## August 21, 2020

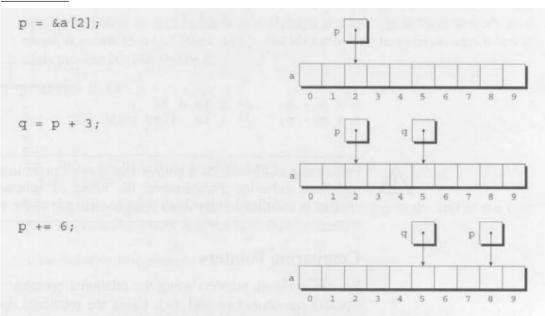
- 1. a) 14
  - b) 34
  - c) 4
  - d) true
  - e) false

### Notes

### • Pointer Arithematic

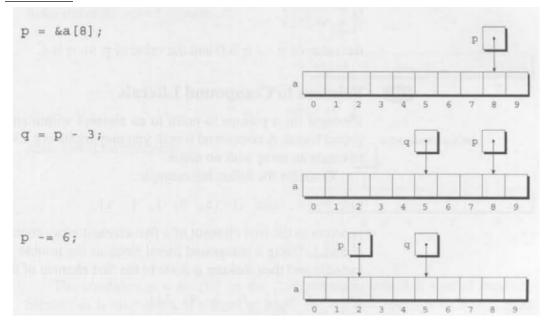
- Adding an integer to a pointer

### Example



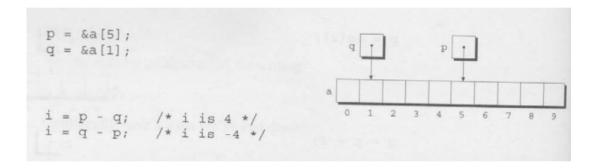
- Subtracting an integer from a pointer

### Example



- Subtracting one pointer from another

### Example



### • Comparing pointers

- Can compare pointers using relational operators (i.e. <,<=,>,>=) and the equality operators (i.e. ==,!=)
- Returns 1 if true and 0 if false

### Example

```
p = &a[5];

q = &a[1];

p <= q \text{ is } 0 \text{ and } p >= q \text{ is } 1
```

2. low and high are memory addresses.

So, low + high is out of bound, and it could potentially point to an undesirable or wrong value.

To fix this, we subtract the from high value to the low value:

$$\mathtt{middle} = \frac{\mathtt{low} \; + \; \mathtt{high}}{2} \tag{1}$$

3. I need to write the contents of an array a after the execution of statements outlined in problem sheet.

After execution, the array would have contents of [10, 9, 8, 7, 6, 5, 4, 3, 2, 1].

#### Notes

- Combining the \* and ++ Operators
  - \*p++ or \*p++  $\rightarrow$  Value of expression is \*p before increment; increment p later
  - (\*p)++  $\rightarrow$  Value of expression is \*p before increment; increment \*p later
  - -\*++p or  $*(++p) \rightarrow$  Increment p first; value of expression is \*p after increment
  - $++*p \text{ or } ++(*p) \rightarrow \text{Increment } *p \text{ first; value of expression is } *p \text{ after increment}$

#### Example

$$a[i++] = j$$

Means assign the value j to a[i] before increment

#### Example 2

```
for (p = &a[0]; p < &a[N]; p++)
sum += *p;
```

Is the same as

```
p = &a[0];
while (p < &a[N])
  sum += *p++;</pre>
```

4. I need to re-write prototype make\_empty, is\_empty and is\_full of the following code to use the pointer variable top\_ptr instead of the integer variable top.

```
#include <stdbool.h>
1
2
      #define STACK_SIZE 100
3
      /*external variables*/
5
      int contents[STACK_SIZE]
      int top = 0;
8
      void make_empty(void) {
9
           top = 0;
10
      }
11
12
      bool is_empty(void) {
13
          return top == 0;
14
15
16
      bool is_full(void) {
17
          return top == STACK_SIZE;
18
19
```

