

Midterm: Part Two

Note

This is an open-book exam. You may consult any books, papers, or notes, but discussion with others is strictly forbidden.

Problems

1. (10 %) Validation and verification are two related but different activities in the software development process. What do they mean? How do the two differ? What are the primary means to verification?
2. (5 %) How is formal logic relevant to software development?
3. (20 %) Please make precise each of the following statements enclosed in double-quotes, by writing a suitable first-order formula/sentence. The functions, predicates, and constants you may use are: $+$, \times , $<$, $=$, \leq , 0 , 1 , plus those introduced in the problem statements.
 - (a) “ a divides b ,” assuming $a \neq 0$ (i.e., $\neg(a = 0)$).
 - (b) Let $a|b$ denote that a divides b . “ $\text{gcd}(a, b)$ is the greatest common divisor of a and b .”
 - (c) An array can be seen as a function. For an array A , let $A(i)$ denote the i -th element of A . Suppose A is an array with N elements. “Array A is sorted increasingly.”
 - (d) Suppose A and B are two arrays with N elements. “Array B is a permutation of array A .”
4. (20 %) You have been assigned to design a computerized course scheduling and enrollment system for a university. The staff of the university may use the system to schedule classes, including assignment of courses to classrooms, while the students may use it to enroll in classes. Among other things, you have managed to gather the following requirements:
 - (a) A professor or staff can be uniquely identified by her employment ID.

- (b) A student can be uniquely identified by her student ID.
- (c) Each person has a name, which is composed of family and given names.
- (d) A course can be uniquely identified by its course ID and the year and semester when it is offered; a course also has a title.
- (e) A course may be offered by one or more professors.
- (f) Some courses may have prerequisite courses. (To take a course with prerequisites, a student must have taken and passed the prerequisite courses.)
- (g) A classroom has a location and a fixed capacity.

Now the next step should be to turn all these relevant concepts into a more concrete design by drawing a UML class diagram. You should anticipate the usages of the various classes and provide suitable operations. Please carry out this step as thoroughly as possible; make assumptions wherever necessary.

5. (10 %) SQL Injection and Cross-Site Scripting are the two most common types of Web application security vulnerabilities/risks. What is the main cause of the two security vulnerabilities? How do the two compare?