Internet and Web Technologies

Sample Solutions – 2018

1. (a)  
<xsl:template match="/cinema">
  <html>
    <body>
      <h1>Films on Saturday</h1>
      <table>
        <xsl:apply-templates select="film/schedule[day='Sat']"/>
      </table>
    </body>
  </html>
</xsl:template>

<xsl:template match="schedule">
  <xsl:for-each select="time">
    <tr>
      <td><xsl:value-of select="../../title"/></td>
      <td><xsl:value-of select="."/></td>
    </tr>
  </xsl:for-each>
</xsl:template>

(b) One would want the type of the day element to be an enumerated type. This is only possible for attributes, not elements, in a DTD. One would want the times to conform to a standard syntax. Only PCDATA is provided by a DTD. Ensuring that each day value appears at most once under each film also cannot be enforced by a DTD since it cannot constrain occurrences of values. (6 marks)

2. (a)  
  i. The cost of the shortest path to node F is 5. (1 mark)
  ii. There are two shortest paths between A and F: A, C, D, E, F and A, C, E, F. (2 marks)
  iii. OSPF is a greedy algorithm, so after A it moves to B which has the current smallest cost. It finds the cost to D to be 4. Only when it then moves to C does it discover a smaller cost of 3. (3 marks)

(b) The time-to-live field contains a positive integer and is initialised by the sender. It is decremented by one at each router that handles the IP datagram. When it reaches zero, the datagram is discarded by the router, and the sender notified with an ICMP message. (6 marks)
(c) The sequence number for a TCP segment is the byte-stream number of the first
data byte in the segment, offset by a random starting number. The receiver
uses the sequence number to re-order segments arriving out of order and to
calculate an acknowledgement number. The acknowledgement number identifies the sequence number of the incoming data that the receiver expects next. Cumulative acknowledgements mean that TCP only acknowledges bytes up to the first missing byte in the stream. (8 marks)

3. (a) 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)

(b) The “let” version will output {"number": [1, 2, 3, 4, 5]}, while the “for” version will output { "number" : 1 }{ "number" : 2 }{ "number" : 3 }{ "number" : 4 }{ "number" : 5 }. “Let” binds a single sequence to the variable, whereas “for” binds each item in the sequence to the variable. (6 marks)

(c) The Address Resolution Protocol (ARP) translates between addresses on LANs, which are MAC addresses, to addresses at the network layer, which are, e.g., IP addresses. ARP takes an IP address on the same LAN and returns the corresponding MAC address.

Each node (host or router) has an ARP table in memory, containing mappings between IP addresses and MAC addresses. If an IP address is not in the table, it sends an ARP query packet to the broadcast MAC address FF-FF-FF-FF-FF-FF. The packet contains the desired IP address and the MAC address of the sender. The one node with the matching IP address sends a response ARP packet with its MAC address. (8 marks)

4. (a) i. /books/book[count(author) > 2] (4 marks)

ii. //book[isbn]/author[first-name] (4 marks)

(b) TCP provides a reliable service by acknowledging the safe receipt of packets, detecting missing/corrupted/duplicated packets, and providing a method to resend missing/corrupted packets. UDP provides a connectionless, unreliable service, so it is faster than TCP. UDP adds only checksum and process-to-process addressing to IP. UDP is used for DNS and NFS. (8 marks)

(c) Event attributes in HTML allow scripts to be executed in response to (user) events on a web page. Some events are onClick (triggered when the left mouse
button is clicked), **onLoad** (triggered when the page is loaded), and **onKeyUp** (triggered when a key on the keyboard is released). 

5. (a) 

```xml
<!ELEMENT wines (wine+) >
<!ELEMENT wine (name, price, vintage?, grape*) >
<!ELEMENT name (#PCDATA) >
<!ELEMENT grape (#PCDATA) >
<!ELEMENT vintage (#PCDATA) >
<!ELEMENT price (#PCDATA) >
<!ATTLIST wine
  type (red|white) #REQUIRED>
<!ATTLIST grape
  percentage CDATA #IMPLIED>
<!ATTLIST price
  quantity (bottle|case) "bottle">
```

(14 marks)

(b) Each header consists of a key/value pair. Request headers include (any two):

- Host: the domain name (and port) of the server; allows server to differentiate requests for multiple hosts with same IP address
- User-Agent: information about the client program (type, version)
- Accept: formats acceptable to the client, given using MIME types

Response headers include (any three):

- Server: name and version of server
- Content-Type: the (MIME) media type of the resource being returned
- Content-Length: size of message body in bytes
- Last-Modified: date and time when entity was last modified

(6 marks)

6. (a) XML namespaces solve the problem that arises when using elements, say, from two different vocabularies in the same document and ambiguity arises as to which vocabulary each element is from. A namespace is declared by using a special attribute whose name starts with `xmlns`, followed by an optional prefix. The value of the attribute is the namespace URI.

(b) Some methods are (any four):

- The `write` method of `document` writes data into the document.
- The `alert` method of `window` pops up an alert window.
- The `prompt` method of `window` pops up dialog box.
- The `createElement` and `createTextNode` methods of `document` create new instances of the respective nodes.
• The `appendChild` method of a `node` appends a node to the end of the given node’s children. 

(c) 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. 

(d) 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. 

7. (a) The MTU is the size of the largest frame that can be transmitted over the network. When an IP datagram is larger than the MTU, IP fragmentation arises. The IP datagram is divided into fragments, each with the original destination and identification field, but with a flag set to indicate that each is a fragment, along with its position in the original datagram specified using a fragmentation offset. The fragments are reassembled at the final destination using the identification, fragmentation offset and flag fields. 

(b) The `action` attribute takes a URI as its value. The `method` attribute takes an HTTP method, such as GET or PUT as value. When a user clicks on a submit button for the form, the corresponding HTTP method is invoked, using the URI specified. Input values from the form are sent to the resource specified by the URI, either as a query string (GET) or as the message body (POST). 

(c) 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.