CSE 484 / CSE M 584

Computer Security: Buffer Overflows II

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Lab 1 Deadline Reminders

- Lab 1 Checkpoint (Sploits 1-3) due tomorrow at **5pm**!
  - Turn in text file of md5sums for sploits 1-3, **include all group member UW NetIDs**.
- Lab 1 Final due in two weeks (2/8, 5pm).
- If you don't have a group or VM access yet, talk to me today!
- Upcoming office hours:
  - Tomorrow (Friday) 10:30 am – Ian
  - Monday 1:30 pm – Yoshi
  - Wednesday 1:00 pm – Daseul and Ian
  - Thursday 12:30 pm – Franzi and Daseul

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.
- You have more than one copy of your buffer: (1) as argument to function, (2) where it gets copied.
- Sploit 4 is not necessarily harder than Sploit 3.

Sploit 5 Tips

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

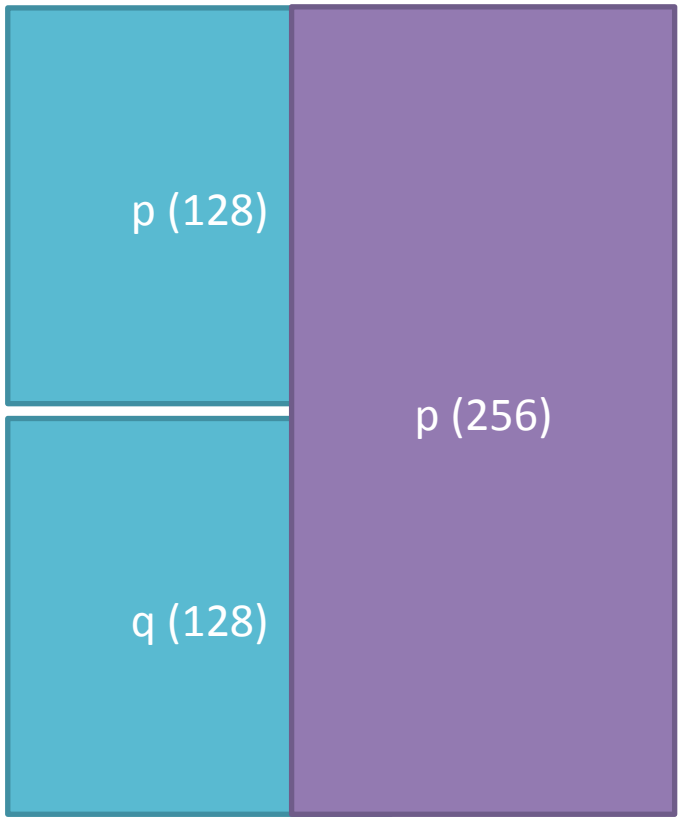
Dynamic Memory Management in C

- 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 free(p) has been called before ("double free"), undefined behavior occurs.
  - If p is null, no operation is performend.

(Some memory management slides adapted from Vitaly Shmatikov)

Target5: What's the problem?

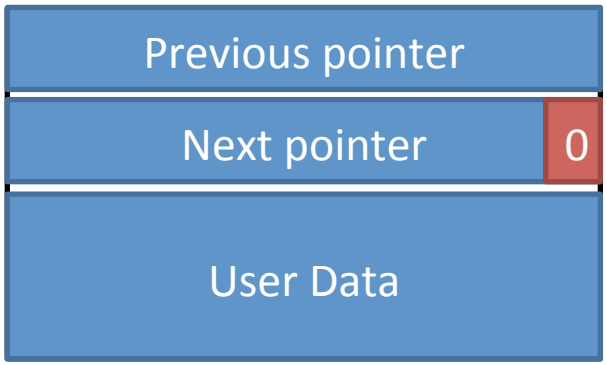
```
char *p; char *q;

if ( (p = tmalloc(128)) == NULL)
{ exit(EXIT_FAILURE); }

if ( (q = tmalloc(128)) == NULL)
{exit(EXIT_FAILURE); }

tfree(p);
tfree(q);

if ( (p = tmalloc(256)) == NULL)
{exit(EXIT_FAILURE); }

obsd_strlcpy(p, arg, 256);
tfree(q);
```



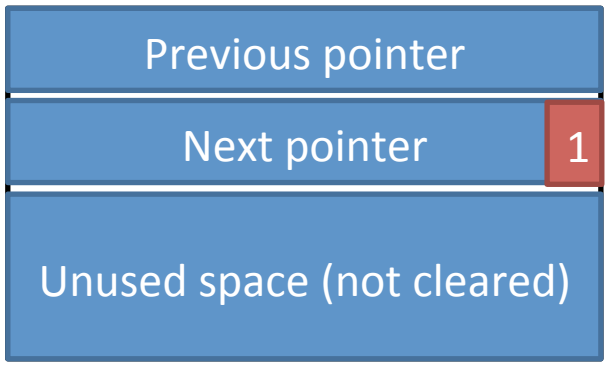
"Undefined" behavior on second free()

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.

