

Dynamic Memory Allocation

9.6 Determine the block sizes and header values that would result from the following sequence of `malloc` requests. Assume that the allocator maintains **double-word** alignment and uses an **implicit** free list with the block format from fig 9.35 in CSAPP (or slide 11 of the allocator lecture). The **word size is 4** (not 8), and block sizes are rounded up to **nearest multiple of 8 bytes**.

Request	Block size allocated (bytes, in decimal)	Block header (in hex)
<code>malloc(1)</code>	$1+4=5 \rightarrow 8$ (3 = padding, 1 = payload, 4 = header, no footers)	0x9 = 1001 (because lsb = 1 for used)
<code>malloc(5)</code>	$5+4 = 9 \rightarrow 16$	0x11 = 00010001
<code>malloc(12)</code>	$12+4=16 \rightarrow 16$	0x11
<code>malloc(13)</code>	$13+4=17 \rightarrow 24$	0x19 = 00011001

9.7 Determine the minimum block size for each of the following combinations of alignment requirements and block formats. Assume **implicit** free list, payloads must have non-zero size, the **word size is 4**, and header and footers are each stored in **4-byte words**.

Alignment	Allocated block	Free block	Minimum block size (bytes)
Single word	Header, footer	Header, footer	$4+4+4 = 12$ (header, footer, payload)
Single word	Header, NO footer	Header, footer	8 (header, and footer/payload)
Double word	Header, footer	Header, footer	$4+4+2*4=16$ (header, footer, double-word payload)
Double word	Header, NO footer	Header, footer	8 (header, footer/payload, works for double-word alignment)

(Review problems for the Remembrallocator assignment: CSAPP Practice Problems 9.6 & 9.7, Homework Problems 9.15 & 9.16)

9.15 Determine the block sizes and header values that would result from the following sequence of `malloc` requests. Assume that the allocator maintains **double-word** alignment and uses an **implicit** free list with the block format from fig 9.35 in CSAPP (or slide 11 of the allocator lecture). The **word size is 4** (not 8), and block sizes are rounded up to **nearest multiple of 8 bytes**.

Request	Block size allocated (bytes, in decimal)	Block header (in hex)
<code>malloc(3)</code>	$4+3=7 \rightarrow 8$	0x9
<code>malloc(11)</code>	$4+11=15 \rightarrow 16$	0x11
<code>malloc(20)</code>	$4+20=24 \rightarrow 24$	0x19
<code>malloc(21)</code>	$4+21=25 \rightarrow 32$ double-word = want multiples of 8 bytes	0x21

9.16 Determine the minimum block size for each of the following combinations of alignment requirements and block formats. Assume **explicit** free list, **4-byte pred and succ pointers in each free block**, payloads must have non-zero size, and header and footers are each stored in **4-byte words**.

Alignment	Allocated block	Free block	Minimum block size (bytes)
Single word	Header, footer	Header, footer	$4*4=16$
Single word	Header, NO footer	Header, footer	16 (because free blocks has ptrs)
Double word	Header, footer	Header, footer	16
Double word	Header, NO footer	Header, footer	16