to u is dificult if u lose - u lose if u win - u still lose.',
 'ham\tWhen can Ã¼ come out?',
 'ham\tCheck with nuerologist.',
 'ham\tLolnice. I went from a fish to ..water.?',
 "spam\t+123 Congratulations - in this week's competition draw u have won the Â£14
50 prize to claim just call 09050002311 b4280703. T&Cs/stop SMS 08718727868. Over
18 only 150ppm",
 "ham\tNo it's waiting in e car dat's bored wat. Cos wait outside got nothing 2 d
o. At home can do my stuff or watch tv wat.",
 'ham\tMaybe westshore or hyde park village, the place near my house?',
 "ham\tYou should know now. So how's anthony. Are you bringing money. I've school
fees to pay and rent and stuff like that. Thats why i need your help. A friend in

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need....|",
 "ham\tWhat's the significance?",
 'ham\tYour opinion about me? 1. Over 2. Jada 3. Kusruthi 4. Lovable 5. Silent 6. Spl character 7. Not matured 8. Stylish 9. Simple Pls reply..',
 "ham\t8 at the latest, g's still there if you can scrounge up some ammo and want to give the new ak a try",
 "ham\tPrabha..i'm soryda..realy..frm heart i'm sory",
 'ham\tLol ok your forgiven :)',
 'ham\tNo..jst change tat only..',
 'spam\tYou are guaranteed the latest Nokia Phone, a 40GB iPod MP3 player or a Â£5 00 prize! Txt word: COLLECT to No: 83355! IBHltd LdnW15H 150p/Mtmsgrcvd18+',
 'ham\tS:)no competition for him.',
 'spam\tBoltblue tones for 150p Reply POLY# or MONO# eg POLY3 1. Cha Cha Slide 2. Yeah 3. Slow Jamz 6. Toxic 8. Come With Me or STOP 4 more tones txt MORE',
 'spam\tYour credits have been topped up for http://www.bubbletext.com Your renewa l Pin is tgxxrz',
 'ham\tThat way transport is less problematic than on sat night. By the way, if u want to ask  n  to join my bday, feel free. But need to know definite nos as booki ng on fri.',
 "ham\tUsually the person is unconscious that's in children but in adults they may just behave abnormally. I.ll call you now",
 "ham\tBut that's on ebay it might be less elsewhere.",
 'ham\tShall i come to get pickle',
 'ham\tWere gonna go get some tacos',
 "ham\tThat's very rude, you on campus?",
 'spam\tURGENT!: Your Mobile No. was awarded a Â£2,000 Bonus Caller Prize on 02/0 9/03! This is our 2nd attempt to contact YOU! Call 0871-872-9755 BOX95QU',
 "ham\tHi i won't b ard 4 christmas. But do enjoy n merry x'mas.",
 "spam\tToday's Offer! Claim ur Â£150 worth of discount vouchers! Text YES to 8502 3 now! SavaMob, member offers mobile! T Cs 08717898035. Â£3.00 Sub. 16 . Unsub rep ly X",
 'ham\tYes! How is a pretty lady like you single?',
 'spam\tYou will recieve your tone within the next 24hrs. For Terms and conditions please see Channel U Teletext Pg 750',
 "ham\tJay says that you're a double-faggot",
 'spam\tPRIVATE! Your 2003 Account Statement for 07815296484 shows 800 un-redeemed S.I.M. points. Call 08718738001 Identifier Code 41782 Expires 18/11/04',
 'ham\tWhat Today-sunday..sunday is holiday..so no work..',
 'ham\tGudnite....tc...practice going on',
 "ham\tI'll be late...",
 "ham\tI've not called you in a while. This is hoping it was l8r malaria and that you know that we miss you guys. I miss Bani big, so pls give her my love especiall y. Have a great day.",
 'ham\tGood afternoon, my love! How goes that day ? I hope maybe you got some lead s on a job. I think of you, boytoy and send you a passionate kiss from across the sea',
 'ham\tProbably gonna be here for a while, see you later tonight &lt;)',
 "ham\tOr maybe my fat fingers just press all these buttons and it doesn't know wh at to do.",
 'ham\tUmmmmmaah Many many happy returns of d day my dear sweet heart.. HAPPY BIRT HDAY dear',
 'ham\tI am in tirupur da, once you started from office call me.',
 'spam\tfrom www.Applausestore.com MonthlySubscription@50p/msg max6/month T&CsC we b age16 2stop txt stop',
 "ham\tA famous quote : when you develop the ability to listen to 'anything' uncon ditionally without losing your temper or self confidence, it means you are
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..... 'MARRIED'",
 'ham\tBut am going to college pa. What to do. are else ill come there it self. P
a.',
 'ham\t4 oclock at mine. Just to bash out a flat plan.',
 "ham\tThis girl does not stay in bed. This girl doesn't need recovery time. Id ra
ther pass out while having fun then be cooped up in bed",
 'ham\tThen any special there?',
 "ham\tI know but you need to get hotel now. I just got my invitation but i had to
apologise. Cali is to sweet for me to come to some english bloke's weddin",
 'ham\tSorry that took so long, omw now',
 'ham\tWait  &lt;#&gt;  min..',
 "ham\tOk give me 5 minutes I think I see her. BTW you're my alibi. You were cutti
ng my hair the whole time.",
 'ham\tImagine you finally get to sink into that bath after I have put you through
your paces, maybe even having you eat me for a while before I left ... But also im
agine the feel of that cage on your cock surrounded by the bath water, reminding y
ou always who owns you ... Enjoy, my cuck',
 "ham\tHurry up, I've been weed-deficient for like three days",
 "ham\tSure, if I get an acknowledgement from you that it's astoundingly tactless
and generally faggy to demand a blood oath fo",
 "ham\tOk. Every night take a warm bath drink a cup of milk and you'll see a work
of magic. You still need to loose weight. Just so that you know",
 'ham\tIâ€˜ll have a look at the frying pan in case itâ€˜s cheap or a book perhap
s. No thatâ€˜s silly a frying pan isnâ€˜t likely to be a book',
 'ham\tO. Well uv causes mutations. Sunscreen is like essential thesedays',
 'ham\tHaving lunch:)you are not in online?why?',
 'ham\tI know that my friend already told that.',
 'ham\tHi Princess! Thank you for the pics. You are very pretty. How are you?',
 'ham\tAiyo... U always c our ex one... I dunno abt mei, she haven reply... First
time u reply so fast... Y so lucky not workin huh, got bao by ur sugardad ah...ge
e..',
 "ham\tHi msg me:)i'm in office..",
 "ham\tThanx 4 e brownie it's v nice...",
 'ham\tGeeeee ... I love you so much I can barely stand it',
 'spam\tGENT! We are trying to contact you. Last weekends draw shows that you won
a Â£1000 prize GUARANTEED. Call 09064012160. Claim Code K52. Valid 12hrs only. 150
ppm',
 "ham\tFuck babe ... I miss you already, you know ? Can't you let me send you some
money towards your net ? I need you ... I want you ... I crave you ...",
 'ham\tIll call u 2mrw at ninish, with my address that icky American freek wont st
op callin me 2 bad Jen k eh?',
 'ham\tOooh bed ridden ey? What are YOU thinking of?',
 'ham\tSo anyways, you can just go to your gym or whatever, my love *smiles* I hop
e your ok and having a good day babe ... I miss you so much already',
 'ham\tLove it! Daddy will make you scream with pleasure! I am going to slap your
ass with my dick!',
 'ham\tWOT U WANNA DO THEN MISSY?',
 'ham\tYar lor wait 4 my mum 2 finish sch then have lunch lor... I whole morning s
tay at home clean my room now my room quite clean... Hee...',
 'ham\tDo you know where my lab goggles went',
 'ham\tCan you open the door?',
 'ham\tWaiting for your call.',
 'ham\tNope i waiting in sch 4 daddy...',
 'spam\tYou have won ?1,000 cash or a ?2,000 prize! To claim, call09050000327',
 "ham\tI'm tired of arguing with you about this week after week. Do what you want
and from now on, i'll do the same.",
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 'ham\tÃœ wait 4 me in sch i finish ard 5..',
 'spam\tour mobile number has won Â£5000, to claim calls us back or ring the claim
s hot line on 09050005321.',
 'ham\tArngd marriage is while u r walkin unfortuntly a snake bites u. bt love mar
riage is dancing in frnt of d snake &amp;amp; sayin Bite me, bite me.',
 'ham\tHuh so early.. Then Ã¼ having dinner outside izzit?',
 'ham\tOk anyway no need to change with what you said',
 'spam\tWe tried to contact you re your reply to our offer of 750 mins 150 textand
a new video phone call 08002988890 now or reply for free delivery tomorrow',
 'ham\tmy ex-wife was not able to have kids. Do you want kids one day?',
 "ham\tSo how's scotland. Hope you are not over showing your JJC tendencies. Take
care. Live the dream",
 'ham\tTell them u have a headache and just want to use 1 hour of sick time.',
 "ham\tI dun thk i'll quit yet... Hmmm, can go jazz ? Yogasana oso can... We can g
o meet em after our lessons den...",
 'ham\t"Pete can you please ring meive hardly gotany credit"',
 'ham\tYa srsly better than yi tho',
 "ham\tI'm in a meeting, call me later at",
 "spam\tFor ur chance to win a Â£250 wkly shopping spree TXT: SHOP to 80878. T's&
C's www.txt-2-shop.com custcare 08715705022, 1x150p/wk",
 'spam\tYou have been specially selected to receive a 2000 pound award! Call 08712
402050 BEFORE the lines close. Cost 10ppm. 16+. T&Cs apply. AG Promo',
 'spam\tPRIVATE! Your 2003 Account Statement for 07753741225 shows 800 un-redeemed
S. I. M. points. Call 08715203677 Identifier Code: 42478 Expires 24/10/04',
 'ham\tYou still at grand prix?',
 'ham\tI met you as a stranger and choose you as my friend. As long as the world s
tands, our friendship never ends. Lets be Friends forever!!! Gud nitz...',
 'ham\tI am great! How are you?',
 'ham\tGud mrng dear have a nice day',
 'spam\tYou have an important customer service announcement. Call FREEPHONE 0800 5
42 0825 now!',
 'ham\tWill do. Was exhausted on train this morning. Too much wine and pie. You sl
eep well too',
 "ham\tI'm going out to buy mum's present ar.",
 'ham\tMind blastin.. No more Tsunamis will occur from now on.. Rajnikant stopped
swimming in Indian Ocean..:-D',
 "ham\tIf u sending her home first it's ok lor. I'm not ready yet.",
 'ham\tSpeaking of does he have any cash yet?',
 'ham\tBe happy there. I will come after noon',
 'ham\tMeet after lunch la...',
 'ham\tTaKe CaRE n gET WeLL sOOn',
 'spam\tXCLUSIVE@CLUBSAISAI 2MOROW 28/5 SOIREE SPECIALE ZOUK WITH NICHOLS FROM PAR
IS.FREE ROSES 2 ALL LADIES !!! info: 07946746291/07880867867',
 'ham\twhat I meant to say is cant wait to see u again getting bored of this bridg
water banter',
 "ham\tNeva mind it's ok..",
 "ham\tIt's fine, imma get a drink or somethin. Want me to come find you?",
 'spam\t22 days to kick off! For Euro2004 U will be kept up to date with the lates
t news and results daily. To be removed send GET TXT STOP to 83222',
 'ham\tIts a valentine game. . . Send dis msg to all ur friends. .. If 5 answers r
d same then someone really loves u. Ques- which colour suits me the best?rply me',
 'ham\tI have many dependents',
 'ham\tTHANX4 TODAY CER IT WAS NICE 2 CATCH UP BUT WE AVE 2 FIND MORE TIME MORE OF
TEN OH WELL TAKE CARE C U SOON.C',
 'ham\tI called and said all to him:)then he have to choose this future.',
 'ham\t"Happy valentines day" I know its early but i have hundreds of handsomes an
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d beauties to wish. So i thought to finish off aunties and uncles 1st...',
 'ham\tHe like not v shock leh. Cos telling shuhui is like telling leona also. Lik
e dat almost all know liao. He got ask me abt ur reaction lor.',
 'ham\tFor my family happiness..',
 'ham\tI come n pick Ã¼ up... Come out immediately aft ur lesson...',
 'ham\tLet there be snow. Let there be snow. This kind of weather brings ppl toget
her so friendships can grow.',
 'ham\tDear we got <#> dollars hi hi',
 'ham\tGood words.... But words may leave u in dismay many times.',
 "ham\tMAKE SURE ALEX KNOWS HIS BIRTHDAY IS OVER IN FIFTEEN MINUTES AS FAR AS YO
U'RE CONCERNED",
 'ham\tsorry, no, have got few things to do. may be in pub later.',
 "ham\tNah it's straight, if you can just bring bud or drinks or something that's
actually a little more useful than straight cash",
 "ham\tHaha good to hear, I'm officially paid and on the market for an 8th",
 'ham\tHow many licks does it take to get to the center of a tootsie pop?',
 'ham\tYup i thk they r e teacher said that will make my face look longer. Darren
ask me not 2 cut too short.',
 'spam\tNew TEXTBUDDY Chat 2 horny guys in ur area 4 just 25p Free 2 receive Searc
h postcode or at gaytextbuddy.com. TXT ONE name to 89693',
 'spam\tTodays Vodafone numbers ending with 4882 are selected to a receive a Â£350
award. If your number matches call 09064019014 to receive your Â£350 award.',
 'ham\tPlease dont say like that. Hi hi hi',
 'ham\tThank u!',
 'ham\tOh that was a forwarded message. I thought you send that to me',
 'ham\tGot it. Seventeen pounds for seven hundred ml â€“ hope ok.',
 'spam\tDear Voucher Holder, 2 claim this weeks offer, at your PC go to http://ww
w.e-tlp.co.uk/expressoffer Ts&Cs apply.2 stop texts txt STOP to 80062.',
 'ham\tMe n him so funny...',
 'ham\tSweetheart, hope you are not having that kind of day! Have one with loads o
f reasons to smile. Biola',
 'ham\tWhen Ã¼ login dat time... Dad fetching Ã¼ home now?',
 'ham\tWhat will we do in the shower, baby?',
 'ham\tI had askd u a question some hours before. Its answer',
 "ham\tWell imma definitely need to restock before thanksgiving, I'll let you know
when I'm out",
 "ham\t said kiss, kiss, i can't do the sound effects! He is a gorgeous man isn't
he! Kind of person who needs a smile to brighten his day!",
 'ham\tProbably gonna swing by in a wee bit',
 'ham\tYa very nice. . .be ready on thursday',
 'ham\tAllo! We have braved the buses and taken on the trains and triumphed. I mea
n weâ€˜re in bâ€˜ham. Have a jolly good rest of week',
 'ham\tWatching cartoon, listening music & at eve had to go temple & churc
h.. What about u?',
 'ham\tDo you mind if I ask what happened? You dont have to say if it is uncomfort
able.',
 'spam\tPRIVATE! Your 2003 Account Statement for shows 800 un-redeemed S. I. M. po
ints. Call 08715203694 Identifier Code: 40533 Expires 31/10/04',
 'ham\tNo prob. I will send to your email.',
 'spam\tYou have won ?1,000 cash or a ?2,000 prize! To claim, call09050000327. T&
C: RSTM, SW7 3SS. 150ppm',
 'ham\tThats cool! Sometimes slow and gentle. Sonetimes rough and hard :)',
 "ham\tI'm gonna say no. Sorry. I would but as normal am starting to panic about t
ime. Sorry again! Are you seeing on Tuesday?",
 'ham\tWait, do you know if wesleys in town? I bet she does hella drugs!',
 'ham\tFine i miss you very much.',

