

END LAB EXAM (END-TERM EXAM):

HALLTICKET- NO: 2403A51410

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BATCH: 24BTCAIAIB16

COURSE: AI ASSISTED CODING (AIAC)

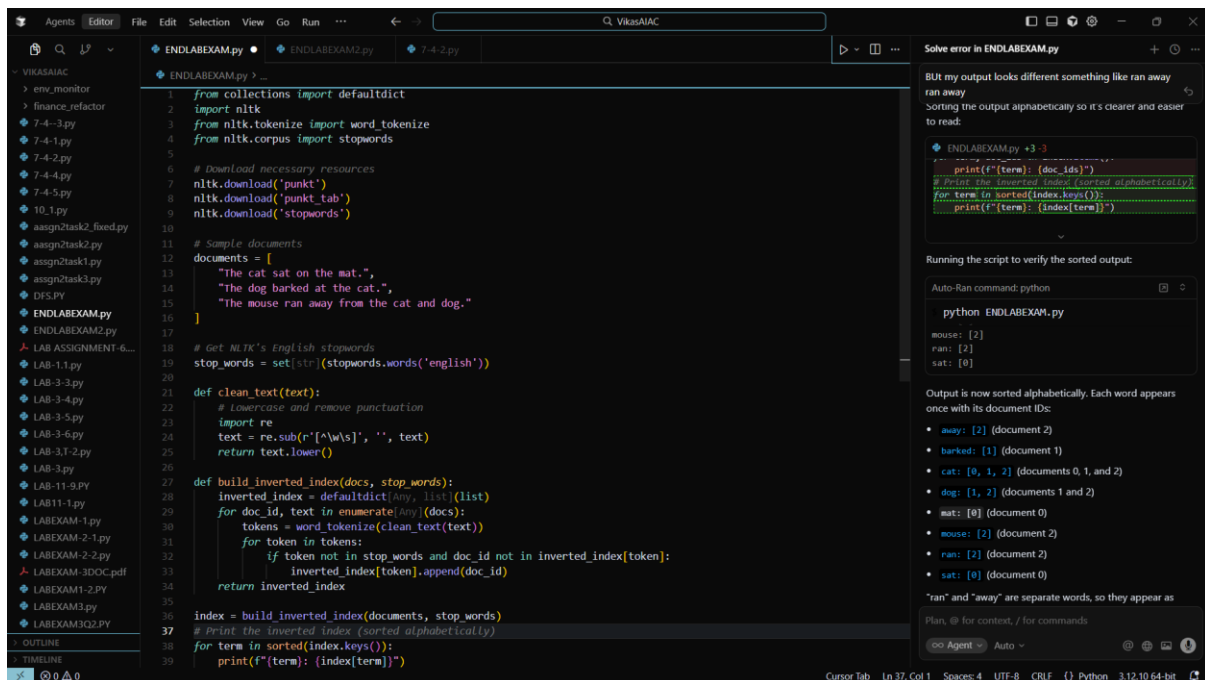
SUBSET – 8:

Q1:

Design inverted index for search.

- Task 1: Use AI to implement index builder.
- Task 2: Add support for tokenization and stop words.

PROMPT:



The screenshot shows a code editor with a file explorer on the left, a main code editor, and a terminal window on the right. The file explorer shows a project named 'VIKASAIAC' with various files and folders. The main code editor displays a Python script named 'ENDLABEXAM.py' which implements an inverted index. The script includes imports for 'collections', 'nltk', 'nltk.tokenize', 'word_tokenize', and 'nltk.corpus'. It defines a 'clean_text' function to lowercase and remove punctuation, and a 'build_inverted_index' function to create an index of words mapped to document IDs. The script also includes sample documents and stopwords. The terminal window on the right shows the output of the script, displaying the sorted output of the inverted index. The output is a list of words mapped to document IDs, sorted alphabetically. The terminal also shows the command 'python ENDLABEXAM.py' and the resulting output.

```
1 from collections import defaultdict
2 import nltk
3 from nltk.tokenize import word_tokenize
4 from nltk.corpus import stopwords
5
6 # Download necessary resources
7 nltk.download("punkt")
8 nltk.download("punkt_tab")
9 nltk.download("stopwords")
10
11 # Sample documents
12 documents = [
13     "The cat sat on the mat.",
14     "The dog barked at the cat.",
15     "The mouse ran away from the cat and dog."
16 ]
17
18 # Get NLTK's English stopwords
19 stop_words = set([str(word) for word in stopwords.words('english')])
20
21 def clean_text(text):
22     # Lowercase and remove punctuation
23     import re
24     text = re.sub(r'[^\w\s]', '', text)
25     return text.lower()
26
27 def build_inverted_index(docs, stop_words):
28     inverted_index = defaultdict(list)
29     for doc_id, text in enumerate(docs):
30         tokens = word_tokenize(clean_text(text))
31         for token in tokens:
32             if token not in stop_words and doc_id not in inverted_index[token]:
33                 inverted_index[token].append(doc_id)
34     return inverted_index
35
36 index = build_inverted_index(documents, stop_words)
37 # Print the inverted index (sorted alphabetically)
38 for term in sorted(index.keys()):
39     print(f"{term}: {index[term]}")
```

