CSE 484 / CSE M 584
Computer Security: Buffer Overflows II

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Original slides by Franzi

Lab 1 Deadline Reminders

- Lab 1 Checkpoint (Sploits 1-3) due Oct 14th at **5pm**!
  - Turn in text file of md5sums for sploits 1-3

    8a4d47b908dc53f760e8fa51b02bd440 sploit1.c
    545879cf5523e93be9a693111ee967e8 sploit2.c
    1cea0ba2bb9b5bb0fafe448a8a7bf0df sploit3.c

- Lab 1 Final due in two weeks (Oct 31th, 5pm).
- If you don't have a group or access yet, talk to me today!
- Upcoming office hours:
  - Monday after lecture (TAs)
  - Wednesday after lecture (Ada)

Lab 1 Notes/Hints

- If you get stuck, move on!
- Don't procrastinate on Sploits 4-7. Some of them are much harder.
- Sploit 3: No frame pointer, so you can only change last byte of saved EIP. Think about an existing instruction you could point to that would have desirable side effects.

Sploit 5 Tips

- Buffer copied to the heap.
- Target 5 uses the implementation that's found in `~/sources/tmalloc.c`.
- Read "Once upon a free()": http://www.phrack.org/issues.html?issue=57&id=9&mode=txt

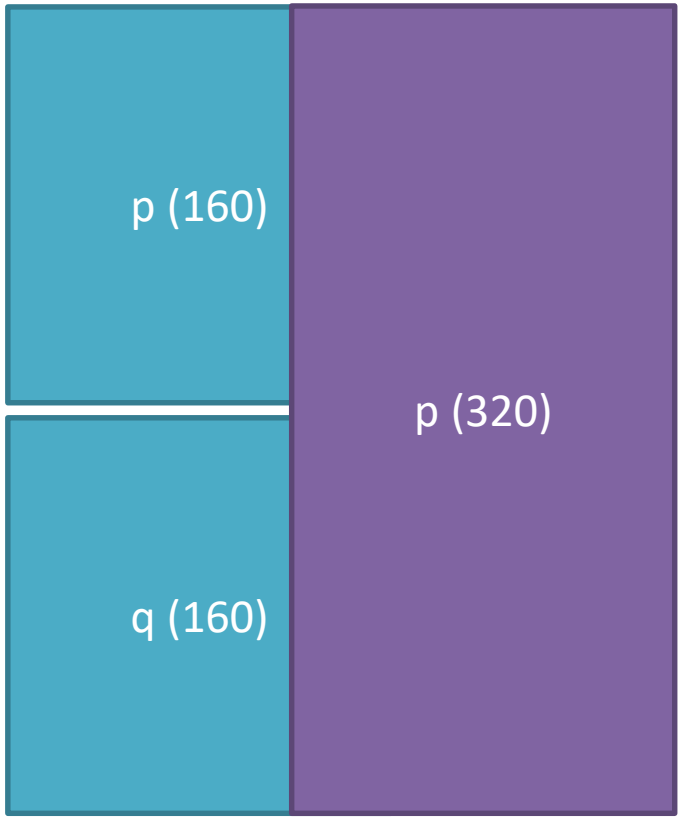
Dynamic Memory Management in C

- Memory allocation: malloc(size_t n)
  - Allocates n bytes and returns a pointer to the allocated memory; memory not cleared.
- Memory deallocation: free(void * p)
  - Frees the memory space pointed to by p, which must have been returned by a previous call to malloc() (or similar).
  - If p is null, no operation is performed.
  - If free(p) has been called before ("double free"), undefined behavior occurs.

(Some memory management slides adapted from Vitaly Shmatikov)

Target5: What's the problem?

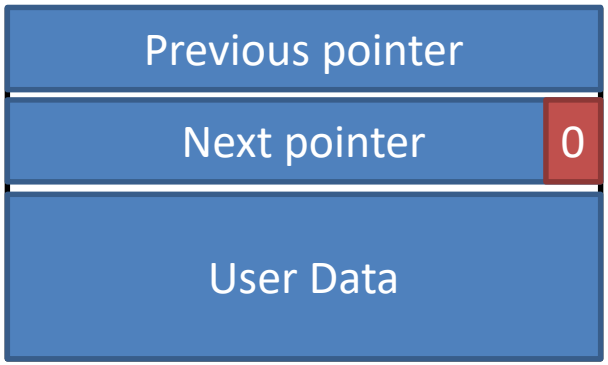
```
char *p; char *q;

if ( (p = tmalloc(160)) == NULL)
{ exit(EXIT_FAILURE); }

if ( (q = tmalloc(160)) == NULL)
{exit(EXIT_FAILURE); }

tfree(p);
tfree(q);

if ( (p = tmalloc(320)) == NULL)
{exit(EXIT_FAILURE); }

obsd_strlcpy(p, arg, 320);
tfree(q);
```



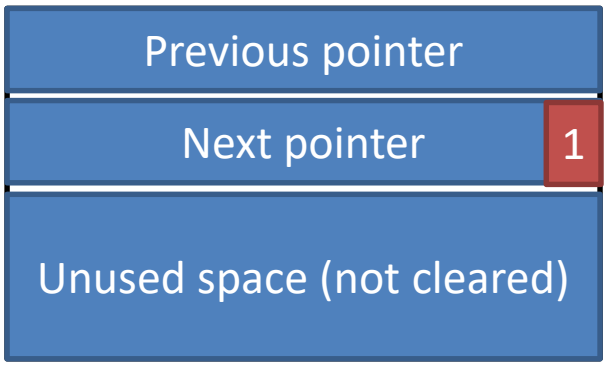
"Undefined" behavior on second free()

Free Chunks (as used in tmalloc.c)

- Chunks organized into doubly-linked list.
- Each chunk on list contains forward/back pointers to next/previous chunks in the list.
  - LSB of right pointer contains free bit.
  - Adjacent free chunks are consolidated.

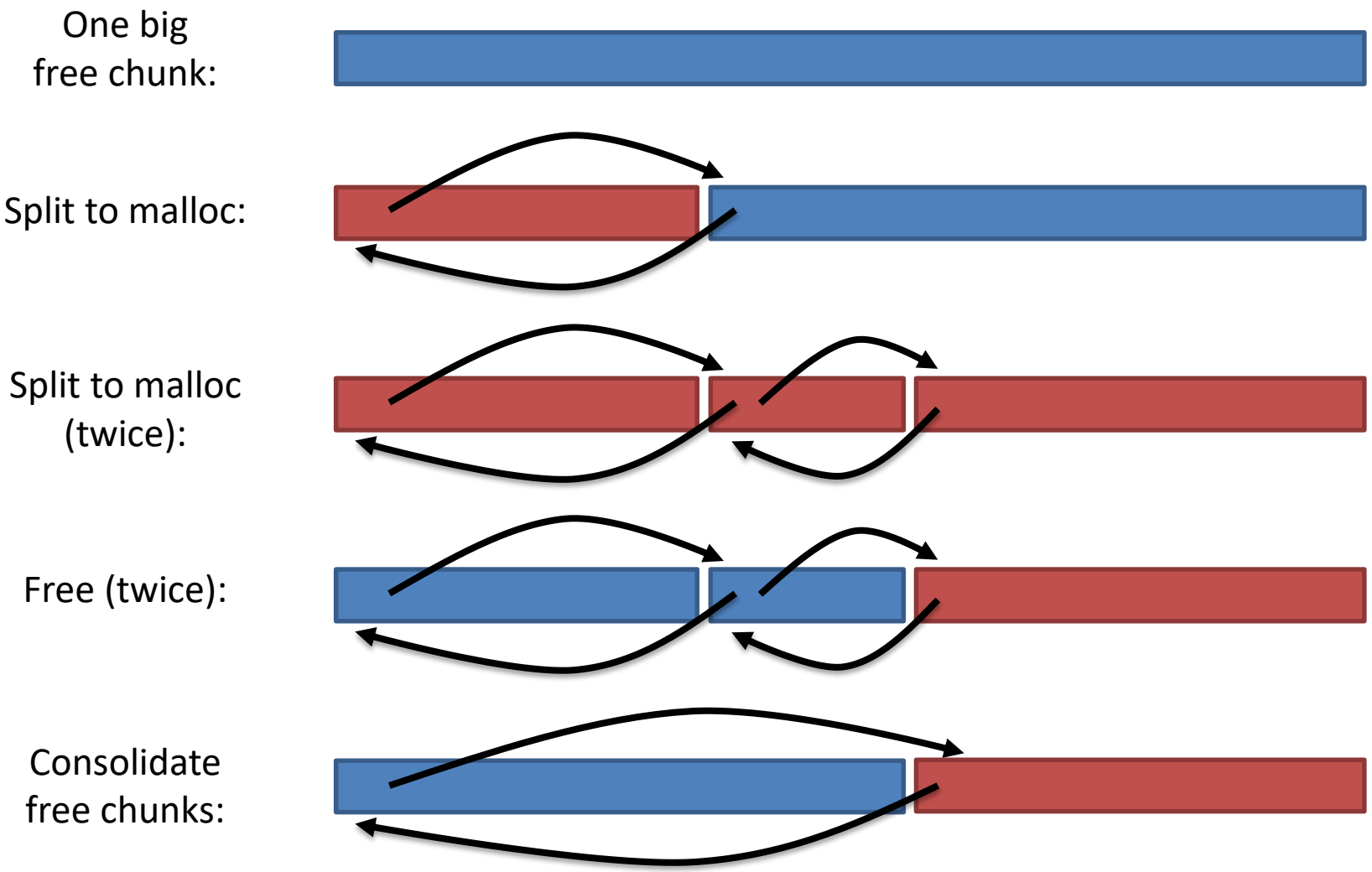


Allocated Chunk



Free Chunk

Chunk Maintenance



Chunks in tmalloc.c

- Lines 20-28 give chunk structure:

- Look at chunk consolidation in `tfree(p)`:

```
q = p->s.l;
…
q->s.r = p->s.r;
p->s.r->s.l = q;
```

Hey look, if we control chunks p (and q), this code will write the value of q (address of buffer?) to a location we specify (location of saved EIP?).

- Goal: populate (fake) chunks appropriately.

General Questions?