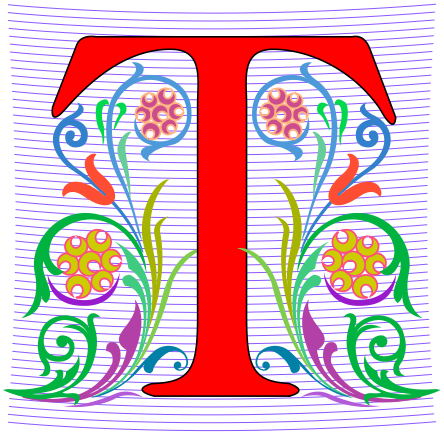
CompSci 101
Stable Sorting, Lambda

```
f = lambda x : x[1]
sorted(lst, key=f)
```

Susan Rodger

April 4, 2023

`T` is for …



- **Type**
  - From int to float to string to list to …
- **Text**
  - From .txt to editors to …
- **Turing Award – Highest Honor in CS**
  - Nobel, Fields, Turing
  - Turing Duke Alums:
    - Ed Clarke (MS)
    - John Cocke (BS, PhD)
    - Fred Brooks (BS)

Shaundra Daily

- **Professor of the Practice, Duke University**
- **B.S. Florida State, Electrical Eng**
- **PhD Media Arts/Sciences – MIT**
- **Combines Dance with Robotics**
- **Focuses on technologies, programs and curricula to support Diversity, Equity and Inclusion in STEM Fields**

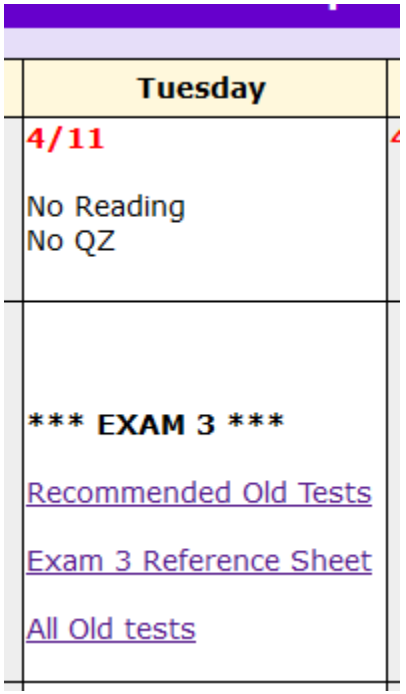
Announcements

- **Assignment 5 due Thursday!**
  - Sakai quiz due tonight! (no grace day)
- **Assignment 6 out Thursday, due April 20**
- **APT-6 out today, Due 4/13**
- **Still to come (APT-7 and Assign 7 (short))**

- **Lab 9 Friday**
  - There is a prelab
- **Coming up…**
  - Exam 3 – Tues, April 11

Exam 3– Tues, April 11 – in one week!

- **Exam is in class on paper – 10:15am**
  - Need pen or pencil
- **See materials under 4/11 date**
  - Exam 3 Reference sheet - part of exam
- **Covers**
  - topics
  - APTs through APT6
  - Labs through Lab 9
  - Assignments through Assignment 5



Exam 3 topics include …

- **List, tuples, list comprehensions**
- **Loops – for loop, while loop, indexing with a loop**
- **Reading from a file**
  - Converting data into a list of things
- **Parallel lists**
- **Sets – solving problems**
- **Dictionaries – solving problems**
- **Sorting – lists, tuples**
- **No turtles, no images - but note we are practicing other concepts with images**

Exam 3

- **Exam 3 is your own work!**
- **No looking at other people's exam**
- **You cannot use any notes, books, computing devices, calculators, or any extra paper**
- **Bring only a pen or pencil**
- **The exam has extra white space and has the Exam 3 reference sheet as part of the exam.**

- **Do not discuss any problems on the exam with others until it is handed back**

