

CS 115 Lecture 16

List algorithms, parallel lists

Neil Moore

Department of Computer Science
University of Kentucky
Lexington, Kentucky 40506
neil@cs.uky.edu

12 Nov 2015

Functions that mutate lists

Let's write a function that mutates a list.

- **Scaling**: multiply all the elements by the same number.
- Parameters: a list and a scaling factor.
- Postconditions: mutates the list and returns nothing.

Functions that mutate lists

Let's write a function that mutates a list.

- **Scaling**: multiply all the elements by the same number.
- Parameters: a list and a scaling factor.
- Postconditions: mutates the list and returns nothing.
- Usually a mutating function needs to loop over indices, not elements.

Functions that mutate lists

Let's write a function that mutates a list.

- **Scaling**: multiply all the elements by the same number.
- Parameters: a list and a scaling factor.
- Postconditions: mutates the list and returns nothing.
- Usually a mutating function needs to loop over indices, not elements.
- `scale.py`
- What happens if we pass it a string instead of a list?

Functions that mutate lists

Let's write a function that mutates a list.

- **Scaling**: multiply all the elements by the same number.
- Parameters: a list and a scaling factor.
- Postconditions: mutates the list and returns nothing.
- Usually a mutating function needs to loop over indices, not elements.
- `scale.py`
- What happens if we pass it a string instead of a list?

List algorithms

Let's look at and implement several algorithms for lists.

List algorithms

Let's look at and implement several algorithms for lists.

- Pretty much all list algorithms use a loop.
 - ▶ Usually a for loop, occasionally a while.

List algorithms

Let's look at and implement several algorithms for lists.

- Pretty much all list algorithms use a loop.
 - ▶ Usually a for loop, occasionally a while.
- Sum: add together all the elements.
- Count: find the number of occurrences of a value.
- Max/min: find the largest/smallest value.
- Sort: rearrange the elements to be in order.

List algorithms

Let's look at and implement several algorithms for lists.

- Pretty much all list algorithms use a loop.
 - ▶ Usually a for loop, occasionally a while.
- Sum: add together all the elements.
- Count: find the number of occurrences of a value.
- Max/min: find the largest/smallest value.
- Sort: rearrange the elements to be in order.
- All of these are available as built-in functions or methods.
 - ▶ But we'll still write them ourselves. Why?

List algorithms

Let's look at and implement several algorithms for lists.

- Pretty much all list algorithms use a loop.
 - ▶ Usually a for loop, occasionally a while.
- Sum: add together all the elements.
- Count: find the number of occurrences of a value.
- Max/min: find the largest/smallest value.
- Sort: rearrange the elements to be in order.
- All of these are available as built-in functions or methods.
 - ▶ But we'll still write them ourselves. Why?
 - ▶ It's good to understand how they work.

List algorithms

Let's look at and implement several algorithms for lists.

- Pretty much all list algorithms use a loop.
 - ▶ Usually a for loop, occasionally a while.
- Sum: add together all the elements.
- Count: find the number of occurrences of a value.
- Max/min: find the largest/smallest value.
- Sort: rearrange the elements to be in order.
- All of these are available as built-in functions or methods.
 - ▶ But we'll still write them ourselves. Why?
 - ▶ It's good to understand how they work.
 - ▶ And sometimes we need a slightly different variant.

List algorithms

Let's look at and implement several algorithms for lists.

- Pretty much all list algorithms use a loop.
 - ▶ Usually a for loop, occasionally a while.
- Sum: add together all the elements.
- Count: find the number of occurrences of a value.
- Max/min: find the largest/smallest value.
- Sort: rearrange the elements to be in order.
- All of these are available as built-in functions or methods.
 - ▶ But we'll still write them ourselves. Why?
 - ▶ It's good to understand how they work.
 - ▶ And sometimes we need a slightly different variant.

Sum

Adding up the elements of a list works like adding up user input, which we've done before.

Sum

Adding up the elements of a list works like adding up user input, which we've done before.

