```
In [8]:    from face_embeddings_compressed import FaceEmbeddingsCompression
```

Create an instance of FaceEmbeddingsCompression class

```
In [9]:    train_emb_path = ".\\LFW_embeddings\\train_embeddings.pkl"
           test_emb_path = ".\\LFW_embeddings\\test_embeddings.pkl"
           lfw_full_list_path = ".\\LFW_embeddings\\lfw_full_list.txt"

           lfw_embeddings_compression = FaceEmbeddingsCompression(512, None, None, None)
```

Load embeddings of LFW dataset

```
In [10]:   lfw_embeddings_compression.load_lfw(train_emb_path, test_emb_path, lfw_full_list_path)
```

Let's find out precision, memory, time indicators for index without compression

Name of index: FlatIP

```
In [12]:   lfw_embeddings_compression.index_without_compression(nn_quantity=5, show_index_info=True)
```

```
Index contains 5297 embeddings
Time spent for searching : 0.09 seconds
Shape of D: 2306 and I: 2306
Precision : 0.9986990459670425
Memory : 10.85 MB
```

Let's find out precision, memory, time indicators for index with compression

Name of index: IVFPQ

Compression method: Product Quantization

```
In [14]:   lfw_embeddings_compression.index_ivfpq(nn_quantity=5, n_list=100, n_probe_values=[20, 60],
                                                  n_bits=6, show_index_info=True)
```

```
Train time: 2.88 seconds
Addition time: 0.33 seconds
        nprobe = 20
        Search time: 0.54 seconds Precision: 0.9943625325238509 Memory: 0.633484 MB
        nprobe = 60
        Search time: 1.34 seconds Precision: 0.9978317432784042 Memory: 0.633484 MB
----------
The highest precision: 0.99783 (nprobe=60)
The smallest memory size: 0.633484 MB (nprobe=20)
The fastest search: 0.54seconds (nprobe=20)
----------
```
```
Out[14]:   {'train_time': 2.8766183853149414,
            'add_time': 0.3306751251220703,
            'precision': 0.9978317432784042,
            'search_time': 1.3364145755767822,
            'nprobe': 60,
            'memory_size': 0.633484}
```

Search for optimal values of IVPQ's parameters

```
lfw_embeddings_compression.find_optim_params(nn_quantity=5, n_bits=8, n_subquantizers=64,
```

```
Finding optim parameters
Initial values: n_bits=8 n_subquantizers=64
n_list = 20
Train time: 9.31 seconds
Addition time: 0.48 seconds
        nprobe = 2
        Search time: 0.48 seconds Precision: 0.9444926279271466 Memory: 0.946972 MB
        nprobe = 4
        Search time: 0.45 seconds Precision: 0.9835212489158717 Memory: 0.946972 MB
        nprobe = 6
        Search time: 0.46 seconds Precision: 0.9934952298352124 Memory: 0.946972 MB
        nprobe = 8
        Search time: 0.66 seconds Precision: 0.9965307892454467 Memory: 0.946972 MB
        nprobe = 10
        Search time: 0.85 seconds Precision: 0.997398091934085 Memory: 0.946972 MB
        nprobe = 12
        Search time: 0.98 seconds Precision: 0.9978317432784042 Memory: 0.946972 MB
        nprobe = 14
        Search time: 1.17 seconds Precision: 0.9986990459670425 Memory: 0.946972 MB
        nprobe = 16
        Search time: 1.33 seconds Precision: 0.9986990459670425 Memory: 0.946972 MB
        nprobe = 18
        Search time: 1.61 seconds Precision: 0.9986990459670425 Memory: 0.946972 MB
        nprobe = 20
        Search time: 1.67 seconds Precision: 0.9986990459670425 Memory: 0.946972 MB
----------
The highest precision: 0.99870 (nprobe=14)
The smallest memory size: 0.946972 MB (nprobe=2)
The fastest search: 0.45seconds (nprobe=4)
----------
n_list = 40
Train time: 8.53 seconds
Addition time: 0.24 seconds
        nprobe = 4
        Search time: 0.41 seconds Precision: 0.9761491760624458 Memory: 0.988092 MB
        nprobe = 8
        Search time: 0.76 seconds Precision: 0.9934952298352124 Memory: 0.988092 MB
        nprobe = 12
        Search time: 1.13 seconds Precision: 0.9960971379011275 Memory: 0.988092 MB
        nprobe = 16
        Search time: 1.75 seconds Precision: 0.9982653946227233 Memory: 0.988092 MB
        nprobe = 20
        Search time: 2.07 seconds Precision: 0.9982653946227233 Memory: 0.988092 MB
        nprobe = 24
        Search time: 2.13 seconds Precision: 0.9982653946227233 Memory: 0.988092 MB
        nprobe = 28
        Search time: 2.60 seconds Precision: 0.9982653946227233 Memory: 0.988092 MB
        nprobe = 32
        Search time: 2.77 seconds Precision: 0.9982653946227233 Memory: 0.988092 MB
        nprobe = 36
        Search time: 3.12 seconds Precision: 0.9982653946227233 Memory: 0.988092 MB
        nprobe = 40
        Search time: 3.39 seconds Precision: 0.9982653946227233 Memory: 0.988092 MB
----------
The highest precision: 0.99827 (nprobe=16)
The smallest memory size: 0.988092 MB (nprobe=4)
The fastest search: 0.41seconds (nprobe=4)
----------
n_list = 60
Train time: 8.78 seconds
Addition time: 0.25 seconds
        nprobe = 6
        Search time: 0.55 seconds Precision: 0.9856895056374675 Memory: 1.029212 MB
```

```
            nprobe = 12
            Search time: 1.00 seconds Precision: 0.9930615784908933 Memory: 1.029212 MB
            nprobe = 18
            Search time: 1.66 seconds Precision: 0.99479618386817 Memory: 1.029212 MB
            nprobe = 24
            Search time: 2.11 seconds Precision: 0.9969644405897659 Memory: 1.029212 MB
            nprobe = 30
            Search time: 2.55 seconds Precision: 0.997398091934085 Memory: 1.029212 MB
            nprobe = 36
            Search time: 3.03 seconds Precision: 0.9982653946227233 Memory: 1.029212 MB
            nprobe = 42
            Search time: 3.45 seconds Precision: 0.9982653946227233 Memory: 1.029212 MB
            nprobe = 48
            Search time: 3.97 seconds Precision: 0.9982653946227233 Memory: 1.029212 MB
            nprobe = 54
            Search time: 4.39 seconds Precision: 0.9982653946227233 Memory: 1.029212 MB
            nprobe = 60
            Search time: 5.05 seconds Precision: 0.9982653946227233 Memory: 1.029212 MB
        ----------
    The highest precision: 0.99827 (nprobe=36)
    The smallest memory size: 1.029212 MB (nprobe=6)
    The fastest search: 0.55seconds (nprobe=6)
    ----------
    n_list = 80
    Train time: 10.62 seconds
    Addition time: 0.29 seconds
            nprobe = 8
            Search time: 0.85 seconds Precision: 0.9874241110147441 Memory: 1.070332 MB
            nprobe = 16
            Search time: 1.55 seconds Precision: 0.9952298352124892 Memory: 1.070332 MB
            nprobe = 24
            Search time: 2.58 seconds Precision: 0.9965307892454467 Memory: 1.070332 MB
            nprobe = 32
            Search time: 3.15 seconds Precision: 0.9982653946227233 Memory: 1.070332 MB
            nprobe = 40
            Search time: 3.83 seconds Precision: 0.9982653946227233 Memory: 1.070332 MB
            nprobe = 48
            Search time: 4.62 seconds Precision: 0.9986990459670425 Memory: 1.070332 MB
            nprobe = 56
            Search time: 5.52 seconds Precision: 0.9986990459670425 Memory: 1.070332 MB
            nprobe = 64
            Search time: 6.15 seconds Precision: 0.9986990459670425 Memory: 1.070332 MB
            nprobe = 72
            Search time: 6.82 seconds Precision: 0.9986990459670425 Memory: 1.070332 MB
            nprobe = 80
            Search time: 7.55 seconds Precision: 0.9986990459670425 Memory: 1.070332 MB
        ----------
    The highest precision: 0.99870 (nprobe=48)
    The smallest memory size: 1.070332 MB (nprobe=8)
    The fastest search: 0.85seconds (nprobe=8)
    ----------
    n_list = 100
    Train time: 11.37 seconds
    Addition time: 0.38 seconds
            nprobe = 10
            Search time: 1.19 seconds Precision: 0.9878577623590633 Memory: 1.111452 MB
            nprobe = 20
            Search time: 2.07 seconds Precision: 0.99479618386817 Memory: 1.111452 MB
            nprobe = 30
            Search time: 3.30 seconds Precision: 0.9978317432784042 Memory: 1.111452 MB
            nprobe = 40
            Search time: 4.19 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
            nprobe = 50
            Search time: 5.26 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
            nprobe = 60
            Search time: 6.00 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
```

```
                nprobe = 70
                Search time: 6.98 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
                nprobe = 80
                Search time: 7.91 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
                nprobe = 90
                Search time: 8.95 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
                nprobe = 100
                Search time: 9.88 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
        ----------
        The highest precision: 0.99913 (nprobe=40)
        The smallest memory size: 1.111452 MB (nprobe=10)
        The fastest search: 1.19seconds (nprobe=10)
        ----------
        n_list = 120
        Train time: 10.14 seconds
        Addition time: 0.25 seconds
                nprobe = 12
                Search time: 1.05 seconds Precision: 0.9908933217692975 Memory: 1.152572 MB
                nprobe = 24
                Search time: 2.20 seconds Precision: 0.9952298352124892 Memory: 1.152572 MB
                nprobe = 36
                Search time: 3.38 seconds Precision: 0.9969644405897659 Memory: 1.152572 MB
                nprobe = 48
                Search time: 4.34 seconds Precision: 0.9978317432784042 Memory: 1.152572 MB
                nprobe = 60
                Search time: 5.43 seconds Precision: 0.9978317432784042 Memory: 1.152572 MB
                nprobe = 72
                Search time: 6.38 seconds Precision: 0.9978317432784042 Memory: 1.152572 MB
                nprobe = 84
                Search time: 7.64 seconds Precision: 0.9978317432784042 Memory: 1.152572 MB
                nprobe = 96
                Search time: 9.03 seconds Precision: 0.9978317432784042 Memory: 1.152572 MB
                nprobe = 108
                Search time: 10.09 seconds Precision: 0.9978317432784042 Memory: 1.152572 MB
                nprobe = 120
                Search time: 14.00 seconds Precision: 0.9978317432784042 Memory: 1.152572 MB
        ----------
        The highest precision: 0.99783 (nprobe=48)
        The smallest memory size: 1.152572 MB (nprobe=12)
        The fastest search: 1.05seconds (nprobe=12)
        ----------
        n_list = 140
        Train time: 12.43 seconds
        Addition time: 0.35 seconds
                nprobe = 14
                Search time: 1.65 seconds Precision: 0.9904596704249783 Memory: 1.193692 MB
                nprobe = 28
                Search time: 3.21 seconds Precision: 0.9952298352124892 Memory: 1.193692 MB
                nprobe = 42
                Search time: 4.81 seconds Precision: 0.9978317432784042 Memory: 1.193692 MB
                nprobe = 56
                Search time: 6.42 seconds Precision: 0.9982653946227233 Memory: 1.193692 MB
                nprobe = 70
                Search time: 7.75 seconds Precision: 0.9982653946227233 Memory: 1.193692 MB
                nprobe = 84
                Search time: 9.16 seconds Precision: 0.9982653946227233 Memory: 1.193692 MB
                nprobe = 98
                Search time: 10.67 seconds Precision: 0.9982653946227233 Memory: 1.193692 MB
                nprobe = 112
                Search time: 12.09 seconds Precision: 0.9982653946227233 Memory: 1.193692 MB
                nprobe = 126
                Search time: 13.32 seconds Precision: 0.9982653946227233 Memory: 1.193692 MB
                nprobe = 140
                Search time: 13.70 seconds Precision: 0.9982653946227233 Memory: 1.193692 MB
        ----------
        The highest precision: 0.99827 (nprobe=56)
```

```
        The smallest memory size: 1.193692 MB (nprobe=14)
        The fastest search: 1.65seconds (nprobe=14)
        ----------
        n_list = 160
        Train time: 12.90 seconds
        Addition time: 0.39 seconds
                nprobe = 16
                Search time: 1.83 seconds Precision: 0.9934952298352124 Memory: 1.234812 MB
                nprobe = 32
                Search time: 3.64 seconds Precision: 0.9965307892454467 Memory: 1.234812 MB
                nprobe = 48
                Search time: 5.73 seconds Precision: 0.9978317432784042 Memory: 1.234812 MB
                nprobe = 64
                Search time: 7.25 seconds Precision: 0.9982653946227233 Memory: 1.234812 MB
                nprobe = 80
                Search time: 8.79 seconds Precision: 0.9982653946227233 Memory: 1.234812 MB
                nprobe = 96
                Search time: 10.03 seconds Precision: 0.9982653946227233 Memory: 1.234812 MB
                nprobe = 112
                Search time: 11.63 seconds Precision: 0.9982653946227233 Memory: 1.234812 MB
                nprobe = 128
                Search time: 13.51 seconds Precision: 0.9982653946227233 Memory: 1.234812 MB
                nprobe = 144
                Search time: 14.97 seconds Precision: 0.9982653946227233 Memory: 1.234812 MB
                nprobe = 160
                Search time: 14.39 seconds Precision: 0.9982653946227233 Memory: 1.234812 MB
        ----------
        The highest precision: 0.99827 (nprobe=64)
        The smallest memory size: 1.234812 MB (nprobe=16)
        The fastest search: 1.83seconds (nprobe=16)
        ----------
        n_list = 180
        Train time: 9.69 seconds
        Addition time: 0.28 seconds
                nprobe = 18
                Search time: 1.70 seconds Precision: 0.99479618386817 Memory: 1.275932 MB
                nprobe = 36
                Search time: 3.49 seconds Precision: 0.9969644405897659 Memory: 1.275932 MB
                nprobe = 54
                Search time: 5.05 seconds Precision: 0.9982653946227233 Memory: 1.275932 MB
                nprobe = 72
                Search time: 8.24 seconds Precision: 0.9986990459670425 Memory: 1.275932 MB
                nprobe = 90
                Search time: 10.12 seconds Precision: 0.9986990459670425 Memory: 1.275932 MB
                nprobe = 108
                Search time: 11.67 seconds Precision: 0.9986990459670425 Memory: 1.275932 MB
                nprobe = 126
                Search time: 13.22 seconds Precision: 0.9986990459670425 Memory: 1.275932 MB
                nprobe = 144
                Search time: 15.09 seconds Precision: 0.9986990459670425 Memory: 1.275932 MB
                nprobe = 162
                Search time: 15.79 seconds Precision: 0.9986990459670425 Memory: 1.275932 MB
                nprobe = 180
                Search time: 15.82 seconds Precision: 0.9986990459670425 Memory: 1.275932 MB
        ----------
        The highest precision: 0.99870 (nprobe=72)
        The smallest memory size: 1.275932 MB (nprobe=18)
        The fastest search: 1.70seconds (nprobe=18)
        ----------
        n_list = 200
        Train time: 9.74 seconds
        Addition time: 0.27 seconds
                nprobe = 20
                Search time: 1.80 seconds Precision: 0.9952298352124892 Memory: 1.317052 MB
                nprobe = 40
                Search time: 3.82 seconds Precision: 0.9965307892454467 Memory: 1.317052 MB
```

```
            nprobe = 60
            Search time: 5.45 seconds Precision: 0.9969644405897659 Memory: 1.317052 MB
            nprobe = 80
            Search time: 7.28 seconds Precision: 0.9982653946227233 Memory: 1.317052 MB
            nprobe = 100
            Search time: 10.95 seconds Precision: 0.9982653946227233 Memory: 1.317052 MB
            nprobe = 120
            Search time: 12.96 seconds Precision: 0.9982653946227233 Memory: 1.317052 MB
            nprobe = 140
            Search time: 14.78 seconds Precision: 0.9982653946227233 Memory: 1.317052 MB
            nprobe = 160
            Search time: 16.67 seconds Precision: 0.9982653946227233 Memory: 1.317052 MB
            nprobe = 180
            Search time: 18.36 seconds Precision: 0.9982653946227233 Memory: 1.317052 MB
            nprobe = 200
            Search time: 21.16 seconds Precision: 0.9982653946227233 Memory: 1.317052 MB
    ----------
    The highest precision: 0.99827 (nprobe=80)
    The smallest memory size: 1.317052 MB (nprobe=20)
    The fastest search: 1.80seconds (nprobe=20)
    ----------
    n_list = 220
    Train time: 9.76 seconds
    Addition time: 0.28 seconds
            nprobe = 22
            Search time: 2.03 seconds Precision: 0.9952298352124892 Memory: 1.358172 MB
            nprobe = 44
            Search time: 4.21 seconds Precision: 0.9978317432784042 Memory: 1.358172 MB
            nprobe = 66
            Search time: 5.99 seconds Precision: 0.9982653946227233 Memory: 1.358172 MB
            nprobe = 88
            Search time: 10.14 seconds Precision: 0.9986990459670425 Memory: 1.358172 MB
            nprobe = 110
            Search time: 11.90 seconds Precision: 0.9986990459670425 Memory: 1.358172 MB
            nprobe = 132
            Search time: 13.77 seconds Precision: 0.9986990459670425 Memory: 1.358172 MB
            nprobe = 154
            Search time: 15.91 seconds Precision: 0.9986990459670425 Memory: 1.358172 MB
            nprobe = 176
            Search time: 17.97 seconds Precision: 0.9986990459670425 Memory: 1.358172 MB
            nprobe = 198
            Search time: 20.46 seconds Precision: 0.9986990459670425 Memory: 1.358172 MB
            nprobe = 220
            Search time: 22.97 seconds Precision: 0.9986990459670425 Memory: 1.358172 MB
    ----------
    The highest precision: 0.99870 (nprobe=88)
    The smallest memory size: 1.358172 MB (nprobe=22)
    The fastest search: 2.03seconds (nprobe=22)
    ----------
    n_list = 240
    Train time: 12.46 seconds
    Addition time: 0.41 seconds
            nprobe = 24
            Search time: 2.78 seconds Precision: 0.9952298352124892 Memory: 1.399292 MB
            nprobe = 48
            Search time: 5.36 seconds Precision: 0.9986990459670425 Memory: 1.399292 MB
            nprobe = 72
            Search time: 7.92 seconds Precision: 0.9991326973113617 Memory: 1.399292 MB
            nprobe = 96
            Search time: 10.32 seconds Precision: 0.9991326973113617 Memory: 1.399292 MB
            nprobe = 120
            Search time: 12.59 seconds Precision: 0.9991326973113617 Memory: 1.399292 MB
            nprobe = 144
            Search time: 13.00 seconds Precision: 0.9991326973113617 Memory: 1.399292 MB
            nprobe = 168
            Search time: 15.17 seconds Precision: 0.9991326973113617 Memory: 1.399292 MB
```

```
          nprobe = 192
          Search time: 17.27 seconds Precision: 0.9991326973113617 Memory: 1.399292 MB
          nprobe = 216
          Search time: 21.06 seconds Precision: 0.9991326973113617 Memory: 1.399292 MB
          nprobe = 240
          Search time: 25.82 seconds Precision: 0.9991326973113617 Memory: 1.399292 MB
----------
The highest precision: 0.99913 (nprobe=72)
The smallest memory size: 1.399292 MB (nprobe=24)
The fastest search: 2.78seconds (nprobe=24)
----------
n_list = 260
Train time: 11.93 seconds
Addition time: 0.35 seconds
          nprobe = 26
          Search time: 3.01 seconds Precision: 0.9956634865568084 Memory: 1.440412 MB
          nprobe = 52
          Search time: 5.83 seconds Precision: 0.9969644405897659 Memory: 1.440412 MB
          nprobe = 78
          Search time: 8.15 seconds Precision: 0.9982653946227233 Memory: 1.440412 MB
          nprobe = 104
          Search time: 11.32 seconds Precision: 0.9982653946227233 Memory: 1.440412 MB
          nprobe = 130
          Search time: 13.64 seconds Precision: 0.9982653946227233 Memory: 1.440412 MB
          nprobe = 156
          Search time: 14.22 seconds Precision: 0.9982653946227233 Memory: 1.440412 MB
          nprobe = 182
          Search time: 18.67 seconds Precision: 0.9982653946227233 Memory: 1.440412 MB
          nprobe = 208
          Search time: 21.84 seconds Precision: 0.9982653946227233 Memory: 1.440412 MB
          nprobe = 234
          Search time: 24.46 seconds Precision: 0.9982653946227233 Memory: 1.440412 MB
          nprobe = 260
          Search time: 24.25 seconds Precision: 0.9982653946227233 Memory: 1.440412 MB
----------
The highest precision: 0.99827 (nprobe=78)
The smallest memory size: 1.440412 MB (nprobe=26)
The fastest search: 3.01seconds (nprobe=26)
----------
n_list = 280
Train time: 9.54 seconds
Addition time: 0.26 seconds
          nprobe = 28
          Search time: 2.46 seconds Precision: 0.9952298352124892 Memory: 1.481532 MB
          nprobe = 56
          Search time: 5.10 seconds Precision: 0.9982653946227233 Memory: 1.481532 MB
          nprobe = 84
          Search time: 7.68 seconds Precision: 0.9982653946227233 Memory: 1.481532 MB
          nprobe = 112
          Search time: 10.18 seconds Precision: 0.9982653946227233 Memory: 1.481532 MB
          nprobe = 140
          Search time: 12.89 seconds Precision: 0.9986990459670425 Memory: 1.481532 MB
          nprobe = 168
          Search time: 14.91 seconds Precision: 0.9986990459670425 Memory: 1.481532 MB
          nprobe = 196
          Search time: 18.75 seconds Precision: 0.9986990459670425 Memory: 1.481532 MB
          nprobe = 224
          Search time: 24.21 seconds Precision: 0.9986990459670425 Memory: 1.481532 MB
          nprobe = 252
          Search time: 23.90 seconds Precision: 0.9986990459670425 Memory: 1.481532 MB
          nprobe = 280
          Search time: 24.71 seconds Precision: 0.9986990459670425 Memory: 1.481532 MB
----------
The highest precision: 0.99870 (nprobe=140)
The smallest memory size: 1.481532 MB (nprobe=28)
The fastest search: 2.46seconds (nprobe=28)
```
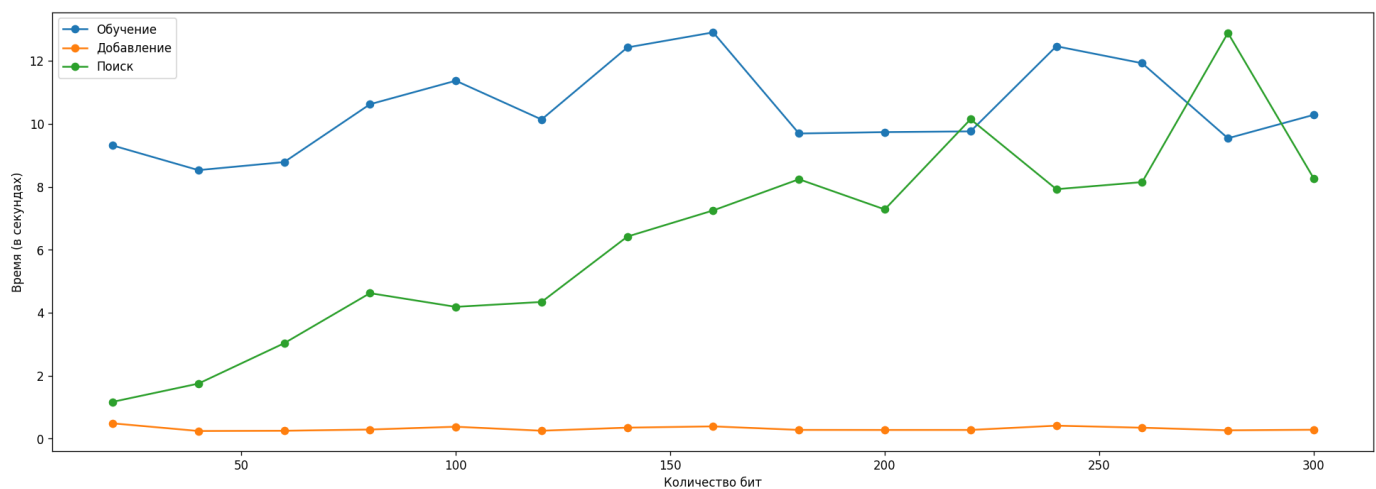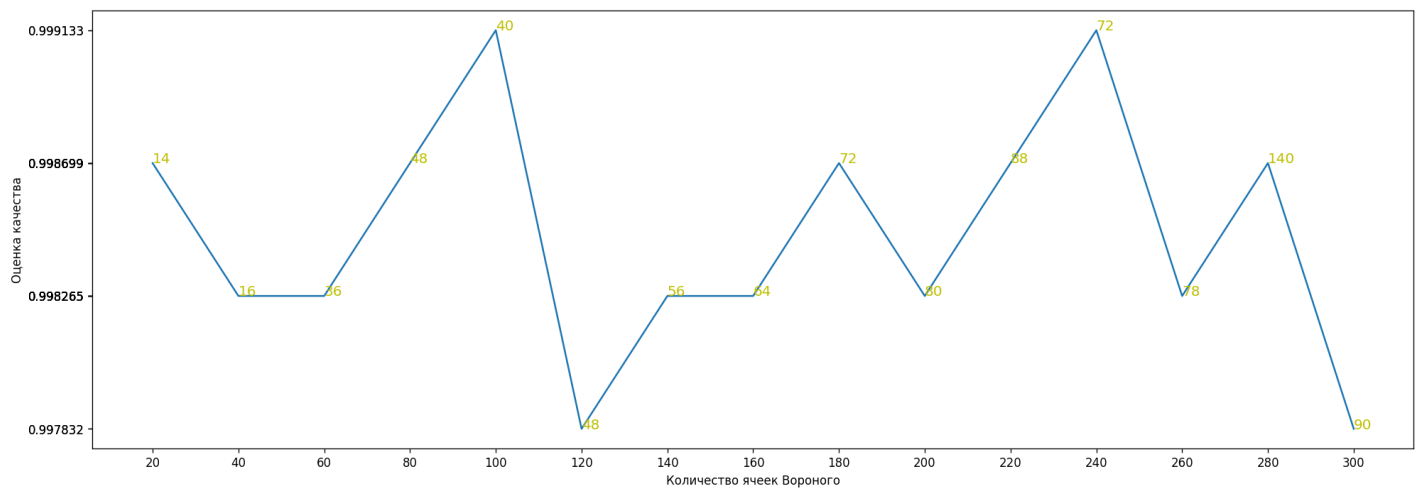
```
----------
n_list = 300
Train time: 10.28 seconds
Addition time: 0.28 seconds
        nprobe = 30
        Search time: 2.76 seconds Precision: 0.9952298352124892 Memory: 1.522652 MB
        nprobe = 60
        Search time: 5.64 seconds Precision: 0.9969644405897659 Memory: 1.522652 MB
        nprobe = 90
        Search time: 8.26 seconds Precision: 0.9978317432784042 Memory: 1.522652 MB
        nprobe = 120
        Search time: 11.06 seconds Precision: 0.9978317432784042 Memory: 1.522652 MB
        nprobe = 150
        Search time: 15.96 seconds Precision: 0.9978317432784042 Memory: 1.522652 MB
        nprobe = 180
        Search time: 19.29 seconds Precision: 0.9978317432784042 Memory: 1.522652 MB
        nprobe = 210
        Search time: 18.67 seconds Precision: 0.9978317432784042 Memory: 1.522652 MB
        nprobe = 240
        Search time: 21.29 seconds Precision: 0.9978317432784042 Memory: 1.522652 MB
        nprobe = 270
        Search time: 24.30 seconds Precision: 0.9978317432784042 Memory: 1.522652 MB
        nprobe = 300
        Search time: 27.52 seconds Precision: 0.9978317432784042 Memory: 1.522652 MB
----------
The highest precision: 0.99783 (nprobe=90)
The smallest memory size: 1.522652 MB (nprobe=30)
The fastest search: 2.76seconds (nprobe=30)
----------
```
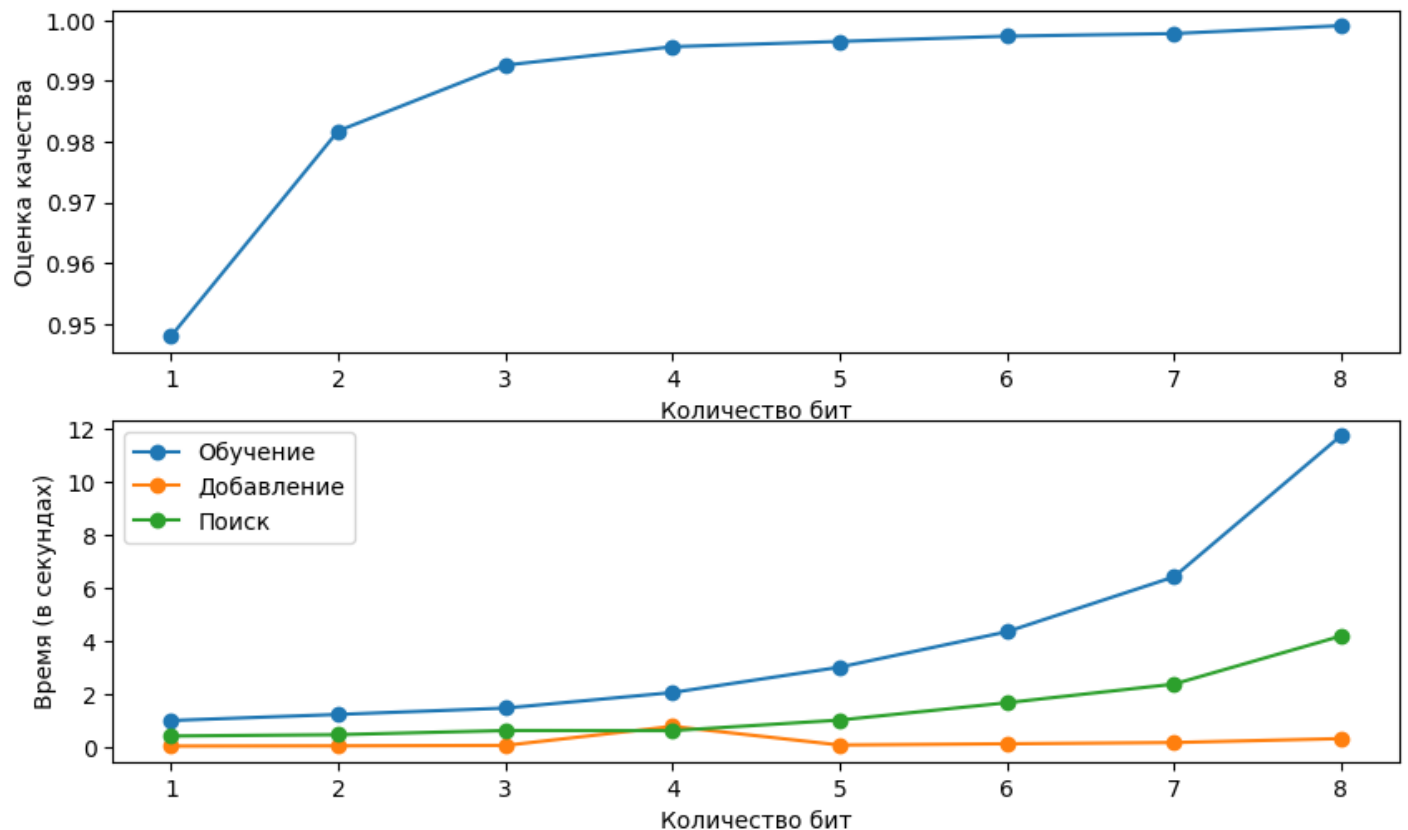
```
n_bits = 1
Train time: 1.00 seconds
Addition time: 0.04 seconds
        nprobe = 40
```
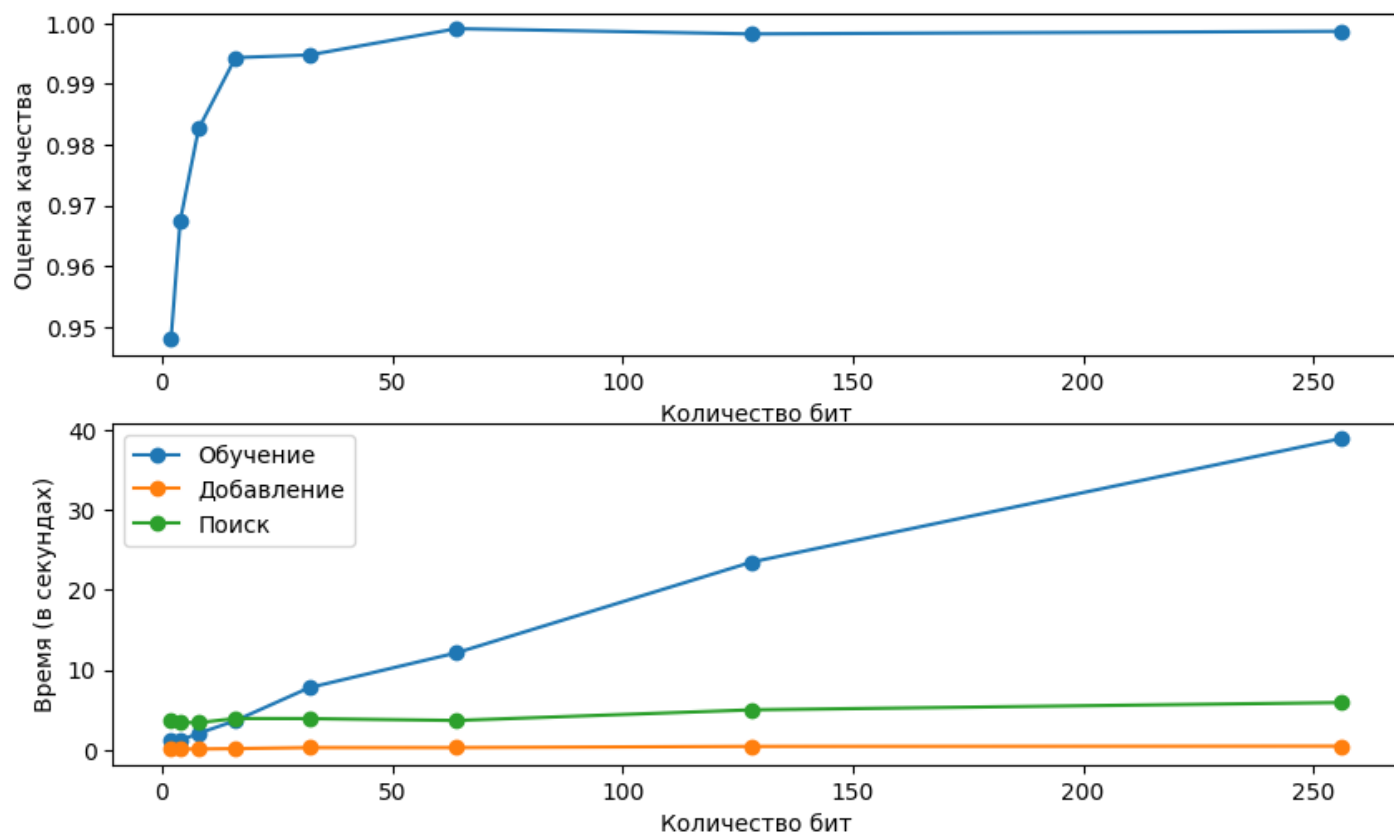
```
        Search time: 0.42 seconds Precision: 0.9479618386816999 Memory: 0.294628 MB
n_bits = 2
Train time: 1.23 seconds
Addition time: 0.05 seconds
        nprobe = 40
        Search time: 0.47 seconds Precision: 0.981786643538595 Memory: 0.3411 MB
n_bits = 3
Train time: 1.47 seconds
Addition time: 0.06 seconds
        nprobe = 40
        Search time: 0.62 seconds Precision: 0.9926279271465741 Memory: 0.391668 MB
n_bits = 4
Train time: 2.06 seconds
Addition time: 0.78 seconds
        nprobe = 40
        Search time: 0.62 seconds Precision: 0.9956634865568084 Memory: 0.450428 MB
n_bits = 5
Train time: 3.02 seconds
Addition time: 0.08 seconds
        nprobe = 40
        Search time: 1.02 seconds Precision: 0.9965307892454467 Memory: 0.525572 MB
n_bits = 6
Train time: 4.35 seconds
Addition time: 0.12 seconds
        nprobe = 40
        Search time: 1.67 seconds Precision: 0.997398091934085 Memory: 0.633484 MB
n_bits = 7
Train time: 6.43 seconds
Addition time: 0.17 seconds
        nprobe = 40
        Search time: 2.38 seconds Precision: 0.9978317432784042 Memory: 0.806932 MB
n_bits = 8
Train time: 11.76 seconds
Addition time: 0.32 seconds
        nprobe = 40
        Search time: 4.19 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
```



```
n_subquantizers = 2
Train time: 1.26 seconds
```