Output:

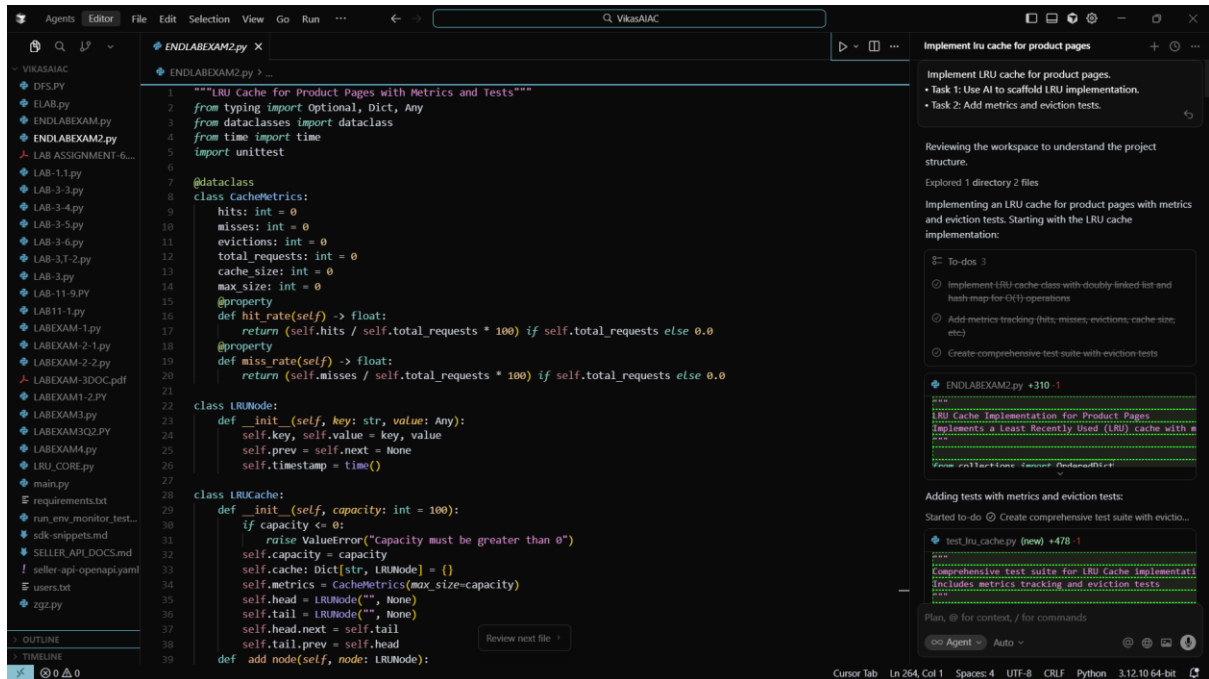
```
away: [2] (document 2)
barked: [1] (document 1)
cat: [0, 1, 2] (documents 0, 1, and 2)
dog: [1, 2] (documents 1 and 2)
mat: [0] (document 0)
mouse: [2] (document 2)
ran: [2] (document 2)
sat: [0] (document 0)
```

CODE:

Implement LRU cache for product pages.

- Task 1: Use AI to scaffold LRU implementation.
- Task 2: Add metrics and eviction tests.

