Name: Student ID: Section:

Homework 4: Information Representation

INFO/CSE 100 Autumn 2004

Print out this page and write your answers to the following questions.

Information Representation: Data Encoding

1. Example: Consider the encoding from the lecture 18 for a game of Tic-Tac-Toe.
   (a) How many different items of information were chosen to represent the game?

      3 items – *empty cell* or *player 1* or *player 2*

   (b) How many positions were used?

      9 positions – one per board square

   (c) How many possible game states are there?

      3^9

2. Construct an encoding for a traditional chess board and chess pieces. (refer to http://en.wikipedia.org/wiki/Chess for a description of 8x8 board and the different kinds of pieces)
   (a) Items of information
      i. How many different items of information did you chose to represent the game? In other words, how many distinct symbols will you need in your encoding scheme?

2 pts.

1 blank space, 6 white pieces (K, Q, N, B, R, P), 6 black pieces (same)
Total is 13. *Any reasonably justified answer is allowable (i.e. blank, 16 different white pieces, 16 different black pieces = 33 total) -1 for missing blank*

      ii. Write out your encoding using numbers as symbols, explaining what each number represents. Follow the example in Lecture 18, Slide 5

2 pts.

00 for blank	***Must reflect the answer they put in i. If they said***
01 for white K	***33 total items, there should be 33 different encodings***
02 for white Q	
03 for white N	**08 for black Q**
04 for white B	**09 for black N**
05 for white R	**10 for black B**
06 for white P	**11 for black R**
07 for black K	**12 for black P**

   (b) How many positions did you chose, and why?

2 pts.

64 – one per board square

   (c) How many possible game states are there? (You can ignore the fact that some game states cannot be reached in normal play. Include those "impossible" states in your calculation.)

2 pts.

2(a)i ^ 2(b), in this case 13^{64}

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Positions and Decimal, Binary, & Hexadecimal Numbers

3. Conversions (Lecture 18, slide 14 & Lecture 19, slide 5)
   (a) Convert these numbers to decimal (base 10)

110_2 = **6**

1 pt.

1101_2 = **13**

1 pt.

10_{10} = **10**

1 pt.

10_{16} = **16**

1 pt.

   (b) Convert these numbers to binary (base 2)

FF_{16} = **11111111**

1 pt.

10_2 = **10**

1 pt.

A_{16} = **1010**

1 pt.

   (c) Convert these numbers to hexadecimal (base 16)

1_2 = **1**

1 pt.

16_{10} = **10**

1 pt.

4. Consider a number in base 5. What is the largest possible number you can represent with 4 positions? Write your answer in decimal. (hint, Lecture 19, slide 3)

2 pts.

$$\begin{aligned} \mathbf{4444_5} &= \mathbf{(4 \times 5^3) + (4 \times 5^2) + (4 \times 5^1) + (4 \times 5^0)} \\ &= \mathbf{(4 \times 125) + (4 \times 25) + (4 \times 5) + (4 \times 1)} \\ &= \mathbf{500 + 100 + 20 + 4} \\ &= \mathbf{624} \end{aligned}$$

5. Consider using binary bits to represent the numbers 0, 1, 2, and 3.
   (a) At least how many positions are required to represent this in binary?

2 pts. **2 positions**

   (b) Why are the minimum number of positions from answer 5a insufficient if you want to represent 0 and both positive and negative 1, 2, and 3?

2 pts. **Because the numbers -3, -2, -1, 0, 1, 2, 3 are six distinct values. You can't store six values in the space of two binary positions.**

Total: 23 pts.