

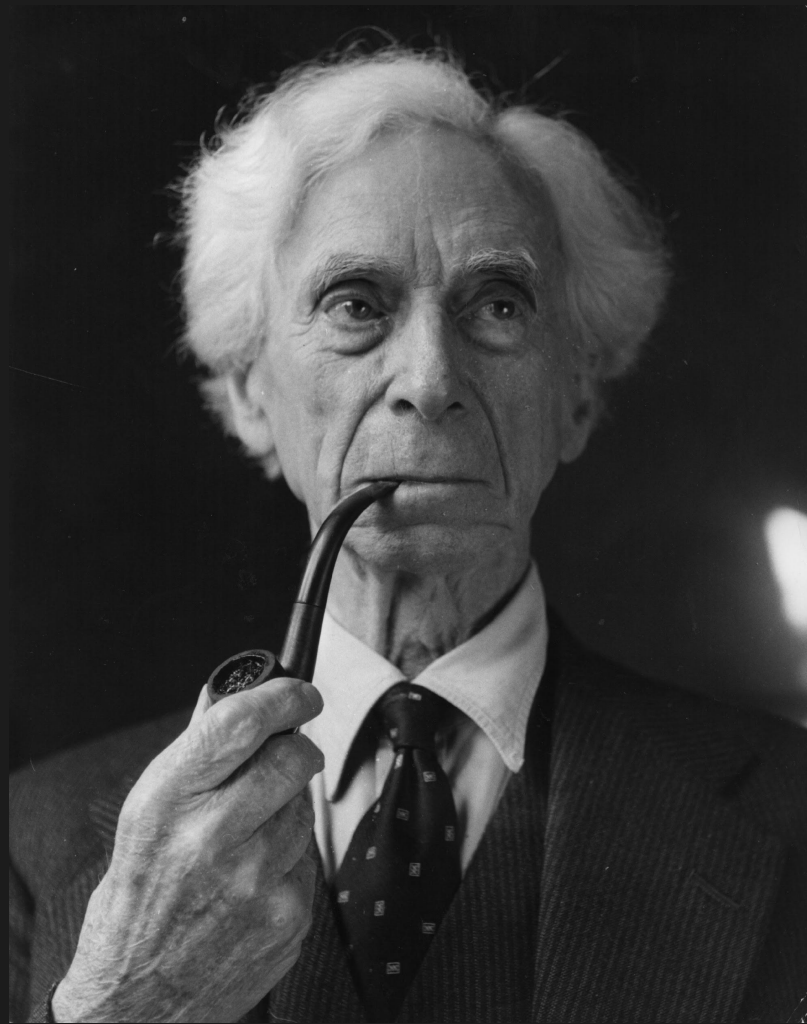
A dark, stylized illustration of a worker's fist raised above a crowd of workers in a factory setting. The fist is the central focus, rendered in a bold, sketchy style. Below it, a dense crowd of workers is depicted, some holding tools like hammers and wrenches. The background shows industrial structures and machinery. The overall tone is somber and industrial, with a focus on labor and solidarity.

Type Theory for the Working Rustacean

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$a : A$

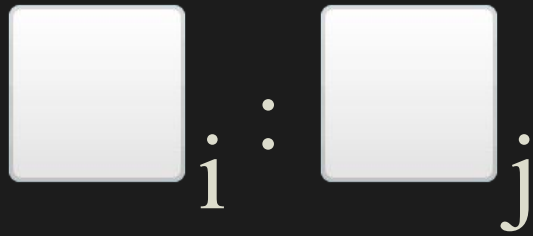
x: u8





A : ★





$a : A : \star : \square_i : \square_j : \dots$

```
fn f(x: u8) -> String;
```



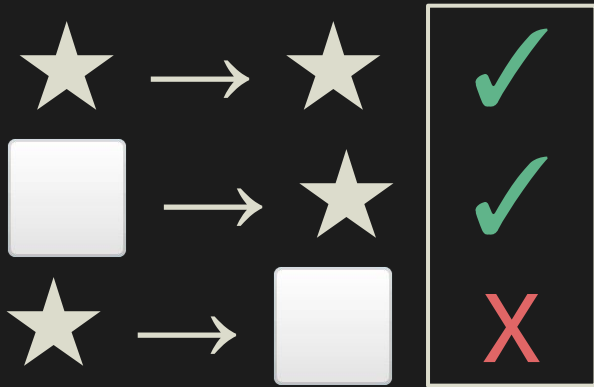
```
fn poly<T>(x: T) -> String;
```

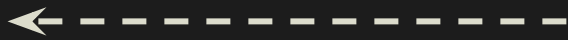


```
struct Vec<T, n : u8>;
```

```
let v: Vec<&str, 1> = vec!["hi"];
```











★ → ■

(Dependent Types)

“Dependently typed programs are,
by their nature, proof carrying code.”

- Altenkirch, McBride, & McKinna, *Why Dependent Types Matter*

```
data Nat : Type where
  zero : Nat
  suc  : Nat → Nat
```

```
data Vec (X : Type) : (n : Nat) → Type where
  empty : Vec X zero
  cons  : {n : Nat} → X → Vec X n → Vec X (suc n)
```



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```
struct Vec<T, n : u8>;
```



```
struct Vec<T, N : Nat>;
```

```
trait Nat {}
struct Zero {}
impl Nat for Zero {}
struct Suc<N: Nat> {
    _pred: PhantomData<N>,
}

impl<N: Nat> Nat for Suc<N> {}
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trait Nat {}
struct Zero {}
impl Nat for Zero {}
struct Suc<N: Nat> {
    _pred: PhantomData<N>,
}

impl<N: Nat> Nat for Suc<N> {}
```

```
struct SizeProofVec<T, N: Nat> {
    v: Vec<T>,
    _size: PhantomData<N>,
}

impl<T, N: Nat> SizeProofVec<T, N> {
    fn push(mut self, x: T) -> SizeProofVec<T, Suc<N>>
    {
        self.v.push(x);
        SizeProofVec {
            v: self.v,
            _size: PhantomData,
        }
    }
}
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        }
    }
}
```

```
fn copy_from_slice(&mut self, src: &[T])  
where  
    T: Copy;
```

```
thread 'main' panicked at 'assertion failed: `(left == right)`  
  left: `6`,  
 right: `4`: destination and source slices have different  
lengths'
```

```
fn copy_from<M: Nat>(&mut self, src: &SizeProofVec<T, M>)
where
    T: Copy,
    M: IsLessOrEqualTo<N, Result = True>,
{
    for (idx, item) in src.vec.iter().enumerate() {
        self.vec[idx] = *item;
    }
}
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        self.vec[idx] = *item;
    }
}
```

```
85 |         b.copy_from(&a);  
    |         ^^^^^^^^^ expected struct `False`, found struct `True`  
    |  
= note: expected type `False`  
        found type `True`
```