

CSC 209 Review 4 Solution

August 20, 2020

1. The answer is a) `*p` and g) `*&i`.

Notes

- **Address and Indirection Pointers**

- If `x` is a variable, `&x` points to its memory address
- `*` in `*p` is called **Indirection operator**
 - * Allows variable to gain access to the object pointed by `p`

- **Aliases**

- Is the situation where the value in same memory location can be accessed using different variable names.

Example 1:

```
int i, p*;
p = & i;
printf("%d\n", *p); /* *p is an alias of i */
```

Example 2:

```
int i, p*;
p = *&i /* *p is an alias of i */
```

2. The answers are b) `*p = &i;`, f) `p = q;`, and i) `*p = *q;`

Correct Solution

The answers are e) `p = *&q;`, f) `p = q;`, and i) `*p = *q;`

`p = *&q;` is the same as `p = q`

Notes

- The `*` operator turns a *value* of type **pointer** to **T** into a *variable* of type **T**.
- The `&` operator turns a *variable* of type **T** into a *value* of type pointer to **T**.

- **Pointer Assignment**

- The following is an example of correct pointer assignment

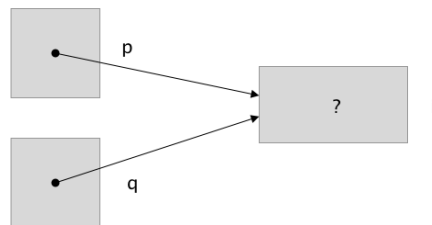
```
int i, j, *p, *q;  
p = &i;
```

* Means the memory address of **p** is pointing to memory address of **i**

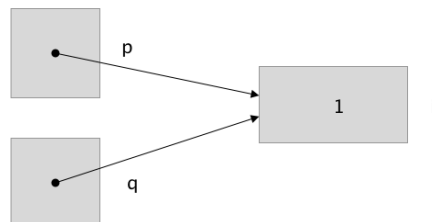
- The following is another valid example of pointer assignment

```
int i, j, *p, *q;  
p = &i;  
q = p;
```

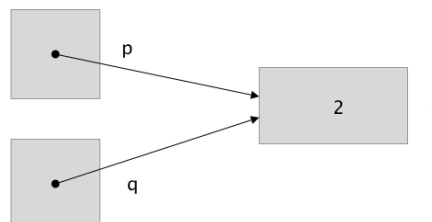
* Means memory address of **q** is the memory address of **p** (which is the memory address of **i**)



```
*p = 1;
```



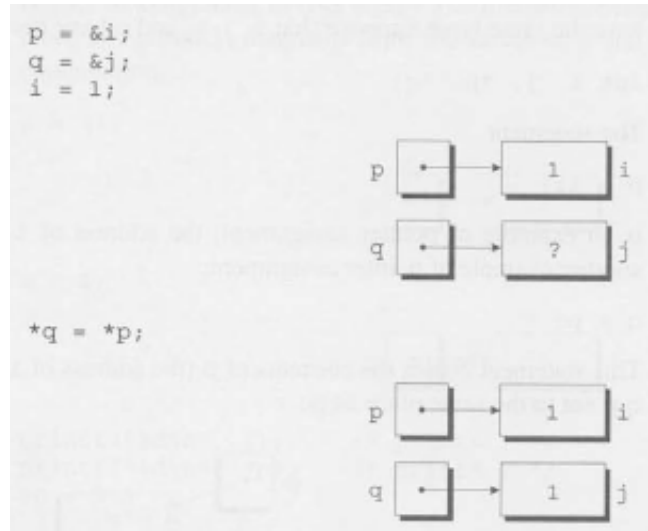
```
*p = 2;
```



- The following is not a pointer assignment

`*q = *p`

- * It copies the value that p points to



```

31 void avg_sum(double a[], int n, double *avg, double *sum)
2   {
3     int i;
4
5     *sum = 0.0;
6     for (i = 0; i < n; i++)
7         *sum += a[i];
8     *avg = *sum / n;
9   }

```

Notes:

- **Pointer as Arguments:**

- Construct prototype using pointer variable as parameter so it can be passed by reference

Example

```

void decompose(double x, long *int_part, double *frac_part);
or
void decompose(double, long *, double *);

void decompose(double x, long *int_part, double *frac_part)
{
    *int_part = (long) x;
    *frac_part = x - *int_part;
}

