

# 1. Скачать нейросети ResNet и написать короткую процедуру для предсказания класса изображения

```
In [ ]: !pip install deeppavlov

In [1]: import torch
from torchvision import transforms
import urllib.request
from PIL import Image
from matplotlib import pyplot as plt
from matplotlib import cm
import plotly.express as px
from deeppavlov.core.common.file import read_json
from deeppavlov import build_model, configs
from scipy import spatial
import numpy as np
import pandas as pd
from sklearn.decomposition import PCA
from sklearn.cluster import AgglomerativeClustering

In [ ]: model = torch.hub.load('pytorch/vision:v0.10.0', 'resnet50', pretrained=True)
model.eval()
device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
model = model.to(device)

In [3]: IMAGENET_LABELS = {0: 'tench, Tinca tinca',
1: 'goldfish, Carassius auratus',
2: 'great white shark, white shark, man-eater, man-eating shark, Carcharodon carcharias',
3: 'tiger shark, Galeocerdo cuvieri',
4: 'hammerhead, hammerhead shark',
5: 'electric ray, crampfish, numbfish, torpedo',
6: 'stingray',
7: 'cock',
8: 'hen',
9: 'ostrich, Struthio camelus',
10: 'brambling, Fringilla montifringilla',
11: 'goldfinch, Carduelis carduelis',
12: 'house finch, linnet, Carpodacus mexicanus',
13: 'junco, snowbird',
14: 'indigo bunting, indigo finch, indigo bird, Passerina cyanea',
15: 'robin, American robin, Turdus migratorius',
16: 'bulbul',
17: 'jay',
18: 'magpie',
19: 'chickadee',
20: 'water ouzel, dipper',
21: 'kite',
22: 'bald eagle, American eagle, Haliaeetus leucocephalus',
23: 'vulture',
24: 'great grey owl, great gray owl, Strix nebulosa',
25: 'European fire salamander, Salamandra salamandra',
26: 'common newt, Triturus vulgaris',
27: 'eft',
28: 'spotted salamander, Ambystoma maculatum',
29: 'axolotl, mud puppy, Ambystoma mexicanum',
30: 'bullfrog, Rana catesbeiana',
31: 'tree frog, tree-frog',
32: 'tailed frog, bell toad, ribbed toad, tailed toad, Ascaphus trui',
33: 'loggerhead, loggerhead turtle, Caretta caretta',
34: 'leatherback turtle, leatherback, leathery turtle, Dermochelys coriacea',
35: 'mud turtle',
36: 'terrapin',
37: 'box turtle, box tortoise',
38: 'banded gecko',
39: 'common iguana, iguana, Iguana iguana',
40: 'American chameleon, anole, Anolis carolinensis',
41: 'whiptail, whiptail lizard',
42: 'agama',
43: 'frilled lizard, Chlamydosaurus kingi',
44: 'alligator lizard',
45: 'Gila monster, Heloderma suspectum',
```

```
46: 'green lizard, Lacerta viridis',  
47: 'African chameleon, Chamaeleo chamaeleon',  
48: 'Komodo dragon, Komodo lizard, dragon lizard, giant lizard, Varanus komodoensis',  
49: 'African crocodile, Nile crocodile, Crocodylus niloticus',  
50: 'American alligator, Alligator mississippiensis',  
51: 'triceratops',  
52: 'thunder snake, worm snake, Carpophis amoenus',  
53: 'ringneck snake, ring-necked snake, ring snake',  
54: 'hognose snake, puff adder, sand viper',  
55: 'green snake, grass snake',  
56: 'king snake, kingsnake',  
57: 'garter snake, grass snake',  
58: 'water snake',  
59: 'vine snake',  
60: 'night snake, Hypsiglena torquata',  
61: 'boa constrictor, Constrictor constrictor',  
62: 'rock python, rock snake, Python sebae',  
63: 'Indian cobra, Naja naja',  
64: 'green mamba',  
65: 'sea snake',  
66: 'horned viper, cerastes, sand viper, horned asp, Cerastes cornutus',  
67: 'diamondback, diamondback rattlesnake, Crotalus adamanteus',  
68: 'sidewinder, horned rattlesnake, Crotalus cerastes',  
69: 'trilobite',  
70: 'harvestman, daddy longlegs, Phalangium opilio',  
71: 'scorpion',  
72: 'black and gold garden spider, Argiope aurantia',  
73: 'barn spider, Araneus cavaticus',  
74: 'garden spider, Aranea diademata',  
75: 'black widow, Latrodectus mactans',  
76: 'tarantula',  
77: 'wolf spider, hunting spider',  
78: 'tick',  
79: 'centipede',  
80: 'black grouse',  
81: 'ptarmigan',  
82: 'ruffed grouse, partridge, Bonasa umbellus',  
83: 'prairie chicken, prairie grouse, prairie fowl',  
84: 'peacock',  
85: 'quail',  
86: 'partridge',  
87: 'African grey, African gray, Psittacus erithacus',  
88: 'macaw',  
89: 'sulphur-crested cockatoo, Kakatoe galerita, Cacatua galerita',  
90: 'lorikeet',  
91: 'coucal',  
92: 'bee eater',  
93: 'hornbill',  
94: 'hummingbird',  
95: 'jacamar',  
96: 'toucan',  
97: 'drake',  
98: 'red-breasted merganser, Mergus serrator',  
99: 'goose',  