Exam 3 – How to Study

- **Practice writing code on paper!**
- **Rewrite an APT**
- **Try to write code from lecture from scratch**
- **Try to write code from lab from scratch**
- **Practice from old exams**
- **Put up old Sakai quizzes, but better to practice writing code**
- **Look at Exam 3 reference sheet when writing code!**

PFTD

- **Sorting in Python and sorting in general**
  - How to use .sort and sorted, differences
  - Key function – change how sorting works
  - Lambda – create anonymous functions

- **Stable sorting**
  - How to leverage when solving problems
  - Why Timsort is the sort-of-choice (! quicksort)

Python Sorting API

- **We'll use both `sorted()` and `.sort()` API**
  - How to call, what options are
  - How to sort on several criteria

- **One creates a new list, one modifies existing list**
  - **`sorted(..)`** creates list from .. Iterable
  - **`x.sort()`** modifies the list x, no return value!

API to change sorting

- **In SongReader.py we changed order of tuples to change sorting order**
  - Then we sliced the end to get "top" songs

- **Can supply a function to compare elements**
  - Function return value used to sort, key=function
  - Change order: reverse=True

Sorting Examples (with optional parameters)

- **Use key=function argument and reverse=True**
  - What if we want to write our own function?

```
a = ['red', 'orange', 'green', 'blue', 'indigo', 'violet']
print(sorted(a))

print(sorted(a, key=len))

print(sorted(a, key=len, reverse=True))
```

Sorting Examples (with optional parameters)

- **Use key=function argument and reverse=True**
  - What if we want to write our own function?

```
a = ['red', 'orange', 'green', 'blue', 'indigo', 'violet']
print(sorted(a))
['blue', 'green', 'indigo', 'orange', 'red', 'violet']
print(sorted(a, key=len))
['red', 'blue', 'green', 'orange', 'indigo', 'violet']
print(sorted(a, key=len, reverse=True))
['orange', 'indigo', 'violet', 'green', 'blue', red']
```

Sorting Examples

a = [4, 1, 7, 3]

b = sorted(a)

a.sort()

a = [‘Q’, ‘W’, ‘B’, ‘F’]

b = sorted(a)

c = sorted(a, reverse = True)

a = [‘hello’, ‘blue’, ’car’]

b = sorted(b, key=len)

Sorting Examples

```
a = [4, 1, 7, 3]
b = sorted(a)
a.sort()
a = ['Q', 'W', 'B', 'F']
b = sorted(a)
c = sorted(a, reverse = True)
a = ['hello', 'blue', 'car']
b = sorted(a, key=len)
```

```
a:   [4, 1, 7, 3]
b:   [1, 3, 4, 7]
a:   [1, 3, 4, 7]
a: ['Q', 'W', 'B', 'F']
b: ['B', 'F', 'Q', 'W']
c: ['W', 'Q', 'F', 'B']
a: ['hello','blue','car']
b: ['car','blue','hello']
```

More Sorting Examples

a = [[2, 2, 34], [2, 6, 7, -1], [1, 2, 3]]

b = sorted(a)

c = sorted(a, key = len)

d = sorted(a, key=max)

e = sorted(a, key=min)

More Sorting Examples

```
a = [ [2, 2, 34], [2, 6, 7, -1], [1, 2, 3] ]
b = sorted(a)
   b:  [ [1, 2, 3], [2, 2, 34], [2, 6, 7, -1] ]
c = sorted(a, key = len)
   c:  [ [ 2, 2, 34], [1, 2, 3], [2, 6, 7, -1] ]
d = sorted(a, key=max)
   d:  [ [1, 2, 3], [2, 6, 7, -1], [2, 2, 34] ]
e = sorted(a, key=min)
   e:  [ [2, 6, 7, -1], [1, 2, 3], [2, 2, 34] ]
```

Sort lists on first element

Sort lists on length of lists

Sort lists on max element

Sort lists on min element

WOTO-1 Basic Sorting
http://bit.ly/101s23-0404-1

WOTO – 1st question

Showing the list and the list sorted

```
In[14]: a = ['red', 'orange', 'yellow', 'green', 'blue', 'indigo', 'violet']
In[15]: sorted(a)
Out[15]: ['blue', 'green', 'indigo', 'orange', 'red', 'violet', 'yellow']
```