- Need an accumulator. What initial value?

Sum

Adding up the elements of a list works like adding up user input, which we've done before.

- Need an accumulator. What initial value?
 - ▶ 0 — the additive identity (adding 0 doesn't change anything)

Sum

Adding up the elements of a list works like adding up user input, which we've done before.

- Need an accumulator. What initial value?
 - ▶ 0 — the additive identity (adding 0 doesn't change anything)
- The algorithm:
 - 1 Initialize the accumulator to 0.
 - 2 For each element of the list, add it to the accumulator.
 - 3 Return the accumulator.

Sum

Adding up the elements of a list works like adding up user input, which we've done before.

- Need an accumulator. What initial value?
 - ▶ 0 — the additive identity (adding 0 doesn't change anything)
- The algorithm:
 - 1 Initialize the accumulator to 0.
 - 2 For each element of the list, add it to the accumulator.
 - 3 Return the accumulator.
- In Python we can also use the built-in function `sum`:
`total = sum(mylist)`

Sum

Adding up the elements of a list works like adding up user input, which we've done before.

- Need an accumulator. What initial value?
 - ▶ 0 — the additive identity (adding 0 doesn't change anything)
- The algorithm:
 - 1 Initialize the accumulator to 0.
 - 2 For each element of the list, add it to the accumulator.
 - 3 Return the accumulator.
- In Python we can also use the built-in function `sum`:
`total = sum(mylist)`
- Variations: sum of squares, product, concatenation.

Sum

Adding up the elements of a list works like adding up user input, which we've done before.

- Need an accumulator. What initial value?
 - ▶ 0 — the additive identity (adding 0 doesn't change anything)
- The algorithm:
 - 1 Initialize the accumulator to 0.
 - 2 For each element of the list, add it to the accumulator.
 - 3 Return the accumulator.
- In Python we can also use the built-in function `sum`:
`total = sum(mylist)`
- Variations: sum of squares, product, concatenation.
- `addup.py`

Sum

Adding up the elements of a list works like adding up user input, which we've done before.

- Need an accumulator. What initial value?
 - ▶ 0 — the additive identity (adding 0 doesn't change anything)
- The algorithm:
 - 1 Initialize the accumulator to 0.
 - 2 For each element of the list, add it to the accumulator.
 - 3 Return the accumulator.
- In Python we can also use the built-in function `sum`:
`total = sum(mylist)`
- Variations: sum of squares, product, concatenation.
- `addup.py`

Count

The `in` operator tells us *whether* an value is in a list. Sometimes we also want to know *how many times* it is there.

Count

The `in` operator tells us *whether* an value is in a list. Sometimes we also want to know *how many times* it is there.

- Two parameters: a list, and the value to search for.

Count

The `in` operator tells us *whether* an value is in a list. Sometimes we also want to know *how many times* it is there.

- Two parameters: a list, and the value to search for.
- We'll need an accumulator again to keep track of the count.
 - ▶ In particular, a **counter**.

Count

The `in` operator tells us *whether* an value is in a list. Sometimes we also want to know *how many times* it is there.

- Two parameters: a list, and the value to search for.
- We'll need an accumulator again to keep track of the count.
 - ▶ In particular, a **counter**.
- The algorithm:
 - 1 Initialize the counter to 0.
 - 2 For each element of the list:
 - (2.1) If it equals the search value, add one to the counter.
 - 3 Return the counter.

Count

The `in` operator tells us *whether* an value is in a list. Sometimes we also want to know *how many times* it is there.

- Two parameters: a list, and the value to search for.
- We'll need an accumulator again to keep track of the count.
 - ▶ In particular, a **counter**.
- The algorithm:
 - 1 Initialize the counter to 0.
 - 2 For each element of the list:
 - (2.1) If it equals the search value, add one to the counter.
 - 3 Return the counter.
- Python lists have a `count` method:

```
numzeros = mylist.count(0)
```

Count

The `in` operator tells us *whether* an value is in a list. Sometimes we also want to know *how many times* it is there.

