CS 142 Final Examination
Fall Quarter, 2010
SOLUTIONS

You have 3 hours (180 minutes) for this examination; the number of points for each question indicates roughly how many minutes you should spend on that question. Make sure you print your name and sign the Honor Code below. During the examination you may consult two double-sided pages of notes as well as a solution for Project #5; all other sources of information, including laptops, cell phones, etc. are prohibited. If there is a trivial detail that you need for one of your answers but cannot recall, such as the name of a particular CSS attribute or Ruby library method, you may ask the course staff for help.

I acknowledge and accept the Stanford University Honor Code. I have neither given nor received aid in answering the questions on this examination.

____

(Signature)

____

(Print your name, legibly!)

____

(email id, for sending score)

Problem	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	Total
Score												
Max	12	15	4	4	8	20	14	8	15	30	35	165

Problem 1 (12 points)

Indicate whether each of the following statements is True or False, and explain your answer briefly.

(a) In HTML *entities* are used to incorporate external content into a Web page, such as images.

Answer: false. Entities are used to display characters that have special HTML meaning, such as "<" and ">".

(b) A single partial-page template in Rails can be used in more than one Web page.

Answer: true. A partial can be rendered any number of times, either within the same page, or in different pages.

(c) When a user places an order via the Web and posts the final "Confirm" form for the purchase, the Web server should normally return HTML for the order confirmation page in the response for the HTTP request.

Answer: false. The normal response to a form post should be to redirect the browser, so that the post-action does not appear in the browser's history list.

(d) Suppose that an online retailer uses a relational database to keep track of orders, and one table contains a row for each order. If an order contains several items, the foreign keys for each of those items would typically be stored in the row for that order.

Answer: false. A row in a database cannot contain a variable number of items; thus, a separate join table should be used to keep track of the items in orders.

(e) In a scripting language types are typically associated with values, not variables.

Answer: true. Variables are typically not declared in scripting language is, so there is no opportunity to assign them a type.

(f) Web browsers are stateless: if a browser isn't displaying a page for a particular server it need not retain any state related to that server.

Answer: false. Web *servers* are stateless, not browsers. In particular, a browser must retain cookies, which store state related to particular servers.

Problem 2 (15 points)

(a) List 3 ways in which Web applications are revolutionary compared to traditional applications.

Possible answers:

- **Scale: Web applications serve 100-1000x more users than traditional applications.**
- **Easy access: the Web makes it easy to access any application from anywhere in the world.**
- **Collaboration is possible on a much larger scale.**
- **No need to install binaries, and applications can be updated without requiring any effort from users.**

(b) Explain 2 different ways that CSS supports the DRY (Don't Repeat Yourself) principle.

Possible answers:

- **Elements with the same class can share a single copy of styles.**
- **Styles can be inherited by child elements from their parents.**
- **Stylesheets can be shared between Web pages.**

(c) Give 2 examples of how Rails takes advantage of meta-programming facilities in the Ruby language.

Possible answers:

- **The "has_many" method automatically generates methods such as "students".**
- **Rails introspect the database and creates methods such as "find_all_by_name".**
- **"validates_format_of" causes new validations to be added to a model.**

(d) In your opinion, which programming language is better, Ruby or Javascript? List 2 specific reasons to justify your choice.

Answer: this question is subjective; we allowed many possible answers, such as:

- Javascript is simpler.
- Ruby has more features.
- Ruby metaprogramming is more powerful than anything in Javscript.

(e) Describe a simple attack that could be executed if browsers did not implement the Same-Origin Policy.

One possible answer: if a good page is open in one tab and a bad page in another, the bad page could modify and corrupt the good one (e.g., by stealing its cookies or posting its forms).

Problem 3 (4 points)

Consider the following security attack where an evil server attempts to impersonate a good server:

- The evil server obtains the certificate for the good server (available publically from certificate authorities).
- The evil server uses an active network attack to arrange for traffic from a particular browser intended for the good server to be sent to the evil server instead.
- When a client attempts to open an HTTPS connection to the good server, the evil server receives the connection open request and behaves just like the good server, returning the good server's certificate at the appropriate point in the protocol.

Assuming that the evil server can obtain a valid certificate and mount an active network attack, can the client's security be compromised? Explain your answer.

Answer: no. The bad server does not have the good server’s private key, so it will not be able to decrypt the client’s message.

Problem 4 (4 points)

How many alert dialogs will the following Javascript generate, and what will be displayed in each of them?

```
var x = "10";
function f(){
    var x = "4";
    alert(this.x);
    function g(){alert(x);}
    g();
}
f();
```

Answer: there will be 2 alert dialogs. The first will display “10”, and the second will display “4”.