What's the list returned by sorted(a, reverse=True)? *

- ['yellow','violet', 'red', 'orange', 'indigo', 'green', 'blue']
- ['violet', 'indigo', 'blue', 'green', 'yellow', 'orange', 'red']

WOTO – 1st question

Showing the list and the list sorted

```
In[14]: a = ['red', 'orange', 'yellow', 'green', 'blue', 'indigo', 'violet']
In[15]: sorted(a)
Out[15]: ['blue', 'green', 'indigo', 'orange', 'red', 'violet', 'yellow']
```

What's the list returned by sorted(a, reverse=True)? *

- ◯ ['yellow','violet', 'red', 'orange', 'indigo', 'green', 'blue'] 
- ◯ ['violet', 'indigo', 'blue', 'green', 'yellow', 'orange', 'red']

WOTO – 2cd question

Showing the list and the list sorted

```
In[14]: a = ['red', 'orange', 'yellow', 'green', 'blue', 'indigo', 'violet']
In[15]: sorted(a)
Out[15]: ['blue', 'green', 'indigo', 'orange', 'red', 'violet', 'yellow']
```

What's the list returned by sorted(a, key=len)? *

- ['red', 'blue', 'green', 'orange', 'yellow', 'indigo', 'violet']
- ['red', 'blue', 'orange', 'green', 'yellow', 'indigo', 'violet']

WOTO – 2cd question

Showing the list and the list sorted

```
In[14]: a = ['red', 'orange', 'yellow', 'green', 'blue', 'indigo', 'violet']
In[15]: sorted(a)
Out[15]: ['blue', 'green', 'indigo', 'orange', 'red', 'violet', 'yellow']
```

What's the list returned by sorted(a, key=len)? *

- ['red', 'blue', 'green', 'orange', 'yellow', 'indigo', 'violet'] 
- ['red', 'blue', 'orange', 'green', 'yellow', 'indigo', 'violet']

WOTO – 3rd question

Showing the list and the list sorted

```
In[14]: a = ['red', 'orange', 'yellow', 'green', 'blue', 'indigo', 'violet']
In[15]: sorted(a)
Out[15]: ['blue', 'green', 'indigo', 'orange', 'red', 'violet', 'yellow']
```

The function max applied to a string returns the alphabetically greatest character in the string, so max('indigo') == 'o' and max('yellow') == 'y'. What's the list returned by sorted(a, key=max)? *

- ['indigo', 'orange', 'green', 'red', 'blue', 'violet', 'yellow']
- ['indigo', 'red', 'orange', 'green', 'blue', 'violet', 'yellow']

WOTO – 3rd question

2 2 5 2 3 1 4

Showing the list and the list sorted

r r y r u o v

```
In[14]: a = ['red', 'orange', 'yellow', 'green', 'blue', 'indigo', 'violet']
In[15]: sorted(a)
Out[15]: ['blue', 'green', 'indigo', 'orange', 'red', 'violet', 'yellow']
```

The function max applied to a string returns the alphabetically greatest character in the string, so max('indigo') == 'o' and max('yellow') == 'y'. What's the list returned by sorted(a, key=max)? *

- ['indigo', 'orange', 'green', 'red', 'blue', 'violet', 'yellow']
- ['indigo', 'red', 'orange', 'green', 'blue', 'violet', 'yellow'] 

The power of lambda

- **We want to create a function "on-the-fly"**
  - aka anonymous function
  - aka "throw-away" function

```
In[7]: a
Out[7]: ['red', 'orange', 'green', 'blue', 'indigo', 'violet']
In[8]: sorted(a,key=lambda x : x.count("e"))
Out[8]: ['indigo', 'red', 'orange', 'blue', 'violet', 'green']
```

