CSC 209 Review 5 Solution

August 21, 2020

1. a) 14

   b) 34

   c) 4

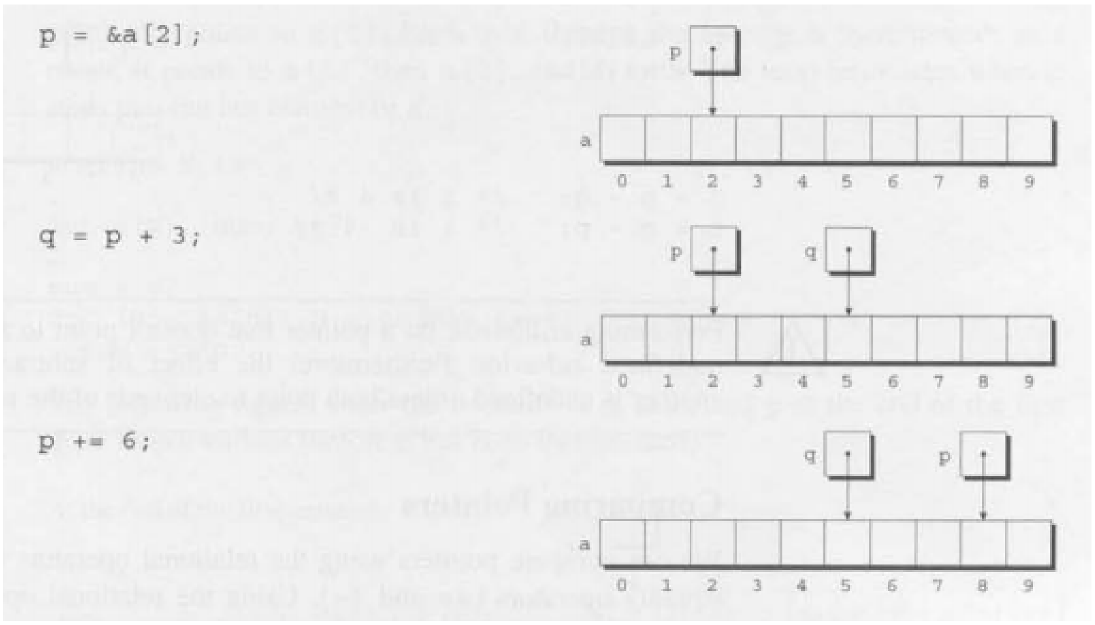
   d) true

   e) false

   Notes

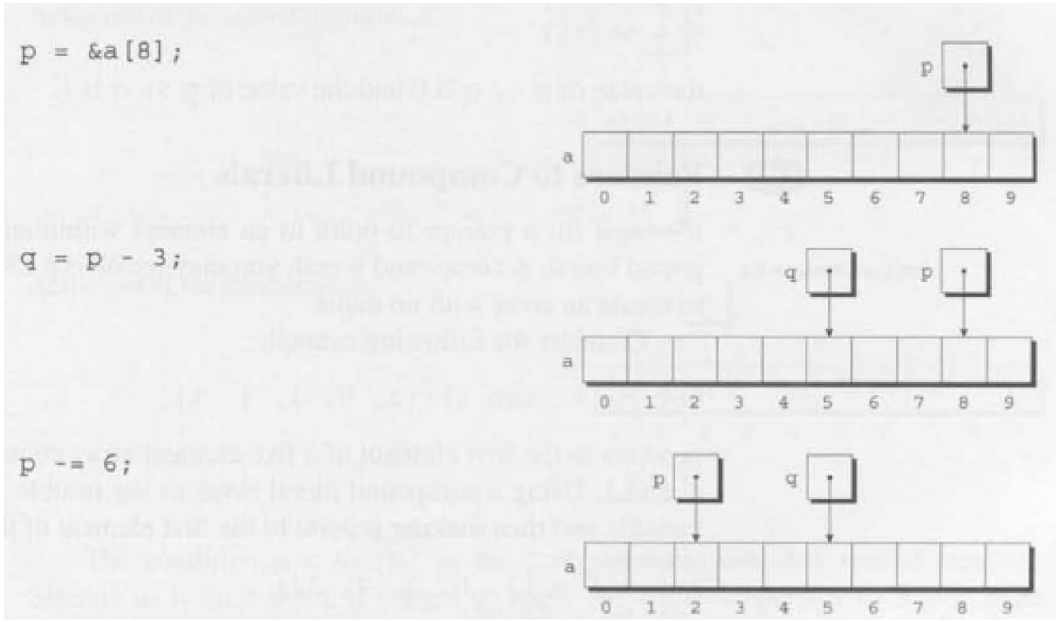
   - **Pointer Arithematic**
     - Adding an integer to a pointer