100: 'black swan, Cygnus atratus',  
101: 'tusker',  
102: 'echidna, spiny anteater, anteater',  
103: 'platypus, duckbill, duckbilled platypus, duck-billed platypus, Ornithorhynchus anatinus',  
104: 'wallaby, brush kangaroo',  
105: 'koala, koala bear, kangaroo bear, native bear, Phascolarctos cinereus',  
106: 'wombat',  
107: 'jellyfish',  
108: 'sea anemone, anemone',  
109: 'brain coral',  
110: 'flatworm, platyhelminth',  
111: 'nematode, nematode worm, roundworm',  
112: 'conch',  
113: 'snail',  
114: 'slug',  
115: 'sea slug, nudibranch',  
116: 'chiton, coat-of-mail shell, sea cradle, polyplacophore',  
117: 'chambered nautilus, pearly nautilus, nautilus',  
118: 'Dungeness crab, Cancer magister',  
119: 'rock crab, Cancer irroratus',  
120: 'fiddler crab',
```

```
121: 'king crab, Alaska crab, Alaskan king crab, Alaska king crab, Paralithodes camtschatica',  
122: 'American lobster, Northern lobster, Maine lobster, Homarus americanus',  
123: 'spiny lobster, langouste, rock lobster, crawfish, crayfish, sea crawfish',  
124: 'crayfish, crawfish, crawdad, crawdaddy',  
125: 'hermit crab',  
126: 'isopod',  
127: 'white stork, Ciconia ciconia',  
128: 'black stork, Ciconia nigra',  
129: 'spoonbill',  
130: 'flamingo',  
131: 'little blue heron, Egretta caerulea',  
132: 'American egret, great white heron, Egretta albus',  
133: 'bittern',  
134: 'crane',  
135: 'limpkin, Aramus pictus',  
136: 'European gallinule, Porphyrio porphyrio',  
137: 'American coot, marsh hen, mud hen, water hen, Fulica americana',  
138: 'bustard',  
139: 'ruddy turnstone, Arenaria interpres',  
140: 'red-backed sandpiper, dunlin, Erolia alpina',  
141: 'redshank, Tringa totanus',  
142: 'dowitcher',  
143: 'oystercatcher, oyster catcher',  
144: 'pelican',  
145: 'king penguin, Aptenodytes patagonica',  
146: 'albatross, mollymawk',  
147: 'grey whale, gray whale, devilfish, Eschrichtius gibbosus, Eschrichtius robustus',  
148: 'killer whale, killer, orca, grampus, sea wolf, Orcinus orca',  
149: 'dugong, Dugong dugon',  
150: 'sea lion',  
151: 'Chihuahua',  
152: 'Japanese spaniel',  
153: 'Maltese dog, Maltese terrier, Maltese',  
154: 'Pekinese, Pekingese, Peke',  
155: 'Shih-Tzu',  
156: 'Blenheim spaniel',  
157: 'papillon',  
158: 'toy terrier',  
159: 'Rhodesian ridgeback',  
160: 'Afghan hound, Afghan',  
161: 'basset, basset hound',  
162: 'beagle',  
163: 'bloodhound, sleuthhound',  
164: 'bluetick',  
165: 'black-and-tan coonhound',  
166: 'Walker hound, Walker foxhound',  
167: 'English foxhound',  
168: 'redbone',  
169: 'borzoi, Russian wolfhound',  
170: 'Irish wolfhound',  
171: 'Italian greyhound',  
172: 'whippet',  
173: 'Ibizan hound, Ibizan Podenco',  
174: 'Norwegian elkhound, elkhound',  
175: 'otterhound, otter hound',  
176: 'Saluki, gazelle hound',  
177: 'Scottish deerhound, deerhound',  
178: 'Weimaraner',  
179: 'Staffordshire bullterrier, Staffordshire bull terrier',  
180: 'American Staffordshire terrier, Staffordshire terrier, American pit bull terrier, pit bu  
181: 'Bedlington terrier',  
182: 'Border terrier',  
183: 'Kerry blue terrier',  
184: 'Irish terrier',  
185: 'Norfolk terrier',  
186: 'Norwich terrier',  
187: 'Yorkshire terrier',  
188: 'wire-haired fox terrier',  
189: 'Lakeland terrier',  
190: 'Sealyham terrier, Sealyham',  
191: 'Airedale, Airedale terrier',  
192: 'cairn, cairn terrier',  
193: 'Australian terrier',  
194: 'Dandie Dinmont, Dandie Dinmont terrier',  
195: 'Boston bull, Boston terrier',
```

```
196: 'miniature schnauzer',
197: 'giant schnauzer',
198: 'standard schnauzer',
199: 'Scotch terrier, Scottish terrier, Scottie',
200: 'Tibetan terrier, chrysanthemum dog',
201: 'silky terrier, Sydney silky',
202: 'soft-coated wheaten terrier',
203: 'West Highland white terrier',
204: 'Lhasa, Lhasa apso',
205: 'flat-coated retriever',
206: 'curly-coated retriever',
207: 'golden retriever',
208: 'Labrador retriever',
209: 'Chesapeake Bay retriever',
210: 'German short-haired pointer',
211: 'vizsla, Hungarian pointer',
212: 'English setter',
213: 'Irish setter, red setter',
214: 'Gordon setter',
215: 'Brittany spaniel',
216: 'clumber, clumber spaniel',
217: 'English springer, English springer spaniel',
218: 'Welsh springer spaniel',
219: 'cocker spaniel, English cocker spaniel, cocker',
220: 'Sussex spaniel',
221: 'Irish water spaniel',
222: 'kuvasz',
223: 'schipperke',
