Internet and Web Technologies

Sample Solutions – 2015

1. (a) Line 2 calls the jQuery function ($ and invokes the ajax method. This method takes an object as argument: the first property is the URL of the page to be retrieved, the second property is the type of the data to be retrieved (XML in this case), and the third property specifies that the script does not execute asynchronously with the request. The ajax method returns an XMLHttpRequest object which is referenced by xhr. Line 7 returns the retrieved page as an XML DOM document by using the responseXML property.

(b) The transport layer provides process-to-process communication. This is basically all UDP provides, with single messages being exchanged between processes. On the other hand, TCP allows an application to send a continuous stream of data across the connection. TCP is connection-oriented, whereas UDP is connectionless: TCP requires that two applications must agree to the new connection before it is established. TCP provides reliability, whereas UDP offers the same best-effort delivery as IP. TCP guarantees that the data sent across the connection will be delivered exactly as sent, without missing or duplicate data. TCP guarantees to deliver all the data reliably before closing the connection. Finally, each TCP connection has exactly two end points, while UDP allows processes to send to and receive from as many other processes as they choose.

2. (a) 

<!ELEMENT tournament (match*) >
<!ELEMENT match (player, player) >
<!ELEMENT player (name, set, set, set?, set?, set?) >
<!ELEMENT name (#PCDATA) >
<!ELEMENT set (#PCDATA) >
<!ATTLIST player
    result (won|lost) #REQUIRED >

(b) CGI provides a mechanism for information to be passed from a web server to another application process (i.e., executing script) and for the result to be passed back. CGI applications run as separate processes which incur substantial overhead. They also have to generate all static HTML content from within the script.
(c) A codeword is a fixed sized unit of data along with a fixed number of check bits. The Hamming distance between two codewords is the number of bits in which they differ. The maximum number of bit errors which can be detected is given by one less than the minimum Hamming distance between any pair of codewords.

(5 marks)

3. (a) The construct is a document type declaration. It must directly follow the XML declaration, and it would appear as follows:

```xml
<!DOCTYPE open-auctions SYSTEM "auction.dtd">
```

(5 marks)

(b) `<xsl:template match="/open_auctions">
    <html>
        <body>
            <table border="1">
                <tr>
                    <th>Seller</th><th>Initial price</th>
                    <th>Bidder</th><th>Increase</th>
                </tr>
                <xsl:apply-templates select="open_auction"/>
            </table>
        </body>
    </html>
</xsl:template>`

`<xsl:template match="open_auction">
    <tr>
        <td><xsl:value-of select="seller/name"/></td>
        <td><xsl:value-of select="initial"/></td>
        <xsl:for-each select="bidder">
            <tr>
                <td><xsl:value-of select="name"/></td>
                <td><xsl:value-of select="bid"/>
                    <xsl:if test="bid &lt; ../reserve"> (&lt;) </xsl:if>
                </td>
            </tr>
        </xsl:for-each>
    </tr>
</xsl:template>`
4. (a) i. \(\text{count}(/\text{booker/award[author='J.M. Coetzee']})\)  
ii. \(/\text{booker/award[year='1998'][title='Amsterdam']}/\text{author}\)  
(b) Without persistent connections, each HTTP request has to establish a new TCP connection which takes time. Persistent connections send multiple request and response interactions over a single TCP connection, which results in improved performance.  
(c) Any request coming from the local host with IP address 10.0.0.1 using port 3445 would have its source address and port replaced by 138.76.29.7 and 5001, respectively. Any response arriving with destination address 138.76.29.7 and port 5001 would be redirected to the local host with address 10.0.0.1 and port 3445. Criticisms of NAT include: (i) port numbers should be used for addressing processes, not hosts; (ii) routers are supposed to process packets only up to layer 3; (iii) NAT violates end-to-end principle: hosts should be communicating directly; (iv) IPv6 should be used to solve problem of shortage of addresses.

5. (a) DNS servers cache the mappings between DNS names and IP addresses in order to improve performance and reduce load. If nothing is cached, full recursive name resolution will have to be employed, by contacting authoritative DNS servers. A mapping coming from the authoritative DNS server for a name is called an authoritative answer. A mapping coming from the cache of some DNS server is called a non-authoritative answer. The length of time a mapping stays in the cache is given by its time to live (TTL).

(b) In URIs, special characters are escaped by using \% followed by the ASCII value of the character in hexadecimal. In XML, special characters are escaped using references to built-in entities, using the notation \&name;\, where name is the name of the built-in entity.

(c) The signal starts at a high voltage which drops to low in the middle of the first time slot (1). It rises to high at the end of the first slot, and drops to low again in the middle of the second slot (1). It stays low until the middle of the third slot when it rise to high (0). It drops to low at the end of the third slot, and rises to high in the middle of the fourth slot (0).
6. (a) Well-formed means that the document conforms to the XML syntax requirements, whereas valid means that the document is well-formed and references a DTD and satisfies all the structural requirements specified in the DTD. (3 marks)

(b) Namespaces are needed when element and attribute names are to be interpreted as coming from a particular well-known vocabulary, and also in order to disambiguate between elements or attributes which have the same name but come from different vocabularies. (4 marks)

(c) var elem = document.getElementById("target");
   elem.parentNode.removeChild(elem); (7 marks)

(d) (6 marks)

7. (a) JavaScript Object Notation. The data types are: number, string, Boolean, null, array and object. (7 marks)

(b) The first is a multiple selector, while the second is a contextual selector. For a multiple selector, the style is applied to each element occurrence with one of the names (i.e., a or b) in the selector. For a contextual selector such as c d, the style is applied to those element occurrences named d that are descendants of an element named c. (6 marks)
(c) The notation denotes that the network prefix is given by the first 22 bits, with the host suffix consuming the remaining 10 bits. (i) Router 1. (ii) Router 2. 40 is 00101000 in binary and the network prefix consumes the leftmost 6 of these bits \((22 = 8 + 8 + 6)\). 43 is 00101011 in binary so the network prefix matches the entry for Router 1. 48 is 00110000 in binary so the network prefix does not match the entry for Router 1; hence the default route is chosen.

(7 marks)