CS 340
Computer Systems

#1: Course Introduction, Binary, and Hex

Aug. 23, 2022 · Wade Fagen-Ulmschneider

Welcome to CS 340: Introduction to Computer Systems
Course Website: https://courses.grainger.illinois.edu/cs340/

Description: Basics of computer systems. Number representations, assembly/machine language, abstract models of processors (fetch/execute, memory hierarchy), processes/process control, simple memory management, file I/O and directories, network programming, usage of cloud services. 3 credit hours.

Staff:
Prof. Wade Fagen-Ulmschneider <waf@>, Course Instructor
Teaching Associate Professor of Computer Science, Grainger College of Engineering

TAs: Anna Mazhar and **Ameya Gharpure**

Coursework and Grading
A total of 1,000 points are available in CS 340, along with many opportunities to earn extra credit. The points are broken down in the following way:

- **140 points**: Homeworks (1-2 /week)
  - Points even divided between the homeworks
  - Usually on PrairieLearn, but occasionally another platform
- **300 points**: Midterm Exams in CBTF (2 × 150 points)
  - Midterm 1 Exam (CBTF): Tues, Oct. 4 - Sat, Oct. 8
  - Midterm 2 Exam (CBTF): Tues, Nov. 29 - Sat, Dec. 3
- **440 points**: Machine Projects (11 weeks × 40 points)
  - Weekly machine problems, released every Tuesday and due the following Tuesday with a Wednesday grace period.
  - Extra credit for completing early milestones and completion.
- **120 points**: Final Project
  - Multi-week Final Project, presented during the final exam period instead of a final exam (no final exam!)

We never curve individual exam or assignment scores. Instead, if necessary, we may lower the points required for each grade cutoff to be lower than the stated cutoff. In no case will we raise the stated cutoff, so having 930 points will always earn you an "A" in the course.

Final Course Grades
Your course grade is determined by the number of points you earn:

Points	Grade	Points	Grade	Points	Grade
Exceptional	A+	[930, 1070)	A	[900, 930)	A-
[870, 900)	B+	[830, 870)	B	[800, 830)	B-
[770, 800)	C+	[730, 770)	C	[700, 730)	C-
[670, 700)	D+	[630, 670)	D	[600, 630)	D-
		(600, 0]	F		

Foundations of Computer Systems
There are six major components to a computer, which we will refer to as the "foundations" of a computer system:

[1]:

[2]:

[3]:

[4]:

[5]:

[6]:

System-level Abstractions
After covering the "foundations", we will begin to abstract the entire system as single **node** and explore more complex topics:

[1]:

[2]:

[3]:

Representing Data: Binary

All data within a computer is _____; either **0** or **1**.

Converting between base-2 and base-10:

1_2 = _____ $_{10}$

10_2 = _____ $_{10}$

11_2 = _____ $_{10}$

100_2 = _____ $_{10}$

Just like every digit has a "place value" in decimal (base-10), every digit has a "place value" in binary:

Binary Number:	0	1	0	1	1	0	0	0
(x) Place Value:	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Decimal Place Value:	128	64	32	16	8	4	2	1
SUM:								

Using this system, we can calculate more complex numbers:

$101\ 1000_2$ = _____ $_{10}$

$11\ 0100_2$ = _____ $_{10}$

Any value can be represented in binary by writing it in base-2, which be written in C by prefixing the number with **0b**:

4_{10} = _____ $_2$ = **0b** _____

7_{10} = _____ $_2$ = **0b** _____

18_{10} = _____ $_2$ = **0b** _____

01/binary.c

```
4    int v1 = 0b10010;
5    int v2 = 0b11001;
6    int v3 = v1 + v2;
7    printf("%d\n", v3);
```

Note: All source code will always be available in the lecture repository! You are highly encouraged to run it yourself – they're minimally working examples of the topic at hand! :)

Representing Data: Hexadecimal

Binary data gets really long, really fast! The number of students enrolled at University of Illinois is **0b1100 1100 0110 1011**
-   To represent binary data in a compact way, we often will use **hexadecimal** -- or "base-16" -- denoted by the prefix **0x**.

Hexadecimal Digits:

Place of Hexadecimal Numbers:

Hex Number:	c	0	f	f	e	e
Place Value:	16^5	16^4	16^3	16^2	16^1	16^0
Decimal Place Value:	1048576	65536	4096	256	16	1
SUM:						

Translation from Decimal to Hexadecimal:

11_{10} = **0x** _____ 87_{10} = **0x** _____

34_{10} = **0x** _____ 255_{10} = **0x** _____

Hexadecimal is particularly useful as it _____:

University of Illinois student population last Fall (52,331):			
0b 1100	1100	0110	1011
0x			

Number of people following Taylor Swift on Twitter (90,918,443):
0b 101 0110 1011 0100 1110 0010 1011
0x

01/hex.c

```
4    int h1 = 0xc0ffee;
5    int h2 = 0xf00d;
6    printf("%x\n", h1 + h2);
```