224: 'groenendael',
225: 'malinois',
226: 'briard',
227: 'kelpie',
228: 'komondor',
229: 'Old English sheepdog, bobtail',
230: 'Shetland sheepdog, Shetland sheep dog, Shetland',
231: 'collie',
232: 'Border collie',
233: 'Bouvier des Flandres, Bouviers des Flandres',
234: 'Rottweiler',
235: 'German shepherd, German shepherd dog, German police dog, alsatian',
236: 'Doberman, Doberman pinscher',
237: 'miniature pinscher',
238: 'Greater Swiss Mountain dog',
239: 'Bernese mountain dog',
240: 'Appenzeller',
241: 'EntleBucher',
242: 'boxer',
243: 'bull mastiff',
244: 'Tibetan mastiff',
245: 'French bulldog',
246: 'Great Dane',
247: 'Saint Bernard, St Bernard',
248: 'Eskimo dog, husky',
249: 'malamute, malemute, Alaskan malamute',
250: 'Siberian husky',
251: 'dalmatian, coach dog, carriage dog',
252: 'affenpinscher, monkey pinscher, monkey dog',
253: 'basenji',
254: 'pug, pug-dog',
255: 'Leonberg',
256: 'Newfoundland, Newfoundland dog',
257: 'Great Pyrenees',
258: 'Samoyed, Samoyede',
259: 'Pomeranian',
260: 'chow, chow chow',
261: 'keeshond',
262: 'Brabancon griffon',
263: 'Pembroke, Pembroke Welsh corgi',
264: 'Cardigan, Cardigan Welsh corgi',
265: 'toy poodle',
266: 'miniature poodle',
267: 'standard poodle',
268: 'Mexican hairless',
269: 'timber wolf, grey wolf, gray wolf, Canis lupus',
270: 'white wolf, Arctic wolf, Canis lupus tundrarum',
```

```
271: 'red wolf, maned wolf, Canis rufus, Canis niger',  
272: 'coyote, prairie wolf, brush wolf, Canis latrans',  
273: 'dingo, warrigal, warragal, Canis dingo',  
274: 'dhole, Cuon alpinus',  
275: 'African hunting dog, hyena dog, Cape hunting dog, Lycaon pictus',  
276: 'hyena, hyaena',  
277: 'red fox, Vulpes vulpes',  
278: 'kit fox, Vulpes macrotis',  
279: 'Arctic fox, white fox, Alopex lagopus',  
280: 'grey fox, gray fox, Urocyon cinereoargenteus',  
281: 'tabby, tabby cat',  
282: 'tiger cat',  
283: 'Persian cat',  
284: 'Siamese cat, Siamese',  
285: 'Egyptian cat',  
286: 'cougar, puma, catamount, mountain lion, painter, panther, Felis concolor',  
287: 'lynx, catamount',  
288: 'leopard, Panthera pardus',  
289: 'snow leopard, ounce, Panthera uncia',  
290: 'jaguar, panther, Panthera onca, Felis onca',  
291: 'lion, king of beasts, Panthera leo',  
292: 'tiger, Panthera tigris',  
293: 'cheetah, cheta, Acinonyx jubatus',  
294: 'brown bear, bruin, Ursus arctos',  
295: 'American black bear, black bear, Ursus americanus, Euarctos americanus',  
296: 'ice bear, polar bear, Ursus Maritimus, Thalarctos maritimus',  
297: 'sloth bear, Melursus ursinus, Ursus ursinus',  
298: 'mongoose',  
299: 'meerkat, mierkat',  
300: 'tiger beetle',  
301: 'ladybug, ladybeetle, lady beetle, ladybird, ladybird beetle',  
302: 'ground beetle, carabid beetle',  
303: 'long-horned beetle, longicorn, longicorn beetle',  
304: 'leaf beetle, chrysomelid',  
305: 'dung beetle',  
306: 'rhinoceros beetle',  
307: 'weevil',  
308: 'fly',  
309: 'bee',  
310: 'ant, emmet, pismire',  
311: 'grasshopper, hopper',  
312: 'cricket',  
313: 'walking stick, walkingstick, stick insect',  
314: 'cockroach, roach',  
315: 'mantis, mantid',  
316: 'cicada, cicala',  
317: 'leafhopper',  
318: 'lacewing, lacewing fly',  
319: "dragonfly, darning needle, devil's darning needle, sewing needle, snake feeder, snake do  
320: 'damselfly',  
321: 'admiral',  
322: 'ringlet, ringlet butterfly',  
323: 'monarch, monarch butterfly, milkweed butterfly, Danaus plexippus',  
324: 'cabbage butterfly',  
325: 'sulphur butterfly, sulfur butterfly',  
326: 'lycaenid, lycaenid butterfly',  
327: 'starfish, sea star',  
328: 'sea urchin',  
329: 'sea cucumber, holothurian',  
330: 'wood rabbit, cottontail, cottontail rabbit',  
331: 'hare',  
332: 'Angora, Angora rabbit',  
333: 'hamster',  
334: 'porcupine, hedgehog',  
335: 'fox squirrel, eastern fox squirrel, Sciurus niger',  
336: 'marmot',  
337: 'beaver',  
338: 'guinea pig, Cavia cobaya',  
339: 'sorrel',  
340: 'zebra',  
341: 'hog, pig, grunter, squealer, Sus scrofa',  
342: 'wild boar, boar, Sus scrofa',  
343: 'warthog',  
344: 'hippopotamus, hippo, river horse, Hippopotamus amphibius',  
345: 'ox',
```

```
346: 'water buffalo, water ox, Asiatic buffalo, Bubalus bubalis',  
347: 'bison',  
348: 'ram, tup',  
349: 'bighorn, bighorn sheep, cimarron, Rocky Mountain bighorn, Rocky Mountain sheep, Ovis can-  
350: 'ibex, Capra ibex',  
