

2024 NCKU Program Design I HW10

Task 2

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程式碼 (Function 4 ~ 7) 的思維與過程

Function 4: segment

```
31 struct prefix* routingGroupsHash[33][256] = {NULL};
```

- 32bit_IP最長的prefix length是32，即0-32種，為routingGroupsHash先開33的位置，ms8b最多能到255，然後為每一個length開size 256的hash table
- 先遍歷 groups[i]，把 prefix->ip 的最高 8 bits向右移24 bits並跟0xFF取AND，拿來當成 bucket index
- 使用 insert_prefix()，將該 prefix 以linked list插入到對應的 hash_tables[i][bucket]的最尾端
- 就得到0~32 的prefix-length，每個都有 256 個桶子的hash table

Function 5: prefix_insert

```
27  struct prefix* insert = NULL;
```

```
234 void prefix_insert(struct prefix* insert_list, struct prefix* hash_tables[][256])
```

- 在執行input(argv[2], &insert)把inserted_prefixes.txt資料加到struct prefix* insert之後，要將insert這個list插入至現有 hash_tables
- Fcn是逐一從 insert_list 拿出一個待插入的前綴insertCurr
- 取其 prefix-length 與高位 8 bits，得知要插入哪一個hash_tables[][]
- 如果 hash_tables[len][bucket]的*head == NULL || (*head)->ip > new_prefix->ip, 表示list是空的或新的prefix的ip最小，將新的prefix插入在第一個位置
- 否則就在hash_tables[len][bucket]找一個合適的位置，維持 IP 從小到大的順序
- RDTSC：進行每次插入前後做 rdtsc() 量測週期差，並根據 TIME_RANGE 分到 perform_insert[] 對應的 bin

Function 6: prefix_delete

```
28  struct prefix* delete = NULL;
275 void prefix_delete(struct prefix* delete_list, struct prefix* hash_tables[][256])
```

- 和prefix_insert類似，在執行input(argv[3], &delete)把deleted_prefixes.txt資料加到struct prefix* delete之後，要將delete這個list的資料從hash_tables刪除
- 首先在fcn裏，依相同邏輯計算出對應 hash_tables[len][bucket]
- deleteCurr負責遍歷整個刪除清單delete_list
- hashCurr在每次拿到一個要刪的節點後，用來遍歷hash_table對應 bucket 裡的串列，直到找到並刪除目標節點為止並將它從hash_tables[len][bucket]移除並 free()
- 同樣也有 RDTSC 量測，更新 perform_delete[]

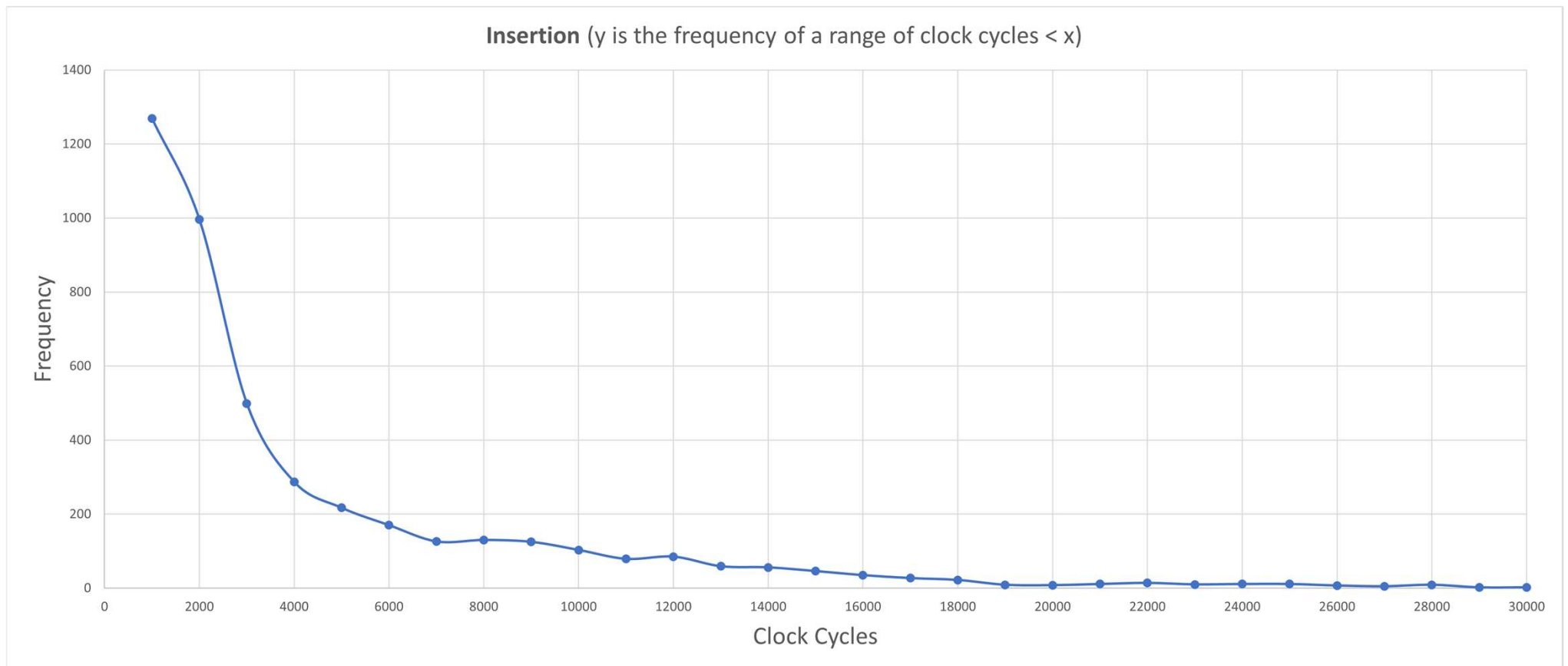
Function 7: search

```
29  struct prefix* trace = NULL;  
319  void search(struct prefix* trace_list, struct prefix* hash_tables[][256])
```

