

## Importing the libraries

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from keras.models import Model, Sequential
from keras.layers import LSTM, Activation, Dense, Dropout, Input,
Embedding
from keras.optimizers import Adam
from keras.preprocessing.text import Tokenizer
from keras.preprocessing import sequence
from keras.utils import pad_sequences
from keras.utils import to_categorical
from keras.callbacks import EarlyStopping
%matplotlib inline
```

## Reading the dataset

```
df = pd.read_csv('/content/drive/MyDrive/spam.csv', encoding='latin-1')
df.head()
```

```
   v1  ... Unnamed: 4
0  ham  ...        NaN
1  ham  ...        NaN
2 spam  ...        NaN
3  ham  ...        NaN
4  ham  ...        NaN
```

[5 rows x 5 columns]

```
df.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed:
4'], axis=1, inplace=True)
df.info()
```

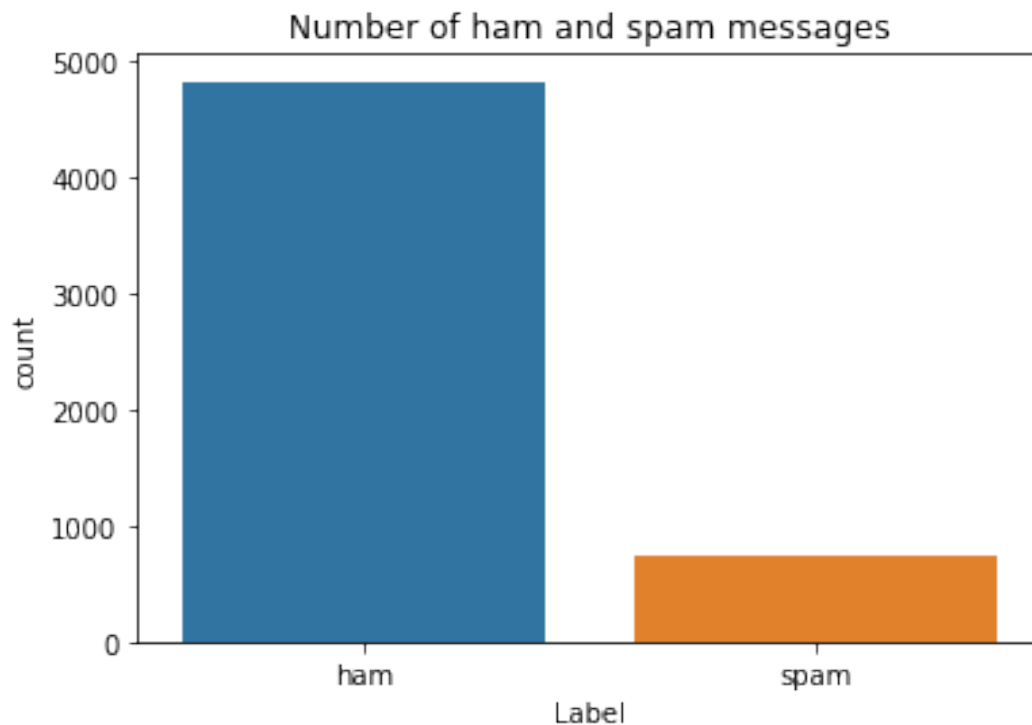
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype
---  -
 0    v1      5572 non-null    object
 1    v2      5572 non-null    object
dtypes: object(2)
memory usage: 87.2+ KB
```

```
sns.countplot(df.v1)
plt.xlabel('Label')
plt.title('Number of ham and spam messages')
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:
FutureWarning: Pass the following variable as a keyword arg: x. From
version 0.12, the only valid positional argument will be `data`, and
passing other arguments without an explicit keyword will result in an
error or misinterpretation.
```

```
FutureWarning
```

```
Text(0.5, 1.0, 'Number of ham and spam messages')
```



```
X = df.v2
Y = df.v1
le = LabelEncoder()
Y = le.fit_transform(Y)
Y = Y.reshape(-1,1)
```

```
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.15)
```