351: 'hartebeest',  
352: 'impala, Aepyceros melampus',  
353: 'gazelle',  
354: 'Arabian camel, dromedary, Camelus dromedarius',  
355: 'llama',  
356: 'weasel',  
357: 'mink',  
358: 'polecat, fitch, foulmart, foumart, Mustela putorius',  
359: 'black-footed ferret, ferret, Mustela nigripes',  
360: 'otter',  
361: 'skunk, polecat, wood pussy',  
362: 'badger',  
363: 'armadillo',  
364: 'three-toed sloth, ai, Bradypus tridactylus',  
365: 'orangutan, orang, orangutang, Pongo pygmaeus',  
366: 'gorilla, Gorilla gorilla',  
367: 'chimpanzee, chimp, Pan troglodytes',  
368: 'gibbon, Hylobates lar',  
369: 'siamang, Hylobates syndactylus, Sympalangus syndactylus',  
370: 'guenon, guenon monkey',  
371: 'patas, hussar monkey, Erythrocebus patas',  
372: 'baboon',  
373: 'macaque',  
374: 'langur',  
375: 'colobus, colobus monkey',  
376: 'proboscis monkey, Nasalis larvatus',  
377: 'marmoset',  
378: 'capuchin, ringtail, Cebus capucinus',  
379: 'howler monkey, howler',  
380: 'titi, titi monkey',  
381: 'spider monkey, Ateles geoffroyi',  
382: 'squirrel monkey, Saimiri sciureus',  
383: 'Madagascar cat, ring-tailed lemur, Lemur catta',  
384: 'indri, indris, Indri indri, Indri brevicaudatus',  
385: 'Indian elephant, Elephas maximus',  
386: 'African elephant, Loxodonta africana',  
387: 'lesser panda, red panda, panda, bear cat, cat bear, Ailurus fulgens',  
388: 'giant panda, panda, panda bear, coon bear, Ailuropoda melanoleuca',  
389: 'barracouta, snoek',  
390: 'eel',  
391: 'coho, cohoe, coho salmon, blue jack, silver salmon, Oncorhynchus kisutch',  
392: 'rock beauty, Holocanthus tricolor',  
393: 'anemone fish',  
394: 'sturgeon',  
395: 'gar, garfish, garpike, billfish, Lepisosteus osseus',  
396: 'lionfish',  
397: 'puffer, pufferfish, blowfish, globefish',  
398: 'abacus',  
399: 'abaya',  
400: "academic gown, academic robe, judge's robe",  
401: 'accordion, piano accordion, squeeze box',  
402: 'acoustic guitar',  
403: 'aircraft carrier, carrier, flattop, attack aircraft carrier',  
404: 'airliner',  
405: 'airship, dirigible',  
406: 'altar',  
407: 'ambulance',  
408: 'amphibian, amphibious vehicle',  
409: 'analog clock',  
410: 'apiary, bee house',  
411: 'apron',  
412: 'ashcan, trash can, garbage can, wastebin, ash bin, ash-bin, ashbin, dustbin, trash barre',  
413: 'assault rifle, assault gun',  
414: 'backpack, back pack, knapsack, packsack, rucksack, haversack',  
415: 'bakery, bakeshop, bakehouse',  
416: 'balance beam, beam',  
417: 'balloon',  
418: 'ballpoint, ballpoint pen, ballpen, Biro',  
419: 'Band Aid',  
420: 'banjo',
```

421: 'bannister, banister, balustrade, balusters, handrail',  
422: 'barbell',  
423: 'barber chair',  
424: 'barbershop',  
425: 'barn',  
426: 'barometer',  
427: 'barrel, cask',  
428: 'barrow, garden cart, lawn cart, wheelbarrow',  
429: 'baseball',  
430: 'basketball',  
431: 'bassinet',  
432: 'bassoon',  
433: 'bathing cap, swimming cap',  
434: 'bath towel',  
435: 'bathtub, bathing tub, bath, tub',  
436: 'beach wagon, station wagon, wagon, estate car, beach waggon, station waggon, waggon',  
437: 'beacon, lighthouse, beacon light, pharos',  
438: 'beaker',  
439: 'bearskin, busby, shako',  
440: 'beer bottle',  
441: 'beer glass',  
442: 'bell cote, bell cot',  
443: 'bib',  
444: 'bicycle-built-for-two, tandem bicycle, tandem',  
445: 'bikini, two-piece',  
446: 'binder, ring-binder',  
447: 'binoculars, field glasses, opera glasses',  
448: 'birdhouse',  
449: 'boathouse',  
450: 'bobsled, bobsleigh, bob',  
451: 'bole tie, bolo, bola tie, bola',  
452: 'bonnet, poke bonnet',  
453: 'bookcase',  
454: 'bookshop, bookstore, bookstall',  
455: 'bottlecap',  
456: 'bow',  
457: 'bow tie, bow-tie, bowtie',  
458: 'brass, memorial tablet, plaque',  
459: 'brassiere, bra, bandeau',  
460: 'breakwater, groin, groyne, mole, bulwark, seawall, jetty',  
461: 'breastplate, aegis, egis',  
462: 'broom',  
463: 'bucket, pail',  
464: 'buckle',  
465: 'bulletproof vest',  
466: 'bullet train, bullet',  
467: 'butcher shop, meat market',  
468: 'cab, hack, taxi, taxicab',  
469: 'caldron, cauldron',  
470: 'candle, taper, wax light',  
471: 'cannon',  
472: 'canoe',  
473: 'can opener, tin opener',  
474: 'cardigan',  
475: 'car mirror',  
476: 'carousel, carrousel, merry-go-round, roundabout, whirligig',  
477: "carpenter's kit, tool kit",  