- 對每個欲查詢的 IP 執行最長前綴匹配(Longest Prefix Match)，以模擬路由查表的過程
- 在fcu裏，從 len=32 減到 len=0，逐步縮短前綴長度
- 取 IP 的高 8 bits (ip >> 24) & 0xFF，計算 bucket，定位到 hash_tables[len][bucket]
- 用mask = ~0 << (32 - len)作比對掩碼，若 (traceCurr->ip & mask) == (hashCurr->ip & mask)，則表示匹配
- 找到立即停止， found=1，否則繼續更短前綴
- 同樣有以 rdtsc() 量測每一個search，不管找到還是沒有找到，量測結果透過 perform_search[] 累積

insert/delete/search執行的結果

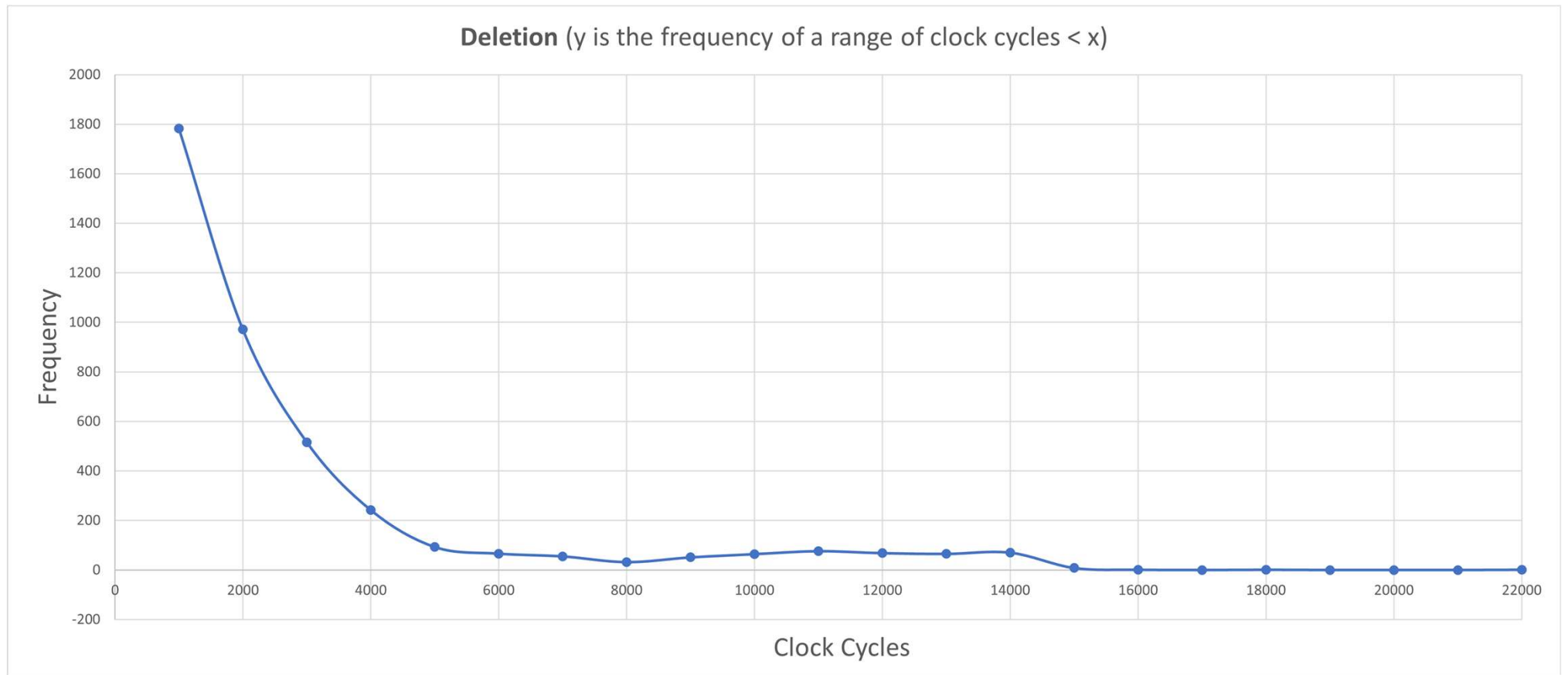
Insertion



Histogram for Insertion:

Range 0-999:	1269 occurrences
Range 1000-1999:	996 occurrences
Range 2000-2999:	499 occurrences
Range 3000-3999:	287 occurrences
Range 4000-4999:	217 occurrences
Range 5000-5999:	170 occurrences
Range 6000-6999:	126 occurrences
Range 7000-7999:	130 occurrences
Range 8000-8999:	125 occurrences
Range 9000-9999:	103 occurrences
Range 10000-10999:	79 occurrences
Range 11000-11999:	85 occurrences
Range 12000-12999:	59 occurrences
Range 13000-13999:	56 occurrences
Range 14000-14999:	46 occurrences
Range 15000-15999:	35 occurrences
Range 16000-16999:	27 occurrences
Range 17000-17999:	22 occurrences
Range 18000-18999:	9 occurrences
Range 19000-19999:	8 occurrences
Range 20000-20999:	11 occurrences
Range 21000-21999:	14 occurrences
Range 22000-22999:	10 occurrences
Range 23000-23999:	11 occurrences
Range 24000-24999:	11 occurrences
Range 25000-25999:	7 occurrences
Range 26000-26999:	5 occurrences
Range 27000-27999:	9 occurrences
Range 28000-28999:	2 occurrences
Range 29000-29999:	2 occurrences
Range 30000-30999:	2 occurrences
Range 31000-31999:	3 occurrences
Range 34000-34999:	2 occurrences
Range 36000-36999:	2 occurrences
Range 37000-37999:	2 occurrences
Range 38000-38999:	1 occurrences
Range 43000-43999:	1 occurrences
Range 45000-45999:	1 occurrences
Range 48000-48999:	1 occurrences
Range 50000-50999:	2 occurrences
Range 55000-55999:	1 occurrences
Range 56000-56999:	1 occurrences
Range 59000-59999:	1 occurrences
Range 61000-61999:	1 occurrences
Range 64000-64999:	1 occurrences
Range 84000-84999:	1 occurrences
Range 92000-92999:	1 occurrences
Range 272000-272999:	1 occurrences