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 'ham\tDid u got that persons story',
 "ham\tTell them the drug dealer's getting impatient",
 'ham\tSun cant come to earth but send luv as rays. cloud cant come to river but s
end luv as rain. I cant come to meet U, but can send my care as msg to U. Gud evn
g',
 'ham\tYou will be in the place of that man',
 'ham\tIt doesnt make sense to take it there unless its free. If you need to know
more, wikipedia.com',
 'spam\t88800 and 89034 are premium phone services call 08718711108',
 "ham\tUnder the sea, there lays a rock. In the rock, there is an envelope. In the
envelope, there is a paper. On the paper, there are 3 words... '",
 "ham\tThen mum's repent how?",
 'ham\tSorry me going home first... Daddy come fetch Ã¼ later...',
 'ham\tLeave it de:-). Start Prepare for next:-)..',
 'ham\tYes baby! We can study all the positions of the kama sutra ;)',
 'ham\tEn chikku nange bakra msg kalstiya..then had tea/coffee?',
 "ham\tCarlos'll be here in a minute if you still need to buy",
 'ham\tThis pay is  &lt;DECIMAL&gt;  lakhs:)',
 'ham\tHave a good evening! Ttyl',
 'ham\tDid u receive my msg?',
 'ham\tHo ho - big belly laugh! See ya tomo',
 'spam\tSMS. ac sun0819 posts HELLO:"You seem cool, wanted to say hi. HI!!!" Stop?
Send STOP to 62468',
 'spam\tGet ur 1st RINGTONE FREE NOW! Reply to this msg with TONE. Gr8 TOP 20 tone
s to your phone every week just Â£1.50 per wk 2 opt out send STOP 08452810071 16',
 "ham\tDitto. And you won't have to worry about me saying ANYTHING to you anymore.
Like i said last night, you do whatever you want and i'll do the same. Peace.",
 "ham\tI've got  &lt;#&gt; , any way I could pick up?",
 'ham\tI dont knw pa, i just drink milk..',
 'ham\tMaybe?! Say hi to  and find out if  got his card. Great escape or wetherspo
ons?',
 "ham\tPiggy, r u awake? I bet u're still sleeping. I'm going 4 lunch now...",
 "ham\tCause I'm not freaky lol",
 "ham\tMissed your call cause I was yelling at scrappy. Miss u. Can't wait for u t
o come home. I'm so lonely today.",
 "ham\tWhat is this 'hex' place you talk of? Explain!",
 "ham\tÃœ log off 4 wat. It's sdryb8i",
 'ham\tIs xy going 4 e lunch?',
 "spam\tHi I'm sue. I am 20 years old and work as a lapdancer. I love sex. Text me
live - I'm i my bedroom now. text SUE to 89555. By TextOperator G2 1DA 150ppmsg 18
+",
 'ham\tI wanted to ask Ã¼ to wait 4 me to finish lect. Cos my lect finishes in an
hour anyway.',
 'ham\tHave you finished work yet? :)',
 'ham\tEvery King Was Once A Crying Baby And Every Great Building Was Once A Map..
Not Imprtant Where U r TODAY, BUT Where U Wil Reach TOMORW. Gud ni8',
 'ham\tDear,Me at cherthala.in case u r coming cochin pls call bfore u start.i sha
ll also reach accordingly.or tell me which day u r coming.tmorow i am engaged ans
its holiday.',
 'ham\tThanks love. But am i doing torch or bold.',
 'spam\t<Forwarded from 448712404000>Please CALL 08712404000 immediately as there
is an urgent message waiting for you.',
 'ham\tWas the farm open?',
 'ham\tSorry to trouble u again. Can buy 4d for my dad again? 1405, 1680, 1843. Al
l 2 big 1 small, sat n sun. Thanx.',
 'ham\tMy sister in law, hope you are having a great month. Just saying hey. Abiol
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a',
 'ham\tWill purchase d stuff today and mail to you. Do you have a po box number?',
 'ham\tAh poop. Looks like ill prob have to send in my laptop to get fixed cuz it has a gpu problem',
 'ham\tGood. Good job. I like entrepreneurs',
 "ham\tAight, you close by or still down around alex's place?",
 'ham\tmeet you in corporation st outside gap â€¦ you can see how my mind is working!',
 'ham\tMum ask Ã¼ to buy food home...',
 'ham\tK..u also dont msg or reply to his msg..',
 'ham\tHow much r Ã¼ willing to pay?',
 "ham\tSorry, I'll call later",
 'ham\tWhat is important is that you prevent dehydration by giving her enough fluids',
 'ham\tThats a bit weird, even ?- where is the do supposed to be happening? But good idea, sure they will be in pub!',
 "ham\tTrue dear..i sat to pray evening and felt so.so i sms'd you in some time...",
 "ham\tI don't think I can get away for a trek that long with family in town, sorry",
 'ham\tSo when do you wanna gym harri',
 'ham\tQuite late lar... Ard 12 anyway i wun b drivin...',
 'spam\tTo review and KEEP the fantastic Nokia N-Gage game deck with Club Nokia, go 2 www.cnupdates.com/newsletter. unsubscribe from alerts reply with the word OUT',
 'spam\t4mths half price Orange line rental & latest camera phones 4 FREE. Had your phone 11mths+? Call MobilesDirect free on 08000938767 to update now! or2stoptxt T&Cs',
 'ham\tHeight of Confidence: All the Aeronautics professors wer calld & they wer askd 2 sit in an aeroplane. Aftr they sat they wer told dat the plane ws made by their students. Dey all hurried out of d plane.. Bt only 1 didnt move... He said:"if it is made by my students,this wont even start..... Datz confidence..',
 'ham\tIt just seems like weird timing that the night that all you and g want is for me to come smoke is the same day as when a shitstorm is attributed to me always coming over and making everyone smoke',
 'spam\t08714712388 between 10am-7pm Cost 10p',
 'ham\tSave yourself the stress. If the person has a dorm account, just send your account details and the money will be sent to you.',
 'ham\tHe also knows about lunch menu only da. . I know',
 'ham\tWhen i have stuff to sell i.ll tell you',
 'spam\t+449071512431 URGENT! This is the 2nd attempt to contact U!U have WON Â£1250 CALL 09071512433 b4 050703 T&CsBCM4235WC1N3XX. callcost 150ppm mobilesvary. max Â£7. 50',
 "ham\tBook which lesson? then you msg me... I will call up after work or sth... I'm going to get specs. My membership is PX3748",
 'spam\tYou have WON a guaranteed Â£1000 cash or a Â£2000 prize. To claim yr prize call our customer service representative on 08714712394 between 10am-7pm',
 'ham\tMacha dont feel upset.i can assume your mindset.believe me one evening with me and i have some wonderful plans for both of us.LET LIFE BEGIN AGAIN.call me any time',
 'ham\tOh is it? Send me the address',
 "ham\tS'fine. Anytime. All the best with it.",
 'ham\tThat is wondar full flim.',
 'ham\tYa even those cookies have jelly on them',
 'ham\tThe world is running and i am still.maybe all are feeling the same,so be it.or i have to admit,i am mad.then where is the correction?or let me call this is

