Object Allocator Diagrams (Handout)

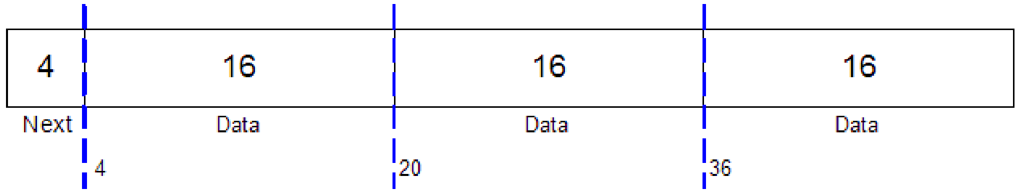
These are the diagrams that were handed out in class:

- Diagram 1 Allocating the first page, building free list
- Diagram 2 Completed free list, removing Objects for client
- Diagram 3 All Objects removed, allocating second page
- Diagram 4 Linking pages, rebuilding free list
- Diagram 5 Second page of Objects exhausted, no more memory for pages
- Diagram 6 Client starts freeing Objects: `ObjectAllocator->Free()`
- Diagram 7 Freelist after client frees 4 Objects

More Details

Example 1: 16-byte data, no padding, no header blocks, no alignment.

Field	Size
Next pointer	4 bytes
Padding	0 bytes (not used)
Header block	0 bytes (not used)
Data	16 bytes
Alignment	0/0 bytes (not used)
Page size	52 bytes



Memory dump:

```
 0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49
50 51
00 00 00 00 00 00 00 00 AA AA AA AA AA AA AA AA AA AA AA AA B4 3D 33 00 AA
AA AA AA AA AA AA AA AA AA AA AA C4 3D 33 00 AA AA AA AA AA AA AA AA AA AA
AA AA
```

Wrapped at 16 bytes:

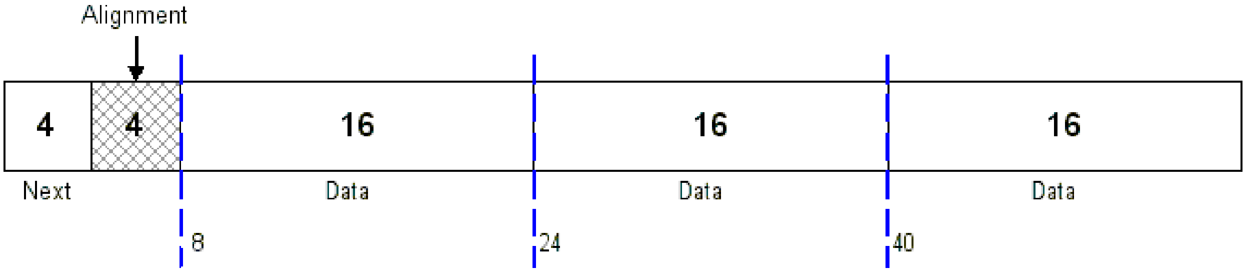
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	00	00	00	00	00	00	00	AA	AA	AA	AA	AA	AA	AA	AA
AA	AA	AA	AA	B4	3D	33	00	AA	AA	AA	AA	AA	AA	AA	AA
AA	AA	AA	AA	C4	3D	33	00	AA	AA	AA	AA	AA	AA	AA	AA

AA	AA	AA	AA												

Note, however, that the data will naturally be aligned on 4-byte boundaries, due to the size of the data.

Example 2: 16-byte data, no padding, no header blocks, 8-byte alignment.

Field	Size
Next pointer	4 bytes
Padding	0 bytes (not used)
Header block	0 bytes (not used)
Data	16 bytes
Alignment	4/0 bytes (left/interblock)
Page size	56 bytes



Memory dump:

