Please answer question one and two of the remaining four questions. Include citations for relevant literature where appropriate.

1. **Research Impact – You must answer this question**
   It has been claimed that software engineering research has had relatively little impact on actual software development practice. Select three different areas of practice. The first should be an area for which you can show the direct impact of academic software engineering research. For this area, do the following.
   a) Describe the state of the practice in the area in terms of methods and technology (tools) currently used
   b) Indicate the role that software engineering research has had on these methods and technologies citing at least two specific papers. Include a precise statement of the research contribution made in each paper
   c) Argue why you think that research has been able to impact this area of practice
   For the second area, select an area in which academic software engineering research has not had much practical impact. For this area, do the following.
   a) Describe the state of the practice in the area in terms of methods and technology (tools) currently used
   b) Provide at least two major historical research results in this area, including citations of papers and precise statement of the contributions made
   c) Explain why you think that research results have not had an impact on this area
   For the third area, select an area for which you think current research will have a major impact in the future. For this area do the following.
   a) Describe the state of the practice in the area in terms of methods and technology (tools) currently actually used by developers today
   b) Provide at least two recent research results that you believe will have future impact, include citations and a precise statement of research contributions made
   c) Argue why you think this research will have an impact, including overcoming the kinds of barriers you discussed for the second area

Select two of the following four questions to answer.

2. **Object Orientation**
   Object oriented (OO) methods are now ubiquitous in software engineering research and practice.
   a) Characterize, in general, what object orientation is and then indicate at least three areas/activities of software development in which it used. For each area describe how your characterization is realized
   b) Summarize the argument on why OO methods are beneficial?
   c) Point out any published results, either positive or negative, evaluating the effectiveness of OO. Why is evidence of the value of OO so sparse?
d) Outline a 5-year research program for measuring the cost/benefits of OO methods to industrial practice. Include at least three specific research projects that you would run. Include at least the following items for each. 1) research questions/hypothesis being tested; 2) approach taken and research methods used; and 3) validation procedures

3. **Cloud Computing**
   Cloud computing, also called Software as a Service (SaaS) has been proposed as an alternative delivery vehicle for providing access to software applications.
   a) From the point of view of the customer/user, how does SaaS differ from traditional application delivery in terms of non-functional qualities?
   b) From the point of view of developers, how does SaaS differ from traditional development and delivery?
   c) What sorts of applications do you think can be effectively delivered this way, and what sorts do you think will continue to be delivered traditionally? Give reasons for your choices
   d) Describe how software engineering research should address this trend

4. **Silver Bullet**
   Brooks argued more than twenty years ago in his classic "No Silver Bullet" essay that no single innovation would lead to an order of magnitude improvement in software development practice.
   a) Summarize his argument. Include definitions of what he meant by the terms *accidental* and *essential*
   b) Indicate how his argument might be attacked; that is, give some counter arguments
   c) How would you determine whether he was correct of not? That is, how is software development practice measured?

5. **Testing**
   Most existing software testing tools use some form of "coverage" as a way of measuring and controlling the testing process.
   a) Define the term *coverage*, and give examples of at least three kinds of coverage currently employed in actual practice
   b) Cite recent research results that have advanced new approaches to coverage. Summarize the major contribution of this research
   c) Coverage measures treats all parts of a program uniformly implying that equal effort will be expended on infrequently occurring situation as on those which are likely to occur frequently. What alternatives to coverage-based testing exist that address this issue? Provide a comparison of these approaches to coverage-based approaches