Section 1. Multiple choice questions (4 points each)

• a correct answer is worth 4 points,
• A wrong answer gives a penalty of -1 point,
• No answer gives no point.

1. Consider the following function:

```c
void fs(char *s)
{
    char *z = s + 1;
    if (*s == 0) return;
    while (*z != 0) {
        *s = *z;
        s ++; z ++;
    }
}
```

Now, suppose we call the function as follows:

```c
char s1[] = "abcdef";
... 
fs(s1);
```

What is the value of s1 after the call?

(a) “abcdef”
(b) “badcfe”
(c) “fedcba”
(d) “bcdeff”
2. Find all the values of variable a such that the following algorithm goes into an infinite loop.

```c
int k = 7;
int c = 0;
int a = ???;
while (k % 2)
{
    c = 3*a + k;
    k = 3*c;
}
```

(a) for \( a \leq 1 \)
(b) for \( a > 1 \)
(c) for all even values of \( a \)
(d) for all odd values of \( a \)

3. Consider the malloc() function. Which one of the following sentences is correct?

(a) The malloc() returns the amount of memory allocated
(b) The malloc() allocates the desired amount of memory on the stack
(c) The malloc() allocates the desired amount of memory on the heap
(d) The allocated memory is only local to the function
4. What is printed by the following program:

```c
int ii = 5;

int fun(int i)
{
    int ii = 2*i;
    i = i % 10;
    return 2*i;
}

void main()
{
    int x;
    x = fun(ii);
    printf("x = %d  ii=%d\n", x, ii);
}
```

(a)  $x = 0$ and $ii = 10$
(b)  $x = 10$ and $ii = 10$
(c)  $x = 0$ and $ii = 5$
(d)  $x = 10$ and $ii = 5$
5. Consider the following function:

```c
int fc(char *s)
{
    int n = strlen(s);
    int i;
    for (i = 0; i < n / 2; i++) {
        if (s[i] != s[n - n / 2 + i]) return 0;
    }
    return 1;
}
```

Now suppose that the function is called with the following parameters:

- `x1 = fc("abab")`;
- `x2 = fc("abba")`;
- `x3 = fc("abcba")`;
- `x4 = fc("abcab")`;

Which is the value of `x1`, `x2`, `x3`, `x4` after the calls?

(a) `x1 = 1, x2 = 0, x3 = 0, x4 = 1`
(b) `x1 = 1, x2 = 1, x3 = 1, x4 = 1`
(c) `x1 = 0, x2 = 1, x3 = 1, x4 = 0`
(d) none of the above

6. Consider the following code:

```c
#define SIZE 2*3
...
int x = 12 / SIX;
int y = SIX / 2;
```

What is the value of `x` and `y` after the operations?

(a) `x = 18 and y = 3`
(b) `x = 2 and y = 2`
(c) `x = 18 and y = 2`
(d) none of the above
7. Consider a linked list, implemented by the following data structure:

```c
struct lnode {
    int data;
    struct lnode *next;
};
typedef struct lnode *LIST;

void pf(LIST p)
{
    if (p == 0) return;
    else {
        pf(p->next);
        printf("%d ", p->data);
    }
}
```

Now suppose the list has the following data inside:

```
2 5 7 9
```

What is the output on screen of calling pf() on the above list?

(a) 2 5 7 9
(b) 9
(c) 9 7 5 2
(d) out of memory

---

Section 2. Free questions (6 points)

You are required to write a program or a small text. These questions are valid a maximum of 6 points each.

8. Write a function that takes a string, and reorders all the letters in alphabetic order. The function prototype must be the following:

```c
void sortchars(char *str);
```

You can assume that the following functions are defined:
void swapchars(char *a, char *b);
int strlen(char *s);

(Hint: use any of the sorting algorithm seen during the lectures)

9. Consider the following function.

int revert(char *str)
{
    int i;
    int l = strlen(str);
    char *copied;

    copied = malloc(1+1);
    strcpy(copied, str);

    for (i = 0; i<l; i++)
        copied[i] = str[l-i-1];

    copied[l] = 0;
    strcpy(str, copied);
    return l;
}
10. Consider the following C function.

```c
int isprime(int a)
{
    int i;
    while (i<a) {
        if (a % i == 0) return 0;
        i++;
    }
}
```

The expected result of isprime(7) is 1. However, the function contains a bug. Can you find it?
Answer Key for Exam A

Section 1. Multiple choice questions (4 points each)

1. (d)
2. (c)
3. (c)
4. (d)
5. (a)
6. (a)
7. (c)

Section 2. Free questions (6 points)

8. **Answer:** A possible implementation is the following:

   ```c
   void sortchars(char *str)
   {
       int i=0, j=1;
       int l = strlen(str);
       for (i=0; i<l; i++) {
           for (j=i+1; j<l; j++)
               if (str[i] > str[j]) swapchars(&str[i], &str[j]);
       }
   }
   ```

9. **Answer:** The function has a “memory leak”: there is a malloc(), but not the corresponding free(). Therefore, every time it is called, it will continue to allocate memory without releasing it. If the function is called many times, eventually it will cause a “out of memory” error.