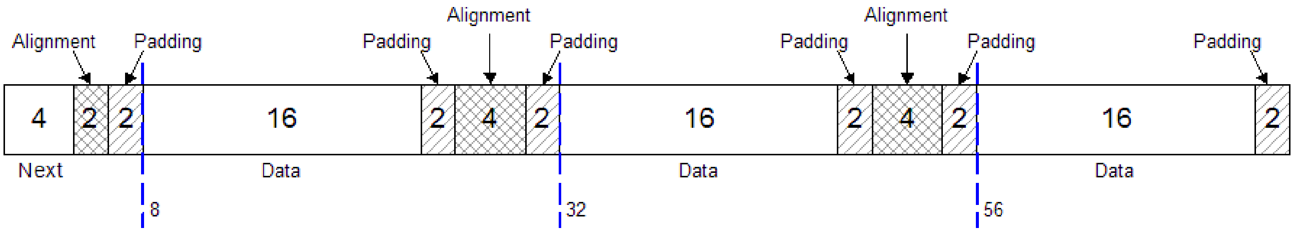
```
 0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49
50 51 52 53 54 55
00 00 00 00 EE EE EE EE 00 00 00 00 AA AA AA AA AA AA AA AA AA AA AA AA B8
3D 33 00 AA AA AA AA AA AA AA AA AA AA AA AA C8 3D 33 00 AA AA AA AA AA AA
AA AA AA AA AA AA
```

Wrapped at 16 bytes:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	00	00	00	EE	EE	EE	EE	00	00	00	00	AA	AA	AA	AA
AA	AA	AA	AA	AA	AA	AA	AA	B8	3D	33	00	AA	AA	AA	AA
AA	AA	AA	AA	AA	AA	AA	AA	C8	3D	33	00	AA	AA	AA	AA
AA	AA	AA	AA	AA	AA	AA	AA								

Example 3: 16-byte data, 2-byte padding (left/right), no header blocks, 8-byte alignment.

Field	Size
Next pointer	4 bytes
Padding	2 bytes
Header block	0 bytes (not used)
Data	16 bytes
Alignment	2/4 bytes (left/interblock)
Page size	74 bytes



Memory dump (wrapped at 32 bytes):

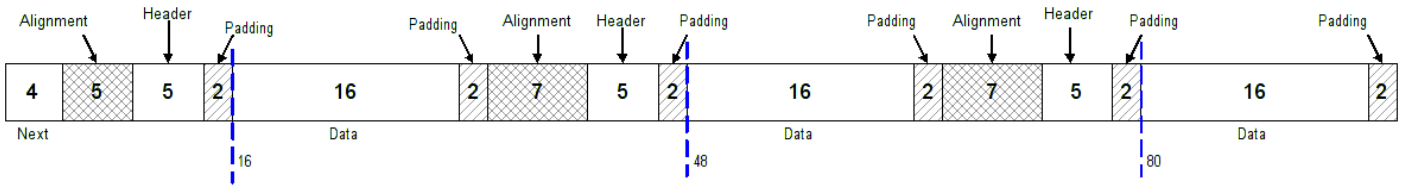
```
 0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31
00 00 00 00 EE EE DD DD 00 00 00 00 AA AA AA AA AA AA AA AA AA AA AA AA DD
DD EE EE EE EE DD DD
B8 3D 33 00 AA AA AA AA AA AA AA AA AA AA AA AA DD DD EE EE EE EE DD DD D0
3D 33 00 AA AA AA AA
AA AA AA AA AA AA AA AA DD DD
```

Wrapped at 16 bytes:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	00	00	00	EE	EE	DD	DD	00	00	00	00	AA	AA	AA	AA
AA	AA	AA	AA	AA	AA	AA	AA	DD	DD	EE	EE	EE	EE	DD	DD
B8	3D	33	00	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA
DD	DD	EE	EE	EE	EE	DD	DD	D0	3D	33	00	AA	AA	AA	AA
AA	AA	AA	AA	AA	AA	AA	AA	DD	DD						

Example 4: 16-byte data, 2-byte padding (left/right), basic header blocks (5 bytes), 16-byte alignment.

