1. (10 pts) The native character encoding of the Java programming language is UTF-16: A Java character is encoded as a 16 bit string.

(a) How many different Java characters strings of length 5 can be written using UTF-16?
Answer: There are \((2^{16})^5 = 2^{80}\) Java characters strings of length 5.

(b) If you need to name \(n\) things using fixed length strings written in UTF-16, how long would the strings need to be?
Answer: The strings would need to be 
\[
\lceil \log_{2^{16}} n \rceil = \lceil \log_2 n / 16 \rceil
\]
characters long.

2. (5 pts) Write 59 as an unsigned binary number.
Answer:

<table>
<thead>
<tr>
<th>REPEATED REMAINDERING MOD 2^T</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUOTIENTS</td>
</tr>
<tr>
<td>REMAINERS</td>
</tr>
</tbody>
</table>

Therefore \((59)_{10} = (1011011)_2\).

3. (5 pts) Write \(+59\) as a signed binary number in two’s complement notation.
Answer: Since \((59)_{10} = (1011011)_2\) as an unsigned binary, \((59)_{10} = (01011011)_{2c}\) as a two’s complement number.

4. (5 pts) Write \(-59\) as a signed binary number in two’s complement notation.
Answer: Since \((-59)_{10} = (01011011)_2\) as a two’s complement number, \((-59)_{10} = (10100101)_{2c}\).

5. (5 pts) Write \(-59\) as a decimal number in biased notation with bias \(b = 64\).
Answer: \((-59)_{10} = (-59 + 64)_{b=64} = (5)_{b=64}\).

6. (5 pts) Use Horner’s rule to convert the unsigned binary \((0110 0110)_2\) to decimal notation.
Answer:

<table>
<thead>
<tr>
<th>HORNER’S RULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 1 0 0 1 1 0</td>
</tr>
<tr>
<td>0 2 6 12 24 50 100</td>
</tr>
<tr>
<td>0 1 3 6 12 25 50 100</td>
</tr>
</tbody>
</table>

Therefore \((0110 0110)_2 = (100)_{10}\).

Total Points: 35