### Process the data

```
max_words = 1000
max_len = 150
tok = Tokenizer(num_words=max_words)
tok.fit_on_texts(X_train)
sequences = tok.texts_to_sequences(X_train)
sequences_matrix = pad_sequences(sequences,maxlen=max_len)
sequences_matrix
```

```
array([[ 0,  0,  0, ..., 135, 453, 391],
       [ 0,  0,  0, ..., 65, 782, 842],
```

```

[ 0, 0, 0, ..., 82, 2, 176],
...,
[ 0, 0, 0, ..., 51, 960, 256],
[ 0, 0, 0, ..., 49, 12, 298],
[ 0, 0, 0, ..., 753, 853, 59]], dtype=int32)

```

```
tok.index_word
```

```

{1: 'i',
 2: 'to',
 3: 'you',
 4: 'a',
 5: 'the',
 6: 'u',
 7: 'and',
 8: 'is',
 9: 'in',
10: 'me',
11: 'my',
12: 'for',
13: 'your',
14: 'it',
15: 'of',
16: 'call',
17: 'have',
18: 'on',
19: '2',
20: 'that',
21: 'are',
22: 'now',
23: 'so',
24: 'not',
25: 'or',
26: 'but',
27: 'do',
28: 'at',
29: 'get',
30: 'can',
31: 'ur',
32: 'if',
33: 'will',
34: 'be',
35: "i'm",
36: 'no',
37: 'just',
38: 'with',
39: 'we',
40: 'this',
41: '4',
42: 'gt',
43: 'up',

```

44: 'lt',  
45: 'how',  
46: 'when',  
47: 'free',  
48: 'ok',  
49: 'go',  
50: 'all',  
51: 'from',  
52: 'out',  
53: 'good',  
54: 'got',  
55: 'know',  
56: 'was',  
57: 'what',  
58: 'then',  
59: 'like',  
60: 'its',  
61: 'day',  
62: 'am',  
63: 'time',  
64: 'come',  
65: 'only',  
66: 'love',  
67: 'there',  
68: 'text',  
69: 'he',  
70: 'send',  
71: 'want',  
72: 'txt',  
73: 'going',  
74: 'one',  
75: 'need',  
76: 'as',  
77: 'home',  
78: 'by',  
79: "i'll",  
80: 'about',  
81: 'sorry',  
82: 'stop',  
83: 'see',  
84: 'r',  
85: 'still',  
86: 'lor',  
87: 'n',  
88: 'back',  
89: 'today',  
90: 'reply',  
91: 'tell',  
92: 'our',  
93: 'da',

94: 'she',  
95: 'dont',  
96: 'hi',  
97: 'new',  
98: 'take',  
99: "don't",  
100: 'mobile',  
101: 'dear',  
102: 'pls',  
103: 'please',  
104: 'k',  
105: 'any',  
106: 'later',  
107: 'think',  
108: 'her',  
109: 'did',  
110: 'some',  
111: 'an',  
112: 'been',  
113: 'much',  
114: 'week',  
115: 'great',  
116: 'they',  
117: 'phone',  
118: 'i',  
119: 'oh',  
120: 'claim',  
121: 'well',  
122: 'here',  
123: 'l',  
124: 'who',  
125: 'him',  
126: 'has',  
127: 'd',  
128: 'more',  
129: 'hey',  
130: 'had',  
131: 'hope',  
132: 'where',  
133: 'too',  
134: 'night',  
135: 'msg',  
136: 'happy',  
137: 'www',  
138: 'number',  
139: 'c',  
140: 'should',  
141: 'wat',  
142: 'make',  
143: 'give',

144: 'prize',  
145: 'yes',  
146: 'message',  
147: 'work',  
148: 'after',  
149: 'really',  
150: 'tomorrow',  
151: "it's",  
152: '3',  
153: 'e',  
154: 'cash',  
155: 'said',  
156: 'amp',  
157: 'way',  
158: 'yeah',  
159: 'say',  
160: 'find',  
161: 'already',  
162: 'doing',  
163: 'ask',  
164: 'why',  
165: 'im',  
166: 'right',  
167: 'babe',  
168: 'life',  
169: 'them',  
170: 'cos',  
171: 'last',  
172: 'very',  
173: 'would',  
174: 'win',  
175: 'lol',  
176: '150p',  
177: 'miss',  
178: 'urgent',  
179: 't',  
180: 'pick',  
181: 'morning',  
182: 'won',  
183: 'every',  
184: 'thanks',  
185: 'sent',  
186: 'meet',  
187: 'something',  
188: 'care',  
189: 'nokia',  
190: 'over',  
191: 'us',  
192: 'b',  
193: 'let',