Field	Size
Next pointer	4 bytes
Padding	2 bytes
Basic header block	5 bytes
Data	16 bytes
Alignment	5/7 bytes (left/interblock)
Page size	98 bytes



Memory dump (wrapped at 32 bytes):

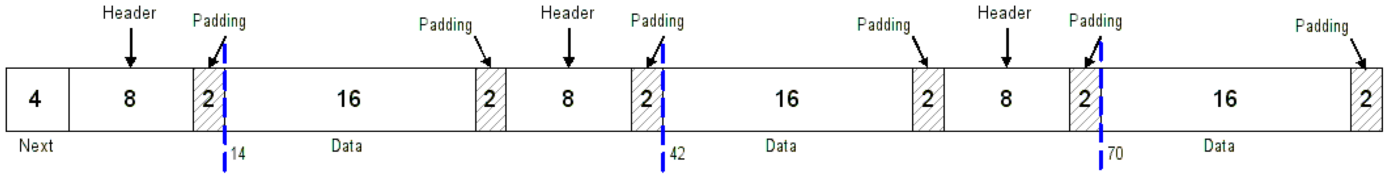
```
0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29 30 31
00 00 00 00 EE EE EE EE EE 00 00 00 00 00 DD DD 00 00 00 00 AA AA AA AA AA
AA AA AA AA AA AA AA
DD DD EE EE EE EE EE EE EE 00 00 00 00 00 DD DD C0 3D 33 00 AA AA AA AA AA
AA AA AA AA AA AA AA
DD DD EE EE EE EE EE EE EE 00 00 00 00 00 DD DD E0 3D 33 00 AA AA AA AA AA
AA AA AA AA AA AA AA
DD DD
```

Wrapped at 16 bytes:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	00	00	00	EE	EE	EE	EE	EE	00	00	00	00	00	DD	DD
00	00	00	00	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA
DD	DD	EE	EE	EE	EE	EE	EE	EE	00	00	00	00	00	DD	DD
C0	3D	33	00	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA
DD	DD	EE	EE	EE	EE	EE	EE	EE	00	00	00	00	00	DD	DD
E0	3D	33	00	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA
DD	DD														

Example 5: 16-byte data, 2-byte padding (left/right), extended header blocks with 1 additional byte (8 bytes), no alignment.

Field	Size
Next pointer	4 bytes
Padding	2 bytes
Extended header block	8 bytes
Data	16 bytes
Alignment	0/0 no alignment
Page size	88 bytes



Memory dump (wrapped at 32 bytes):

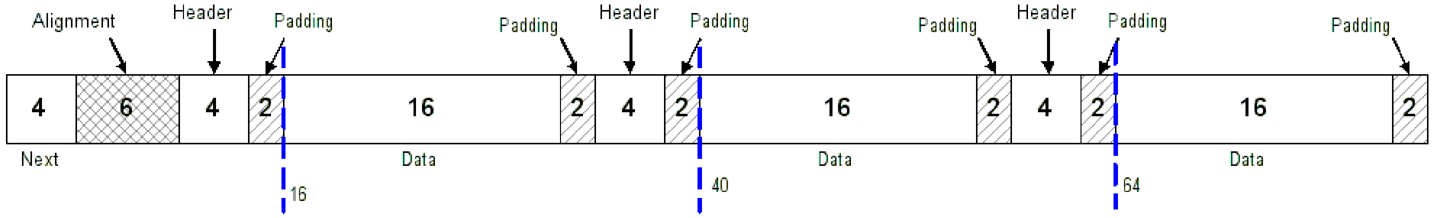
```
 0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31
00 00 00 00 00 00 00 00 00 00 00 00 DD DD 00 00 00 00 AA AA AA AA AA AA AA
AA AA AA AA AA DD DD
00 00 00 00 00 00 00 00 DD DD 8E 4D 33 00 AA AA AA AA AA AA AA AA AA AA AA
AA DD DD 00 00 00 00
00 00 00 00 DD DD AA 4D 33 00 AA AA AA AA AA AA AA AA AA AA AA AA DD DD
```

Wrapped at 16 bytes:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	00	00	00	00	00	00	00	00	00	00	00	DD	DD	00	00
00	00	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	DD	DD
00	00	00	00	00	00	00	00	DD	DD	8E	4D	33	00	AA	AA
AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	DD	DD	00	00	00	00
00	00	00	00	DD	DD	AA	4D	33	00	AA	AA	AA	AA	AA	AA
AA	AA	AA	AA	AA	AA	DD	DD								

Example 6: 16-byte data, 2-byte padding (left/right), external header blocks (4 bytes, 32-bit), 8-byte alignment.