```

- When using the prototype, pass variable to prototype by reference using & operator (points to variable's memory location)

```
decompose(3.14159, &i, &d);
```

```
41 void swap(int *p, int *q) {
2   int temp;
3
4   temp = *p;
5   *p = *q;
6   *q = temp;
7 }
```

```
51 void split_time(long total_sec, int *hr, int *min, int *sec) {
2   int hours, mins, seconds, min_sec;
3
4   hours = total_sec % 60;
5   min_sec = total_sec - hours;
6   mins = min_sec % 60;
7   seconds = min_sec - mins;
8
9   *hr = hours;
10  *min = mins;
11  *sec = seconds;
12 }
```

Correct Solution:

```
1 void split_time(long total_sec, int *hr, int *min, int *sec) {
2   int hours, mins, seconds, min_sec;
3
4   hours = total_sec % 3600;
5   min_sec = total_sec - (hours * 3600);
6   mins = min_sec % 60;
7   seconds = min_sec - (mins * 60);
8
9   *hr = hours;
10  *min = mins;
11  *sec = seconds;
12 }
```

```
61 #include <stdbool.h> // bool
2   #include <limits.h> // INT_MIN
3
4   bool is_largest(int current_max, int val);
5
6   void find_two_largest (int a[], int n, int *largest, int*
second_largest) {
```

```

7     int current_max = INT_MIN;
8     int current_second_max = INT_MIN;
9
10    for (int i = 0; i < n; i++) {
11        if (is_largest(current_max, a[i])) {
12            current_second_max = current_max;
13            current_max = a[i];
14        }
15    }
16
17    *largest = current_max;
18    *second_largest = current_second_max;
19 }
20
21 bool is_largest(int current_max, int val) {
22     if (val > current_max) {
23         return true;
24     }
25
26     return false;
27 }

```

7. From calendar, we can see that

- January, March, May, July, August, October and December have 31 days
- February has 28 days (Assuming it has no leap year)
- The rest (April, June, September and November) have 30 days

Using this knowledge, we have

```

1     void split_date (int day_of_year, int year, int *month, int *day) {
2         int days_in_month;
3
4         for (let i = 1; i < 13; i++) {
5             *month = i
6
7             if (i == 1 ||
8                 i == 3 ||
9                 i == 5 ||
10                i == 7 ||
11                i == 8 ||
12                i == 10 ||
13                i == 12
14            ) {
15                days_in_month = 31;
16            } else if (
17                i == 4 ||
18                i == 6 ||
19                i == 9 ||
20                i == 11
21            ) {

```

```

22         days_in_month = 30;
23     } else {
24         days_in_month = 28;
25     }
26
27     day_of_year -= days_in_month;
28
29     if (day_of_year < 0) {
30         break;
31     }
32 }
33
34 *day = day_of_year + days_in_month;
35 }

```

```

81 int *find_largest(int a[], int n) {
2     int curr_max = a[0];
3     int i_max = 0;
4
5     for (int i = 0; i < n; i++) {
6         if (a[i] > curr_max) {
7             curr_max = a[i];
8             i_max = i;
9         }
10    }
11
12    return &a[i_max];
13 }

```

Notes

• Pointers as Return Values

- Must return one of parameter's value of type pointer to T as return value

Example

```

1     int *max(int *a, int *b) {
2         if (*a > *b)
3             return a;
4         else
5             return b;
6     }
7
8     ...
9
10    int *p, i, j;
11    p = max(&i, &j);

```

Example 2

```
1  int *find_middle(int a[], int n) {  
2      return &a[n/2];  
3  }
```

- Never return a pointer to an automatic local variable

Example

```
1  int *f(void) {  
2      int i;  
3      ...  
4      return &i;  
5  }
```

* Because variable `i` doesn't exist once `f` returns.

9. Please refer to file `question_9.c`.
10. Please refer to file `question_10.c`.

References

- 1) Github (William Gherman), c-solutions (Chapter 5 Project 8), link
11. Please refer to file `question_11.c`.

References

- 1) Github (William Gherman), c-solutions (Chapter 6 Project 3), link
12. I need to move all external variables to `main` and modify functions so that they communicate by passing arguments.
Please refer to file `question_12.c`.