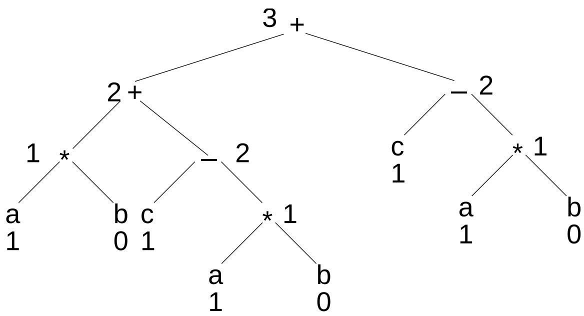
QUIZ 4

DATE: 18th April 2003 **Maximum Marks: 30**

1. Consider generating code using Sethi-Ullman algorithm for the expression

$$((a * b) + (c - (a * b))) + (c - (a * b))$$

   (a) Represent the expression as a tree. Show the label at each node of the tree.



   (b) Show the code produced by *gencode* for the tree assuming only two registers are available.

$R_1 \leftarrow a$
$R_1 \leftarrow R_1 * b$
$R_2 \leftarrow c$
$R_2 \leftarrow R_2 - R_1$
$m \leftarrow R_2$

$R_1 \leftarrow a$
$R_1 \leftarrow R_1 * b$
$R_2 \leftarrow c$
$R_2 \leftarrow R_2 - R_1$

$R_1 \leftarrow a$
$R_1 \leftarrow R_1 * b$

$R_1 \leftarrow R_1 + R_2$
$R_1 \leftarrow R_1 - m$

   (c) What is the best code that you can write manually for this expression?

$R_1 \leftarrow a$
$R_1 \leftarrow R_1 * b$
$R_2 \leftarrow c$

$R_2 \leftarrow R_2 - R_1$

$R_1 \leftarrow a$
$R_1 \leftarrow R_1 * b$

$R_1 \leftarrow R_1 + R_2$
$R_1 \leftarrow R_1 + R_2$

$(2 + 4 + 4 = 10$ marks)

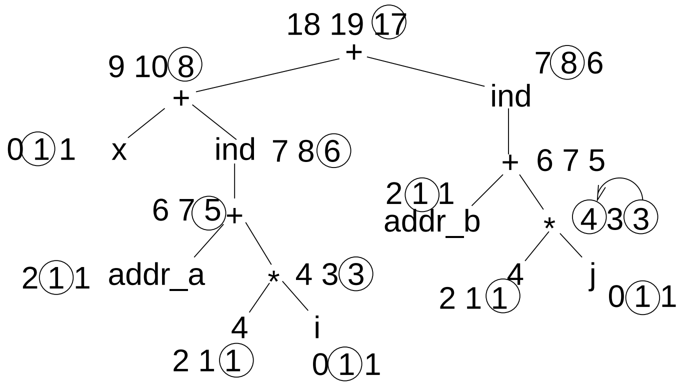
2. Consider a machine model with 2 general purpose registers and instructions shown below with their costs.

$R_i \leftarrow R_i \ op\ R_j$	cost – 1
$R_i \leftarrow R_i \ op\ m$	cost – 2
$R \leftarrow c$	cost – 1
$R \leftarrow m$	cost – 1
$R \leftarrow ind(R)$	cost – 1
$R \leftarrow ind(R + m)$	cost – 3
$m \leftarrow R$	cost – 1

Now consider generating code for the expression $(x + ind(addr_a + 4 * i)) + ind(addr_b + 4 * j)$ using Aho-Johnson's algorithm.

(a) Represent the expression as a tree. Calculate the array of costs for each node in the tree.

(b) Encircle the least cost element at the root and the element at each node which gave rise to the least cost element at the root.



(c) Mark which nodes require a store.

(d) Write the code generated for the expression.
$R_1 \leftarrow 4$
$R_2 \leftarrow j$

$R_1 \leftarrow R_1 * R_2$
$m \leftarrow R_1$

$R_1 \leftarrow 4$
$R_2 \leftarrow i$
$R_1 \leftarrow R_1 * R_2$

$R_2 \leftarrow addr_a$
$R_2 \leftarrow R_2 + R_1$
$R_2 \leftarrow ind(R_2)$

$R_1 \leftarrow x$
$R_1 \leftarrow R_1 + R_2$

$R_2 \leftarrow addr\_b$
$R_2 \leftarrow R_2 + m$
$R_2 \leftarrow ind(R_2)$

$R_1 \leftarrow R_1 + R_2$ $(10 + 3 + 2 + 5 = 20$ marks)