194: 'again',  
195: 'also',  
196: 'com',  
197: 'anything',  
198: 'buy',  
199: 'contact',  
200: 'first',  
201: 'sure',  
202: 'someone',  
203: 'even',  
204: 'uk',  
205: 'thing',  
206: 'soon',  
207: 'tone',  
208: 'which',  
209: 'before',  
210: 'keep',  
211: "can't",  
212: 'service',  
213: 'wait',  
214: 'cant',  
215: 'his',  
216: 's',  
217: 'sleep',  
218: 'around',  
219: 'min',  
220: 'went',  
221: 'place',  
222: 'next',  
223: '5',  
224: "i've",  
225: 'money',  
226: 'were',  
227: 'leave',  
228: 'feel',  
229: 'could',  
230: 'always',  
231: 'co',  
232: 'told',  
233: 'nice',  
234: 'many',  
235: 'late',  
236: 'gonna',  
237: 'tonight',  
238: 'wish',  
239: '50',  
240: 'year',  
241: 'other',  
242: 'friend',  
243: 'x',

244: '16',  
245: 'waiting',  
246: 'per',  
247: "that's",  
248: 'down',  
249: 'off',  
250: 'customer',  
251: 'chat',  
252: 'ii',  
253: 'hello',  
254: 'ya',  
255: 'getting',  
256: 'help',  
257: 'friends',  
258: 'gud',  
259: 'wan',  
260: "you're",  
261: 'dun',  
262: 'fine',  
263: 'sms',  
264: 'name',  
265: 'done',  
266: '6',  
267: 'guaranteed',  
268: 'try',  
269: 'yet',  
270: '18',  
271: 'same',  
272: 'class',  
273: 'haha',  
274: 'special',  
275: 'holiday',  
276: 'mins',  
277: 'smile',  
278: 'people',  
279: 'heart',  
280: 'things',  
281: '7',  
282: 'cs',  
283: 'best',  
284: 'thk',  
285: 'coming',  
286: 'use',  
287: 'stuff',  
288: 'ill',  
289: 'may',  
290: 'cool',  
291: 'thought',  
292: 'finish',  
293: "didn't",



294: 'bit',  
295: 'y',  
296: 'chance',  
297: 'v',  
298: 'lunch',  
299: 'latest',  
300: 'trying',  
301: 'better',  
302: 'man',  
303: 'having',  
304: 'days',  
305: 'person',  
306: 'ready',  
307: 'because',  
308: 'being',  
309: 'thats',  
310: 'meeting',  
311: 'long',  
312: 'eat',  
313: 'yo',  
314: 'problem',  
315: 'talk',  
316: '1st',  
317: 'end',  
318: 'guess',  
319: 'house',  
320: 'receive',  
321: 'than',  
322: 'live',  
323: 'wk',  
324: 'car',  
325: 'lot',  
326: 'into',  
327: 'big',  
328: 'line',  
329: 'draw',  
330: 'mind',  
331: 'word',  
332: 'never',  
333: 'sir',  
334: 'god',  
335: 'half',  
336: 'ever',  
337: 'real',  
338: 'yup',  
339: 'few',  
340: 'shit',  
341: 'quite',  
342: 'job',  
343: 'birthday',

344: 'another',  
345: 'lar',  
346: 'camera',  
347: 'dinner',  
348: 'world',  
349: 'account',  
350: 'åf1000',  
351: 'girl',  
352: 'wanna',  
353: 'dat',  
354: 'boy',  
355: 'åf1',  
356: 'month',  
357: 'forgot',  
358: 'play',  
359: 'den',  
360: 'sweet',  
361: 'awarded',  
362: 'video',  
363: 'wont',  
364: 'bad',  
365: 'speak',  
366: 'shows',  
367: 'rate',  
368: 'ah',  
369: 'probably',  
370: 'guys',  
371: 'check',  
372: 'called',  
373: 'enjoy',  
374: 'liao',  
375: 'landline',  
376: 'face',  
377: 'left',  
378: 'bed',  
379: 'watch',  
380: 'remember',  
381: 'apply',  
382: 'll',  
383: '2nd',  
384: 'reach',  
385: 'tv',  
386: 'award',  
387: 'cost',  
388: 'room',  
389: 'once',  
390: 'nothing',  
391: 'box',  
392: 'shall',  
393: 'xxx',

