Department of Computer Science and Engineering

Indian Institute of Technology, Bombay

QUIZ ONE, 2004-2005 SESSION

CS 616 : PARALLELIZING COMPILERS

Date : 10-09-2004 **Day : Friday**
Time : 09:30 hrs to 10:30 hrs **Marks : 20**
Weightage : 5%

Remarks : 1. Open Notes Examination (no books/xerox copies).
2. Exchange of material is not permitted.
3. Please answer the questions in the order given.

Q1. (a) Write the data flow equations for finding out the definitions reaching a node in a control flow graph.

(b) Write the normalized form of the loop given below and justify your answer.

```
      do I = 5 , 21, 3
S :        a[2*I + 1] = a[3*I - 15] + 25
      endo
```

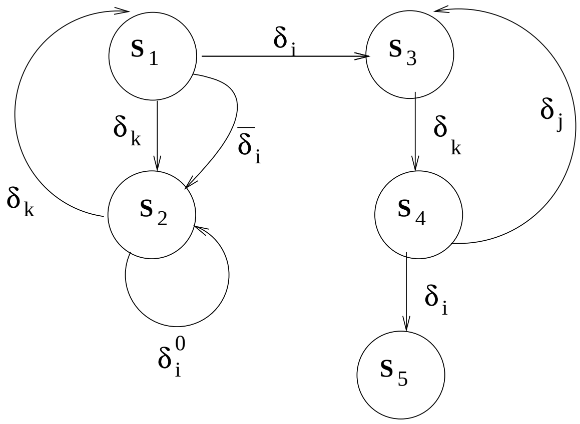
(2 + 2 = 4 marks)

Q2. Find all dependence information for the loop given below using
(a) the gcd test, and
(b) Banerjee's test.
(c) Construct the DDG from the above data. Indicate the type of dependence against each edge - (i) loop carried / loop independent, (ii) flow / anti / output, and (iii) direction vectors. (2 + 2 + 2 = 6 marks)

```
      do I = 1 , 10
S :        ... = a[2*I + 15]
T :        a[4*I - 6] = ...
      endo
```

Q3. Consider the following DDG, which was constructed from 3 nested loops containing all the 5 statements, S_1, S_2, S_3, S_4, S_5 in the innermost loop. The loops i, j and k are in the order from outermost to innermost.

(3 + 4 + 3 = 10 marks)



(a). Determine and show the values of $\eta(S_i, S_i)$ and $\rho(S_i)$ for $1 \leq i \leq 5$.

(b). Show the vector code produced by Allen-Kennedy's Algorithm (without considering loop interchange). Also write the intermediate vector code produced at each recursive call. Use terms like, " S_1 vectorized in i " etc. as appropriate in the generated code.

(c). Can this vector code be improved by using loop interchange transformation ? Show the best vector code for this program and justify your answer.

**** **End of the Paper** ****