- **Why 'indigo' first and 'green' last?**
  - What about order of ties? Later today! Stable

Anonymous Functions

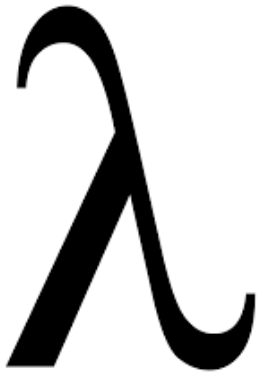
- **Useful when want "throw-away" function**
  - Our case mainly sort

- **Syntax: `lambda PARAMETERS: EXPRESSION`**
  - `PARAMETERS` – 0 or more comma separated
  - `EXPRESSION` – evaluates to something

Why is lambda used?

- **It doesn't matter at all could use zeta? iota? …**
  - https://en.wikipedia.org/wiki/Alonzo_Church

  - Lisp and Scheme have lambda expressions
  - Guido van Rossom, learned to live with lambda



What is a lambda expression?

- **It's a function object, treat like expression/variable**
  - Like list comprehensions, access variables

```
>>> inc = lambda x : x + 1
>>> p = [1, 3, 5, 7]
>>> [inc(num) for num in p]
[2, 4, 6, 8]
```

Syntactic sugar (makes the medicine go down)

- **Syntactic sugar for a normal function definition**

```
def f(x):
    return x[1]
sorted(lst, key=f)
```

```
>>> d.items()
dict_items([('a', [1, 2, 3]), ('b', [4, 7]), ('c', [1, 1, 5, 8])])
>>> sorted(d.items(), key=lambda x : len(x[1]))

>>> sorted(d.items(), key=lambda sparky : len(sparky[1]))
```

Syntactic sugar (makes the medicine go down)

- **Syntactic sugar for a normal function definition**

```
def f(x):
    return x[1]
sorted(lst, key=f)
```

```
f = lambda x : x[1]
sorted(lst, key=f)
```

```
sorted(lst, key=lambda x : x[1])
```

```
>>> d.items()
dict_items([('a', [1, 2, 3]), ('b', [4, 7]), ('c', [1, 1, 5, 8])])
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Parameter name does not matter

Syntactic sugar (makes the medicine go down)

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def f(x):
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sorted(lst, key=f)
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f = lambda x : x[1]
sorted(lst, key=f)
```

```
sorted(lst, key=lambda x : x[1])
```

```
>>> d.items()
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[('b', [4, 7]), ('a', [1, 2, 3]), ('c', [1, 1, 5, 8])]
>>> sorted(d.items(), key=lambda sparky : len(sparky[1]))
[('b', [4, 7]), ('a', [1, 2, 3]), ('c', [1, 1, 5, 8])]
```

Parameter name does not matter

Syntax and Semantics of Lambda

- **Major use: single variable function as key**

fruits = [‘banana’, ‘apple’, ’lemon’, ’kiwi’, ’pineapple’]
b = sorted(fruits)

c = min(fruits)

d = max(fruits)

Syntax and Semantics of Lambda

- **Major use: single variable function as key**

fruits = [‘banana’, ‘apple’, ’lemon’, ’kiwi’, ’pineapple’]
b = sorted(fruits)
b: [‘apple’, ‘banana’, ‘kiwi’, ‘lemon’, ‘pineapple’]
c = min(fruits)
c: ‘apple’
d = max(fruits)
d: ‘pineapple’

Syntax and Semantics of Lambda (2)

fruits = [‘banana’, ‘apple’, ’lemon’, ’kiwi’, ’pineapple’]

e = min(fruits, key=lambda f: len(f))

g = max(fruits, key=lambda z: z.count(‘e’))

h = sortedfruits, key=lambda z: z.count(‘e’))