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life.and keep running with the world,may be u r also running.lets run.',
 'ham\tGot it! It looks scrumptious... daddy wants to eat you all night long!',
 "ham\tOf cos can lar i'm not so ba dao ok... 1 pm lor... Y u never ask where we g
o ah... I said u would ask on fri but he said u will ask today...",
 'ham\tAlright omw, gotta change my order to a half8th',
 'ham\tExactly. Anyways how far. Is jide her to study or just visiting',
 'ham\tDunno y u ask me.',
 'spam\tEmail AlertFrom: Jeri StewartSize: 2KBSubject: Low-cost prescripiton drvgs
To listen to email call 123',
 "ham\tNo he didn't. Spring is coming early yay!",
 "ham\tLol you won't feel bad when I use her money to take you out to a steak dinn
er =D",
 'ham\tEven u dont get in trouble while convincing..just tel him once or twice and
just tel neglect his msgs dont c and read it..just dont reply',
 'ham\tLeaving to qatar tonite in search of an opportunity.all went fast.pls add m
e in ur prayers dear.Rakhesh',
 'ham\tThen why no one talking to me',
 'ham\tThanks for looking out for me. I really appreciate.',
 'spam\tHi. Customer Loyalty Offer:The NEW Nokia6650 Mobile from ONLY Â£10 at TXTA
UCTION! Txt word: START to No: 81151 & get yours Now! 4T&Ctxt TC 150p/MTmsg',
 'ham\tWish i were with you now!',
 "ham\tHaha mayb u're rite... U know me well. Da feeling of being liked by someone
is gd lor. U faster go find one then all gals in our group attached liao.",
 'ham\tYes i will be there. Glad you made it.',
 'ham\tDo well :)all will for little time. Thing of good times ahead:',
 "ham\tJust got up. have to be out of the room very soon. â€¦. i hadn't put the cl
ocks back til at 8 i shouted at everyone to get up and then realised it was 7. wah
ay. another hour in bed.",
 'ham\tOk. There may be a free gym about.',
 'ham\tMen like shorter ladies. Gaze up into his eyes.',
 'ham\tDunno he jus say go lido. Same time 930.',
 'ham\tI promise to take good care of you, princess. I have to run now. Please sen
d pics when you get a chance. Ttyl!',
 'spam\tU are subscribed to the best Mobile Content Service in the UK for Â£3 per
10 days until you send STOP to 82324. Helpline 08706091795',
 "ham\tIs there a reason we've not spoken this year? Anyways have a great week and
all the best in your exam",
 'ham\tBy monday next week. Give me the full gist',
 "spam\tDo you realize that in about 40 years, we'll have thousands of old ladies
running around with tattoos?",
 'spam\tYou have an important customer service announcement from PREMIER.',
 'ham\tDont gimme that lip caveboy',
 'ham\tWhen did you get to the library',
 "ham\tRealy sorry-i don't recognise this number and am now confused :) who r u pl
ease?!",
 'ham\tSo why didnt you holla?',
 'ham\tCant think of anyone with * spare room off * top of my head',
 'ham\tFaith makes things possible,Hope makes things work,Love makes things beauti
ful,May you have all three this Christmas!Merry Christmas!',
 'ham\tU should have made an appointment',
 "ham\tCall me when you/carlos is/are here, my phone's vibrate is acting up and I
might not hear texts",
 'spam\tRomantic Paris. 2 nights, 2 flights from Â£79 Book now 4 next year. Call 0
8704439680Ts&Cs apply.',
 'ham\tWe are at grandmas. Oh dear, u still ill? I felt Shit this morning but i th
ink i am just hungover! Another night then. We leave on sat.',
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'spam\tUrgent Ur Â£500 guaranteed award is still unclaimed! Call 09066368327 NOW closingdate04/09/02 claimcode M39M51 Â£1.50pmmorefrommobile2Bremoved-MobyPOBox734LS27YF',
'ham\tNothing but we jus tot u would ask cos u ba gua... But we went mt faber yes t... Yest jus went out already mah so today not going out... Jus call lor...',
'ham\tWishing you and your family Merry "X" mas and HAPPY NEW Year in advance..',
'spam\tUR awarded a City Break and could WIN a Â£200 Summer Shopping spree every WK. Txt STORE to 88039 . SkilGme. TsCs087147403231Winawk!Age16 Â£1.50perWKsub',
"ham\tI'm nt goin, got somethin on, unless they meetin 4 dinner lor... Haha, i wonder who will go tis time...",
"ham\tSorry, I'll call later",
'ham\tI cant pick the phone right now. Pls send a message',
"ham\tLol I know! They're so dramatic. Schools already closed for tomorrow. Apparently we can't drive in the inch of snow were supposed to get.",
'ham\tNot getting anywhere with this damn job hunting over here!',
'ham\tLol! U drunkard! Just doing my hair at d moment. Yeah still up 4 tonight. Wats the plan?',
'ham\tidc get over here, you are not weaseling your way out of this shit twice in a row',
'ham\tI wil be there with in <#> minutes. Got any space',
'ham\tJust sleeping..and surfing',
'ham\tThanks for picking up the trash.',
"ham\tWhy don't you go tell your friend you're not sure you want to live with him because he smokes too much then spend hours begging him to come smoke",
'ham\t"Hi its Kate it was lovely to see you tonight and ill phone you tomorrow. I got to sing and a guy gave me his card! xxx"',
'ham\tHappy New year my dear brother. I really do miss you. Just got your number and decided to send you this text wishing you only happiness. Abiola',
'ham\tThat means get the door',
'ham\tYour opinion about me? 1. Over 2. Jada 3. Kusruthi 4. Lovable 5. Silent 6. Spl character 7. Not matured 8. Stylish 9. Simple Pls reply..',
'ham\tHmmm ... I thought we said 2 hours slave, not 3 ... You are late ... How should I punish you ?',
'ham\tBeerage?',
'spam\tYou have an important customer service announcement from PREMIER. Call FREEPHONE 0800 542 0578 now!',
'ham\tDont think so. It turns off like randomlly within 5min of opening',
"ham\tShe was supposed to be but couldn't make it, she's still in town though",
'ham\tIt does it on its own. Most of the time it fixes my spelling. But sometimes it gets a completely diff word. Go figure',
'spam\tEver thought about living a good life with a perfect partner? Just txt back NAME and AGE to join the mobile community. (100p/SMS)',
'spam\t5 Free Top Polyphonic Tones call 087018728737, National Rate. Get a toppoly tune sent every week, just text SUBPOLY to 81618, Â£3 per pole. UnSub 08718727870.',
'ham\tGud mrng dear hav a nice day',
"ham\tThis is hoping you enjoyed your game yesterday. Sorry i've not been in touch but pls know that you are fondly bein thot off. Have a great week. Abiola",
'ham\tAll e best 4 ur driving tmr :-)',
'ham\tY?WHERE U AT DOGBREATH? ITS JUST SOUNDING LIKE JAN C THATÂ’S AL!!!!!!!!!',
'ham\tOmg I want to scream. I weighed myself and I lost more weight! Woohoo!',
"ham\tThere generally isn't one. It's an uncountable noun - u in the dictionary. pieces of research?",
"ham\tit's really getting me down just hanging around.",
'spam\tOrange customer, you may now claim your FREE CAMERA PHONE upgrade for your loyalty. Call now on 0207 153 9996. Offer ends 14thMarch. T&C's apply. Opt-out ava

