HW 1
Due: Tue Jan. 31

CS442: Great Insights in Computer Science
Michael L. Littman, Spring 2006

Rules

• You may work together, but you are expected to turn in your own writeup of answers.
• HW is due at the beginning of class.
• Email questions to:
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  • Gabriel Nieves <camilo@eden.rutgers.edu>
  • Monica Babes <babes@cs.rutgers.edu>
Python

To use the programs created for class, you need access to Python.

Install it on your system. One place to download it is from: http://www.python.org/ftp/python/2.4.2/python-2.4.2.msi.

1. Difference Engine

Run my Difference Engine program:

http://www.cs.rutgers.edu/~mlittman/courses/cs442-06/python/differences.py.

a. What sequence arises from the “program” 191, -23, -8, 6?

b. What “program” creates the sequence: “1, 2, 4, 8, 16, 31, 57, 99, 163, 256, 386, 562”? 
**Glossary**

- byte = 8 bits
- mega = a million
- giga = a billion
- pixels = picture element, typically specified by one byte each of R, G, and B intensity
- MB = megabyte
- baud = bits per second
- Kbps = kilobits per second
- video frame = a still image
- video rate = 25-30 frames per second

**2. MegaPixels**

- The Kodak EasyShare Z760 Digital Camera takes images that 2856x2142 pixels.
  a. How many megapixels does it have?
  b. A typical storage card holds 128 MB. How many photos can you store on such a card? (In reality, photos are very compressible and the cameras can squeeze more of them into the same number of bytes.)
3. Logical Expressions

- chickensAreMammals = False
- batsAreMammals = False
- MichaelEatsMammals = False
- MichaelEatsChicken = True
- MichaelEatsBats = True

a. MichaelEatsMammals or 
   not (chickensAreMammals and MichaelEatsChicken) = ?

b. MichaelEatsMammals or 
   not (batsAreMammals and MichaelEatsBats) = ?

4. Relay Circuit

a. Fill in the truth table for this relay circuit.

b. Invent a name for this logic gate.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
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<tr>
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5. Invent a Bit

- Bits can be represented many ways. Make a new way. It doesn’t have to work—it should be creative and sound plausible. Describe:
  a. How does it encode 1/0?
  b. How do bits move?
  c. How do bits spread?
  d. How do you build a “not” gate?
  e. How do you build an “or” gate?

Extra Credit

- The remaining problems require a bit more thought!
- Try these for fun.
AntoNim9

• There’s a pile of 9 objects to start.
• On her turn, a player can take away either one or two objects.
• Players alternate.
• The player to take the last object loses.

6. Win AntoNim9

• Run my Nim 9 program:
  a. What sequence of switches should you flip to guarantee a win (light the “You Win” bulb)?
7. Limits of Differences

• Although the Difference Engine can capture many interesting sequences, there are some it can’t represent.

• One very important sequence is:
  • 1, 2, 4, 8, 16, 32, 64, 128, ...

a. Provide a simple argument showing that no (finite length) DE program can produce the powers of 2.