- Two parameters: a list, and the value to search for.
- We'll need an accumulator again to keep track of the count.
 - ▶ In particular, a **counter**.
- The algorithm:
 - 1 Initialize the counter to 0.
 - 2 For each element of the list:
 - (2.1) If it equals the search value, add one to the counter.
 - 3 Return the counter.
- Python lists have a `count` method:

```
numzeros = mylist.count(0)
```
- Variations: count the elements with a particular property.

Count

The `in` operator tells us *whether* an value is in a list. Sometimes we also want to know *how many times* it is there.

- Two parameters: a list, and the value to search for.
- We'll need an accumulator again to keep track of the count.
 - ▶ In particular, a **counter**.
- The algorithm:
 - 1 Initialize the counter to 0.
 - 2 For each element of the list:
 - (2.1) If it equals the search value, add one to the counter.
 - 3 Return the counter.
- Python lists have a `count` method:

```
numzeros = mylist.count(0)
```
- Variations: count the elements with a particular property.
- `count.py`

Count

The `in` operator tells us *whether* an value is in a list. Sometimes we also want to know *how many times* it is there.

- Two parameters: a list, and the value to search for.
- We'll need an accumulator again to keep track of the count.
 - ▶ In particular, a **counter**.
- The algorithm:
 - 1 Initialize the counter to 0.
 - 2 For each element of the list:
 - (2.1) If it equals the search value, add one to the counter.
 - 3 Return the counter.
- Python lists have a `count` method:

```
numzeros = mylist.count(0)
```
- Variations: count the elements with a particular property.
- `count.py`

Maximum and minimum

What if we want to find the largest element?

Maximum and minimum

What if we want to find the largest element?

- Use a variable to track the largest so far.
 - ▶ What to initialize it to?
 - ▶ 0?

Maximum and minimum

What if we want to find the largest element?

- Use a variable to track the largest so far.
 - ▶ What to initialize it to?
 - ▶ 0? What if the list is all negative?

Maximum and minimum

What if we want to find the largest element?

- Use a variable to track the largest so far.
 - ▶ What to initialize it to?
 - ▶ 0? What if the list is all negative?
 - ▶ -999999?

Maximum and minimum

What if we want to find the largest element?

- Use a variable to track the largest so far.
 - ▶ What to initialize it to?
 - ▶ 0? What if the list is all negative?
 - ▶ -999999? Same problem: the elements might all be smaller.

Maximum and minimum

What if we want to find the largest element?

- Use a variable to track the largest so far.
 - ▶ What to initialize it to?
 - ▶ 0? What if the list is all negative?
 - ▶ -999999? Same problem: the elements might all be smaller.
 - ▶ Use the first element of the list!
 - ★ “The largest” doesn’t make sense on an empty list: error.

Maximum and minimum

What if we want to find the largest element?

- Use a variable to track the largest so far.
 - ▶ What to initialize it to?
 - ▶ 0? What if the list is all negative?
 - ▶ -999999? Same problem: the elements might all be smaller.
 - ▶ Use the first element of the list!
 - ★ “The largest” doesn’t make sense on an empty list: error.
- The algorithm:
 - 1 Initialize the “best” variable to the first element.
 - 2 For each element in the rest of the list:
 - (2.1) If it’s bigger than the best, it is the new best.
 - 3 Return the best.

Maximum and minimum

What if we want to find the largest element?

- Use a variable to track the largest so far.
 - ▶ What to initialize it to?
 - ▶ 0? What if the list is all negative?
 - ▶ -999999? Same problem: the elements might all be smaller.
 - ▶ Use the first element of the list!
 - ★ “The largest” doesn’t make sense on an empty list: error.
- The algorithm:
 - 1 Initialize the “best” variable to the first element.
 - 2 For each element in the rest of the list:
 - (2.1) If it’s bigger than the best, it is the new best.
 - 3 Return the best.
- Python has functions `max` and `min`:

```
largest = max(mylist)
```

 - ▶ Elements must be comparable (all str or all numbers, not a mix)
- Variations: index of the maximum, maximum function value.

