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Readings K&R 1-5

mins Outline

- 20 1. Lab learnings
- 20 2. Concepts beneath the l.
 - scalar values: near
- 10 3. Learn ^{the}
 - limits to finite rep
 - where data lives
 - scalar vs complex

I Lab Learnings (20)

1. Basic Environment *ed / comp / debug*
2. Control structures & Scalars

- you know how to program. Learn to prog in C,

* Q & A about what people learned from lab.

- What you should have learned

+ declarations

+ Control structures (K&R ch 3) (10)

- 1 - statements; - (even assignment is a expression)
- 2 - blocks { } - sequencing - Java too!, but bad
- 3 - conditional - write the clear ver.

```

if (expression) statement_T
else statement_F
  
```

language concept of boolean

- use ? !
- includes else if

(clearly refer to 56)

- 4 - dispatch


```

switch (expression) {
  case const_expr: statements
  :
  default: statements
}
      
```

may include break

- 5 - while (expression) statement;
- 6 - for (expr_{init}; expr_{term}; expr_{next}) statement

- 7 - do statement
- 8 - while (expression);

functions { declarations ; statements

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function fun(parameters)

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- e data types

char - 1 byte, holds one "character" in local character set (ASCII)

int - "integer", typically reflects the natural size of integers on host machine

float - single precision FP } very specific meaning
double

type qualifier (like JAVA wrapper class)
- guide representation

length

short int x; typically 16, no bigger than int
~~long~~ int y; typically 16 - 32, but sometimes 64
long int z; at least 32

specific sizes are defined by machine dependent include files

~~#include~~

- "system types" #include <sys/types.h>

int8_t, uint16_t

signed

int x;
signed int y;
unsigned int z;

same

different meaning, especially comparison

constant

const unsigned short int y;

What about boolean?

- All types have special $\emptyset \equiv \text{False}$, $!\emptyset \equiv \text{True}$

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- literals

- program text representation of values

+ chars 'a'

- special chars have escape sequence

\', \?', \", and \\

- display control chars have escapes too

- \a - bell
- \b - backspace
- \f - formfeed
- \n - newline
- \r - carriage return
- \t - tab
- \v - vertical tab (???)

- explicit 8 bit values

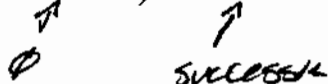
\ooo \xhh

null char '\0'

Symbolic constants

- ~~enum~~ - program names for constants

enum boolean { FALSE, TRUE }



+ numbers

17 - decimal 17

017 - octal 17 ≡ dec 15

0x17 - hex 17 ≡ dec 23 ≡ 027

binary?

example EOF defined in stdio.h

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Concepts beneath the Lab

- Meaning vs representation

Characters

meaning

'A' - prints as A
 != '6'

' ' - space. often separates words
 '\n' -

'0' - the character zero

representation

65 0101 0x41

32 0040 0x20

10 0012 0x0A

26 020 0x10

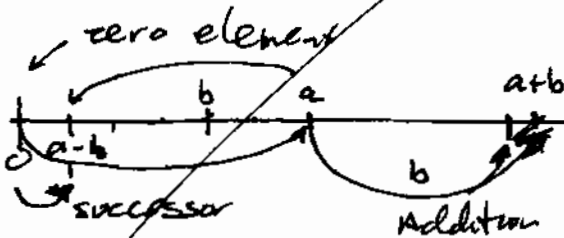
Numbers

How many chars?

61, 001? 0001, .. 00...061, 00...0
 all mean the same

"whole numbers"

meaning



$$a - a = 0$$

$$a + 0 = a$$

$$a * 0 = 0$$

$$a * 1 = a$$

$$a + b = b + a$$

$$a \neq b \Rightarrow a - b \neq 0$$

well defined?

- comm
- assoc.
- distrib

representation

n-bit unsigned int

0

$b_{n-1} b_{n-2} \dots b_0$
 n bits

- 1 - finite set
- $2^n - 1$ - how many?
- 2^n - biggest

map representation to "MEANING"

$$b_{n-1} \dots b_0 \rightarrow b_{n-1} \cdot 2^{n-1} + b_{n-2} \cdot 2^{n-2} + \dots + b_0$$

