NYU, Tandon School of Engineering
Bridge to CS — Spring 2018

Homework #1
Due by Friday 4/20 11:55pm

Submission instructions:

1. You should submit your homework in the NYU Classes system.
2. For this assignment you should turn in a '.pdf' file with your answers. Name your file 'YourNetID_hw1.pdf'
3. For questions 1-3, make sure to include the conversion calculations, not just the final answer.

Question 1:

A. Convert the following numbers to their decimal representation:
1. $10011011_2 =$
2. $456_7 =$
3. $38A_{16} =$
4. $2214_5 =$

B. Convert the following numbers to their binary representation:
1. $69_{10} =$
2. $485_{10} =$
3. $6D1A_{16} =$

C. Convert the following numbers to their hexadecimal representation:
1. $1101011_2 =$
2. $895_{10} =$

Question 2:

Solve the following, do all calculation in the given base:
1. $7566_8 + 4515_8 =$
2. $10110011_2 + 1101_2 =$
3. $7A66_{16} + 45C5_{16} =$
4. $3022_5 - 2433_5 =$

Question 3:

A. Convert the following numbers to their 8-bits two's complement representation:
1. $124_{10} =$
2. $-124_{10} =$
3. $109_{10} =$
4. $-79_{10} =$

B. Convert the following numbers (represented as 8-bit two's complement) to their decimal representation:
1. $00011110_{\text{8 bit 2's comp}} =$
2. $11100110_{\text{8 bit 2's comp}} =$
3. $00101101_{\text{8 bit 2's comp}} =$
4. $10011110_{\text{8 bit 2's comp}} =$

Question 4:

A. For each of the following sets, determine whether 2 is a member of that set.

a) $\{x \in \mathbf{R} /\ x \text{ is an integer greater than } 1\}$ **b)** $\{2, \{2\}\}$
c) $\{x \in \mathbf{R} /\ x \text{ is the square of an integer}\}$ **d)** $\{\{2\}, \{\{2\}\}\}$
e) $\{\{2\}, \{2, \{2\}\}\}$ **f)** $\{\{\{2\}\}\}$

B. Determine whether each of these statements is true or false.

a) $x \in \{x\}$ **b)** $\{x\} \subseteq \{x\}$ **c)** $\{x\} \in \{x\}$
d) $\{x\} \in \{\{x\}\}$ **e)** $\varnothing \subseteq \{x\}$ **f)** $\varnothing \in \{x\}$

C. Find two sets A and B such that $A \in B$ and $A \subseteq B$.

D. For each of these pairs of sets, determine whether the first is a subset of the second, the second is a subset of the first, or neither is a subset of the other.
  i.   the set of airline flights from New York to New Delhi, the set of nonstop airline flights from New York to New Delhi.
  ii. the set of people who speak English, the set of people who speak Chinese
  iii. the set of flying squirrels, the set of living creatures that can fly

Question 5:

Let $A = \{a, b, c, d, e\}$ and $B = \{a, b, c, d, e, f, g, h\}$. Find:
a) $A \cup B$
b) $A \cap B$
c) $A - B$
d) $B - A$

Question 6:
Draw the Venn diagrams for each of these combinations of the sets A, B, and C.
a) $A \cap (B - C)$
b) $(A \cap B) \cup (A \cap C)$
c) $(A \cap \overline{B}) \cup (A \cap \overline{C})$

Question 7:
Let A, B, and C be sets. Use a membership table to show that:
a) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
b) $(B - A) \cup (C - A) = (B \cup C) - A$
c) $\overline{(A \cap B \cap C)} = (\overline{A} \cup \overline{B} \cup \overline{C})$
d) $(A - C) \cap (C - B) = \varnothing$
e) $(A - B) - C \subseteq (A - C)$

Question 8:
Let A, B, and C be sets. Use a set identities to show that:
a) $A - B = \overline{B} - \overline{A}$
b) $(A \cap B) \cup (A \cap \overline{B}) = A$
c) $A - (B - C) = (A - B) \cup (A - \overline{C})$

Question 9:
Can you conclude that $A=B$, if A, B, and C are sets, such that:
a) $A \cup C = B \cup C$?
b) $A \cap C = B \cap C$?
c) $(A \cup C = B \cup C)$ and $(A \cap C = B \cap C)$?

Question 10:
Find $\bigcup_{i=1}^{\infty} A_i$ and $\bigcap_{i=1}^{\infty} A_i$, if for every positive integer i:
a) $A_i = \{-i, \ -i + 1, \dots, -1, 0, 1, \dots, i - 1, i\}$
b) $A_i = \{-i, i\}$
c) $A_i = [-i, i]$, that is, the set of real numbers x with $-i \le x \le i$
d) $A_i = [-i, \infty)$, that is, the set of real numbers x with $x \ge -i$