394: 'start',  
395: 'between',  
396: 'princess',  
397: 'code',  
398: 'does',  
399: 'minutes',  
400: 'two',  
401: 'wife',  
402: 'plan',  
403: 'weekend',  
404: 'maybe',  
405: 'aight',  
406: 'hour',  
407: 'luv',  
408: '10',  
409: 'texts',  
410: 'dunno',  
411: 'bus',  
412: 'everything',  
413: 'most',  
414: 'offer',  
415: '000',  
416: 'thanx',  
417: 'sat',  
418: '9',  
419: '150ppm',  
420: 'pa',  
421: 'selected',  
422: 'while',  
423: 'missing',  
424: 'those',  
425: 'orange',  
426: 'might',  
427: 'pay',  
428: 'says',  
429: 'part',  
430: 'actually',  
431: 'kiss',  
432: 'looking',  
433: 'baby',  
434: 'enough',  
435: 'network',  
436: 'jus',  
437: 'hear',  
438: 'fun',  
439: 'put',  
440: 'shopping',  
441: 'asked',  
442: 'ringtone',  
443: 'update',

444: 'didn't',  
445: 'bring',  
446: 'early',  
447: 'sexy',  
448: 'dis',  
449: 'mail',  
450: 'easy',  
451: 'years',  
452: 'without',  
453: 'po',  
454: 'hav',  
455: 'look',  
456: 'plus',  
457: 'must',  
458: 'okay',  
459: 'means',  
460: 'mob',  
461: "how's",  
462: 'anyway',  
463: 'bt',  
464: 'watching',  
465: 'evening',  
466: 'thank',  
467: 'fuck',  
468: 'school',  
469: 'tones',  
470: 'xmas',  
471: "he's",  
472: 'entry',  
473: 'abt',  
474: 'collect',  
475: 'join',  
476: 'true',  
477: 'important',  
478: 'details',  
479: 'afternoon',  
480: 'made',  
481: 'leh',  
482: 'weekly',  
483: '10p',  
484: 'attempt',  
485: 'collection',  
486: 'colour',  
487: 'since',  
488: 'office',  
489: 'tmr',  
490: 'came',  
491: 'bored',  
492: 'wen',  
493: 'dad',

494: 'until',  
495: 'able',  
496: 'price',  
497: 'plz',  
498: 'change',  
499: 'pain',  
500: 'goes',  
501: 'wot',  
502: 'dude',  
503: 'these',  
504: 'town',  
505: 'run',  
506: 'little',  
507: '8',  
508: 'wake',  
509: 'm',  
510: 'yesterday',  
511: 'book',  
512: 'calls',  
513: 'messages',  
514: 'worry',  
515: 'though',  
516: 'havent',  
517: 'online',  
518: 'test',  
519: 'alright',  
520: 'away',  
521: 'wanted',  
522: 'else',  
523: 'national',  
524: 'guy',  
525: 'working',  
526: 'game',  
527: 'g',  
528: 'saw',  
529: 'smiling',  
530: 'net',  
531: 'wif',  
532: 'valid',  
533: 'making',  
534: 'show',  
535: 'sad',  
536: 'words',  
537: 'comes',  
538: 'hair',  
539: 'juz',  
540: 'gift',  
541: 'de',  
542: 'missed',  
543: 'trip',

