ECE 421
Assignment 2

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1

```
struct Bag<T> {
 items: [T; 3],
}
```

2

```
#[allow(non_snake_case)]
fn BagSize<T>(_: Bag<T>) -> usize {
    std::mem::size_of::<Bag<T>>()
}
```

3

```
#[allow(non_camel_case_types)]
struct Bag_u8 {
 items: [u8; 3],
}

#[allow(non_camel_case_types)]
struct Bag_u32 {
 items: [u32; 3],
}

#[allow(non_snake_case)]
fn BagSize_u8 (_: Bag_u8) -> usize{
    std::mem::size_of::<Bag_u8>()
}

#[allow(non_snake_case)]
```

```
fn BagSize_u32 (_: Bag_u32) -> usize{
    std::mem::size_of::<Bag_u32>()
}

fn main() {
    let b1 = Bag_u8 {items: [1u8, 2u8, 3u8], };
    let b2 = Bag_u32 {items: [1u32, 2u32, 3u32], };

    println!("size of First Bag = {} bytes", BagSize_u8(b1));
    println!("size of Second Bag = {} bytes", BagSize_u32(b2));
}
```

4

```
use std::mem::size_of_val;

fn main() {

    let vec1 = vec![12, 32, 13];
    let vec2 = vec![44, 55, 16];
    {
        let vec1_iter = vec1.iter();
        println!("size of vec1_iter = {} bytes", size_of_val(&vec1_iter));
    }
    {
        let vec_chained = vec1.iter().chain(vec2.iter());
        println!("size of vec_chained = {} bytes", size_of_val(&vec_chained));
    }
    {
        let vec1_2=vec![vec1, vec2];
    println!("{}", size_of_val(&vec1_2));
        let vec_flattened = vec1_2.iter().flatten();
        println!("size of vec_flattened = {} bytes", size_of_val(&vec_flattened));
    }

}

/* Output:
size of vec1_iter = 16 bytes
size of vec_chained = 40 bytes
size of vec_flattened = 64 bytes
*/
```