Field	Size
Next pointer	4 bytes
Padding	2 bytes
External header block	4 bytes
Data	16 bytes
Alignment	6/0 alignment
Page size	82 bytes



Memory dump (wrapped at 32 bytes):

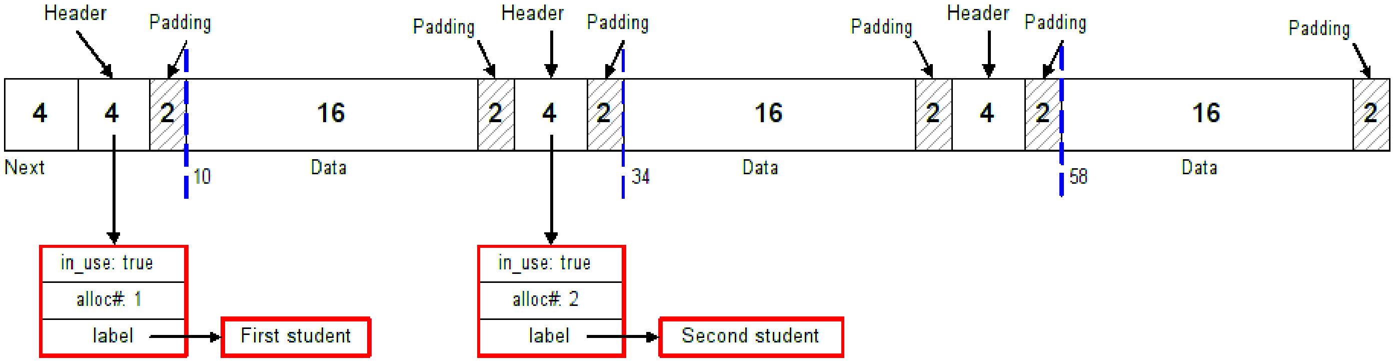
```
 0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
28 29 30 31
00 00 00 00 EE EE EE EE EE EE 00 00 00 00 DD DD 00 00 00 00 AA AA AA AA AA AA AA AA
AA AA AA AA
DD DD 00 00 00 00 DD DD 90 4D 33 00 AA AA AA AA AA AA AA AA AA AA AA AA DD DD 00 00
00 00 DD DD
A8 4D 33 00 AA AA AA AA AA AA AA AA AA AA AA AA DD DD
```

Wrapped at 16 bytes:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	00	00	00	EE	EE	EE	EE	EE	EE	00	00	00	00	DD	DD
00	00	00	00	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA
DD	DD	00	00	00	00	DD	DD	90	4D	33	00	AA	AA	AA	AA
AA	AA	AA	AA	AA	AA	AA	AA	DD	DD	00	00	00	00	DD	DD
A8	4D	33	00	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA
DD	DD														

Example 7: 16-byte data, 2-byte padding (left/right), external header blocks (4 bytes, 32-bit) showing the dynamically-allocated structs and dynamically-allocated strings, no alignment, assuming 32-bit computer.

Field	Size
Next pointer	4 bytes
Padding	2 bytes
External header block	4 bytes
Data	16 bytes
Alignment	no alignment
Page size	76 bytes



Memory dump (wrapped at 32 bytes):

```
 0   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24
25  26  27  28  29  30  31
00  00  00  00  00  00  00  00  DD  DD  00  00  00  00  AA  AA  AA  AA  AA  AA  AA  AA  AA  AA  AA
AA  DD  DD  B8  4E  33  00
DD  DD  BB  BB  BB  BB  BB  BB  BB  BB  BB  BB  BB  BB  BB  BB  BB  BB  DD  DD  40  4E  33  00  DD
DD  BB  BB  BB  BB  BB  BB
BB  BB  BB  BB  BB  BB  BB  BB  BB  BB  DD  DD
```

Wrapped at 16 bytes:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	00	00	00	00	00	00	00	DD	DD	00	00	00	00	AA	AA
AA	AA	AA	AA	AA	AA	AA	AA	AA	AA	DD	DD	B8	4E	33	00
DD	DD	BB	BB	BB	BB	BB	BB	BB	BB	BB	BB	BB	BB	BB	BB
BB	BB	DD	DD	40	4E	33	00	DD	DD	BB	BB	BB	BB	BB	BB
BB	BB	BB	BB	BB	BB	BB	BB	BB	BB	DD	DD				