PROMPT:



The screenshot shows a code editor with a file explorer on the left, a main code editor in the center, and a right-hand sidebar with a task list and file navigation. The main code editor displays the implementation of an LRU cache with metrics and tests. The code is written in Python and includes imports for typing, dataclasses, and time. It defines a CacheMetrics class with attributes for hits, misses, evictions, total requests, cache size, and max size. It also defines a LRUNode class and a LRUCache class. The LRUCache class has a capacity attribute and a cache attribute. It implements methods for adding, getting, and deleting items from the cache. The code also includes tests for the LRUCache class.

```
1 """LRU Cache for Product Pages with Metrics and Tests"""
2 from typing import Optional, Dict, Any
3 from dataclasses import dataclass
4 from time import time
5 import unittest
6
7 @dataclass
8 class CacheMetrics:
9     hits: int = 0
10    misses: int = 0
11    evictions: int = 0
12    total_requests: int = 0
13    cache_size: int = 0
14    max_size: int = 0
15
16    @property
17    def hit_rate(self) -> float:
18        return (self.hits / self.total_requests * 100) if self.total_requests else 0.0
19
20    @property
21    def miss_rate(self) -> float:
22        return (self.misses / self.total_requests * 100) if self.total_requests else 0.0
23
24 class LRUNode:
25     def __init__(self, key: str, value: Any):
26         self.key, self.value = key, value
27         self.prev = self.next = None
28         self.timestamp = time()
29
30 class LRUCache:
31     def __init__(self, capacity: int = 100):
32         if capacity <= 0:
33             raise ValueError("Capacity must be greater than 0")
34         self.capacity = capacity
35         self.cache: Dict[str, LRUNode] = {}
36         self.metrics = CacheMetrics(max_size=capacity)
37         self.head = LRUNode("", None)
38         self.tail = LRUNode("", None)
39         self.head.next = self.tail
40         self.tail.prev = self.head
41
42     def add_node(self, node: LRUNode):
43         self.cache[node.key] = node
44         self.metrics.cache_size += 1
45         node.prev = self.tail
46         node.next = None
47         self.tail.next = node
48         self.tail = node
49
50     def get(self, key: str) -> Optional[Any]:
51         if key not in self.cache:
52             self.metrics.misses += 1
53             return None
54         node = self.cache[key]
55         self.metrics.hits += 1
56         self._move_to_tail(node)
57         return node.value
58
59     def _move_to_tail(self, node: LRUNode):
60         node.prev.next = node.next
61         node.next = None
62         node.prev = self.tail
63         self.tail.next = node
64         self.tail = node
65
66     def delete(self, key: str):
67         if key in self.cache:
68             node = self.cache[key]
69             self.cache.pop(key)
70             self.metrics.cache_size -= 1
71             self._delete_node(node)
72
73     def _delete_node(self, node: LRUNode):
74         node.prev.next = node.next
75         node.next.prev = node.prev
76         node.next = None
77         node.prev = None
78
79     def __str__(self):
80         return f"LRUCache(capacity={self.capacity}, hits={self.metrics.hits}, misses={self.metrics.misses})"
```

The right-hand sidebar shows a task list with the following items:

- Implement LRU cache for product pages.
- Task 1: Use AI to scaffold LRU implementation.
- Task 2: Add metrics and eviction tests.

Below the task list, there is a section titled "Implement LRU cache for product pages" with a description of the task and a list of files to be created or modified. The files listed are:

- LRU_CACHE.py (new) +478-1
- test_lru_cache.py (new) +478-1

The bottom of the sidebar shows a "Plan, @ for context, / for commands" section with a search bar and a list of files to be searched.

