Georgia State University
Department of Computer Science

CSC4330/6330 – Assignment #4
Summer 2017
Due Sunday July 23nd, 11:59 pm

All answers must be computer-printed, except for diagrams. Use your own words; do not copy material verbatim from a web site or other source.

1. The following questions concern the C# language.
(a) Explain the difference between a "value type" and a "reference type" in C#.
(b) Is the C# string type a value type or a reference type?
(c) Are the operations allowed on C# strings more like the operations defined for C++ string objects or are they more like the operations defined for Java String objects?

2. Suppose that a C array has been declared as follows:

```
int a[5][8][4];
```

(a) Give the access function for this array, assuming that the address of a is 1000 and int values occupy four bytes.
(b) What is the address of a[2][4][3]?

3. Suppose that L1 is the list ((A B) C D) and L2 is the list ((E) F). Give the value of each of the following LISP expressions:

(a) (CONS (CAR L1) (LIST (CDR L2)))
(b) (CONS (CAR (CDR L2)) (CAR L1))
(c) (CDR (CONS (CAR (CONS 'G L1)) '(H)))
(d) (LIST (LIST (CAR L1) L2) 'G)

4. Consider the following C++ function:

```
int *create_node(int n)
{
  int *p1 = new int(n);
  int *p2 = new int(n);
  int *p3 = p2;
  int *p4 = p1;
  q = p1;          // q is an external variable
  return p3;
}
```

When create_node returns, how many of the anonymous variables that it creates will be garbage?

5. Give the minimum size of each of the following C data structures, assuming that char values occupy one byte, int and float values occupy four bytes, double values occupy eight bytes, and pointers occupy four bytes.

(a)
```
char str[] = "Curly";
```

(b)
```
double *a[4][4];
```

(c)
```
char *str[3] = {"Moe", "Larry", "Curly"};
```
(Include the space occupied by the string literals in your answer.)

(d)
```
union {
  int a;
  char b;
  float c[4];
} u;
```

(e)
```
struct {
  int a;
  char b;
  float c[4];
} s;
```

(f)
```
union {
  int a[3];
  double b;
  struct {
    float c;
    char d[4];
  } s;
} u;
```

(g)
```
struct {
  float a;
  union {
    double b[2];
    int c;
  } u;
  char d;
} s;
```

6. Assume that the following C declarations are in effect:

```
int a[4] = {6, 4, 1, 2};
int b[8] = {9, 8, 11, 10, 5, 7, 0, 3};
int *p = &a[1];
int *q = b;
int *r = b + 2;
```

Give the value of each of the following expressions. If an expression is illegal, give ILLEGAL as the answer. (Consider an expression to be illegal if it is rejected by a C compiler.) If an expression is legal but has an undefined value, give UNDEFINED as the answer.

(a) *p
(b) *q
(c) *r
(d) p + q
(e) r - q
(f) *(p + 1)
(g) q[3]
(h) b - a

7. Give the value of each of the following APL expressions:

(a) 120÷2×3×2-4×3
(b) 9×7-8÷13-2×1+5

8. Classify each of the following C conversions as either narrowing or widening. Explain your reasoning in each case.

(a) char to short
(b) unsigned int to int

9. Problem 9 in Chapter 7 of Sebesta. For each expression, show every possible order of evaluation. (Some expressions may have only one possible order of evaluation, but others may have two or more.)

10. When an operator is overloaded in C++ (by writing a function with a name such as operator+), what restrictions, if any, does C++ place on the types of the function's parameter(s)?

11. Explain the difference between the following three C function prototypes:

```
void f(int n);
extern void f(int n);
static void f(int n);
```

Submission Instructions:

- **Make sure to justify all answers – show all work.**
- The Assignment must be submitted electronically through ICollege/D2L.
- Upload the answers in a pdf file to ICollege/D2L in the respective assignment dropbox.
- All work must be neat and legible. Illegible work will receive no credit. This includes work where the print contrast or darkness are too faint
- The work that you turn in must be your own --- copying is not allowed for any assignments.
- Using another student's work as your own, allowing another student to use your work as their own, is academic misconduct and is not tolerated.