

**King Saud University**  
**College of Computer and Information Sciences**  
**Computer Science Department**  
**CSC 340: Programming Language and Compilation**  
**Three Address Code and Code Generating**



**Q1. Translate each of the following arithmetic expressions into a) Quadruples b) Triples.**

1.  $a + -(b+c)$
2.  $Y * Z + 7 * 6$
3.  $Y + Z * W$

<b>1. <math>a + -(b+c)</math></b>			
<b>Triples</b>			
	<b>op</b>	<b>Arg1</b>	<b>Arg2</b>
<b>(0)</b>	<b>+</b>	<b>b</b>	<b>c</b>
<b>(1)</b>	<b>minus</b>	<b>(0)</b>	
<b>(2)</b>	<b>+</b>	<b>a</b>	<b>(1)</b>

<b>1. <math>a + -(b+c)</math></b>				
<b>Quadruples</b>				
	<b>op</b>	<b>Arg1</b>	<b>Arg2</b>	<b>result</b>
<b>(0)</b>	<b>+</b>	<b>b</b>	<b>c</b>	<b>t0</b>
<b>(1)</b>	<b>minus</b>	<b>t0</b>		<b>t1</b>
<b>(2)</b>	<b>+</b>	<b>a</b>	<b>t1</b>	<b>t2</b>

<b>2. <math>Y * Z + 7 * 6</math></b>			
<b>Triples</b>			
	<b>op</b>	<b>Arg1</b>	<b>Arg2</b>
<b>(0)</b>	<b>*</b>	<b>Y</b>	<b>Z</b>
<b>(1)</b>	<b>*</b>	<b>6</b>	<b>7</b>
<b>(2)</b>	<b>+</b>	<b>(0)</b>	<b>(1)</b>

<b>2. <math>Y * Z + 7 * 6</math></b>				
<b>Quadruples</b>				
	<b>op</b>	<b>Arg1</b>	<b>Arg2</b>	<b>result</b>
<b>(0)</b>	<b>*</b>	<b>Y</b>	<b>Z</b>	<b>t0</b>
<b>(1)</b>	<b>*</b>	<b>7</b>	<b>6</b>	<b>t1</b>
<b>(2)</b>	<b>+</b>	<b>t0</b>	<b>t1</b>	

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<b>3. Y+Z*W</b>			
<b>Triples</b>			
	<b>op</b>	<b>Arg1</b>	<b>Arg2</b>
<b>(0)</b>	*	Z	W
<b>(1)</b>	+	Y	<b>(0)</b>

<b>3. Y+Z*W</b>				
<b>Quadruplets</b>				
	<b>op</b>	<b>Arg1</b>	<b>Arg2</b>	<b>result</b>
<b>(0)</b>	*	Z	W	<b>t0</b>
<b>(1)</b>	+	Y	t0	<b>t1</b>

**Q2. How many labels are needed to be created in converting each of the following code segments to machine code?**

```
1. if ( X >7 )
    { y=1;
      printf("...");
    }
    else
    { y=2;
      printf("...");
    }
```

**Two Labels.**

```
2.
X=10;
printf(".....");
```

**Zero Labels.**

```
3. While (Y<X)
{
    if ( X >7 )
    {...}

    .....
}
```

**Three Labels.**

```

4. while(Y<X)
   {...
     while(YY==XX)
       { ... }
   }
    
```

Four Labels

Q3.

The following figure is a matrix elements initialization code segment.

- Translate the program into *three-address statements* (Triplets). Assume the matrix entries are numbers that require 8 bytes, and that matrices are stored in row-major order.
- Construct the flow graph for your code from (a).
- Identify the loops in your flow graph from (b).

