CS107
Autumn 2018

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CS107 Midterm Examination SOLUTIONS

Problem 1: Integer Representation

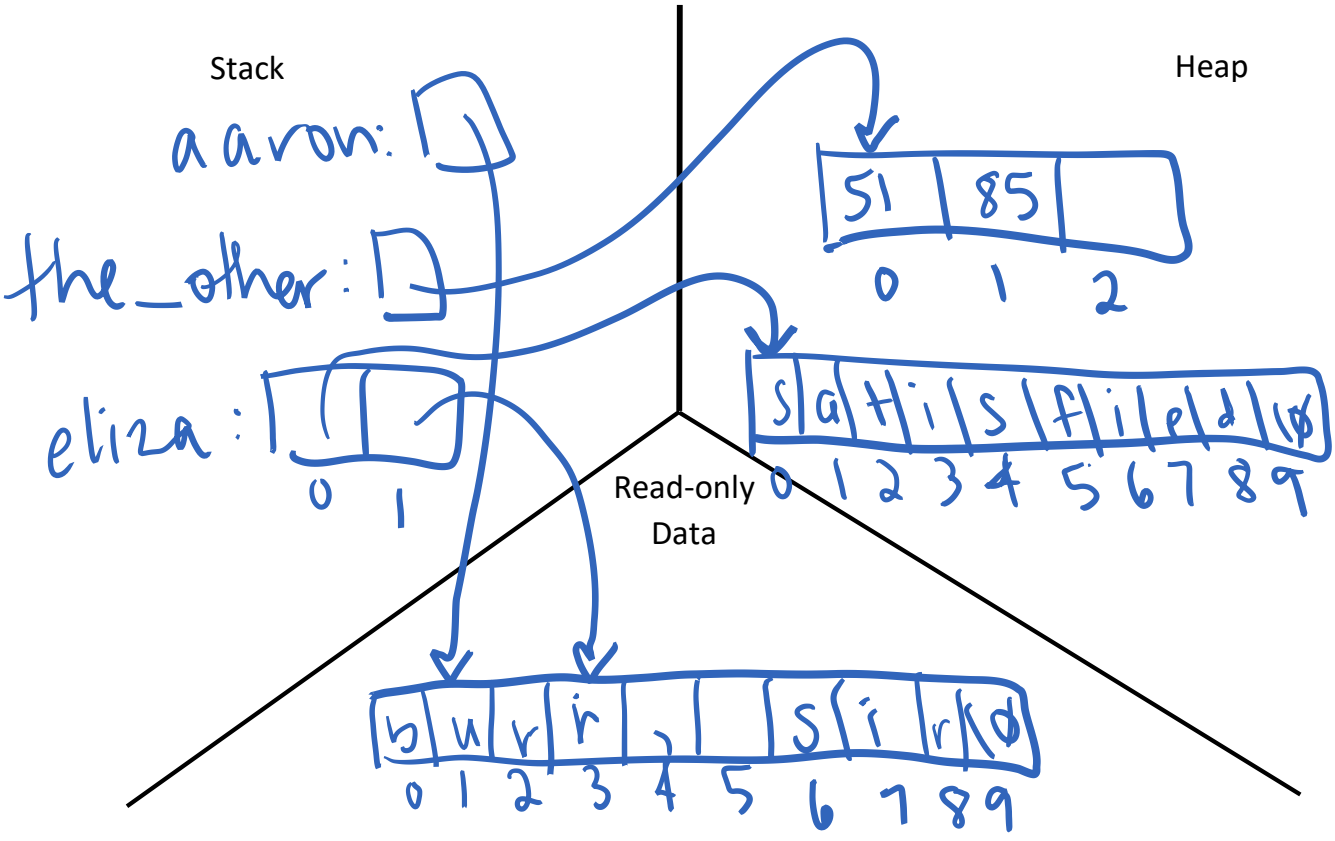
(a) 0110 1101
(b) -54
(c) 1110 0001
(d) (any)

Problem 2: Pointers and Arrays

(a) Leave blank or `assert(nelems > 0)`. Although sort of harmless, `assert(nelems >= 0)` is not helpful because its size is unsigned anyway. Code should not be mallocing temp space.
(b) `nelems * sizeof(int)`
(c)
```
copy[i] = *(arr[i]);
free(arr[i]);
arr[i] = copy + i;
```

(d) Leave blank.

Problem 3: Memory Diagram



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Problem 4: Generics and Function Pointers

(a)

```
void remove_less (void *arr, size_t *nelems, size_t width,
                  int (*cmp)(const void *p, const void *q))
{
    // this guards against nelems = 0
    for (size_t i = (*nelems) ? (*nelems - 1) : 0; i > 0; i--) {
        void *ith = (char*)arr + i * width;
        int res = cmp(ith, arr);
        if (res < 0) {
            memmove(ith, (char*)ith + width, (*nelems - 1 - i) * width);
            *nelems = *nelems - 1; // *nelems--; doesn't work due to op precedence
        }
    }
}
```

(b)

```
int farm_compare(const void *p, const void *q)
{
    const struct farm *farm_p = (const struct farm *)p;
    const struct farm *farm_q = (const struct farm *)q;
    return farm_p->count + strlen(farm_p->species) -
          (farm_q->count + strlen(farm_q->species));
}
```

Problem 5: Bitwise Operations

(a)

```
bool zeros_detector_loop(unsigned int n)
{
    unsigned int mask = 0x3; // 0b000....00011
    for (int i = 0; i < 31; i++) {
        if (!(n & mask)) return true;
        mask <<= 1;
    }
    return false;
}
```

(b)

```
// one elegant solution
bool zeros_detector(unsigned int n)
{
    return (~n) & (~n << 1);
}
// a alternate mask-based solution
bool zeros_detector(unsigned int n)
{
    return ((n | (n >> 1)) & 0x7FFFFFFF) != 0x7FFFFFFF;
}
```