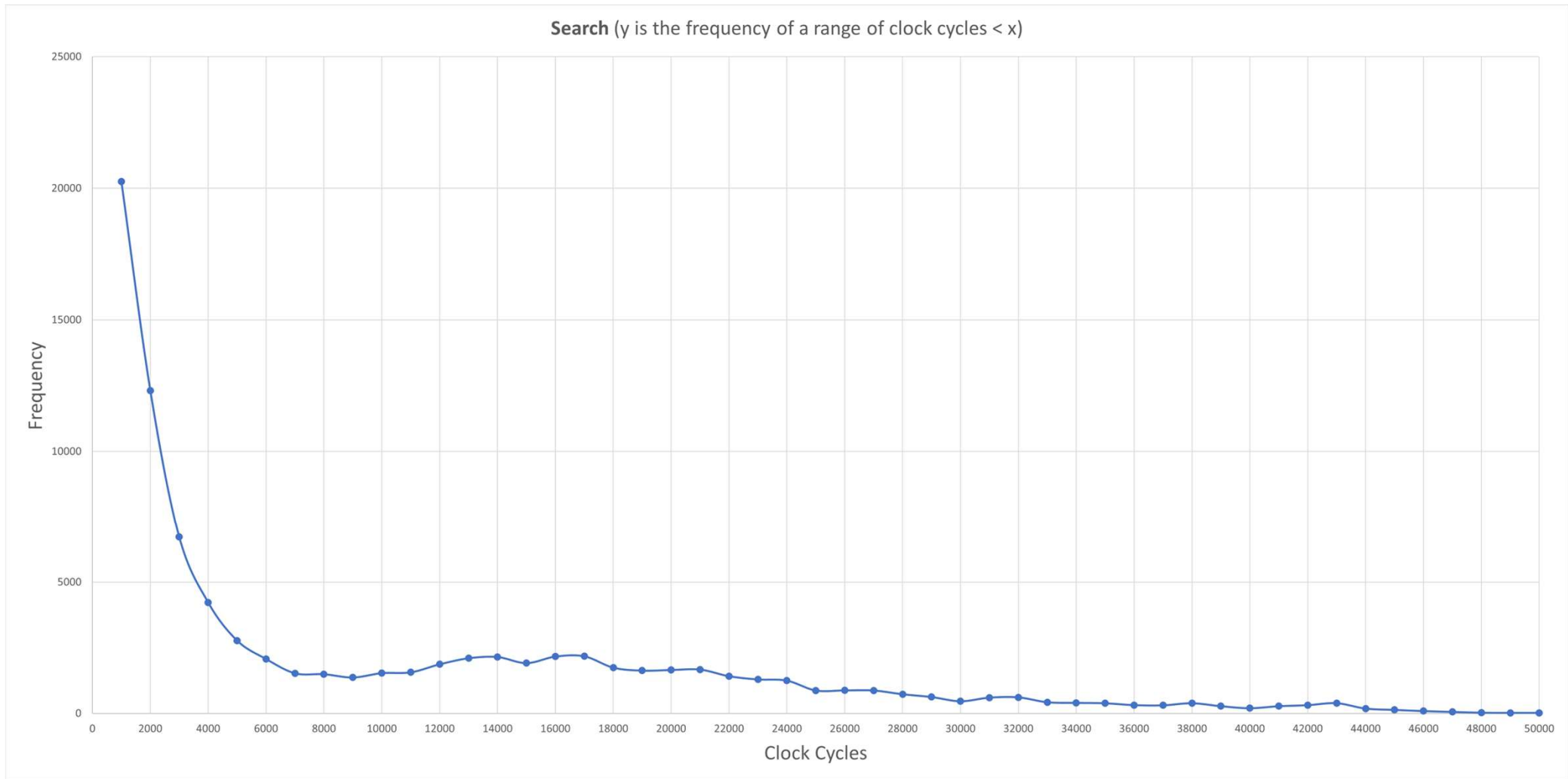
Deletion



Histogram for Deletion:

Range 0-999: 1783 occurrences
Range 1000-1999: 971 occurrences
Range 2000-2999: 516 occurrences
Range 3000-3999: 242 occurrences
Range 4000-4999: 93 occurrences
Range 5000-5999: 66 occurrences
Range 6000-6999: 55 occurrences
Range 7000-7999: 32 occurrences
Range 8000-8999: 51 occurrences
Range 9000-9999: 64 occurrences
Range 10000-10999: 76 occurrences
Range 11000-11999: 68 occurrences
Range 12000-12999: 65 occurrences
Range 13000-13999: 70 occurrences
Range 14000-14999: 8 occurrences
Range 15000-15999: 1 occurrences
Range 17000-17999: 1 occurrences
Range 21000-21999: 1 occurrences

Search



Histogram for Search:
Range 0-999: 20261 occurrences
Range 1000-1999: 12316 occurrences
Range 2000-2999: 6723 occurrences
Range 3000-3999: 4228 occurrences
Range 4000-4999: 2776 occurrences
Range 5000-5999: 2074 occurrences
Range 6000-6999: 1529 occurrences
Range 7000-7999: 1494 occurrences
Range 8000-8999: 1370 occurrences
Range 9000-9999: 1534 occurrences
Range 10000-10999: 1565 occurrences
Range 11000-11999: 1872 occurrences
Range 12000-12999: 2102 occurrences
Range 13000-13999: 2149 occurrences
Range 14000-14999: 1917 occurrences
Range 15000-15999: 2166 occurrences