Maximum and minimum

What if we want to find the largest element?

- Use a variable to track the largest so far.
 - ▶ What to initialize it to?
 - ▶ 0? What if the list is all negative?
 - ▶ -999999? Same problem: the elements might all be smaller.
 - ▶ Use the first element of the list!
 - ★ “The largest” doesn’t make sense on an empty list: error.
- The algorithm:
 - 1 Initialize the “best” variable to the first element.
 - 2 For each element in the rest of the list:
 - (2.1) If it’s bigger than the best, it is the new best.
 - 3 Return the best.
- Python has functions `max` and `min`:
`largest = max(mylist)`
 - ▶ Elements must be comparable (all str or all numbers, not a mix)
- Variations: index of the maximum, maximum function value.
- `maximum.py`

Maximum and minimum

What if we want to find the largest element?

- Use a variable to track the largest so far.
 - ▶ What to initialize it to?
 - ▶ 0? What if the list is all negative?
 - ▶ -999999? Same problem: the elements might all be smaller.
 - ▶ Use the first element of the list!
 - ★ “The largest” doesn’t make sense on an empty list: error.
- The algorithm:
 - 1 Initialize the “best” variable to the first element.
 - 2 For each element in the rest of the list:
 - (2.1) If it’s bigger than the best, it is the new best.
 - 3 Return the best.
- Python has functions `max` and `min`:
`largest = max(mylist)`
 - ▶ Elements must be comparable (all str or all numbers, not a mix)
- Variations: index of the maximum, maximum function value.
- `maximum.py`

Sorting

- We already know the `sort` function.
- But how does it work?

Sorting

- We already know the sort function.
- But how does it work?
- There are several algorithms for sorting:
 - ▶ Selection sort, insertion sort, quick sort, merge sort.
 - ▶ <http://www.sorting-algorithms.com/>

Sorting

- We already know the sort function.
- But how does it work?
- There are several algorithms for sorting:
 - ▶ Selection sort, insertion sort, quick sort, merge sort.
 - ▶ <http://www.sorting-algorithms.com/>
 - ▶ Most of these algorithms are based around:
 - ★ Comparing elements.
 - ★ Then swapping them into the right place.

Sorting

- We already know the sort function.
- But how does it work?
- There are several algorithms for sorting:
 - ▶ Selection sort, insertion sort, quick sort, merge sort.
 - ▶ <http://www.sorting-algorithms.com/>
 - ▶ Most of these algorithms are based around:
 - ★ Comparing elements.
 - ★ Then swapping them into the right place.
 - ▶ Different algorithms have different trade-offs:
 - ★ Some require fewer comparisons.
 - ★ Some require fewer swaps.
 - ★ Some require less memory.
 - ★ Some are good on “almost-sorted” data.

Sorting

- We already know the sort function.
- But how does it work?
- There are several algorithms for sorting:
 - ▶ Selection sort, insertion sort, quick sort, merge sort.
 - ▶ <http://www.sorting-algorithms.com/>
 - ▶ Most of these algorithms are based around:
 - ★ Comparing elements.
 - ★ Then swapping them into the right place.
 - ▶ Different algorithms have different trade-offs:
 - ★ Some require fewer comparisons.
 - ★ Some require fewer swaps.
 - ★ Some require less memory.
 - ★ Some are good on “almost-sorted” data.
- We'll look at one algorithm: selection sort.
 - ▶ Not the fastest, but one of the simplest.
 - ▶ Also requires the fewest swaps.

