

Jade Yu Cheng  
ICS 313  
Homework #13  
March 12, 2009

Homework #13: p.339 nos. 2, 3, 9, 10, 13, 19.  
Answers for Question 2 and Question 3 are not included.

---

**Question 9:** Assume the following rules of associativity and precedence of expressions:

<i>Precedence:</i>	<i>Highest</i>	<b>*</b> , <b>/</b> , <b>not</b>
		<b>+</b> , <b>-</b> , <b>&amp;</b> , <b>mod</b>
		- (unary)
		<b>=</b> , <b>/=</b> , <b>&lt;</b> , <b>&lt;=</b> , <b>&gt;=</b> , <b>&gt;</b>
		<b>and</b>
	<i>Lowest</i>	<b>or</b> , <b>xor</b>
<i>Associativity:</i>	<i>Left to right</i>	

Show the order of evaluation of the following expressions by parenthesizing all subexpressions and placing a superscript on the right parenthesis to indicate order. For example. for the expression :  $a + b * c + d$

The order of evaluation would be represented as:  $((a + (b * c)^1)^2 + d)^3$

a.  $a * b - 1 + c$

**Answer:**

$$(((a * b)^1 - 1)^2 + c)^3$$

b.  $a * (b - 1) / c \text{ mod } d$

**Answer:**

$$(((a * (b - 1)^1) / c)^3 \text{ mod } d)^4$$

c.  $(a - b) / c \ \& \ (d * e / a - 3)$

**Answer:**

$$(((a - b)^1 / c)^2 \ \& \ ((d * (e / a)^3)^4 - 3)^5)^6$$

d.  $- a \ \text{or} \ c = d \ \text{and} \ e$

**Answer:**

$$((- a)^1 \ \text{or} \ ((c = d)^2 \ \text{and} \ e)^3)^4$$

e.  $a > b \ \text{xor} \ c \ \text{or} \ d \leq 17$

**Answer:**

$$(((a > b)^1 \ \text{xor} \ c)^3 \ \text{or} \ (d \leq 17)^2)^4$$

f.  $- a + b$

**Answer:**

$$(- (a + b)^1)^2$$

**Question 10:** Show the order of evaluation of the expressions of Problem 9, assuming that there are no precedence rules and all operators associate right to left.

a.  $a * b - 1 + c$

**Answer:**

$$(a * (b - (1 + c)^1)^2)^3$$

b.  $a * (b - 1) / c \ \text{mod} \ d$

**Answer:**

$$(a * ((b - 1)^2 / (c \ \text{mod} \ d)^1)^3)^4$$

c.  $(a - b) / c \ \& \ (d * e / a - 3)$

**Answer:**

$$((a - b)^5 / (c \ \& \ (d * (e / (a - 3)^1)^2)^3)^4)^6$$

d. `- a or c = d and e`

**Answer:**

```
(- (a (or (c = (d and e)1)2)3)4)5
```

e. `a > b xor c or d <= 17`

**Answer:**

```
(a > (b xor (c or (d <= 17)1)2)3)4
```

f. `- a + b`

**Answer:**

```
(- (a + b)1)2
```

**Question 13:** 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);
}
```

a. What are the values of `sum1` and `sum2`, if the operands in the expressions are evaluated left to right?

**Answer:**

```
sum1 = (iold / 2) + fun(&iold)
      = (10 / 2) + (3 * (10 + 4) - 1)
      = 5 + 41
      = 46
```

```
sum2 = fun(&jold) + (jnew / 2)
      = (3 * (10 + 4) - 1) + (14 / 2)
      = 41 + 7
      = 48
```

- b. What are the values of sum1 and sum2, if the operands in the expressions are evaluated right to left?

**Answer:**

```
sum1 = (inew / 2) + fun(&iold)
      = 14 / 2 + (3 * (10 + 4) - 1)
      = 7 + 41
      = 48

sum2 = fun(&jold) + (jold / 2)
      = (3 * (10 + 4) - 1) + (10 / 2)
      = 41 + 5
      = 46
```

**Question 19:** Consider the following C program:

```
int fun (int *i) {
    *i += 5;
    return 4;
}

void main() {
    int x = 3;
    x = x + fun (&x);
}
```

- a. What is the value of x after the assignment statement in main, assuming operands are evaluated left to right.

**Answer:**

```
x = xold + 4
  = 3 + 4
  = 7
```

- b. What is the value of x after the assignment statement in main, assuming operands are evaluated right to left.

**Answer:**

$$\begin{aligned}x &= x_{\text{new}} + 4 \\ &= 8 + 4 \\ &= 12\end{aligned}$$