ila",
 'ham\t"Petey boy whereare you me and all your friendsare in theKingshead come dow
n if you canlove Nic"',
 'ham\tOk i msg u b4 i leave my house.',
 'ham\t"Gimme a few" was <#> minutes ago',
 'spam\tLast Chance! Claim ur Â£150 worth of discount vouchers today! Text SHOP to
85023 now! SavaMob, offers mobile! T Cs SavaMob POBOX84, M263UZ. Â£3.00 Sub. 16',
 "ham\tAppt is at <TIME> am. Not my fault u don't listen. I told u twice",
 'spam\tFREE for 1st week! No1 Nokia tone 4 ur mobile every week just txt NOKIA to
8077 Get txting and tell ur mates. www.getzed.co.uk POBox 36504 W45WQ 16+ norm150
p/tone',
 'spam\tYou have won a guaranteed Â£200 award or even Â£1000 cashto claim UR award
call free on 08000407165 (18+) 2 stop getstop on 88222 PHP. RG21 4JX',
 "ham\tK I'll be there before 4.",
 'ham\tI dled 3d its very imp',
 "ham\tsure, but make sure he knows we ain't smokin yet",
 'ham\tBoooo you always work. Just quit.',
 'ham\tI am taking half day leave bec i am not well',
 "ham\tUgh I don't wanna get out of bed. It's so warm.",
 'ham\tS:)s.nervous <#> :)',
 "ham\tSo there's a ring that comes with the guys costumes. It's there so they can
gift their future yowifes. Hint hint",
 'spam\tCongratulations ur awarded either Â£500 of CD gift vouchers & Free entry 2
our Â£100 weekly draw txt MUSIC to 87066 TnCs www.Ldew.com1win150ppmx3age16',
 'ham\tI borrow ur bag ok.',
 'spam\tU were outbid by simonwatson5120 on the Shinco DVD Plyr. 2 bid again, visi
t sms. ac/smsrewards 2 end bid notifications, reply END OUT',
 "ham\tWhere's my boytoy? I miss you ... What happened?",
 "ham\tHe has lots of used ones babe, but the model doesn't help. Youi have to bri
ng it over and he'll match it up",
 'ham\tAlso are you bringing galileo or dobby',
 'ham\tThen why you not responding',
 'ham\t"BOO BABE! U ENJOYIN YOURJOB? U SEEMED 2 B GETTIN ON WELL HUNNY!HOPE URE O
K?TAKE CARE & IÂ’LLSPEAK 2U SOONLOTS OF LOVEME XXXX."',
 "ham\tGood afternoon starshine! How's my boytoy? Does he crave me yet? Ache to fu
ck me ? *sips cappuccino* I miss you babe *teasing kiss*",
 'ham\tOn the road so cant txt',
 'spam\tSMSSERVICES. for yourinclusive text credits, pls goto www.comuk.net login=
3qxj9 unsubscribe with STOP, no extra charge. help 08702840625.COMUK. 220-CM2 9A
E',
 'spam\t25p 4 alfie Moon's Children in need song on ur mob. Tell ur m8s. Txt Tone
charity to 8007 for Nokias or Poly charity for polys: zed 08701417012 profit 2 cha
rity.",
 'ham\tHave a good evening! Ttyl',
 'ham\tHmm .. Bits and pieces lol ... *sighs* ...',
 'ham\tHahaha..use your brain dear',
 'ham\tHey. You got any mail?',
 'ham\tSorry light turned green, I meant another friend wanted <#> worth b
ut he may not be around',
 'ham\tThanks for yesterday sir. You have been wonderful. Hope you enjoyed the bur
ial. MojiBiola',
 'spam\tU have a secret admirer. REVEAL who thinks U R So special. Call 0906517404
2. To opt out Reply REVEAL STOP. 1.50 per msg recd. Cust care 07821230901',
 'ham\tHi mate its RV did u hav a nice hol just a message 3 say hello coz havenÂ’t
sent u 1 in ages started driving so stay off roads!RVx',
 'spam\tDear Voucher Holder, To claim this weeks offer, at you PC please go to htt