Addition time: 0.08 seconds
        nprobe = 40
        Search time: 3.78 seconds Precision: 0.9479618386816999 Memory: 0.783038 MB
n_subquantizers = 4
Train time: 1.19 seconds
Addition time: 0.08 seconds
        nprobe = 40
        Search time: 3.42 seconds Precision: 0.9674761491760624 Memory: 0.793632 MB
n_subquantizers = 8
Train time: 2.05 seconds
Addition time: 0.09 seconds
        nprobe = 40
        Search time: 3.38 seconds Precision: 0.9826539462272333 Memory: 0.81482 MB
n_subquantizers = 16
Train time: 3.64 seconds
Addition time: 0.13 seconds
        nprobe = 40
        Search time: 3.90 seconds Precision: 0.9943625325238509 Memory: 0.857196 MB
n_subquantizers = 32
Train time: 7.76 seconds
Addition time: 0.26 seconds
        nprobe = 40
        Search time: 3.89 seconds Precision: 0.99479618386817 Memory: 0.941948 MB
n_subquantizers = 64
Train time: 12.13 seconds
Addition time: 0.27 seconds
        nprobe = 40
        Search time: 3.66 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
n_subquantizers = 128
Train time: 23.48 seconds
Addition time: 0.41 seconds
        nprobe = 40
        Search time: 4.98 seconds Precision: 0.9982653946227233 Memory: 1.45046 MB
n_subquantizers = 256
Train time: 38.94 seconds
Addition time: 0.45 seconds
        nprobe = 40
        Search time: 5.90 seconds Precision: 0.9986990459670425 Memory: 2.128476 MB

```
        Train time: 9.95 seconds
        Addition time: 0.27 seconds
                nprobe = 40
                Search time: 3.67 seconds Precision: 0.9991326973113617 Memory: 1.111452 MB
        Find optim params report:
        {'train_time': 9.953381538391113, 'add_time': 0.2712743282318115, 'precision': 0.999132697
        3113617, 'search_time': 3.6671929359436035, 'nprobe': 40, 'memory_size': 1.111452, 'n_lis
        t': 100, 'n_subquantizers': 64, 'n_bits': 8}
```

```
        {'train_time': 9.953381538391113,
         'add_time': 0.2712743282318115,
         'precision': 0.9991326973113617,
         'search_time': 3.6671929359436035,
         'nprobe': 40,
         'memory_size': 1.111452,
         'n_list': 100,
         'n_subquantizers': 64,
         'n_bits': 8}
```

Search for optimal values of IVPQ's parameters using multiple iterations

```
lfw_embeddings_compression.find_params_until_iterations(nn_quantity=5, iterations=5, show_
```

```
        ---------------
        Iteration #1
        Finding optim parameters
        Initial values: n_bits=5 n_subquantizers=128
        n_list = 20
        Train time: 4.28 seconds
        Addition time: 0.06 seconds
                nprobe = 2
                Search time: 0.19 seconds Precision: 0.9440589765828274 Memory: 0.572972 MB
                nprobe = 4
                Search time: 0.30 seconds Precision: 0.9835212489158717 Memory: 0.572972 MB
                nprobe = 6
                Search time: 0.44 seconds Precision: 0.9930615784908933 Memory: 0.572972 MB
                nprobe = 8
                Search time: 0.52 seconds Precision: 0.9965307892454467 Memory: 0.572972 MB
                nprobe = 10
                Search time: 0.67 seconds Precision: 0.997398091934085 Memory: 0.572972 MB
                nprobe = 12
                Search time: 0.83 seconds Precision: 0.9978317432784042 Memory: 0.572972 MB
                nprobe = 14
                Search time: 0.91 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
                nprobe = 16
                Search time: 0.99 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
                nprobe = 18
                Search time: 1.12 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
                nprobe = 20
                Search time: 1.26 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
        ----------
        The highest precision: 0.99870 (nprobe=14)
        The smallest memory size: 0.572972 MB (nprobe=2)
        The fastest search: 0.19seconds (nprobe=2)
        ----------
        n_list = 40
        Train time: 3.90 seconds
        Addition time: 0.05 seconds
                nprobe = 4
                Search time: 0.30 seconds Precision: 0.9770164787510841 Memory: 0.614092 MB
                nprobe = 8
                Search time: 0.45 seconds Precision: 0.9939288811795317 Memory: 0.614092 MB
                nprobe = 12
                Search time: 0.55 seconds Precision: 0.9965307892454467 Memory: 0.614092 MB
                nprobe = 16
```

```
         Search time: 0.73 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 20
         Search time: 0.89 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 24
         Search time: 1.04 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 28
         Search time: 1.16 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 32
         Search time: 1.29 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 36
         Search time: 1.45 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 40
         Search time: 1.58 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
----------
The highest precision: 0.99870 (nprobe=16)
The smallest memory size: 0.614092 MB (nprobe=4)
The fastest search: 0.30seconds (nprobe=4)
----------
n_list = 60
Train time: 3.89 seconds
Addition time: 0.08 seconds
         nprobe = 6
         Search time: 0.25 seconds Precision: 0.9848222029488292 Memory: 0.655212 MB
         nprobe = 12
         Search time: 0.46 seconds Precision: 0.9930615784908933 Memory: 0.655212 MB
         nprobe = 18
         Search time: 0.66 seconds Precision: 0.99479618386817 Memory: 0.655212 MB
         nprobe = 24
         Search time: 0.82 seconds Precision: 0.9969644405897659 Memory: 0.655212 MB
         nprobe = 30
         Search time: 0.97 seconds Precision: 0.9978317432784042 Memory: 0.655212 MB
         nprobe = 36
         Search time: 1.11 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
         nprobe = 42
         Search time: 1.29 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
         nprobe = 48
         Search time: 1.43 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
         nprobe = 54
         Search time: 1.59 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
         nprobe = 60
         Search time: 1.72 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
----------
The highest precision: 0.99870 (nprobe=36)
The smallest memory size: 0.655212 MB (nprobe=6)
The fastest search: 0.25seconds (nprobe=6)
----------
n_list = 80
Train time: 3.67 seconds
Addition time: 0.06 seconds
         nprobe = 8
         Search time: 0.39 seconds Precision: 0.9874241110147441 Memory: 0.696332 MB
         nprobe = 16
         Search time: 0.50 seconds Precision: 0.9956634865568084 Memory: 0.696332 MB
         nprobe = 24
         Search time: 0.75 seconds Precision: 0.9969644405897659 Memory: 0.696332 MB
         nprobe = 32
         Search time: 0.88 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
         nprobe = 40
         Search time: 1.03 seconds Precision: 0.9978317432784042 Memory: 0.696332 MB
         nprobe = 48
         Search time: 1.18 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
         nprobe = 56
         Search time: 1.37 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
         nprobe = 64
         Search time: 1.52 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
         nprobe = 72
```

```
        Search time: 1.70 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 80
        Search time: 1.90 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
----------
The highest precision: 0.99827 (nprobe=32)
The smallest memory size: 0.696332 MB (nprobe=8)
The fastest search: 0.39seconds (nprobe=8)
----------
n_list = 100
Train time: 4.33 seconds
Addition time: 0.05 seconds
        nprobe = 10
        Search time: 0.35 seconds Precision: 0.9874241110147441 Memory: 0.737452 MB
        nprobe = 20
        Search time: 0.52 seconds Precision: 0.9943625325238509 Memory: 0.737452 MB
        nprobe = 30
        Search time: 0.69 seconds Precision: 0.997398091934085 Memory: 0.737452 MB
        nprobe = 40
        Search time: 0.87 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 50
        Search time: 1.10 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 60
        Search time: 1.30 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 70
        Search time: 1.45 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 80
        Search time: 1.65 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 90
        Search time: 1.83 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 100
        Search time: 1.99 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
----------
The highest precision: 0.99870 (nprobe=40)
The smallest memory size: 0.737452 MB (nprobe=10)
The fastest search: 0.35seconds (nprobe=10)
----------
n_list = 120
Train time: 3.54 seconds
Addition time: 0.08 seconds
        nprobe = 12
        Search time: 0.33 seconds Precision: 0.9900260190806591 Memory: 0.778572 MB
        nprobe = 24
        Search time: 0.56 seconds Precision: 0.9952298352124892 Memory: 0.778572 MB
        nprobe = 36
        Search time: 0.77 seconds Precision: 0.997398091934085 Memory: 0.778572 MB
        nprobe = 48
        Search time: 1.03 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 60
        Search time: 1.25 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 72
        Search time: 1.44 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 84
        Search time: 1.62 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 96
        Search time: 1.88 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 108
        Search time: 2.10 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 120
        Search time: 2.26 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
----------
The highest precision: 0.99827 (nprobe=48)
The smallest memory size: 0.778572 MB (nprobe=12)
The fastest search: 0.33seconds (nprobe=12)
----------
n_list = 140
Train time: 3.96 seconds
```

```
Addition time: 0.05 seconds
        nprobe = 14
        Search time: 0.39 seconds Precision: 0.9908933217692975 Memory: 0.819692 MB
        nprobe = 28
        Search time: 0.60 seconds Precision: 0.9952298352124892 Memory: 0.819692 MB
        nprobe = 42
        Search time: 0.81 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
        nprobe = 56
        Search time: 1.08 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
        nprobe = 70
        Search time: 1.25 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
        nprobe = 84
        Search time: 1.53 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
        nprobe = 98
        Search time: 1.81 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
        nprobe = 112
        Search time: 2.03 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
        nprobe = 126
        Search time: 2.24 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
        nprobe = 140
        Search time: 2.47 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
----------
The highest precision: 0.99870 (nprobe=56)
The smallest memory size: 0.819692 MB (nprobe=14)
The fastest search: 0.39seconds (nprobe=14)
----------
n_list = 160
Train time: 3.62 seconds
Addition time: 0.05 seconds
        nprobe = 16
        Search time: 0.39 seconds Precision: 0.9939288811795317 Memory: 0.860812 MB
        nprobe = 32
        Search time: 0.69 seconds Precision: 0.9969644405897659 Memory: 0.860812 MB
        nprobe = 48
        Search time: 0.94 seconds Precision: 0.9982653946227233 Memory: 0.860812 MB
        nprobe = 64
        Search time: 1.21 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
        nprobe = 80
        Search time: 1.54 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
        nprobe = 96
        Search time: 1.72 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
        nprobe = 112
        Search time: 1.99 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
        nprobe = 128
        Search time: 2.33 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
        nprobe = 144
        Search time: 2.52 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
        nprobe = 160
        Search time: 2.85 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
----------
The highest precision: 0.99913 (nprobe=112)
The smallest memory size: 0.860812 MB (nprobe=16)
The fastest search: 0.39seconds (nprobe=16)
----------
n_list = 180
Train time: 3.97 seconds
Addition time: 0.06 seconds
        nprobe = 18
        Search time: 0.43 seconds Precision: 0.99479618386817 Memory: 0.901932 MB
        nprobe = 36
        Search time: 0.70 seconds Precision: 0.997398091934085 Memory: 0.901932 MB
        nprobe = 54
        Search time: 1.02 seconds Precision: 0.9986990459670425 Memory: 0.901932 MB
        nprobe = 72
        Search time: 1.28 seconds Precision: 0.9991326973113617 Memory: 0.901932 MB
        nprobe = 90
```

```
            Search time: 1.57 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 108
            Search time: 1.88 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 126
            Search time: 2.14 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 144
            Search time: 2.52 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 162
            Search time: 2.82 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 180
            Search time: 3.02 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        ----------
        The highest precision: 0.99957 (nprobe=90)
        The smallest memory size: 0.901932 MB (nprobe=18)
        The fastest search: 0.43seconds (nprobe=18)
        ----------
        n_list = 200
        Train time: 4.26 seconds
        Addition time: 0.05 seconds
            nprobe = 20
            Search time: 0.42 seconds Precision: 0.9960971379011275 Memory: 0.943052 MB
            nprobe = 40
            Search time: 0.80 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
            nprobe = 60
            Search time: 1.17 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
            nprobe = 80
            Search time: 1.43 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 100
            Search time: 1.71 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 120
            Search time: 2.10 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 140
            Search time: 2.31 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 160
            Search time: 2.72 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 180
            Search time: 3.04 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 200
            Search time: 3.48 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        ----------
        The highest precision: 0.99827 (nprobe=80)
        The smallest memory size: 0.943052 MB (nprobe=20)
        The fastest search: 0.42seconds (nprobe=20)
        ----------
        n_list = 220
        Train time: 3.97 seconds
        Addition time: 0.05 seconds
            nprobe = 22
            Search time: 0.44 seconds Precision: 0.9952298352124892 Memory: 0.984172 MB
            nprobe = 44
            Search time: 0.80 seconds Precision: 0.997398091934085 Memory: 0.984172 MB
            nprobe = 66
            Search time: 1.19 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 88
            Search time: 1.50 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 110
            Search time: 1.84 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 132
            Search time: 2.23 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 154
            Search time: 2.57 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 176
            Search time: 3.03 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 198
            Search time: 3.33 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 220
```

```
                 Search time: 3.73 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        ----------
        The highest precision: 0.99827 (nprobe=66)
        The smallest memory size: 0.984172 MB (nprobe=22)
        The fastest search: 0.44seconds (nprobe=22)
        ----------
        n_list = 240
        Train time: 4.23 seconds
        Addition time: 0.09 seconds
                 nprobe = 24
                 Search time: 0.47 seconds Precision: 0.9952298352124892 Memory: 1.025292 MB
                 nprobe = 48
                 Search time: 0.93 seconds Precision: 0.9978317432784042 Memory: 1.025292 MB
                 nprobe = 72
                 Search time: 1.31 seconds Precision: 0.9982653946227233 Memory: 1.025292 MB
                 nprobe = 96
                 Search time: 1.70 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
                 nprobe = 120
                 Search time: 2.11 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
                 nprobe = 144
                 Search time: 2.54 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
                 nprobe = 168
                 Search time: 2.95 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
                 nprobe = 192
                 Search time: 3.47 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
                 nprobe = 216
                 Search time: 3.92 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
                 nprobe = 240
                 Search time: 4.29 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        ----------
        The highest precision: 0.99913 (nprobe=144)
        The smallest memory size: 1.025292 MB (nprobe=24)
        The fastest search: 0.47seconds (nprobe=24)
        ----------
        n_list = 260
        Train time: 4.63 seconds
        Addition time: 0.06 seconds
                 nprobe = 26
                 Search time: 0.68 seconds Precision: 0.9956634865568084 Memory: 1.066412 MB
                 nprobe = 52
                 Search time: 1.04 seconds Precision: 0.9969644405897659 Memory: 1.066412 MB
                 nprobe = 78
                 Search time: 1.51 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                 nprobe = 104
                 Search time: 1.93 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                 nprobe = 130
                 Search time: 2.34 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                 nprobe = 156
                 Search time: 2.83 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                 nprobe = 182
                 Search time: 3.31 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                 nprobe = 208
                 Search time: 3.74 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                 nprobe = 234
                 Search time: 4.15 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                 nprobe = 260
                 Search time: 4.67 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        ----------
        The highest precision: 0.99783 (nprobe=78)
        The smallest memory size: 1.066412 MB (nprobe=26)
        The fastest search: 0.68seconds (nprobe=26)
        ----------
        n_list = 280
        Train time: 5.05 seconds
        Addition time: 0.06 seconds
                 nprobe = 28
```

```
            Search time: 0.61 seconds Precision: 0.9960971379011275 Memory: 1.107532 MB
            nprobe = 56
            Search time: 1.19 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
            nprobe = 84
            Search time: 1.53 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
            nprobe = 112
            Search time: 2.07 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
            nprobe = 140
            Search time: 2.42 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
            nprobe = 168
            Search time: 2.98 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
            nprobe = 196
            Search time: 3.58 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
            nprobe = 224
            Search time: 4.28 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
            nprobe = 252
            Search time: 4.43 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
            nprobe = 280
            Search time: 4.83 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
    ----------
The highest precision: 0.99913 (nprobe=56)
The smallest memory size: 1.107532 MB (nprobe=28)
The fastest search: 0.61seconds (nprobe=28)
    ----------
n_list = 300
Train time: 5.01 seconds
Addition time: 0.08 seconds
            nprobe = 30
            Search time: 0.66 seconds Precision: 0.9965307892454467 Memory: 1.148652 MB
            nprobe = 60
            Search time: 1.09 seconds Precision: 0.9982653946227233 Memory: 1.148652 MB
            nprobe = 90
            Search time: 1.61 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
            nprobe = 120
            Search time: 2.02 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
            nprobe = 150
            Search time: 2.64 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
            nprobe = 180
            Search time: 3.11 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
            nprobe = 210
            Search time: 3.56 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
            nprobe = 240
            Search time: 4.11 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
            nprobe = 270
            Search time: 4.54 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
            nprobe = 300
            Search time: 5.12 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
    ----------
The highest precision: 0.99913 (nprobe=90)
The smallest memory size: 1.148652 MB (nprobe=30)
The fastest search: 0.66seconds (nprobe=30)
    ----------
```
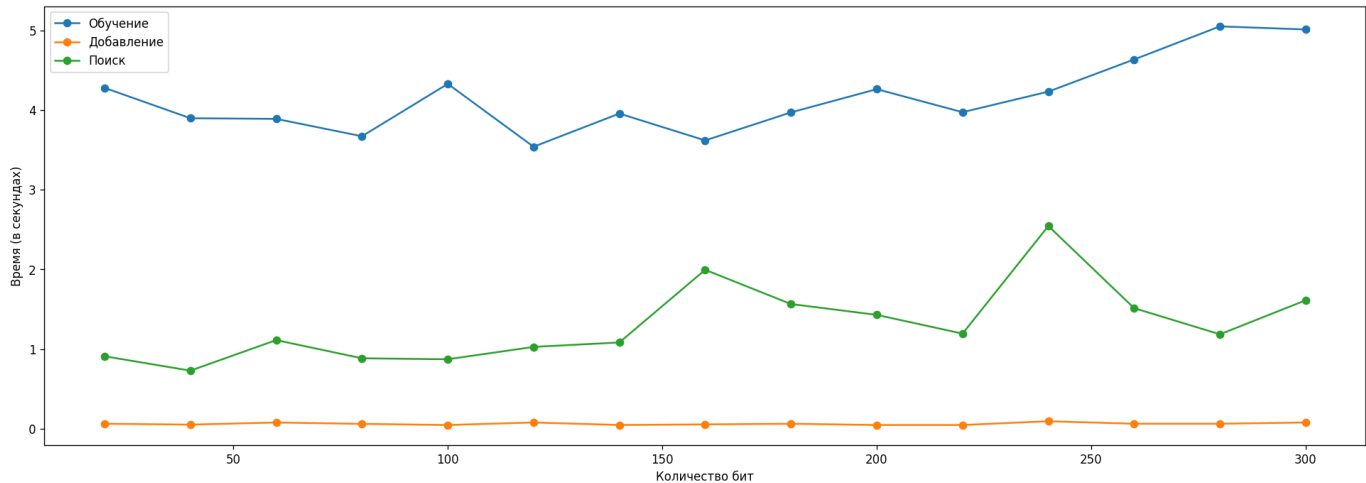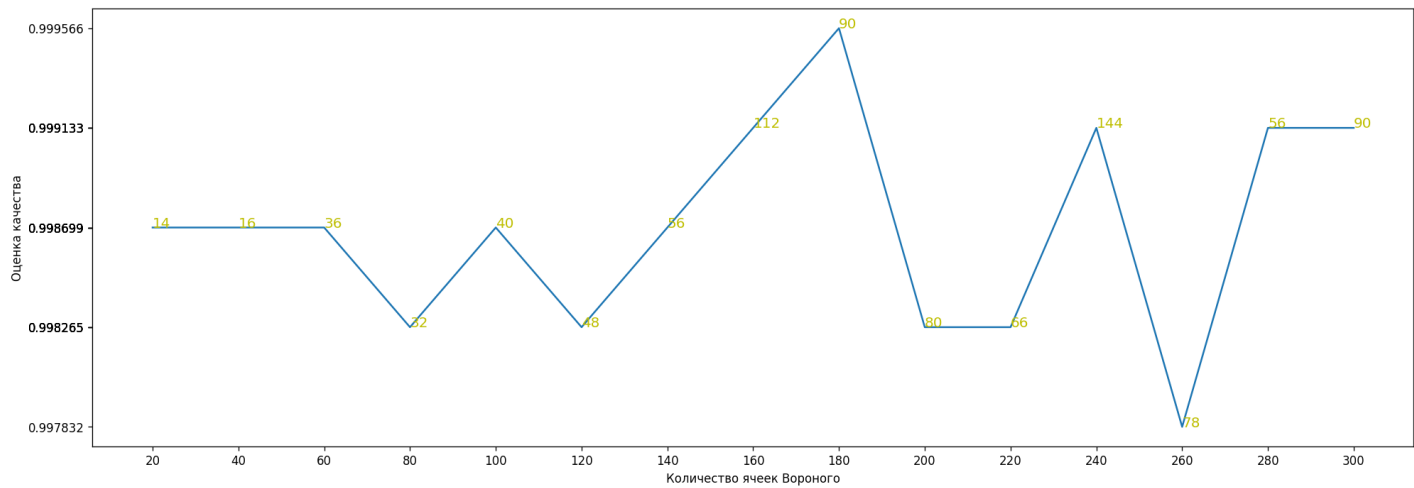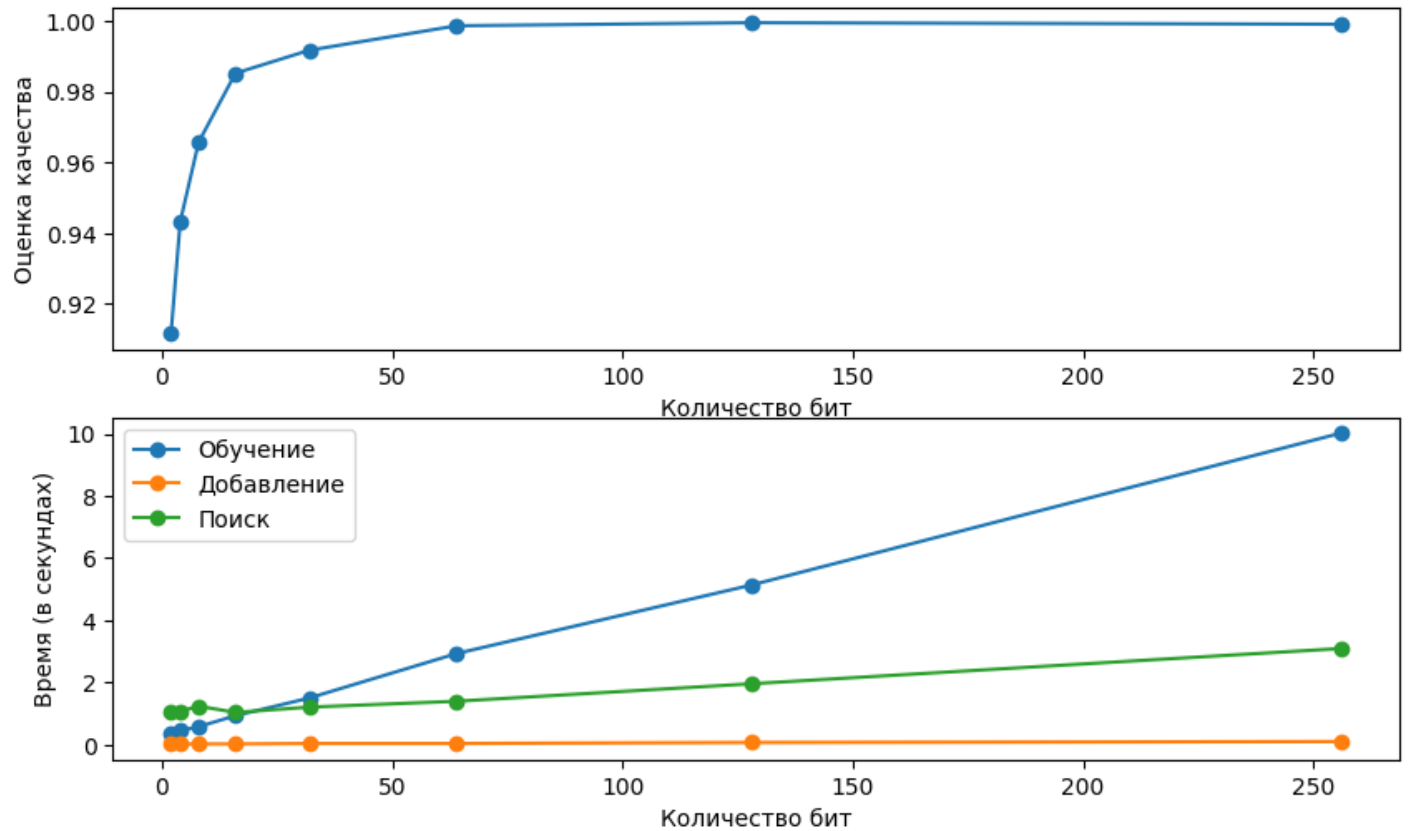
```
n_subquantizers = 2
Train time: 0.38 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.07 seconds Precision: 0.9115351257588898 Memory: 0.488766 MB
n_subquantizers = 4
Train time: 0.46 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.08 seconds Precision: 0.9431916738941891 Memory: 0.494063 MB
n_subquantizers = 8
Train time: 0.59 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.25 seconds Precision: 0.9657415437987857 Memory: 0.504657 MB
n_subquantizers = 16
Train time: 0.94 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.04 seconds Precision: 0.9852558542931483 Memory: 0.531142 MB
n_subquantizers = 32
Train time: 1.51 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.21 seconds Precision: 0.9917606244579358 Memory: 0.584112 MB
n_subquantizers = 64
Train time: 2.94 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.40 seconds Precision: 0.9986990459670425 Memory: 0.690052 MB
n_subquantizers = 128
Train time: 5.14 seconds
Addition time: 0.08 seconds
```

```
        nprobe = 90
        Search time: 1.97 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
n_subquantizers = 256
Train time: 10.02 seconds
Addition time: 0.11 seconds
        nprobe = 90
        Search time: 3.10 seconds Precision: 0.9991326973113617 Memory: 1.325692 MB
```
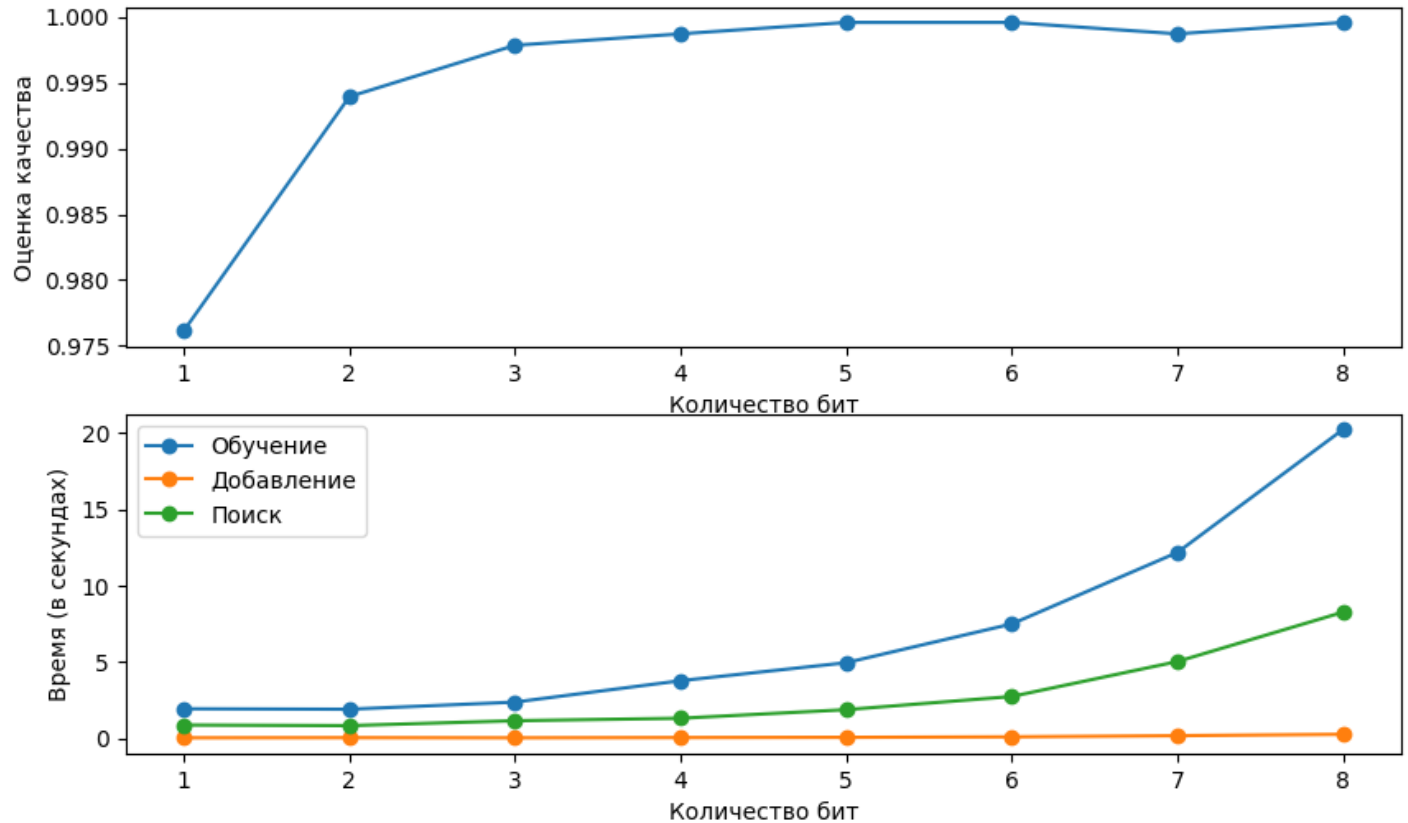


```
n_bits = 1
Train time: 1.93 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.87 seconds Precision: 0.9761491760624458 Memory: 0.501484 MB
n_bits = 2
Train time: 1.90 seconds
Addition time: 0.04 seconds
        nprobe = 90
        Search time: 0.83 seconds Precision: 0.9939288811795317 Memory: 0.590332 MB
n_bits = 3
Train time: 2.37 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.15 seconds Precision: 0.9978317432784042 Memory: 0.683276 MB
n_bits = 4
Train time: 3.77 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.31 seconds Precision: 0.9986990459670425 Memory: 0.784412 MB
n_bits = 5
Train time: 4.95 seconds
Addition time: 0.06 seconds
        nprobe = 90
        Search time: 1.88 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
n_bits = 6
Train time: 7.49 seconds
Addition time: 0.09 seconds
        nprobe = 90
        Search time: 2.74 seconds Precision: 0.9995663486556808 Memory: 1.05222 MB
n_bits = 7
```

```
Train time: 12.18 seconds
Addition time: 0.17 seconds
        nprobe = 90
        Search time: 5.03 seconds Precision: 0.9986990459670425 Memory: 1.268044 MB
n_bits = 8
Train time: 20.23 seconds
Addition time: 0.26 seconds
        nprobe = 90
        Search time: 8.27 seconds Precision: 0.9995663486556808 Memory: 1.61494 MB
```



```
Train time: 4.31 seconds
Addition time: 0.06 seconds
        nprobe = 90
        Search time: 1.83 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
Find optim params report:
{'train_time': 4.314014196395874, 'add_time': 0.0624842643737793, 'precision': 0.999566348
6556808, 'search_time': 1.8281195163726807, 'nprobe': 90, 'memory_size': 0.901932, 'n_lis
t': 180, 'n_subquantizers': 128, 'n_bits': 5}
---------------
Iteration #2
Finding optim parameters
Initial values: n_bits=5 n_subquantizers=128
n_list = 20
Train time: 4.17 seconds
Addition time: 0.05 seconds
        nprobe = 2
        Search time: 0.24 seconds Precision: 0.9440589765828274 Memory: 0.572972 MB
        nprobe = 4
        Search time: 0.38 seconds Precision: 0.9835212489158717 Memory: 0.572972 MB
        nprobe = 6
        Search time: 0.53 seconds Precision: 0.9930615784908933 Memory: 0.572972 MB
        nprobe = 8
        Search time: 0.65 seconds Precision: 0.9965307892454467 Memory: 0.572972 MB
        nprobe = 10
        Search time: 0.83 seconds Precision: 0.997398091934085 Memory: 0.572972 MB
        nprobe = 12
        Search time: 1.08 seconds Precision: 0.9978317432784042 Memory: 0.572972 MB
        nprobe = 14
        Search time: 1.14 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
        nprobe = 16
```

```
         Search time: 1.22 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
         nprobe = 18
         Search time: 1.38 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
         nprobe = 20
         Search time: 1.50 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
----------
The highest precision: 0.99870 (nprobe=14)
The smallest memory size: 0.572972 MB (nprobe=2)
The fastest search: 0.24seconds (nprobe=2)
----------
n_list = 40
Train time: 4.20 seconds
Addition time: 0.06 seconds
         nprobe = 4
         Search time: 0.33 seconds Precision: 0.9770164787510841 Memory: 0.614092 MB
         nprobe = 8
         Search time: 0.46 seconds Precision: 0.9939288811795317 Memory: 0.614092 MB
         nprobe = 12
         Search time: 0.64 seconds Precision: 0.9965307892454467 Memory: 0.614092 MB
         nprobe = 16
         Search time: 0.88 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 20
         Search time: 0.97 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 24
         Search time: 1.16 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 28
         Search time: 1.33 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 32
         Search time: 1.53 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 36
         Search time: 1.66 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
         nprobe = 40
         Search time: 1.86 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
----------
The highest precision: 0.99870 (nprobe=16)
The smallest memory size: 0.614092 MB (nprobe=4)
The fastest search: 0.33seconds (nprobe=4)
----------
n_list = 60
Train time: 4.31 seconds
Addition time: 0.05 seconds
         nprobe = 6
         Search time: 0.31 seconds Precision: 0.9848222029488292 Memory: 0.655212 MB
         nprobe = 12
         Search time: 0.48 seconds Precision: 0.9930615784908933 Memory: 0.655212 MB
         nprobe = 18
         Search time: 0.80 seconds Precision: 0.99479618386817 Memory: 0.655212 MB
         nprobe = 24
         Search time: 1.02 seconds Precision: 0.9969644405897659 Memory: 0.655212 MB
         nprobe = 30
         Search time: 1.15 seconds Precision: 0.9978317432784042 Memory: 0.655212 MB
         nprobe = 36
         Search time: 1.34 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
         nprobe = 42
         Search time: 1.65 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
         nprobe = 48
         Search time: 1.73 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
         nprobe = 54
         Search time: 2.01 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
         nprobe = 60
         Search time: 2.17 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
----------
The highest precision: 0.99870 (nprobe=36)
The smallest memory size: 0.655212 MB (nprobe=6)
The fastest search: 0.31seconds (nprobe=6)
----------
```

```
n_list = 80
Train time: 5.08 seconds
Addition time: 0.08 seconds
        nprobe = 8
        Search time: 0.47 seconds Precision: 0.9874241110147441 Memory: 0.696332 MB
        nprobe = 16
        Search time: 0.63 seconds Precision: 0.9956634865568084 Memory: 0.696332 MB
        nprobe = 24
        Search time: 0.81 seconds Precision: 0.9969644405897659 Memory: 0.696332 MB
        nprobe = 32
        Search time: 1.14 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 40
        Search time: 1.32 seconds Precision: 0.9978317432784042 Memory: 0.696332 MB
        nprobe = 48
        Search time: 1.56 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 56
        Search time: 1.82 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 64
        Search time: 2.19 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 72
        Search time: 2.28 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 80
        Search time: 2.47 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
----------
The highest precision: 0.99827 (nprobe=32)
The smallest memory size: 0.696332 MB (nprobe=8)
The fastest search: 0.47seconds (nprobe=8)
----------
n_list = 100
Train time: 6.26 seconds
Addition time: 0.06 seconds
        nprobe = 10
        Search time: 0.39 seconds Precision: 0.9874241110147441 Memory: 0.737452 MB
        nprobe = 20
        Search time: 0.76 seconds Precision: 0.9943625325238509 Memory: 0.737452 MB
        nprobe = 30
        Search time: 1.09 seconds Precision: 0.997398091934085 Memory: 0.737452 MB
        nprobe = 40
        Search time: 1.27 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 50
        Search time: 1.52 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 60
        Search time: 1.82 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 70
        Search time: 1.98 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 80
        Search time: 2.20 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 90
        Search time: 2.35 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 100
        Search time: 2.65 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
----------
The highest precision: 0.99870 (nprobe=40)
The smallest memory size: 0.737452 MB (nprobe=10)
The fastest search: 0.39seconds (nprobe=10)
----------
n_list = 120
Train time: 4.86 seconds
Addition time: 0.06 seconds
        nprobe = 12
        Search time: 0.42 seconds Precision: 0.9900260190806591 Memory: 0.778572 MB
        nprobe = 24
        Search time: 0.68 seconds Precision: 0.9952298352124892 Memory: 0.778572 MB
        nprobe = 36
        Search time: 0.96 seconds Precision: 0.997398091934085 Memory: 0.778572 MB
        nprobe = 48
```

```
          Search time: 1.26 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
          nprobe = 60
          Search time: 1.43 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
          nprobe = 72
          Search time: 1.70 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
          nprobe = 84
          Search time: 1.96 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
          nprobe = 96
          Search time: 2.21 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
          nprobe = 108
          Search time: 2.56 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
          nprobe = 120
          Search time: 2.97 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
----------
The highest precision: 0.99827 (nprobe=48)
The smallest memory size: 0.778572 MB (nprobe=12)
The fastest search: 0.42seconds (nprobe=12)
----------
n_list = 140
Train time: 4.39 seconds
Addition time: 0.06 seconds
          nprobe = 14
          Search time: 0.43 seconds Precision: 0.9908933217692975 Memory: 0.819692 MB
          nprobe = 28
          Search time: 0.70 seconds Precision: 0.9952298352124892 Memory: 0.819692 MB
          nprobe = 42
          Search time: 0.96 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
          nprobe = 56
          Search time: 1.40 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
          nprobe = 70
          Search time: 1.73 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
          nprobe = 84
          Search time: 1.98 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
          nprobe = 98
          Search time: 2.21 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
          nprobe = 112
          Search time: 2.74 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
          nprobe = 126
          Search time: 2.86 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
          nprobe = 140
          Search time: 3.34 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
----------
The highest precision: 0.99870 (nprobe=56)
The smallest memory size: 0.819692 MB (nprobe=14)
The fastest search: 0.43seconds (nprobe=14)
----------
n_list = 160
Train time: 4.46 seconds
Addition time: 0.06 seconds
          nprobe = 16
          Search time: 0.44 seconds Precision: 0.9939288811795317 Memory: 0.860812 MB
          nprobe = 32
          Search time: 0.55 seconds Precision: 0.9969644405897659 Memory: 0.860812 MB
          nprobe = 48
          Search time: 0.88 seconds Precision: 0.9982653946227233 Memory: 0.860812 MB
          nprobe = 64
          Search time: 1.71 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
          nprobe = 80
          Search time: 1.92 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
          nprobe = 96
          Search time: 2.27 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
          nprobe = 112
          Search time: 2.61 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
          nprobe = 128
          Search time: 2.94 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
          nprobe = 144
```

```
        Search time: 3.48 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
        nprobe = 160
        Search time: 3.93 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
----------
The highest precision: 0.99913 (nprobe=112)
The smallest memory size: 0.860812 MB (nprobe=16)
The fastest search: 0.44seconds (nprobe=16)
----------
n_list = 180
Train time: 5.23 seconds
Addition time: 0.07 seconds
        nprobe = 18
        Search time: 0.60 seconds Precision: 0.99479618386817 Memory: 0.901932 MB
        nprobe = 36
        Search time: 0.91 seconds Precision: 0.997398091934085 Memory: 0.901932 MB
        nprobe = 54
        Search time: 1.31 seconds Precision: 0.9986990459670425 Memory: 0.901932 MB
        nprobe = 72
        Search time: 1.88 seconds Precision: 0.9991326973113617 Memory: 0.901932 MB
        nprobe = 90
        Search time: 2.18 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 108
        Search time: 2.29 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 126
        Search time: 3.08 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 144
        Search time: 3.48 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 162
        Search time: 4.01 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 180
        Search time: 3.67 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
----------
The highest precision: 0.99957 (nprobe=90)
The smallest memory size: 0.901932 MB (nprobe=18)
The fastest search: 0.60seconds (nprobe=18)
----------
n_list = 200
Train time: 4.70 seconds
Addition time: 0.06 seconds
        nprobe = 20
        Search time: 0.44 seconds Precision: 0.9960971379011275 Memory: 0.943052 MB
        nprobe = 40
        Search time: 0.91 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
        nprobe = 60
        Search time: 1.24 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
        nprobe = 80
        Search time: 1.52 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        nprobe = 100
        Search time: 1.94 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        nprobe = 120
        Search time: 2.27 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        nprobe = 140
        Search time: 2.78 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        nprobe = 160
        Search time: 3.02 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        nprobe = 180
        Search time: 3.31 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        nprobe = 200
        Search time: 3.69 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
----------
The highest precision: 0.99827 (nprobe=80)
The smallest memory size: 0.943052 MB (nprobe=20)
The fastest search: 0.44seconds (nprobe=20)
----------
n_list = 220
Train time: 4.47 seconds
```

```
Addition time: 0.06 seconds
        nprobe = 22
        Search time: 0.50 seconds Precision: 0.9952298352124892 Memory: 0.984172 MB
        nprobe = 44
        Search time: 0.98 seconds Precision: 0.997398091934085 Memory: 0.984172 MB
        nprobe = 66
        Search time: 1.29 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 88
        Search time: 1.68 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 110
        Search time: 1.99 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 132
        Search time: 2.33 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 154
        Search time: 2.70 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 176
        Search time: 3.20 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 198
        Search time: 3.42 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 220
        Search time: 3.80 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
----------
The highest precision: 0.99827 (nprobe=66)
The smallest memory size: 0.984172 MB (nprobe=22)
The fastest search: 0.50seconds (nprobe=22)
----------
n_list = 240
Train time: 4.26 seconds
Addition time: 0.05 seconds
        nprobe = 24
        Search time: 0.51 seconds Precision: 0.9952298352124892 Memory: 1.025292 MB
        nprobe = 48
        Search time: 0.88 seconds Precision: 0.9978317432784042 Memory: 1.025292 MB
        nprobe = 72
        Search time: 1.05 seconds Precision: 0.9982653946227233 Memory: 1.025292 MB
        nprobe = 96
        Search time: 1.80 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
        nprobe = 120
        Search time: 2.30 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
        nprobe = 144
        Search time: 2.78 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        nprobe = 168
        Search time: 3.33 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        nprobe = 192
        Search time: 3.73 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        nprobe = 216
        Search time: 4.02 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        nprobe = 240
        Search time: 4.49 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
----------
The highest precision: 0.99913 (nprobe=144)
The smallest memory size: 1.025292 MB (nprobe=24)
The fastest search: 0.51seconds (nprobe=24)
----------
n_list = 260
Train time: 5.08 seconds
Addition time: 0.09 seconds
        nprobe = 26
        Search time: 0.61 seconds Precision: 0.9956634865568084 Memory: 1.066412 MB
        nprobe = 52
        Search time: 1.29 seconds Precision: 0.9969644405897659 Memory: 1.066412 MB
        nprobe = 78
        Search time: 1.80 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        nprobe = 104
        Search time: 1.97 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        nprobe = 130
```

```
                Search time: 2.23 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                nprobe = 156
                Search time: 2.81 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                nprobe = 182
                Search time: 3.01 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                nprobe = 208
                Search time: 3.37 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                nprobe = 234
                Search time: 3.81 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                nprobe = 260
                Search time: 4.27 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        ----------
        The highest precision: 0.99783 (nprobe=78)
        The smallest memory size: 1.066412 MB (nprobe=26)
        The fastest search: 0.61seconds (nprobe=26)
        ----------
        n_list = 280
        Train time: 4.30 seconds
        Addition time: 0.09 seconds
                nprobe = 28
                Search time: 0.66 seconds Precision: 0.9960971379011275 Memory: 1.107532 MB
                nprobe = 56
                Search time: 1.15 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                nprobe = 84
                Search time: 1.66 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                nprobe = 112
                Search time: 2.27 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                nprobe = 140
                Search time: 2.56 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                nprobe = 168
                Search time: 3.09 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                nprobe = 196
                Search time: 3.66 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                nprobe = 224
                Search time: 4.09 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                nprobe = 252
                Search time: 4.64 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                nprobe = 280
                Search time: 5.26 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        ----------
        The highest precision: 0.99913 (nprobe=56)
        The smallest memory size: 1.107532 MB (nprobe=28)
        The fastest search: 0.66seconds (nprobe=28)
        ----------
        n_list = 300
        Train time: 4.31 seconds
        Addition time: 0.06 seconds
                nprobe = 30
                Search time: 0.56 seconds Precision: 0.9965307892454467 Memory: 1.148652 MB
                nprobe = 60
                Search time: 1.07 seconds Precision: 0.9982653946227233 Memory: 1.148652 MB
                nprobe = 90
                Search time: 1.46 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
                nprobe = 120
                Search time: 2.08 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
                nprobe = 150
                Search time: 2.49 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
                nprobe = 180
                Search time: 2.85 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
                nprobe = 210
                Search time: 3.41 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
                nprobe = 240
                Search time: 3.74 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
                nprobe = 270
                Search time: 4.34 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
                nprobe = 300
```
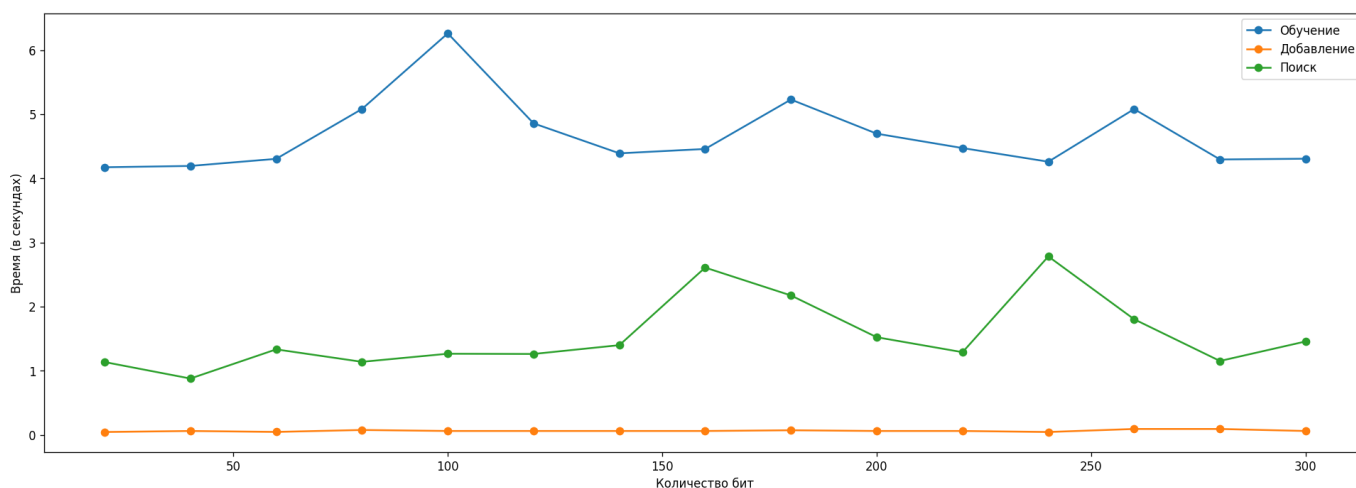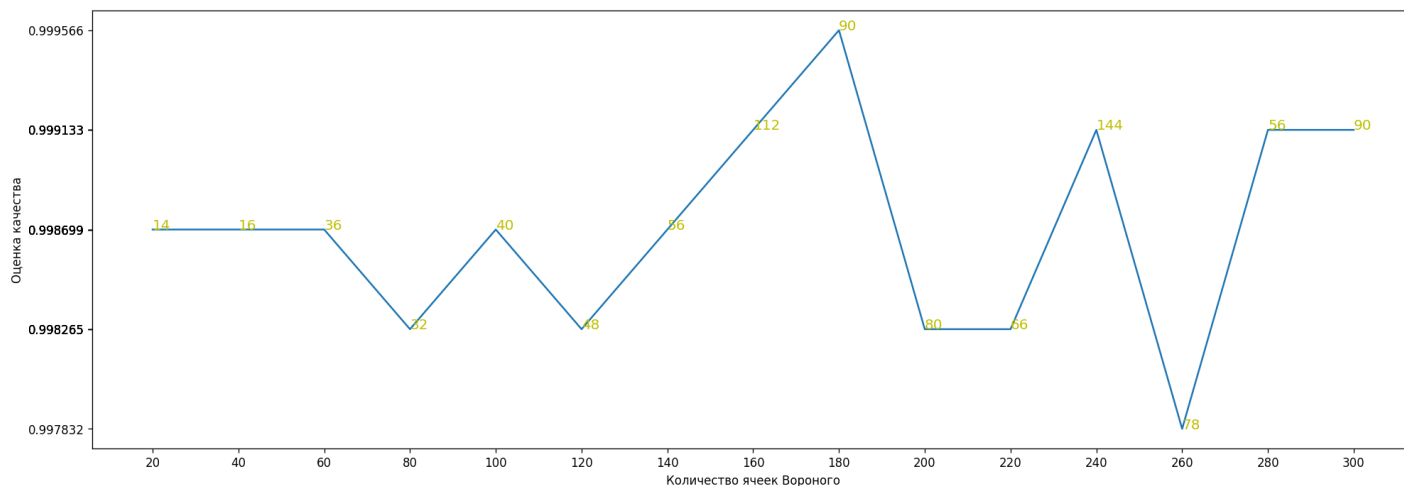
Search time: 4.78 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB

The highest precision: 0.99913 (nprobe=90)
The smallest memory size: 1.148652 MB (nprobe=30)
The fastest search: 0.56seconds (nprobe=30)
----

n_subquantizers = 2
Train time: 0.33 seconds
Addition time: 0.02 seconds
        nprobe = 90
        Search time: 0.99 seconds Precision: 0.9115351257588898 Memory: 0.488766 MB
n_subquantizers = 4
Train time: 0.38 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.06 seconds Precision: 0.9431916738941891 Memory: 0.494063 MB
n_subquantizers = 8
Train time: 0.54 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.04 seconds Precision: 0.9657415437987857 Memory: 0.504657 MB
n_subquantizers = 16
Train time: 0.74 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.93 seconds Precision: 0.9852558542931483 Memory: 0.531142 MB
n_subquantizers = 32
Train time: 1.27 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 0.98 seconds Precision: 0.9917606244579358 Memory: 0.584112 MB
n_subquantizers = 64
Train time: 2.29 seconds

```
Addition time: 0.06 seconds
        nprobe = 90
        Search time: 1.30 seconds Precision: 0.9986990459670425 Memory: 0.690052 MB
n_subquantizers = 128
Train time: 4.10 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.76 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
n_subquantizers = 256
Train time: 7.82 seconds
Addition time: 0.08 seconds
        nprobe = 90
        Search time: 2.82 seconds Precision: 0.9991326973113617 Memory: 1.325692 MB
```
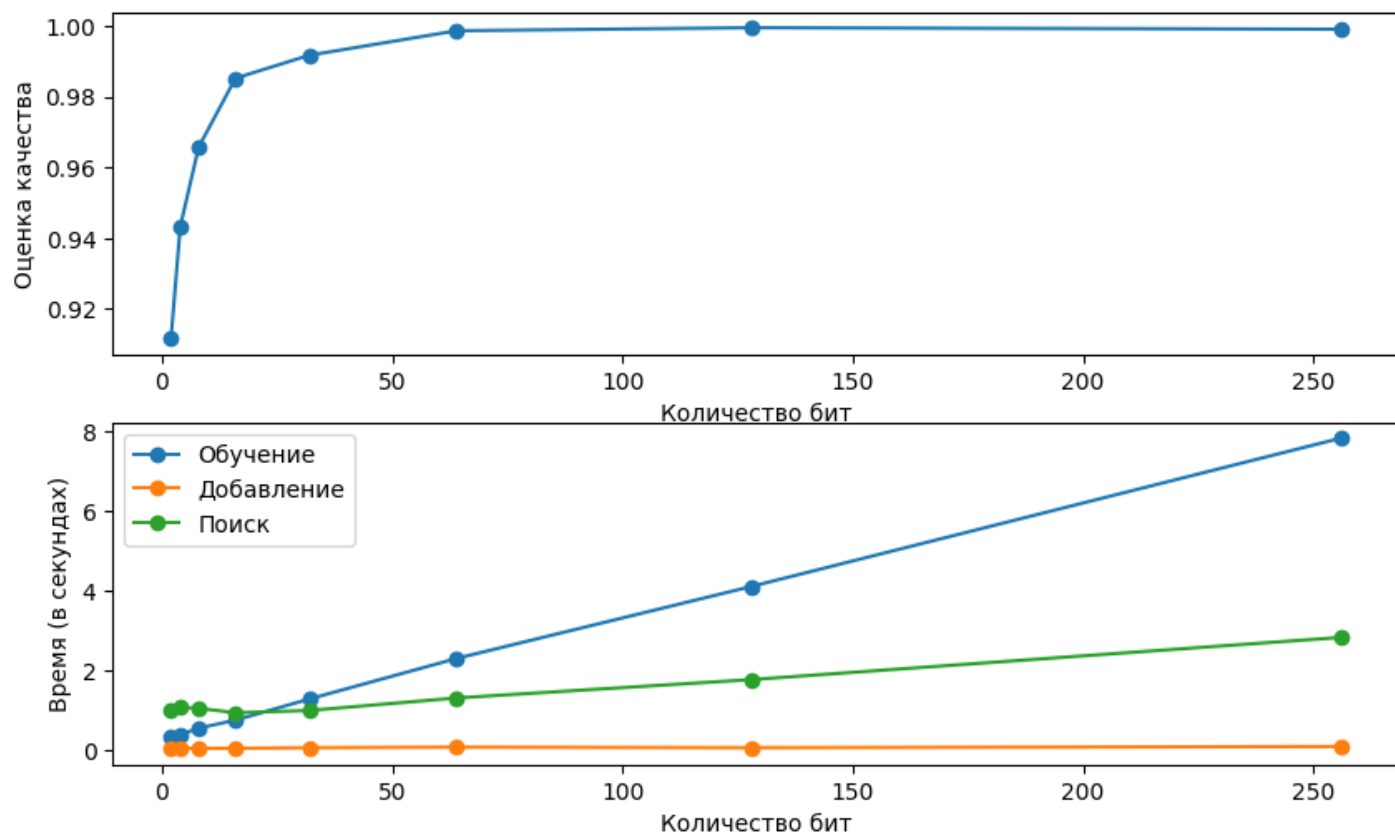


```
n_bits = 1
Train time: 1.49 seconds
Addition time: 0.02 seconds
        nprobe = 90
        Search time: 0.73 seconds Precision: 0.9761491760624458 Memory: 0.501484 MB
n_bits = 2
Train time: 1.71 seconds
Addition time: 0.02 seconds
        nprobe = 90
        Search time: 0.79 seconds Precision: 0.9939288811795317 Memory: 0.590332 MB
n_bits = 3
Train time: 2.06 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.00 seconds Precision: 0.9978317432784042 Memory: 0.683276 MB
n_bits = 4
Train time: 3.06 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.16 seconds Precision: 0.9986990459670425 Memory: 0.784412 MB
n_bits = 5
Train time: 4.24 seconds
Addition time: 0.06 seconds
        nprobe = 90
        Search time: 1.79 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
```
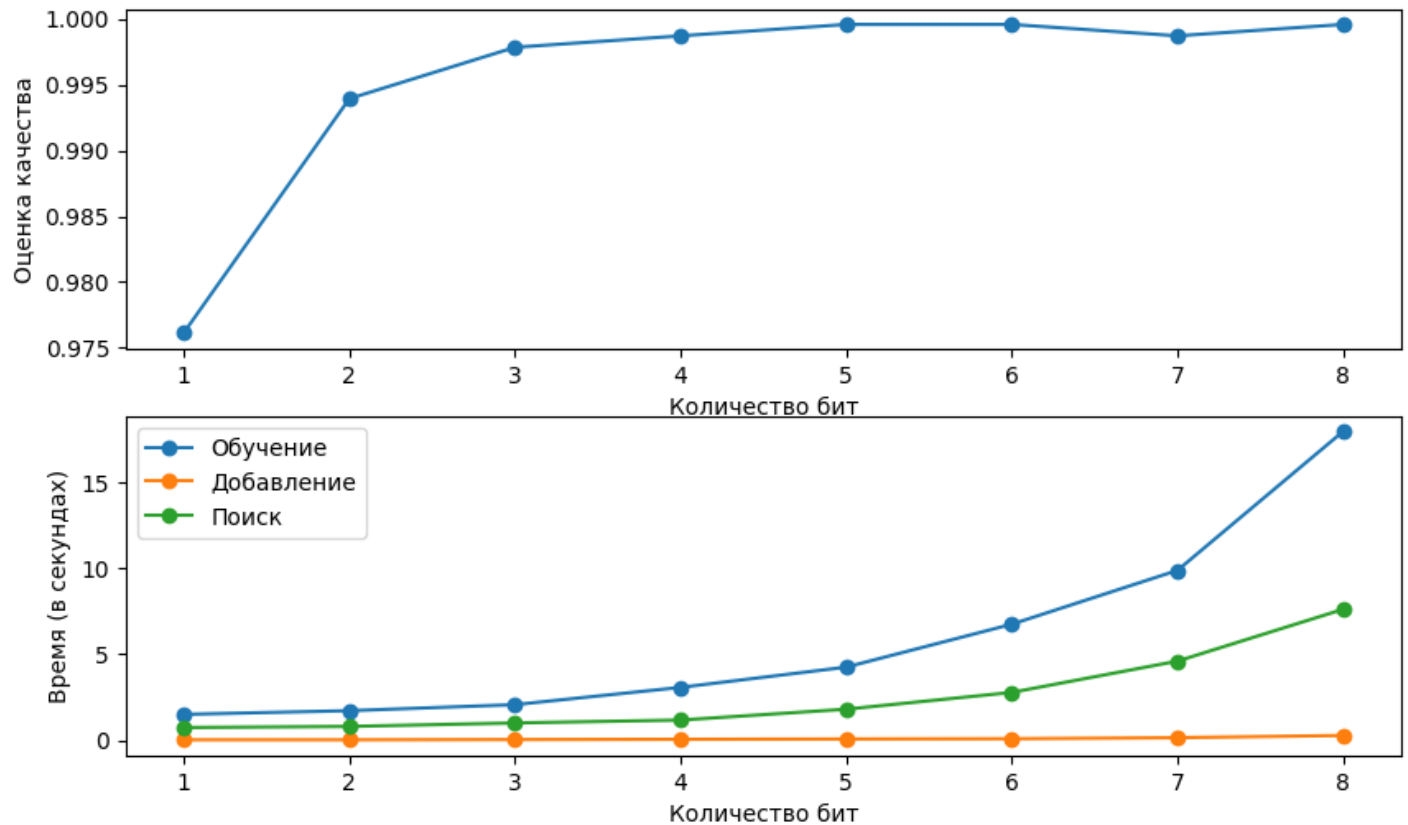
```
n_bits = 6
Train time: 6.73 seconds
Addition time: 0.08 seconds
        nprobe = 90
        Search time: 2.77 seconds Precision: 0.9995663486556808 Memory: 1.05222 MB
n_bits = 7
Train time: 9.86 seconds
Addition time: 0.14 seconds
        nprobe = 90
        Search time: 4.59 seconds Precision: 0.9986990459670425 Memory: 1.268044 MB
n_bits = 8
Train time: 17.93 seconds
Addition time: 0.27 seconds
        nprobe = 90
        Search time: 7.60 seconds Precision: 0.9995663486556808 Memory: 1.61494 MB
```



```
Train time: 4.12 seconds
Addition time: 0.08 seconds
        nprobe = 90
        Search time: 1.76 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
Find optim params report:
{'train_time': 4.119032382965088, 'add_time': 0.07810568809509277, 'precision': 0.99956634
86556808, 'search_time': 1.7608540058135986, 'nprobe': 90, 'memory_size': 0.901932, 'n_lis
t': 180, 'n_subquantizers': 128, 'n_bits': 5}
---------------
Iteration #3
Finding optim parameters
Initial values: n_bits=5 n_subquantizers=128
n_list = 20
Train time: 4.19 seconds
Addition time: 0.05 seconds
        nprobe = 2
        Search time: 0.23 seconds Precision: 0.9440589765828274 Memory: 0.572972 MB
        nprobe = 4
        Search time: 0.41 seconds Precision: 0.9835212489158717 Memory: 0.572972 MB
        nprobe = 6
        Search time: 0.61 seconds Precision: 0.9930615784908933 Memory: 0.572972 MB
        nprobe = 8
        Search time: 0.71 seconds Precision: 0.9965307892454467 Memory: 0.572972 MB
        nprobe = 10
```

```
              Search time: 0.83 seconds Precision: 0.997398091934085 Memory: 0.572972 MB
              nprobe = 12
              Search time: 0.97 seconds Precision: 0.9978317432784042 Memory: 0.572972 MB
              nprobe = 14
              Search time: 1.15 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
              nprobe = 16
              Search time: 1.25 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
              nprobe = 18
              Search time: 1.35 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
              nprobe = 20
              Search time: 1.53 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
       ----------
       The highest precision: 0.99870 (nprobe=14)
       The smallest memory size: 0.572972 MB (nprobe=2)
       The fastest search: 0.23seconds (nprobe=2)
       ----------
       n_list = 40
       Train time: 4.09 seconds
       Addition time: 0.06 seconds
              nprobe = 4
              Search time: 0.28 seconds Precision: 0.9770164787510841 Memory: 0.614092 MB
              nprobe = 8
              Search time: 0.44 seconds Precision: 0.9939288811795317 Memory: 0.614092 MB
              nprobe = 12
              Search time: 0.70 seconds Precision: 0.9965307892454467 Memory: 0.614092 MB
              nprobe = 16
              Search time: 0.82 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
              nprobe = 20
              Search time: 1.04 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
              nprobe = 24
              Search time: 1.23 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
              nprobe = 28
              Search time: 1.29 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
              nprobe = 32
              Search time: 1.46 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
              nprobe = 36
              Search time: 1.62 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
              nprobe = 40
              Search time: 1.81 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
       ----------
       The highest precision: 0.99870 (nprobe=16)
       The smallest memory size: 0.614092 MB (nprobe=4)
       The fastest search: 0.28seconds (nprobe=4)
       ----------
       n_list = 60
       Train time: 4.15 seconds
       Addition time: 0.06 seconds
              nprobe = 6
              Search time: 0.35 seconds Precision: 0.9848222029488292 Memory: 0.655212 MB
              nprobe = 12
              Search time: 0.48 seconds Precision: 0.9930615784908933 Memory: 0.655212 MB
              nprobe = 18
              Search time: 0.64 seconds Precision: 0.99479618386817 Memory: 0.655212 MB
              nprobe = 24
              Search time: 0.81 seconds Precision: 0.9969644405897659 Memory: 0.655212 MB
              nprobe = 30
              Search time: 1.11 seconds Precision: 0.9978317432784042 Memory: 0.655212 MB
              nprobe = 36
              Search time: 1.27 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
              nprobe = 42
              Search time: 1.46 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
              nprobe = 48
              Search time: 1.58 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
              nprobe = 54
              Search time: 1.87 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
              nprobe = 60
```

```
            Search time: 2.05 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
----------
The highest precision: 0.99870 (nprobe=36)
The smallest memory size: 0.655212 MB (nprobe=6)
The fastest search: 0.35seconds (nprobe=6)
----------
n_list = 80
Train time: 4.22 seconds
Addition time: 0.06 seconds
        nprobe = 8
        Search time: 0.42 seconds Precision: 0.9874241110147441 Memory: 0.696332 MB
        nprobe = 16
        Search time: 0.56 seconds Precision: 0.9956634865568084 Memory: 0.696332 MB
        nprobe = 24
        Search time: 0.80 seconds Precision: 0.9969644405897659 Memory: 0.696332 MB
        nprobe = 32
        Search time: 0.95 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 40
        Search time: 1.25 seconds Precision: 0.9978317432784042 Memory: 0.696332 MB
        nprobe = 48
        Search time: 1.38 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 56
        Search time: 1.66 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 64
        Search time: 1.87 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 72
        Search time: 1.98 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
        nprobe = 80
        Search time: 2.29 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
----------
The highest precision: 0.99827 (nprobe=32)
The smallest memory size: 0.696332 MB (nprobe=8)
The fastest search: 0.42seconds (nprobe=8)
----------
n_list = 100
Train time: 4.04 seconds
Addition time: 0.06 seconds
        nprobe = 10
        Search time: 0.37 seconds Precision: 0.9874241110147441 Memory: 0.737452 MB
        nprobe = 20
        Search time: 0.59 seconds Precision: 0.9943625325238509 Memory: 0.737452 MB
        nprobe = 30
        Search time: 0.87 seconds Precision: 0.997398091934085 Memory: 0.737452 MB
        nprobe = 40
        Search time: 1.07 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 50
        Search time: 1.36 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 60
        Search time: 1.57 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 70
        Search time: 1.77 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 80
        Search time: 1.94 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 90
        Search time: 2.19 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
        nprobe = 100
        Search time: 2.40 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
----------
The highest precision: 0.99870 (nprobe=40)
The smallest memory size: 0.737452 MB (nprobe=10)
The fastest search: 0.37seconds (nprobe=10)
----------
n_list = 120
Train time: 4.08 seconds
Addition time: 0.05 seconds
        nprobe = 12
```

```
        Search time: 0.37 seconds Precision: 0.9900260190806591 Memory: 0.778572 MB
        nprobe = 24
        Search time: 0.65 seconds Precision: 0.9952298352124892 Memory: 0.778572 MB
        nprobe = 36
        Search time: 0.88 seconds Precision: 0.997398091934085 Memory: 0.778572 MB
        nprobe = 48
        Search time: 1.17 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 60
        Search time: 1.43 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 72
        Search time: 1.73 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 84
        Search time: 1.89 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 96
        Search time: 2.15 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 108
        Search time: 2.45 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        nprobe = 120
        Search time: 2.74 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
----------
The highest precision: 0.99827 (nprobe=48)
The smallest memory size: 0.778572 MB (nprobe=12)
The fastest search: 0.37seconds (nprobe=12)
----------
n_list = 140
Train time: 4.21 seconds
Addition time: 0.05 seconds
        nprobe = 14
        Search time: 0.52 seconds Precision: 0.9908933217692975 Memory: 0.819692 MB
        nprobe = 28
        Search time: 0.72 seconds Precision: 0.9952298352124892 Memory: 0.819692 MB
        nprobe = 42
        Search time: 0.95 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
        nprobe = 56
        Search time: 1.26 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
        nprobe = 70
        Search time: 1.58 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
        nprobe = 84
        Search time: 1.82 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
        nprobe = 98
        Search time: 2.11 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
        nprobe = 112
        Search time: 2.58 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
        nprobe = 126
        Search time: 2.73 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
        nprobe = 140
        Search time: 3.07 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
----------
The highest precision: 0.99870 (nprobe=56)
The smallest memory size: 0.819692 MB (nprobe=14)
The fastest search: 0.52seconds (nprobe=14)
----------
n_list = 160
Train time: 4.28 seconds
Addition time: 0.06 seconds
        nprobe = 16
        Search time: 0.47 seconds Precision: 0.9939288811795317 Memory: 0.860812 MB
        nprobe = 32
        Search time: 0.80 seconds Precision: 0.9969644405897659 Memory: 0.860812 MB
        nprobe = 48
        Search time: 1.10 seconds Precision: 0.9982653946227233 Memory: 0.860812 MB
        nprobe = 64
        Search time: 1.41 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
        nprobe = 80
        Search time: 1.73 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
        nprobe = 96
```

```
            Search time: 2.05 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
            nprobe = 112
            Search time: 2.40 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
            nprobe = 128
            Search time: 2.64 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
            nprobe = 144
            Search time: 2.88 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
            nprobe = 160
            Search time: 3.22 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
    ----------
    The highest precision: 0.99913 (nprobe=112)
    The smallest memory size: 0.860812 MB (nprobe=16)
    The fastest search: 0.47seconds (nprobe=16)
    ----------
    n_list = 180
    Train time: 4.16 seconds
    Addition time: 0.06 seconds
            nprobe = 18
            Search time: 0.50 seconds Precision: 0.99479618386817 Memory: 0.901932 MB
            nprobe = 36
            Search time: 0.77 seconds Precision: 0.997398091934085 Memory: 0.901932 MB
            nprobe = 54
            Search time: 1.13 seconds Precision: 0.9986990459670425 Memory: 0.901932 MB
            nprobe = 72
            Search time: 1.48 seconds Precision: 0.9991326973113617 Memory: 0.901932 MB
            nprobe = 90
            Search time: 1.77 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 108
            Search time: 2.09 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 126
            Search time: 2.39 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 144
            Search time: 2.70 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 162
            Search time: 3.05 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
            nprobe = 180
            Search time: 3.32 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
    ----------
    The highest precision: 0.99957 (nprobe=90)
    The smallest memory size: 0.901932 MB (nprobe=18)
    The fastest search: 0.50seconds (nprobe=18)
    ----------
    n_list = 200
    Train time: 4.22 seconds
    Addition time: 0.08 seconds
            nprobe = 20
            Search time: 0.44 seconds Precision: 0.9960971379011275 Memory: 0.943052 MB
            nprobe = 40
            Search time: 0.89 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
            nprobe = 60
            Search time: 1.29 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
            nprobe = 80
            Search time: 1.52 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 100
            Search time: 1.92 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 120
            Search time: 2.49 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 140
            Search time: 2.97 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 160
            Search time: 3.28 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 180
            Search time: 3.79 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 200
            Search time: 4.11 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
    ----------
```

```
        The highest precision: 0.99827 (nprobe=80)
        The smallest memory size: 0.943052 MB (nprobe=20)
        The fastest search: 0.44seconds (nprobe=20)
        ----------
        n_list = 220
        Train time: 4.72 seconds
        Addition time: 0.09 seconds
               nprobe = 22
               Search time: 0.62 seconds Precision: 0.9952298352124892 Memory: 0.984172 MB
               nprobe = 44
               Search time: 1.04 seconds Precision: 0.997398091934085 Memory: 0.984172 MB
               nprobe = 66
               Search time: 1.39 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
               nprobe = 88
               Search time: 1.85 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
               nprobe = 110
               Search time: 2.27 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
               nprobe = 132
               Search time: 2.72 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
               nprobe = 154
               Search time: 3.03 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
               nprobe = 176
               Search time: 3.54 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
               nprobe = 198
               Search time: 3.93 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
               nprobe = 220
               Search time: 4.41 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        ----------
        The highest precision: 0.99827 (nprobe=66)
        The smallest memory size: 0.984172 MB (nprobe=22)
        The fastest search: 0.62seconds (nprobe=22)
        ----------
        n_list = 240
        Train time: 4.85 seconds
        Addition time: 0.08 seconds
               nprobe = 24
               Search time: 0.70 seconds Precision: 0.9952298352124892 Memory: 1.025292 MB
               nprobe = 48
               Search time: 1.04 seconds Precision: 0.9978317432784042 Memory: 1.025292 MB
               nprobe = 72
               Search time: 1.60 seconds Precision: 0.9982653946227233 Memory: 1.025292 MB
               nprobe = 96
               Search time: 2.15 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
               nprobe = 120
               Search time: 2.44 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
               nprobe = 144
               Search time: 2.49 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
               nprobe = 168
               Search time: 3.00 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
               nprobe = 192
               Search time: 3.25 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
               nprobe = 216
               Search time: 3.62 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
               nprobe = 240
               Search time: 3.92 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        ----------
        The highest precision: 0.99913 (nprobe=144)
        The smallest memory size: 1.025292 MB (nprobe=24)
        The fastest search: 0.70seconds (nprobe=24)
        ----------
        n_list = 260
        Train time: 4.20 seconds
        Addition time: 0.06 seconds
               nprobe = 26
               Search time: 0.56 seconds Precision: 0.9956634865568084 Memory: 1.066412 MB
               nprobe = 52
```

```
              Search time: 0.90 seconds Precision: 0.9969644405897659 Memory: 1.066412 MB
              nprobe = 78
              Search time: 1.41 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
              nprobe = 104
              Search time: 1.82 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
              nprobe = 130
              Search time: 2.20 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
              nprobe = 156
              Search time: 2.73 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
              nprobe = 182
              Search time: 3.08 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
              nprobe = 208
              Search time: 3.43 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
              nprobe = 234
              Search time: 3.83 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
              nprobe = 260
              Search time: 4.21 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
       ----------
       The highest precision: 0.99783 (nprobe=78)
       The smallest memory size: 1.066412 MB (nprobe=26)
       The fastest search: 0.56seconds (nprobe=26)
       ----------
       n_list = 280
       Train time: 4.20 seconds
       Addition time: 0.06 seconds
              nprobe = 28
              Search time: 0.50 seconds Precision: 0.9960971379011275 Memory: 1.107532 MB
              nprobe = 56
              Search time: 0.94 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
              nprobe = 84
              Search time: 1.42 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
              nprobe = 112
              Search time: 1.87 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
              nprobe = 140
              Search time: 2.34 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
              nprobe = 168
              Search time: 2.71 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
              nprobe = 196
              Search time: 3.15 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
              nprobe = 224
              Search time: 3.61 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
              nprobe = 252
              Search time: 4.08 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
              nprobe = 280
              Search time: 4.49 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
       ----------
       The highest precision: 0.99913 (nprobe=56)
       The smallest memory size: 1.107532 MB (nprobe=28)
       The fastest search: 0.50seconds (nprobe=28)
       ----------
       n_list = 300
       Train time: 4.57 seconds
       Addition time: 0.06 seconds
              nprobe = 30
              Search time: 0.60 seconds Precision: 0.9965307892454467 Memory: 1.148652 MB
              nprobe = 60
              Search time: 1.01 seconds Precision: 0.9982653946227233 Memory: 1.148652 MB
              nprobe = 90
              Search time: 1.53 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
              nprobe = 120
              Search time: 2.07 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
              nprobe = 150
              Search time: 2.50 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
              nprobe = 180
              Search time: 2.96 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
              nprobe = 210
```
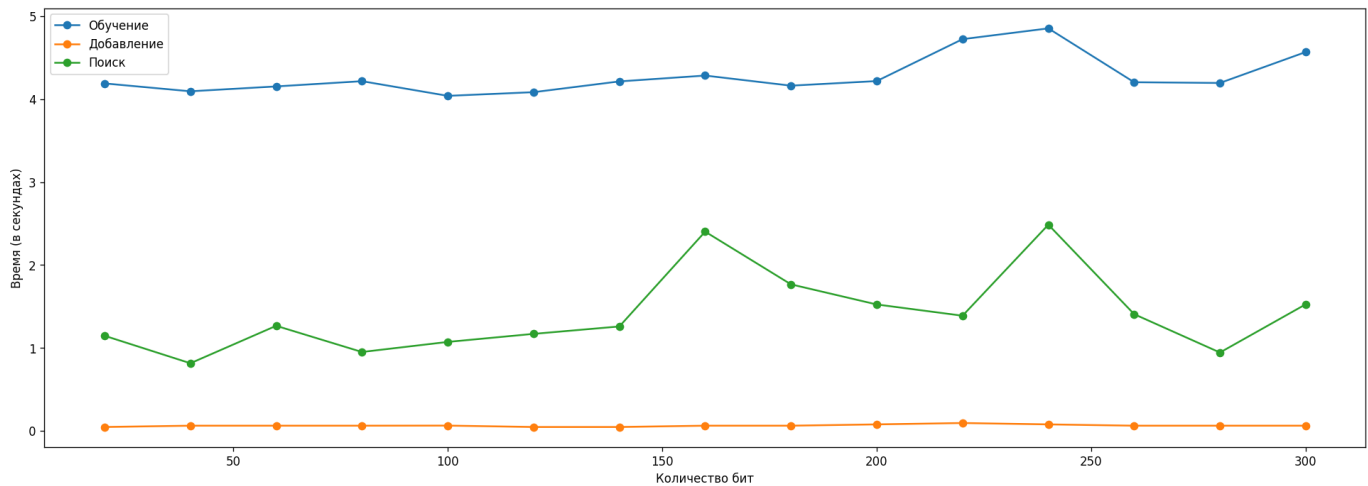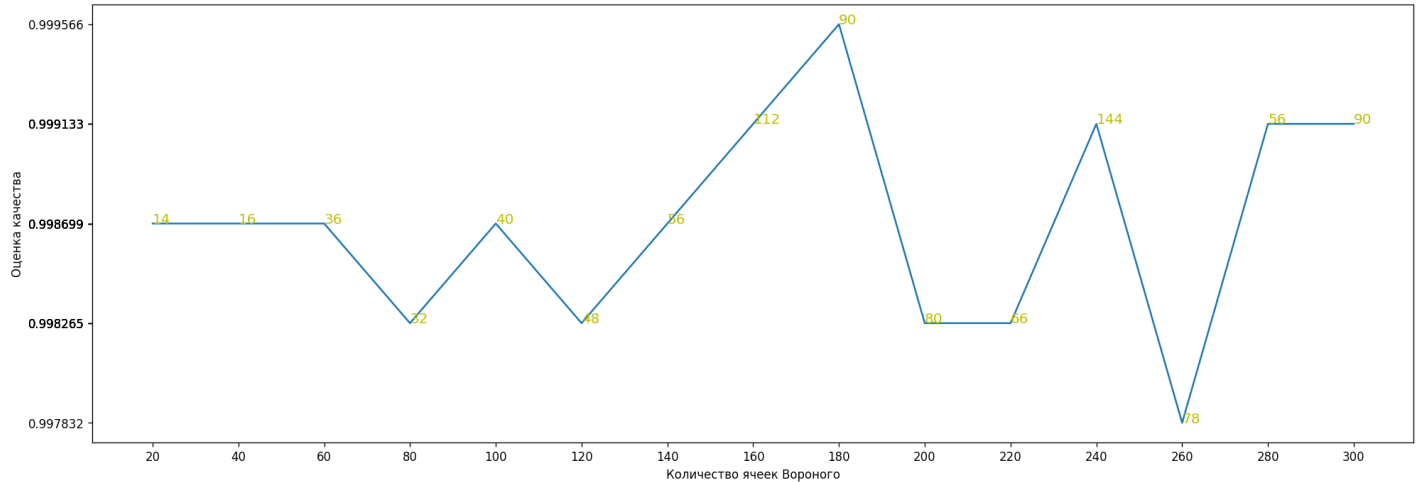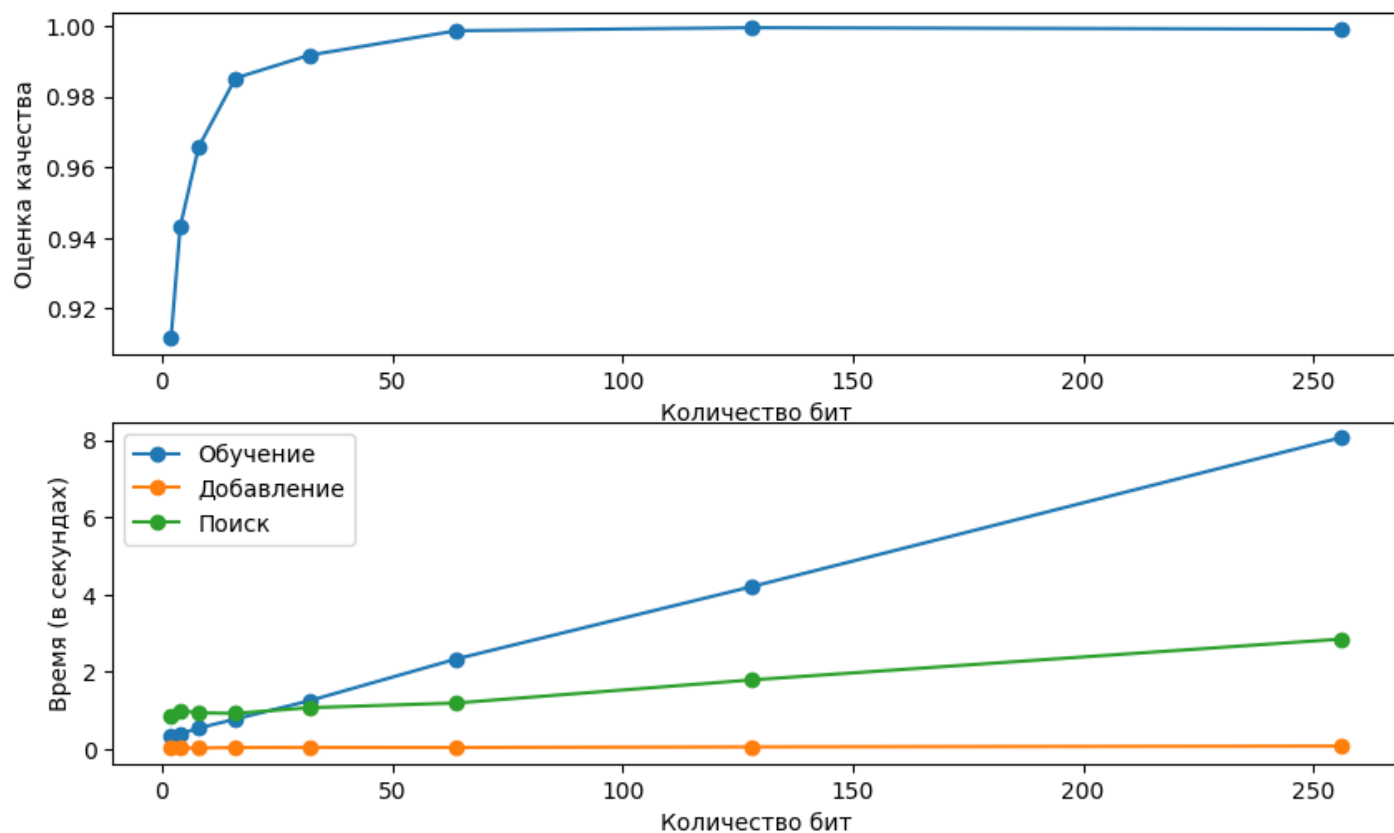
        Search time: 3.36 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 240
        Search time: 3.71 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 270
        Search time: 4.27 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 300
        Search time: 4.70 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB

The highest precision: 0.99913 (nprobe=90)
The smallest memory size: 1.148652 MB (nprobe=30)
The fastest search: 0.60seconds (nprobe=30)
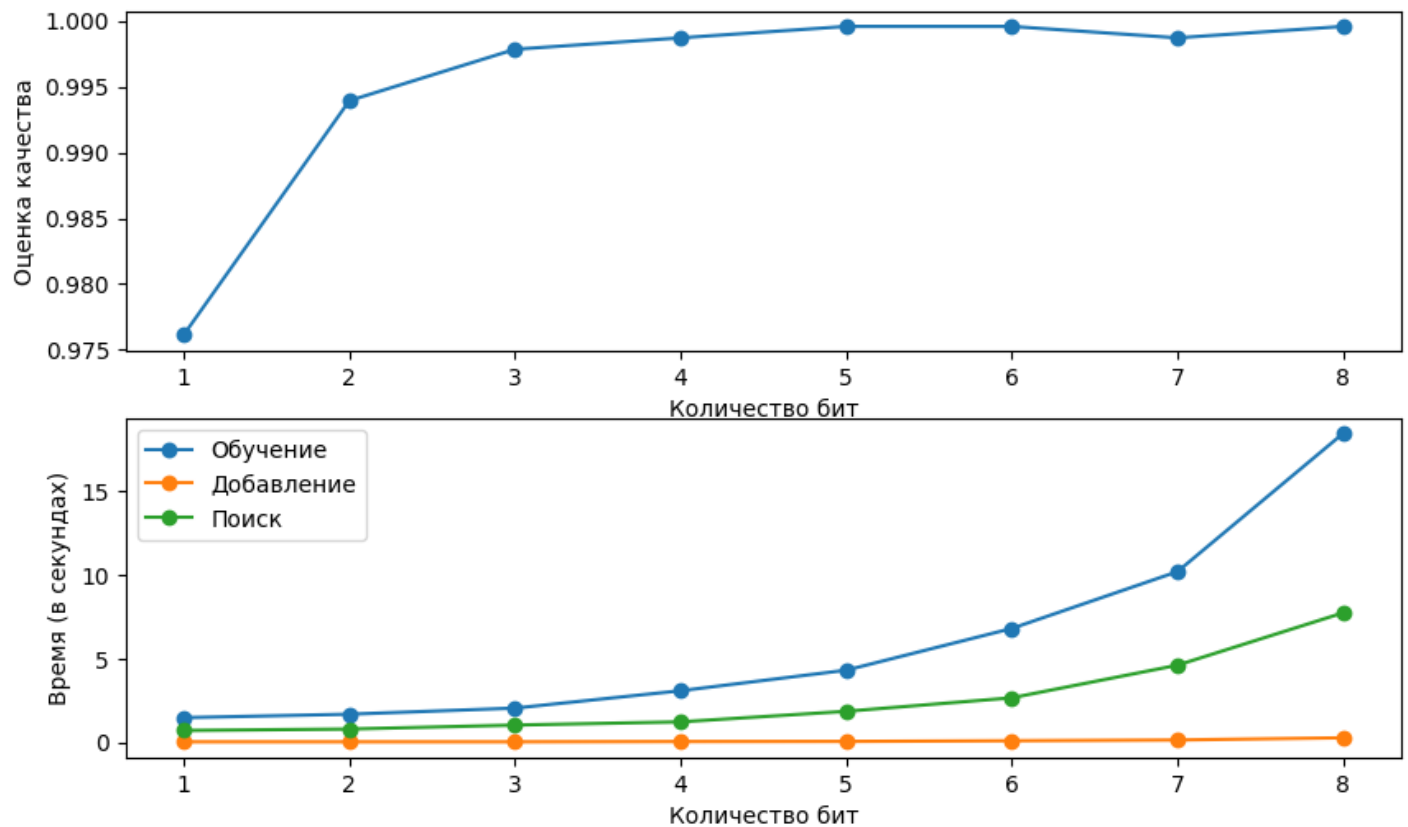----------

n_subquantizers = 2
Train time: 0.33 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.88 seconds Precision: 0.9115351257588898 Memory: 0.488766 MB
n_subquantizers = 4
Train time: 0.40 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.00 seconds Precision: 0.9431916738941891 Memory: 0.494063 MB
n_subquantizers = 8
Train time: 0.55 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.94 seconds Precision: 0.9657415437987857 Memory: 0.504657 MB
n_subquantizers = 16
Train time: 0.78 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 0.93 seconds Precision: 0.9852558542931483 Memory: 0.531142 MB
n_subquantizers = 32

```
Train time: 1.25 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.08 seconds Precision: 0.9917606244579358 Memory: 0.584112 MB
n_subquantizers = 64
Train time: 2.34 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.20 seconds Precision: 0.9986990459670425 Memory: 0.690052 MB
n_subquantizers = 128
Train time: 4.20 seconds
Addition time: 0.06 seconds
        nprobe = 90
        Search time: 1.79 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
n_subquantizers = 256
Train time: 8.06 seconds
Addition time: 0.08 seconds
        nprobe = 90
        Search time: 2.85 seconds Precision: 0.9991326973113617 Memory: 1.325692 MB
```



```
n_bits = 1
Train time: 1.48 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.71 seconds Precision: 0.9761491760624458 Memory: 0.501484 MB
n_bits = 2
Train time: 1.68 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.79 seconds Precision: 0.9939288811795317 Memory: 0.590332 MB
n_bits = 3
Train time: 2.05 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.03 seconds Precision: 0.9978317432784042 Memory: 0.683276 MB
n_bits = 4
Train time: 3.08 seconds
Addition time: 0.05 seconds
        nprobe = 90
```

         Search time: 1.22 seconds Precision: 0.9986990459670425 Memory: 0.784412 MB
n_bits = 5
Train time: 4.31 seconds
Addition time: 0.05 seconds
         nprobe = 90
         Search time: 1.85 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
n_bits = 6
Train time: 6.81 seconds
Addition time: 0.09 seconds
         nprobe = 90
         Search time: 2.66 seconds Precision: 0.9995663486556808 Memory: 1.05222 MB
n_bits = 7
Train time: 10.21 seconds
Addition time: 0.14 seconds
         nprobe = 90
         Search time: 4.61 seconds Precision: 0.9986990459670425 Memory: 1.268044 MB
n_bits = 8
Train time: 18.47 seconds
Addition time: 0.27 seconds
         nprobe = 90
         Search time: 7.74 seconds Precision: 0.9995663486556808 Memory: 1.61494 MB

Train time: 4.33 seconds
Addition time: 0.05 seconds
         nprobe = 90
         Search time: 1.73 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
Find optim params report:
{'train_time': 4.333058595657349, 'add_time': 0.04686260223388672, 'precision': 0.99956634
86556808, 'search_time': 1.7345085144042969, 'nprobe': 90, 'memory_size': 0.901932, 'n_lis
t': 180, 'n_subquantizers': 128, 'n_bits': 5}

Iteration #4
Finding optim parameters
Initial values: n_bits=5 n_subquantizers=128
n_list = 20
Train time: 4.06 seconds
Addition time: 0.05 seconds
         nprobe = 2
         Search time: 0.22 seconds Precision: 0.9440589765828274 Memory: 0.572972 MB
         nprobe = 4

```
            Search time: 0.38 seconds Precision: 0.9835212489158717 Memory: 0.572972 MB
            nprobe = 6
            Search time: 0.53 seconds Precision: 0.9930615784908933 Memory: 0.572972 MB
            nprobe = 8
            Search time: 0.73 seconds Precision: 0.9965307892454467 Memory: 0.572972 MB
            nprobe = 10
            Search time: 0.81 seconds Precision: 0.997398091934085 Memory: 0.572972 MB
            nprobe = 12
            Search time: 0.95 seconds Precision: 0.9978317432784042 Memory: 0.572972 MB
            nprobe = 14
            Search time: 1.08 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
            nprobe = 16
            Search time: 1.28 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
            nprobe = 18
            Search time: 1.36 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
            nprobe = 20
            Search time: 1.50 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
----------
The highest precision: 0.99870 (nprobe=14)
The smallest memory size: 0.572972 MB (nprobe=2)
The fastest search: 0.22seconds (nprobe=2)
----------
n_list = 40
Train time: 4.11 seconds
Addition time: 0.05 seconds
            nprobe = 4
            Search time: 0.35 seconds Precision: 0.9770164787510841 Memory: 0.614092 MB
            nprobe = 8
            Search time: 0.46 seconds Precision: 0.9939288811795317 Memory: 0.614092 MB
            nprobe = 12
            Search time: 0.61 seconds Precision: 0.9965307892454467 Memory: 0.614092 MB
            nprobe = 16
            Search time: 0.79 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
            nprobe = 20
            Search time: 0.94 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
            nprobe = 24
            Search time: 1.10 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
            nprobe = 28
            Search time: 1.23 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
            nprobe = 32
            Search time: 1.49 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
            nprobe = 36
            Search time: 1.64 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
            nprobe = 40
            Search time: 1.75 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
----------
The highest precision: 0.99870 (nprobe=16)
The smallest memory size: 0.614092 MB (nprobe=4)
The fastest search: 0.35seconds (nprobe=4)
----------
n_list = 60
Train time: 4.29 seconds
Addition time: 0.06 seconds
            nprobe = 6
            Search time: 0.29 seconds Precision: 0.9848222029488292 Memory: 0.655212 MB
            nprobe = 12
            Search time: 0.50 seconds Precision: 0.9930615784908933 Memory: 0.655212 MB
            nprobe = 18
            Search time: 0.74 seconds Precision: 0.99479618386817 Memory: 0.655212 MB
            nprobe = 24
            Search time: 0.86 seconds Precision: 0.9969644405897659 Memory: 0.655212 MB
            nprobe = 30
            Search time: 1.06 seconds Precision: 0.9978317432784042 Memory: 0.655212 MB
            nprobe = 36
            Search time: 1.25 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
            nprobe = 42
```

```
            Search time: 1.47 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
            nprobe = 48
            Search time: 1.70 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
            nprobe = 54
            Search time: 1.83 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
            nprobe = 60
            Search time: 2.12 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
    ----------
    The highest precision: 0.99870 (nprobe=36)
    The smallest memory size: 0.655212 MB (nprobe=6)
    The fastest search: 0.29seconds (nprobe=6)
    ----------
    n_list = 80
    Train time: 4.26 seconds
    Addition time: 0.06 seconds
            nprobe = 8
            Search time: 0.37 seconds Precision: 0.9874241110147441 Memory: 0.696332 MB
            nprobe = 16
            Search time: 0.61 seconds Precision: 0.9956634865568084 Memory: 0.696332 MB
            nprobe = 24
            Search time: 0.83 seconds Precision: 0.9969644405897659 Memory: 0.696332 MB
            nprobe = 32
            Search time: 0.95 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
            nprobe = 40
            Search time: 1.19 seconds Precision: 0.9978317432784042 Memory: 0.696332 MB
            nprobe = 48
            Search time: 1.48 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
            nprobe = 56
            Search time: 1.63 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
            nprobe = 64
            Search time: 1.86 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
            nprobe = 72
            Search time: 2.11 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
            nprobe = 80
            Search time: 2.29 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
    ----------
    The highest precision: 0.99827 (nprobe=32)
    The smallest memory size: 0.696332 MB (nprobe=8)
    The fastest search: 0.37seconds (nprobe=8)
    ----------
    n_list = 100
    Train time: 4.27 seconds
    Addition time: 0.06 seconds
            nprobe = 10
            Search time: 0.31 seconds Precision: 0.9874241110147441 Memory: 0.737452 MB
            nprobe = 20
            Search time: 0.65 seconds Precision: 0.9943625325238509 Memory: 0.737452 MB
            nprobe = 30
            Search time: 0.87 seconds Precision: 0.997398091934085 Memory: 0.737452 MB
            nprobe = 40
            Search time: 1.10 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
            nprobe = 50
            Search time: 1.30 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
            nprobe = 60
            Search time: 1.61 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
            nprobe = 70
            Search time: 1.87 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
            nprobe = 80
            Search time: 2.30 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
            nprobe = 90
            Search time: 2.73 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
            nprobe = 100
            Search time: 2.84 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
    ----------
    The highest precision: 0.99870 (nprobe=40)
    The smallest memory size: 0.737452 MB (nprobe=10)
```

```
        The fastest search: 0.31seconds (nprobe=10)
        ----------
        n_list = 120
        Train time: 4.91 seconds
        Addition time: 0.08 seconds
                nprobe = 12
                Search time: 0.47 seconds Precision: 0.9900260190806591 Memory: 0.778572 MB
                nprobe = 24
                Search time: 0.71 seconds Precision: 0.9952298352124892 Memory: 0.778572 MB
                nprobe = 36
                Search time: 1.07 seconds Precision: 0.997398091934085 Memory: 0.778572 MB
                nprobe = 48
                Search time: 1.32 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
                nprobe = 60
                Search time: 1.65 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
                nprobe = 72
                Search time: 1.93 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
                nprobe = 84
                Search time: 2.28 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
                nprobe = 96
                Search time: 2.56 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
                nprobe = 108
                Search time: 2.90 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
                nprobe = 120
                Search time: 3.23 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
        ----------
        The highest precision: 0.99827 (nprobe=48)
        The smallest memory size: 0.778572 MB (nprobe=12)
        The fastest search: 0.47seconds (nprobe=12)
        ----------
        n_list = 140
        Train time: 4.53 seconds
        Addition time: 0.06 seconds
                nprobe = 14
                Search time: 0.44 seconds Precision: 0.9908933217692975 Memory: 0.819692 MB
                nprobe = 28
                Search time: 0.75 seconds Precision: 0.9952298352124892 Memory: 0.819692 MB
                nprobe = 42
                Search time: 1.02 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
                nprobe = 56
                Search time: 1.43 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
                nprobe = 70
                Search time: 1.56 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
                nprobe = 84
                Search time: 1.93 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
                nprobe = 98
                Search time: 2.16 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
                nprobe = 112
                Search time: 2.41 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
                nprobe = 126
                Search time: 2.73 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
                nprobe = 140
                Search time: 3.00 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
        ----------
        The highest precision: 0.99870 (nprobe=56)
        The smallest memory size: 0.819692 MB (nprobe=14)
        The fastest search: 0.44seconds (nprobe=14)
        ----------
        n_list = 160
        Train time: 4.45 seconds
        Addition time: 0.06 seconds
                nprobe = 16
                Search time: 0.40 seconds Precision: 0.9939288811795317 Memory: 0.860812 MB
                nprobe = 32
                Search time: 0.83 seconds Precision: 0.9969644405897659 Memory: 0.860812 MB
                nprobe = 48
```

```
           Search time: 1.10 seconds Precision: 0.9982653946227233 Memory: 0.860812 MB
           nprobe = 64
           Search time: 1.40 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
           nprobe = 80
           Search time: 1.70 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
           nprobe = 96
           Search time: 1.96 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
           nprobe = 112
           Search time: 2.30 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
           nprobe = 128
           Search time: 2.62 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
           nprobe = 144
           Search time: 2.90 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
           nprobe = 160
           Search time: 3.26 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
        ----------
        The highest precision: 0.99913 (nprobe=112)
        The smallest memory size: 0.860812 MB (nprobe=16)
        The fastest search: 0.40seconds (nprobe=16)
        ----------
        n_list = 180
        Train time: 4.41 seconds
        Addition time: 0.06 seconds
           nprobe = 18
           Search time: 0.43 seconds Precision: 0.99479618386817 Memory: 0.901932 MB
           nprobe = 36
           Search time: 0.77 seconds Precision: 0.997398091934085 Memory: 0.901932 MB
           nprobe = 54
           Search time: 1.08 seconds Precision: 0.9986990459670425 Memory: 0.901932 MB
           nprobe = 72
           Search time: 1.41 seconds Precision: 0.9991326973113617 Memory: 0.901932 MB
           nprobe = 90
           Search time: 1.78 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
           nprobe = 108
           Search time: 2.09 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
           nprobe = 126
           Search time: 2.51 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
           nprobe = 144
           Search time: 2.79 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
           nprobe = 162
           Search time: 3.14 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
           nprobe = 180
           Search time: 3.44 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        ----------
        The highest precision: 0.99957 (nprobe=90)
        The smallest memory size: 0.901932 MB (nprobe=18)
        The fastest search: 0.43seconds (nprobe=18)
        ----------
        n_list = 200
        Train time: 4.40 seconds
        Addition time: 0.06 seconds
           nprobe = 20
           Search time: 0.54 seconds Precision: 0.9960971379011275 Memory: 0.943052 MB
           nprobe = 40
           Search time: 0.79 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
           nprobe = 60
           Search time: 1.21 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
           nprobe = 80
           Search time: 1.61 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
           nprobe = 100
           Search time: 1.87 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
           nprobe = 120
           Search time: 2.14 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
           nprobe = 140
           Search time: 2.50 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
           nprobe = 160
```

```
        Search time: 2.86 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        nprobe = 180
        Search time: 3.27 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        nprobe = 200
        Search time: 3.60 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
----------
The highest precision: 0.99827 (nprobe=80)
The smallest memory size: 0.943052 MB (nprobe=20)
The fastest search: 0.54seconds (nprobe=20)
----------
n_list = 220
Train time: 4.65 seconds
Addition time: 0.08 seconds
        nprobe = 22
        Search time: 0.48 seconds Precision: 0.9952298352124892 Memory: 0.984172 MB
        nprobe = 44
        Search time: 0.94 seconds Precision: 0.997398091934085 Memory: 0.984172 MB
        nprobe = 66
        Search time: 1.44 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 88
        Search time: 1.76 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 110
        Search time: 2.23 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 132
        Search time: 2.57 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 154
        Search time: 2.97 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 176
        Search time: 3.41 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 198
        Search time: 3.82 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        nprobe = 220
        Search time: 4.08 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
----------
The highest precision: 0.99827 (nprobe=66)
The smallest memory size: 0.984172 MB (nprobe=22)
The fastest search: 0.48seconds (nprobe=22)
----------
n_list = 240
Train time: 4.87 seconds
Addition time: 0.08 seconds
        nprobe = 24
        Search time: 0.52 seconds Precision: 0.9952298352124892 Memory: 1.025292 MB
        nprobe = 48
        Search time: 1.15 seconds Precision: 0.9978317432784042 Memory: 1.025292 MB
        nprobe = 72
        Search time: 1.40 seconds Precision: 0.9982653946227233 Memory: 1.025292 MB
        nprobe = 96
        Search time: 1.94 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
        nprobe = 120
        Search time: 2.39 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
        nprobe = 144
        Search time: 2.63 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        nprobe = 168
        Search time: 3.01 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        nprobe = 192
        Search time: 3.32 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        nprobe = 216
        Search time: 3.69 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
        nprobe = 240
        Search time: 4.09 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
----------
The highest precision: 0.99913 (nprobe=144)
The smallest memory size: 1.025292 MB (nprobe=24)
The fastest search: 0.52seconds (nprobe=24)
----------
```

```
            n_list = 260
            Train time: 4.38 seconds
            Addition time: 0.06 seconds
                    nprobe = 26
                    Search time: 0.49 seconds Precision: 0.9956634865568084 Memory: 1.066412 MB
                    nprobe = 52
                    Search time: 0.91 seconds Precision: 0.9969644405897659 Memory: 1.066412 MB
                    nprobe = 78
                    Search time: 1.35 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                    nprobe = 104
                    Search time: 1.90 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                    nprobe = 130
                    Search time: 2.22 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                    nprobe = 156
                    Search time: 2.62 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                    nprobe = 182
                    Search time: 2.92 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                    nprobe = 208
                    Search time: 3.40 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                    nprobe = 234
                    Search time: 3.82 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
                    nprobe = 260
                    Search time: 4.32 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        ----------
      The highest precision: 0.99783 (nprobe=78)
      The smallest memory size: 1.066412 MB (nprobe=26)
      The fastest search: 0.49seconds (nprobe=26)
        ----------
      n_list = 280
      Train time: 4.69 seconds
      Addition time: 0.06 seconds
                    nprobe = 28
                    Search time: 0.57 seconds Precision: 0.9960971379011275 Memory: 1.107532 MB
                    nprobe = 56
                    Search time: 1.04 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                    nprobe = 84
                    Search time: 1.46 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                    nprobe = 112
                    Search time: 1.93 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                    nprobe = 140
                    Search time: 2.44 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                    nprobe = 168
                    Search time: 2.89 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                    nprobe = 196
                    Search time: 3.38 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                    nprobe = 224
                    Search time: 3.65 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                    nprobe = 252
                    Search time: 4.13 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
                    nprobe = 280
                    Search time: 4.56 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        ----------
      The highest precision: 0.99913 (nprobe=56)
      The smallest memory size: 1.107532 MB (nprobe=28)
      The fastest search: 0.57seconds (nprobe=28)
        ----------
      n_list = 300
      Train time: 4.29 seconds
      Addition time: 0.06 seconds
                    nprobe = 30
                    Search time: 0.60 seconds Precision: 0.9965307892454467 Memory: 1.148652 MB
                    nprobe = 60
                    Search time: 1.09 seconds Precision: 0.9982653946227233 Memory: 1.148652 MB
                    nprobe = 90
                    Search time: 1.53 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
                    nprobe = 120
```
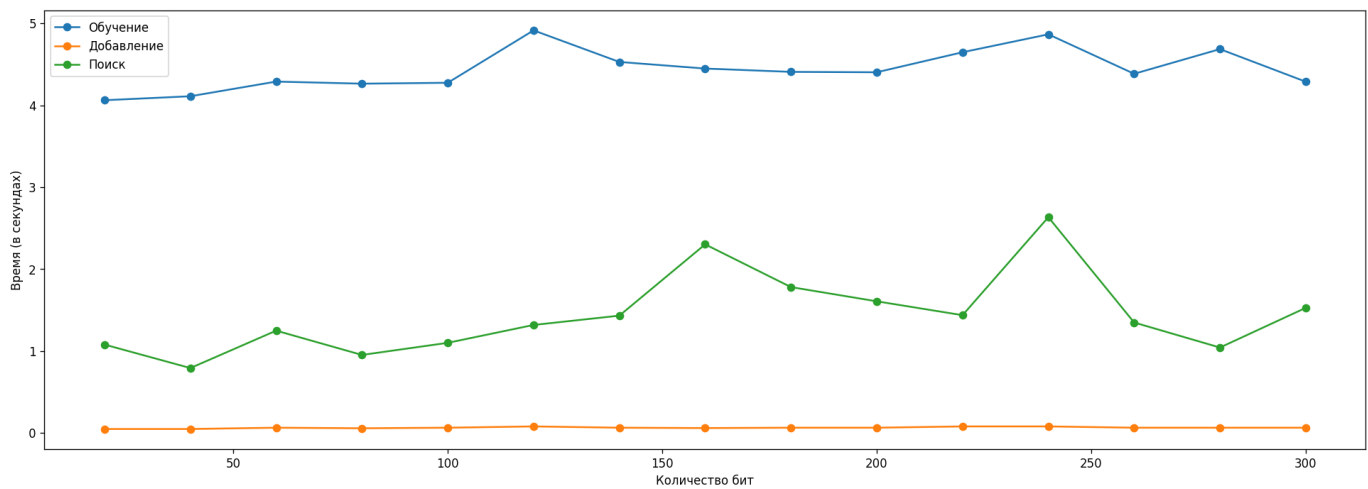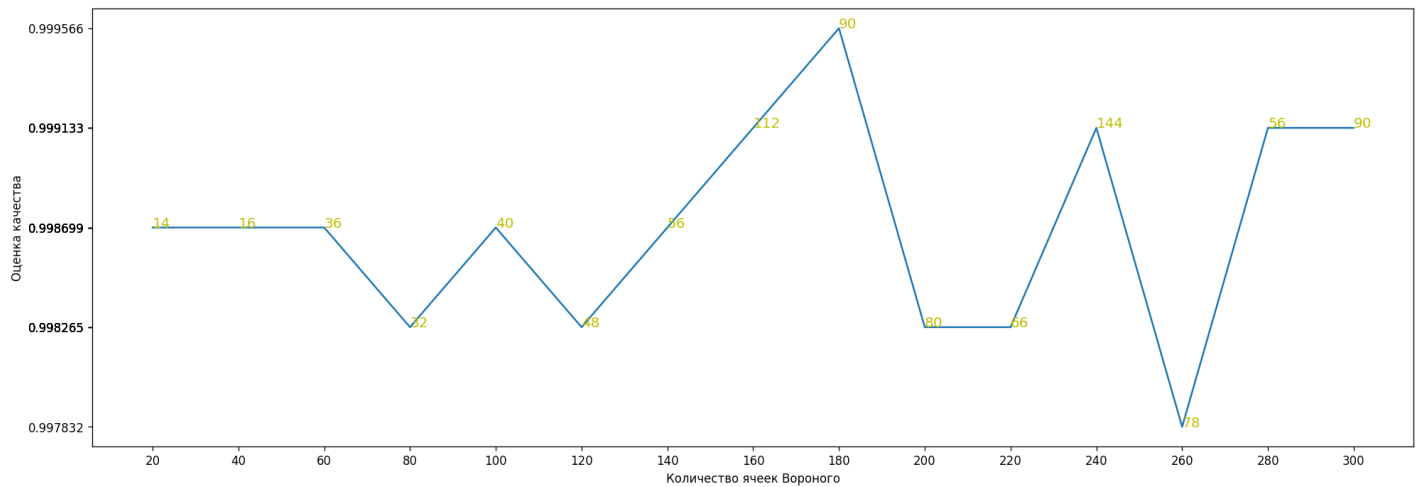
        Search time: 2.02 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 150
        Search time: 2.49 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 180
        Search time: 2.94 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 210
        Search time: 3.34 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 240
        Search time: 3.85 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 270
        Search time: 4.30 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 300
        Search time: 4.96 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB

The highest precision: 0.99913 (nprobe=90)
The smallest memory size: 1.148652 MB (nprobe=30)
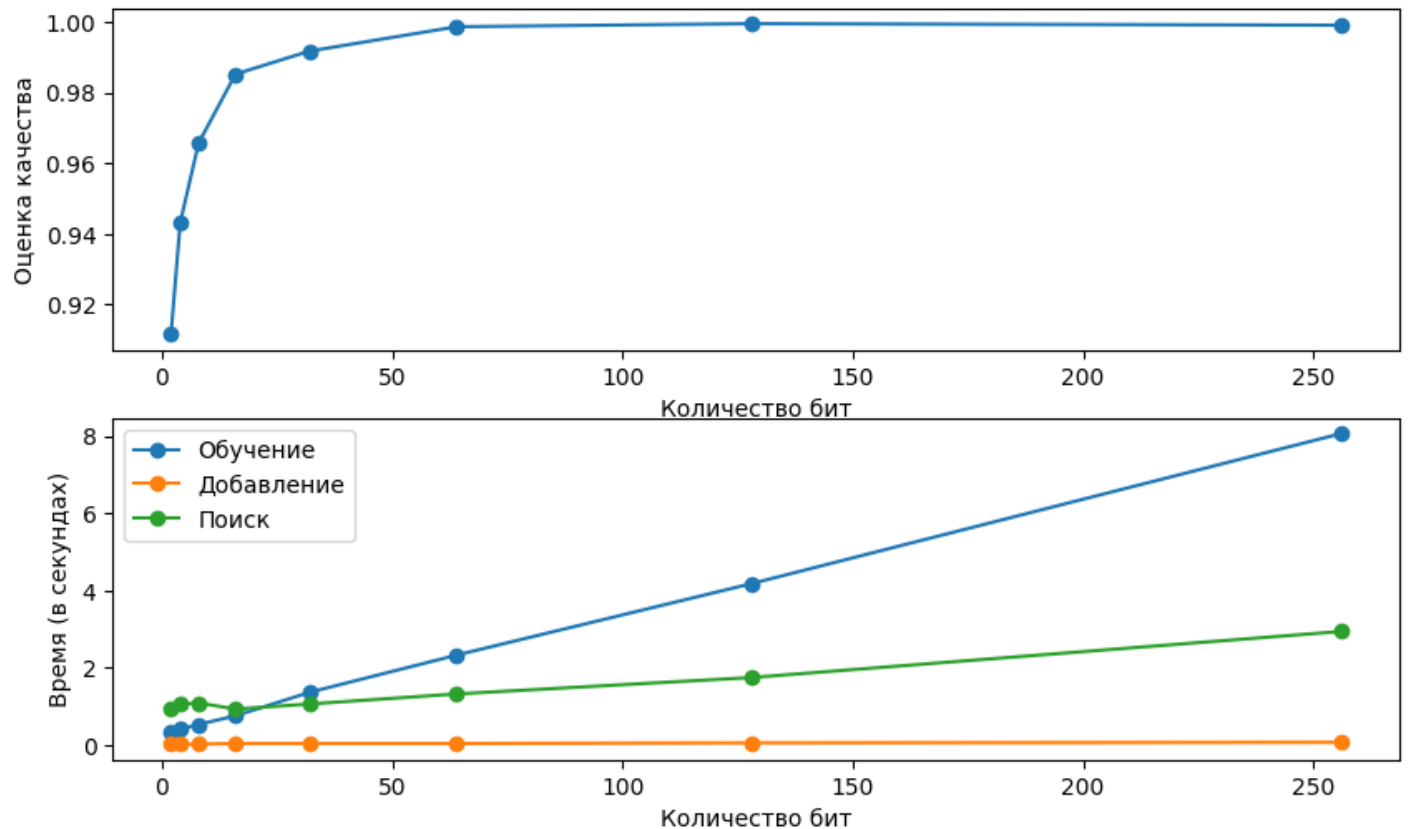The fastest search: 0.60seconds (nprobe=30)
----

n_subquantizers = 2
Train time: 0.33 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.93 seconds Precision: 0.9115351257588898 Memory: 0.488766 MB
n_subquantizers = 4
Train time: 0.42 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.06 seconds Precision: 0.9431916738941891 Memory: 0.494063 MB
n_subquantizers = 8
Train time: 0.54 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.10 seconds Precision: 0.9657415437987857 Memory: 0.504657 MB

```
n_subquantizers = 16
Train time: 0.76 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 0.94 seconds Precision: 0.9852558542931483 Memory: 0.531142 MB
n_subquantizers = 32
Train time: 1.37 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.07 seconds Precision: 0.9917606244579358 Memory: 0.584112 MB
n_subquantizers = 64
Train time: 2.33 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.33 seconds Precision: 0.9986990459670425 Memory: 0.690052 MB
n_subquantizers = 128
Train time: 4.18 seconds
Addition time: 0.06 seconds
        nprobe = 90
        Search time: 1.75 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
n_subquantizers = 256
Train time: 8.06 seconds
Addition time: 0.08 seconds
        nprobe = 90
        Search time: 2.94 seconds Precision: 0.9991326973113617 Memory: 1.325692 MB
```
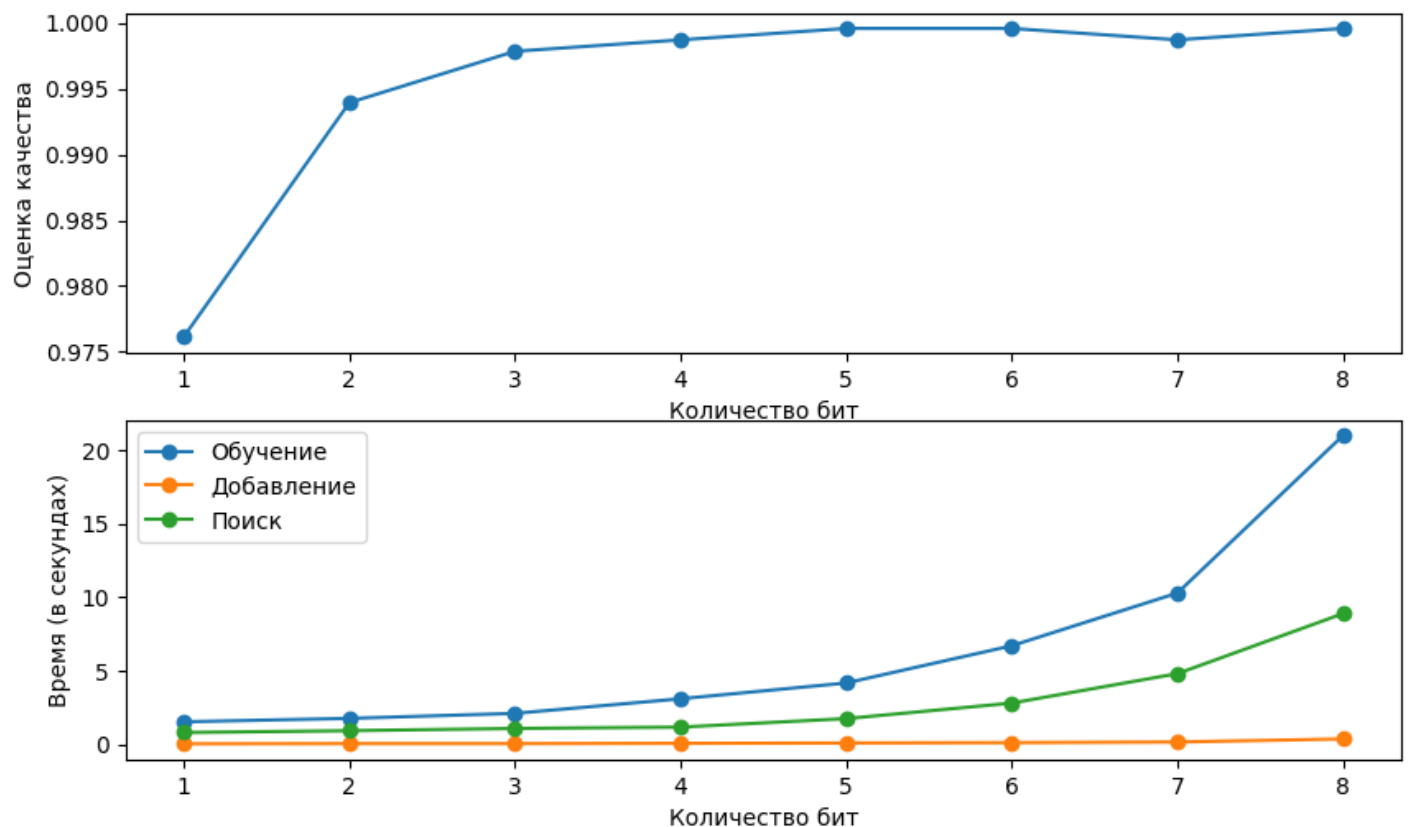


```
n_bits = 1
Train time: 1.51 seconds
Addition time: 0.02 seconds
        nprobe = 90
        Search time: 0.79 seconds Precision: 0.9761491760624458 Memory: 0.501484 MB
n_bits = 2
Train time: 1.75 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.91 seconds Precision: 0.9939288811795317 Memory: 0.590332 MB
n_bits = 3
Train time: 2.09 seconds
Addition time: 0.03 seconds
```

```
                nprobe = 90
                Search time: 1.06 seconds Precision: 0.9978317432784042 Memory: 0.683276 MB
n_bits = 4
Train time: 3.08 seconds
Addition time: 0.05 seconds
                nprobe = 90
                Search time: 1.15 seconds Precision: 0.9986990459670425 Memory: 0.784412 MB
n_bits = 5
Train time: 4.15 seconds
Addition time: 0.07 seconds
                nprobe = 90
                Search time: 1.73 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
n_bits = 6
Train time: 6.69 seconds
Addition time: 0.09 seconds
                nprobe = 90
                Search time: 2.79 seconds Precision: 0.9995663486556808 Memory: 1.05222 MB
n_bits = 7
Train time: 10.28 seconds
Addition time: 0.14 seconds
                nprobe = 90
                Search time: 4.79 seconds Precision: 0.9986990459670425 Memory: 1.268044 MB
n_bits = 8
Train time: 21.00 seconds
Addition time: 0.35 seconds
                nprobe = 90
                Search time: 8.88 seconds Precision: 0.9995663486556808 Memory: 1.61494 MB
```



```
Train time: 5.04 seconds
Addition time: 0.10 seconds
                nprobe = 90
                Search time: 1.75 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
Find optim params report:
{'train_time': 5.042146444320679, 'add_time': 0.09691786766052246, 'precision': 0.99956634
86556808, 'search_time': 1.7520983219146729, 'nprobe': 90, 'memory_size': 0.901932, 'n_lis
t': 180, 'n_subquantizers': 128, 'n_bits': 5}
---------------
Iteration #5
Finding optim parameters
Initial values: n_bits=5 n_subquantizers=128
```

```
n_list = 20
Train time: 4.06 seconds
Addition time: 0.05 seconds
        nprobe = 2
        Search time: 0.21 seconds Precision: 0.9440589765828274 Memory: 0.572972 MB
        nprobe = 4
        Search time: 0.41 seconds Precision: 0.9835212489158717 Memory: 0.572972 MB
        nprobe = 6
        Search time: 0.51 seconds Precision: 0.9930615784908933 Memory: 0.572972 MB
        nprobe = 8
        Search time: 0.66 seconds Precision: 0.9965307892454467 Memory: 0.572972 MB
        nprobe = 10
        Search time: 0.86 seconds Precision: 0.997398091934085 Memory: 0.572972 MB
        nprobe = 12
        Search time: 0.99 seconds Precision: 0.9978317432784042 Memory: 0.572972 MB
        nprobe = 14
        Search time: 1.07 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
        nprobe = 16
        Search time: 1.21 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
        nprobe = 18
        Search time: 1.38 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
        nprobe = 20
        Search time: 1.45 seconds Precision: 0.9986990459670425 Memory: 0.572972 MB
----------
The highest precision: 0.99870 (nprobe=14)
The smallest memory size: 0.572972 MB (nprobe=2)
The fastest search: 0.21seconds (nprobe=2)
----------
n_list = 40
Train time: 3.98 seconds
Addition time: 0.05 seconds
        nprobe = 4
        Search time: 0.32 seconds Precision: 0.9770164787510841 Memory: 0.614092 MB
        nprobe = 8
        Search time: 0.42 seconds Precision: 0.9939288811795317 Memory: 0.614092 MB
        nprobe = 12
        Search time: 0.68 seconds Precision: 0.9965307892454467 Memory: 0.614092 MB
        nprobe = 16
        Search time: 0.75 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
        nprobe = 20
        Search time: 0.98 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
        nprobe = 24
        Search time: 1.14 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
        nprobe = 28
        Search time: 1.28 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
        nprobe = 32
        Search time: 1.39 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
        nprobe = 36
        Search time: 1.61 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
        nprobe = 40
        Search time: 1.78 seconds Precision: 0.9986990459670425 Memory: 0.614092 MB
----------
The highest precision: 0.99870 (nprobe=16)
The smallest memory size: 0.614092 MB (nprobe=4)
The fastest search: 0.32seconds (nprobe=4)
----------
n_list = 60
Train time: 4.15 seconds
Addition time: 0.06 seconds
        nprobe = 6
        Search time: 0.34 seconds Precision: 0.9848222029488292 Memory: 0.655212 MB
        nprobe = 12
        Search time: 0.48 seconds Precision: 0.9930615784908933 Memory: 0.655212 MB
        nprobe = 18
        Search time: 0.72 seconds Precision: 0.99479618386817 Memory: 0.655212 MB
        nprobe = 24
```

```
          Search time: 0.86 seconds Precision: 0.9969644405897659 Memory: 0.655212 MB
          nprobe = 30
          Search time: 1.07 seconds Precision: 0.9978317432784042 Memory: 0.655212 MB
          nprobe = 36
          Search time: 1.25 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
          nprobe = 42
          Search time: 1.49 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
          nprobe = 48
          Search time: 1.65 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
          nprobe = 54
          Search time: 1.77 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
          nprobe = 60
          Search time: 2.02 seconds Precision: 0.9986990459670425 Memory: 0.655212 MB
  ----------
  The highest precision: 0.99870 (nprobe=36)
  The smallest memory size: 0.655212 MB (nprobe=6)
  The fastest search: 0.34seconds (nprobe=6)
  ----------
  n_list = 80
  Train time: 4.11 seconds
  Addition time: 0.05 seconds
          nprobe = 8
          Search time: 0.32 seconds Precision: 0.9874241110147441 Memory: 0.696332 MB
          nprobe = 16
          Search time: 0.57 seconds Precision: 0.9956634865568084 Memory: 0.696332 MB
          nprobe = 24
          Search time: 0.81 seconds Precision: 0.9969644405897659 Memory: 0.696332 MB
          nprobe = 32
          Search time: 1.06 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
          nprobe = 40
          Search time: 1.22 seconds Precision: 0.9978317432784042 Memory: 0.696332 MB
          nprobe = 48
          Search time: 1.40 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
          nprobe = 56
          Search time: 1.57 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
          nprobe = 64
          Search time: 1.81 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
          nprobe = 72
          Search time: 2.06 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
          nprobe = 80
          Search time: 2.27 seconds Precision: 0.9982653946227233 Memory: 0.696332 MB
  ----------
  The highest precision: 0.99827 (nprobe=32)
  The smallest memory size: 0.696332 MB (nprobe=8)
  The fastest search: 0.32seconds (nprobe=8)
  ----------
  n_list = 100
  Train time: 4.17 seconds
  Addition time: 0.06 seconds
          nprobe = 10
          Search time: 0.37 seconds Precision: 0.9874241110147441 Memory: 0.737452 MB
          nprobe = 20
          Search time: 0.60 seconds Precision: 0.9943625325238509 Memory: 0.737452 MB
          nprobe = 30
          Search time: 0.90 seconds Precision: 0.997398091934085 Memory: 0.737452 MB
          nprobe = 40
          Search time: 1.12 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
          nprobe = 50
          Search time: 1.30 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
          nprobe = 60
          Search time: 1.54 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
          nprobe = 70
          Search time: 1.88 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
          nprobe = 80
          Search time: 2.01 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
          nprobe = 90
```

```
              Search time: 2.24 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
              nprobe = 100
              Search time: 2.48 seconds Precision: 0.9986990459670425 Memory: 0.737452 MB
       ----------
       The highest precision: 0.99870 (nprobe=40)
       The smallest memory size: 0.737452 MB (nprobe=10)
       The fastest search: 0.37seconds (nprobe=10)
       ----------
       n_list = 120
       Train time: 4.12 seconds
       Addition time: 0.05 seconds
              nprobe = 12
              Search time: 0.36 seconds Precision: 0.9900260190806591 Memory: 0.778572 MB
              nprobe = 24
              Search time: 0.65 seconds Precision: 0.9952298352124892 Memory: 0.778572 MB
              nprobe = 36
              Search time: 0.91 seconds Precision: 0.997398091934085 Memory: 0.778572 MB
              nprobe = 48
              Search time: 1.14 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
              nprobe = 60
              Search time: 1.44 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
              nprobe = 72
              Search time: 1.67 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
              nprobe = 84
              Search time: 1.95 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
              nprobe = 96
              Search time: 2.19 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
              nprobe = 108
              Search time: 2.45 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
              nprobe = 120
              Search time: 2.64 seconds Precision: 0.9982653946227233 Memory: 0.778572 MB
       ----------
       The highest precision: 0.99827 (nprobe=48)
       The smallest memory size: 0.778572 MB (nprobe=12)
       The fastest search: 0.36seconds (nprobe=12)
       ----------
       n_list = 140
       Train time: 4.08 seconds
       Addition time: 0.05 seconds
              nprobe = 14
              Search time: 0.42 seconds Precision: 0.9908933217692975 Memory: 0.819692 MB
              nprobe = 28
              Search time: 0.70 seconds Precision: 0.9952298352124892 Memory: 0.819692 MB
              nprobe = 42
              Search time: 1.02 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
              nprobe = 56
              Search time: 1.23 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
              nprobe = 70
              Search time: 1.53 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
              nprobe = 84
              Search time: 1.78 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
              nprobe = 98
              Search time: 2.08 seconds Precision: 0.9982653946227233 Memory: 0.819692 MB
              nprobe = 112
              Search time: 2.33 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
              nprobe = 126
              Search time: 2.61 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
              nprobe = 140
              Search time: 2.96 seconds Precision: 0.9986990459670425 Memory: 0.819692 MB
       ----------
       The highest precision: 0.99870 (nprobe=56)
       The smallest memory size: 0.819692 MB (nprobe=14)
       The fastest search: 0.42seconds (nprobe=14)
       ----------
       n_list = 160
       Train time: 4.22 seconds
```

```
Addition time: 0.06 seconds
        nprobe = 16
        Search time: 0.45 seconds Precision: 0.9939288811795317 Memory: 0.860812 MB
        nprobe = 32
        Search time: 0.83 seconds Precision: 0.9969644405897659 Memory: 0.860812 MB
        nprobe = 48
        Search time: 1.07 seconds Precision: 0.9982653946227233 Memory: 0.860812 MB
        nprobe = 64
        Search time: 1.52 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
        nprobe = 80
        Search time: 1.83 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
        nprobe = 96
        Search time: 2.09 seconds Precision: 0.9986990459670425 Memory: 0.860812 MB
        nprobe = 112
        Search time: 2.45 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
        nprobe = 128
        Search time: 2.61 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
        nprobe = 144
        Search time: 2.94 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
        nprobe = 160
        Search time: 3.24 seconds Precision: 0.9991326973113617 Memory: 0.860812 MB
----------
The highest precision: 0.99913 (nprobe=112)
The smallest memory size: 0.860812 MB (nprobe=16)
The fastest search: 0.45seconds (nprobe=16)
----------
n_list = 180
Train time: 4.30 seconds
Addition time: 0.06 seconds
        nprobe = 18
        Search time: 0.50 seconds Precision: 0.99479618386817 Memory: 0.901932 MB
        nprobe = 36
        Search time: 0.83 seconds Precision: 0.997398091934085 Memory: 0.901932 MB
        nprobe = 54
        Search time: 1.16 seconds Precision: 0.9986990459670425 Memory: 0.901932 MB
        nprobe = 72
        Search time: 1.60 seconds Precision: 0.9991326973113617 Memory: 0.901932 MB
        nprobe = 90
        Search time: 1.85 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 108
        Search time: 2.12 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 126
        Search time: 2.46 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 144
        Search time: 2.73 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 162
        Search time: 3.06 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
        nprobe = 180
        Search time: 3.37 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
----------
The highest precision: 0.99957 (nprobe=90)
The smallest memory size: 0.901932 MB (nprobe=18)
The fastest search: 0.50seconds (nprobe=18)
----------
n_list = 200
Train time: 4.13 seconds
Addition time: 0.06 seconds
        nprobe = 20
        Search time: 0.49 seconds Precision: 0.9960971379011275 Memory: 0.943052 MB
        nprobe = 40
        Search time: 0.79 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
        nprobe = 60
        Search time: 1.19 seconds Precision: 0.997398091934085 Memory: 0.943052 MB
        nprobe = 80
        Search time: 1.58 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        nprobe = 100
```

```
            Search time: 1.93 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 120
            Search time: 2.22 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 140
            Search time: 2.55 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 160
            Search time: 2.90 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 180
            Search time: 3.27 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
            nprobe = 200
            Search time: 3.69 seconds Precision: 0.9982653946227233 Memory: 0.943052 MB
        ----------
        The highest precision: 0.99827 (nprobe=80)
        The smallest memory size: 0.943052 MB (nprobe=20)
        The fastest search: 0.49seconds (nprobe=20)
        ----------
        n_list = 220
        Train time: 4.21 seconds
        Addition time: 0.06 seconds
            nprobe = 22
            Search time: 0.46 seconds Precision: 0.9952298352124892 Memory: 0.984172 MB
            nprobe = 44
            Search time: 0.88 seconds Precision: 0.997398091934085 Memory: 0.984172 MB
            nprobe = 66
            Search time: 1.28 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 88
            Search time: 1.72 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 110
            Search time: 1.99 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 132
            Search time: 2.27 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 154
            Search time: 2.75 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 176
            Search time: 3.01 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 198
            Search time: 3.50 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
            nprobe = 220
            Search time: 3.87 seconds Precision: 0.9982653946227233 Memory: 0.984172 MB
        ----------
        The highest precision: 0.99827 (nprobe=66)
        The smallest memory size: 0.984172 MB (nprobe=22)
        The fastest search: 0.46seconds (nprobe=22)
        ----------
        n_list = 240
        Train time: 4.19 seconds
        Addition time: 0.06 seconds
            nprobe = 24
            Search time: 0.55 seconds Precision: 0.9952298352124892 Memory: 1.025292 MB
            nprobe = 48
            Search time: 0.91 seconds Precision: 0.9978317432784042 Memory: 1.025292 MB
            nprobe = 72
            Search time: 1.25 seconds Precision: 0.9982653946227233 Memory: 1.025292 MB
            nprobe = 96
            Search time: 1.70 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
            nprobe = 120
            Search time: 2.11 seconds Precision: 0.9986990459670425 Memory: 1.025292 MB
            nprobe = 144
            Search time: 2.48 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
            nprobe = 168
            Search time: 2.81 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
            nprobe = 192
            Search time: 3.22 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
            nprobe = 216
            Search time: 3.56 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
            nprobe = 240
```

```
            Search time: 3.98 seconds Precision: 0.9991326973113617 Memory: 1.025292 MB
----------
The highest precision: 0.99913 (nprobe=144)
The smallest memory size: 1.025292 MB (nprobe=24)
The fastest search: 0.55seconds (nprobe=24)
----------
n_list = 260
Train time: 4.19 seconds
Addition time: 0.06 seconds
        nprobe = 26
        Search time: 0.51 seconds Precision: 0.9956634865568084 Memory: 1.066412 MB
        nprobe = 52
        Search time: 0.96 seconds Precision: 0.9969644405897659 Memory: 1.066412 MB
        nprobe = 78
        Search time: 1.41 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        nprobe = 104
        Search time: 1.82 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        nprobe = 130
        Search time: 2.24 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        nprobe = 156
        Search time: 2.55 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        nprobe = 182
        Search time: 3.04 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        nprobe = 208
        Search time: 3.46 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        nprobe = 234
        Search time: 3.86 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
        nprobe = 260
        Search time: 4.30 seconds Precision: 0.9978317432784042 Memory: 1.066412 MB
----------
The highest precision: 0.99783 (nprobe=78)
The smallest memory size: 1.066412 MB (nprobe=26)
The fastest search: 0.51seconds (nprobe=26)
----------
n_list = 280
Train time: 4.27 seconds
Addition time: 0.06 seconds
        nprobe = 28
        Search time: 0.68 seconds Precision: 0.9960971379011275 Memory: 1.107532 MB
        nprobe = 56
        Search time: 1.01 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        nprobe = 84
        Search time: 1.42 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        nprobe = 112
        Search time: 1.86 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        nprobe = 140
        Search time: 2.38 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        nprobe = 168
        Search time: 2.77 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        nprobe = 196
        Search time: 3.20 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        nprobe = 224
        Search time: 3.58 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        nprobe = 252
        Search time: 4.04 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
        nprobe = 280
        Search time: 4.51 seconds Precision: 0.9991326973113617 Memory: 1.107532 MB
----------
The highest precision: 0.99913 (nprobe=56)
The smallest memory size: 1.107532 MB (nprobe=28)
The fastest search: 0.68seconds (nprobe=28)
----------
n_list = 300
Train time: 4.92 seconds
Addition time: 0.10 seconds
        nprobe = 30
```
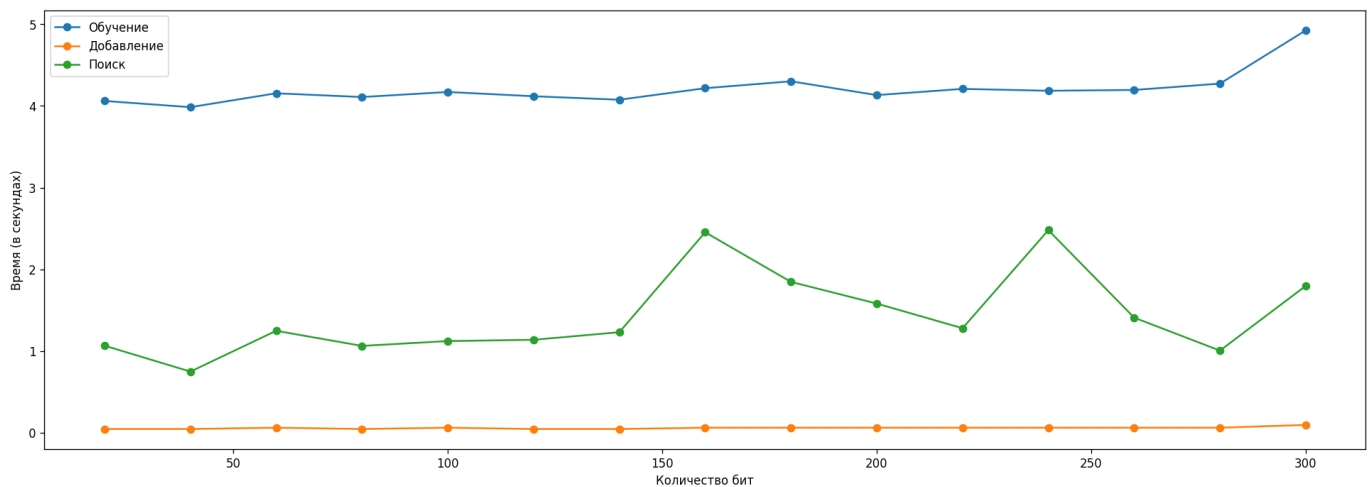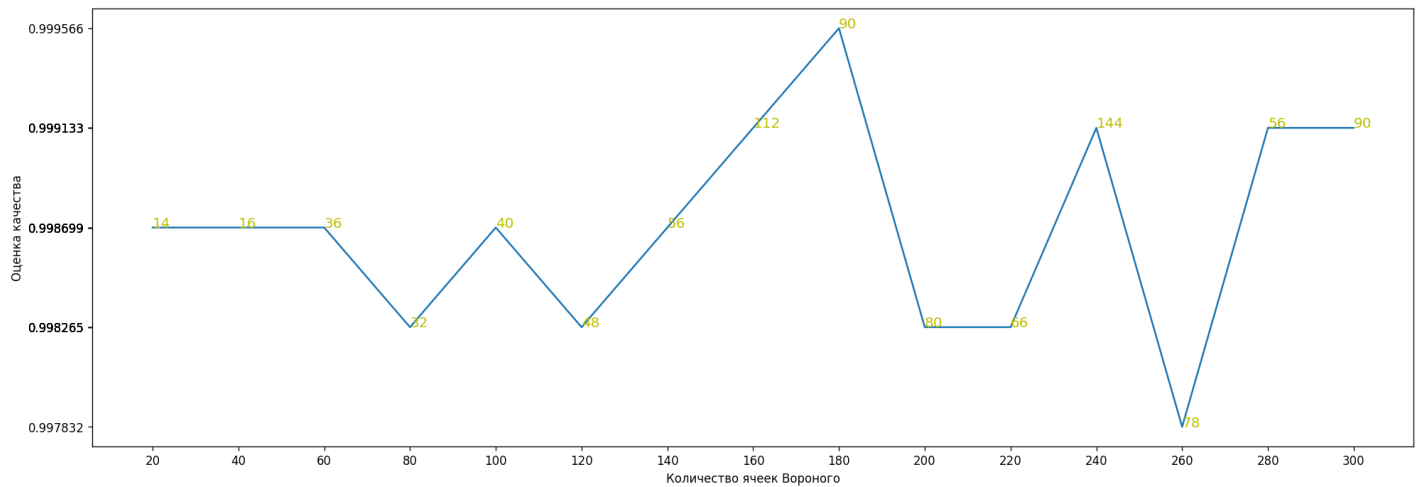
        Search time: 0.70 seconds Precision: 0.9965307892454467 Memory: 1.148652 MB
        nprobe = 60
        Search time: 1.21 seconds Precision: 0.9982653946227233 Memory: 1.148652 MB
        nprobe = 90
        Search time: 1.80 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 120
        Search time: 2.32 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 150
        Search time: 2.76 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 180
        Search time: 3.31 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 210
        Search time: 3.93 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 240
        Search time: 4.34 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 270
        Search time: 5.17 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB
        nprobe = 300
        Search time: 5.06 seconds Precision: 0.9991326973113617 Memory: 1.148652 MB

