CS131 Compilers: Writing Assignment 4
Due 11:59pm June 7, 2023
(Late submission could be accepted.)

Name - ID

I worked with Name1 Name2 ...
Complteted on May 21, 2023

Code of Conduct

This writing assignments should be your own individual work. Discussion on concept, methodology, and class materials are welcomed, but you should list all the people you have discussed with. Copying is strictly prohibited. Plagiarism, once confirmed, may result in assignment grades reduced to zero for all involved people. And this event will be reported. Also you should use LaTeX or Typst to produce your response based on this template. Submission in other forms won't be graded.

1. (**15 pts**) In the C code to compute Fibonacci numbers recursively. Suppose that the activation record for f includes the following elements in order: (return value, argument n, local s, local t); there will normally be other elements in the activation record as well. The questions below assume that the initial call is f (5).

```
int f(int n) {
    int t, s;
    if (n < 2) return 1;
    s = f(n-1);
    t = f(n-2);
    return s+t;
}
```

   (a) Show the complete activation tree.

   (b) What does the stack and its activation records look like the first time f(1) is about to return?

   (c) What does the stack and its activation records look like the fifth time f(1) is about to return?

   RESPONSE:

2. (**15 pts**) **Garbage Collection** Answer the following question

   (a) what kind of GC strategy is used in JVM(Java Run Time Environment).

   (b) what kind of GC strategy is used in the Smart Pointer of modern C++.

   (c) Name one advantage that Stop-and-Copy has over Mark-and-Sweep.

   RESPONSE:

3. (**20 pts**) **Code Optimization** Consider the following basic block, in which all variables are integers, and ** denotes exponentiation.

```
a := b + c
z := a ** 2
x := 0 * b
y := b + c
w := y * y
u := x + 3
v := u + w
```

   Assume that the only variables that are live at the exit of this block are v and z. In order, apply the following optimizations to this basic block. Show the result of each transformation.

(a) algebraic simplification

(b) common sub-expression elimination

(c) copy propagation

(d) constant folding

(e) dead code elimination

RESPONSE:

4. (**20 pts**) **Register Allocation.** Consider the following program, annotated with live variable information:

```
// live: {v, x}
u = v + 1
// live: {u, v, x}
w = u - v
// live: {u, w, x}
x = x + w
// live: {u, w, x}
y = u - w
// live: {x, y}
z = x + y
// live {z}
```

(a) Draw the interference graph for the program.

(b) What is the smallest number of colors that can be used to color the graph without spilling? Explain why no smaller number of colors will be enough.

RESPONSE: