CS 358 Principles of Programming Languages Winter 2025
Week 6 Other Problems

Put your solutions to these problems in a plain-text file `other_solutions.txt`.

Problem 3.

Suppose a C compiler uses a stack to store activation data in the style of Week 6a slide 10, and consider the following program. (The line numbers on the left are not part of the program.)

```
01 int g(int s, int t) {
02    int p = s * 2;
03    return p+1;
04 }
05 int f(int r) {
06    r = r + 1;
07    int q = r;
08    q = g(q, r + 7);
09    return q+1;
10 }
11 void main() {
12    int a = 2;
13    int b = 20;
14    b = f(a);
15 }
```

For each of the following program points, what local variables and parameters are on the stack and what are their values?

 (i) Beginning of line 14.

 (ii) Beginning of line 08.

 (iii) Beginning of line 03.

 (iv) Beginning of line 09.

 (v) Beginning of line 15.

Problem 4.

Consider the following C program fragment:

```
#include <stdio.h>

void f() {
  int a = 42;
}
int g() {
  int b;
  return b;
}
int h() {
  f();
  return g();
}
int main() {
  printf("%d\n", h());
}
```

(a) According to the C language definition, it is undefined what result value is printed. Why?

(b) When this code is given to the `gcc` or `clang` C compiler (with default `-O0` optimization setting), it may produce machine code that, when run, prints `42`. Give a plausible explanation for why the machine code behaves this way. (If you are comfortable reading assembly code and want to confirm your explanation, you can use the `-S` flag to the compiler to see exactly what code is produced.)

Problem 5.

Compare and contrast how the Python and C++ standard libraries support sorting. Specifically, consider in-place sorting of lists in Python (list method `sort()` and of vectors in C++ (`std::sort`). In particular, describe how each language uses functions as parameters to control how items are compared when sorting. To illustrate your answer, show how we would sort a list (or vector) of employee records, each containing a name and a salary, in decreasing order of salary.