Internet and Web Technologies

Sample Solutions – 2016

1. (a) The DTD is as follows.

```xml
<!ELEMENT library ((album | track)*)>
<!ELEMENT album (title, track+)>
<!ELEMENT track (title, artist, time?, genre?)>
<!ELEMENT title (#PCDATA)>
<!ELEMENT artist (#PCDATA)>
<!ELEMENT time (#PCDATA)>
<!ELEMENT genre (#PCDATA)>
```

(10 marks)

(b) i. //track[time][genre]/title

(5 marks)

ii. //album[count(track)>10]

(5 marks)

2. (a) The scope of the declaration is the element itself as well as all of its descendants.

Yes, an element can belong to a different namespace by using a prefix other than the one associated with the original namespace declaration. (5 marks)

(b) RAC parity arranges the bits of each dataword conceptually into rows and columns, and then adds a parity bit for each row and column. For example, a 12-bit word might be arranged into 3 rows and 4 columns as shown below, where the parity bits for each row are in the last column and the parity bits for each column are in the last row (assuming even parity).

```
1 0 1 1 1
0 0 1 0 1
1 0 1 0 0
0 0 1 1 0
```

Now assume that the bit shown below is flipped:

```
1 0 1 1 1
0 1 1 0 1
1 0 1 0 0
0 0 1 1 0
```

RAC parity determines the row and column of the flipped bit by seeing where the parity is odd rather than even. RAC parity cannot correct all two-bit errors. If the errors occur in the same row or same column, the parity of that row or column will be unchanged. (8 marks)
(c) The two pieces of information are the window size and randomly-chosen initial sequence number. (3 marks)

(d) After byte stuffing, the output is: A B esc esc C esc esc esc eot esc soh D (4 marks)

3. (a) i. If the query string in the URL contains a name inventor with a value Berners-Lee, then the paragraph on the HTML page returned to the client would contain “Congratulations.”; otherwise, it would contain “Sorry, please try again.”. (5 marks)

ii. The URL is http://www.dcs.bbk.ac.uk/server/test.html?inventor=Berners-Lee. (2 marks)

(b) DHCP enables a computer to obtain an IP address automatically when it connects to a network. DHCP also allows a host to learn additional information, such as its subnet mask, the address of its first-hop router (often called the default gateway), and its local DNS server. The four steps are: the client sends a discover message to find a server. A server sends an offer message with an IP address. The client sends a request message with the IP address. The server replies with an ACK. (6 marks)

(c) The final cost to B is 1, to C is 2, to D is 3, and to E is 5. Initial costs to C, D and E would have been 3, 4 and 6, respectively. (7 marks)

4. (a) window is an object representing the browser window; onload is an event triggered when the page has finished loading; document is an object representing the page displayed; getElementById is a method which returns the element identified by the id attribute whose value is given (hello-button in this case); onclick is an event triggered when the button is clicked; hello is the name of a function to be called when the event is triggered. (7 marks)

(b) (i) The acknowledgement numbers are 130 and 170. (ii) Host A does not retransmit if the timeout interval expires after $t_3$ because it has received the acknowledgement from Host B that it has received all 169 bytes in the two segments. (iii) If the interval had expired before $t_2$, Host A would have retransmitted the segment with sequence number 122 before transmitting the segment with sequence number 130. (iv) If the interval had expired after $t_2$ but before $t_3$, Host A would have retransmitted the segment with sequence number 122 after transmitting the segment with sequence number 130. (7 marks)

(c) The network prefix specifies the high-order address bits (in this case 16 bits) for every IP address within the address space. The remaining 16 bits are for host addresses, so $2^{16} - 2$ IP addresses could be allocated since the host addresses corresponding to all zeroes and all ones are reserved (for booting and broadcasting, respectively). (6 marks)
5. (a) A centralised server would be a single point of failure, it would need to handle huge volumes of queries, it could not be “close” to all clients, and it would have to handle all updates for new hosts. The name given is “resolver”. (5 marks)

(b) <xsl:template match="/publications">
  <html>
    <body>
      <h1>List of publications</h1>
      <ul>
        <xsl:apply-templates select="article"/>
      </ul>
    </body>
  </html>
</xsl:template>

<xsl:template match="article">
  <li>
    <xsl:for-each select="author">
      <xsl:if test="position()=last() and not(position()=1)"
        and>
        and
      </xsl:if>
      <xsl:value-of select="."/>
      ,
    </xsl:for-each>
    "<xsl:value-of select="title"/>".
  </li>
</xsl:template>

(15 marks)

6. (a) Base64 encoding uses a table of 64 ASCII characters to encode each 6-bit sequence in the input. It starts by taking each sequence of 3 bytes (24 bits) and viewing it as a sequence of four 6-bit quantities. Each of these is encoded using a single ASCII character form the table. Decoding uses the table to replace the ASCII characters by their 6-bit sequences, and then viewing the result as a sequence of 8-bit bytes. (6 marks)

(b) The first selector applies the style to all elements having a class attribute with the value “red”, while the second applies the style to the unique element having an id attribute with the value “red”. (4 marks)

(c) i. Any two from: GET: request document named by URL-path; HEAD: return only header information of URL-path; POST: submit information to entity on server given by URL-path; PUT: server will replace entity given by URL-path. (4 marks)

ii. The following are some possibilities. The Host header allows a server to differentiate requests for multiple hosts with same IP address. The
User-Agent header includes information about the client program (e.g., type, version). The Accept header lists formats acceptable to the client, which are given using MIME types. (4 marks)

iii. The body is empty for GET and HEAD requests. (2 marks)

7. (a) IPv6 addresses are 128 bits long. They are written as a series of up to 8 blocks of 4 hexadecimal numbers each, whereas IPv4 addresses are written as 4 decimal numbers in dotted decimal notation. (4 marks)

(b) HTML is an SGML vocabulary where a DTD can specify that start and/or end tags are optional, whereas XHTML is an XML vocabulary where every element is required to have a start and end tag. An HTML parser knows the HTML DTD which has been designed in such a way that missing tags can be inferred by the parser. (6 marks)

(c)

<table>
<thead>
<tr>
<th>Event</th>
<th>Segment 1</th>
<th>Segment 2</th>
<th>Frame sent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge boots</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>A sends to E</td>
<td>A</td>
<td>–</td>
<td>1,2</td>
</tr>
<tr>
<td>D broadcasts</td>
<td>A</td>
<td>D</td>
<td>1,2</td>
</tr>
<tr>
<td>E sends to D</td>
<td>A</td>
<td>D,E</td>
<td>2</td>
</tr>
<tr>
<td>B sends to C</td>
<td>A,B</td>
<td>D,E</td>
<td>1,2</td>
</tr>
<tr>
<td>A sends to B</td>
<td>A,B</td>
<td>D,E</td>
<td>1</td>
</tr>
</tbody>
</table>

(10 marks)