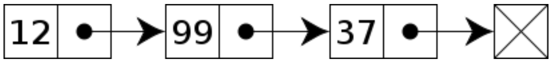
Lab # 6

Collaboration is encouraged. You may discuss the problems with other students, but you must **write up your own solutions**, *including all your C programs, by yourself. If you submit identical or nearly identical solutions to someone else, this will be considered a violation of the code on academic honesty.*

In this lab, we'll study a very useful data structure: a **linked list**. A linked list consists of a sequence of data records. In each record, there is a pointer (i.e., a "link") to the next record. Linked lists are often used to implement other data structures such as stacks, queues and, hash tables. The principal benefit of a linked list over an array is that items can be easily added to and removed from the list. The disadvantage is that one cannot jump to a given point in the list; one has to follow all the links to get there.



We'll use a simple structure for each record: some data (an `int`) and a pointer to the next record. (Instead of an `int`, imagine that we had a big chunk of data.)

```
struct record {
   int           data; /* data */
   struct record *next; /* pointer to next record */
};
```

Note that, in C, a pointer can have a special value called `NULL` which indicates it doesn't point to anything. Consider the following three functions. These add a record to the list, remove a record from the list, and search the list for a specific data value. Note that pointers and pointers to pointers are used.

```
struct record *list_add(struct record *p, int i)
{
   struct record *n = (struct record *) malloc(sizeof(struct record));
   if (n == NULL) return NULL;

   n->next = p; /* the previous record (*p) now becomes the next record */
   p = n;       /* add new empty record to the head of the list */
   n->data = i;

   return p;
}

void list_remove(struct record *p) /* remove head */
{
   if (p != NULL) {
      struct record *n = p;
      p = p->next;
      free(n);
   }
}

struct record *list_search(struct record *n, int i)
{
   while (n != NULL) {
      if (n->data == i) return n;
      n = n->next;
   }
   return NULL;
}
```

We can print the list, starting at the record pointed by `n`, with the following function (note that `%p` prints out a pointer value):

```
void list_print(struct record *n)
{
   if (n == NULL) {
      printf("list is empty\n");
   }
   while (n != NULL) {
      printf("address %p, next address, %p, data %d\n", n, n->next, n->data)
      n = n->next;
   }
}
```

In order to create a list populated with data, we'll use the `rand()` function in C. This function returns a sequence of *pseudo-random* numbers (i.e., random looking numbers). It returns a different sequence for every *seed* value. You can set the seed value as follows:

```
srand(atoi(argv[1]));
```

Then you can call the `rand()` function as follows to create records with pseudo-random numbers between 0 and 99:

```
for (i = 0; i < atoi(argv[2]); i++) {
   list_add(&l, rand() % 100);
}
```

Here is a `main()` function that uses the first argument as the seed; the second argument as the list length; and the third argument as an integer to search for. If the list contains a record with the third argument, the program prints "found".

```
#include "stdafx.h"
#include <stdio.h>     /* for printf */
#include <stdlib.h>    /* for malloc */

int main(int argc, char **argv)
{
   int i;
   struct record *l = NULL;
   struct record *s;

   srand(atoi(argv[1]));
   for (i = 0; i < atoi(argv[2]); i++) {
      l = list_add(l, rand() % 100);
   }
   list_print(l);
   s = list_search(l, atoi(argv[3]));
   if (s != NULL) {
      printf("found\n");
   }

   return 0;
}
```

Problem

- Write a program that accepts two arguments: the seed value and the list length. It prints the list; then it deletes all records with value 13; then it prints out the list again.
- Write a program that accepts two arguments: the seed value and the list length. It

prints the list; then it deletes each record *before* a record with value 13; then it prints out the list again.

(Isn't it idiotic that some buildings don't have a floor 13? The floors are numbered 1 - 12, and then 14 and above.)