Syntax and Semantics of Lambda (2)

fruits = [‘banana’, ‘apple’, ’lemon’, ’kiwi’, ’pineapple’]

e = min(fruits, key=lambda f: len(f))

e: ‘kiwi’

g = max(fruits, key=lambda z: z.count(‘e’))

g: ‘pineapple’

h = sorted(fruits, key=lambda z: z.count(‘e’))

h: [‘banana’, ‘kiwi’, ‘apple’, ‘lemon’, ‘pineapple’]

Review: CSV and Sort for top artists

- **Using two-sorts to get top artists**

```
31      print('\nTop 5 artists:')
32      sortbycount = sorted([(a[1], a[0]) for a in counts.items()])
33      sortedArtists = [(a[1], a[0]) for a in sortbycount]
34      for artist in sortedArtists[-5:]:
35          print(artist)
```

- **Reverse tuples to sort**
- **Reverse tuples to print**

```
Top 5 artists:
('John, Elton', 21)
('Who', 24)
('Rolling Stones', 36)
('Led Zeppelin', 38)
('Beatles', 51)
```

Top 5 Artists

- **Instead of intermediary list, use `lambda`**
- **Instead of `[-5:]`, use `reverse=True`**

```
31      print('\nTop 5 artists:')
32      sortbycount = sorted([(a[1], a[0]) for a in counts.items()])
33      sortedArtists = [(a[1], a[0]) for a in sortbycount]
34      for artist in sortedArtists[-5:]:
35          print(artist)
36
37      print("repeat it")
38      sortedArtists = sorted(counts.items(), key=lambda item: item[1], reverse=True)
39      for tup in sortedArtists[:5]:
40          print(tup)
```

```
repeat it
('Beatles', 51)
('Led Zeppelin', 38)
('Rolling Stones', 36)
('Who', 24)
('Eagles', 21)
```

Top 5 Artists

- **Instead of intermediary list, use `lambda`**
- **Instead of `[-5:]`, use `reverse=True`**

```
31      print('\nTop 5 artists:')
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38      sortedArtists = sorted(counts.items(), key=lambda item: item[1], reverse=True)
39      for tup in sortedArtists[:5]:
40          print(tup)
```
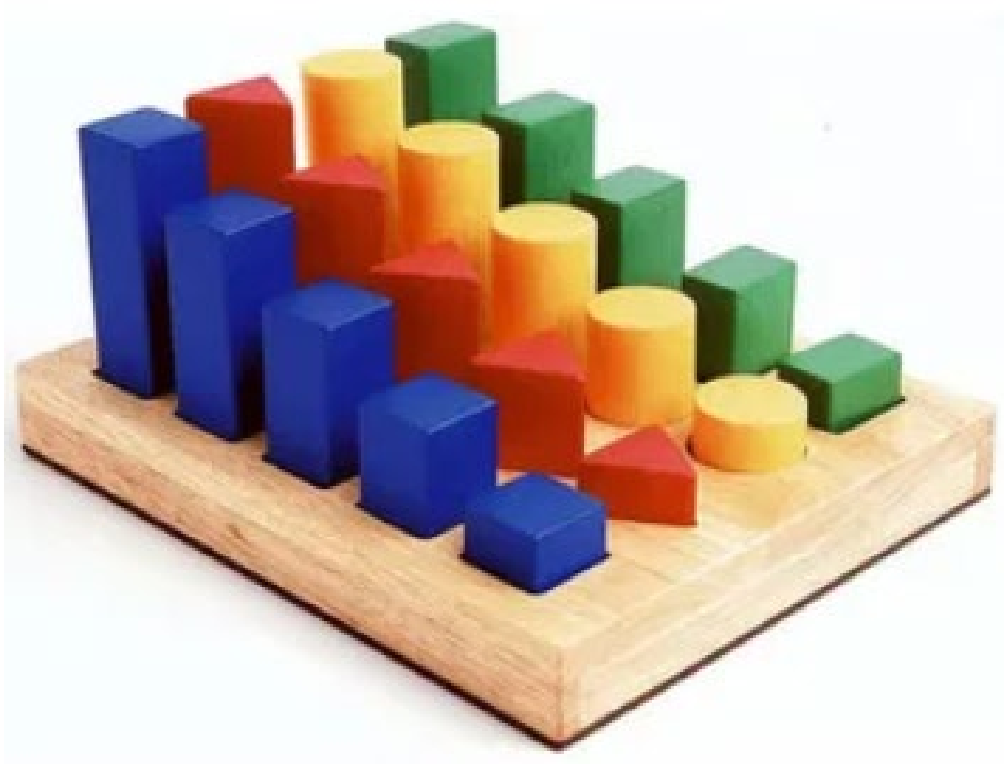