Problem 5 (8 points)

Below you will see some snippets of HTML from a Web page. Fill in the body of the Javascript function `changeColor` so that the color of the text changes in response to the selection made in the menu.

```
<style type="text/css">
  .a {color:red;}
  .b {color:green;}
  .c {color:blue;}
</style>
...
<div id="colorText">Select below to change the color of this text</div>
  <select onchange="changeColor(this.value)">
    <option value="a">Red</option>
    <option value="b">Green</option>
    <option value="c">Blue</option>
  </select>
  <script type="text/javascript">
    //<![CDATA[
      function changeColor(value) {


        // Answer:
        Document.getElementById("colorText").className = value








      }
    //]]>
  </script>
```

Problem 6 (20 points)

Write Ruby code for a method `link` that behaves somewhat like the Rails `link_to` method. The function takes 2 arguments; the first argument is the text that should be displayed for a link (which could have come from an unknown source such as a user) and the second argument is a hash describing the URL for the link. The function returns valid XHTML for an `<a>` element. For example, consider the following invocation:

```
link_to("Click on me", :controller => "student", :action => "show",
        :name => "Lee");
```

This will return the following XHTML:

```
<a href="/student/show?name=Lee">Click on me</a>
```

Here are some additional details and requirements:

- You can assume that the second argument always contains `:controller` and `:action` entries, which describe the hierarchical portion of the URL.
- The second argument may contain any number of additional entries, such as `:name` in the example above. All of these entries should be included in the URL as query values; the names and values of these entries are of unknown origin (i.e., they could have been typed by a user).
- You may not use the Rails methods `link_to`, `url_for`, or anything similar in your solution.
- You may use the Rails method `h` in your solution, as well as the Ruby method `URI.escape`, which takes a string argument and returns a URL-encoded result (it will escape any characters other than `A-Z`, `a-z`, `0-9`, or any of `-_.~` using %-notation).

Answer:

```
def link(text, args)
  result = "<a href = \"/"
  result += URI.escape(args[:controller]) + "/" +
    URI.escape(args[:action])
  prefix = "?"
  args.each do |key, value|
    if (key == :controller) || (key == :action)
      next
    end
    result += prefix
    result += URI.escape(key.to_s)
    result += "="
    result += URI.escape(value)
    prefix = "&amp;"
  end
  result += "\"> + h(text) + "</a>"
  return result
end
```

Problem 7 (14 points)

Given the following pairs of potential attacks and countermeasures, state whether the countermeasure is ineffective, somewhat effective, or very effective against the attack, and justify your answer:

a) Spoofed sites for phishing : extended validation certificates

Answer: somewhat effective. Browsers will display a special indicator for valid extended validation certificates, but users may notice the lack of an indication.

b) Session hijacking via stolen cookies : HTTPS

Answer: very effective. With HTTPS, an attacker cannot decrypt messages to steal cookies. However, if the connection starts off with HTTP then this approach is only somewhat effective, since there are scenarios were cookies can be stolen during the upgrade to HTTPS.

c) Reflected XSS : same-origin policy

Answer: ineffective. In this attack, the attacker's code executes in the page of the good site, so the same-origin policy has no impact on it.

d) Mixed content attack : relative resource links

Answer: very effective. The relative resource links guarantee that HTTPS will be used to fetch the resources if it was used to fetch the overall page.

e) Cross-site request forgery (CSRF) : HTTPS

Answer: ineffective. This attack does not depend on the attacker reading transmissions over the network; it depends on the browser automatically attaching cookies to requests.

f) SQL injection : escaping user-supplied data when generating HTML

Answer: ineffective. SQL injection is enabled when server code forgets to escape user-supplied data when generating SQL to access a database.

g) Stored XSS : escaping user-supplied data when generating HTML

Answer: very effective. If all user-supplied data is escaped, then a malicious script will be displayed as a script, rather than being executed.

Problem 8 (8 points)

Label each of the tasks below with “Model”, “View”, or “Controller” to indicate where that task would typically be implemented in a Web application using an MVC architecture.

(a) Validate form data

Answer: model.

(b) Make sure a user is logged in

Answer: controller.

(c) Invoke the `link_to` method

Answer: view.

(d) Return a “redirect” to the browser

Answer: controller.

(e) Define an event handler for a custom form element

Answer: view.

(f) Generate a new session token

Answer: controller.

(g) Invoke the `find_all_by_name` method

Answer: controller.

(h) Create a “salt” for a password

Answer: model.

Problem 9 (15 points)

Write Ruby code that will define a method `partition` in the Enumerable module. The `partition` method invokes a block on each element of its enumerable and returns two arrays, the first containing all of the elements for which the block evaluated to true, and the second containing all of the other elements. For example,

```
[1, 5, 96, 43, 88, 17].partition {|i| (i&1) != 0}
```

should return

```
[[1, 5, 43, 17], [96, 88]]
```

You may not use any existing methods of the Enumerable module in your solution.

