Symbol Tables

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1

1

ADT

Key-value pair abstraction.

- Insert a value with specified key.
- Given a key, search for the corresponding value.

Example: DNS lookup.

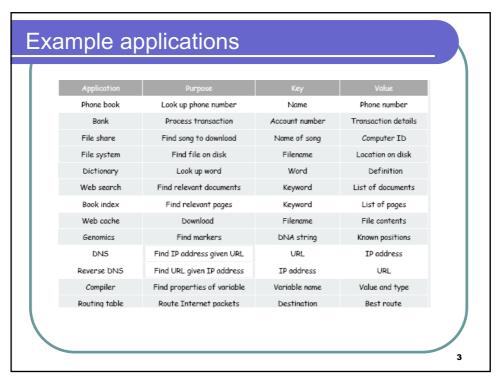
- Insert URL with specified IP address.
- Given URL, find corresponding IP address

www.cs.princeton.edu	128.112.136.11
www.princeton.edu	128.112.128.15
www.yale.edu	130.132.143.21
www.harvard.edu	128.103.060.55
www.simpsons.com	209.052.165.60
key	value

Can interchange roles: given IP address find corresponding URL

2

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3

Phone Book

 Define a structure to store name and phone number pair. The key is name and the value is number.

```
typedef struct {
   char name[80];
   long number;
} PhoneEntry;
```

4

Using array for implementation

Key-value pairs are stored in an ordered array as the following

```
typedef struct {
    PhoneEntry * entries;
    int total;
    int size;
} PhoneBook;
```

- The memory to store the entries should be allocated dynamically according to the maximal size of the phone book.
- When the total number of entries exceeds the maximal size, the memory have to be reallocated with a new maximal size

5

5

API

 Let define two constant numbers to represent the initial size of a phone book and the gap size of the array each to time to be reallocated

```
#define INITIAL_SIZE 10
#define INCREMENTAL_SIZE 5
```

 Write two functions to create a new phone book and drop the entries of a phone book as the following

PhoneBook createPhoneBook(); void dropPhoneBook(PhoneBook* book);

6

API

Add an entry in the phone book

void addPhoneNumber(char * name, long number, PhoneBook* book);

NB: If the entry exists, the value should be overwritten.

Find an entry in the phone book

PhoneEntry * getPhoneNumber(char * name, PhoneBook book);

returns null if the entry does not exist

7

7

Quiz 1

- Complete the API specified for the phone book.
- Write a phone book program using the given API

Hint

- PhoneBook createPhoneBook();
- void dropPhoneBook(PhoneBook* book);
- void addPhoneNumber(char * name, long number, PhoneBook* book);
- PhoneEntry * getPhoneNumber(char * name, PhoneBook book);

9

9

Hint

- 1 . PhoneBook createPhoneBook()
 - declare PhoneBook p
 - using malloc to allocate memory for p
 - assign beginning values to p
- 2. void dropPhoneBook(PhoneBook* book);
 - free memory in p
 - assign ending values to p

10

Hint

- 3'. int binarySearch(PhoneEntry* entries, int I, int r, char * name, int* found)
 - found = 0 or 1
 - return index to insert name if we don't find or the found index
- 3. void addPhoneNumber(char * name, long number, PhoneBook* book);
 - call binarySearch
 - if (found==1) update the number
 - else, using memcpy to move copy data
 - insert new (name, number) pair

11

11

Hint

- 4. PhoneEntry * getPhoneNumber(char * name, PhoneBook book);
 - call pos = binarySearch(PhoneEntry* entries, int I, int r, char * name, int* found)
 - if (found==1) return &book.entries[pos]
 - else return NULL

Solution

• phonebook.c

13

Generic symbol tables

```
• Define a generic structure for entries
```

```
typedef struct {
    void * key;
    void * value;
} Entry;
```

} SymbolTable;

• Define a generic structure for symbol tables typedef struct {

```
Entry * entries;
int size, total;
Entry (*makeNode)(void*, void*);
int (*compare)(void*, void*);
```

makeNode is a function pointer to refer to a function to create a node with a key and a value passed

compare is a function to refer to a function to compare two keys

14

13

API

15

15

Example

```
Entry makePhone(void* name, void* phone) {
    Entry res;
    res.key = strdup( (char*)name );
    res.value = malloc(sizeof(long));
    memcpy( res.value, phone, sizeof(long) );
    return res;
}
int comparePhone(void * key1, void* key2) {
    return strcmp((char*)key1, (char*)key2);
}

SymbolTable phoneBook = createSymbolTable(makePhone, comparePhone);
long number = 983984775;
char name[] = "Ta Tuan Anh";
addEntry(name, &number, &phoneBook);
```

Quiz 2

 Rewrite the phone book program using the generic symbol table

17

Solution

• phonebook_generic.c