1. (15 pts) What is the scale type for each of the following measures? Justify your answer.

   a. average nesting level – **ordinal since there is not a fixed interval**
   
   b. number of attributes in a class – **absolute or ratio**
   
   c. the severity of an error – **ordinal or nominal if categories are not ordered**
   
   d. type of cohesion – **nominal or ordinal if weak and strong**
   
   e. average functions per class – **ordinal since there is not a fixed interval**

2. (30 pts) Using Kitchenham(1995)’s structural model (framework), specify a measure that counts the average for each function in the system of the number of unique classes containing functions called by that function in a system. Assume that the name of this measure is aveuniqclasses.

   **The following items need to be defined in each section**
   
   **entities** – program, class, function (3pts each)
   
   **attributes** – what functions a method calls; what class a function is in, name of class (3 pts each)
   
   **units** – cardinality
   
   **values** – continuous for aveuniqclass, discrete for classes called (2 pts each)
   
   **scale types** – absolute, ordinal (2 pts each)
   
   **measurement instrument:**
   
   \[
   \text{aveuniqclass} = \frac{\sum_{\text{all methods } i} \left| \{\text{classes containing functions called by method}\} \right|}{\text{card of functions}}
   \]

   **scores** – 28,27, 25, 24, 24, 22,18, 14,14,12,12,11,0,
3. (30 pts) For a measure that counts the max length of recursive calls, use Briand’s approach and define a representation \( S = \langle E, R \rangle \). Identify the type of measure and show which properties are valid.

An acceptable answer has these parts:

- \( E \) is set of methods, \( R \) is set of “calling” arcs – 5 pts
- measure is max length of cycle. 5pts
- measure is close to Briand’s length but does not satisfy property 3 (nonincreasing monotonicity) – the rest are satisfied (4 pts each)

scores 29, 25, 25, 25, 25, 21, 16, 16, 14, 10, 10, 0

4. (40 pts) Multiple choice – Circle the best answer. Remember that “all of the above” means that all answers above it would be correct and that “none of the above” means that all answers above it would not be correct.

4.1 GQM stands for
- a. goal, query, method
- b. general question methodology
- c. goal question method
- d. all of the above
- e. none of the above

4.2 Before defining measures, Offen requires that a company
- a. understand the business imperatives
- b. build a model of the environment
- c. identify the business goals
- d. all of the above
- e. none of the above
4.3 M3P stands for
   a. method, model, measure, process
   b. measure, model, manage, process
   c. model, measure, manage paradigm
   d. all of the above
   e. none of the above

4.4 If 90% are X and 60% are Y and the combination of notX and Y occurs 19 out 100 times, what is the interestingness level of notX and Y?
   a. 0.35
   b. –0.35
   c. 0.13
   d. 0.19
   e. none of the above

4.5 Which of the following would not be an example of metadata as used by Kitchenham (2001)?
   a. DM entity name
   b. scale type
   c. unit range
   d. all of the above
   e. none of the above

4.6 Let A and B be systems according to Briand’s definition, then B is a module of A if
   a. $E_B$ is a subset $E_A$
   b. $E_A$ is a subset $E_B$
   c. $R_B$ is a subset of $R_A$ and $R_B$ is a subset of $E_B$ cross $E_B$
   d. all of the above
   e. none of the above

4.7 Let A be a system according to Briand’s definition and let B be a module of A, then
   a. B is a system
   b. A union B is a system
   c. A intersect B is a system
   d. all of the above
   e. none of the above

4.8 According to the article by Pfleeger, the most successful measures programs involve
   a. users
   b. practitioners and researchers
   c. coordination to meet goals
   d. collaboration to solve problems
   e. all of the above
   f. none of the above

4.9 The representation condition
   a. requires an absolute scale
   b. is not required for predictive measures
   c. is not required for indirect measures
   d. all of the above
   e. none of the above
4.10 Which of the following is not one of Mendonca’s desired properties of a framework?
   a. lean
   b. **tight**
   c. complete
   d. sound
   e. none of the above
5. (28 pts) Fill in the blanks

5.1 Paraphrasing Lord Kelvin, it isn’t _________ (science) unless you can __________ (measure) it.

5.2 Measurement is the ______ (process) in which ____________ (numbers) or __________ (symbols) are attached to ____________ (attributes) of ____________ (objects) in the real world.

5.3 Offen prefers the term ______________ (measure) since ________ (metric) refers to a generic distance.

5.4 Identifying metrics is the first step of the approach described in the article by __________ (Mendonca).

5.5 Offen uses the term ______________ (framework) interchangeably with metamodel.

5.6 M3P uses GQM as ______________ (measure selection) technology.

5.7 The article by ______ (Mendonca) describes an approach that is intended to deal with existing data bases of measures.

5.8 The ________ (AF or attribute focus) is an example of data mining.

6. (7 pts) matching

briand’s size ____d a. fred’s head is higher
briand’s complexity ____ c b. 5 less than or equal 6
line of code ___g c. cardinality of R
empirical relationship ___a d. cardinality of E
numerical relationship ___b e. ordinal
transform is 3x + 5 ___f f. interval
rank between 1 and 5 ____e g. absolute