544: 'driving',  
545: 'both',  
546: '500',  
547: 'feeling',  
548: 'stay',  
549: 'drive',  
550: 'lei',  
551: 'club',  
552: 'shop',  
553: 'haf',  
554: 'friendship',  
555: 'huh',  
556: 're',  
557: 'order',  
558: '8007',  
559: 'double',  
560: 'hours',  
561: 'gr8',  
562: 'hot',  
563: 'åf5000',  
564: 'bonus',  
565: 'id',  
566: 'todays',  
567: 'wants',  
568: 'sae',  
569: "we're",  
570: "''",  
571: 'oso',  
572: 'dreams',  
573: 'decimal',  
574: 'ring',  
575: 'chikku',  
576: 'times',  
577: 'address',  
578: 'eve',  
579: 'http',  
580: 'saying',  
581: 'coz',  
582: 'poly',  
583: 'makes',  
584: 'family',  
585: 'top',  
586: 'aft',  
587: 'points',  
588: 'tried',  
589: 'pics',  
590: 'food',  
591: 'nite',  
592: 'goin',  
593: 'await',

594: 'pic',  
595: 'âf2000',  
596: 'date',  
597: 'calling',  
598: 'minute',  
599: 'delivery',  
600: 'mean',  
601: 'old',  
602: 'neva',  
603: 'awesome',  
604: 'news',  
605: 'tomo',  
606: 'leaving',  
607: 'finished',  
608: 'final',  
609: 'âf100',  
610: 'til',  
611: 'hurt',  
612: "there's",  
613: 'busy',  
614: 'knw',  
615: 'question',  
616: 'answer',  
617: 'till',  
618: 'rite',  
619: 'story',  
620: 'dating',  
621: 'okie',  
622: "haven't",  
623: 'either',  
624: 'everyone',  
625: 'believe',  
626: 'wid',  
627: "she's",  
628: 'simple',  
629: 'touch',  
630: 'full',  
631: 'pounds',  
632: 'post',  
633: 'beautiful',  
634: 'yours',  
635: 'âf500',  
636: 'sister',  
637: 'private',  
638: 'visit',  
639: 'charge',  
640: 'yourself',  
641: 'noe',  
642: "what's",  
643: 'email',

644: 'happen',  
645: 'sounds',  
646: 'tot',  
647: 'walk',  
648: 'pm',  
649: 'loving',  
650: 'auction',  
651: 'tho',  
652: 'took',  
653: 'movie',  
654: 'forget',  
655: 'xx',  
656: 'available',  
657: 'mobileupd8',  
658: 'college',  
659: 'drink',  
660: 'fast',  
661: 'type',  
662: "won't",  
663: 'sch',  
664: 'choose',  
665: 'lets',  
666: 'together',  
667: 'search',  
668: 'statement',  
669: 'light',  
670: 'whats',  
671: 'taking',  
672: 'congrats',  
673: 'hard',  
674: 'smth',  
675: 'w',  
676: "we'll",  
677: 'land',  
678: 'needs',  
679: 'second',  
680: 'company',  
681: 'pobox',  
682: 'mine',  
683: 'row',  
684: 'sleeping',  
685: '86688',  
686: 'lose',  
687: 'lots',  
688: 'brother',  
689: 'decided',  
690: 'angry',  
691: 'lesson',  
692: 'gone',  
693: 'ltd',



694: '100',  
695: 'smoke',  
696: 'found',  
697: 'card',  
698: 'wil',  
699: '12hrs',  
700: 'vouchers',  
701: 'set',  
702: 'identifier',  
703: 'expires',  
704: 'music',  
705: '750',  
706: '08000839402',  
707: 'âf250',  
708: "c's",  
709: 'case',  
710: 'takes',  
711: 'o',  
712: 'anyone',  
713: 'b4',  
714: 'happened',  
715: 'yr',  
716: 'fri',  
717: 'unsubscribe',  
718: 'head',  
719: 'ard',  
720: 'prob',  
721: 'drop',  
722: 'each',  
723: 'fancy',  
724: 'open',  
725: 'close',  
726: '\x89û',  
727: 'cause',  
728: 'pub',  
729: 'etc',  
730: 'least',  
731: 'bout',  
732: 'reason',  
733: 'mum',  
734: 'far',  
735: 'saturday',  
736: 'used',  
737: 'thinking',  
738: 'break',  
739: 'âf3',  
740: 'lucky',  
741: 'quiz',  
742: 'f',  
743: 'weeks',