CODE:

```
Agents Editor File Edit Selection View Go Run ... Q, VikasAIAC
ENDLABEXAM2.py X
ENDLABEXAM2.py > ...
1 """LRU Cache for Product Pages with Metrics and Tests"""
2 from typing import Optional, Dict, Any
3 from dataclasses import dataclass
4 from time import time
5 import unittest
6
7 @dataclass
8 class CacheMetrics:
9     hits: int = 0
10    misses: int = 0
11    evictions: int = 0
12    total_requests: int = 0
13    cache_size: int = 0
14    max_size: int = 0
15    @property
16    def hit_rate(self) -> float:
17        return (self.hits / self.total_requests * 100) if self.total_requests else 0.0
18    @property
19    def miss_rate(self) -> float:
20        return (self.misses / self.total_requests * 100) if self.total_requests else 0.0
21
22 class LRUNode:
23     def __init__(self, key: str, value: Any):
24         self.key, self.value = key, value
25         self.prev = self.next = None
26         self.timestamp = time()
27
28 class LRUCache:
29     def __init__(self, capacity: int = 100):
30         if capacity <= 0:
31             raise ValueError("Capacity must be greater than 0")
32         self.capacity = capacity
33         self.cache: Dict[str, LRUNode] = {}
34         self.metrics = CacheMetrics(max_size=capacity)
35         self.head = LRUNode("", None)
36         self.tail = LRUNode("", None)
37         self.head.next = self.tail
38         self.tail.prev = self.head
39     def add_node(self, node: LRUNode):
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Agents Editor File Edit Selection View Go Run ... Q, VikasAIAC
ENDLABEXAM2.py X
ENDLABEXAM2.py ...
class LRUCache:
    def put(self, key: str, value: Any) -> bool:
        self._move_to_head(node)
        return False
    def delete(self, key: str) -> bool:
        node = self.cache.get(key)
        if node is None:
            return False
        self._remove_node(node)
        del self.cache[key]
        self.metrics.cache_size = len(self.cache)
        return True
    def clear(self):
        self.cache.clear()
        self.head.next, self.tail.prev = self.tail, self.head
        self.metrics.cache_size = 0
    def size(self) -> int:
        return len(self.cache)
    def get_metrics(self) -> CacheMetrics:
        self.metrics.cache_size = len(self.cache)
        return self.metrics

class ProductPageCache:
    def __init__(self, capacity: int = 100):
        self.cache = LRUCache(capacity)
    def get_product(self, product_id: str) -> Optional[Dict[str, Any]]:
        return self.cache.get(product_id)
    def cache_product(self, product_id: str, product_data: Dict[str, Any]) -> bool:
        return self.cache.put(product_id, product_data)
    def get_stats(self) -> Dict[str, Any]:
        m = self.cache.get_metrics()
        return {'size': m.cache_size, 'capacity': m.max_size, 'hits': m.hits,
                'misses': m.misses, 'evictions': m.evictions,
                'total_requests': m.total_requests,
                'hit_rate': f'{m.hit_rate:.2f}%', 'miss_rate': f'{m.miss_rate:.2f}%'}

class TestLRUCache(unittest.TestCase):
    def setUp(self):
        self.cache = LRUCache(capacity=3)
        Review next file >
```

```
Agents Editor File Edit Selection View Go Run ... Q, VikasAIAC
ENDLABEXAM2.py X
ENDLABEXAM2.py ...
class TestLRUCache(unittest.TestCase):
    def setUp(self):
        self.cache = LRUCache(capacity=3)
    def test_basic_ops(self):
        self.cache.put("k1", "v1")
        self.cache.put("k2", "v2")
        self.assertEqual(self.cache.get("k1"), "v1")
        self.assertIsNone(self.cache.get("k3"))
    def test_eviction(self):
        for i in range(4):
            self.cache.put(f"k{i}", f"v{i}")
            self.assertIsNone(self.cache.get(f"k0"))
            self.assertEqual(self.cache.get(f"k3"), "v3")
    def test_lru_order(self):
        self.cache.put("k1", "v1")
        self.cache.put("k2", "v2")
        self.cache.put("k3", "v3")
        self.cache.get("k1")
        self.cache.put("k4", "v4")
        self.assertIsNone(self.cache.get("k2"))
        self.assertEqual(self.cache.get("k1"), "v1")
    def test_update_no_eviction(self):
        for i in range(3):
            self.cache.put(f"k{i}", f"v{i}")
            self.cache.put("k0", "updated")
            self.assertEqual(self.cache.size(), 3)
            self.assertEqual(self.cache.get("k0"), "updated")
    def test_delete_clear(self):
        self.cache.put("k1", "v1")
        self.cache.put("k2", "v2")
        self.assertTrue(self.cache.delete("k1"))
        self.cache.clear()
        self.assertEqual(self.cache.size(), 0)

class TestMetrics(unittest.TestCase):
    def setUp(self):
        self.cache = LRUCache(capacity=3)
    def test_hit_miss(self):
        self.cache.put("k1", "v1")
        self.cache.get("k1")
        Review next file >
```

```
Agents Editor File Edit Selection View Go Run ... Q, VikasAIAC

ENDLABEXAM2.py X
ENDLABEXAM2.py ...

class TestMetrics(unittest.TestCase):
    def test_hit_miss(self):
        self.cache.get("k1")
        self.cache.get("k2")
        m = self.cache.get_metrics()
        self.assertEqual(m.hits, 1)
        self.assertEqual(m.misses, 1)
        self.assertEqual(m.hit_rate, 50.0, places=1)
    def test_eviction_count(self):
        for i in range(4):
            self.cache.put(f"k{i}", f"v{i}")
        self.assertEqual(self.cache.get_metrics().evictions, 1)
        self.cache.put("k4", "v4")
        self.assertEqual(self.cache.get_metrics().evictions, 2)

class TestEvictionScenarios(unittest.TestCase):
    def test_sequential_access(self):
        c = LRUCache(capacity=3)
        for i in range(1, 4):
            c.put(f"p{i}", {"name": f"Product {i}"})
        for i in range(1, 4):
            c.get(f"p{i}")
        c.put("p4", {"name": "Product 4"})
        self.assertIsNone(c.get("p1"))
        self.assertIsNotNone(c.get("p4"))
    def test_repeated_access(self):
        c = LRUCache(capacity=3)
        for i in range(1, 4):
            c.put(f"p{i}", {"name": f"Product {i}"})
        for _ in range(5):
            c.get("p1")
            c.put("p4", {"name": "Product 4"})
        self.assertIsNone(c.get("p2"))
        self.assertIsNotNone(c.get("p1"))
    def test_update_eviction(self):
        c = LRUCache(capacity=3)
        for i in range(1, 4):
            c.put(f"p{i}", {"price": i * 10})
        c.put("n1", {"price": 151})

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```