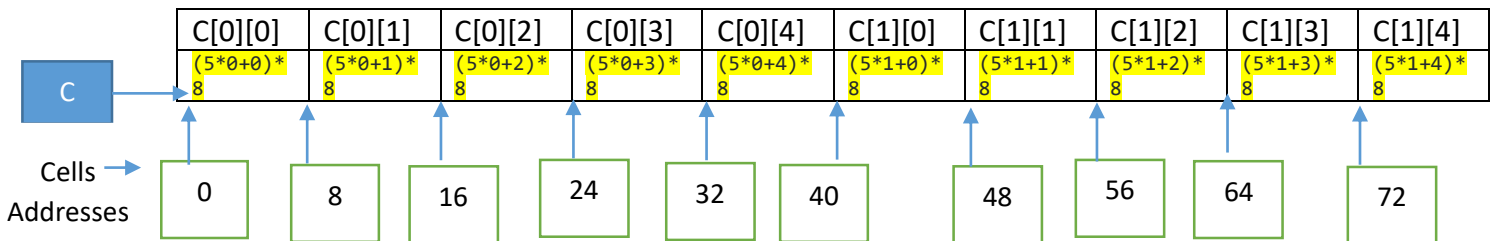
```

for (i=0; i<n; i++)
  for (j=0; j<n; j++)
    c[i][j] = 0.0;
    
```

Solutions:

The Address equation in 2D matrix in row-major order is:  $indx = (clm * i + j) * (data\text{-}type\ size\ in\ byte)$

Example: Array C: r=2 c=5



a) three-address statements

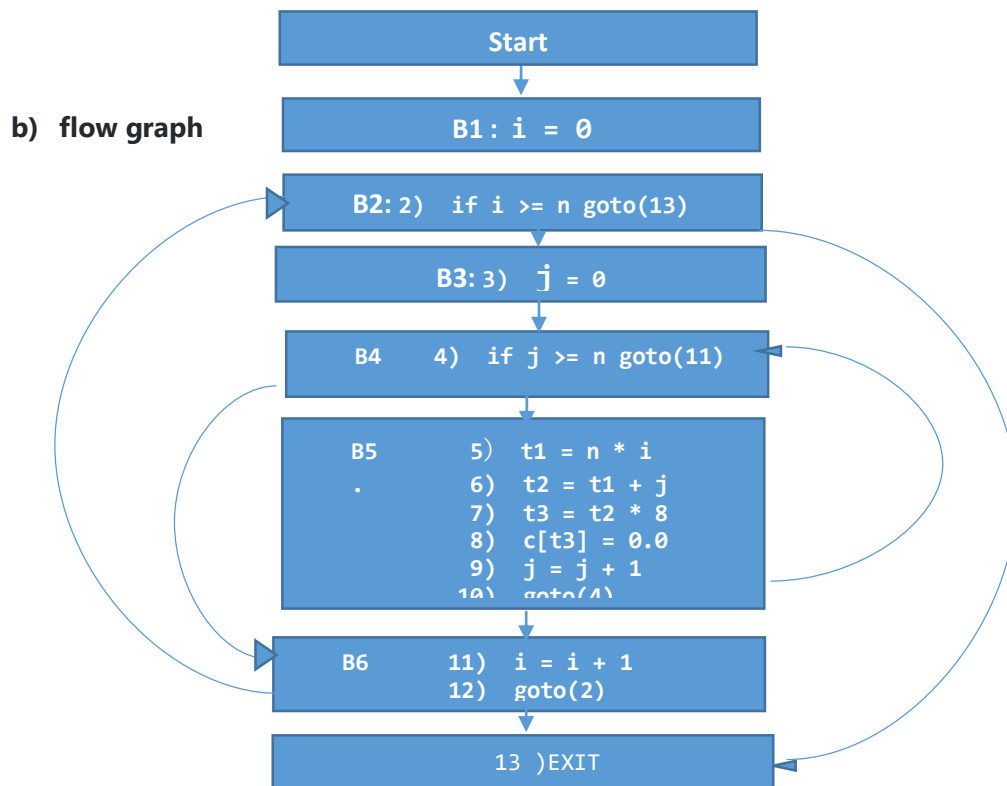
<u>Op</u>	<u>Arg1</u>	<u>Arg2</u>
<u>=</u>	<u>i</u>	<u>0</u>
<u>...</u>	<u>...</u>	<u>...</u>

Complete it accordingly

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c) The loops

- {B2, B3, B4, B6}
- {B4, B5}