744: 'read',  
745: 'goodmorning',  
746: 'frnds',  
747: 'credit',  
748: 'party',  
749: 'winner',  
750: 'caller',  
751: 'secret',  
752: "doesn't",  
753: 'treat',  
754: 'services',  
755: 'hows',  
756: 'operator',  
757: 'voucher',  
758: 'rs',  
759: '08000930705',  
760: 'gas',  
761: 'sun',  
762: 'don',  
763: 'msgs',  
764: 'india',  
765: '03',  
766: 'opt',  
767: 'sis',  
768: 'tel',  
769: 'seeing',  
770: 'started',  
771: 'hungry',  
772: 'congratulations',  
773: 'project',  
774: 'hmm',  
775: 'â€2',  
776: 'download',  
777: 'gd',  
778: 'numbers',  
779: 'â€350',  
780: 'kind',  
781: 'frnd',  
782: 'happiness',  
783: 'pretty',  
784: 'dnt',  
785: 'girls',  
786: 'phones',  
787: 'info',  
788: 'darlin',  
789: 'tc',  
790: 'games',  
791: 'chennai',  
792: 'sunday',  
793: 'march',

794: "you'll",  
795: 'song',  
796: 'area',  
797: 'savamob',  
798: 'luck',  
799: 'friday',  
800: 'ago',  
801: 'point',  
802: 'nope',  
803: 'knew',  
804: 'felt',  
805: 'hold',  
806: 'sending',  
807: 'stupid',  
808: 'yar',  
809: 'mu',  
810: 'boytoy',  
811: 'course',  
812: 'fone',  
813: 'whole',  
814: 'ass',  
815: 'wit',  
816: 'mates',  
817: 'camcorder',  
818: 'alone',  
819: 'nt',  
820: 'fucking',  
821: 'complimentary',  
822: 'ugh',  
823: "you've",  
824: 'side',  
825: 'comp',  
826: 'reading',  
827: 'anytime',  
828: 'park',  
829: 'll',  
830: 'motorola',  
831: 'suite342',  
832: '2lands',  
833: 'understand',  
834: 'wrong',  
835: 'mom',  
836: 'na',  
837: 'ni8',  
838: 'wkly',  
839: 'father',  
840: 'gal',  
841: 'balance',  
842: 'abiola',  
843: 'hit',

844: 'oredi',  
845: 'wine',  
846: 'extra',  
847: 'listen',  
848: '20',  
849: 'rental',  
850: 'call2optout',  
851: 'exam',  
852: 'laptop',  
853: 'their',  
854: "'",  
855: 'lovely',  
856: 'bath',  
857: 'sort',  
858: 'worth',  
859: 'offers',  
860: 'jay',  
861: 'log',  
862: 'surprise',  
863: 'hmmm',  
864: 'sea',  
865: 'frm',  
866: 'ipod',  
867: 'player',  
868: 'pass',  
869: '2003',  
870: '800',  
871: 'un',  
872: 'couple',  
873: 'truth',  
874: '0800',  
875: 'earlier',  
876: 'reveal',  
877: 'thinks',  
878: 'shower',  
879: 'hand',  
880: '30',  
881: 'crazy',  
882: 'mate',  
883: 'freemsg',  
884: 'wonder',  
885: 'snow',  
886: 'difficult',  
887: 'slow',  
888: 'std',  
889: 'carlos',  
890: 'swing',  
891: 'ten',  
892: 'mah',  
893: 'outside',

894: 'small',  
895: 'finally',  
896: 'content',  
897: 'wonderful',  
898: 'bslvyl',  
899: 'bank',  
900: 'valued',  
901: 'p',  
902: 'meant',  
903: 'john',  
904: 'mrng',  
905: 'police',  
906: 'currently',  
907: 'wishing',  
908: 'clean',  
909: 'tickets',  
910: 'th',  
911: 'usf',  
912: '12',  
913: 'txts',  
914: 'through',  
915: 'warm',  
916: 'reached',  
917: 'tired',  
918: 'myself',  
919: 'askd',  
920: 'darren',  
921: 'redeemed',  
922: 'feels',  
923: 'rply',  
924: 'store',  
925: 'ts',  
926: 'somebody',  
927: 'rest',  
928: 'months',  
929: 'custcare',  
930: 'welcome',  
931: 'heard',  
932: 'rakhesh',  
933: 'parents',  
934: 'kids',  
935: 'rates',  
936: 'hee',  
937: 'usual',  
938: 'link',  
939: 'ex',  
940: 'bcoz',  
941: 'hoping',  
942: 'checking',  
943: 'entered',