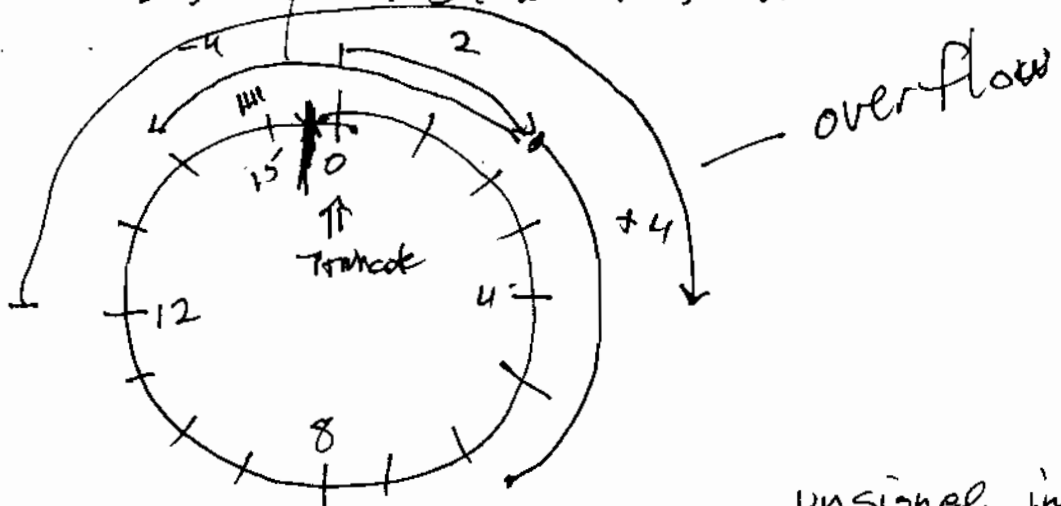
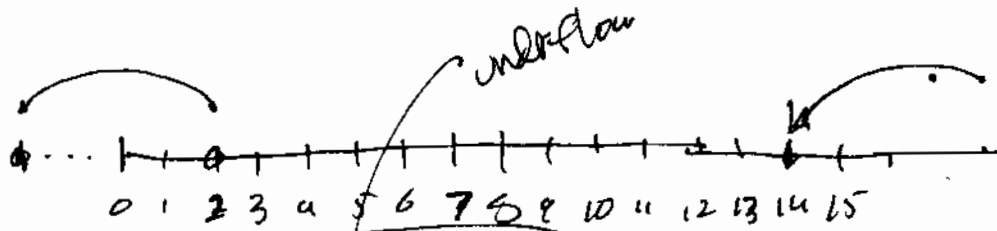
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What happens when you go "off the end"?

4 bits

2-4



unsigned int
closed under
abstraction

$$\begin{array}{r} 12 + 8 \\ 12 \\ + 8 \\ \hline \end{array}$$

$$\begin{array}{r} 1100 \\ 0000 \\ \hline 10100 \end{array}$$

C. overflow & underflow are silent

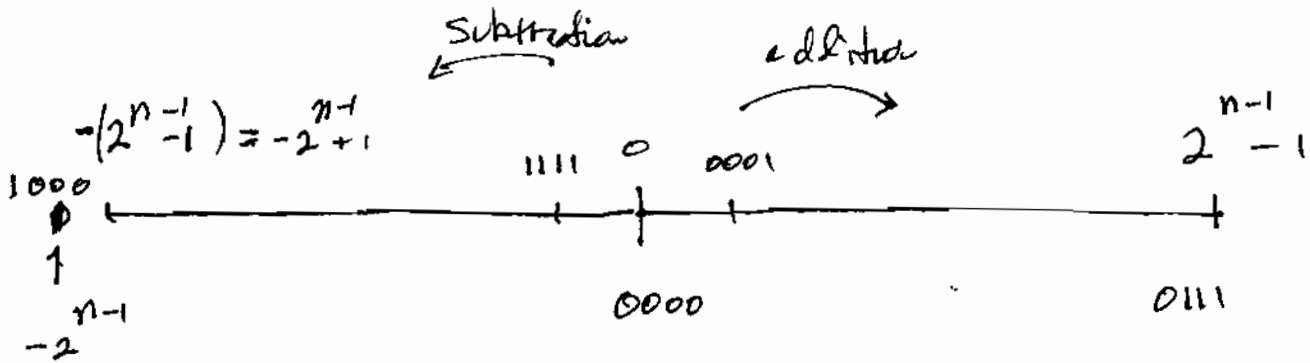
JAVA - NO unsigned
- modular arithmetic

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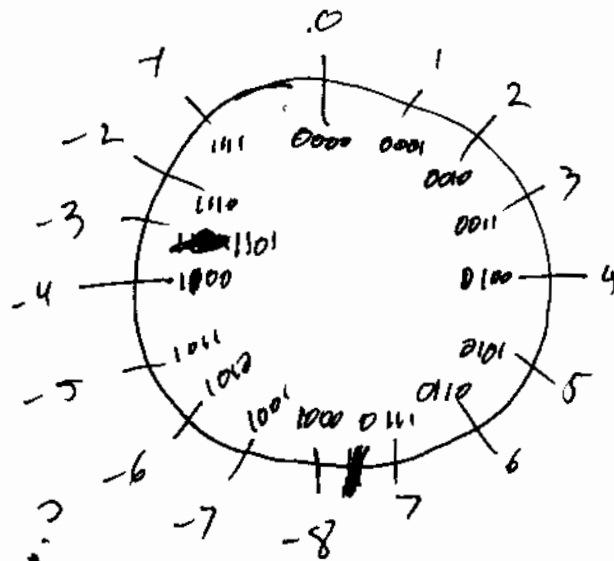
Signed Integer

- n bits \Rightarrow 2^n values
which ones?



