**Advanced Web Development – Midterm (100 points)**

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**Due date on blackboard. No late submissions will be graded.**

Instructions:

1. This is a take-home midterm. Please submit typed answers and computer generated diagrams through the blackboard, if you choose to include hand-drawn diagrams, then they should be neat, legible, and properly referenced in text.
2. If you have hand drawn diagrams then scan and email to me or give hardcopies to the department secretary by due date.
3. All work is to be done independently: you may not discuss any of the material with your classmates, friends, or colleagues.
4. You may use external references including web pages, research literature, and textbooks. However, you must indicate which resources you have consulted. If your answers make use of specific facts that you find in an external resource, please reference the resource. Don’t just copy from an external resource, use your own words. Any use of external resources without proper attributionwill be examined for signs of possible plagiarism. I take this very seriously.

Question 1 – Web application design (70%)

The aim of this question is to **design** **(not implement)** a web application (using Rails) to manage online testing and certifications (for an example see [www.brainbench.com](http://www.brainbench.com) – individual certification). The website will offer tests in various categories (e.g., information technology, aptitude, finance etc.) and under each category offer specific certification (e.g., Java certification under IT, problem solving under aptitude, etc.). The functionality provided by the website will include the following:

1. Users will be able to search for (using various criteria), register, login, and take tests.
2. Each test area (say Java) will lead to a certification (say Java certification) if the user passes the test.
3. The application **will store the results of all the tests that a user has taken and also store all the certifications that a user has received.**
4. Each **test result and certification can be marked as “public”** by the user so the world can see it.
5. Unregistered users (say employers) will be able to access the results of tests taken by a user and certifications received by entering a **PIN number provided by the user**. They can also provide the **user lastname and email to access all the results that the user has marked as “public**.”
6. The application will store a question bank for all the tests that it provides. There will be two question banks: **real and practice**. Each user should be able to take practice tests for any certification.
7. The application should maintain relevant statistics about usage: **how many tests have been taken, when, in what categories, etc.? How much time have users spent on each test?**
8. The questions, certifications, categories, users, and other pertinent data can be modified by administrators.

Answer the following based on the description above. Be as comprehensive as possible with the functionalities in mind. While designing, keep good design principles in mind with respect to the database, application structure (MVC etc.), and scalability. With each answer include a brief description whenever needed:

1. Provide all the models (in the Rails sense) that you will need to implement the above application. Include all attributes (table columns) that each model needs to have to implement the above functionality. (10 points)
   1. User
      1. userID, type of user, first name, last name, email address, pin, password
   2. Tests
      1. testID, certificationID, userID, start time, endtime, result
   3. Questions
      1. questionID, certificationID, practice or real, question, answer
   4. Certifications
      1. certificationID, testCategoryID, certificationName
   5. Test Category
      1. testCategoryID, testCategoryName
2. Provide the relationships between all the models (using the has\_many, has\_one, belongs\_to, etc.). (10 points)
   1. User has many Tests
   2. Tests belongs to Users
   3. Tests belongs to Certifications
   4. Tests has many Questions
   5. Questions belongs to Certifications
   6. Certification has many Tests
   7. Certification belongs to Test Category
   8. Test Category has many Certifications
3. Provide a list of all the controllers that you might need for such an application. Please think about REST (each resource has one controller) principles here (10 points)
   1. Main
   2. User
   3. Test
   4. Certification
4. Provide the main functions/methods/actions for each controller that will be needed to implement the above functionality. (10 points)
   1. Main
      1. Index
      2. Login
      3. Authenticate User (if registered user)
         1. Otherwise, Public User
      4. Logout
      5. Register
   2. User
      1. Search for Certification Tests
      2. Take tests
   3. Test
      1. Show test results for user
   4. Certification
      1. Administer test for user
      2. Display search results for Certification tests
   5. Administrator
      1. Modify
         1. Questions
         2. Certifications
         3. Users
      2. Show statistics
5. Show the workflow through the system for the following scenarios (see example below): (30 points)
   1. User logs in
      1. User enters login information on the login view of the Main controller. User clicks Login button in the login view of the Main controller. If the user is authenticated, login passes the userID to the index view of the main controller.
   2. User searches for tests to take
      1. The user can enter test search criteria on the index view of the main controller. The main controller will pass a combination of attributes (certificationName, certificationID, testCategoryID, and/or testCategoryName) when the Search button is clicked from the index view of the main controller. The certifications view of the Certifications controller will display all the certification tests that fit the criteria.
   3. User lists all the tests he/she took with a listing of certifications obtained.
      1. User presses the “Show All Tests” button on the index view of User controller. userID is passed to the show\_tests view of the test controller which displays all the tests the user has taken. Tests with a pass score are Certifications that the user has obtained.
   4. Employer searches for all the public tests and certifications for a user “Smith” with email address [smith@gmail.com.](mailto:smith@gmail.com.)
      1. User (public – guest) enters the information on the index view of Main controller and clicks the Search button. User type, last name, and email address attributes are passed to the show\_tests view of the Test controller and public results for that test taker and certifications are displayed.
   5. Administrator wants to know how much total time the users have spent testing on the system.
      1. The administrator selects total time button on the show\_statistics view of the Administrator controller.