The highest precision: 0.99913 (nprobe=90)
The smallest memory size: 1.148652 MB (nprobe=30)
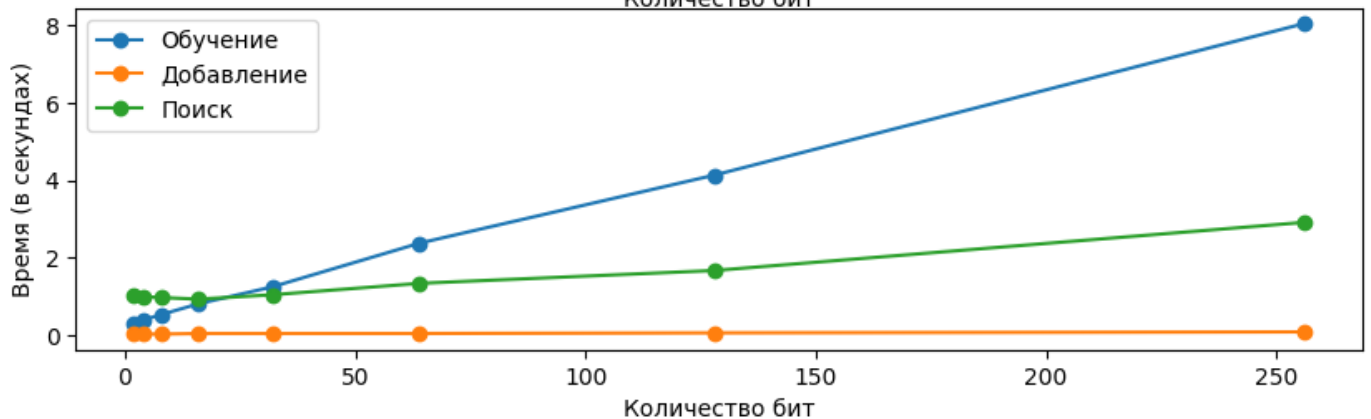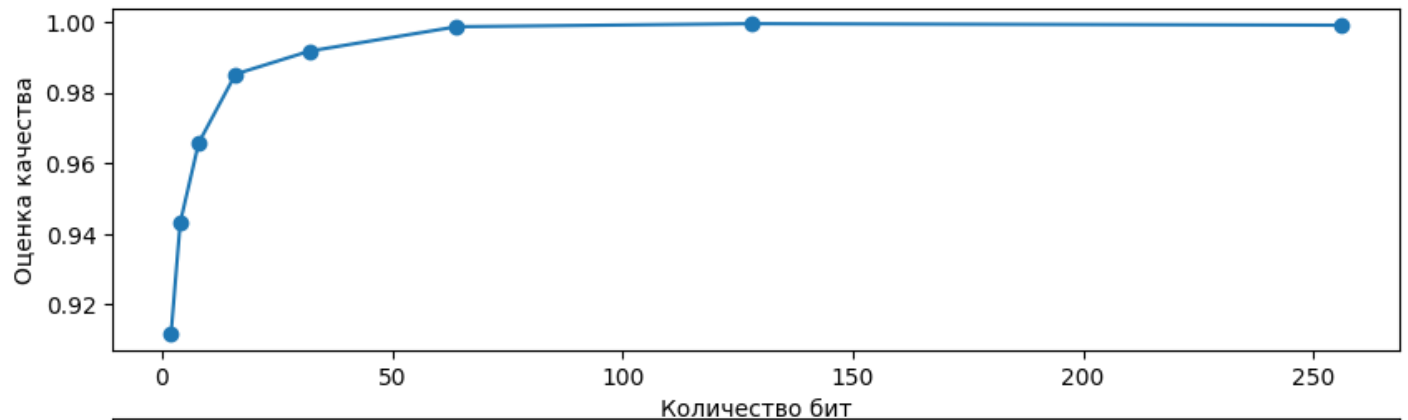The fastest search: 0.70seconds (nprobe=30)
----

n_subquantizers = 2
Train time: 0.32 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 1.04 seconds Precision: 0.9115351257588898 Memory: 0.488766 MB
n_subquantizers = 4
Train time: 0.40 seconds
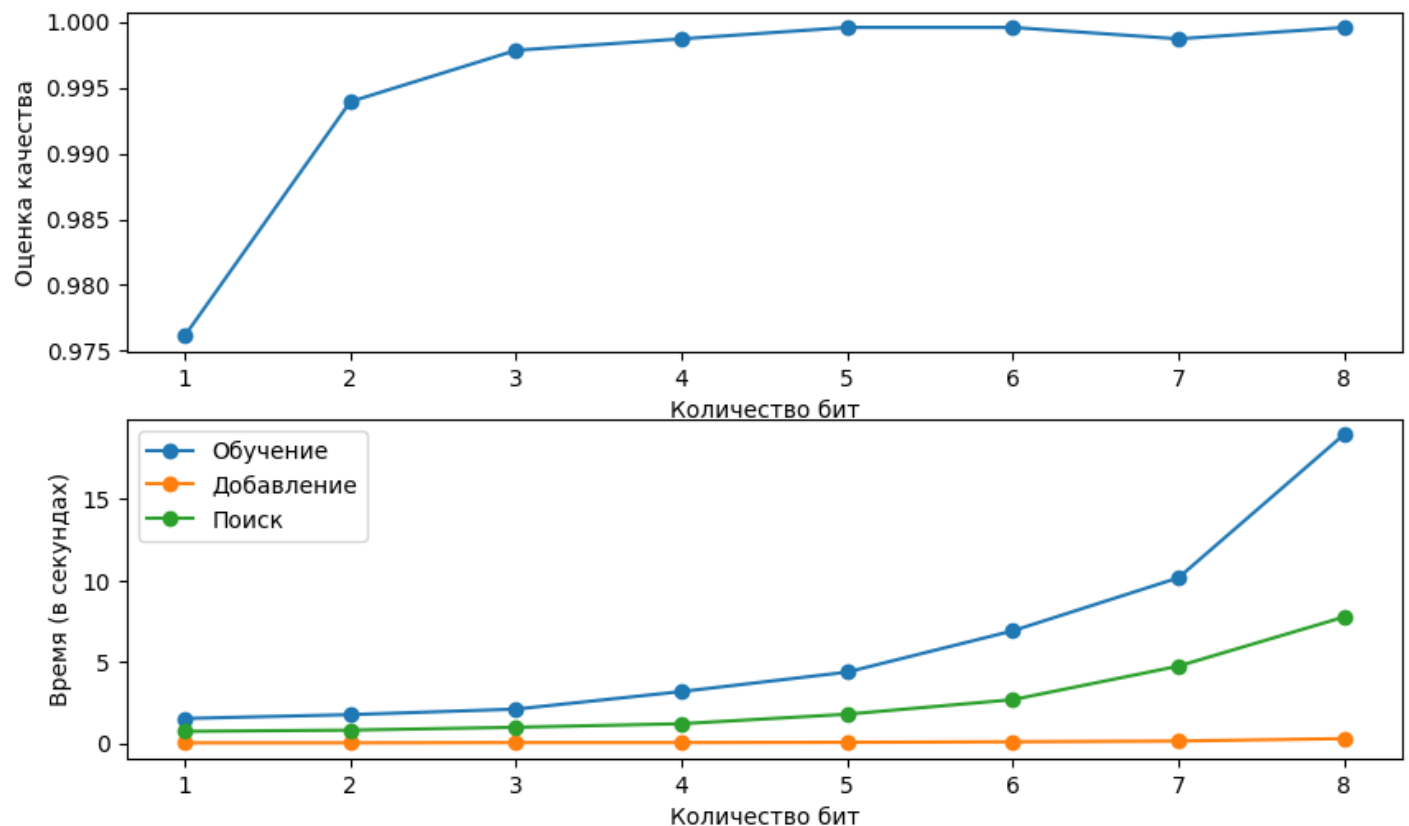Addition time: 0.03 seconds
        nprobe = 90

        Search time: 1.00 seconds Precision: 0.9431916738941891 Memory: 0.494063 MB
n_subquantizers = 8
Train time: 0.54 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.97 seconds Precision: 0.9657415437987857 Memory: 0.504657 MB
n_subquantizers = 16
Train time: 0.81 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 0.93 seconds Precision: 0.9852558542931483 Memory: 0.531142 MB
n_subquantizers = 32
Train time: 1.25 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.04 seconds Precision: 0.9917606244579358 Memory: 0.584112 MB
n_subquantizers = 64
Train time: 2.38 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.34 seconds Precision: 0.9986990459670425 Memory: 0.690052 MB
n_subquantizers = 128
Train time: 4.13 seconds
Addition time: 0.06 seconds
        nprobe = 90
        Search time: 1.67 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
n_subquantizers = 256
Train time: 8.03 seconds
Addition time: 0.09 seconds
        nprobe = 90
        Search time: 2.91 seconds Precision: 0.9991326973113617 Memory: 1.325692 MB

n_bits = 1
Train time: 1.52 seconds
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.74 seconds Precision: 0.9761491760624458 Memory: 0.501484 MB
n_bits = 2
Train time: 1.76 seconds

```
Addition time: 0.03 seconds
        nprobe = 90
        Search time: 0.81 seconds Precision: 0.9939288811795317 Memory: 0.590332 MB
n_bits = 3
Train time: 2.10 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 0.99 seconds Precision: 0.9978317432784042 Memory: 0.683276 MB
n_bits = 4
Train time: 3.18 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.20 seconds Precision: 0.9986990459670425 Memory: 0.784412 MB
n_bits = 5
Train time: 4.37 seconds
Addition time: 0.06 seconds
        nprobe = 90
        Search time: 1.79 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
n_bits = 6
Train time: 6.91 seconds
Addition time: 0.09 seconds
        nprobe = 90
        Search time: 2.68 seconds Precision: 0.9995663486556808 Memory: 1.05222 MB
n_bits = 7
Train time: 10.16 seconds
Addition time: 0.14 seconds
        nprobe = 90
        Search time: 4.74 seconds Precision: 0.9986990459670425 Memory: 1.268044 MB
n_bits = 8
Train time: 18.96 seconds
Addition time: 0.29 seconds
        nprobe = 90
        Search time: 7.76 seconds Precision: 0.9995663486556808 Memory: 1.61494 MB
```



```
Train time: 4.14 seconds
Addition time: 0.05 seconds
        nprobe = 90
        Search time: 1.76 seconds Precision: 0.9995663486556808 Memory: 0.901932 MB
Find optim params report:
{'train_time': 4.136669158935547, 'add_time': 0.04686307907104492, 'precision': 0.99956634
```

86556808, 'search_time': 1.7644383907318115, 'nprobe': 90, 'memory_size': 0.901932, 'n_list': 180, 'n_subquantizers': 128, 'n_bits': 5}

Out[4]:
[{'train_time': 4.314014196395874,
  'add_time': 0.0624842643737793,
  'precision': 0.9995663486556808,
  'search_time': 1.8281195163726807,
  'nprobe': 90,
  'memory_size': 0.901932,
  'n_list': 180,
  'n_subquantizers': 128,
  'n_bits': 5},
 {'train_time': 4.119032382965088,
  'add_time': 0.07810568809509277,
  'precision': 0.9995663486556808,
  'search_time': 1.7608540058135986,
  'nprobe': 90,
  'memory_size': 0.901932,
  'n_list': 180,
  'n_subquantizers': 128,
  'n_bits': 5},
 {'train_time': 4.333058595657349,
  'add_time': 0.04686260223388672,
  'precision': 0.9995663486556808,
  'search_time': 1.7345085144042969,
  'nprobe': 90,
  'memory_size': 0.901932,
  'n_list': 180,
  'n_subquantizers': 128,
  'n_bits': 5},
 {'train_time': 5.042146444320679,
  'add_time': 0.09691786766052246,
  'precision': 0.9995663486556808,
  'search_time': 1.7520983219146729,
  'nprobe': 90,
  'memory_size': 0.901932,
  'n_list': 180,
  'n_subquantizers': 128,
  'n_bits': 5},
 {'train_time': 4.136669158935547,
  'add_time': 0.04686307907104492,
  'precision': 0.9995663486556808,
  'search_time': 1.7644383907318115,
  'nprobe': 90,
  'memory_size': 0.901932,
  'n_list': 180,
  'n_subquantizers': 128,
  'n_bits': 5}]

Search for optimal values of IVPQ's parameters using threshold

It searchs for optimal values until absolute value of difference between current and previous accuracy is less than threshold

In [6]:
```
lfw_embeddings_compression.find_params_until_threshold(5, 0.01, show_process=True, plot_g
```

```
Starting experiment...
Random values of n_bits=3 and n_subquantizers=8
---------------
Iteration #1
n_list = 20
Train time: 0.31 seconds
Addition time: 0.01 seconds
        nprobe = 2
        Search time: 0.06 seconds Precision: 0.8673026886383348 Memory: 0.115951 MB
        nprobe = 4
```

```
          Search time: 0.02 seconds Precision: 0.8842150910667823 Memory: 0.115951 MB
          nprobe = 6
          Search time: 0.05 seconds Precision: 0.8872506504770165 Memory: 0.115951 MB
          nprobe = 8
          Search time: 0.07 seconds Precision: 0.8868169991326973 Memory: 0.115951 MB
          nprobe = 10
          Search time: 0.07 seconds Precision: 0.8868169991326973 Memory: 0.115951 MB
          nprobe = 12
          Search time: 0.09 seconds Precision: 0.8868169991326973 Memory: 0.115951 MB
          nprobe = 14
          Search time: 0.10 seconds Precision: 0.8868169991326973 Memory: 0.115951 MB
          nprobe = 16
          Search time: 0.12 seconds Precision: 0.8868169991326973 Memory: 0.115951 MB
          nprobe = 18
          Search time: 0.12 seconds Precision: 0.8868169991326973 Memory: 0.115951 MB
          nprobe = 20
          Search time: 0.15 seconds Precision: 0.8868169991326973 Memory: 0.115951 MB
----------
The highest precision: 0.88725 (nprobe=6)
The smallest memory size: 0.115951 MB (nprobe=2)
The fastest search: 0.02seconds (nprobe=4)
----------
n_list = 40
Train time: 0.28 seconds
Addition time: 0.03 seconds
          nprobe = 4
          Search time: 0.03 seconds Precision: 0.8985255854293148 Memory: 0.157071 MB
          nprobe = 8
          Search time: 0.05 seconds Precision: 0.901561144839549 Memory: 0.157071 MB
          nprobe = 12
          Search time: 0.09 seconds Precision: 0.9019947961838681 Memory: 0.157071 MB
          nprobe = 16
          Search time: 0.12 seconds Precision: 0.9024284475281873 Memory: 0.157071 MB
          nprobe = 20
          Search time: 0.10 seconds Precision: 0.9024284475281873 Memory: 0.157071 MB
          nprobe = 24
          Search time: 0.15 seconds Precision: 0.9024284475281873 Memory: 0.157071 MB
          nprobe = 28
          Search time: 0.12 seconds Precision: 0.9024284475281873 Memory: 0.157071 MB
          nprobe = 32
          Search time: 0.22 seconds Precision: 0.9024284475281873 Memory: 0.157071 MB
          nprobe = 36
          Search time: 0.19 seconds Precision: 0.9024284475281873 Memory: 0.157071 MB
          nprobe = 40
          Search time: 0.18 seconds Precision: 0.9024284475281873 Memory: 0.157071 MB
----------
The highest precision: 0.90243 (nprobe=16)
The smallest memory size: 0.157071 MB (nprobe=4)
The fastest search: 0.03seconds (nprobe=4)
----------
n_list = 60
Train time: 0.22 seconds
Addition time: 0.02 seconds
          nprobe = 6
          Search time: 0.05 seconds Precision: 0.9163052905464006 Memory: 0.198191 MB
          nprobe = 12
          Search time: 0.06 seconds Precision: 0.9184735472679966 Memory: 0.198191 MB
          nprobe = 18
          Search time: 0.09 seconds Precision: 0.9184735472679966 Memory: 0.198191 MB
          nprobe = 24
          Search time: 0.10 seconds Precision: 0.9184735472679966 Memory: 0.198191 MB
          nprobe = 30
          Search time: 0.16 seconds Precision: 0.9184735472679966 Memory: 0.198191 MB
          nprobe = 36
          Search time: 0.16 seconds Precision: 0.9184735472679966 Memory: 0.198191 MB
          nprobe = 42
```

```
          Search time: 0.19 seconds Precision: 0.9184735472679966 Memory: 0.198191 MB
          nprobe = 48
          Search time: 0.24 seconds Precision: 0.9184735472679966 Memory: 0.198191 MB
          nprobe = 54
          Search time: 0.22 seconds Precision: 0.9184735472679966 Memory: 0.198191 MB
          nprobe = 60
          Search time: 0.24 seconds Precision: 0.9184735472679966 Memory: 0.198191 MB
----------
The highest precision: 0.91847 (nprobe=12)
The smallest memory size: 0.198191 MB (nprobe=6)
The fastest search: 0.05seconds (nprobe=6)
----------
n_list = 80
Train time: 0.22 seconds
Addition time: 0.02 seconds
          nprobe = 8
          Search time: 0.05 seconds Precision: 0.9150043365134432 Memory: 0.239311 MB
          nprobe = 16
          Search time: 0.08 seconds Precision: 0.9154379878577623 Memory: 0.239311 MB
          nprobe = 24
          Search time: 0.12 seconds Precision: 0.9154379878577623 Memory: 0.239311 MB
          nprobe = 32
          Search time: 0.16 seconds Precision: 0.9154379878577623 Memory: 0.239311 MB
          nprobe = 40
          Search time: 0.22 seconds Precision: 0.9154379878577623 Memory: 0.239311 MB
          nprobe = 48
          Search time: 0.21 seconds Precision: 0.9154379878577623 Memory: 0.239311 MB
          nprobe = 56
          Search time: 0.27 seconds Precision: 0.9154379878577623 Memory: 0.239311 MB
          nprobe = 64
          Search time: 0.31 seconds Precision: 0.9154379878577623 Memory: 0.239311 MB
          nprobe = 72
          Search time: 0.27 seconds Precision: 0.9154379878577623 Memory: 0.239311 MB
          nprobe = 80
          Search time: 0.27 seconds Precision: 0.9154379878577623 Memory: 0.239311 MB
----------
The highest precision: 0.91544 (nprobe=16)
The smallest memory size: 0.239311 MB (nprobe=8)
The fastest search: 0.05seconds (nprobe=8)
----------
n_list = 100
Train time: 0.22 seconds
Addition time: 0.02 seconds
          nprobe = 10
          Search time: 0.05 seconds Precision: 0.9189071986123157 Memory: 0.280431 MB
          nprobe = 20
          Search time: 0.09 seconds Precision: 0.9184735472679966 Memory: 0.280431 MB
          nprobe = 30
          Search time: 0.14 seconds Precision: 0.9189071986123157 Memory: 0.280431 MB
          nprobe = 40
          Search time: 0.18 seconds Precision: 0.9189071986123157 Memory: 0.280431 MB
          nprobe = 50
          Search time: 0.21 seconds Precision: 0.9189071986123157 Memory: 0.280431 MB
          nprobe = 60
          Search time: 0.22 seconds Precision: 0.9189071986123157 Memory: 0.280431 MB
          nprobe = 70
          Search time: 0.25 seconds Precision: 0.9189071986123157 Memory: 0.280431 MB
          nprobe = 80
          Search time: 0.36 seconds Precision: 0.9189071986123157 Memory: 0.280431 MB
          nprobe = 90
          Search time: 0.35 seconds Precision: 0.9189071986123157 Memory: 0.280431 MB
          nprobe = 100
          Search time: 0.39 seconds Precision: 0.9189071986123157 Memory: 0.280431 MB
----------
The highest precision: 0.91891 (nprobe=10)
The smallest memory size: 0.280431 MB (nprobe=10)
```

```
         The fastest search: 0.05seconds (nprobe=10)
         ----------
         n_list = 120
         Train time: 0.23 seconds
         Addition time: 0.02 seconds
                 nprobe = 12
                 Search time: 0.06 seconds Precision: 0.9189071986123157 Memory: 0.321551 MB
                 nprobe = 24
                 Search time: 0.12 seconds Precision: 0.9197745013009541 Memory: 0.321551 MB
                 nprobe = 36
                 Search time: 0.12 seconds Precision: 0.9197745013009541 Memory: 0.321551 MB
                 nprobe = 48
                 Search time: 0.22 seconds Precision: 0.9197745013009541 Memory: 0.321551 MB
                 nprobe = 60
                 Search time: 0.23 seconds Precision: 0.9197745013009541 Memory: 0.321551 MB
                 nprobe = 72
                 Search time: 0.30 seconds Precision: 0.9197745013009541 Memory: 0.321551 MB
                 nprobe = 84
                 Search time: 0.32 seconds Precision: 0.9197745013009541 Memory: 0.321551 MB
                 nprobe = 96
                 Search time: 0.37 seconds Precision: 0.9197745013009541 Memory: 0.321551 MB
                 nprobe = 108
                 Search time: 0.38 seconds Precision: 0.9197745013009541 Memory: 0.321551 MB
                 nprobe = 120
                 Search time: 0.40 seconds Precision: 0.9197745013009541 Memory: 0.321551 MB
         ----------
         The highest precision: 0.91977 (nprobe=24)
         The smallest memory size: 0.321551 MB (nprobe=12)
         The fastest search: 0.06seconds (nprobe=12)
         ----------
         n_list = 140
         Train time: 0.27 seconds
         Addition time: 0.03 seconds
                 nprobe = 14
                 Search time: 0.06 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
                 nprobe = 28
                 Search time: 0.13 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
                 nprobe = 42
                 Search time: 0.13 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
                 nprobe = 56
                 Search time: 0.24 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
                 nprobe = 70
                 Search time: 0.23 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
                 nprobe = 84
                 Search time: 0.35 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
                 nprobe = 98
                 Search time: 0.32 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
                 nprobe = 112
                 Search time: 0.38 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
                 nprobe = 126
                 Search time: 0.39 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
                 nprobe = 140
                 Search time: 0.45 seconds Precision: 0.9245446660884649 Memory: 0.362671 MB
         ----------
         The highest precision: 0.92454 (nprobe=14)
         The smallest memory size: 0.362671 MB (nprobe=14)
         The fastest search: 0.06seconds (nprobe=14)
         ----------
         n_list = 160
         Train time: 0.25 seconds
         Addition time: 0.02 seconds
                 nprobe = 16
                 Search time: 0.09 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
                 nprobe = 32
                 Search time: 0.16 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
                 nprobe = 48
```

```
          Search time: 0.21 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
          nprobe = 64
          Search time: 0.30 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
          nprobe = 80
          Search time: 0.27 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
          nprobe = 96
          Search time: 0.38 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
          nprobe = 112
          Search time: 0.37 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
          nprobe = 128
          Search time: 0.51 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
          nprobe = 144
          Search time: 0.52 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
          nprobe = 160
          Search time: 0.55 seconds Precision: 0.9306157849089333 Memory: 0.403791 MB
----------
The highest precision: 0.93062 (nprobe=16)
The smallest memory size: 0.403791 MB (nprobe=16)
The fastest search: 0.09seconds (nprobe=16)
----------
n_list = 180
Train time: 0.27 seconds
Addition time: 0.02 seconds
          nprobe = 18
          Search time: 0.09 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
          nprobe = 36
          Search time: 0.13 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
          nprobe = 54
          Search time: 0.27 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
          nprobe = 72
          Search time: 0.33 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
          nprobe = 90
          Search time: 0.38 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
          nprobe = 108
          Search time: 0.40 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
          nprobe = 126
          Search time: 0.41 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
          nprobe = 144
          Search time: 0.57 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
          nprobe = 162
          Search time: 0.52 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
          nprobe = 180
          Search time: 0.52 seconds Precision: 0.927580225498699 Memory: 0.444911 MB
----------
The highest precision: 0.92758 (nprobe=18)
The smallest memory size: 0.444911 MB (nprobe=18)
The fastest search: 0.09seconds (nprobe=18)
----------
n_list = 200
Train time: 0.27 seconds
Addition time: 0.03 seconds
          nprobe = 20
          Search time: 0.11 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
          nprobe = 40
          Search time: 0.15 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
          nprobe = 60
          Search time: 0.31 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
          nprobe = 80
          Search time: 0.33 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
          nprobe = 100
          Search time: 0.32 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
          nprobe = 120
          Search time: 0.35 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
          nprobe = 140
          Search time: 0.45 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
          nprobe = 160
```

```
          Search time: 0.51 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
          nprobe = 180
          Search time: 0.62 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
          nprobe = 200
          Search time: 0.71 seconds Precision: 0.9414570685169124 Memory: 0.486031 MB
----------
The highest precision: 0.94146 (nprobe=20)
The smallest memory size: 0.486031 MB (nprobe=20)
The fastest search: 0.11seconds (nprobe=20)
----------
n_list = 220
Train time: 0.29 seconds
Addition time: 0.02 seconds
          nprobe = 22
          Search time: 0.12 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
          nprobe = 44
          Search time: 0.22 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
          nprobe = 66
          Search time: 0.31 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
          nprobe = 88
          Search time: 0.35 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
          nprobe = 110
          Search time: 0.38 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
          nprobe = 132
          Search time: 0.44 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
          nprobe = 154
          Search time: 0.53 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
          nprobe = 176
          Search time: 0.57 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
          nprobe = 198
          Search time: 0.64 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
          nprobe = 220
          Search time: 0.66 seconds Precision: 0.9388551604509974 Memory: 0.527151 MB
----------
The highest precision: 0.93886 (nprobe=22)
The smallest memory size: 0.527151 MB (nprobe=22)
The fastest search: 0.12seconds (nprobe=22)
----------
n_list = 240
Train time: 0.31 seconds
Addition time: 0.03 seconds
          nprobe = 24
          Search time: 0.14 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
          nprobe = 48
          Search time: 0.19 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
          nprobe = 72
          Search time: 0.27 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
          nprobe = 96
          Search time: 0.30 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
          nprobe = 120
          Search time: 0.47 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
          nprobe = 144
          Search time: 0.54 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
          nprobe = 168
          Search time: 0.61 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
          nprobe = 192
          Search time: 0.60 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
          nprobe = 216
          Search time: 0.64 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
          nprobe = 240
          Search time: 0.71 seconds Precision: 0.9444926279271466 Memory: 0.568271 MB
----------
The highest precision: 0.94449 (nprobe=24)
The smallest memory size: 0.568271 MB (nprobe=24)
The fastest search: 0.14seconds (nprobe=24)
----------
```

```
        n_list = 260
        Train time: 0.30 seconds
        Addition time: 0.03 seconds
                nprobe = 26
                Search time: 0.12 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
                nprobe = 52
                Search time: 0.22 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
                nprobe = 78
                Search time: 0.28 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
                nprobe = 104
                Search time: 0.33 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
                nprobe = 130
                Search time: 0.43 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
                nprobe = 156
                Search time: 0.54 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
                nprobe = 182
                Search time: 0.53 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
                nprobe = 208
                Search time: 0.65 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
                nprobe = 234
                Search time: 0.73 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
                nprobe = 260
                Search time: 0.83 seconds Precision: 0.9444926279271466 Memory: 0.609391 MB
        ----------
        The highest precision: 0.94449 (nprobe=26)
        The smallest memory size: 0.609391 MB (nprobe=26)
        The fastest search: 0.12seconds (nprobe=26)
        ----------
        n_list = 280
        Train time: 0.31 seconds
        Addition time: 0.03 seconds
                nprobe = 28
                Search time: 0.16 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
                nprobe = 56
                Search time: 0.22 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
                nprobe = 84
                Search time: 0.37 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
                nprobe = 112
                Search time: 0.38 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
                nprobe = 140
                Search time: 0.46 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
                nprobe = 168
                Search time: 0.50 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
                nprobe = 196
                Search time: 0.56 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
                nprobe = 224
                Search time: 0.63 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
                nprobe = 252
                Search time: 0.68 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
                nprobe = 280
                Search time: 0.75 seconds Precision: 0.9505637467476149 Memory: 0.650511 MB
        ----------
        The highest precision: 0.95056 (nprobe=28)
        The smallest memory size: 0.650511 MB (nprobe=28)
        The fastest search: 0.16seconds (nprobe=28)
        ----------
        n_list = 300
        Train time: 0.33 seconds
        Addition time: 0.03 seconds
                nprobe = 30
                Search time: 0.14 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
                nprobe = 60
                Search time: 0.20 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
                nprobe = 90
                Search time: 0.30 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
                nprobe = 120
```

Search time: 0.47 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
        nprobe = 150
        Search time: 0.55 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
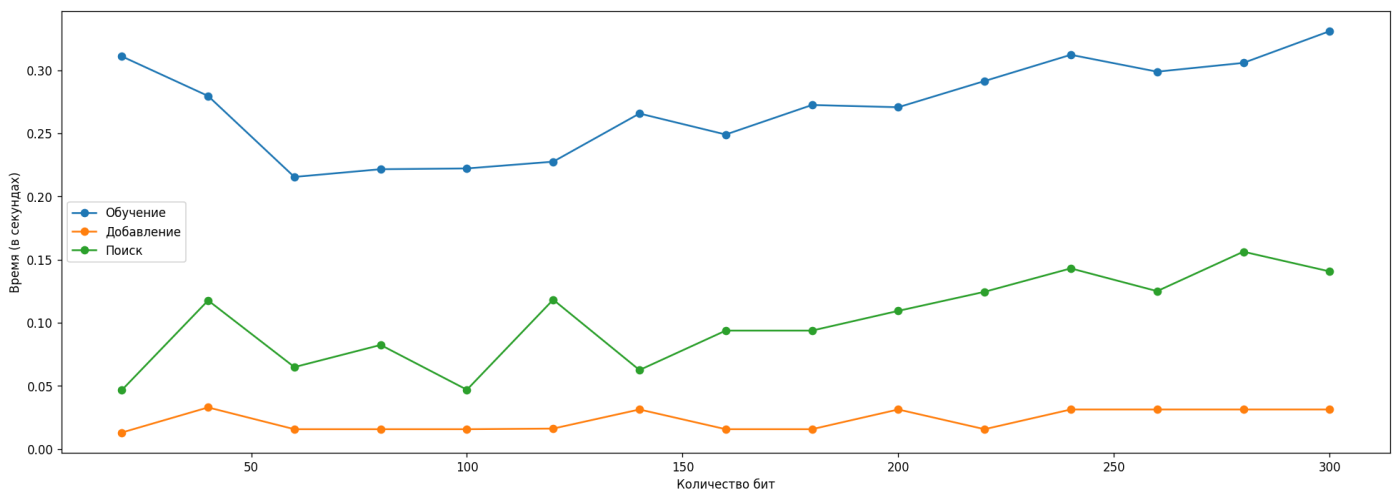   nprobe = 180
        Search time: 0.64 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
        nprobe = 210
        Search time: 0.82 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
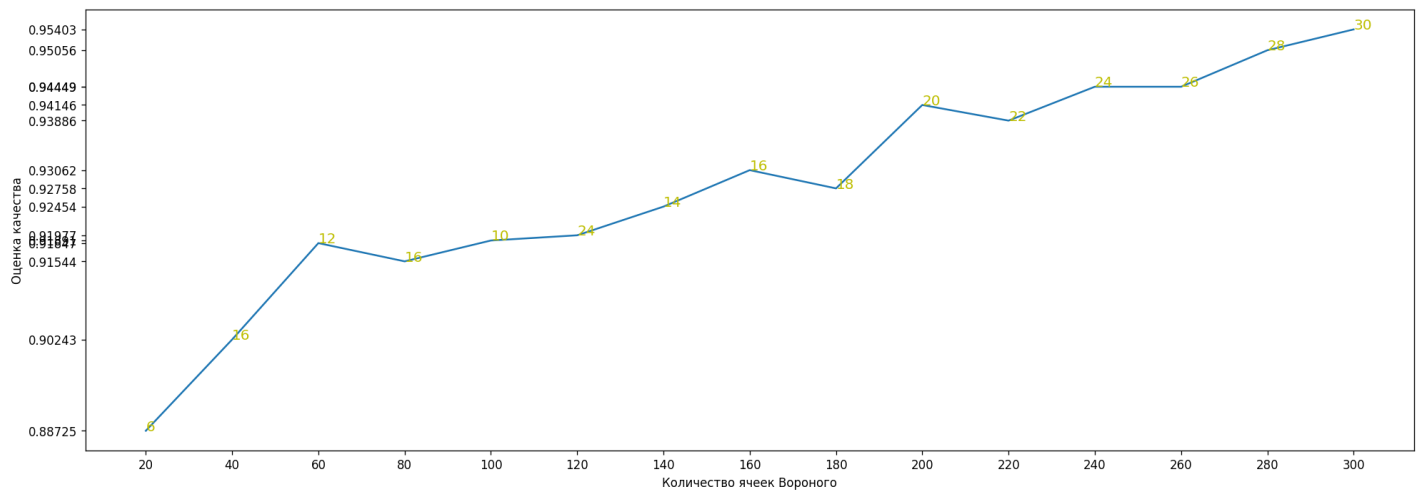   nprobe = 240
        Search time: 0.75 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
        nprobe = 270
        Search time: 0.83 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
        nprobe = 300
        Search time: 0.87 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB

The highest precision: 0.95403 (nprobe=30)
The smallest memory size: 0.691631 MB (nprobe=30)
The fastest search: 0.14seconds (nprobe=30)
----

n_subquantizers = 2
Train time: 0.30 seconds
Addition time: 0.02 seconds
        nprobe = 30
        Search time: 0.14 seconds Precision: 0.9267129228100607 Memory: 0.681037 MB
n_subquantizers = 4
Train time: 0.25 seconds
Addition time: 0.02 seconds
        nprobe = 30
        Search time: 0.13 seconds Precision: 0.9414570685169124 Memory: 0.686334 MB
n_subquantizers = 8
Train time: 0.30 seconds
Addition time: 0.03 seconds
        nprobe = 30
        Search time: 0.12 seconds Precision: 0.9540329575021682 Memory: 0.691631 MB
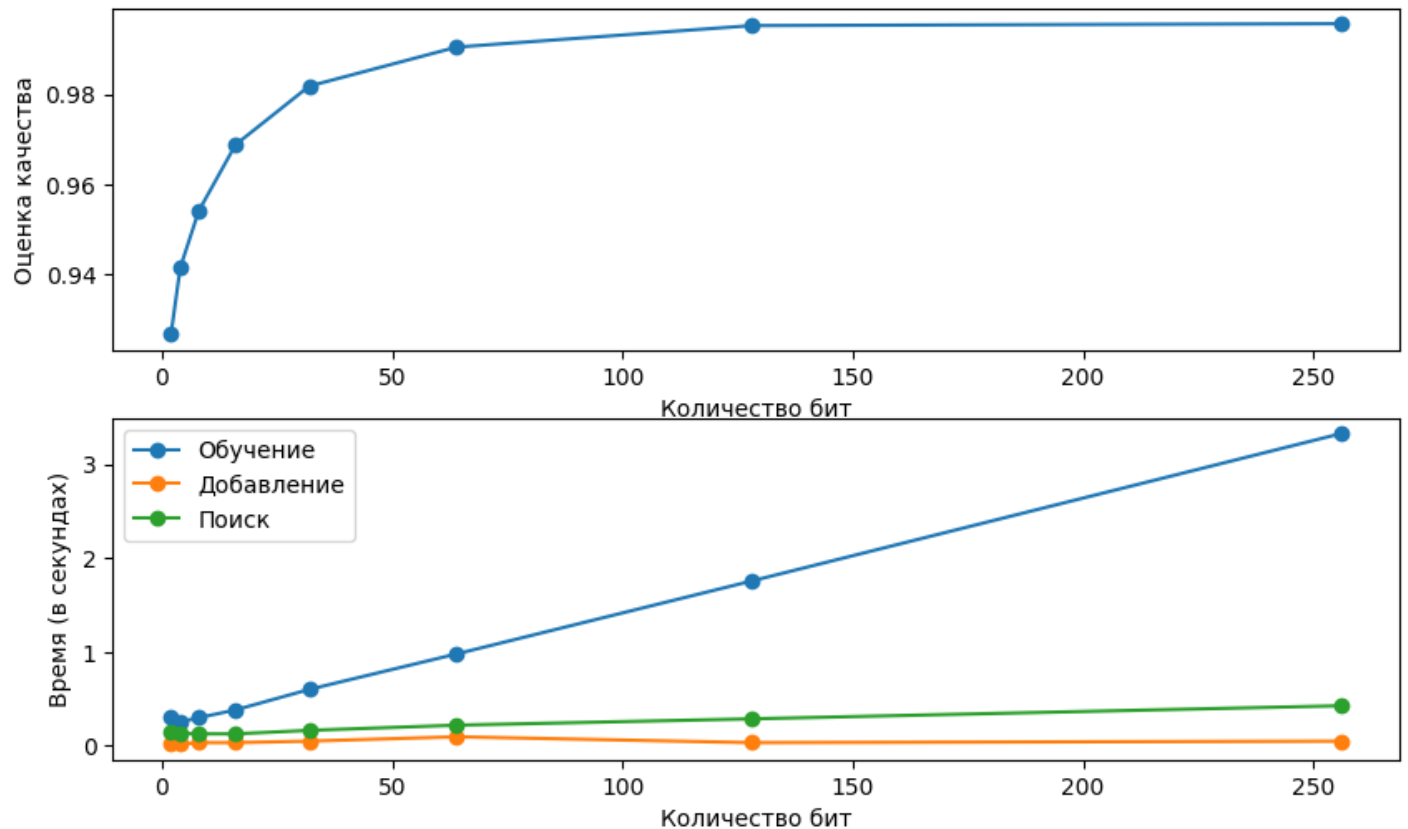
```
n_subquantizers = 16
Train time: 0.38 seconds
Addition time: 0.03 seconds
        nprobe = 30
        Search time: 0.12 seconds Precision: 0.96877710320902 Memory: 0.707522 MB
n_subquantizers = 32
Train time: 0.60 seconds
Addition time: 0.05 seconds
        nprobe = 30
        Search time: 0.16 seconds Precision: 0.981786643538595 Memory: 0.739304 MB
n_subquantizers = 64
Train time: 0.98 seconds
Addition time: 0.09 seconds
        nprobe = 30
        Search time: 0.22 seconds Precision: 0.9904596704249783 Memory: 0.802868 MB
n_subquantizers = 128
Train time: 1.75 seconds
Addition time: 0.03 seconds
        nprobe = 30
        Search time: 0.28 seconds Precision: 0.9952298352124892 Memory: 0.929996 MB
n_subquantizers = 256
Train time: 3.33 seconds
Addition time: 0.05 seconds
        nprobe = 30
        Search time: 0.42 seconds Precision: 0.9956634865568084 Memory: 1.184252 MB
```



```
n_bits = 1
Train time: 2.48 seconds
Addition time: 0.03 seconds
        nprobe = 30
        Search time: 0.39 seconds Precision: 0.9926279271465741 Memory: 0.832956 MB
n_bits = 2
Train time: 2.80 seconds
Addition time: 0.05 seconds
        nprobe = 30
        Search time: 0.36 seconds Precision: 0.9960971379011275 Memory: 1.006556 MB
n_bits = 3
Train time: 3.54 seconds
Addition time: 0.06 seconds
```
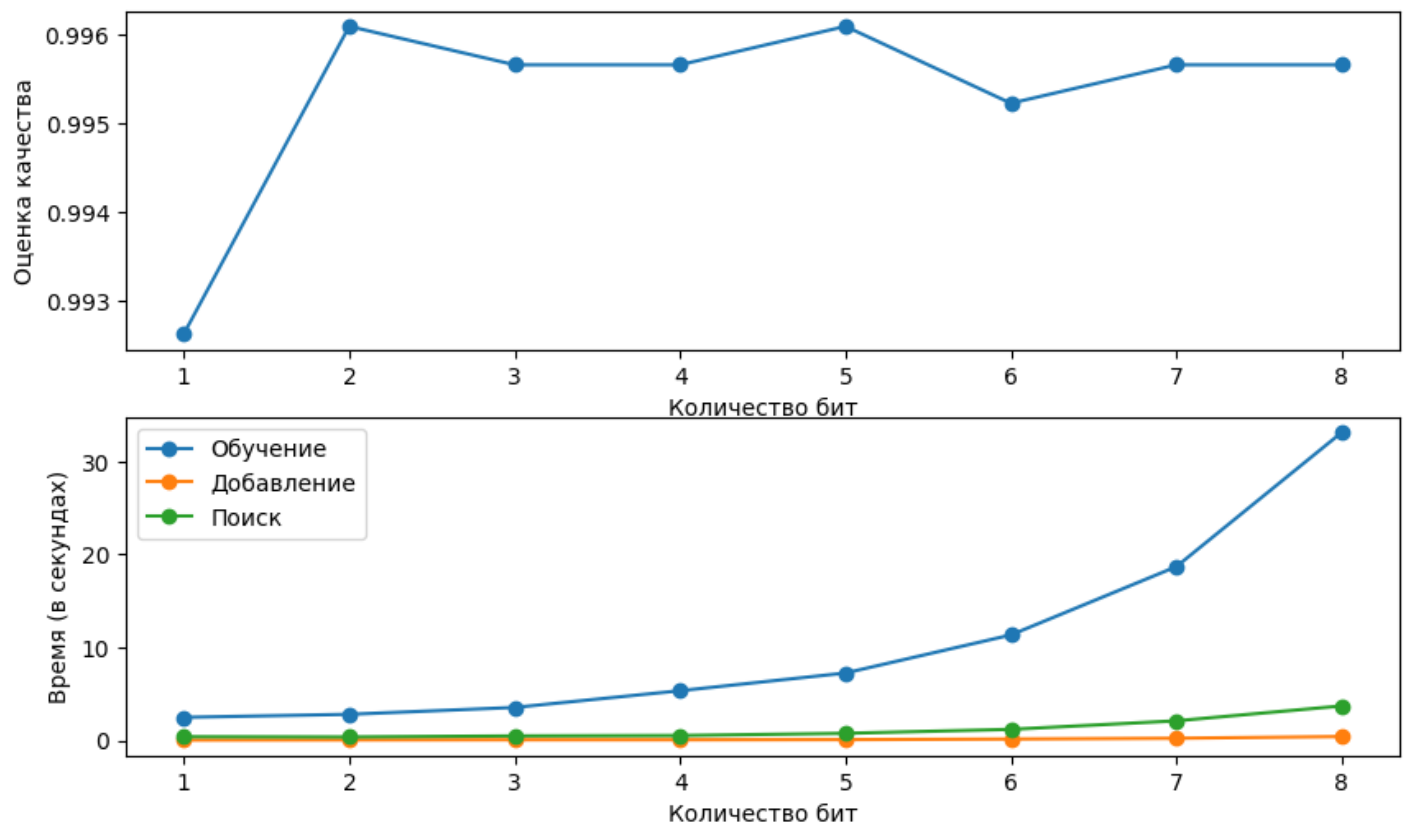
```
          nprobe = 30
          Search time: 0.48 seconds Precision: 0.9956634865568084 Memory: 1.184252 MB
n_bits = 4
Train time: 5.34 seconds
Addition time: 0.06 seconds
          nprobe = 30
          Search time: 0.52 seconds Precision: 0.9956634865568084 Memory: 1.37014 MB
n_bits = 5
Train time: 7.25 seconds
Addition time: 0.08 seconds
          nprobe = 30
          Search time: 0.76 seconds Precision: 0.9960971379011275 Memory: 1.572412 MB
n_bits = 6
Train time: 11.34 seconds
Addition time: 0.14 seconds
          nprobe = 30
          Search time: 1.18 seconds Precision: 0.9952298352124892 Memory: 1.807452 MB
n_bits = 7
Train time: 18.70 seconds
Addition time: 0.22 seconds
          nprobe = 30
          Search time: 2.10 seconds Precision: 0.9956634865568084 Memory: 2.108028 MB
n_bits = 8
Train time: 33.15 seconds
Addition time: 0.41 seconds
          nprobe = 30
          Search time: 3.70 seconds Precision: 0.9956634865568084 Memory: 2.539676 MB
```



```
Train time: 3.04 seconds
Addition time: 0.04 seconds
          nprobe = 30
          Search time: 0.41 seconds Precision: 0.9960971379011275 Memory: 1.006556 MB
Find optim params report:
```

{'train_time': 3.037064552307129, 'add_time': 0.043859720230102540, 'precision': 0.99609713
79011275, 'search_time': 0.40669775009155273, 'nprobe': 30, 'memory_size': 1.006556, 'n_li
st': 300, 'n_subquantizers': 256, 'n_bits': 2}

```
---------------
---------------
Iteration #2
n_list = 20
```

```
          Train time: 2.95 seconds
          Addition time: 0.05 seconds
                  nprobe = 2
                  Search time: 0.33 seconds Precision: 0.9440589765828274 Memory: 0.430876 MB
                  nprobe = 4
                  Search time: 0.50 seconds Precision: 0.9835212489158717 Memory: 0.430876 MB
                  nprobe = 6
                  Search time: 0.70 seconds Precision: 0.9930615784908933 Memory: 0.430876 MB
                  nprobe = 8
                  Search time: 0.89 seconds Precision: 0.9969644405897659 Memory: 0.430876 MB
                  nprobe = 10
                  Search time: 1.11 seconds Precision: 0.9978317432784042 Memory: 0.430876 MB
                  nprobe = 12
                  Search time: 1.22 seconds Precision: 0.9978317432784042 Memory: 0.430876 MB
                  nprobe = 14
                  Search time: 1.46 seconds Precision: 0.9986990459670425 Memory: 0.430876 MB
                  nprobe = 16
                  Search time: 1.67 seconds Precision: 0.9986990459670425 Memory: 0.430876 MB
                  nprobe = 18
                  Search time: 1.76 seconds Precision: 0.9986990459670425 Memory: 0.430876 MB
                  nprobe = 20
                  Search time: 1.93 seconds Precision: 0.9986990459670425 Memory: 0.430876 MB
        ----------
        The highest precision: 0.99870 (nprobe=14)
        The smallest memory size: 0.430876 MB (nprobe=2)
        The fastest search: 0.33seconds (nprobe=2)
        ----------
        n_list = 40
        Train time: 3.21 seconds
        Addition time: 0.03 seconds
                  nprobe = 4
                  Search time: 0.41 seconds Precision: 0.9774501300954033 Memory: 0.471996 MB
                  nprobe = 8
                  Search time: 0.48 seconds Precision: 0.9943625325238509 Memory: 0.471996 MB
                  nprobe = 12
                  Search time: 0.74 seconds Precision: 0.9965307892454467 Memory: 0.471996 MB
                  nprobe = 16
                  Search time: 0.82 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
                  nprobe = 20
                  Search time: 0.98 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
                  nprobe = 24
                  Search time: 1.25 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
                  nprobe = 28
                  Search time: 1.36 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
                  nprobe = 32
                  Search time: 1.58 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
                  nprobe = 36
                  Search time: 1.68 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
                  nprobe = 40
                  Search time: 1.90 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
        ----------
        The highest precision: 0.99870 (nprobe=16)
        The smallest memory size: 0.471996 MB (nprobe=4)
        The fastest search: 0.41seconds (nprobe=4)
        ----------
        n_list = 60
        Train time: 2.99 seconds
        Addition time: 0.03 seconds
                  nprobe = 6
                  Search time: 0.28 seconds Precision: 0.9861231569817867 Memory: 0.513116 MB
                  nprobe = 12
                  Search time: 0.46 seconds Precision: 0.9943625325238509 Memory: 0.513116 MB
                  nprobe = 18
                  Search time: 0.72 seconds Precision: 0.9960971379011275 Memory: 0.513116 MB
                  nprobe = 24
                  Search time: 0.93 seconds Precision: 0.9978317432784042 Memory: 0.513116 MB
```

```
            nprobe = 30
            Search time: 1.05 seconds Precision: 0.9986990459670425 Memory: 0.513116 MB
            nprobe = 36
            Search time: 1.24 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
            nprobe = 42
            Search time: 1.43 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
            nprobe = 48
            Search time: 1.35 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
            nprobe = 54
            Search time: 1.79 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
            nprobe = 60
            Search time: 2.00 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
    ----------
    The highest precision: 0.99957 (nprobe=36)
    The smallest memory size: 0.513116 MB (nprobe=6)
    The fastest search: 0.28seconds (nprobe=6)
    ----------
    n_list = 80
    Train time: 3.05 seconds
    Addition time: 0.03 seconds
            nprobe = 8
            Search time: 0.31 seconds Precision: 0.9878577623590633 Memory: 0.554236 MB
            nprobe = 16
            Search time: 0.60 seconds Precision: 0.9956634865568084 Memory: 0.554236 MB
            nprobe = 24
            Search time: 0.78 seconds Precision: 0.9969644405897659 Memory: 0.554236 MB
            nprobe = 32
            Search time: 1.02 seconds Precision: 0.9982653946227233 Memory: 0.554236 MB
            nprobe = 40
            Search time: 1.21 seconds Precision: 0.9982653946227233 Memory: 0.554236 MB
            nprobe = 48
            Search time: 1.32 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
            nprobe = 56
            Search time: 1.47 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
            nprobe = 64
            Search time: 1.69 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
            nprobe = 72
            Search time: 1.82 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
            nprobe = 80
            Search time: 2.13 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
    ----------
    The highest precision: 0.99870 (nprobe=48)
    The smallest memory size: 0.554236 MB (nprobe=8)
    The fastest search: 0.31seconds (nprobe=8)
    ----------
    n_list = 100
    Train time: 3.15 seconds
    Addition time: 0.03 seconds
            nprobe = 10
            Search time: 0.41 seconds Precision: 0.9878577623590633 Memory: 0.595356 MB
            nprobe = 20
            Search time: 0.59 seconds Precision: 0.99479618386817 Memory: 0.595356 MB
            nprobe = 30
            Search time: 0.81 seconds Precision: 0.997398091934085 Memory: 0.595356 MB
            nprobe = 40
            Search time: 1.01 seconds Precision: 0.9978317432784042 Memory: 0.595356 MB
            nprobe = 50
            Search time: 1.31 seconds Precision: 0.9978317432784042 Memory: 0.595356 MB
            nprobe = 60
            Search time: 1.43 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
            nprobe = 70
            Search time: 1.56 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
            nprobe = 80
            Search time: 1.82 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
            nprobe = 90
            Search time: 2.00 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
```

```
                nprobe = 100
                Search time: 2.23 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
        ----------
        The highest precision: 0.99827 (nprobe=60)
        The smallest memory size: 0.595356 MB (nprobe=10)
        The fastest search: 0.41seconds (nprobe=10)
        ----------
        n_list = 120
        Train time: 3.27 seconds
        Addition time: 0.03 seconds
                nprobe = 12
                Search time: 0.34 seconds Precision: 0.9908933217692975 Memory: 0.636476 MB
                nprobe = 24
                Search time: 0.59 seconds Precision: 0.9960971379011275 Memory: 0.636476 MB
                nprobe = 36
                Search time: 0.78 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
                nprobe = 48
                Search time: 1.08 seconds Precision: 0.9982653946227233 Memory: 0.636476 MB
                nprobe = 60
                Search time: 1.20 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
                nprobe = 72
                Search time: 1.52 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
                nprobe = 84
                Search time: 1.86 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
                nprobe = 96
                Search time: 1.89 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
                nprobe = 108
                Search time: 2.13 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
                nprobe = 120
                Search time: 2.36 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
        ----------
        The highest precision: 0.99827 (nprobe=48)
        The smallest memory size: 0.636476 MB (nprobe=12)
        The fastest search: 0.34seconds (nprobe=12)
        ----------
        n_list = 140
        Train time: 3.34 seconds
        Addition time: 0.05 seconds
                nprobe = 14
                Search time: 0.40 seconds Precision: 0.9900260190806591 Memory: 0.677596 MB
                nprobe = 28
                Search time: 0.60 seconds Precision: 0.99479618386817 Memory: 0.677596 MB
                nprobe = 42
                Search time: 0.90 seconds Precision: 0.997398091934085 Memory: 0.677596 MB
                nprobe = 56
                Search time: 1.10 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
                nprobe = 70
                Search time: 1.36 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
                nprobe = 84
                Search time: 1.58 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
                nprobe = 98
                Search time: 1.80 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
                nprobe = 112
                Search time: 2.06 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
                nprobe = 126
                Search time: 2.20 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
                nprobe = 140
                Search time: 2.43 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
        ----------
        The highest precision: 0.99783 (nprobe=56)
        The smallest memory size: 0.677596 MB (nprobe=14)
        The fastest search: 0.40seconds (nprobe=14)
        ----------
        n_list = 160
        Train time: 3.28 seconds
        Addition time: 0.03 seconds
```

```
          nprobe = 16
          Search time: 0.33 seconds Precision: 0.9939288811795317 Memory: 0.718716 MB
          nprobe = 32
          Search time: 0.63 seconds Precision: 0.9969644405897659 Memory: 0.718716 MB
          nprobe = 48
          Search time: 0.85 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
          nprobe = 64
          Search time: 1.05 seconds Precision: 0.9986990459670425 Memory: 0.718716 MB
          nprobe = 80
          Search time: 1.43 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
          nprobe = 96
          Search time: 1.55 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
          nprobe = 112
          Search time: 1.76 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
          nprobe = 128
          Search time: 1.97 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
          nprobe = 144
          Search time: 2.11 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
          nprobe = 160
          Search time: 2.37 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
    ----------
    The highest precision: 0.99870 (nprobe=64)
    The smallest memory size: 0.718716 MB (nprobe=16)
    The fastest search: 0.33seconds (nprobe=16)
    ----------
    n_list = 180
    Train time: 3.28 seconds
    Addition time: 0.03 seconds
          nprobe = 18
          Search time: 0.48 seconds Precision: 0.99479618386817 Memory: 0.759836 MB
          nprobe = 36
          Search time: 0.67 seconds Precision: 0.997398091934085 Memory: 0.759836 MB
          nprobe = 54
          Search time: 0.99 seconds Precision: 0.9982653946227233 Memory: 0.759836 MB
          nprobe = 72
          Search time: 1.21 seconds Precision: 0.9986990459670425 Memory: 0.759836 MB
          nprobe = 90
          Search time: 1.50 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
          nprobe = 108
          Search time: 1.53 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
          nprobe = 126
          Search time: 1.74 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
          nprobe = 144
          Search time: 2.01 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
          nprobe = 162
          Search time: 2.24 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
          nprobe = 180
          Search time: 2.50 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
    ----------
    The highest precision: 0.99913 (nprobe=90)
    The smallest memory size: 0.759836 MB (nprobe=18)
    The fastest search: 0.48seconds (nprobe=18)
    ----------
    n_list = 200
    Train time: 3.27 seconds
    Addition time: 0.05 seconds
          nprobe = 20
          Search time: 0.42 seconds Precision: 0.9965307892454467 Memory: 0.800956 MB
          nprobe = 40
          Search time: 0.74 seconds Precision: 0.9978317432784042 Memory: 0.800956 MB
          nprobe = 60
          Search time: 0.97 seconds Precision: 0.9982653946227233 Memory: 0.800956 MB
          nprobe = 80
          Search time: 1.21 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
          nprobe = 100
          Search time: 1.40 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
```

```
              nprobe = 120
              Search time: 1.64 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
              nprobe = 140
              Search time: 1.81 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
              nprobe = 160
              Search time: 2.06 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
              nprobe = 180
              Search time: 2.30 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
              nprobe = 200
              Search time: 2.57 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
      ----------
      The highest precision: 0.99913 (nprobe=80)
      The smallest memory size: 0.800956 MB (nprobe=20)
      The fastest search: 0.42seconds (nprobe=20)
      ----------
      n_list = 220
      Train time: 3.23 seconds
      Addition time: 0.03 seconds
              nprobe = 22
              Search time: 0.39 seconds Precision: 0.9960971379011275 Memory: 0.842076 MB
              nprobe = 44
              Search time: 0.68 seconds Precision: 0.9978317432784042 Memory: 0.842076 MB
              nprobe = 66
              Search time: 0.91 seconds Precision: 0.9978317432784042 Memory: 0.842076 MB
              nprobe = 88
              Search time: 1.20 seconds Precision: 0.9978317432784042 Memory: 0.842076 MB
              nprobe = 110
              Search time: 1.38 seconds Precision: 0.9978317432784042 Memory: 0.842076 MB
              nprobe = 132
              Search time: 1.69 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
              nprobe = 154
              Search time: 1.92 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
              nprobe = 176
              Search time: 2.13 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
              nprobe = 198
              Search time: 2.43 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
              nprobe = 220
              Search time: 2.68 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
      ----------
      The highest precision: 0.99827 (nprobe=132)
      The smallest memory size: 0.842076 MB (nprobe=22)
      The fastest search: 0.39seconds (nprobe=22)
      ----------
      n_list = 240
      Train time: 3.24 seconds
      Addition time: 0.05 seconds
              nprobe = 24
              Search time: 0.38 seconds Precision: 0.9956634865568084 Memory: 0.883196 MB
              nprobe = 48
              Search time: 0.68 seconds Precision: 0.997398091934085 Memory: 0.883196 MB
              nprobe = 72
              Search time: 1.03 seconds Precision: 0.997398091934085 Memory: 0.883196 MB
              nprobe = 96
              Search time: 1.23 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
              nprobe = 120
              Search time: 1.50 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
              nprobe = 144
              Search time: 1.70 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
              nprobe = 168
              Search time: 1.98 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
              nprobe = 192
              Search time: 2.17 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
              nprobe = 216
              Search time: 2.44 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
              nprobe = 240
              Search time: 2.71 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
```

```
          ----------
          The highest precision: 0.99783 (nprobe=96)
          The smallest memory size: 0.883196 MB (nprobe=24)
          The fastest search: 0.38seconds (nprobe=24)
          ----------
          n_list = 260
          Train time: 3.25 seconds
          Addition time: 0.05 seconds
                  nprobe = 26
                  Search time: 0.41 seconds Precision: 0.9965307892454467 Memory: 0.924316 MB
                  nprobe = 52
                  Search time: 0.71 seconds Precision: 0.9978317432784042 Memory: 0.924316 MB
                  nprobe = 78
                  Search time: 0.90 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
                  nprobe = 104
                  Search time: 1.22 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
                  nprobe = 130
                  Search time: 1.36 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
                  nprobe = 156
                  Search time: 1.64 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
                  nprobe = 182
                  Search time: 1.93 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
                  nprobe = 208
                  Search time: 2.15 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
                  nprobe = 234
                  Search time: 2.39 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
                  nprobe = 260
                  Search time: 2.71 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
          ----------
          The highest precision: 0.99913 (nprobe=78)
          The smallest memory size: 0.924316 MB (nprobe=26)
          The fastest search: 0.41seconds (nprobe=26)
          ----------
          n_list = 280
          Train time: 3.23 seconds
          Addition time: 0.05 seconds
                  nprobe = 28
                  Search time: 0.40 seconds Precision: 0.9960971379011275 Memory: 0.965436 MB
                  nprobe = 56
                  Search time: 0.67 seconds Precision: 0.9986990459670425 Memory: 0.965436 MB
                  nprobe = 84
                  Search time: 0.97 seconds Precision: 0.9986990459670425 Memory: 0.965436 MB
                  nprobe = 112
                  Search time: 1.29 seconds Precision: 0.9991326973113617 Memory: 0.965436 MB
                  nprobe = 140
                  Search time: 1.45 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
                  nprobe = 168
                  Search time: 1.74 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
                  nprobe = 196
                  Search time: 2.04 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
                  nprobe = 224
                  Search time: 2.22 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
                  nprobe = 252
                  Search time: 2.60 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
                  nprobe = 280
                  Search time: 2.88 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
          ----------
          The highest precision: 0.99957 (nprobe=140)
          The smallest memory size: 0.965436 MB (nprobe=28)
          The fastest search: 0.40seconds (nprobe=28)
          ----------
          n_list = 300
          Train time: 3.34 seconds
          Addition time: 0.03 seconds
                  nprobe = 30
                  Search time: 0.36 seconds Precision: 0.9960971379011275 Memory: 1.006556 MB
```
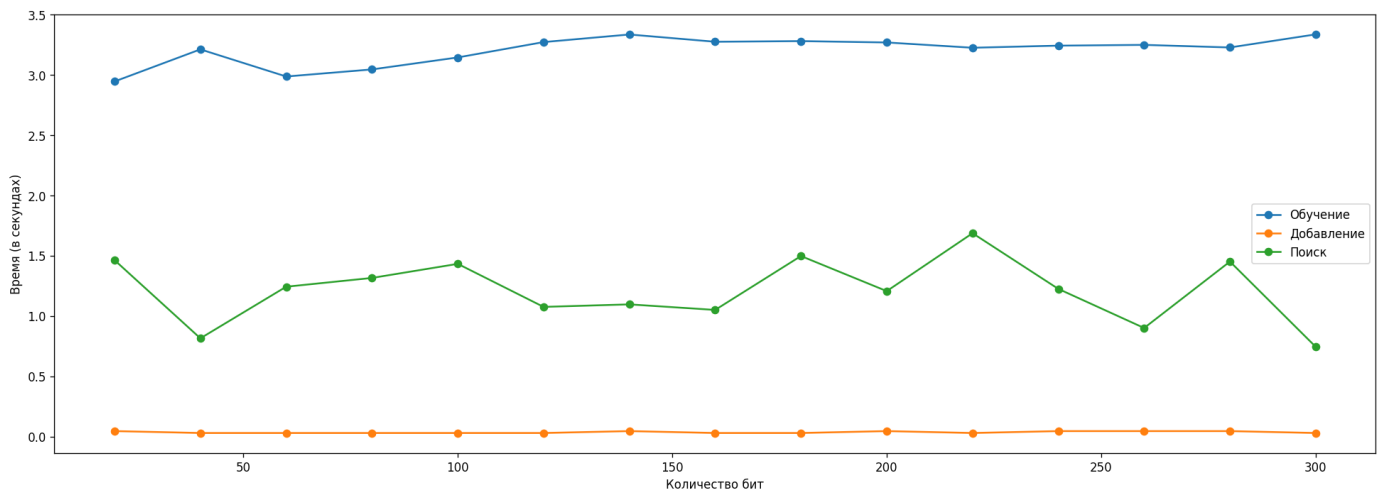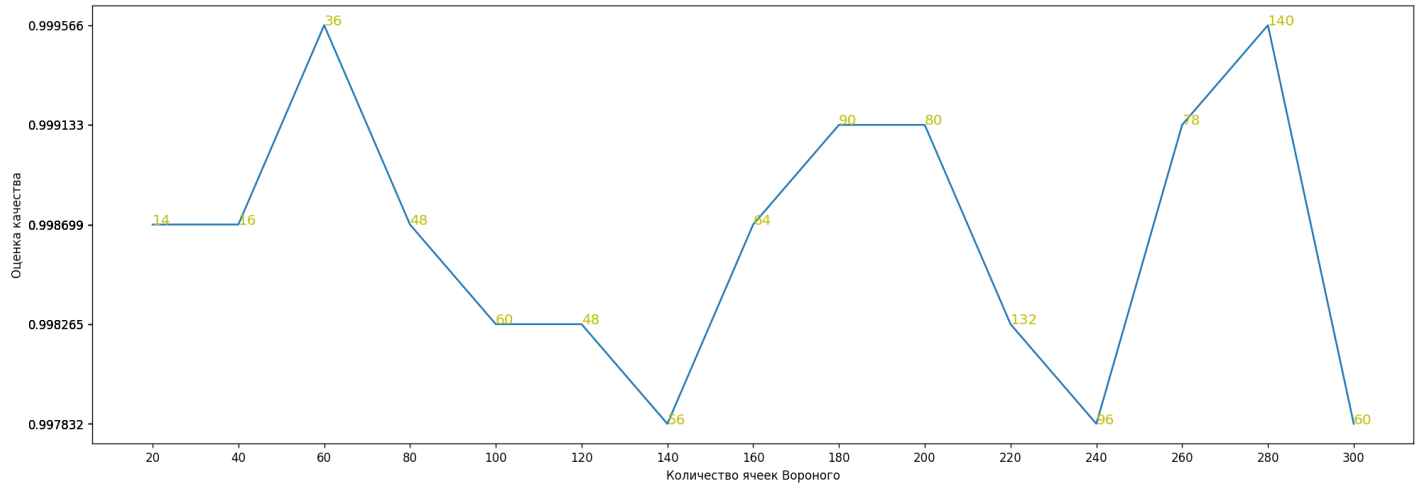
        nprobe = 60
        Search time: 0.75 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 90
        Search time: 0.97 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 120
        Search time: 1.29 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 150
        Search time: 1.65 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 180
        Search time: 1.86 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 210
        Search time: 1.84 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 240
        Search time: 2.36 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 270
        Search time: 2.63 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 300
        Search time: 2.87 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB

The highest precision: 0.99783 (nprobe=60)
The smallest memory size: 1.006556 MB (nprobe=30)
The fastest search: 0.36seconds (nprobe=30)
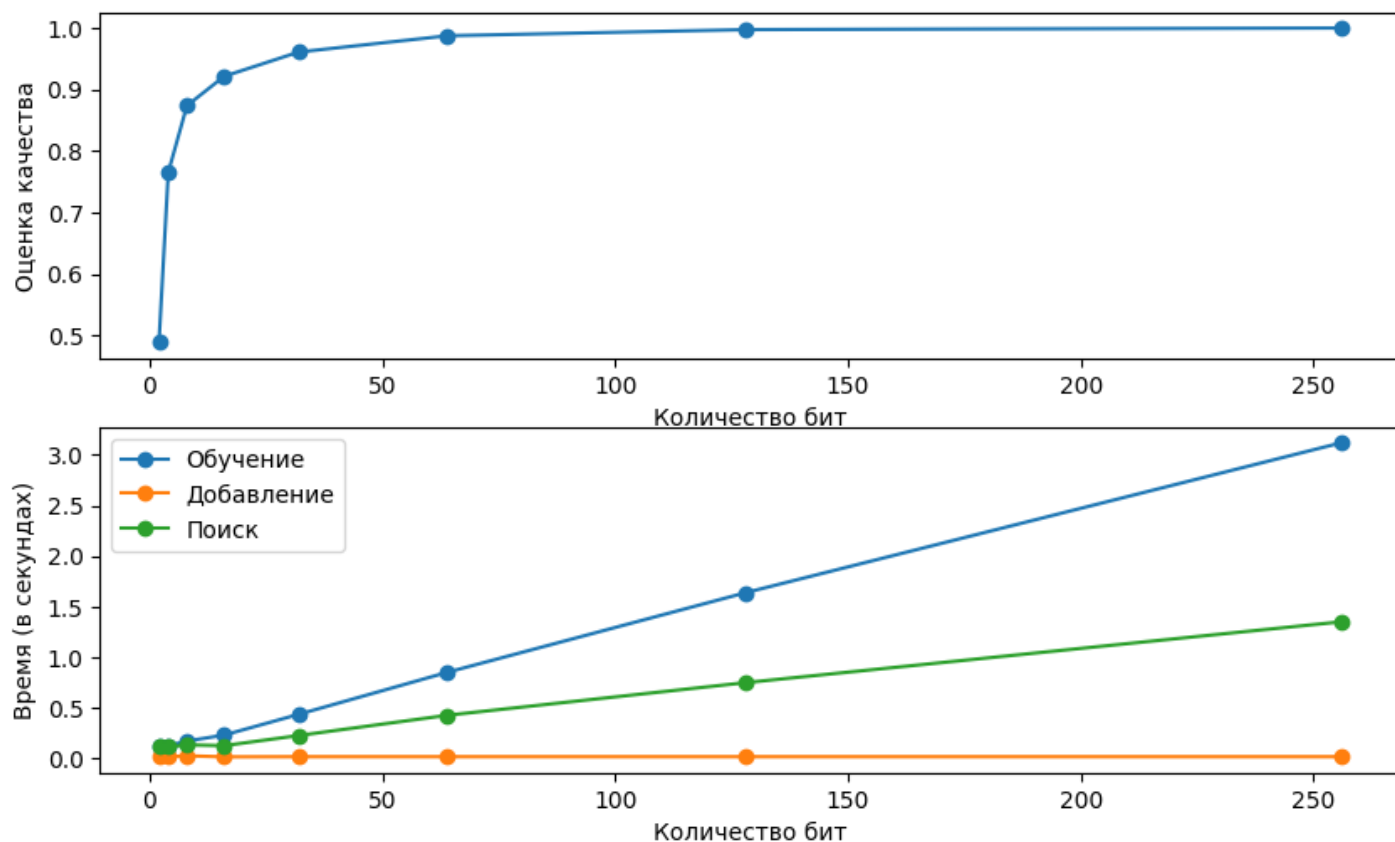----------