Range 16000-16999: 2177 occurrences
Range 17000-17999: 1744 occurrences
Range 18000-18999: 1631 occurrences
Range 19000-19999: 1654 occurrences
Range 20000-20999: 1671 occurrences
Range 21000-21999: 1418 occurrences
Range 22000-22999: 1295 occurrences
Range 23000-23999: 1251 occurrences
Range 24000-24999: 873 occurrences
Range 25000-25999: 877 occurrences
Range 26000-26999: 874 occurrences
Range 27000-27999: 731 occurrences
Range 28000-28999: 624 occurrences
Range 29000-29999: 464 occurrences
Range 30000-30999: 601 occurrences
Range 31000-31999: 612 occurrences
Range 32000-32999: 426 occurrences
Range 33000-33999: 402 occurrences
Range 34000-34999: 387 occurrences
Range 35000-35999: 316 occurrences
Range 36000-36999: 308 occurrences
Range 37000-37999: 388 occurrences
Range 38000-38999: 275 occurrences
Range 39000-39999: 198 occurrences
Range 40000-40999: 275 occurrences
Range 41000-41999: 314 occurrences
Range 42000-42999: 390 occurrences
Range 43000-43999: 185 occurrences
Range 44000-44999: 134 occurrences
Range 45000-45999: 90 occurrences
Range 46000-46999: 57 occurrences
Range 47000-47999: 25 occurrences
Range 48000-48999: 20 occurrences
Range 49000-49999: 19 occurrences
Range 50000-50999: 26 occurrences