Sorting

- We already know the sort function.
- But how does it work?
- There are several algorithms for sorting:
 - ▶ Selection sort, insertion sort, quick sort, merge sort.
 - ▶ <http://www.sorting-algorithms.com/>
 - ▶ Most of these algorithms are based around:
 - ★ Comparing elements.
 - ★ Then swapping them into the right place.
 - ▶ Different algorithms have different trade-offs:
 - ★ Some require fewer comparisons.
 - ★ Some require fewer swaps.
 - ★ Some require less memory.
 - ★ Some are good on “almost-sorted” data.
- We'll look at one algorithm: selection sort.
 - ▶ Not the fastest, but one of the simplest.
 - ▶ Also requires the fewest swaps.

Selection sort

The idea behind selection sort: iterate through the list in multiple passes:

- First, put the smallest element into the right place.

Selection sort

The idea behind selection sort: iterate through the list in multiple passes:

- First, put the smallest element into the right place.
 - ▶ Can find the smallest with `min` and `index`.
 - ▶ Then swap it with the first element.
`lst[0], lst[minpos] = lst[minpos], lst[0]`

Selection sort

The idea behind selection sort: iterate through the list in multiple passes:

- First, put the smallest element into the right place.
 - ▶ Can find the smallest with `min` and `index`.
 - ▶ Then swap it with the first element.
`lst[0], lst[minpos] = lst[minpos], lst[0]`
 - ▶ This is pass 1.

Selection sort

The idea behind selection sort: iterate through the list in multiple passes:

- First, put the smallest element into the right place.
 - ▶ Can find the smallest with `min` and `index`.
 - ▶ Then swap it with the first element.
`lst[0], lst[minpos] = lst[minpos], lst[0]`
 - ▶ This is pass 1.
- Then put the second-smallest element into the right place.
 - ▶ Use `min` and `index` on the unsorted part of the list.
 - ▶ Then swap it with the second element.

Selection sort

The idea behind selection sort: iterate through the list in multiple passes:

- First, put the smallest element into the right place.
 - ▶ Can find the smallest with `min` and `index`.
 - ▶ Then swap it with the first element.
`lst[0], lst[minpos] = lst[minpos], lst[0]`
 - ▶ This is pass 1.
- Then put the second-smallest element into the right place.
 - ▶ Use `min` and `index` on the unsorted part of the list.
 - ▶ Then swap it with the second element.
 - ▶ That's pass 2.

Selection sort

The idea behind selection sort: iterate through the list in multiple passes:

- First, put the smallest element into the right place.
 - ▶ Can find the smallest with `min` and `index`.
 - ▶ Then swap it with the first element.
`lst[0], lst[minpos] = lst[minpos], lst[0]`
 - ▶ This is pass 1.
- Then put the second-smallest element into the right place.
 - ▶ Use `min` and `index` on the unsorted part of the list.
 - ▶ Then swap it with the second element.
 - ▶ That's pass 2.
- And the third-smallest, and the fourth, and...

Selection sort

The idea behind selection sort: iterate through the list in multiple passes:

- First, put the smallest element into the right place.
 - ▶ Can find the smallest with `min` and `index`.
 - ▶ Then swap it with the first element.
`lst[0], lst[minpos] = lst[minpos], lst[0]`
 - ▶ This is pass 1.
- Then put the second-smallest element into the right place.
 - ▶ Use `min` and `index` on the unsorted part of the list.
 - ▶ Then swap it with the second element.
 - ▶ That's pass 2.
- And the third-smallest, and the fourth, and . . .
- Sounds like we need a loop!

Selection sort

The idea behind selection sort: iterate through the list in multiple passes:

- First, put the smallest element into the right place.
 - ▶ Can find the smallest with `min` and `index`.
 - ▶ Then swap it with the first element.
`lst[0], lst[minpos] = lst[minpos], lst[0]`
 - ▶ This is pass 1.
- Then put the second-smallest element into the right place.
 - ▶ Use `min` and `index` on the unsorted part of the list.
 - ▶ Then swap it with the second element.
 - ▶ That's pass 2.
- And the third-smallest, and the fourth, and...
- Sounds like we need a loop!

Selection sort algorithm

- For each index in the list (each pass):
 - 1 Find the smallest element after index i .
 - 2 Swap that element with index i .

