CSE 351 Reference Sheet (Final)

Binary	Decimal	Hex
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F

2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7	2^8	2^9	2^{10}
1	2	4	8	16	32	64	128	256	512	1024

SI Size	Prefix	Symbol	IEC Size	Prefix	Symbol
10^3	Kilo-	K	2^{10}	Kibi-	Ki
10^6	Mega-	M	2^{20}	Mebi-	Mi
10^9	Giga-	G	2^{30}	Gibi-	Gi
10^{12}	Tera-	T	2^{40}	Tebi-	Ti
10^{15}	Peta-	P	2^{50}	Pebi-	Pi
10^{18}	Exa-	E	2^{60}	Exbi-	Ei
10^{21}	Zetta-	Z	2^{70}	Zebi-	Zi
10^{24}	Yotta-	Y	2^{80}	Yobi-	Yi

IEEE 754 FLOATING-POINT STANDARD

Value: $\pm 1 \times \text{Mantissa} \times 2^{\text{Exponent}}$

Bit Fields: $(-1)^S \times 1.M \times 2^{(E+\text{bias})}$

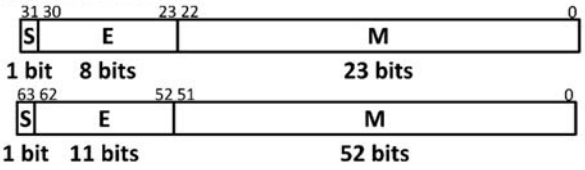
where Single Precision Bias = -127,
Double Precision Bias = -1023.

IEEE 754 Symbols

Exponent	Fraction	Object
0	0	± 0
0	≠0	± Denorm
1 to MAX - 1	anything	± Fl. Pt. Num.
MAX	0	±∞
MAX	≠0	NaN

S.P. MAX = 255, D.P. MAX = 2047

IEEE Single Precision and Double Precision Formats:



Assembly Instructions

`mov a, b`	Copy from `a` to `b`.
`movs a, b`	Copy from `a` to `b` with sign extension.
`movz a, b`	Copy from `a` to `b` with zero extension.
`lea a, b`	Compute address and store in `b`. *Note:* the scaling parameter of memory operands can only be 1, 2, 4, or 8.
`push src`	Push `src` onto the stack and decrement stack pointer.
`pop dst`	Pop from the stack into `dst` and increment stack pointer.
`call <func>`	Push return address onto stack and jump to a procedure.
`ret`	Pop return address and jump there.
`add a, b`	Add from `a` to `b` and store in `b` (and sets flags).
`imul a, b`	Multiply `a` and `b` and store in `b` (and sets flags).
`and a, b`	Bitwise AND of `a` and `b`, store in `b` (and sets flags).
`sar a, b`	Shift value of `b` *right* (*arithmetic*) by `a` bits, store in `b` (and sets flags).
`shr a, b`	Shift value of `b` *right* (*logical*) by `a` bits, store in `b` (and sets flags).
`shl a, b`	Shift value of `b` *left* by `a` bits, store in `b` (and sets flags).
`cmp a, b`	Compare `b` with `a` (compute `b - a` and set condition codes based on result).
`test a, b`	Bitwise AND of `a` and `b` and set condition codes based on result.
`jmp <label>`	Unconditional jump to address.
`j* <label>`	Conditional jump based on condition codes (*more on next page*).
`set* a`	Set byte based on condition codes.

Conditionals

Instruction		`cmp b, a`	`test a, b`
`je`	"Equal"	`a == b`	`a & b == 0`
`jne`	"Not equal"	`a != b`	`a & b != 0`
`js`	"Sign" (negative)		`a & b < 0`
`jns`	(non-negative)		`a & b >= 0`
`jg`	"Greater"	`a > b`	`a & b > 0`
`jge`	"Greater or equal"	`a >= b`	`a & b >= 0`
`jl`	"Less"	`a < b`	`a & b < 0`
`jle`	"Less or equal"	`a <= b`	`a & b <= 0`
`ja`	"Above" (unsigned >)	`a > b`	
`jb`	"Below" (unsigned >)	`a < b`	

Sizes

C type	x86-64 suffix	Size (bytes)
`char`	`b`	1
`short`	`w`	2
`int`	`l`	4
`long`	`q`	8

Registers

Name	Convention	Name of "virtual" register		
		Lowest 4 bytes	Lowest 2 bytes	Lowest byte
`%rax`	Return value – **Caller** saved	`%eax`	`%ax`	`%al`
`%rbx`	**Callee** saved	`%ebx`	`%bx`	`%bl`
`%rcx`	Argument #4 – **Caller** saved	`%ecx`	`%cx`	`%cl`
`%rdx`	Argument #3 – **Caller** saved	`%edx`	`%dx`	`%dl`
`%rsi`	Argument #2 – **Caller** saved	`%esi`	`%si`	`%sil`
`%rdi`	Argument #1 – **Caller** saved	`%edi`	`%di`	`%dil`
`%rsp`	Stack Pointer	`%esp`	`%sp`	`%spl`
`%rbp`	**Callee** saved	`%ebp`	`%bp`	`%bpl`
`%r8`	Argument #5 – **Caller** saved	`%r8d`	`%r8w`	`%r8b`
`%r9`	Argument #6 – **Caller** saved	`%r9d`	`%r9w`	`%r9b`
`%r10`	**Caller** saved	`%r10d`	`%r10w`	`%r10b`
`%r11`	**Caller** saved	`%r11d`	`%r11w`	`%r11b`
`%r12`	**Callee** saved	`%r12d`	`%r12w`	`%r12b`
`%r13`	**Callee** saved	`%r13d`	`%r13w`	`%r13b`
`%r14`	**Callee** saved	`%r14d`	`%r14w`	`%r14b`
`%r15`	**Callee** saved	`%r15d`	`%r15w`	`%r15b`

C Functions

`void*` `malloc(`**`size_t`** `size)`:
Allocate size bytes from the heap.

`void*` `calloc(`**`size_t`** `n, `**`size_t`** `size)`:
Allocate n*size bytes and initialize to 0.

`void` `free(`**`void*`** `ptr)`:
Free the memory space pointed to by ptr.

`size_t` `sizeof(`**`type`**`)`:
Returns the size of a given type (in bytes).

`char*` `gets(`**`char*`** `s)`:
Reads a line from stdin into the buffer.

`pid_t` `fork()`:
Create a new child process (duplicates parent).

`pid_t` `wait(`**`int*`** `status)`:
Blocks calling process until any child process exits.

`int` `execv(`**`char*`** `path, `**`char*`** `argv[])`:
Replace current process image with new image.