Range 50000-50999: 26 occurrences
Range 51000-51999: 25 occurrences
Range 52000-52999: 13 occurrences
Range 53000-53999: 10 occurrences
Range 54000-54999: 11 occurrences
Range 55000-55999: 6 occurrences
Range 56000-56999: 8 occurrences
Range 57000-57999: 31 occurrences
Range 58000-58999: 10 occurrences
Range 59000-59999: 6 occurrences
Range 60000-60999: 8 occurrences
Range 61000-61999: 4 occurrences
Range 62000-62999: 5 occurrences
Range 63000-63999: 2 occurrences
Range 64000-64999: 5 occurrences
Range 65000-65999: 6 occurrences
Range 66000-66999: 5 occurrences
Range 67000-67999: 3 occurrences
Range 68000-68999: 4 occurrences
Range 69000-69999: 10 occurrences
Range 70000-70999: 3 occurrences
Range 71000-71999: 2 occurrences
Range 72000-72999: 3 occurrences
Range 73000-73999: 4 occurrences
Range 74000-74999: 3 occurrences
Range 76000-76999: 2 occurrences
Range 77000-77999: 1 occurrences
Range 78000-78999: 2 occurrences
Range 79000-79999: 4 occurrences
Range 80000-80999: 3 occurrences
Range 81000-81999: 4 occurrences
Range 82000-82999: 4 occurrences
Range 83000-83999: 2 occurrences
Range 84000-84999: 1 occurrences
Range 85000-85999: 3 occurrences
Range 86000-86999: 3 occurrences
Range 87000-87999: 2 occurrences
Range 88000-88999: 1 occurrences
Range 89000-89999: 1 occurrences
Range 92000-92999: 3 occurrences
Range 93000-93999: 1 occurrences
Range 94000-94999: 2 occurrences
Range 95000-95999: 2 occurrences

Range 93000-93999: 1 occurrences
Range 94000-94999: 2 occurrences
Range 95000-95999: 2 occurrences
Range 96000-96999: 1 occurrences
Range 97000-97999: 2 occurrences
Range 98000-98999: 1 occurrences
Range 99000-99999: 1 occurrences
Range 100000-100999: 3 occurrences
Range 101000-101999: 2 occurrences
Range 102000-102999: 1 occurrences
Range 103000-103999: 1 occurrences
Range 104000-104999: 6 occurrences
Range 105000-105999: 1 occurrences
Range 106000-106999: 1 occurrences
Range 107000-107999: 1 occurrences
Range 109000-109999: 2 occurrences
Range 114000-114999: 1 occurrences
Range 117000-117999: 1 occurrences
Range 118000-118999: 3 occurrences
Range 120000-120999: 1 occurrences
Range 121000-121999: 1 occurrences
Range 122000-122999: 1 occurrences
Range 125000-125999: 1 occurrences
Range 137000-137999: 1 occurrences
Range 142000-142999: 1 occurrences
Range 148000-148999: 1 occurrences
Range 154000-154999: 1 occurrences
Range 155000-155999: 1 occurrences
Range 156000-156999: 1 occurrences
Range 160000-160999: 1 occurrences
Range 163000-163999: 1 occurrences
Range 168000-168999: 1 occurrences
Range 169000-169999: 1 occurrences
Range 173000-173999: 1 occurrences
Range 177000-177999: 1 occurrences
Range 182000-182999: 1 occurrences
Range 203000-203999: 1 occurrences
Range 225000-225999: 1 occurrences
Range 274000-274999: 1 occurrences
Range 367000-367999: 1 occurrences
Range 676000-676999: 1 occurrences
Range 722000-722999: 1 occurrences