```
Agents Editor File Edit Selection View Go Run ... Q, VikasAIAC

ENDLABEXAM2.py X
ENDLABEXAM2.py ...

class TestEvictionScenarios(unittest.TestCase):
    def test_update_eviction(self):
        c.put("p1", {"price": 151})
        c.put("p4", {"price": 40})
        self.assertIsNone(c.get("p2"))
        self.assertIsNotNone(c.get("p1"))

class TestProductPageCache(unittest.TestCase):
    def setup(self):
        self.cache = ProductPageCache(capacity=3)
    def test_cache_product(self):
        self.cache.cache_product("p1", {"title": "Laptop", "price": 999.99})
        p = self.cache.get_product("p1")
        self.assertEqual(p["title"], "Laptop")
        self.assertEqual(p["price"], 999.99)
    def test_stats(self):
        self.cache.cache_product("p1", {"title": "p1"})
        self.cache.get_product("p1")
        self.cache.get_product("p2")
        s = self.cache.get_stats()
        self.assertEqual(s["hits"], 1)
        self.assertEqual(s["misses"], 1)
    def test_product_eviction(self):
        for i in range(1, 4):
            self.cache.cache_product(f"p{i}", {"title": f"Product {i}"})
        self.cache.get_product("p1")
        self.cache.cache_product("p4", {"title": "Product 4"})
        self.assertIsNone(self.cache.get_product("p2"))

class TestEdgeCases(unittest.TestCase):
    def test_invalid_capacity(self):
        with self.assertRaises(ValueError):
            LRUCache(capacity=0)
        with self.assertRaises(ValueError):
            LRUCache(capacity=-1)
    def test_single_capacity(self):
        c = LRUCache(capacity=1)
        c.put("k1", "v1")
        c.put("k2", "v2")

