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In [1]:
```
import time
```

In [2]:
```
num_elements = int(input("total no of element in array for loop 1 : "))
user_data = []

print("Enter Elements :")
for i in range(num_elements):
    element = int(input())
    user_data.append(element)
```

```
total no of element in array for loop 1 : 5
Enter Elements :
12
13
14
15
16
```

Loop unrolling

In [3]:
```
def original_loop(arr):
    sum = 0
    for i in range(len(arr)):
        sum += arr[i]
    return sum


start = time.time()
for i in range(100000):
    original_loop(user_data)
end = time.time()
original_time = (end - start) * 1e6  # Convert to microseconds

print(f"\nTime for Original Loop: {original_time} microseconds")
```

```
Time for Original Loop: 192578.07731628418 microseconds
```

In [4]:
```
def loop_unrolling(arr):
    sum = 0
    length = len(arr)
    i = 0

    while i + 4 <= length:
        sum += arr[i]
        sum += arr[i + 1]
        sum += arr[i + 2]
        sum += arr[i + 3]
        i += 4

    while i < length:
        sum += arr[i]
        i += 1

    return sum

start = time.time()
for i in range(100000):
    loop_unrolling(user_data)
end = time.time()
unrolled_time = (end - start) * 1e6  # Convert to microseconds


print(f"Time after Loop Unrolling: {unrolled_time} microseconds\n")
```

```
Time after Loop Unrolling: 186233.5205078125 microseconds
```

In [5]:
```
size = 100000
A = [i for i in range(size)]
B = [size - i for i in range(size)]
C = [0] * size
D = [0] * size
```

In [6]:
```
start_time = time.time()

for i in range(size):
    C[i] = A[i] + B[i]

for i in range(size):
    D[i] = A[i] - B[i]

end_time = time.time()
duration = (end_time - start_time) * 1e6  # Convert to microseconds

print(f"Original Code Execution Time: {duration} microseconds")
```

```
Original Code Execution Time: 106626.51062011719 microseconds
```

In [7]:
```
start_time = time.time()

for i in range(size):
    C[i] = A[i] + B[i]
    D[i] = A[i] - B[i]

end_time = time.time()
duration = (end_time - start_time) * 1e6  # Convert to microseconds

print(f"Optimized (Fused) Code Execution Time: {duration} microseconds")

for i in range(size):
    if C[i] != A[i] + B[i] or D[i] != A[i] - B[i]:
        print("Error: Results do not match.")
        exit(1)

exit(0)
```

```
Optimized (Fused) Code Execution Time: 98369.12155151367
microseconds In [ ]:
```