

Question 3: Consider the following JavaScript skeletal program: [18 Marks]

```
// The main program
var x;
function sub1() {
  var x;
  function sub2() {
    . . .
  }
}
function sub3() {
  . . .
}
```

Assume that the execution of this program is in the following unit order:

- main calls sub1
- sub1 calls sub2
- sub2 calls sub3

a) Assuming **static scoping**, in the following, which declaration of x is the correct one for a reference to x?

1. sub1
2. sub2
3. sub3

b) Repeat part a but assume **dynamic scoping**.

Question 4: [18 Marks]

1. Using the following grammar,

```
<assign> → <id> = <expr>
<id> → A | B | C
<expr> → <expr> + <term>
| <term>
<term> → <term> * <factor>
| <factor>
<factor> → ( <expr> )
| <id>
```

show a parse tree and a leftmost derivation for the following statement:

$$A = (A + B) * C$$

2. Consider the following grammar:

```
<S> → <A> a <B> b
<A> → <A> b | b
<B> → a <B> | a
```

Which of the following sentences are in the language generated by this grammar?

1. baab
2. bbbab
3. bbaaaaaS
4. bbaab

Question 5:

[12 Marks]

Let the function fun be defined as

```
int fun(int* k) {  
    *k += 4;  
    return 3 * (*k) - 1;  
}
```

Suppose fun is used in a program as follows:

```
void main() {  
    int i = 10, j = 10, sum1, sum2;  
    sum1 = (i / 2) + fun(&i);  
    sum2 = fun(&j) + (j / 2);  
}
```

What are the values of sum1 and sum2

1. operands in the expressions are evaluated left to right?
2. operands in the expressions are evaluated right to left?

*With Best Wishes
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