Output slightly different. Why?

```
repeat it
('Beatles', 51)
('Led Zeppelin', 38)
('Rolling Stones', 36)
('Who', 24)
('Eagles', 21)
```

WOTO-2 Sorting
http://bit.ly/101s23-0404-2



That last question on the WOTO

- **We haven't seen that yet!!!!!!!!**
- **The tuple indicates how to sort and how to break ties.**
- **See code**

What is happening?

```
f = open('twain.txt')
lines = [l.strip() for l in f]
s = sorted(lines, key=lambda line: (len(line), line))
```

Sorting this

Using this criteria to sort

Using this criteria to break ties alphabetically

How is the sorting happening?

```
>>> d
{'a': [1, 2, 3], 'b': [4, 7], 'c': [1, 1, 5, 8]}
>>> sorted(d.items())

>>> sorted(d.items(), key=lambda x: x[1])

>>> sorted(d.items(), key=lambda x: x[1][-1])
```

How is the sorting happening?

```
>>> d
{'a': [1, 2, 3], 'b': [4, 7], 'c': [1, 1, 5, 8]}
>>> sorted(d.items())
[('a', [1, 2, 3]), ('b', [4, 7]), ('c', [1, 1, 5, 8])]
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```

How is the sorting happening?

```
>>> d
{'a': [1, 2, 3], 'b': [4, 7], 'c': [1, 1, 5, 8]}
>>> sorted(d.items())
[('a', [1, 2, 3]), ('b', [4, 7]), ('c', [1, 1, 5, 8])]
>>> sorted(d.items(), key=lambda x: x[1])
[('c', [1, 1, 5, 8]), ('a', [1, 2, 3]), ('b', [4, 7])]
>>> sorted(d.items(), key=lambda x: x[1][-1])
```

How is the sorting happening?

```
>>> d
{'a': [1, 2, 3], 'b': [4, 7], 'c': [1, 1, 5, 8]}
>>> sorted(d.items())
[('a', [1, 2, 3]), ('b', [4, 7]), ('c', [1, 1, 5, 8])]
>>> sorted(d.items(), key=lambda x: x[1])
[('c', [1, 1, 5, 8]), ('a', [1, 2, 3]), ('b', [4, 7])]
>>> sorted(d.items(), key=lambda x: x[1][-1])
[('a', [1, 2, 3]), ('b', [4, 7]), ('c', [1, 1, 5, 8])]
```

How to do some “fancy” sorting

- **lambda PARAMETER : EXPRESSION**

- **Given data: list of tuples: (first name, last name, age)**

```
[(‘Percival’, ‘Avram’,  51),
 (‘Melete’,   ‘Sandip’, 24), …]
```

- **What does this do?**
- **sorted(data, key=lambda z : (z[0],z[1],z[2]))**

- **What is the lambda key to sort the following?**
  - Sort by last name, break ties with first name
  - Sort by last name, break ties with age
  - Alphabetical by last name, then first name, then reverse age order

How to do some “fancy” sorting

- **lambda PARAMETER : EXPRESSION**

- **Given data: list of tuples: (first name, last name, age)**

```
[('Percival', 'Avram',  51),
 ('Melete',   'Sandip', 24), …]
```

- **What does this do?**
- **sorted(data, key=lambda z : (z[0],z[1],z[2]))**
  - **Sorts by first name, break ties with last name, break further ties with age**

- **What is the lambda key to sort the following?**
  - Sort by last name, break ties with first name
  - Sort by last name, break ties with age
  - Alphabetical by last name, then first name, then reverse age order

Creating Tuples with lambda

- **Sort by last name, break ties with first name**
- **Sort by last name, break ties with age**
- **Alphabetical by last name, then first name, then reverse age order**

Creating Tuples with lambda

- **Sort by last name, break ties with first name**
  - key = lambda x: (x[1], x[0])
- **Sort by last name, break ties with age**
  - key = lambda x: (x[1], x[2])
- **Alphabetical by last name, then first name, then reverse age order**
  - key = lambda x: (x[1], x[0], -x[2])

Minus "-" means reverse, can only use with numbers

- **What if wanted something really different?**
  - Sort alphabetical by last name, break ties by reverse alphabetical using first name

Can't use "minus" with strings

Leveraging the Algorithm

- **Can’t sort by creating a tuple with lambda, use:**
  - Pattern: Multiple-pass ***stable*** sort – first sort with last tie breaker, then next to last tie breaker, etc. until at main criteria

- **Sort by index 0, break tie in reverse order with index 1**

```
[(‘b’, ‘z’), (‘c’, ‘x’), (‘b’, ‘x’), (‘a’, ‘z’)]
```

- ***Stable*** **sort respects original order of "equal" keys**

Leveraging the Algorithm

- **Can't sort by creating a tuple with lambda, use:**
  - Pattern: Multiple-pass ***stable*** sort – first sort with last tie breaker, then next to last tie breaker, etc. until at main criteria

- **Sort by index 0, break tie in reverse order with index 1**

```
[('b', 'z'), ('c', 'x'), ('b', 'x'), ('a', 'z')]
[('b', 'z'), ('a', 'z'), ('c', 'x'), ('b', 'x')]
```

- ***Stable*** **sort respects original order of "equal" keys**

Leveraging the Algorithm

- **Can't sort by creating a tuple with lambda, use:**
  - Pattern: Multiple-pass ***stable*** sort – first sort with last tie breaker, then next to last tie breaker, etc. until at main criteria

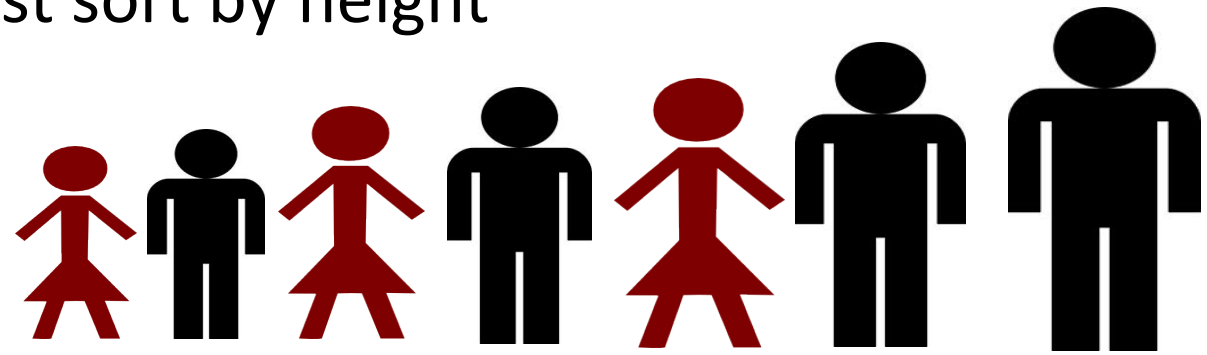
- **Sort by index 0, break tie in reverse order with index 1**

