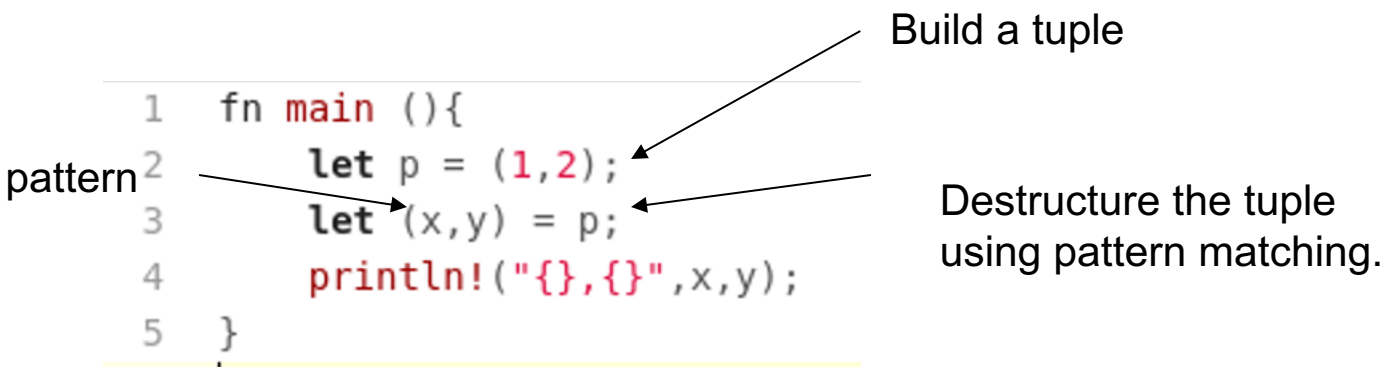
Pattern Matching

- In computer science, *pattern matching* is the act of checking a given sequence of tokens or a given tree structure for the *presence of the constituents of some pattern.*
- A pattern looks like the input sequence or the input tree with the exception that it may contain variables.
- A simple program in Rust that does pattern matching:



Note: the pattern looks just like the structure except that it has variables in it which will get instantiated with values from the structure.

Pattern Matching

- Pattern matching was developed in the 1970's for functional programming languages.
- In functional programming languages virtually all data structures have structure that can be pattern matched – *abstract data types.*
- Pattern matching is a way to compute on those data structures.
- Virtually all modern programming languages support one form or another of pattern matching
  - E.g. Python, Rust, Swift, Scala, Haskell as well as Prolog (being the oldest language on this list)
- Code using pattern matching tends to be much more succinct and readable.

Rust Pattern Matching

- In Rust, similar to functional programming languages, all data structures have structure that can be explicitly matched using pattern matching.
- This includes enums, struct, and primitive data types

Rust Pattern Matching

```rust
enum Coin {
    Penny,
    Nickel,
    Dime,
    Quarter,
}

fn value_in_cents(coin: Coin) -> u8 {
    match coin {
        Coin::Penny => 1,
        Coin::Nickel => 5,
        Coin::Dime => 10,
        Coin::Quarter => 25,
    }
}
```

Here we use ‘match’ to pattern match the value in parameter coin.

```rust
struct Point {
    x: i32,
    y: i32,
}

fn main() {
    let p = Point { x: 0, y: 7 };

    match p {
        Point { x, y: 0 } => println!("Point is on the x axis at {}", x),
        Point { x: 0, y } => println!("Point is on the y axis at {}", y),
        Point { x, y } => println!("Point is on neither axis: ({}, {})", x, y),
    }
}
```

Generate 1 through 4 sequence.

```rust
fn main() {
    let x = 2;

    match x {
        1..=4 => println!("one through four"),
        5 => println!("five"),
        _ => println!("something else"),
    }
}
```

Rust Pattern Matching

```
1
2  fn main () {
3      // define a simple database
4      let db = [
5          // Format:
6          // (Name, Profession, Marital Status, Age, Height, Weight)
7          ("Eddie", "Cook", "Married", 25, 75, 180),
8          ("Betty", "Nurse", "Married", 28, 65, 125),
9          ("Joe", "Bus Driver", "Single", 35, 70, 192),
10         ("Zoey", "CEO", "Married", 45, 72, 120)
11     ];
12
13     // Compute the average age, height, and weight in the db
14     let mut age_sum = 0;
15     let mut height_sum = 0;
16     let mut weight_sum = 0;
17     for (_,_,_,age,height,weight) in db.iter() {
18         age_sum += age;
19         height_sum += height;
20         weight_sum += weight;
21     }
22     println!("age avg={}, height avg={}, weight avg={}",
23         age_sum/db.len(),
24         height_sum/db.len(),
25         weight_sum/db.len()
26         )
27 }
```

Screenshot

Rust Pattern Matching

- Rust allows pattern matching in many different places
- We have seen pattern matching in the ‘let’, ‘for’ and ‘match’ statements
- Beyond that we can pattern match in virtually all control structures and in functions.

Tree Traversal with Pattern Matching

- The idea is to construct a tree structure in Rust representing some computation
- and then walk this tree and generate an infix representation of the tree.
- Here we take advantage of Rust's smart pointers – the Box type – in order to create a tree structure.

Tree Traversal with Pattern Matching

```
17  fn main () {
18      // construct tree using the Node type
19      // (+, (*,2,x),4)
20      let t = Box::new(Node::Binop("+".to_string(),
21                      Box::new(Node::Binop("*".to_string(),
22                            Box::new(Node::Int(2)),
23                            Box::new(Node::Var("x".to_string())))),
24                      Box::new(Node::Int(4))));
25      println!("Tree Dump: {:?}",t);
26      println!("Infix Notation: {}",compute_infix(t));
27  }
```

```
1   #[derive(Debug)]
2   enum Node {
3       Binop(String,Box<Node>,Box<Node>),
4       Int(i64),
5       Var(String)
6   }
7
8   fn compute_infix(node: Box<Node>) -> String {
9       match *node {
10          Node::Binop(op, l, r) =>
11                  format!("({}{}{})",compute_infix(l),op,compute_infix(r)),
12          Node::Int(val) => val.to_string(),
13          Node::Var(name) => name
14      }
15  }
```

```
ubuntu$ ./pattern2
Tree Dump: Binop("+", Binop("*", Int(2), Var("x")), Int(4))
Infix Notation: ((2*x)+4)
ubuntu$
```

Assignments

- Read: doc.rust-lang.org/book/ch18-00-patterns.html
- Assignment #3