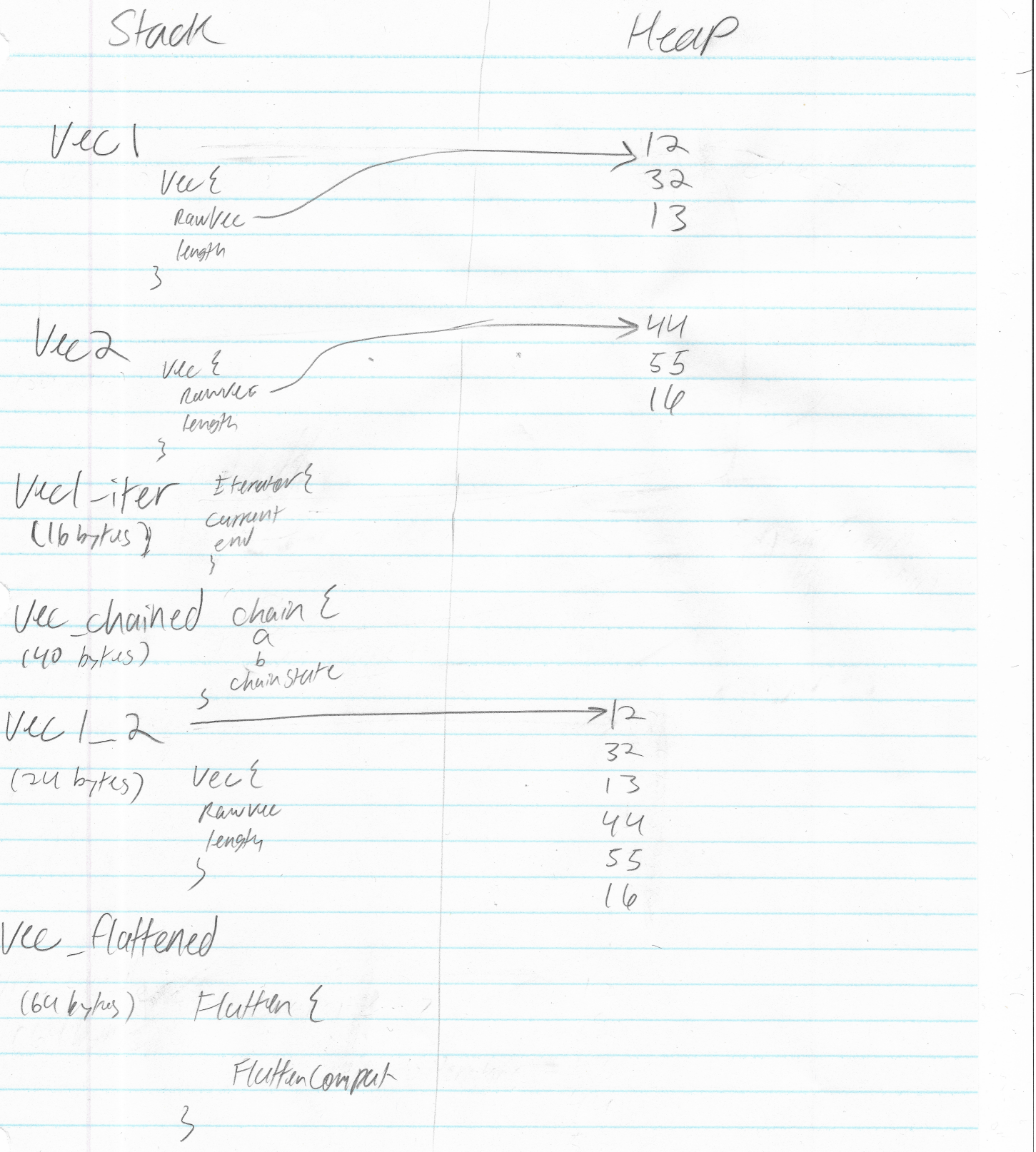
5

```rust
use std::mem::size_of_val;

fn main() {

    let vec1 = Box::new(vec![12, 32, 13]);
    let vec2 = Box::new(vec![44, 55, 16]);
    {
        let vec1_iter = Box::new((*vec1).iter());
        println!("size of vec1_iter = {} bytes", size_of_val(&vec1_iter));
    }
    {
        let vec_chained = Box::new((*vec1).iter().chain((*vec2).iter()));
        println!("size of vec_chained = {} bytes", size_of_val(&vec_chained));
    }
    {
        let vec1_2=Box::new(vec![*vec1, *vec2]);
        let vec_flattened = Box::new((*vec1_2).iter().flatten());
        println!("size of vec_flattened = {} bytes", size_of_val(&vec_flattened));
    }

}

/* Output:
size of vec1_iter = 8 bytes
size of vec_chained = 8 bytes
size of vec_flattened = 8 bytes
*/
```

