MIT 6.035 Spring 2011 Quiz 1 (100 points)

Your Full Name Here:

Your Athena ID Here:

1. (5 points) Write a regular expression for the language $L = \{0^n1^m \mid (n + m) \text{ is even}\}$.

2. (20 points) Let the alphabet $\Sigma = \{0, 1\}$.

(a) (5 points) Write a regular expression for the language of all strings over Σ that contain the contiguous substring 11.

(b) (5 points) Write a regular expression for the language of all strings over Σ that do not contain the contiguous substring 11.

(c) (5 points) Give a non-deterministic finite automaton (NFA) for the language of all strings over $\sum$ that contain the contiguous substring 11.

(d) (5 points) Give a non-deterministic finite automaton (NFA) for the language of all strings over $\sum$ that don't contain the contiguous substring 11.

3. (10 points)

(a) (5 points) Give a non-deterministic finite automaton (NFA) for the language L = (010 | 01)*. The NFA must contain at most 3 states. (Hint: draw an NFA with 4 states, then optimize).

(b) (5 points) Give a deterministic finite automaton for the language L.

4. (30 points)

Consider the following grammar:

$S \rightarrow L = R$

$L \rightarrow *R \mid id$

$R \rightarrow L$

You can think of L and R as standing for l-value and r-value, respectively. * is the dereference operator or indirection operator in C-like languages.

A shift-reduce parser can perform the following sequence of actions to accept the string "*id = id".

shift » shift » reduce » reduce » reduce » shift » shift » reduce » reduce » reduce » accept

(a) (10 points) Give a sequence of actions that a shift-reduce parser can take to accept the string "id = id".

(b) (10 points) Give a sequence of actions that a shift-reduce parser can take to accept the string "*id = *id".

(c) (10 points) Is the grammar ambiguous? Why or why not?

5. (15 points)

Consider the following grammar:

S → `if` E `then` S `else` S | `begin` S L | `print` E | ε

L → `end` | `;` S L

E → num = num

The goal is to write a recursive-descent parser for the grammar. You are given the following `L()` and `E()` functions. Your job is to write the `S()` function on the next page.

```
L() {
      if (token = end) {
            match(end);
      } else if (token = ;) {
            match(;); S(); L();
      } else {
            throw SyntaxError;
      }
}


E() {
      if (token = num) {
            match(num); match(=); match(num);
      } else {
            throw SyntaxError;
      }
}
```

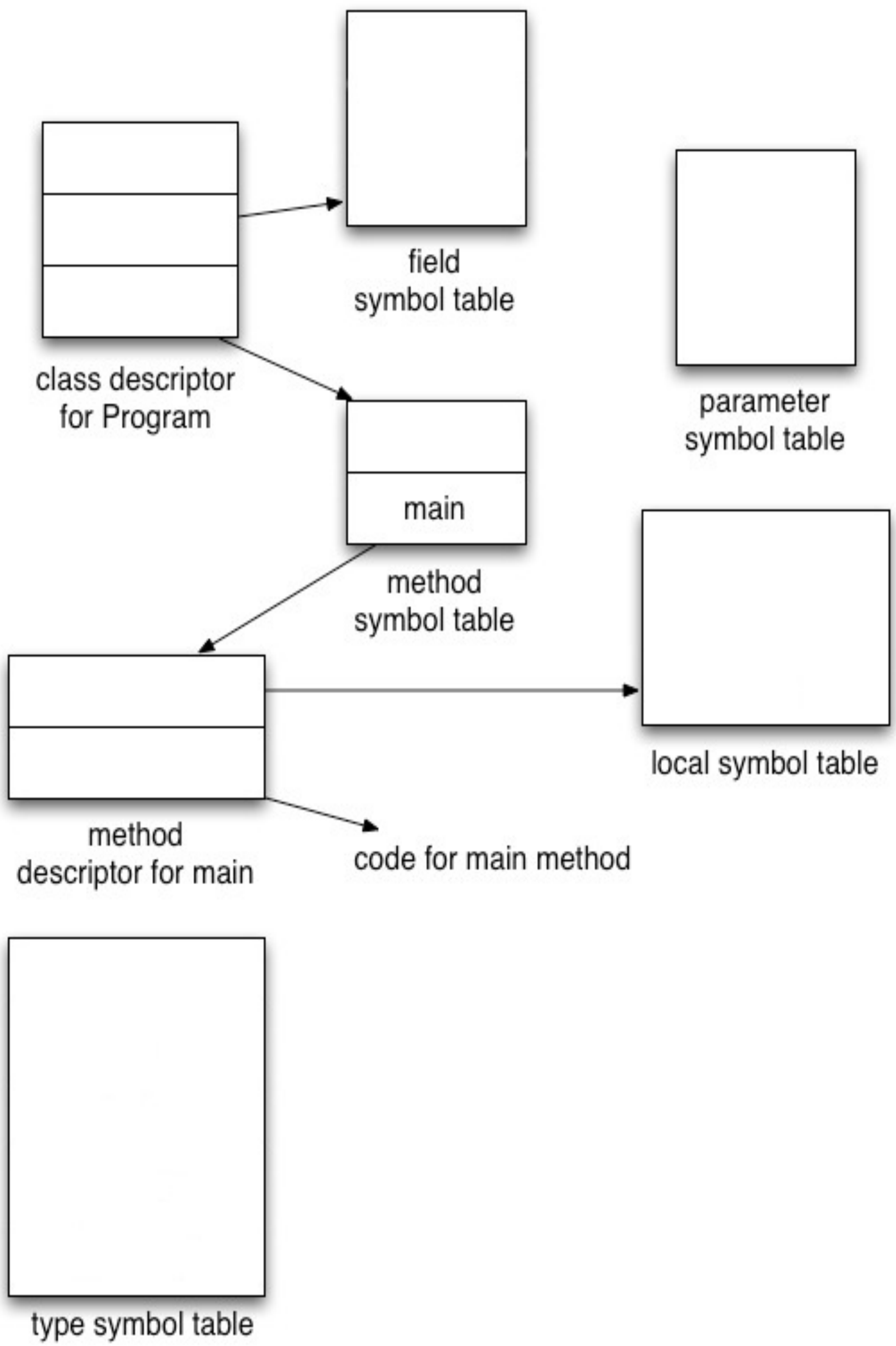
```
S() {




}
```

6. (20 points)

The following is a code snippet of `legal-01.dcf`:

```
class Program {

      int A[100];

      int length;


      void main() {

            int temp;


            length = 100;


            callout("srandom", 17);


            for i = 0, length {

                  temp = callout("random");

                  A[i] = temp;

            }


            /* <HERE> */


      }

}
```

What should the symbol tables look like at `<HERE>`, considering the semantics of the Decaf language? Complete the symbol tables on the next page in the similar way to the symbol tables presented at Lecture 5. (Hint: note that the Decaf language is different from the language presented at Lecture 5).


field
symbol table
class descriptor
for Program
parameter
symbol table
main
method
symbol table
local symbol table
method
descriptor for main
code for main method
type symbol table