p://www.e-tlp.co.uk/expressoffer Ts&Cs apply. To stop texts, txt STOP to 80062',
 "ham\tThank you so much. When we skyped wit kz and sura, we didnt get the pleasur
e of your company. Hope you are good. We've given you ultimatum oh! We are countin
down to aburo. Enjoy! This is the message i sent days ago",
 'ham\tSurely result will offer:)',
 'ham\tGood Morning my Dear..... Have a great & successful day.',
 'spam\tDo you want 750 anytime any network mins 150 text and a NEW VIDEO phone fo
r only five pounds per week call 08002888812 or reply for delivery tomorrow',
 "ham\tSir, I have been late in paying rent for the past few months and had to pay
a $ <#> charge. I felt it would be inconsiderate of me to nag about somethi
ng you give at great cost to yourself and that's why i didnt speak up. I however a
m in a recession and wont be able to pay the charge this month hence my askin well
ahead of month's end. Can you please help. Thanks",
 'spam\tWe tried to contact you re our offer of New Video Phone 750 anytime any ne
twork mins HALF PRICE Rental camcorder call 08000930705 or reply for delivery We
d',
 'spam\tLast chance 2 claim ur Â£150 worth of discount vouchers-Text YES to 85023
now!SavaMob-member offers mobile T Cs 08717898035. Â£3.00 Sub. 16 . Remove txt X o
r STOP',
 'ham\tI luv u soo much u donÂ’t understand how special u r 2 me ring u 2morrow lu
v u xxx',
 "ham\tPls send me a comprehensive mail about who i'm paying, when and how much.",
 "ham\tOur Prashanthettan's mother passed away last night. pray for her and famil
y.",
 'spam\tUrgent! call 09066350750 from your landline. Your complimentary 4* Ibiza H
oliday or 10,000 cash await collection SAE T&Cs PO BOX 434 SK3 8WP 150 ppm 18+',
 'ham\tK.k:)when are you going?',
 "ham\tMeanwhile in the shit suite: xavier decided to give us <#> seconds
of warning that samantha was coming over and is playing jay's guitar to impress he
r or some shit. Also I don't think doug realizes I don't live here anymore",
 "ham\tMy stomach has been thru so much trauma I swear I just can't eat. I better
lose weight.",
 'ham\tI am in office:)whats the matter..msg me now.i will call you at break:).',
 "ham\tYeah there's barely enough room for the two of us, x has too many fucking s
hoes. Sorry man, see you later",
 "spam\tToday's Offer! Claim ur Â£150 worth of discount vouchers! Text YES to 8502
3 now! SavaMob, member offers mobile! T Cs 08717898035. Â£3.00 Sub. 16 . Unsub rep
ly X",
 'ham\tU reach orchard already? U wan 2 go buy tickets first?',
 'ham\tI am real, baby! I want to bring out your inner tigress...',
 'ham\tNo da if you run that it activate the full version da.',
 'ham\t"AH POOR BABY!HOPE URFEELING BETTERSN LUV! PROBTHAT OVERDOSE OF WORK HEY GO
CAREFUL SPK 2 U SN LOTS OF LOVEJEN XXX."',
 "ham\tStop the story. I've told him i've returned it and he's saying i should not
re order it.",
 'spam\tTalk sexy!! Make new friends or fall in love in the worlds most discreet t
ext dating service. Just text VIP to 83110 and see who you could meet.',
 'ham\tGoing to take your babe out ?',
 'ham\tHai ana tomarrow am coming on morning. <DECIMAL> ill be there in sa
thy then we ll go to RTO office. Reply me after came to home.',
 'ham\tSpoons it is then okay?',
 'ham\tDid he just say somebody is named tampa',
 'ham\tIn work now. Going have in few min.',
 'ham\tYour brother is a genius',
 "ham\tSorry, I guess whenever I can get a hold of my connections, maybe an hour o
r two? I'll text you",

```
 'ham\tDid u find out what time the bus is at coz i need to sort some stuff out.',
 'ham\tDude ive been seeing a lotta corvettes lately',
 'spam\tCongratulations ur awarded either a yrs supply of CDs from Virgin Records
or a Mystery Gift GUARANTEED Call 09061104283 Ts&Cs www.smsco.net Â£1.50pm approx
3mins',
 "ham\tSame here, but I consider walls and bunkers and shit important just because
I never play on peaceful but I guess your place is high enough that it don't matte
r",
 'spam\tPRIVATE! Your 2003 Account Statement for 07808 XXXXXX shows 800 un-redeeme
d S. I. M. points. Call 08719899217 Identifier Code: 41685 Expires 07/11/04',
 'spam\tHello. We need some posh birds and chaps to user trial prods for champney
s. Can i put you down? I need your address and dob asap. Ta r',
 'spam\tWhat do U want for Xmas? How about 100 free text messages & a new video ph
one with half price line rental? Call free now on 0800 0721072 to find out more!',
 'ham\tWell am officially in a philosophical hole, so if u wanna call am at home r
eady to be saved!',
 'ham\tIts going good...no problem..but still need little experience to understand
american customer voice...',
 "ham\tI'll text you when I drop x off",
 "ham\tUgh its been a long day. I'm exhausted. Just want to cuddle up and take a n
ap",
 'ham\tTalk With Yourself Atleast Once In A Day...!!! Otherwise You Will Miss Your
Best FRIEND In This WORLD...!!! -Shakespeare- SHESIL  &lt;#&gt;',
 'spam\tShop till u Drop, IS IT YOU, either 10K, 5K, Â£500 Cash or Â£100 Travel vo
ucher, Call now, 09064011000. NTT PO Box CR01327BT fixedline Cost 150ppm mobile va
ry',
 'ham\tAre you in castor? You need to see something',
 'spam\tSunshine Quiz Wkly Q! Win a top Sony DVD player if u know which country Li
verpool played in mid week? Txt ansr to 82277. Â£1.50 SP:Tyrone',
 'spam\tU have a secret admirer who is looking 2 make contact with U-find out who
they R*reveal who thinks UR so special-call on 09058094565',
 'spam\tU have a Secret Admirer who is looking 2 make contact with U-find out who
they R*reveal who thinks UR so special-call on 09065171142-stopsms-08',
 'spam\tReminder: You have not downloaded the content you have already paid for. G
oto http://doit. mymoby. tv/ to collect your content.',
 "ham\tsee, i knew giving you a break a few times woul lead to you always wanting
to miss curfew. I was gonna gibe you 'til one, but a MIDNIGHT movie is not gonna g
et out til after 2. You need to come home. You need to getsleep and, if anything,
you need to b studdying ear training.",
 'ham\tI love to give massages. I use lots of baby oil... What is your fave positi
on?',
 'ham\tDude we should go sup again',
 'ham\tYoyyooo u know how to change permissions for a drive in mac. My usb flash d
rive',
 'ham\tGibbs unsold.mike hussey',
 'ham\tI like to talk pa but am not able to. I dont know y.',
 "ham\tY dun cut too short leh. U dun like ah? She failed. She's quite sad.",
 'ham\tYou unbelievable faglord',
 'ham\tWife.how she knew the time of murder exactly',
 'ham\tWhy do you ask princess?',
 'ham\tI am great princess! What are you thinking about me? :)',
 'ham\tNutter. Cutter. Ctter. Cttergg. Cttargg. Ctargg. Ctagg. ie you',
 "ham\tIt's ok i noe u're busy but i'm really too bored so i msg u. I oso dunno wa
t colour she choose 4 me one.",
 "ham\tDoesn't g have class early tomorrow and thus shouldn't be trying to smoke a
t  &lt;#&gt;",
```

'ham\tSuperb Thought- "Be grateful that u dont have everything u want. That means u still have an opportunity to be happier tomorrow than u are today.":-)',
 'ham\tHope you are having a good week. Just checking in',
 "ham\tI'm used to it. I just hope my agents don't drop me since i've only booked a few things this year. This whole me in boston, them in nyc was an experiment.",
 "ham\tThursday night? Yeah, sure thing, we'll work it out then",
 'spam\tYour free ringtone is waiting to be collected. Simply text the password "MIX" to 85069 to verify. Get Usher and Britney. FML, PO Box 5249, MK17 92H. 450Ppw 16',
 'ham\tProbably money worries. Things are coming due and i have several outstanding invoices for work i did two and three months ago.',
 'ham\tHow is it possible to teach you. And where.',
 'ham\tI wonder if your phone battery went dead ? I had to tell you, I love you babe',
 "ham\tLovely smell on this bus and it ain't tobacco...",
 "ham\tWe're all getting worried over here, derek and taylor have already assumed the worst",
 "ham\tHey what's up charles sorry about the late reply.",
 'spam\tall the lastest from Stereophonics, Marley, Dizzee Racal, Libertines and The Strokes! Win Nookii games with Flirt!! Click TheMob WAP Bookmark or text WAP to 82468',
 'ham\tI.ll give her once i have it. Plus she said grinule greet you whenever we speak',
 'ham\tWHITE FUDGE OREOS ARE IN STORES',
 'spam\tJanuary Male Sale! Hot Gay chat now cheaper, call 08709222922. National rate from 1.5p/min cheap to 7.8p/min peak! To stop texts call 08712460324 (10p/min)',
 "ham\tMy love ! How come it took you so long to leave for Zaher's? I got your words on ym and was happy to see them but was sad you had left. I miss you",
 'ham\tI am sorry it hurt you.',
 "ham\tCan't. I feel nauseous. I'm so pissed. I didn't eat any sweets all week cause today I was planning to pig out. I was dieting all week. And now I'm not hungry :/",
 'ham\tOk lor but not too early. Me still having project meeting now.',
 'ham\tCall me da, i am waiting for your call.',
 'ham\tI could ask carlos if we could get more if anybody else can chip in',
 'ham\tWas actually about to send you a reminder today. Have a wonderful weekend',
 "ham\tWhen people see my msgs, They think Iam addicted to msging... They are wrong, Bcoz They don\\'t know that Iam addicted to my sweet Friends..!! BSLVYL",
 'ham\tHey you gave them your photo when you registered for driving ah? Tmr wanna meet at yck?',
 'ham\tDont talk to him ever ok its my word.',
 'ham\tWhen u wana see it then',
 "ham\tOn ma way to school. Can you pls send me ashley's number",
 'ham\tIt shall be fine. I have avalarr now. Will hollalater',
 "ham\tShe went to attend another two rounds today..but still did't reach home..",
 'ham\tActually i deleted my old website..now i m blogging at magicalsongs.blogspot.com',
 'ham\tK, wait chikku..il send aftr <#> mins',
 "ham\tBut I'm on a diet. And I ate 1 too many slices of pizza yesterday. Ugh I'm ALWAYS on a diet.",
 'ham\tK:)i will give my kvb acc details:)',
 'ham\tOh all have to come ah?',
 'spam\tmoney!!! you r a lucky winner ! 2 claim your prize text money 2 88600 over Â£1million to give away ! ppt150x3+normal text rate box403 w1t1jy',
 "ham\tI'm really sorry i won't b able 2 do this friday.hope u can find an alterna

tive.hope yr term's going ok:-)",
 'ham\tCongratulations ore mo owo re wa. Enjoy it and i wish you many happy moment s to and fro wherever you go',
 'ham\tSo do you have samus shoulders yet',
 "ham\tWhat time you think you'll have it? Need to know when I should be near camp us",
 'spam\tDear Matthew please call 09063440451 from a landline, your complimentary 4 *Lux Tenerife holiday or Â£1000 CASH await collection. ppm150 SAE T&Cs Box334 SK38 XH.',
 'ham\tThen dun wear jeans lor...',
 'ham\tSince when, which side, any fever, any vomitin.',
 'ham\tK:)k.are you in college?',
 'spam\tUrgent! call 09061749602 from Landline. Your complimentary 4* Tenerife Hol iday or Â£10,000 cash await collection SAE T&Cs BOX 528 HP20 1YF 150ppm 18+',
 'ham\tBetter. Made up for Friday and stuffed myself like a pig yesterday. Now I f eel bleh. But at least its not writhing pain kind of bleh.',
 "ham\tNo we sell it all so we'll have tons if coins. Then sell our coins to someo ne thru paypal. Voila! Money back in life pockets:)",
 'ham\tTheyre doing it to lots of places. Only hospitals and medical places are sa fe.',
 'spam\tHow about getting in touch with folks waiting for company? Just txt back y our NAME and AGE to opt in! Enjoy the community (150p/SMS)',
 "ham\tAnd also I've sorta blown him off a couple times recently so id rather not text him out of the blue looking for weed",
 'ham\tI sent my scores to sophas and i had to do secondary application for a few schools. I think if you are thinking of applying, do a research on cost also. Cont act joke ogunrinde, her school is one me the less expensive ones',
 'ham\tI cant wait to see you! How were the photos were useful? :)',
 'spam\tUr cash-balance is currently 500 pounds - to maximize ur cash-in now send GO to 86688 only 150p/msg. CC: 08718720201 PO BOX 114/14 TCR/W1',
 'ham\tHey i booked the kb on sat already... what other lessons are we going for a h? Keep your sat night free we need to meet and confirm our lodging',
 'ham\tChk in ur belovd ms dict',
 'ham\tIs that what time you want me to come?',
 "ham\tAwesome, lemme know whenever you're around",
 'ham\tShb b ok lor... Thanx...',
 'ham\tBeautiful Truth against Gravity.. Read carefully: "Our heart feels light wh en someone is in it.. But it feels very heavy when someone leaves it.." GOOD NIGH T',
 "ham\tAlso remember to get dobby's bowl from your car",
 'spam\tFilthy stories and GIRLS waiting for your',
 "ham\tSorry i now then c ur msg... Yar lor so poor thing... But only 4 one nigh t... Tmr u'll have a brand new room 2 sleep in...",
 "ham\tLove isn't a decision, it's a feeling. If we could decide who to love, the n, life would be much simpler, but then less magical",
 'ham\tWelp apparently he retired',
 "ham\tMy sort code is and acc no is . The bank is natwest. Can you reply to conf irm i've sent this to the right person!",
 'ham\tWhere @',
 "ham\tU sure u can't take any sick time?",
 'spam\tURGENT! We are trying to contact U. Todays draw shows that you have won a Â£800 prize GUARANTEED. Call 09050001808 from land line. Claim M95. Valid12hrs onl y',
 'ham\tWatching cartoon, listening music & at eve had to go temple & churc h.. What about u?',
 'ham\tYo chad which gymnastics class do you wanna take? The site says Christians

```
class is full..',
 'ham\tAre you this much buzy',
 'ham\tOr better still can you catch her and let ask her if she can sell  &lt;#&g
t;  for me.',
 'ham\tI am not sure about night menu. . . I know only about noon menu',
 'ham\tWhat do u want when i come back?.a beautiful necklace as a token of my hear
t for you.thats what i will give but ONLY to MY WIFE OF MY LIKING.BE THAT AND SE
E..NO ONE can give you that.dont call me.i will wait till i come.',
 'ham\tAre you willing to go for aptitude class.',
 'ham\tIt wont b until 2.15 as trying 2 sort house out, is that ok?',
 'ham\tYar lor he wan 2 go c horse racing today mah, so eat earlier lor. I ate chi
cken rice. U?',
 'ham\tHaha awesome, omw back now then',
 'ham\tYup i thk so until e shop closes lor.',
 'ham\twhat is your account number?',
 'ham\tEh u send wrongly lar...',
 'ham\tHey no I ad a crap nite was borin without ya 2 boggy with me u boring biatc
h! Thanx but u wait til nxt time il ave ya',
 'ham\tOk i shall talk to him',
 'ham\tDont hesitate. You know this is the second time she has had weakness like t
hat. So keep i notebook of what she eat and did the day before or if anything chan
ged the day before so that we can be sure its nothing',
 'ham\tHey you can pay. With salary de. Only  &lt;#&gt; .',
 'ham\tAnother month. I need chocolate weed and alcohol.',
 'ham\tIf he started searching he will get job in few days.he have great potential
and talent.',
 'ham\tReckon need to be in town by eightish to walk from * carpark.',
 'spam\tCongrats! 2 mobile 3G Videophones R yours. call 09063458130 now! videochat
wid your mates, play java games, Dload polyPH music, noline rentl.',
 'ham\tLOOK AT THE FUCKIN TIME. WHAT THE FUCK YOU THINK IS UP',
 'ham\tYo guess what I just dropped',
 "ham\tCarlos says he'll be at mu in  &lt;#&gt;  minutes",
 "ham\tI'm in office now . I will call you  &lt;#&gt;  min:)",
 "ham\tGeeee ... I miss you already, you know ? Your all I can think about. Fuck,
I can't wait till next year when we will be together ... *loving kiss*",
 'ham\tYun ah.the ubi one say if Ã¼ wan call by tomorrow.call 67441233 look for ir
ene.ere only got bus8,22,65,61,66,382. Ubi cres,ubi tech park.6ph for 1st 5wkg day
s.Ã¨n',
 'ham\tUgh. Gotta drive back to sd from la. My butt is sore.',
 'ham\t26th OF JULY',
 'ham\tHi im having the most relaxing time ever! we have to get up at 7am every da
y! was the party good the other night? I get home tomorrow at 5ish.',
 'ham\tUp to Ã¼... Ãœ wan come then come lor... But i din c any stripes skirt...',
 'ham\tThe Xmas story is peace.. The Xmas msg is love.. The Xmas miracle is jesu
s.. Hav a blessed month ahead &amp;amp; wish U Merry Xmas...',
 "ham\tI can't, I don't have her number!",
 "ham\tChange again... It's e one next to escalator...",
 "ham\tYetunde i'm in class can you not run water on it to make it ok. Pls now.",
 'ham\tNot a lot has happened here. Feels very quiet. Beth is at her aunts and cha
rlie is working lots. Just me and helen in at the mo. How have you been?',
 'ham\tThen Ã¼ wait 4 me at bus stop aft ur lect lar. If i dun c Ã¼ then i go get
my car then come back n pick Ã¼.',
 'ham\tAight will do, thanks again for comin out',
 'ham\tNo..but heard abt tat..',
 'spam\tPlease call our customer service representative on FREEPHONE 0808 145 4742
between 9am-11pm as you have WON a guaranteed Â£1000 cash or Â£5000 prize!',
```

```
 'ham\tYes..he is really great..bhaji told kallis best cricketer after sachin in w
orld:).very tough to get out.',
 'ham\t&lt;#&gt;  am I think? Should say on syllabus',
 'ham\tUmma. Did she say anything',
 'ham\tGive me a sec to think think about it',
 'spam\tPanasonic & BluetoothHdset FREE. Nokia FREE. Motorola FREE & DoubleMins &
DoubleTxt on Orange contract. Call MobileUpd8 on 08000839402 or call 2optout',
 "ham\tI don't quite know what to do. I still can't get hold of anyone. I cud pick
you up bout 7.30pm and we can see if they're in the pub?",
 'ham\tPoyyarikatur,kolathupalayam,unjalur post,erode dis, &lt;#&gt; .',
 'ham\tDear Hero,i am leaving to qatar tonite for an apt opportunity.pls do keep i
n touch at  &lt;EMAIL&gt; ,kerala',
 'ham\tLol I would but my mom would have a fit and tell the whole family how crazy
and terrible I am',
 'ham\tI just got home babe, are you still awake ?',
 'ham\tI dunno they close oredi not... Ãœ v ma fan...',
 'ham\tJust buy a pizza. Meat lovers or supreme. U get to pick.',
 'ham\tYa, told..she was asking wats matter?',
 'ham\tDear,regret i cudnt pick call.drove down frm ctla now at cochin home.left m
obile in car..ente style ishtamayoo?happy bakrid!',
 'spam\tFREE for 1st week! No1 Nokia tone 4 ur mob every week just txt NOKIA to 80
07 Get txting and tell ur mates www.getzed.co.uk POBox 36504 W45WQ norm150p/tone 1
6+',
 'ham\tShall i send that exe to your mail id.',
 'ham\tNope watching tv at home... Not going out. V bored...',
 'ham\tDon know..wait i will check it.',
 'ham\tGood afternoon on this glorious anniversary day, my sweet J !! I hope this
finds you happy and content, my Prey. I think of you and send a teasing kiss from
across the sea coaxing images of fond souveniers ... You Cougar-Pen',
 'spam\tGuess what! Somebody you know secretly fancies you! Wanna find out who it
is? Give us a call on 09065394514 From Landline DATEBox1282EssexCM61XN 150p/min 1
8',
 'ham\tWe still on for tonight?',
 'ham\tMay i call You later Pls',
 "ham\tHasn't that been the pattern recently crap weekends?",
 "ham\tI have a sore throat. It's scratches when I talk",
 'ham\tYes da. Any plm at ur office',
 'ham\tAre you not around or just still asleep? :V',
 "ham\tLol you forgot it eh ? Yes, I'll bring it in babe",
 "ham\tIts good, we'll find a way",
 'ham\tCan not use foreign stamps in this country. Good lecture .',
 'ham\tYup bathe liao...',
 'ham\tHAPPY NEW YEAR MY NO.1 MAN',
 "ham\tOH MR SHEFFIELD! You wanna play THAT game, okay. You're the boss and I'm th
e nanny. You give me a raise and I'll give YOU one!!",
 'ham\tZOE IT JUST HIT ME 2 IM FUCKING SHITIN MYSELF IL DEFO TRY MY HARDEST 2 CUM
2MOROW LUV U MILLIONS LEKDOG',
 "ham\tHello baby, did you get back to your mom's ? Are you setting up the compute
r now ? Filling your belly ? How goes it loverboy ? I miss you already ... *sighs
*",
 'ham\tNo my blankets are sufficient, thx',
 "ham\tnaughty little thought: 'its better to flirt, flirt n flirt, rather than lo
ving someone n gettin hurt, hurt n hurt...:-) Gud nyt",
 'ham\tEdison has rightly said, "A fool can ask more questions than a wise man can
answer" Now you know why all of us are speechless during ViVa.. GM,GN,GE,GNT:-)',
 'ham\tThey just talking thats it de. They wont any other.',
```

```
 'ham\tToday am going to college so am not able to atten the class.',
 "ham\tI'm in class. Will holla later",
 'ham\tEasy ah?sen got selected means its good..',
 'ham\tMmm thats better now i got a roast down me! iÂ’d b better if i had a few dr
inks down me 2! Good indian?',
 'spam\tWe know someone who you know that fancies you. Call 09058097218 to find ou
t who. POBox 6, LS15HB 150p',
 "ham\tCome round, it's .",
 'ham\tDo 1 thing! Change that sentence into: "Because i want 2 concentrate in my
educational career im leaving here.."',
 ...]
```