Answer:

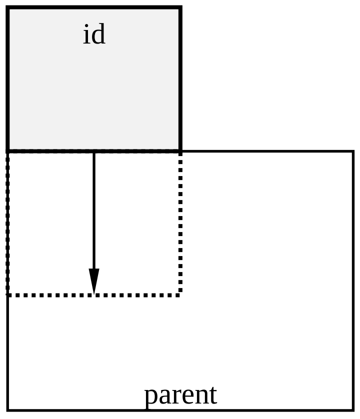
```
module Enumerable
  def partition
    trueAttr = []
    falseAttr = []
    self.each do |element|
      if yield(element)
        trueAttr << element
      else
        falseAttr << element
      end
    return [trueAttr, falseAttr]
  end
end
```

Problem 10 (30 points)

Write a Javascript function `peekDown` that will animate the appearance of an HTML element within its parent. The function will be invoked as follows:

```
peekDown(id, duration)
```

`Id` is the HTML identifier of an element, and *`duration`* indicates how long the animation should take, in milliseconds. `PeekDown` should initially position the given element just above the upper left corner of its parent as shown in the figure below; the element will not be visible because it is entirely outside the bounds of its parent. Then `peekDown` should gradually slide the element down; as it does this, the bottom part of the element will become visible underneath the top edge of the parent. Eventually, *`duration`* ms later, `peekDown` should stop, leaving the entire element just visible at the top of its parent (dotted line in the figure). The result is an animation where the element "peeks" in from the top of its parent.



Additional notes and requirements:

- In order to get full credit, `peekDown` must not use any global variables (except for the `peekDown` function itself) and it must be able to support multiple simultaneous transitions.
- You can assume that the element and its parent have been created already and configured so that the child element is clipped by the boundaries of its parent as described above (CSS "`overflow: hidden;`"); all you need to do in your code is to move the child to create the animation effect.
- You can assume that neither the element nor its parent uses padding, spacing, or a border.
- You may find the following Javascript functions useful:

  ```
  setTimeout(funcOrCode, ms);
  id = setInterval(funcOrCode, ms);
  cancelInterval(id);
  ```

  `setTimeout` returns immediately but arranges for *`funcOrCode`* to be executed (exactly once) *`ms`* milliseconds in the future; *`funcOrCode`* can be either a function to invoke or a string to eval. `setInterval` is similar to `setTimeout` except that *`funcOrCode`* is executed repeatedly every *`ms`* milliseconds; `setInterval` returns a token that can be passed to `cancelInterval` to stop the repeating execution.

Answer for Problem 10:

```
function peekDownTransition(id, duration) {
    var element = document.getElementById(id);
    var position = -element.offsetHeight;
    var interval = duration/10;
    if (interval > 5) {
        interval = 5;
    }
    var delta = -position * interval / duration;
    element.style.top = position + "px";
    element.style.left = "0px";
    var timer = setInterval(function() {
        position += delta;
        if (position >= 0) {
            position = 0;
           clearInterval(timer);
        }
        element.style.top = position + "px";
    }, interval);
}
```

Problem 11 (35 points)

In this problem you will extend your solution for Project #5 (Forms and Validation), the code for which you should have brought to the exam. Following the instructions below, modify the application to provide an additional URL that displays all of the comments written by a particular user (regardless of photo) sorted chronologically with the most recent comment first. For each comment the page should display the text of the comment, the date/time when the comment was created, and the name of the user who owns the photo for which the comment was made (you do not have to display the actual photo). There should also be a link that will go to the page displaying the photo (`/pics/user/`*`id`* for the photo's user).

(a) (5 points) Describe the structure of the URL you propose to use for the new comment page.

One possible answer (assuming Project #5 as defined for Spring 2013): use the URL /comments/index/id, where id is the primary key of the user whose comments are going to be displayed.

(b) (5 points) Describe how the new page will integrate into the application: where will there be links to the page and what form will they take? It must be easy to get to the comments for any given user.

One possible answer: add a "show all comments" link next to each user on the page /users/index. It might also be useful to add an extra link in every comment, which will go to the "all comments" page for the user that wrote that comment.

(c) (25 points) Modify the application to add the new functionality:

- Write all of your new code in the space below and on the next page, but indicate where in the original code each addition/modification should occur (you can mark the original code to indicate insertion points).
- If you need new files, indicate the names for those files below.
- Your solution must be complete and fully functional, except that you do not need to write any CSS for this problem; you can assume the CSS will be written by someone else.
- **TURN IN THE ORIGINAL PROJECT CODE WITH YOUR EXAM.**

Answer for Problem 11:

This answer depends on the structure for your original solution to Project #5....