

COMP102 Fall 2006

Assignment 1

Due: Thursday, September 21, 2006, 8:35 a.m.

Please show all your work. No grade will be given for providing the final answer only. However, partial grade will be given for incomplete answers. Unacknowledged use of resources is prohibited.

Q1: Conversion binary to decimal and vice versa [14]

Convert the following decimal numbers to binary:

[2] (a) 10

[2] (b) 2

[2] (c) 64

Convert the following binary numbers to decimal:

[2] (d) 100101

[2] (e) 0110

[4] (f) 11111111111111111111

Q2: Binary arithmetic [16]

Perform the following computations on binary numbers, without converting them to decimal numbers. It may help to think of the steps taken to solve this problem when the numbers are represented in decimal.

[4] (a) $1101011 + 111010$

[4] (b) $100001 - 1110$

[4] (c) $11001 / 10$

[4] (d) $11001 * 100$

Q3: Numbers of Babylon [10]

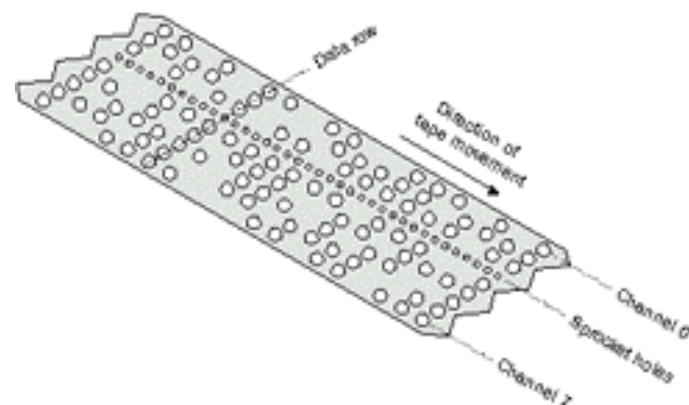
We learnt that the Babylonians used base 60 to represent numbers. Suggest some advantages of this number representation or discuss potential origins. Be creative!

Q4: Paper tape [15]

In the paper tape featured on the right, what is the largest decimal number that can be represented in a data row? [5]

What is the smallest? [5]

What do you think is the significance of the sprocket holes (vertical column of holes very close together)? [5]



Q5: Tally sticks [15]

Suppose you are using tally sticks to count days. To do this, you cut out a gash in the stick for each additional day that passes. What is the base of the number system that you are using? [5] Write “9” using this number system. [2] How does this number system compare to the other number systems we have seen in class in terms of number of symbols required to represent numbers? [4] Is there any number that cannot be represented using this number system? Why or why not? [4]



Q6: Text Representation [15]

The following data is represented as a text file.

[5] (a) How large is the file (in bytes)?

[10] (b) What are the contents of the file?

0100011101101111001000000100100001000001010000100101001100100000010001110110111100100001

Q7: Image encoding [15]

Suppose you were given a binary image file of a triangle, where 0 means that the pixel is white and 1 means that the pixel is black, like so:

```
00000000000000000000
00000000010000000000
00000011111110000000
0001111111111111000
1111111111111111111
00000000000000000000
```

You need to create a more compact file format. Can you suggest a way to encode this image so as to minimize the number of bits used, but without losing any of the information? [10] What is the number of bits that you save using your strategy? [5]

Total Marks: 100