Step 2: Print the length of the dataset and get the information.

In [33]:
```
print(len(messages))
```

```
3623
```

In [34]:
```
messages[5]
```

Out[34]:
```
'ham\tWow. I never realized that you were so embarassed by your accomodations. I t
hought you liked it, since i was doing the best i could and you always seemed so h
appy about "the cave". I\'m sorry I didn\'t and don\'t have more to give. I\'m sor
ry i offered. I\'m sorry your room was so embarassing.'
```

Step 3: For Exploratory Data Analysis (EDA), describe the group for ham and spam 'label'. Check the text length from the messages for the first five rows. Describe the details regarding the dataset

In [35]:
```
for mess_no,message in enumerate(messages[:15]):
 print(mess_no, message)
 print('\n') #print the new line
```

```
0 label message

1 ham   U don't know how stubborn I am. I didn't even want to go to the hospital. I
kept telling Mark I'm not a weak sucker. Hospitals are for weak suckers.

2 ham   What you thinked about me. First time you saw me in class.

3 ham   A gram usually runs like  &lt;#&gt; , a half eighth is smarter though and ge
ts you almost a whole second gram for  &lt;#&gt;

4 ham   K fyi x has a ride early tomorrow morning but he's crashing at our place ton
ight

5 ham   Wow. I never realized that you were so embarassed by your accomodations. I t
hought you liked it, since i was doing the best i could and you always seemed so hap
py about "the cave". I'm sorry I didn't and don't have more to give. I'm sorry i off
ered. I'm sorry your room was so embarassing.

6 spam  SMS. ac Sptv: The New Jersey Devils and the Detroit Red Wings play Ice Hocke
y. Correct or Incorrect? End? Reply END SPTV

7 ham   Do you know what Mallika Sherawat did yesterday? Find out now @  &lt;URL&gt;

8 spam  Congrats! 1 year special cinema pass for 2 is yours. call 09061209465 now! C
Suprman V, Matrix3, StarWars3, etc all 4 FREE! bx420-ip4-5we. 150pm. Dont miss out!

9 ham   Sorry, I'll call later in meeting.

10 ham  Tell where you reached

11 ham  Yes..gauti and sehwag out of odi series.

12 ham  Your gonna have to pick up a $1 burger for yourself on your way home. I ca
n't even move. Pain is killing me.

13 ham  Ha ha ha good joke. Girls are situation seekers.

14 ham  Its a part of checking IQ
```

Step 4: Visualize the text length using the histogram.

In [36]:
```
import pandas as pd
messages = pd.read_csv('SMSSpamHam.txt', sep='\t',
 names=['label', 'Messages'])
```

In [37]:
```
messages
```

Out[37]:

	label	Messages
0	label	message
1	ham	U don't know how stubborn I am. I didn't even ...
2	ham	What you thinked about me. First time you saw ...
3	ham	A gram usually runs like <#> , a half e...
4	ham	K fyi x has a ride early tomorrow morning but ...
...	...	...
3616	spam	This is the 2nd time we have tried 2 contact u...
3617	ham	Will ü b going to esplanade fr home?
3618	ham	Pity, * was in mood for that. So...any other s...
3619	ham	The guy did some bitching but I acted like i'd...
3620	ham	Rofl. Its true to its name

3621 rows × 2 columns

In [39]:
```
messages.describe()
```

Out[39]:

	label	Messages
count	3621	3621
unique	3	3428
top	ham	Sorry, I'll call later
freq	3133	23

In [40]:
```
messages.groupby('label').describe()
```

Out[40]:

	Messages			
	count	unique	top	freq
label				
ham	3133	2975	Sorry, I'll call later	23
label	1	1	message	1
spam	487	452	Today's Offer! Claim ur £150 worth of discount...	2

In [41]:
```
messages['length'] = messages['Messages'].apply(len)
messages.head(5)
```

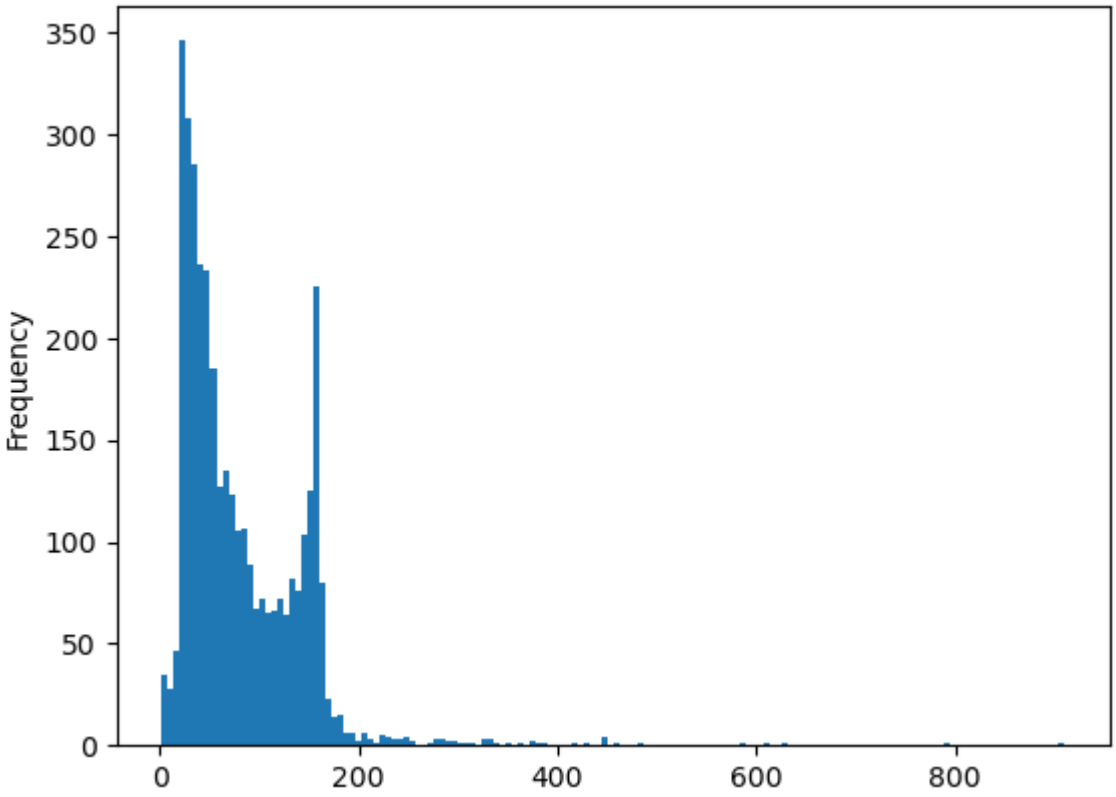
Out[41]:

	label	Messages	length
0	label	message	7
1	ham	U don't know how stubborn I am. I didn't even ...	148
2	ham	What you thinked about me. First time you saw ...	58
3	ham	A gram usually runs like <#> , a half e...	124
4	ham	K fyi x has a ride early tomorrow morning but ...	80