Selection sort algorithm

- For each index in the list (each pass):
 - 1 Find the smallest element after index i .
 - 2 Swap that element with index i .Now all the elements up to index i are sorted.

Selection sort algorithm

- For each index in the list (each pass):
 - ① Find the smallest element after index i .
 - ② Swap that element with index i .
Now all the elements up to index i are sorted.
- That's all!
 - ▶ Each pass makes more of the list sorted than before.
 - ▶ Gets us closer to the goal, but not all the way there.

Selection sort algorithm

- For each index in the list (each pass):
 - ① Find the smallest element after index i .
 - ② Swap that element with index i .
Now all the elements up to index i are sorted.
- That's all!
 - ▶ Each pass makes more of the list sorted than before.
 - ▶ Gets us closer to the goal, but not all the way there.
 - ▶ Then repeat until we reach the goal: common algorithmic technique.
 - ▶ Have to make sure you're getting closer to the goal: in each pass, there are fewer numbers to sort than in the previous.

Selection sort algorithm

- For each index in the list (each pass):
 - ① Find the smallest element after index i .
 - ② Swap that element with index i .
Now all the elements up to index i are sorted.
- That's all!
 - ▶ Each pass makes more of the list sorted than before.
 - ▶ Gets us closer to the goal, but not all the way there.
 - ▶ Then repeat until we reach the goal: common algorithmic technique.
 - ▶ Have to make sure you're getting closer to the goal: in each pass, there are fewer numbers to sort than in the previous.
- It turns out we could stop before the last index. Why?

Selection sort algorithm

- For each index in the list (each pass):
 - ① Find the smallest element after index i .
 - ② Swap that element with index i .
Now all the elements up to index i are sorted.
- That's all!
 - ▶ Each pass makes more of the list sorted than before.
 - ▶ Gets us closer to the goal, but not all the way there.
 - ▶ Then repeat until we reach the goal: common algorithmic technique.
 - ▶ Have to make sure you're getting closer to the goal: in each pass, there are fewer numbers to sort than in the previous.
- It turns out we could stop before the last index. Why?
 - ▶ If everything else is in the right place, it must be too!

Selection sort algorithm

- For each index in the list (each pass):
 - ① Find the smallest element after index i .
 - ② Swap that element with index i .
Now all the elements up to index i are sorted.
- That's all!
 - ▶ Each pass makes more of the list sorted than before.
 - ▶ Gets us closer to the goal, but not all the way there.
 - ▶ Then repeat until we reach the goal: common algorithmic technique.
 - ▶ Have to make sure you're getting closer to the goal: in each pass, there are fewer numbers to sort than in the previous.
- It turns out we could stop before the last index. Why?
 - ▶ If everything else is in the right place, it must be too!
- `sel_sort.py`

Selection sort algorithm

- For each index in the list (each pass):
 - ① Find the smallest element after index i .
 - ② Swap that element with index i .
Now all the elements up to index i are sorted.
- That's all!
 - ▶ Each pass makes more of the list sorted than before.
 - ▶ Gets us closer to the goal, but not all the way there.
 - ▶ Then repeat until we reach the goal: common algorithmic technique.
 - ▶ Have to make sure you're getting closer to the goal: in each pass, there are fewer numbers to sort than in the previous.
- It turns out we could stop before the last index. Why?
 - ▶ If everything else is in the right place, it must be too!
- `sel_sort.py`

Parallel lists

- Sometimes we need to store collections of related information:
 - ▶ Employees and salaries.
 - ▶ Songs, performers, and albums.
 - ▶ Monster locations and hit points.

Parallel lists

- Sometimes we need to store collections of related information:
 - ▶ Employees and salaries.
 - ▶ Songs, performers, and albums.
 - ▶ Monster locations and hit points.
- We can do this using multiple lists with matching indices.
 - ▶ So `songs[0]` goes with `artists[0]`, etc.