10. **Answer:** Variable i is not initialized. It can also be negative or very large. If it is 0, the result of the mod operation is undefined.
Section 1. Multiple choice questions (4 points each)

• a correct answer is worth 4 points,
• A wrong answer gives a penalty of -1 point,
• No answer gives no point.

1. Consider the following code:

```c
#define SIZE 2*3
int x = 12 / SIX;
int y = SIX / 2;
```

What is the value of x and y after the operations?

(a) $x = 18$ and $y = 3$
(b) $x = 2$ and $y = 2$
(c) $x = 18$ and $y = 2$
(d) none of the above
2. Find all the values of variable a such that the following algorithm goes into an infinite loop.

```c
int k = 7;
int c = 0;
int a = ??;
while (k % 2)
{
    c = 3*a + k;
    k = 3*c;
}
```

(a) for $a \leq 1$
(b) for $a > 1$
(c) for all even values of $a$
(d) for all odd values of $a$
3. Consider the following function:

```c
void fs(char *s)
{
    char *z = s + 1;
    if (*s == 0) return;
    while (*z != 0) {
        *s = *z;
        s++; z++;
    }
}
```

Now, suppose we call the function as follows:

```c
char s1[] = "abcdef";
...
fs(s1);
```

What is the value of `s1` after the call?

(a) “abcdef”
(b) “badcfe”
(c) “fedcba”
(d) “bcdeff”
4. What is printed by the following program:

```c
int ii = 5;

int fun(int i)
{
    int ii = 2*i;
    i = i % 10;
    return 2*i;
}

void main()
{
    int x;
    x = fun(ii);
    printf("x = %d ii =%d\n", x, ii);
}
```

(a) $x = 0$ and $ii = 10$
(b) $x = 10$ and $ii = 10$
(c) $x = 0$ and $ii = 5$
(d) $x = 10$ and $ii = 5$

5. Consider the malloc() function. Which one of the following sentences is correct?

(a) The malloc() returns the amount of memory allocated
(b) The malloc() allocates the desired amount of memory on the stack
(c) The malloc() allocates the desired amount of memory on the heap
(d) The allocated memory is only local to the function
6. Consider a linked list, implemented by the following data structure:

```c
struct lnode {
    int data;
    struct lnode *next;
};
typedef struct lnode *LIST;

void pf(LIST p)
{
    if (p == 0) return;
    else {
        pf(p->next);
        printf("%d ", p->data);
    }
}
```

Now suppose the list has the following data inside:

```
 p  2  5  7  9
```

What is the output on screen of calling pf() on the above list?

(a) 2 5 7 9
(b) 9
(c) 9 7 5 2
(d) out of memory
7. Consider the following function:

```c
int fc(char *s)
{
    int n = strlen(s);
    int i;
    for (i=0; i<n/2; i++) {
        if (s[i] != s[n - n/2 + i]) return 0;
    }
    return 1;
}
```

Now suppose that the function is called with the following parameters:

- x1 = fc("abab");
- x2 = fc("abba");
- x3 = fc("abcba");
- x4 = fc("abcab");

Which is the value of x1, x2, x3, x4 after the calls?

(a)  x1 = 1, x2 = 0, x3 = 0, x4 = 1
(b)  x1 = 1, x2 = 1, x3 = 1, x4 = 1
(c)  x1 = 0, x2 = 1, x3 = 1, x4 = 0
(d)  none of the above

---

**Section 2. Free questions (6 points)**

You are required to write a program or a small text. These questions are valid a maximum of 6 points each.

8. Consider the following function.

```c
int revert(char *str)
{
    int i;
    int l = strlen(str);
    char *copied;

    copied = malloc(l+1);
    strcpy(copied, str);

    return 0;
}
```
for (i = 0; i<l; i++)
    copied[i] = str[l-i-1];

    copied[l] = 0;

    strcpy(str, copied);
    return l;
}

The function contains a bug. Can you find it?

9. Consider the following C function.
   
   int isprime(int a)
   {
       int i;
       while (i<a) {
           if (a % i == 0) return 0;
           i++;
       }
   }

   The expected result of isprime(7) is 1. However, the function contains a bug. Can you find it?
10. Write a function that takes a string, and reorders all the letters in alphabetic order. The function prototype must be the following:

```c
void sortchars(char *str);
```

You can assume that the following functions are defined:

```c
void swapchars(char *a, char *b);
int strlen(char *s);
```

(Hint: use any of the sorting algorithm seen during the lectures)
Answer Key for Exam B

Section 1. Multiple choice questions (4 points each)

1. (a)
2. (c)
3. (d)
4. (d)
5. (c)
6. (c)
7. (a)

Section 2. Free questions (6 points)

8. **Answer:** The function has a “memory leak”: there is a malloc(), but not the corresponding free(). Therefore, every time it is called, it will continue to allocate memory without releasing it. If the function is called many times, eventually it will cause a “out of memory” error.

9. **Answer:** Variable i is not initialized. It can also be negative or very large. If it is 0, the result of the mod operation is undefined.

10. **Answer:** A possible implementation is the following:

```c
void sortchars(char *str)
{
    int i=0, j=1;
    int l = strlen(str);
    for (i=0; i<l; i++) {
        for (j=i+1; j<l; j++)
            if (str[i] > str[j]) swapchars(&str[i], &str[j]);
    }
}
```