In [42]:
```
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

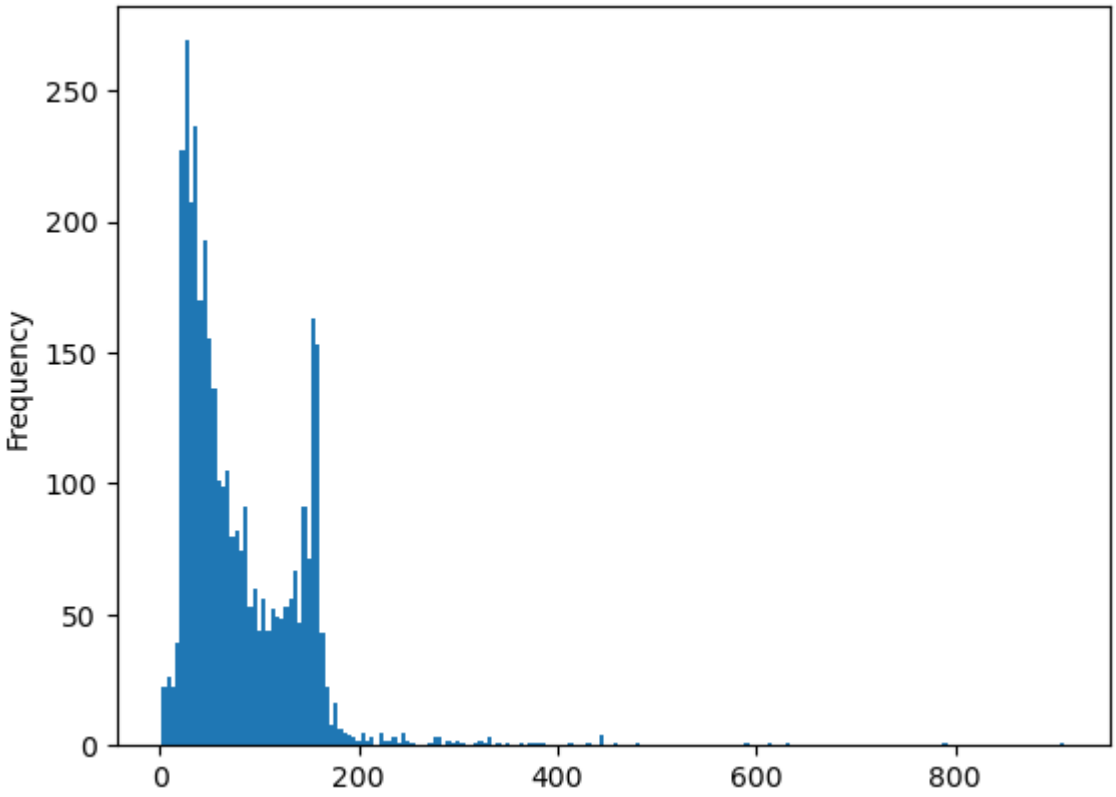
In [43]:
```
messages ['length'].plot.hist(bins=150)
```

Out[43]:
```
<AxesSubplot: ylabel='Frequency'>
```



In [44]:
```
messages ['length'].plot.hist(bins=200)
```

Out[44]: <AxesSubplot: ylabel='Frequency'>



Step 5: Get the maximum characters for the messages and print them.

In [45]:
```
messages['length'].describe()
```

Out[45]:
```
count    3621.000000
mean       80.658105
std        61.219068
min         2.000000
25%        36.000000
50%        62.000000
75%       122.000000
max       910.000000
Name: length, dtype: float64
```

In [46]:
```
messages [messages['length'] == 910]
```

Out[46]:

	label	Messages	length
1037	ham	For me the love should start with attraction.i...	910

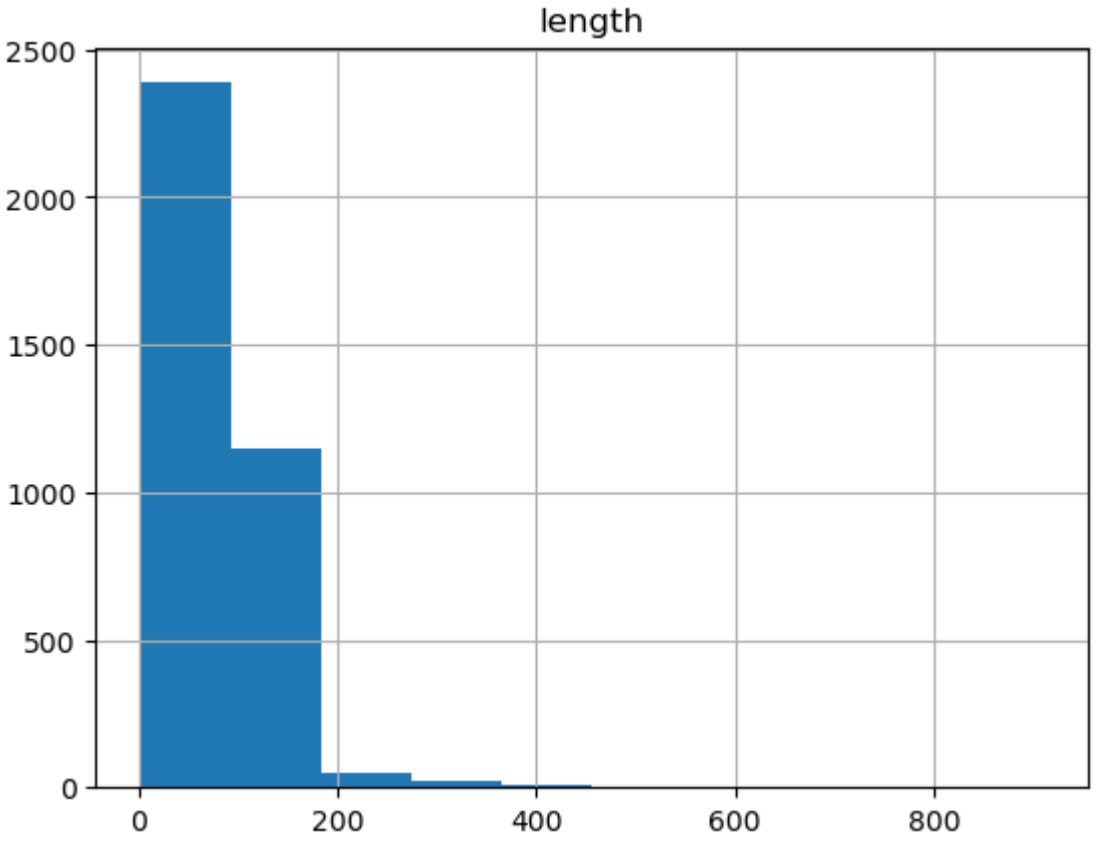
In [47]:
```
messages [messages['length'] == 910]['Messages'].iloc[0]
```

Out[47]:
```
"For me the love should start with attraction.i should feel that I need her every
time around me.she should be the first thing which comes in my thoughts.I would st
art the day and end it with her.she should be there every time I dream.love will b
e then when my every breath has her name.my life should happen around her.my life
will be named to her.I would cry for her.will give all my happiness and take all h
er sorrows.I will be ready to fight with anyone for her.I will be in love when I w
ill be doing the craziest things for her.love will be when I don't have to proove
anyone that my girl is the most beautiful lady on the whole planet.I will always b
e singing praises for her.love will be when I start up making chicken curry and en
d up makiing sambar.life will be the most beautiful then.will get every morning an
d thank god for the day because she is with me.I would like to say a lot..will tel
l later.."
```

Step 6: Visualize two histograms for ham and spam labels. Explain the results.

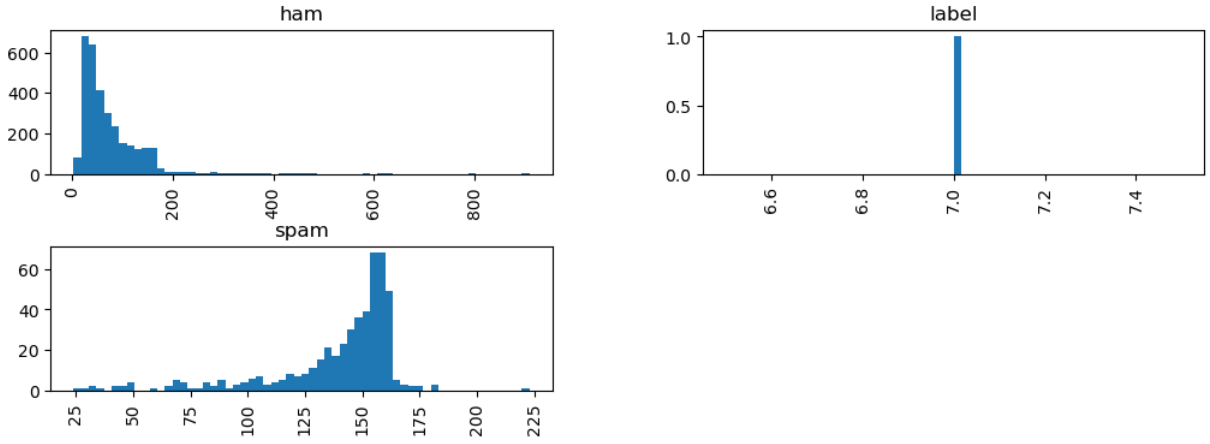
In [48]:
```
messages.hist()
```

Out[48]:
```
array([[<AxesSubplot: title={'center': 'length'}>]], dtype=object)
```



In [49]:
```
messages.hist(column='length', by='label', bins=60,figsize=(12,4))
```

Out[49]:
```
array([[<AxesSubplot: title={'center': 'ham'}>,
        <AxesSubplot: title={'center': 'label'}>],
       [<AxesSubplot: title={'center': 'spam'}>, <AxesSubplot: >]],
      dtype=object)
```



Based on the histrogram, ham label shows that distribution is right skewed. Spam label shows that distribution is left skewed.