478: 'carton',  
479: 'car wheel',  
480: 'cash machine, cash dispenser, automated teller machine, automatic teller machine, automa',  
481: 'cassette',  
482: 'cassette player',  
483: 'castle',  
484: 'catamaran',  
485: 'CD player',  
486: 'cello, violoncello',  
487: 'cellular telephone, cellular phone, cellphone, cell, mobile phone',  
488: 'chain',  
489: 'chainlink fence',  
490: 'chain mail, ring mail, mail, chain armor, chain armour, ring armor, ring armour',  
491: 'chain saw, chainsaw',  
492: 'chest',  
493: 'chiffonier, commode',  
494: 'chime, bell, gong',  
495: 'china cabinet, china closet',

```
496: 'Christmas stocking',
497: 'church, church building',
498: 'cinema, movie theater, movie theatre, movie house, picture palace',
499: 'cleaver, meat cleaver, chopper',
500: 'cliff dwelling',
501: 'cloak',
502: 'clog, geta, patten, sabot',
503: 'cocktail shaker',
504: 'coffee mug',
505: 'coffeepot',
506: 'coil, spiral, volute, whorl, helix',
507: 'combination lock',
508: 'computer keyboard, keypad',
509: 'confectionery, confectionary, candy store',
510: 'container ship, containership, container vessel',
511: 'convertible',
512: 'corkscrew, bottle screw',
513: 'cornet, horn, trumpet, trump',
514: 'cowboy boot',
515: 'cowboy hat, ten-gallon hat',
516: 'cradle',
517: 'crane',
518: 'crash helmet',
519: 'crate',
520: 'crib, cot',
521: 'Crock Pot',
522: 'croquet ball',
523: 'crutch',
524: 'cuirass',
525: 'dam, dike, dyke',
526: 'desk',
527: 'desktop computer',
528: 'dial telephone, dial phone',
529: 'diaper, nappy, napkin',
530: 'digital clock',
531: 'digital watch',
532: 'dining table, board',
533: 'dishrag, dishcloth',
534: 'dishwasher, dish washer, dishwashing machine',
535: 'disk brake, disc brake',
536: 'dock, dockage, docking facility',
537: 'dogsled, dog sled, dog sleigh',
538: 'dome',
539: 'doormat, welcome mat',
540: 'drilling platform, offshore rig',
541: 'drum, membranophone, tympan',
542: 'drumstick',
543: 'dumbbell',
544: 'Dutch oven',
545: 'electric fan, blower',
546: 'electric guitar',
547: 'electric locomotive',
548: 'entertainment center',
549: 'envelope',
550: 'espresso maker',
551: 'face powder',
552: 'feather boa, boa',
553: 'file, file cabinet, filing cabinet',
554: 'fireboat',
555: 'fire engine, fire truck',
556: 'fire screen, fireguard',
557: 'flagpole, flagstaff',
558: 'flute, transverse flute',
559: 'folding chair',
560: 'football helmet',
561: 'forklift',
562: 'fountain',
563: 'fountain pen',
564: 'four-poster',
565: 'freight car',
566: 'French horn, horn',
567: 'frying pan, frypan, skillet',
568: 'fur coat',
569: 'garbage truck, dustcart',
570: 'gasmask, respirator, gas helmet',
```

```
571: 'gas pump, gasoline pump, petrol pump, island dispenser',
572: 'goblet',
573: 'go-kart',
574: 'golf ball',
575: 'golfcart, golf cart',
576: 'gondola',
577: 'gong, tam-tam',
578: 'gown',
579: 'grand piano, grand',
580: 'greenhouse, nursery, glasshouse',
581: 'grille, radiator grille',
582: 'grocery store, grocery, food market, market',
583: 'guillotine',
584: 'hair slide',
585: 'hair spray',
586: 'half track',
587: 'hammer',
588: 'hamper',
589: 'hand blower, blow dryer, blow drier, hair dryer, hair drier',
590: 'hand-held computer, hand-held microcomputer',
591: 'handkerchief, hankie, hanky, hankey',
592: 'hard disc, hard disk, fixed disk',
593: 'harmonica, mouth organ, harp, mouth harp',
594: 'harp',
595: 'harvester, reaper',
596: 'hatchet',
597: 'holster',
598: 'home theater, home theatre',
599: 'honeycomb',
600: 'hook, claw',
601: 'hoop skirt, crinoline',
602: 'horizontal bar, high bar',
603: 'horse cart, horse-cart',
604: 'hourglass',
605: 'iPod',
606: 'iron, smoothing iron',
607: "jack-o'-lantern",
608: 'jean, blue jean, denim',
609: 'jeep, landrover',
610: 'jersey, T-shirt, tee shirt',
611: 'jigsaw puzzle',
612: 'jinrikisha, ricksha, rickshaw',
613: 'joystick',
614: 'kimono',
615: 'knee pad',
616: 'knot',
617: 'lab coat, laboratory coat',
618: 'ladle',
619: 'lampshade, lamp shade',
620: 'laptop, laptop computer',
621: 'lawn mower, mower',
622: 'lens cap, lens cover',
623: 'letter opener, paper knife, paperknife',
624: 'library',
625: 'lifeboat',
626: 'lighter, light, igniter, ignitor',
627: 'limousine, limo',
628: 'liner, ocean liner',
629: 'lipstick, lip rouge',
630: 'Loafer',
631: 'lotion',
632: 'loudspeaker, speaker, speaker unit, loudspeaker system, speaker system',