Parallel lists

- Sometimes we need to store collections of related information:
 - ▶ Employees and salaries.
 - ▶ Songs, performers, and albums.
 - ▶ Monster locations and hit points.
- We can do this using multiple lists with matching indices.
 - ▶ So `songs[0]` goes with `artists[0]`, etc.
 - ▶ That means all the lists must be the same length.

Parallel lists

- Sometimes we need to store collections of related information:
 - ▶ Employees and salaries.
 - ▶ Songs, performers, and albums.
 - ▶ Monster locations and hit points.
- We can do this using multiple lists with matching indices.
 - ▶ So `songs[0]` goes with `artists[0]`, etc.
 - ▶ That means all the lists must be the same length.
 - ▶ These are called **parallel lists**.

Parallel lists

- Sometimes we need to store collections of related information:
 - ▶ Employees and salaries.
 - ▶ Songs, performers, and albums.
 - ▶ Monster locations and hit points.
- We can do this using multiple lists with matching indices.
 - ▶ So `songs[0]` goes with `artists[0]`, etc.
 - ▶ That means all the lists must be the same length.
 - ▶ These are called **parallel lists**.
- Python has other ways to do similar things:
 - ▶ Lists of lists, dictionaries, user-defined objects. . .
 - ▶ Parallel lists are the easiest to get started with.

Parallel lists

- Sometimes we need to store collections of related information:
 - ▶ Employees and salaries.
 - ▶ Songs, performers, and albums.
 - ▶ Monster locations and hit points.
- We can do this using multiple lists with matching indices.
 - ▶ So `songs[0]` goes with `artists[0]`, etc.
 - ▶ That means all the lists must be the same length.
 - ▶ These are called **parallel lists**.
- Python has other ways to do similar things:
 - ▶ Lists of lists, dictionaries, user-defined objects. . .
 - ▶ Parallel lists are the easiest to get started with.

Parallel list examples

- Suppose we have two parallel lists, of student names and scores.

Parallel list examples

- Suppose we have two parallel lists, of student names and scores.
- If I give you a name, how would you find their score?

Parallel list examples

- Suppose we have two parallel lists, of student names and scores.
- If I give you a name, how would you find their score?
 - ▶ Find the index of that name in the name list.
 - ▶ The score is at the same index in the other list.

Parallel list examples

- Suppose we have two parallel lists, of student names and scores.
- If I give you a name, how would you find their score?
 - ▶ Find the index of that name in the name list.
 - ▶ The score is at the same index in the other list.
- What if I wanted a list of all the students with “A”s?

Parallel list examples

- Suppose we have two parallel lists, of student names and scores.
- If I give you a name, how would you find their score?
 - ▶ Find the index of that name in the name list.
 - ▶ The score is at the same index in the other list.
- What if I wanted a list of all the students with “A”s?
 - 1 Build an accumulator list for the answer.
 - 2 Iterate over the score list (keeping track of the index)

Parallel list examples

- Suppose we have two parallel lists, of student names and scores.
- If I give you a name, how would you find their score?
 - ▶ Find the index of that name in the name list.
 - ▶ The score is at the same index in the other list.
- What if I wanted a list of all the students with “A”s?
 - 1 Build an accumulator list for the answer.
 - 2 Iterate over the score list (keeping track of the index)
 - (2.1) If the score is ≥ 90 :
 - (2.1.1) Find the name at the same index.
 - (2.1.2) Append that name to the accumulator.
 - 3 Return the accumulator.