       Example



- Subtracting an integer from a pointer

  Example



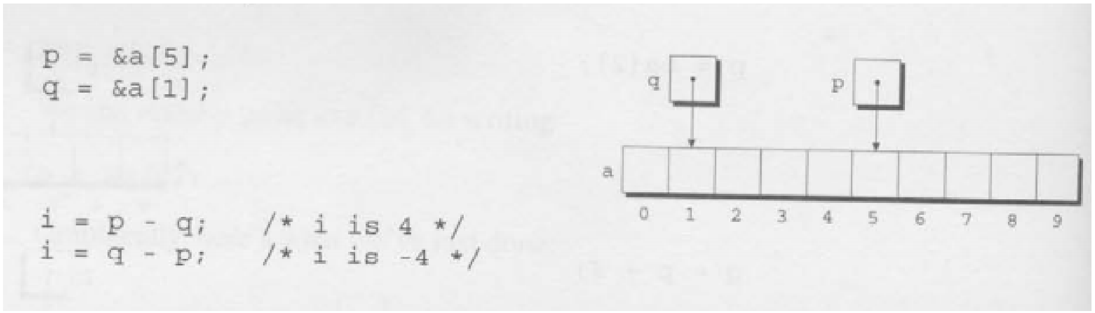
```
p = &a[8];

q = p - 3;

p -= 6;
```

- Subtracting one pointer from another

  Example



```
p = &a[5];
q = &a[1];

i = p - q;    /* i is 4 */
i = q - p;    /* i is -4 */
```

- **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` is 0 and `p >= q` 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:

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

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

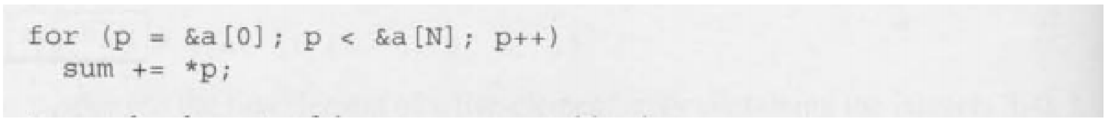
   - **Combining the * and ++ Operators**
     - `*p++` or `*p++` → Value of expression is `*p` before increment; increment `p` later
     - `(*p)++` → Value of expression is `*p` before increment; increment `*p` later
     - `*++p` or `*(++p)` → Increment `p` first; value of expression is `*p` after increment
     - `++*p` or `++(*p)` → Increment `*p` first; value of expression is `*p` after increment

   Example

   `a[i++] = j`

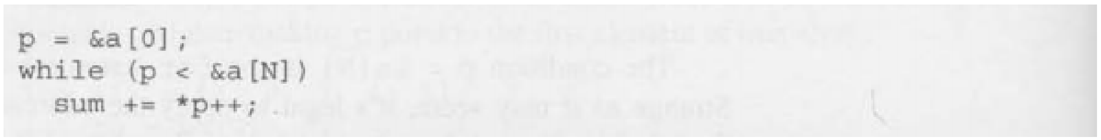
   Means assign the value `j` to `a[i]` before increment

   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++;
```

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`.

```c
#include <stdbool.h>

#define STACK_SIZE 100

/*external variables*/
int contents[STACK_SIZE]
int top = 0;

void make_empty(void) {
    top = 0;
}

bool is_empty(void) {
    return top == 0;
}

bool is_full(void) {
    return top == STACK_SIZE;
}
```

And after re-write using `top_ptr` instead of `top` have:

```c
#include <stdbool.h>

#define STACK_SIZE 100

/*external variables*/
int contents[STACK_SIZE]
int *top_ptr = &contents[0];

void make_empty(void) {
    top_ptr = &contents[0];
}

bool is_empty(void) {
    return top_ptr == &contents[0];
}

bool is_full(void) {
    return top_ptr == &contents[STACK_SIZE-1];
}
```

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

- `*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.

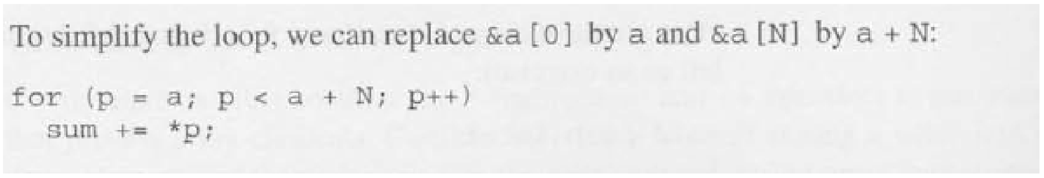
    Example

    ```
    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;
```