Example using the Depot application: user adds item to cart

* User clicks button “add to cart” in the *index* view of *store* controller
* Button triggers method *add\_to\_cart* in *store* controller, passes the *product\_id*
* *add\_to\_cart* uses the *product* model to find the item to be added (by *product\_id*)
* the *add\_to\_cart* view shows the cart with the added product

The above example is in prose, you can use also an activity diagram to show the above if you wish. However, explicitly mention all the models, views, and controller methods being called, use swim lanes if necessary.

Question 2: Agile development (30%)

Your company got the contract to implement the web application you designed in Question 1. Write a short white paper aimed at convincing your managers and their bosses that your organization should adopt agile development methods. Describe what those methods are, how they can help, and what should be done to implement them. Compare them to other methods of development and how they may or may not work for the above work in Question 1. As your management is very cost-sensitive, they may be worried that agile development would increase software development costs: how would you convince them that this is not a problem? Use the papers discussed in class and any others if needed with references. Your management has a short attention span, your job is to explain agile development and convince your management as best as you can in *two* pages (double-spaced). *Please write in your own words, cite all outside sources.*

**Agile Development for Certification Website**

This new website application manages online certifications for its users and provides the ability for employers to verify those credentials. The credential and certification industry is constantly changing, and requires a web platform that is easily updated and scaled for future growth. The software industry has moving towards the frequent use of Agile development methods as a way to manage projects as it provides a way to manage projects and prioritize tasks based on customer needs. The organization should adopt Agile (or Agile-like) development methods for the development of this website because it better fits the needs of the project and organization.

The Agile development method is a software methodology that is specific in how a software project should be conducted. The primary focus is on how to navigate through phases/iterations and how to represent those products at the end of each phase. This methodology is particularly suitable for projects involving new development with constantly changing requirements. Requirements are constantly added, refined and updated through the entire project. These requirements are translated into tasks that are then added to a backlog. The tasks in this backlog are then prioritized and assigned to specific iterations and people by the Scrum master. These tasks may also be defects or software fixes detected during development and testing. Agile development is also suitable for projects that utilize automated testing because the purpose of automated testing is to be able to test incremental code changes continuously. Additional the cost of developing unit tests as code is developed is substantially less than developing scripted tests after code has already been added to the software baseline.

In comparison with the water fall and spiral methods, Agile reduces risk for both the developer and client. It prevents too much time or resources from being spent on an approach that either is not feasible or is not wanted by the client. The danger for the water fall and spiral software development models is that by the time you realize your product has deviated from either the requirements or the customer’s desires, it takes a substantial amount of time and resources for corrective action. In a cost sensitive project, the cost of corrective action needs to be considered carefully when choosing the software development methodology as well as the planned/projected cost. The other advantage of Agile development in a low-cost project is that it is better suited to deal with staffing challenges as each user has multiple roles as opposed to being the single specialist on a project. Low cost projects usually have staff turnover challenges and being able to predict the number of iterations it would take to get a new team member up to speed (and understanding) is important.