633: "loupe, jeweler's loupe",
634: 'lumbermill, sawmill',
635: 'magnetic compass',
636: 'mailbag, postbag',
637: 'mailbox, letter box',
638: 'maillot',
639: 'maillot, tank suit',
640: 'manhole cover',
641: 'maraca',
642: 'marimba, xylophone',
643: 'mask',
644: 'matchstick',
645: 'maypole',
```

646: 'maze, labyrinth',  
647: 'measuring cup',  
648: 'medicine chest, medicine cabinet',  
649: 'megalith, megalithic structure',  
650: 'microphone, mike',  
651: 'microwave, microwave oven',  
652: 'military uniform',  
653: 'milk can',  
654: 'minibus',  
655: 'miniskirt, mini',  
656: 'minivan',  
657: 'missile',  
658: 'mitten',  
659: 'mixing bowl',  
660: 'mobile home, manufactured home',  
661: 'Model T',  
662: 'modem',  
663: 'monastery',  
664: 'monitor',  
665: 'moped',  
666: 'mortar',  
667: 'mortarboard',  
668: 'mosque',  
669: 'mosquito net',  
670: 'motor scooter, scooter',  
671: 'mountain bike, all-terrain bike, off-roader',  
672: 'mountain tent',  
673: 'mouse, computer mouse',  
674: 'mousetrap',  
675: 'moving van',  
676: 'muzzle',  
677: 'nail',  
678: 'neck brace',  
679: 'necklace',  
680: 'nipple',  
681: 'notebook, notebook computer',  
682: 'obelisk',  
683: 'oboe, hautboy, hautbois',  
684: 'ocarina, sweet potato',  
685: 'odometer, hodometer, mileometer, milometer',  
686: 'oil filter',  
687: 'organ, pipe organ',  
688: 'oscilloscope, scope, cathode-ray oscilloscope, CRO',  
689: 'overskirt',  
690: 'oxcart',  
691: 'oxygen mask',  
692: 'packet',  
693: 'paddle, boat paddle',  
694: 'paddlewheel, paddle wheel',  
695: 'padlock',  
696: 'paintbrush',  
697: "pajama, pyjama, pj's, jammies",  
698: 'palace',  
699: 'panpipe, pandean pipe, syrinx',  
700: 'paper towel',  
701: 'parachute, chute',  
702: 'parallel bars, bars',  
703: 'park bench',  
704: 'parking meter',  
705: 'passenger car, coach, carriage',  
706: 'patio, terrace',  
707: 'pay-phone, pay-station',  
708: 'pedestal, plinth, footstall',  
709: 'pencil box, pencil case',  
710: 'pencil sharpener',  
711: 'perfume, essence',  
712: 'Petri dish',  
713: 'photocopier',  
714: 'pick, plectrum, plectron',  
715: 'picklehaube',  
716: 'picket fence, paling',  
717: 'pickup, pickup truck',  
718: 'pier',  
719: 'piggy bank, penny bank',  
720: 'pill bottle',

721: 'pillow',  
722: 'ping-pong ball',  
723: 'pinwheel',  
724: 'pirate, pirate ship',  
725: 'pitcher, ewer',  
726: "plane, carpenter's plane, woodworking plane",  
727: 'planetarium',  
728: 'plastic bag',  
729: 'plate rack',  
730: 'plow, plough',  
731: "plunger, plumber's helper",  
732: 'Polaroid camera, Polaroid Land camera',  
733: 'pole',  
734: 'police van, police wagon, paddy wagon, patrol wagon, wagon, black Maria',  
735: 'poncho',  
736: 'pool table, billiard table, snooker table',  
737: 'pop bottle, soda bottle',  
738: 'pot, flowerpot',  
739: "potter's wheel",  
740: 'power drill',  
741: 'prayer rug, prayer mat',  
742: 'printer',  
743: 'prison, prison house',  
744: 'projectile, missile',  
745: 'projector',  
746: 'puck, hockey puck',  
747: 'punching bag, punch bag, punching ball, punchball',  
748: 'purse',  
749: 'quill, quill pen',  
750: 'quilt, comforter, comfort, puff',  
751: 'racer, race car, racing car',  
752: 'racket, racquet',  
753: 'radiator',  
754: 'radio, wireless',  
755: 'radio telescope, radio reflector',  
756: 'rain barrel',  
757: 'recreational vehicle, RV, R.V.',  
758: 'reel',  
759: 'reflex camera',  
760: 'refrigerator, icebox',  
761: 'remote control, remote',  
762: 'restaurant, eating house, eating place, eatery',  
763: 'revolver, six-gun, six-shooter',  
764: 'rifle',  
765: 'rocking chair, rocker',  
766: 'rotisserie',  
767: 'rubber eraser, rubber, pencil eraser',  
768: 'rugby ball',  
769: 'rule, ruler',  
770: 'running shoe',  
771: 'safe',  
772: 'safety pin',  
773: 'saltshaker, salt shaker',  
774: 'sandal',  
775: 'sarong',  
776: 'sax, saxophone',  
777: 'scabbard',  
778: 'scale, weighing machine',  
779: 'school bus',  
780: 'schooner',  
781: 'scoreboard',  
782: 'screen, CRT screen',  
783: 'screw',  
784: 'screwdriver',  
785: 'seat belt, seatbelt',  
786: 'sewing machine',  
787: 'shield, buckler',  
788: 'shoe shop, shoe-shop, shoe store',  
789: 'shoji',  
790: 'shopping basket',  
791: 'shopping cart',  
792: 'shovel',  
793: 'shower cap',  
794: 'shower curtain',  
795: 'ski',

```
