The assignment is to be turned in before Midnight (by 11:59pm) on January 29th, 2015. Late submissions are accepted, but there is a 5 point deduction for each day the assignment is late. You should turn in the solutions to this assignment as a pdf file through the TEACH website. The solutions should be produced using editing software programs, such as LaTeX or Word, otherwise they will not be graded.

## 1: Relational Model (3 points)

Briefly describe the concepts of order independence and index independence and explain why relational queries are order and index independent.

## 2: Relational Model (1 point)

Briefly explain a disadvantage of relational model.

## 3: Schema Transformation (2 points)

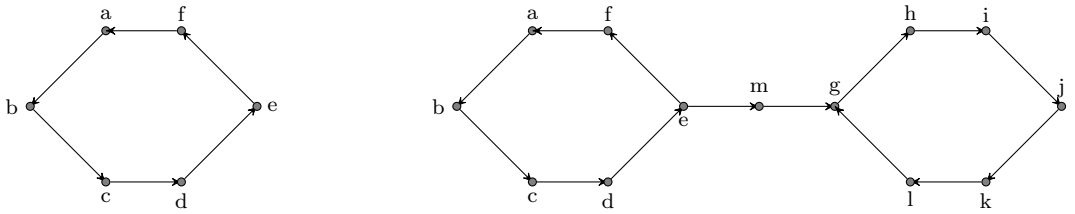
Consider schema $S_1$ that contains relation $R(A, B, C, D, E)$ and schema $S_2$ that contains relations $P_1(A, B, C, D)$ and $P_2(A, B, E)$. Explain whether or not $S_2$ includes $S_1$. If it is not, explain which integrity constraints should be added to $S_2$ and/or $S_1$ so $S_2$ includes $S_1$. Also explain which integrity constraints we should add to $S_2$ and/or $S_1$ so they become equivalent. You should explain your answers using the concepts of schema inclusion and schema equivalence proposed in *P. Atzeni, et. al., Inclusion and Equivalence Between Relational Database Schemata, TCS, 1982.* You do not need to use a lot of mathematical notations in your answers. It is sufficient to clearly explain the reasons.

## 4: Schema Transformation (1 point)

Provide an example of horizontal decomposition where the source schema (original scheme) is **not** included in the refined (target) schema and explain why. You do not need to use a lot of mathematical notations in your answer. It is sufficient to clearly explain the reason.

## 5: PageRank (3 points)

Assume the following graphs depict parts of the Web, where nodes represent pages and edges show hyper-links. Find out the pages whose PageRank values are greater than zero and their relative PageRank values in both graphs. You do **not** need to perform the fix point computation to determine the PageRank values. Instead, you should guess the PageRank values based on your understanding of the PageRank algorithm and explain why you think they are correct. If it is no possible to make any educated guess for some page(s), you should explain why.




(a) Graph 1 (b) Graph 2

Figure 1: Graphs for Problem 5