What is the mapping?

$$b_{n-1} b_{n-2} \dots b_1 b_0 \Rightarrow -2^{n-1} \cdot b_{n-1} + 2^{n-2} \cdot b_{n-2} + \dots + 2 \cdot b_1 + b_0$$

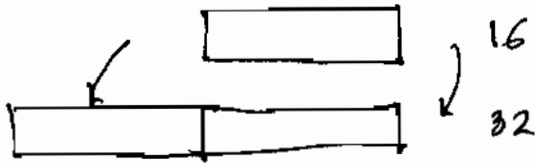


is	1000	0011	3	True
un/un	9	3	3	False
int/int	-7	3	3	False
int/un	-7	3	3	True
un/int	9	3	3	

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Moving values of different sizes



Can always treat a scalar like a larger one

what goes in the

unsigned - zero extend
 signed - sign exten

} preserves meaning

$$\dots 0 \cdot b^n + 2^1 b^{n-1} + \dots + 2^0 b^0 = 2^{n-1} b^{n-1} + \dots + 2^0 b^0$$

add all the zeros you like

moving to smaller - you have to be explicit
 ⇒ truncation

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Where data lives

C language concepts

```

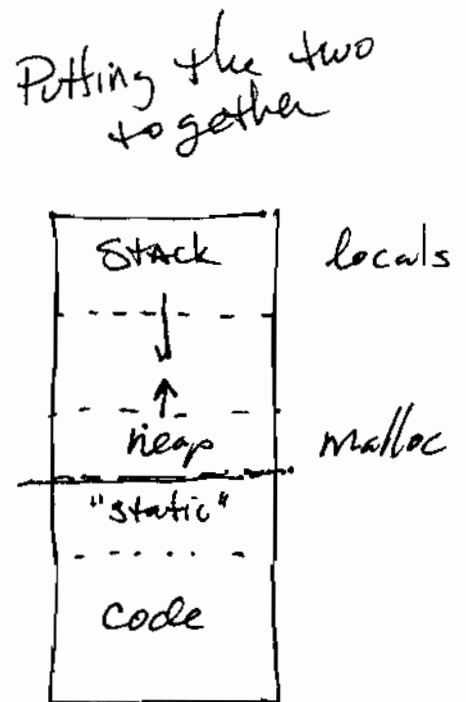
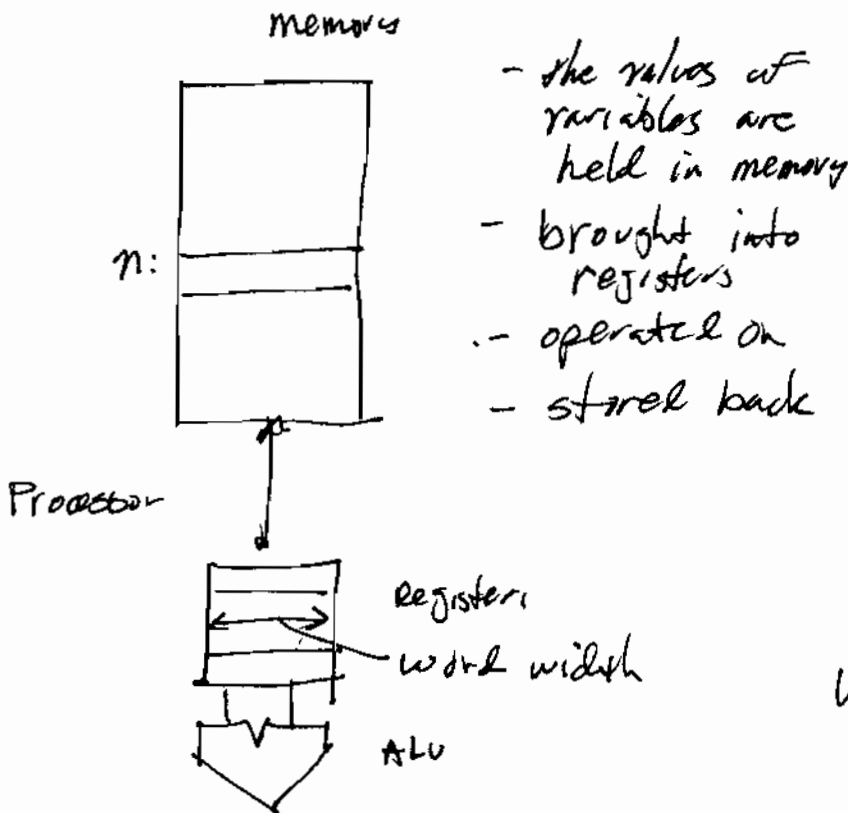
extern int c;
int b;
static int d;
function foo ( ) {
  int a;
}

```

- declared here, but "destined" elsewhere
 visible ~~every~~ in remainder of file "extern"
 - outside?
 hidden outside this file
 local "automatic", ^{internal} visible with the function

external "foo" (pointing to the function definition)

Machine concepts



What about "bigjan" data types?

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