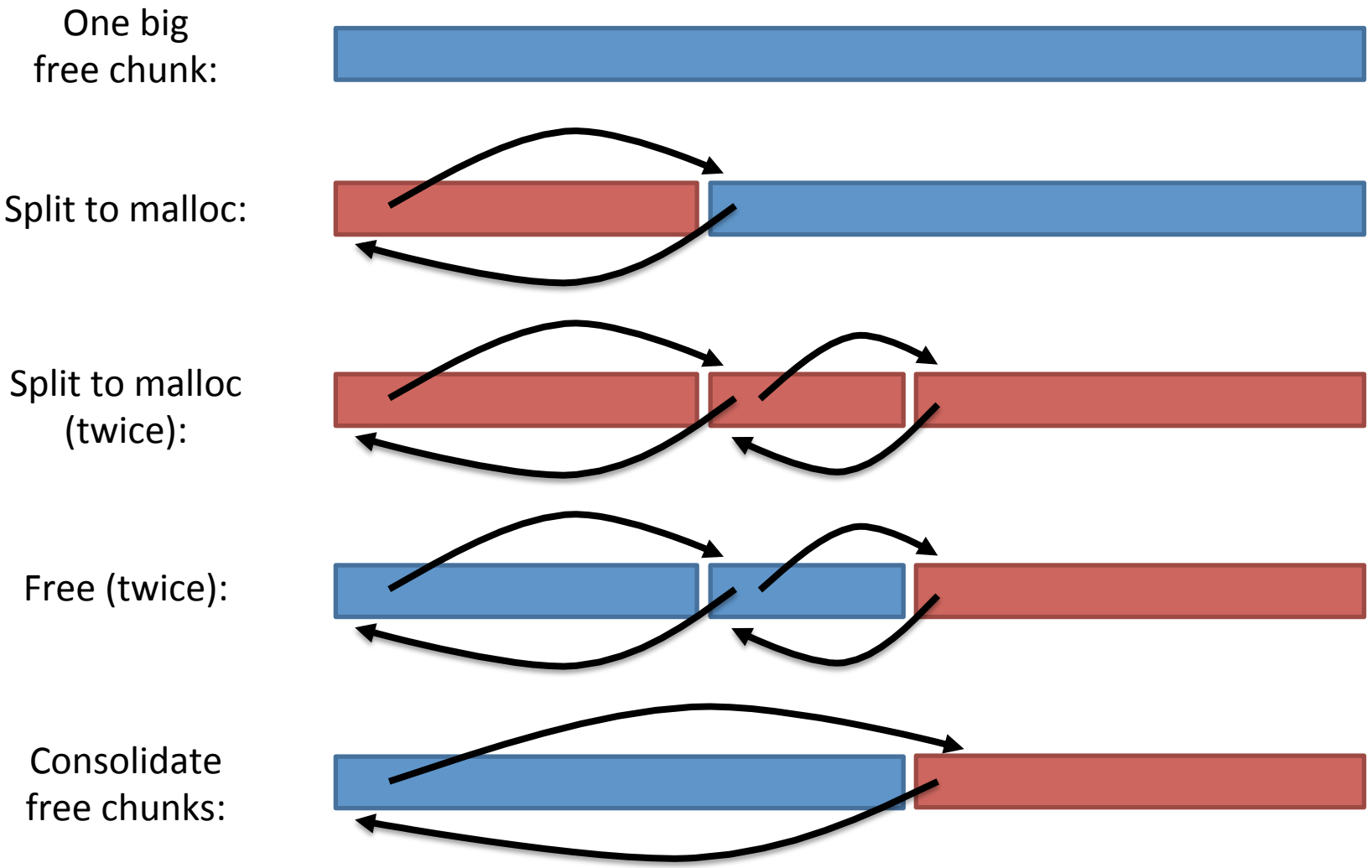


Allocated Chunk



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?