

# 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:
  - Michael <[mlittman@cs.rutgers.edu](mailto:mlittman@cs.rutgers.edu)>
  - Gabriel Nieves <[camilo@eden.rutgers.edu](mailto:camilo@eden.rutgers.edu)>
  - Monica Babes <[babes@cs.rutgers.edu](mailto: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

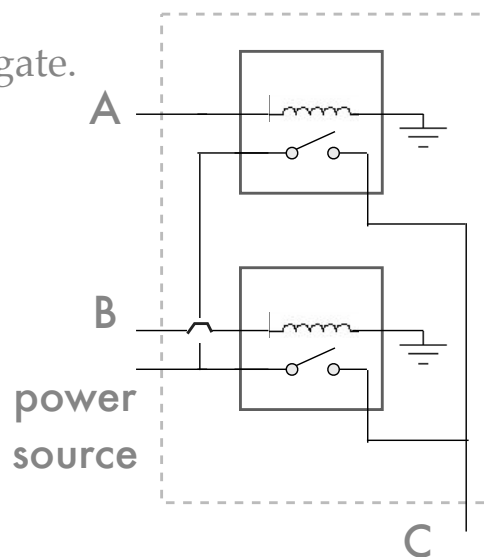
- chickensAreMammals = False
  - batsAreMammals = False
  - MichaelEatsMammals = False
  - MichaelEatsChicken = True
  - MichaelEatsBats = True
- a. MichaelEatsMammals or not (chickensAreMammals and MichaelEatsChicken) = ?
- b. MichaelEatsMammals or not (batsAreMammals and MichaelEatsBats) = ?

# 4. Relay Circuit

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

b. Invent a name for this logic gate.

A	B	C
False	False	
False	True	
True	False	
True	True	



## 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:
  - <http://www.cs.rutgers.edu/~mlittman/courses/cs442-06/python/nim9.py>.
- 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.