6

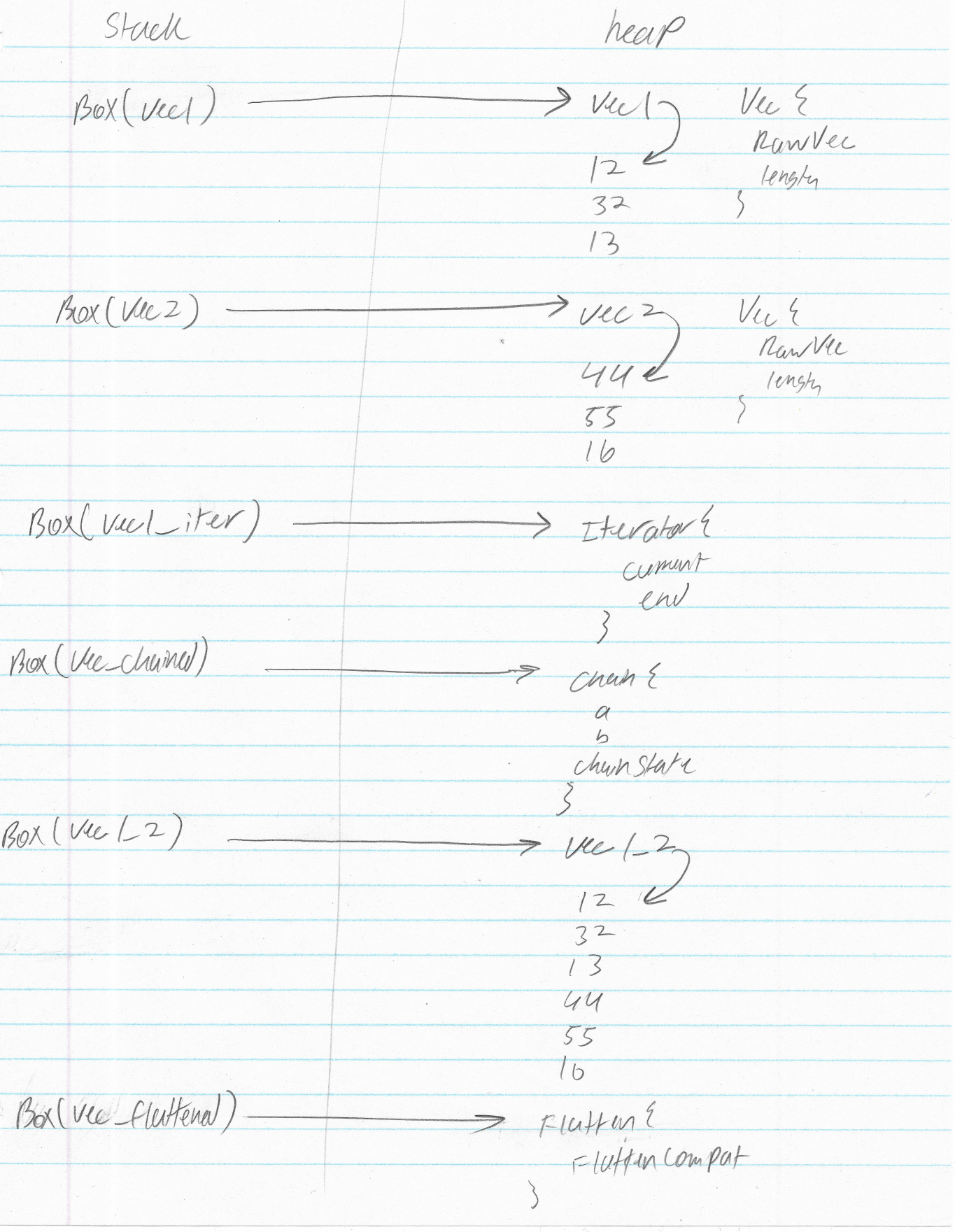
a)

In question 4, most of the variables are on the stack, while the values in the vectors are on the heap. Below is an attempt to demonstrate this. The iterators are basically structs containing references to the actual values on the heap, coupled with something that allows the iterator to keep track of its state, so it knows where to go next.


Stack
Heap
vec1
Vec {
RawVec
length
}
12
32
13
vec2
Vec {
RawVec
length
}
44
55
16
vec1_iter
(16 bytes)
Iterator {
current
end
}
vec_chained
(40 bytes)
chain {
a
b
chainState
}
vec1_2
(24 bytes)
Vec {
RawVec
length
}
12
32
13
44
55
16
vec_flattened
(64 bytes)
Flatten {
FlattenCompat
}

b)

In question 5, almost everything is stored on the heap. Structs that were on the stack in question 4 are now instead on the heap, and we have pointers on the stack pointing to them. That's why in number 5, the size of the value is always 8 bytes, since 8 byte are needed to point to a location in memory on a 64-bit machine.


Stack
heap
Box(vec1)
vec1
12
32
13
Vec {
RawVec
length
}
Box(vec2)
vec2
44
55
16
Vec {
RawVec
length
}
Box(vec1_iter)
Iterator {
current
end
}
Box(vec_chained)
Chain {
a
b
chainState
}
Box(vec1_2)
vec1_2
12
32
13
44
55
16
Box(vec_flattened)
Flatten {
FlattenCompat
}

7

Polymorphism is the ability to process objects differently depending on their data type while still presenting the same interface.

Rust supports polymorphism, but in a dffernt way than you're used to programming if you're used to Java. According to the Rust book: "Rust instead uses generics to abstract over different possible types and trait bounds to impose constraints on what those types must provide. This is sometimes called bounded parametric polymorphism." `https://doc.rust-lang.org/1.30.0/book/2018-edition/ch17-01-what-is-oo.html`

8

It was called 2 times. On lines 1801 and 1812 in the output, we see:

```
call     example::equal
```

9

With the -O flag, it seems like the equal function was called 0 times. It is likely that the compiler inlined the function to produce faster code.