**CPS 450**

**In-Class Activity – 1**

**Date: Jan. 20, 2016**

**Total points: 45**

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**Definition 1:**

Assume the following rules of associativity and precedence for expressions:

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Precedence Highest ()

- **(unary)**

**\*** , **/** , **not**

**+** , **-** , **&** , **mod**

**>, <, >=, <=**

**and**

**or**, **xor**

Lowest **=**

Associativity Left to right

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**Qn. 1 (15 points)**

Write a BNF description of the precedence and associativity rules for definition 1. Assume the only operands are the names a, b, c, d, and e.

<var> ::= 'a' | 'b' | 'c' | 'd' | 'e'

<statement> ::= <var> '=' <log\_or>

<log\_or> ::= <log\_or> 'or' <log\_and>

| <log\_or> 'xor' <log\_and>

| <log\_and>

<log\_and> ::= <log\_and> ‘and’ <log\_exp>

| <log\_exp>

<log\_exp> ::= <log\_exp > '>' <unary\_expr>

| <log\_exp > '<' <unary\_expr>

| <log\_exp > '>=' <unary\_expr>

| <log\_exp > '<=' <unary\_expr>

| <unary\_expr>

<unary\_expr> ::= <unary\_expr> ‘+’ <term>

| <unary\_expr> ‘-’ <term>

| <unary\_expr> ‘&’ <term>

| <unary\_expr> ‘mod’ <term>

| <term>

<term> ::= <term> ‘\*’ <unary>

| <term> ‘/’ <unary>

| <term> ‘not’ <unary>

| <unary>

<unary> ::= <unary> ‘()’ <var>

| <var>

**Qn. 2(15 points):**

Show the order of evaluation of the following expressions by parenthesizing all subexpressions and placing a superscript on the right parenthesis to indicate order. (Use Definition 1 for the rules of associativity and precedence).

For example, for the expression

a + b \* c + d

the order of evaluation would be represented as

( ( a + ( b \* c)1 )2 + d )3

Show the results assuming the following:

* a = 2.0
* b = 3.0
* c = 5
* d = 6.0
* e = 4.0

i. a \* b – 1 + c (((a \* b) 1 – 1)2 + c) 3

Result: 10

ii. a \* ( b – 1 ) / c **mod** d (((a \* (b – 1)1) 2 / c)3 mod d)4

Result: 0.8

iii. ( a – b ) / c & ( d \* e / a - 3) (((a – b)1 / c)2 & ((d \* (e / a)3) 4 – 3)5) 6

Result: -0.2&9

iv. - a **o**r c = d **and** e ((-a)1 or ((c = d)2 and e)3) 4

Result: -2 or 5=6and4

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

Result:

vi. - a + b (­ (a + b)1)2

Result: -5

**Qn. 3 (15 points):**

Show the order of evaluation of the following expressions, assuming that there are no precedence rules and all operators associate right to left, and parentheses have the highest order of precedence.

Show the results assuming the following:

* a = 2.0
* b = 3.0
* c = 5
* d = 6.0
* e = 4.0

i. a \* b – 1 + c (a \* (b – (1 + c)1)2)3

Result: -6

ii. a \* ( b – 1 ) / c **mod** d (a \* ((b – 1)2 / (c mod d)1)3)4

Result: 0.8

iii. ( a – b ) / c **and** ( d \* e / a - 3) ((a – b)5 / (c and (d \* (e / (a – 3)1)2)3)4)

Result:

iv. - a **o**r c = d **and** e (­ (a (or (c = (d and e)1) 2) 3) 4) 5

Result:

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

Result:

vi. - a + b (­- (a + b)1) 2

Result: -5