796: 'ski mask',
797: 'sleeping bag',
798: 'slide rule, slipstick',
799: 'sliding door',
800: 'slot, one-armed bandit',
801: 'snorkel',
802: 'snowmobile',
803: 'snowplow, snowplough',
804: 'soap dispenser',
805: 'soccer ball',
806: 'sock',
807: 'solar dish, solar collector, solar furnace',
808: 'sombrero',
809: 'soup bowl',
810: 'space bar',
811: 'space heater',
812: 'space shuttle',
813: 'spatula',
814: 'speedboat',
815: "spider web, spider's web",
816: 'spindle',
817: 'sports car, sport car',
818: 'spotlight, spot',
819: 'stage',
820: 'steam locomotive',
821: 'steel arch bridge',
822: 'steel drum',
823: 'stethoscope',
824: 'stole',
825: 'stone wall',
826: 'stopwatch, stop watch',
827: 'stove',
828: 'strainer',
829: 'streetcar, tram, tramcar, trolley, trolley car',
830: 'stretcher',
831: 'studio couch, day bed',
832: 'stupa, tope',
833: 'submarine, pigboat, sub, U-boat',
834: 'suit, suit of clothes',
835: 'sundial',
836: 'sunglass',
837: 'sunglasses, dark glasses, shades',
838: 'sunscreen, sunblock, sun blocker',
839: 'suspension bridge',
840: 'swab, swob, mop',
841: 'sweatshirt',
842: 'swimming trunks, bathing trunks',
843: 'swing',
844: 'switch, electric switch, electrical switch',
845: 'syringe',
846: 'table lamp',
847: 'tank, army tank, armored combat vehicle, armoured combat vehicle',
848: 'tape player',
849: 'teapot',
850: 'teddy, teddy bear',
851: 'television, television system',
852: 'tennis ball',
853: 'thatch, thatched roof',
854: 'theater curtain, theatre curtain',
855: 'thimble',
856: 'thresher, thrasher, threshing machine',
857: 'throne',
858: 'tile roof',
859: 'toaster',
860: 'tobacco shop, tobacconist shop, tobacconist',
861: 'toilet seat',
862: 'torch',
863: 'totem pole',
864: 'tow truck, tow car, wrecker',
865: 'toyshop',
866: 'tractor',
867: 'trailer truck, tractor trailer, trucking rig, rig, articulated lorry, semi',
868: 'tray',
869: 'trench coat',
870: 'tricycle, trike, velocipede',
```

```
871: 'trimaran',
872: 'tripod',
873: 'triumphal arch',
874: 'trolleybus, trolley coach, trackless trolley',
875: 'trombone',
876: 'tub, vat',
877: 'turnstile',
878: 'typewriter keyboard',
879: 'umbrella',
880: 'unicycle, monocycle',
881: 'upright, upright piano',
882: 'vacuum, vacuum cleaner',
883: 'vase',
884: 'vault',
885: 'velvet',
886: 'vending machine',
887: 'vestment',
888: 'viaduct',
889: 'violin, fiddle',
890: 'volleyball',
891: 'waffle iron',
892: 'wall clock',
893: 'wallet, billfold, notecase, pocketbook',
894: 'wardrobe, closet, press',
895: 'warplane, military plane',
896: 'washbasin, handbasin, washbowl, lavabo, wash-hand basin',
897: 'washer, automatic washer, washing machine',
898: 'water bottle',
899: 'water jug',
900: 'water tower',
901: 'whiskey jug',
902: 'whistle',
903: 'wig',
904: 'window screen',
905: 'window shade',
906: 'Windsor tie',
907: 'wine bottle',
908: 'wing',
909: 'wok',
910: 'wooden spoon',
911: 'wool, woolen, woollen',
912: 'worm fence, snake fence, snake-rail fence, Virginia fence',
913: 'wreck',
914: 'yawp',
915: 'yurt',
916: 'web site, website, internet site, site',
917: 'comic book',
918: 'crossword puzzle, crossword',
919: 'street sign',
920: 'traffic light, traffic signal, stoplight',
921: 'book jacket, dust cover, dust jacket, dust wrapper',
922: 'menu',
923: 'plate',
924: 'guacamole',
925: 'consomme',
926: 'hot pot, hotpot',
927: 'trifle',
928: 'ice cream, icecream',
929: 'ice lolly, lolly, lollipop, popsicle',
930: 'French loaf',
931: 'bagel, beigel',
932: 'pretzel',
933: 'cheeseburger',
934: 'hotdog, hot dog, red hot',
935: 'mashed potato',
936: 'head cabbage',
937: 'broccoli',
938: 'cauliflower',
939: 'zucchini, courgette',
940: 'spaghetti squash',
941: 'acorn squash',
942: 'butternut squash',
943: 'cucumber, cuke',
944: 'artichoke, globe artichoke',
945: 'bell pepper',
```

```
946: 'cardoon',
947: 'mushroom',
948: 'Granny Smith',
949: 'strawberry',
950: 'orange',
951: 'lemon',
952: 'fig',
953: 'pineapple, ananas',
954: 'banana',
955: 'jackfruit, jak, jack',
956: 'custard apple',
957: 'pomegranate',
958: 'hay',
959: 'carbonara',
960: 'chocolate sauce, chocolate syrup',
961: 'dough',
962: 'meat loaf, meatloaf',
963: 'pizza, pizza pie',
964: 'potpie',
965: 'burrito',
966: 'red wine',
967: 'espresso',
968: 'cup',
969: 'eggnog',
970: 'alp',
971: 'bubble',
972: 'cliff, drop, drop-off',
973: 'coral reef',
974: 'geyser',
975: 'lakeside, lakeshore',