n_subquantizers = 2
Train time: 0.11 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.12 seconds Precision: 0.4891587163920208 Memory: 0.179405 MB
n_subquantizers = 4
Train time: 0.12 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.11 seconds Precision: 0.7649609713790113 Memory: 0.179405 MB

```
n_subquantizers = 8
Train time: 0.17 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.13 seconds Precision: 0.8733738074588031 Memory: 0.184702 MB
n_subquantizers = 16
Train time: 0.23 seconds
Addition time: 0.01 seconds
        nprobe = 36
        Search time: 0.12 seconds Precision: 0.9210754553339116 Memory: 0.195296 MB
n_subquantizers = 32
Train time: 0.43 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.23 seconds Precision: 0.9605377276669558 Memory: 0.216484 MB
n_subquantizers = 64
Train time: 0.85 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.43 seconds Precision: 0.986990459670425 Memory: 0.25886 MB
n_subquantizers = 128
Train time: 1.64 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.75 seconds Precision: 0.9969644405897659 Memory: 0.343612 MB
n_subquantizers = 256
Train time: 3.12 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 1.35 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
```
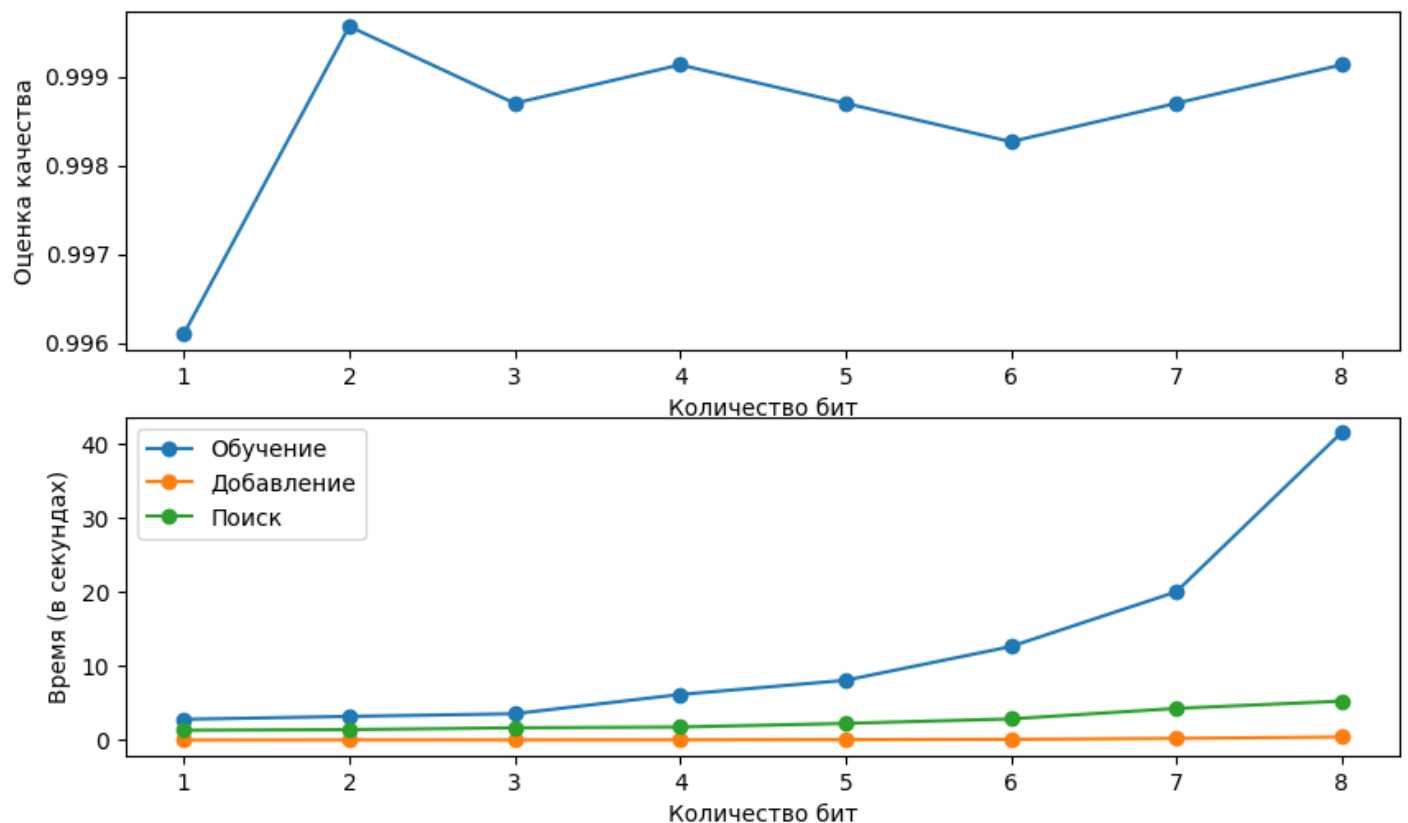


```
n_bits = 1
Train time: 2.82 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 1.34 seconds Precision: 0.9960971379011275 Memory: 0.339516 MB
n_bits = 2
Train time: 3.21 seconds
Addition time: 0.03 seconds
```

```
            nprobe = 36
            Search time: 1.42 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
n_bits = 3
Train time: 3.57 seconds
Addition time: 0.03 seconds
            nprobe = 36
            Search time: 1.67 seconds Precision: 0.9986990459670425 Memory: 0.690812 MB
n_bits = 4
Train time: 6.16 seconds
Addition time: 0.05 seconds
            nprobe = 36
            Search time: 1.77 seconds Precision: 0.9991326973113617 Memory: 0.8767 MB
n_bits = 5
Train time: 8.07 seconds
Addition time: 0.08 seconds
            nprobe = 36
            Search time: 2.26 seconds Precision: 0.9986990459670425 Memory: 1.078972 MB
n_bits = 6
Train time: 12.62 seconds
Addition time: 0.11 seconds
            nprobe = 36
            Search time: 2.87 seconds Precision: 0.9982653946227233 Memory: 1.314012 MB
n_bits = 7
Train time: 20.00 seconds
Addition time: 0.24 seconds
            nprobe = 36
            Search time: 4.28 seconds Precision: 0.9986990459670425 Memory: 1.614588 MB
n_bits = 8
Train time: 41.48 seconds
Addition time: 0.43 seconds
            nprobe = 36
            Search time: 5.26 seconds Precision: 0.9991326973113617 Memory: 2.046236 MB
```



```
Train time: 3.27 seconds
Addition time: 0.03 seconds
            nprobe = 36
            Search time: 1.42 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
Find optim params report:
{'train_time': 3.2745769023895264, 'add_time': 0.03124380111694336, 'precision': 0.9995663
486556808, 'search_time': 1.4159448146820068, 'nprobe': 36, 'memory_size': 0.513116, 'n_li
```

```
st': 60, 'n_subquantizers': 256, 'n_bits': 2}
--------------
--------------
Iteration #3
n_list = 20
Train time: 3.30 seconds
Addition time: 0.03 seconds
        nprobe = 2
        Search time: 0.31 seconds Precision: 0.9440589765828274 Memory: 0.430876 MB
        nprobe = 4
        Search time: 0.48 seconds Precision: 0.9835212489158717 Memory: 0.430876 MB
        nprobe = 6
        Search time: 0.66 seconds Precision: 0.9930615784908933 Memory: 0.430876 MB
        nprobe = 8
        Search time: 0.90 seconds Precision: 0.9969644405897659 Memory: 0.430876 MB
        nprobe = 10
        Search time: 1.05 seconds Precision: 0.9978317432784042 Memory: 0.430876 MB
        nprobe = 12
        Search time: 1.18 seconds Precision: 0.9978317432784042 Memory: 0.430876 MB
        nprobe = 14
        Search time: 1.39 seconds Precision: 0.9986990459670425 Memory: 0.430876 MB
        nprobe = 16
        Search time: 1.49 seconds Precision: 0.9986990459670425 Memory: 0.430876 MB
        nprobe = 18
        Search time: 1.71 seconds Precision: 0.9986990459670425 Memory: 0.430876 MB
        nprobe = 20
        Search time: 1.86 seconds Precision: 0.9986990459670425 Memory: 0.430876 MB
----------
The highest precision: 0.99870 (nprobe=14)
The smallest memory size: 0.430876 MB (nprobe=2)
The fastest search: 0.31seconds (nprobe=2)
----------
n_list = 40
Train time: 3.27 seconds
Addition time: 0.03 seconds
        nprobe = 4
        Search time: 0.34 seconds Precision: 0.9774501300954033 Memory: 0.471996 MB
        nprobe = 8
        Search time: 0.54 seconds Precision: 0.9943625325238509 Memory: 0.471996 MB
        nprobe = 12
        Search time: 0.71 seconds Precision: 0.9965307892454467 Memory: 0.471996 MB
        nprobe = 16
        Search time: 0.99 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
        nprobe = 20
        Search time: 1.03 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
        nprobe = 24
        Search time: 1.29 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
        nprobe = 28
        Search time: 1.43 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
        nprobe = 32
        Search time: 1.59 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
        nprobe = 36
        Search time: 1.90 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
        nprobe = 40
        Search time: 1.96 seconds Precision: 0.9986990459670425 Memory: 0.471996 MB
----------
The highest precision: 0.99870 (nprobe=16)
The smallest memory size: 0.471996 MB (nprobe=4)
The fastest search: 0.34seconds (nprobe=4)
------------
n_list = 60
Train time: 3.12 seconds
Addition time: 0.02 seconds
        nprobe = 6
        Search time: 0.36 seconds Precision: 0.9861231569817867 Memory: 0.513116 MB
        nprobe = 12
```

```
              Search time: 0.55 seconds Precision: 0.9943625325238509 Memory: 0.513116 MB
              nprobe = 18
              Search time: 0.67 seconds Precision: 0.9960971379011275 Memory: 0.513116 MB
              nprobe = 24
              Search time: 0.89 seconds Precision: 0.9978317432784042 Memory: 0.513116 MB
              nprobe = 30
              Search time: 1.04 seconds Precision: 0.9986990459670425 Memory: 0.513116 MB
              nprobe = 36
              Search time: 1.19 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
              nprobe = 42
              Search time: 1.39 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
              nprobe = 48
              Search time: 1.58 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
              nprobe = 54
              Search time: 1.79 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
              nprobe = 60
              Search time: 1.96 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
      ----------
      The highest precision: 0.99957 (nprobe=36)
      The smallest memory size: 0.513116 MB (nprobe=6)
      The fastest search: 0.36seconds (nprobe=6)
      ----------
      n_list = 80
      Train time: 3.11 seconds
      Addition time: 0.03 seconds
              nprobe = 8
              Search time: 0.43 seconds Precision: 0.9878577623590633 Memory: 0.554236 MB
              nprobe = 16
              Search time: 0.57 seconds Precision: 0.9956634865568084 Memory: 0.554236 MB
              nprobe = 24
              Search time: 0.70 seconds Precision: 0.9969644405897659 Memory: 0.554236 MB
              nprobe = 32
              Search time: 0.91 seconds Precision: 0.9982653946227233 Memory: 0.554236 MB
              nprobe = 40
              Search time: 1.14 seconds Precision: 0.9982653946227233 Memory: 0.554236 MB
              nprobe = 48
              Search time: 1.32 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
              nprobe = 56
              Search time: 1.50 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
              nprobe = 64
              Search time: 1.82 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
              nprobe = 72
              Search time: 1.91 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
              nprobe = 80
              Search time: 2.02 seconds Precision: 0.9986990459670425 Memory: 0.554236 MB
      ----------
      The highest precision: 0.99870 (nprobe=48)
      The smallest memory size: 0.554236 MB (nprobe=8)
      The fastest search: 0.43seconds (nprobe=8)
      ----------
      n_list = 100
      Train time: 3.16 seconds
      Addition time: 0.03 seconds
              nprobe = 10
              Search time: 0.35 seconds Precision: 0.9878577623590633 Memory: 0.595356 MB
              nprobe = 20
              Search time: 0.59 seconds Precision: 0.99479618386817 Memory: 0.595356 MB
              nprobe = 30
              Search time: 0.82 seconds Precision: 0.997398091934085 Memory: 0.595356 MB
              nprobe = 40
              Search time: 1.05 seconds Precision: 0.9978317432784042 Memory: 0.595356 MB
              nprobe = 50
              Search time: 1.19 seconds Precision: 0.9978317432784042 Memory: 0.595356 MB
              nprobe = 60
              Search time: 1.35 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
              nprobe = 70
```

```
            Search time: 1.62 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
            nprobe = 80
            Search time: 1.78 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
            nprobe = 90
            Search time: 1.95 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
            nprobe = 100
            Search time: 2.17 seconds Precision: 0.9982653946227233 Memory: 0.595356 MB
----------
The highest precision: 0.99827 (nprobe=60)
The smallest memory size: 0.595356 MB (nprobe=10)
The fastest search: 0.35seconds (nprobe=10)
----------
n_list = 120
Train time: 3.24 seconds
Addition time: 0.03 seconds
            nprobe = 12
            Search time: 0.42 seconds Precision: 0.9908933217692975 Memory: 0.636476 MB
            nprobe = 24
            Search time: 0.61 seconds Precision: 0.9960971379011275 Memory: 0.636476 MB
            nprobe = 36
            Search time: 0.81 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
            nprobe = 48
            Search time: 1.01 seconds Precision: 0.9982653946227233 Memory: 0.636476 MB
            nprobe = 60
            Search time: 1.22 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
            nprobe = 72
            Search time: 1.43 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
            nprobe = 84
            Search time: 1.62 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
            nprobe = 96
            Search time: 1.94 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
            nprobe = 108
            Search time: 2.09 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
            nprobe = 120
            Search time: 2.35 seconds Precision: 0.9978317432784042 Memory: 0.636476 MB
----------
The highest precision: 0.99827 (nprobe=48)
The smallest memory size: 0.636476 MB (nprobe=12)
The fastest search: 0.42seconds (nprobe=12)
----------
n_list = 140
Train time: 3.28 seconds
Addition time: 0.03 seconds
            nprobe = 14
            Search time: 0.38 seconds Precision: 0.9900260190806591 Memory: 0.677596 MB
            nprobe = 28
            Search time: 0.64 seconds Precision: 0.99479618386817 Memory: 0.677596 MB
            nprobe = 42
            Search time: 0.81 seconds Precision: 0.997398091934085 Memory: 0.677596 MB
            nprobe = 56
            Search time: 1.07 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
            nprobe = 70
            Search time: 1.34 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
            nprobe = 84
            Search time: 1.48 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
            nprobe = 98
            Search time: 1.66 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
            nprobe = 112
            Search time: 1.86 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
            nprobe = 126
            Search time: 2.12 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
            nprobe = 140
            Search time: 2.31 seconds Precision: 0.9978317432784042 Memory: 0.677596 MB
----------
The highest precision: 0.99783 (nprobe=56)
The smallest memory size: 0.677596 MB (nprobe=14)
```

```
The fastest search: 0.38seconds (nprobe=14)
----------
n_list = 160
Train time: 3.28 seconds
Addition time: 0.05 seconds
        nprobe = 16
        Search time: 0.37 seconds Precision: 0.9939288811795317 Memory: 0.718716 MB
        nprobe = 32
        Search time: 0.64 seconds Precision: 0.9969644405897659 Memory: 0.718716 MB
        nprobe = 48
        Search time: 0.88 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
        nprobe = 64
        Search time: 1.05 seconds Precision: 0.9986990459670425 Memory: 0.718716 MB
        nprobe = 80
        Search time: 1.27 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
        nprobe = 96
        Search time: 1.50 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
        nprobe = 112
        Search time: 1.69 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
        nprobe = 128
        Search time: 2.07 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
        nprobe = 144
        Search time: 2.19 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
        nprobe = 160
        Search time: 2.47 seconds Precision: 0.9982653946227233 Memory: 0.718716 MB
----------
The highest precision: 0.99870 (nprobe=64)
The smallest memory size: 0.718716 MB (nprobe=16)
The fastest search: 0.37seconds (nprobe=16)
----------
n_list = 180
Train time: 3.34 seconds
Addition time: 0.03 seconds
        nprobe = 18
        Search time: 0.36 seconds Precision: 0.99479618386817 Memory: 0.759836 MB
        nprobe = 36
        Search time: 0.68 seconds Precision: 0.997398091934085 Memory: 0.759836 MB
        nprobe = 54
        Search time: 0.88 seconds Precision: 0.9982653946227233 Memory: 0.759836 MB
        nprobe = 72
        Search time: 1.11 seconds Precision: 0.9986990459670425 Memory: 0.759836 MB
        nprobe = 90
        Search time: 1.28 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
        nprobe = 108
        Search time: 1.65 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
        nprobe = 126
        Search time: 1.86 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
        nprobe = 144
        Search time: 2.01 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
        nprobe = 162
        Search time: 2.30 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
        nprobe = 180
        Search time: 2.38 seconds Precision: 0.9991326973113617 Memory: 0.759836 MB
----------
The highest precision: 0.99913 (nprobe=90)
The smallest memory size: 0.759836 MB (nprobe=18)
The fastest search: 0.36seconds (nprobe=18)
----------
n_list = 200
Train time: 3.34 seconds
Addition time: 0.05 seconds
        nprobe = 20
        Search time: 0.43 seconds Precision: 0.9965307892454467 Memory: 0.800956 MB
        nprobe = 40
        Search time: 0.72 seconds Precision: 0.9978317432784042 Memory: 0.800956 MB
        nprobe = 60
```

```
          Search time: 0.92 seconds Precision: 0.9982653946227233 Memory: 0.800956 MB
          nprobe = 80
          Search time: 1.13 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
          nprobe = 100
          Search time: 1.34 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
          nprobe = 120
          Search time: 1.59 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
          nprobe = 140
          Search time: 1.84 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
          nprobe = 160
          Search time: 2.11 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
          nprobe = 180
          Search time: 2.36 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
          nprobe = 200
          Search time: 2.53 seconds Precision: 0.9991326973113617 Memory: 0.800956 MB
  ----------
  The highest precision: 0.99913 (nprobe=80)
  The smallest memory size: 0.800956 MB (nprobe=20)
  The fastest search: 0.43seconds (nprobe=20)
  ----------
  n_list = 220
  Train time: 3.28 seconds
  Addition time: 0.05 seconds
          nprobe = 22
          Search time: 0.42 seconds Precision: 0.9960971379011275 Memory: 0.842076 MB
          nprobe = 44
          Search time: 0.67 seconds Precision: 0.9978317432784042 Memory: 0.842076 MB
          nprobe = 66
          Search time: 0.93 seconds Precision: 0.9978317432784042 Memory: 0.842076 MB
          nprobe = 88
          Search time: 1.18 seconds Precision: 0.9978317432784042 Memory: 0.842076 MB
          nprobe = 110
          Search time: 1.48 seconds Precision: 0.9978317432784042 Memory: 0.842076 MB
          nprobe = 132
          Search time: 1.60 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
          nprobe = 154
          Search time: 1.92 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
          nprobe = 176
          Search time: 2.13 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
          nprobe = 198
          Search time: 2.31 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
          nprobe = 220
          Search time: 2.53 seconds Precision: 0.9982653946227233 Memory: 0.842076 MB
  ----------
  The highest precision: 0.99827 (nprobe=132)
  The smallest memory size: 0.842076 MB (nprobe=22)
  The fastest search: 0.42seconds (nprobe=22)
  ----------
  n_list = 240
  Train time: 3.29 seconds
  Addition time: 0.03 seconds
          nprobe = 24
          Search time: 0.40 seconds Precision: 0.9956634865568084 Memory: 0.883196 MB
          nprobe = 48
          Search time: 0.69 seconds Precision: 0.997398091934085 Memory: 0.883196 MB
          nprobe = 72
          Search time: 0.90 seconds Precision: 0.997398091934085 Memory: 0.883196 MB
          nprobe = 96
          Search time: 1.19 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
          nprobe = 120
          Search time: 1.40 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
          nprobe = 144
          Search time: 1.63 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
          nprobe = 168
          Search time: 1.95 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
          nprobe = 192
```

```
              Search time: 2.44 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
              nprobe = 216
              Search time: 2.40 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
              nprobe = 240
              Search time: 2.73 seconds Precision: 0.9978317432784042 Memory: 0.883196 MB
      ----------
      The highest precision: 0.99783 (nprobe=96)
      The smallest memory size: 0.883196 MB (nprobe=24)
      The fastest search: 0.40seconds (nprobe=24)
      ----------
      n_list = 260
      Train time: 3.41 seconds
      Addition time: 0.05 seconds
              nprobe = 26
              Search time: 0.43 seconds Precision: 0.9965307892454467 Memory: 0.924316 MB
              nprobe = 52
              Search time: 0.72 seconds Precision: 0.9978317432784042 Memory: 0.924316 MB
              nprobe = 78
              Search time: 0.94 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
              nprobe = 104
              Search time: 1.22 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
              nprobe = 130
              Search time: 1.51 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
              nprobe = 156
              Search time: 1.81 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
              nprobe = 182
              Search time: 1.96 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
              nprobe = 208
              Search time: 2.30 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
              nprobe = 234
              Search time: 2.48 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
              nprobe = 260
              Search time: 2.73 seconds Precision: 0.9991326973113617 Memory: 0.924316 MB
      ----------
      The highest precision: 0.99913 (nprobe=78)
      The smallest memory size: 0.924316 MB (nprobe=26)
      The fastest search: 0.43seconds (nprobe=26)
      ----------
      n_list = 280
      Train time: 3.32 seconds
      Addition time: 0.05 seconds
              nprobe = 28
              Search time: 0.47 seconds Precision: 0.9960971379011275 Memory: 0.965436 MB
              nprobe = 56
              Search time: 0.70 seconds Precision: 0.9986990459670425 Memory: 0.965436 MB
              nprobe = 84
              Search time: 1.01 seconds Precision: 0.9986990459670425 Memory: 0.965436 MB
              nprobe = 112
              Search time: 1.22 seconds Precision: 0.9991326973113617 Memory: 0.965436 MB
              nprobe = 140
              Search time: 1.54 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
              nprobe = 168
              Search time: 1.71 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
              nprobe = 196
              Search time: 1.99 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
              nprobe = 224
              Search time: 2.22 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
              nprobe = 252
              Search time: 2.52 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
              nprobe = 280
              Search time: 2.82 seconds Precision: 0.9995663486556808 Memory: 0.965436 MB
      ----------
      The highest precision: 0.99957 (nprobe=140)
      The smallest memory size: 0.965436 MB (nprobe=28)
      The fastest search: 0.47seconds (nprobe=28)
      ----------
```
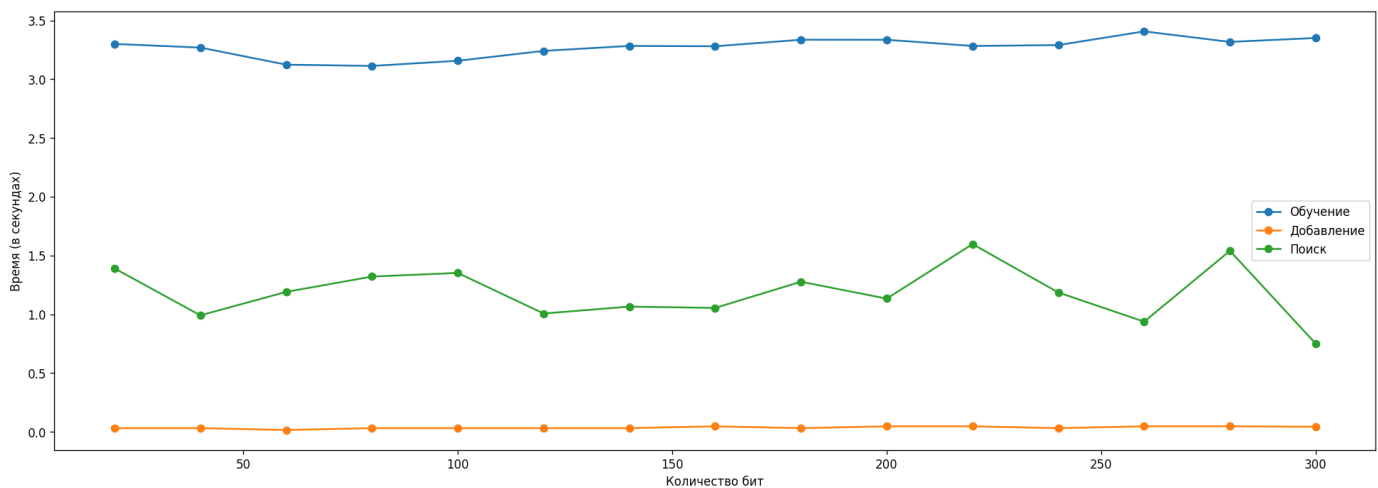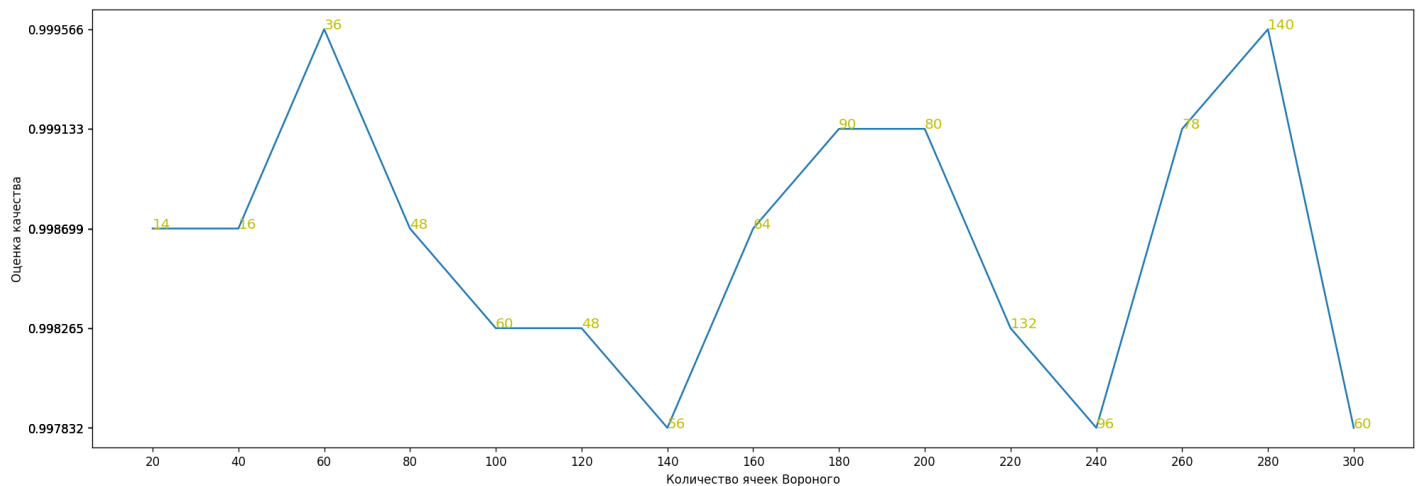
```
n_list = 300
Train time: 3.35 seconds
Addition time: 0.04 seconds
        nprobe = 30
        Search time: 0.44 seconds Precision: 0.9960971379011275 Memory: 1.006556 MB
        nprobe = 60
        Search time: 0.75 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 90
        Search time: 0.97 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 120
        Search time: 1.28 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 150
        Search time: 1.58 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 180
        Search time: 1.80 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 210
        Search time: 2.03 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 240
        Search time: 2.34 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 270
        Search time: 2.61 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
        nprobe = 300
        Search time: 2.91 seconds Precision: 0.9978317432784042 Memory: 1.006556 MB
----------
The highest precision: 0.99783 (nprobe=60)
The smallest memory size: 1.006556 MB (nprobe=30)
The fastest search: 0.44seconds (nprobe=30)
----------
```
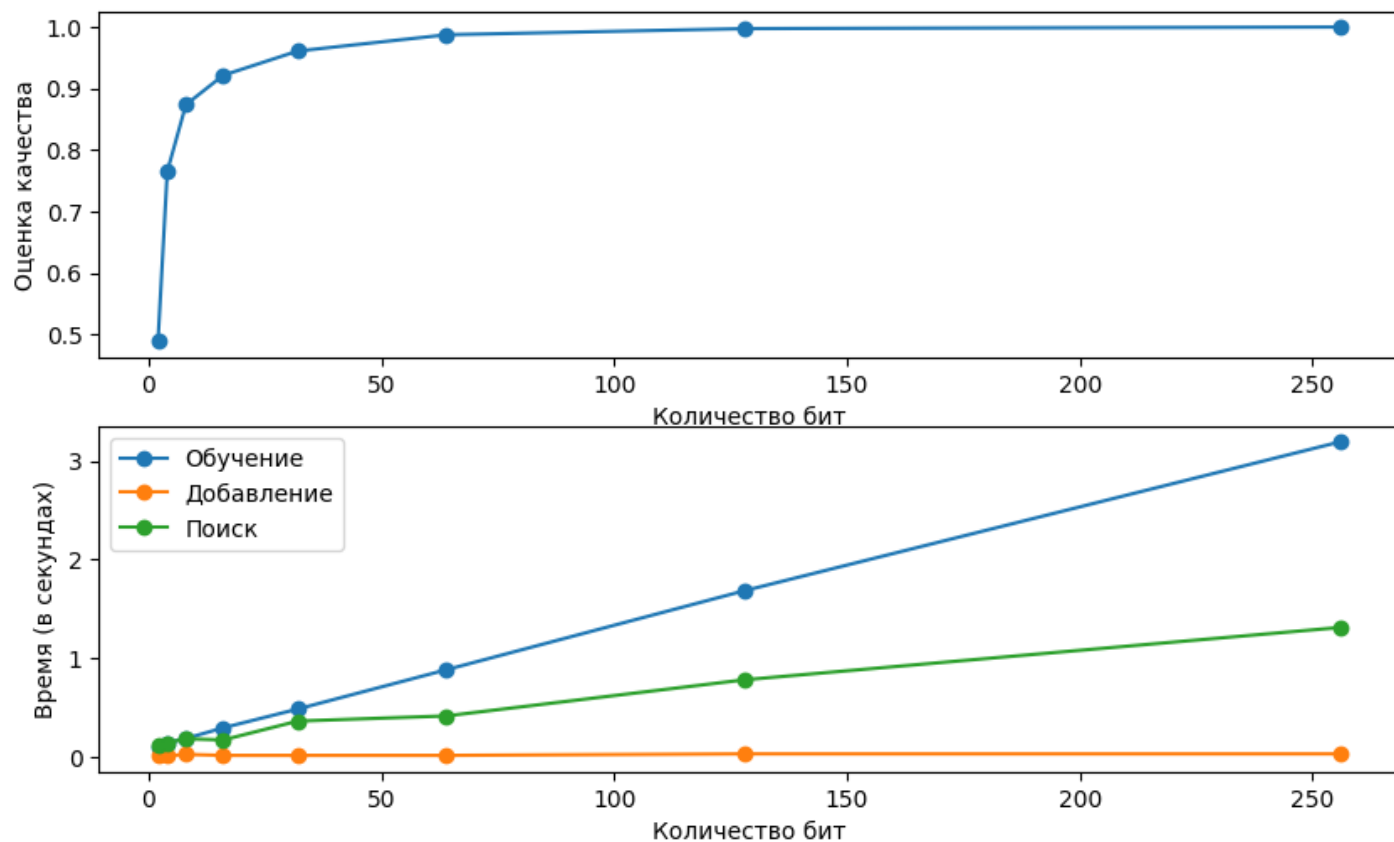


```
n_subquantizers = 2
Train time: 0.10 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.12 seconds Precision: 0.4891587163920208 Memory: 0.179405 MB
```

```
n_subquantizers = 4
Train time: 0.14 seconds
Addition time: 0.01 seconds
        nprobe = 36
        Search time: 0.14 seconds Precision: 0.7649609713790113 Memory: 0.179405 MB
n_subquantizers = 8
Train time: 0.19 seconds
Addition time: 0.03 seconds
        nprobe = 36
        Search time: 0.18 seconds Precision: 0.8733738074588031 Memory: 0.184702 MB
n_subquantizers = 16
Train time: 0.29 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.17 seconds Precision: 0.9210754553339116 Memory: 0.195296 MB
n_subquantizers = 32
Train time: 0.49 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.36 seconds Precision: 0.9605377276669558 Memory: 0.216484 MB
n_subquantizers = 64
Train time: 0.88 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 0.42 seconds Precision: 0.986990459670425 Memory: 0.25886 MB
n_subquantizers = 128
Train time: 1.69 seconds
Addition time: 0.03 seconds
        nprobe = 36
        Search time: 0.78 seconds Precision: 0.9969644405897659 Memory: 0.343612 MB
n_subquantizers = 256
Train time: 3.20 seconds
Addition time: 0.03 seconds
        nprobe = 36
        Search time: 1.31 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
```
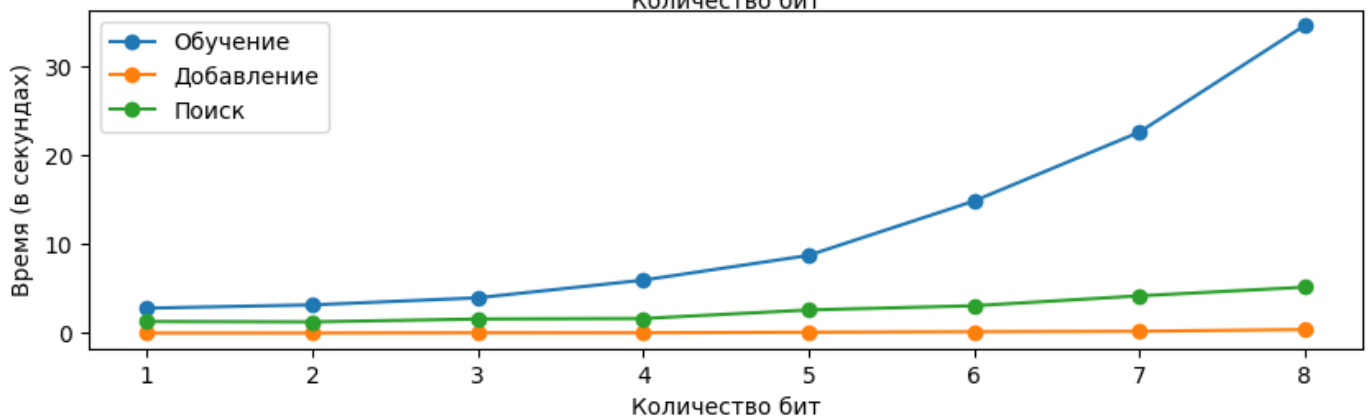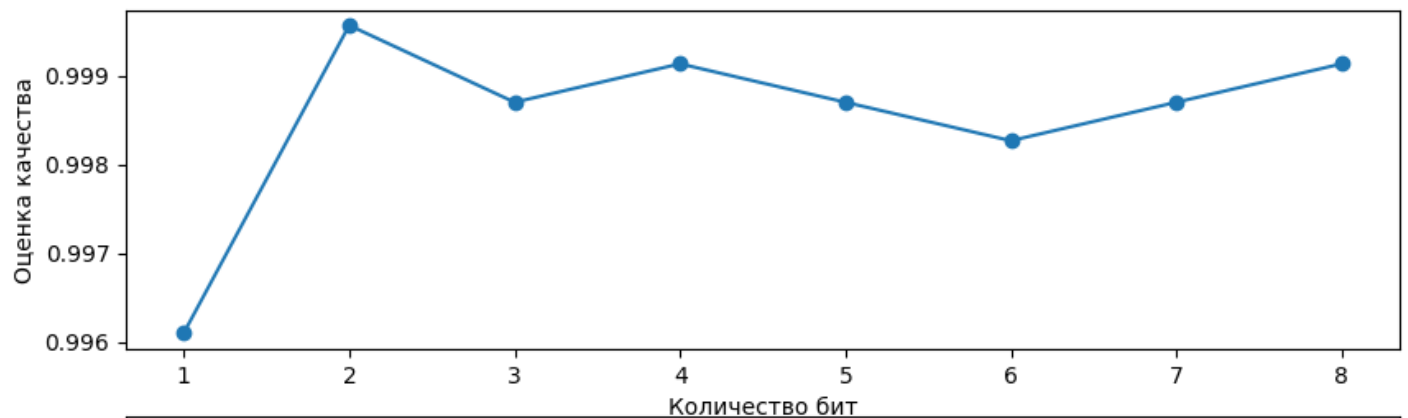


```
n_bits = 1
Train time: 2.82 seconds
Addition time: 0.02 seconds
```

```
        nprobe = 36
        Search time: 1.32 seconds Precision: 0.9960971379011275 Memory: 0.339516 MB
n_bits = 2
Train time: 3.19 seconds
Addition time: 0.02 seconds
        nprobe = 36
        Search time: 1.27 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
n_bits = 3
Train time: 3.98 seconds
Addition time: 0.05 seconds
        nprobe = 36
        Search time: 1.59 seconds Precision: 0.9986990459670425 Memory: 0.690812 MB
n_bits = 4
Train time: 5.97 seconds
Addition time: 0.05 seconds
        nprobe = 36
        Search time: 1.65 seconds Precision: 0.9991326973113617 Memory: 0.8767 MB
n_bits = 5
Train time: 8.76 seconds
Addition time: 0.11 seconds
        nprobe = 36
        Search time: 2.61 seconds Precision: 0.9986990459670425 Memory: 1.078972 MB
n_bits = 6
Train time: 14.87 seconds
Addition time: 0.17 seconds
        nprobe = 36
        Search time: 3.09 seconds Precision: 0.9982653946227233 Memory: 1.314012 MB
n_bits = 7
Train time: 22.63 seconds
Addition time: 0.22 seconds
        nprobe = 36
        Search time: 4.20 seconds Precision: 0.9986990459670425 Memory: 1.614588 MB
n_bits = 8
Train time: 34.65 seconds
Addition time: 0.42 seconds
        nprobe = 36
        Search time: 5.18 seconds Precision: 0.9991326973113617 Memory: 2.046236 MB
```



```
Train time: 3.20 seconds
Addition time: 0.02 seconds
```

```
        nprobe = 36
        Search time: 1.29 seconds Precision: 0.9995663486556808 Memory: 0.513116 MB
Find optim params report:
{'train_time': 3.1954188346862793, 'add_time': 0.015623331069946289, 'precision': 0.999566
3486556808, 'search_time': 1.285489559173584, 'nprobe': 36, 'memory_size': 0.513116, 'n_li
st': 60, 'n_subquantizers': 256, 'n_bits': 2}
---------------
```

Out[6]:
```
[{'train_time': 3.037064552307129,
  'add_time': 0.04385972023010254,
  'precision': 0.9960971379011275,
  'search_time': 0.40669775009155273,
  'nprobe': 30,
  'memory_size': 1.006556,
  'n_list': 300,
  'n_subquantizers': 256,
  'n_bits': 2},
 {'train_time': 3.2745769023895264,
  'add_time': 0.03124380111694336,
  'precision': 0.9995663486556808,
  'search_time': 1.4159448146820068,
  'nprobe': 36,
  'memory_size': 0.513116,
  'n_list': 60,
  'n_subquantizers': 256,
  'n_bits': 2},
 {'train_time': 3.1954188346862793,
  'add_time': 0.015623331069946289,
  'precision': 0.9995663486556808,
  'search_time': 1.285489559173584,
  'nprobe': 36,
  'memory_size': 0.513116,
  'n_list': 60,
  'n_subquantizers': 256,
  'n_bits': 2}]
```