Parallel list examples

- Suppose we have two parallel lists, of student names and scores.
- If I give you a name, how would you find their score?
 - ▶ Find the index of that name in the name list.
 - ▶ The score is at the same index in the other list.
- What if I wanted a list of all the students with “A”s?
 - 1 Build an accumulator list for the answer.
 - 2 Iterate over the score list (keeping track of the index)
 - (2.1) If the score is ≥ 90 :
 - (2.1.1) Find the name at the same index.
 - (2.1.2) Append that name to the accumulator.
 - 3 Return the accumulator.
- Let's implement functions for both of these.
- `parallel.py`

Parallel list examples

- Suppose we have two parallel lists, of student names and scores.
- If I give you a name, how would you find their score?
 - ▶ Find the index of that name in the name list.
 - ▶ The score is at the same index in the other list.
- What if I wanted a list of all the students with “A”s?
 - 1 Build an accumulator list for the answer.
 - 2 Iterate over the score list (keeping track of the index)
 - (2.1) If the score is ≥ 90 :
 - (2.1.1) Find the name at the same index.
 - (2.1.2) Append that name to the accumulator.
 - 3 Return the accumulator.
- Let's implement functions for both of these.
- `parallel.py`

Another example

- Another example related to grading. . . multiple-choice

Another example

- Another example related to grading. . . multiple-choice
- Let's say we have a list of the correct answers.
- . . . and we also have someone's answers to the same questions.
 - ▶ These are parallel lists!

Another example

- Another example related to grading. . . multiple-choice
- Let's say we have a list of the correct answers.
- . . . and we also have someone's answers to the same questions.
 - ▶ These are parallel lists!
- How can we calculate their score (number of right answers)?

Another example

- Another example related to grading... multiple-choice
- Let's say we have a list of the correct answers.
- ... and we also have someone's answers to the same questions.
 - ▶ These are parallel lists!
- How can we calculate their score (number of right answers)?
 - 1 Keep an counter of the number of correct answers.
 - 2 For each index in the lists:
 - (2.1) If the student's answer equals the correct answer:
 - (2.1.1) Increment the counter.
 - 3 Return the counter.

Another example

- Another example related to grading. . . multiple-choice
- Let's say we have a list of the correct answers.
- . . . and we also have someone's answers to the same questions.
 - ▶ These are parallel lists!
- How can we calculate their score (number of right answers)?
 - 1 Keep an counter of the number of correct answers.
 - 2 For each index in the lists:
 - (2.1) If the student's answer equals the correct answer:
 - (2.1.1) Increment the counter.
 - 3 Return the counter.
- `gradequiz.py`

Something to think about

How would you sort parallel lists?

Something to think about

How would you sort parallel lists?

- Can you use the built-in `sort` method?

Something to think about

How would you sort parallel lists?

- Can you use the built-in `sort` method?
- No—because that sorts only one list.

Something to think about

How would you sort parallel lists?

- Can you use the built-in `sort` method?
- No—because that sorts only one list.
- Can't we just call `sort` twice, once on each list?

Something to think about

How would you sort parallel lists?

- Can you use the built-in `sort` method?
- No—because that sorts only one list.
- Can't we just call `sort` twice, once on each list?
 - ▶ No—that would scramble the associations.
 - ▶ Sorry, Aaron, you now have the lowest grade in class.

Something to think about

How would you sort parallel lists?

- Can you use the built-in `sort` method?
- No—because that sorts only one list.
- Can't we just call `sort` twice, once on each list?
 - ▶ No—that would scramble the associations.
 - ▶ Sorry, Aaron, you now have the lowest grade in class.
- We need one function that takes *two* lists.

Something to think about

How would you sort parallel lists?

- Can you use the built-in `sort` method?
- No—because that sorts only one list.
- Can't we just call `sort` twice, once on each list?
 - ▶ No—that would scramble the associations.
 - ▶ Sorry, Aaron, you now have the lowest grade in class.
- We need one function that takes *two* lists.
 - ▶ Use selection sort, comparing the elements of one list.
 - ▶ But when you swap, swap the same positions in both lists.

Something to think about

How would you sort parallel lists?

- Can you use the built-in `sort` method?
- No—because that sorts only one list.
- Can't we just call `sort` twice, once on each list?
 - ▶ No—that would scramble the associations.
 - ▶ Sorry, Aaron, you now have the lowest grade in class.
- We need one function that takes *two* lists.
 - ▶ Use selection sort, comparing the elements of one list.
 - ▶ But when you swap, swap the same positions in both lists.