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```

```
Agents Editor File Edit Selection View Go Run ... Q, VikasAIAC
ENDLABEXAM2.py X
ENDLABEXAM2.py ...
class TestEdgeCases(unittest.TestCase):
    def test_single_capacity(self):
        c.put("k2", "v2")
        self.assertIsNone(c.get("k1"))
        self.assertEqual(c.get("k2"), "v2")

def run_performance_test():
    print("\n" + "-"*50)
    print("Performance Test")
    print("-"*50)
    cache = ProductPageCache(capacity=100)
    for i in range(200):
        cache.cache_product(f"prod{i}", {"title": f"Product {i}", "price": i * 10.0})
    for i in range(150, 200):
        cache.get_product(f"prod{i}")
    for i in range(200, 250):
        cache.get_product(f"prod{i}")
    stats = cache.get_stats()
    print("\nCache Statistics:")
    for key, value in stats.items():
        print(f"    {key}: {value}")
    print()

if __name__ == "__main__":
    import sys
    if len(sys.argv) == 1 or (len(sys.argv) > 1 and sys.argv[1] == "test"):
        if len(sys.argv) > 1 and sys.argv[1] == "test":
            sys.argv = [sys.argv[0]]
            print("Running LRU Cache Tests...")
            print("-"*50)
            unittest.main(verbosity=2, exit=False)
            run_performance_test()
        else:
            cache = ProductPageCache(capacity=3)
            cache.cache_product("prod1", {"title": "Laptop", "price": 999.99})
            cache.cache_product("prod2", {"title": "Mouse", "price": 29.99})
            cache.cache_product("prod3", {"title": "Keyboard", "price": 79.99})
            print("Example Usage:")
            print(f"Retrieved product: {cache.get_product('prod1')}")
```

```
Agents Editor File Edit Selection View Go Run ... Q, VikasAIAC
ENDLABEXAM2.py X
ENDLABEXAM2.py ...
def run_performance_test():
    print("\n" + "-"*50)
    print("Performance Test")
    print("-"*50)
    cache = ProductPageCache(capacity=100)
    for i in range(200):
        cache.cache_product(f"prod{i}", {"title": f"Product {i}", "price": i * 10.0})
    for i in range(150, 200):
        cache.get_product(f"prod{i}")
    for i in range(200, 250):
        cache.get_product(f"prod{i}")
    stats = cache.get_stats()
    print("\nCache Statistics:")
    for key, value in stats.items():
        print(f"    {key}: {value}")
    print()

if __name__ == "__main__":
    import sys
    if len(sys.argv) == 1 or (len(sys.argv) > 1 and sys.argv[1] == "test"):
        if len(sys.argv) > 1 and sys.argv[1] == "test":
            sys.argv = [sys.argv[0]]
            print("Running LRU Cache Tests...")
            print("-"*50)
            unittest.main(verbosity=2, exit=False)
            run_performance_test()
        else:
            cache = ProductPageCache(capacity=3)
            cache.cache_product("prod1", {"title": "Laptop", "price": 999.99})
            cache.cache_product("prod2", {"title": "Mouse", "price": 29.99})
            cache.cache_product("prod3", {"title": "Keyboard", "price": 79.99})
            print("Example Usage:")
            print(f"Retrieved product: {cache.get_product('prod1')}")
            cache.cache_product("prod4", {"title": "Monitor", "price": 299.99})
            print("\nCache Statistics:")
            for k, v in cache.get_stats().items():
                print(f"    {k}: {v}")
```

OUTPUT:

```
Problems  Output  Debug Console  Terminal  Ports
test_lru_order (__main__.TestLRUCache.test_lru_order) ... ok
test_update_no_eviction (__main__.TestLRUCache.test_update_no_eviction) ... ok
test_eviction_count (__main__.TestMetrics.test_eviction_count) ... ok
test_hit_miss (__main__.TestMetrics.test_hit_miss) ... ok
test_cache_product (__main__.TestProductPageCache.test_cache_product) ... ok
test_product_eviction (__main__.TestProductPageCache.test_product_eviction) ... ok
test_stats (__main__.TestProductPageCache.test_stats) ... ok

-----
Ran 15 tests in 0.001s

OK

=====
Performance Test
=====

Cache Statistics:
  size: 100
  capacity: 100
  hits: 50
  misses: 50
  evictions: 100
  total_requests: 100
  hit_rate: 50.00%
  miss_rate: 50.00%

PS C:\Users\vikas\OneDrive\Desktop\VikasAIAC> |
```

=====

THANK YOU

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