Introducing the Erlang Language

- Why Erlang?
  - Exemplifies the "you can have code and concurrency that is free from side effects…there is no other way" perspective
  - Real language used to build real systems
  - A pretty good, practical book exists to use as a text
  - Multi-core applications
  - Fault-tolerant applications

Erlang is a *Functional* Language

- Lots of definitions but some implications
  - Computation is primarily done by evaluating functions that take immutable values as inputs and produce immutable values as outputs
  - Programs are written by defining functions (in terms of other functions)
  - Functions are side-effect free
- Other functional languages: Haskell, Standard ML, LISP (in some variants)
- You can *program functionally* in imperative languages (e.g. C, Java, etc.) but some make it easier than others
- Automatic storage management (GC) is almost always a feature of functional languages (but not vice-versa)

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Erlang values

- Numbers
  - Integers with arbitrary precision (dd*)
  - Floating point (d*d.dd*)
- Tuples
  - {value [, value]*} ; 1-tuple allowed and different from the contained value: 1 != {1}
  - Tuple models data structures of known fixed size
- Atoms
  - Alphanumeric sequences starting with lower-case letter (may contain but not start with _ and @)
  - Any sequence enclosed in single quotes
  - The value of an atom is itself
- Lists
  - Sequence of values of unknown size
  - Compare to python tuples and lists – Erlang lists are not mutable!

Object

02

An Erlang idiom using tuples

struct person { char *first; char *last }; -- C

{person, {first, "carl"}, {last, "hauser"}} – this is just a value; note the use of atoms as tags in the tuples

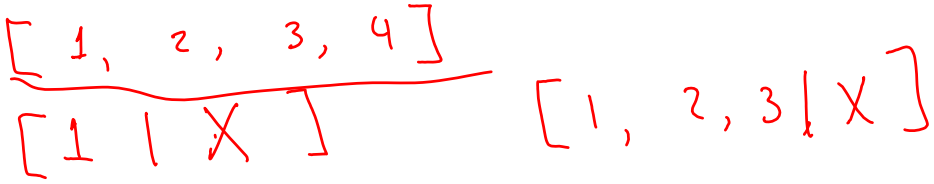
Erlang is a dynamically, strongly typed language. Using tags helps people keep things straight about programs. Compare {"carl", "hauser"}

strongly typed – can't use a value incorrectly by passing to a operation that interprets it as something else.

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

More about lists

- List values can be written directly – [value, value, …, value] or created one element at a time using the *list constructor* [value, …, value | list]
- The first element of a list is called the *head*
- Everything else is the *tail*



erl

Strings

- Erlang strings are really just lists of integers
- 5> "abc".
  "abc"
  6> [1|"abc"].
  [1,97,98,99]
- Shell has a special rule for printing lists that contain only printable characters
- The integer for a character can be written $c
- 7> $a.
  97
- This feels like a *hack* to me

Erlang variables

- Start with upper-case letter (enforced convention for human beings sake)
- Are *write-once*
  - A new variable is called *unbound*
  - After assignment a variable is said to be *bound* and cannot be further changed (limits the possibility for side effects!)
    - "assignment" is technically the wrong term – more properly called *binding*

Erlang approach to binding: assertion of equality

Idea: a form such as X = {1, 3} is an assertion of equality between X and {1, 3}. If something equals something else then they can't later be not equal. Hence the bind-once rule.

```
9> X = {1,3}.
{1,3}
10> x.
x
11> X.
{1,3}
12> X=X.
{1,3}
13> X={1,3}.
{1,3}
14> X={1,4}.
** exception error: no match of right hand side value {1,4}
```

Binding using pattern matching

- You may recall this idea from 355 if you talked about ML there
- What if the LHS is not a single variable but something that looks like a value but with variables embedded at some places

```
17> {Y,Z}=X.
{1,3}
18> Y.
1
19> Z.
3
```

patterns

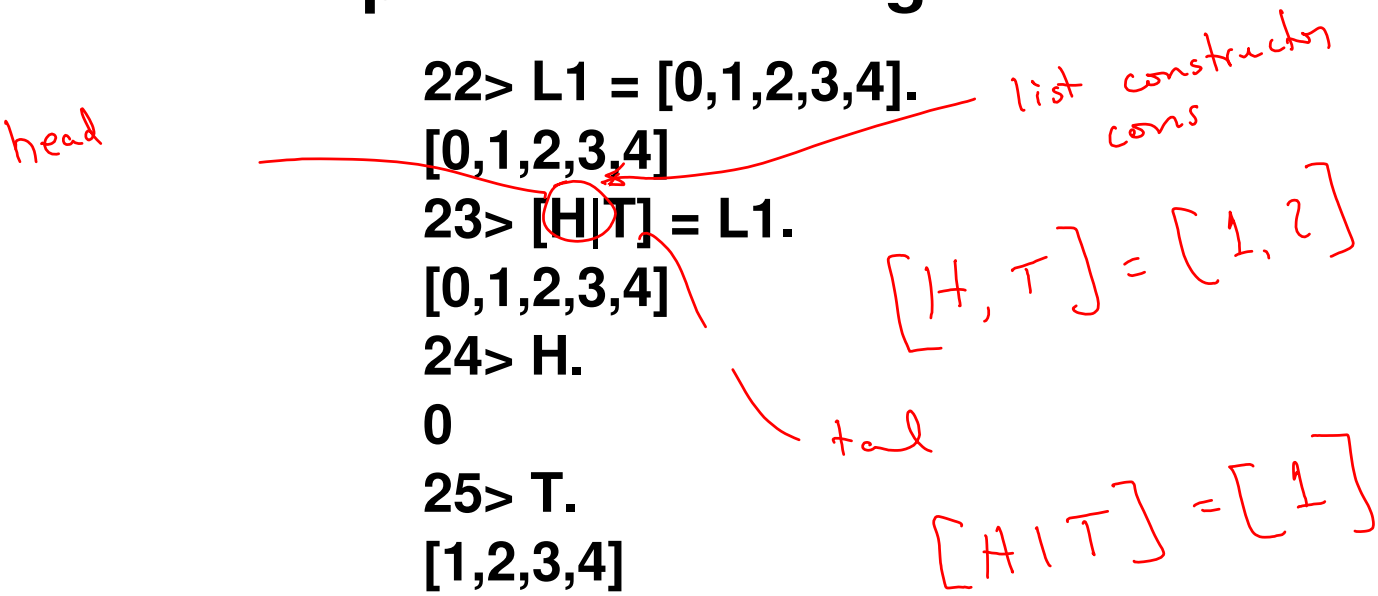
- You may have also noticed this in Python

```
>>> a = [1,2,3]
>>> [d,e,f] = a
>>> d
1
>>> e
2
>>> f
3
```

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

More pattern matching - lists

```
22> L1 = [0,1,2,3,4].
[0,1,2,3,4]
23> [H|T] = L1.
[0,1,2,3,4]
24> H.
0
25> T.
[1,2,3,4]
```



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Assignment

- **Before next class** -- that is, for Feb. 19 class.
  - **Skim Chapters 2-5; read chapter 7** (If using the Armstrong book)
  - **Install Erlang and work through (at the very least) the examples in Chapter 6**
    - **Don't worry about the version: whatever precompiled version is available for your system should be fine**

If you have the kangaroo book, read chapters 2 and 3 for next time and do the exercises in those chapters.