And after re-write using top\_ptr instead of top have:

```
#include <stdbool.h>
2
      #define STACK_SIZE 100
3
4
      /*external variables*/
5
      int contents[STACK_SIZE]
6
      int *top_ptr = &contents[0];
8
      void make_empty(void) {
9
          top_ptr = &contents[0];
11
12
      bool is_empty(void) {
13
          return top_ptr == &contents[0];
14
15
16
      bool is_full(void) {
17
          return top_ptr == &contents[STACK_SIZE-1];
19
```

5. First, I need to identify which of the following expressions are illegal because of mismatched types.

```
a) p == a[0]
```

b) 
$$p == &a[0]$$

```
c) *p == a[0]
```

$$d) p[0] == a[0]$$

Here, only a) is illegal.

Second, I need to write which of the remaining expressions are true.

Here, the expressions that return true are b), c) and d).

#### **Notes**

- \*(a+i) is equal to a[i]
- \*p and a[] are the same given p == a
- Using an Array Name as a Pointer
  - The name of an array can be used as a pointer to the first element in the array.

### Example

```
int a[10];
*a = 7; /* stores 7 in a[0] */
*(a+1) = 12; /* stores 7 in a[1] */
```

### Example 2

```
To simplify the loop, we can replace &a [0] by a and &a [N] by a + N: for (p = a; p < a + N; p++) sum += *p;
```

6. I need to re-write the following to use pointer arithematic instead of array subscripting, and I need to make as few change as possible.

```
int sum_array(cost int a[], int n) {
   int i, sum;

sum = 0;

for (i = 0; i < n; i++)
   sum += a[i];

return sum;
}</pre>
```

After making changes to above code to use pointer arithematic, we have

```
int sum_array(cost int a[], int n) {
   int i, sum;

sum = 0;

for (i = 0; i < n; i++)
   sum += *(a+i);

return sum;

}</pre>
```

7. I need to write the following using pointer arithematic so it finds an element in a that matches to value key. I need to return true if there is a match.

bool search(const int a[], int n, int key);

And the solution is:

```
bool search(cost int a[], int n, int key) {

for (int i = 0; i < n; i++) {
    if (*(a+i) == key) {
        return true
    }
}

return false;
}</pre>
```

8. Here, I need to re-write the following function to use pointer arithmetic instead of array subscripting.

```
void store_zeros(cost int a[], int n) {
   int i;

for (i = 0; i < n; i++) {
      a[i] = 0;
   }
}</pre>
```

After re-writing above code, we have

```
void store_zeros(cost int a[], int n) {
   int *p;

for (p = a; p < a + n; p++) {
     *p = 0;
   }
}</pre>
```

9. Here, I need to write the function

```
double inner_product(const double *a, const double *b, int n) using pointer arithmetic such that it returns a[0] * b[0] + a[1] * b[1] + a[2] * b[2] + ... + a[n-1] * b[n-1].
```

The solution is provided below

```
double inner_product(const double *a, const double *b, int n) {
           double sum = 0, p*;
2
3
          p = a;
5
           while (p < a + n) {
6
               sum += *a * *b;
               a++;
9
               b++;
10
11
               p++;
           }
12
13
           return sum;
```

```
Correct Solution

double inner_product(const double *a, const double *b, int n) {
    double sum = 0, *p;

    p = a;

    while (p++ < a + n) {
        sum += *a++ * *b++;
    }

    return sum;
}</pre>
```

10. Here, I need to rewrite the function find\_middle so that it uses pointer arithmetic - not subscripting - to visit any element.

The solution to this exercise is provided below.

```
int *find_middle(int a[], int n) {
    return a + (n/2)
}
```

11. Here I need to modify the function find\_largest function so that it uses pointer arithmetic - not subscripting - to visit array elements

```
int *find_largest(int a[], int n) {
1
          int *p, *max;
2
3
          max = a;
5
          for (p = a; p < a + n; p++){
6
               if (*p > *max) {
                   max = p;
8
               }
9
          }
10
11
12
          return *max;
13
```