944: 'sex',  
945: 'talking',  
946: 'own',  
947: 'press',  
948: 'age',  
949: 'mr',  
950: 'gym',  
951: 'die',  
952: 'ans',  
953: 'via',  
954: 'uncle',  
955: 'otherwise',  
956: 'direct',  
957: "i'd",  
958: 'eg',  
959: "isn't",  
960: 'lost',  
961: 'kate',  
962: 'match',  
963: 'questions',  
964: 'semester',  
965: 'ha',  
966: 'safe',  
967: 'energy',  
968: 'ac',  
969: 'wana',  
970: 'st',  
971: 'england',  
972: 'immediately',  
973: 'loads',  
974: 'blue',  
975: 'empty',  
976: "wasn't",  
977: 'convey',  
978: 'eh',  
979: 'wow',  
980: 'voice',  
981: 'terms',  
982: 'somewhere',  
983: 'charity',  
984: 'discount',  
985: 'information',  
986: 'fantastic',  
987: 'worried',  
988: 'study',  
989: 'grins',  
990: 'plans',  
991: 'sell',  
992: 'monday',  
993: 'mobiles',

```

994: 'forever',
995: 'fact',
996: 'pray',
997: 'train',
998: 'against',
999: 'kinda',
1000: 'ending',
...}

```

### Creating model and Adding the layers

```

TOT_SIZE = len(tok.word_index)+1
lstm_model = Sequential()
lstm_model.add(Embedding(TOT_SIZE, 32, input_length=max_len))
lstm_model.add(LSTM(100))
lstm_model.add(Dropout(0.4))
lstm_model.add(Dense(20, activation="relu"))
lstm_model.add(Dropout(0.3))
lstm_model.add(Dense(1, activation = "sigmoid"))

```

### Compile the model

```

lstm_model.compile(loss = "binary_crossentropy", optimizer = "adam",
metrics = ["accuracy"])
lstm_model.summary()

```

Model: "sequential\_2"

| Layer (type)              | Output Shape    | Param # |
|---------------------------|-----------------|---------|
| embedding_1 (Embedding)   | (None, 150, 32) | 264032  |
| lstm_1 (LSTM)             | (None, 100)     | 53200   |
| dropout_2 (Dropout)       | (None, 100)     | 0       |
| dense_2 (Dense)           | (None, 20)      | 2020    |
| dropout_3 (Dropout)       | (None, 20)      | 0       |
| dense_3 (Dense)           | (None, 1)       | 21      |
| Total params: 319,273     |                 |         |
| Trainable params: 319,273 |                 |         |
| Non-trainable params: 0   |                 |         |

### Fit the model

```

lstm_model.fit(sequences_matrix,Y_train,batch_size=128,epochs=10,
validation_split=0.2,

```

```
workers=10,  
  
callbacks=[EarlyStopping(monitor='val_loss',min_delta=0.0001)])  
  
Epoch 1/10  
30/30 [=====] - 12s 404ms/step - loss: 0.1012  
- accuracy: 0.9799 - val_loss: 0.0636 - val_accuracy: 0.9831  
Epoch 2/10  
30/30 [=====] - 12s 392ms/step - loss: 0.0488  
- accuracy: 0.9876 - val_loss: 0.0597 - val_accuracy: 0.9852  
  
<keras.callbacks.History at 0x7f845ce77d90>
```

### Save the model

```
lstm_model.save('sms.h5')
```

### Test the model

```
test_sequences = tok.texts_to_sequences(X_test)  
test_sequences_matrix = pad_sequences(test_sequences,maxlen=max_len)  
  
acc = lstm_model.evaluate(test_sequences_matrix,Y_test)  
  
27/27 [=====] - 1s 40ms/step - loss: 0.0646 -  
accuracy: 0.9785  
  
print('Test set\n Loss: {:.3f}\n Accuracy:  
{:.3f}'.format(acc[0],acc[1]))  
  
Test set  
Loss: 0.065  
Accuracy: 0.978
```