976: 'promontory, headland, head, foreland',
977: 'sandbar, sand bar',
978: 'seashore, coast, seacoast, sea-coast',
979: 'valley, vale',
980: 'volcano',
981: 'ballplayer, baseball player',
982: 'groom, bridegroom',
983: 'scuba diver',
984: 'rapeseed',
985: 'daisy',
986: "yellow lady's slipper, yellow lady-slipper, Cypripedium calceolus, Cypripedium parviflor",
987: 'corn',
988: 'acorn',
989: 'hip, rose hip, rosehip',
990: 'buckeye, horse chestnut, conker',
991: 'coral fungus',
992: 'agaric',
993: 'gyromitra',
994: 'stinkhorn, carrion fungus',
995: 'earthstar',
996: 'hen-of-the-woods, hen of the woods, Polyporus frondosus, Grifola frondosa',
997: 'bolete',
998: 'ear, spike, capitulum',
999: 'toilet tissue, toilet paper, bathroom tissue'}
```

```
In [4]: def class_of_picture( url ):
    url = url
    filename = 'photo.jpg'
    urllib.request.urlretrieve(url, filename)
    img = Image.open('photo.jpg');
    plt.imshow(img);
    norm = transforms.Normalize( mean=[0.485, 0.456, 0.406], std=[0.229, 0.224, 0.225] )
    inv_norm = transforms.Normalize(
        mean=[-0.485/0.229, -0.456/0.224, -0.406/0.225],
        std=[1/0.229, 1/0.224, 1/0.225])
    preprocess = transforms.Compose([
        transforms.Resize(256),
        transforms.CenterCrop(224),
        transforms.ToTensor(),
        norm,
    ])
    image_tensor = preprocess(img)
    input_tensor = image_tensor.unsqueeze(0)
    input_tensor = input_tensor.to(device)
    outputs = model( input_tensor )
```

```
prediction = outputs.max(dim=1).indices.item()
return prediction
```

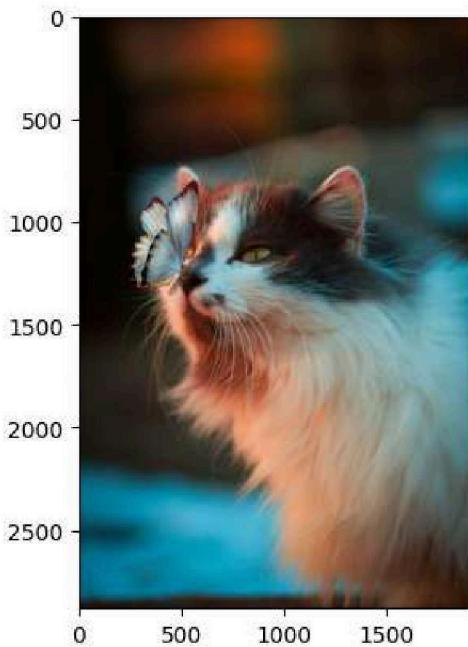
```
In [8]: pred1 = class_of_picture("https://unsplash.com/photos/yMSecCHsIBc/download?ixid=M3wxMjA3fDB8MXx")
```



```
In [9]: pred1, IMAGENET_LABELS[pred1]
```

```
Out[9]: (837, 'sunglasses, dark glasses, shades')
```

```
In [10]: pred2 = class_of_picture("https://unsplash.com/photos/rW-I87aPY5Y/download?ixid=M3wxMjA3fDB8MXx")
```



```
In [11]: pred2, IMAGENET_LABELS[pred2]
```

```
Out[11]: (283, 'Persian cat')
```

```
In [13]: pred3 = class_of_picture("https://unsplash.com/photos/95YRwf6CNw8/download?ixid=M3wxMjA3fDB8MXxz")
```



```
In [14]: pred3, IMAGENET_LABELS[pred3]
```

```
Out[14]: (681, 'notebook, notebook computer')
```

## 2. Скачать нейросеть BERT для лингвистических задач и реализовать процедуру классификации текстов

```
In [ ]: IMAGENET_LABELS_list = IMAGENET_LABELS.values()  
IMAGENET_LABELS_list
```

```
In [ ]: # Скачаем нейросеть (код для Colab)  
!wget http://files.deeppavlov.ai/deeppavlov_data/bert/sentence_multi_cased_L-12_H-768_A-12_pt_v  
# Распаковка нейросети (аналогично)  
!tar -xvf sentence_multi_cased_L-12_H-768_A-12_pt_v1.tar.gz  
# Один из важных файлов в архиве называется config.json, а библиотека ждет файл bert_config.json  
!mv /content/sentence_multi_cased_L-12_H-768_A-12_pt_v1/config.json /content/sentence_multi_cased_L-12_H-768_A-12_pt_v1/bert_config.json  
  
bert_config = read_json( configs.embedder.bert_embedder )  
bert_config['metadata']['variables']['BERT_PATH'] = '/content/sentence_multi_cased_L-12_H-768_A-12_pt_v1'  
model = build_model(bert_config)
```

```
In [ ]: # скачиваем текстовые новости с ленты  
!wget https://github.com/yutkin/Lenta.Ru-News-Dataset/releases/download/v1.1/lenta-ru-news.csv.  
!bz2 -d lenta-ru-news.csv  
df = pd.read_csv( '/content/lenta-ru-news.csv', low_memory=False )  
df['topic'].unique()
```

```
In [18]: def get_sentence_embedding( sentence ):  
    bert_answer = model([sentence])  
    embedding = bert_answer[4]  
    return embedding
```

```
In [19]: embeddings = np.concatenate([ np.array(get_sentence_embedding(s)) for s in IMAGENET_LABELS_list ])
```

```
In [20]: pca = PCA( n_components=15, random_state=42 )  
emb_15d = pca.fit_transform( embeddings )
```

```
In [21]: clustering = AgglomerativeClustering( n_clusters=20, distance_threshold=None,  
                                             affinity='cosine', linkage='average' ).fit(emb_15d)
```

```
In [22]: pca = PCA( n_components=2, random_state=42 )  
emb_2d = pd.DataFrame( pca.fit_transform(embeddings), columns=['x1', 'x2'])  
emb_2d["short_name"] = [ s.split(",")[-1] for s in IMAGENET_LABELS_list ]  
emb_2d['color'] = clustering.labels_.astype(str)
```

```
In [23]: fig = px.scatter( emb_2d, x='x1', y='x2', color='color', hover_name="short_name", width=1200, height=800 )  
fig.show()
```