```
[('b', 'z'), ('c', 'x'), ('b', 'x'), ('a', 'z')]
[('b', 'z'), ('a', 'z'), ('c', 'x'), ('b', 'x')]
[('a', 'z'), ('b', 'z'), ('b', 'x'), ('c', 'x')]
```

- ***Stable*** **sort respects original order of "equal" keys**

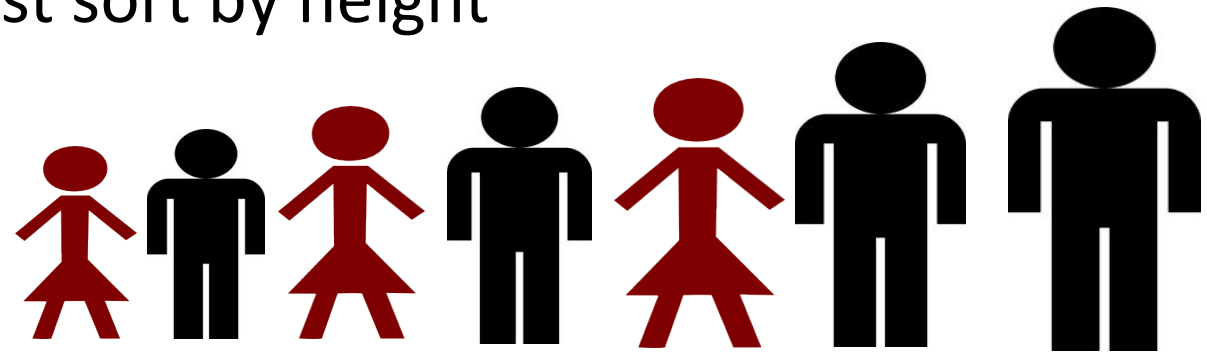
Stable sorting: respect "equal" items

- **Women before men, each group height-sorted**
  - First sort by height

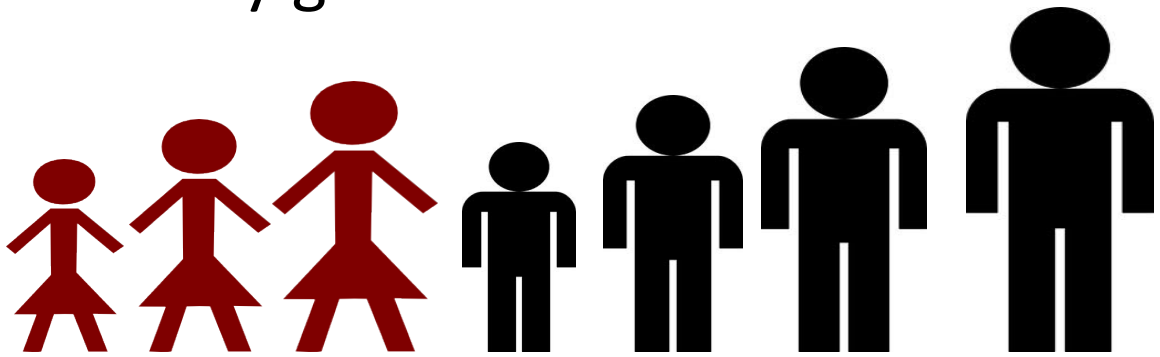


Stable sorting: respect "equal" items

- **Women before men, each group height-sorted**
  - First sort by height



  - Then sort by gender



Understanding Multiple-Pass Sorting

```
> data
[('f', 2, 0), ('e', 1, 4), ('a', 2, 0),
 ('c', 2, 5), ('b', 3, 0), ('d', 2, 4)]
> a0 = sorted(data, key = lambda x: x[0])
> a0
```

```
> a1 = sorted(a0, key = lambda x: x[2])
> a1
```

```
> a2 = sorted(a1, key = lambda x: x[1])
> a2
```

Understanding Multiple-Pass Sorting

```
> data
[('f', 2, 0), ('e', 1, 4), ('a', 2, 0),
 ('c', 2, 5), ('b', 3, 0), ('d', 2, 4)]
> a0 = sorted(data, key = lambda x: x[0])
> a0
[('a', 2, 0), ('b', 3, 0), ('c', 2, 5),
 ('d', 2, 4), ('e', 1, 4), ('f', 2, 0)]
> a1 = sorted(a0, key = lambda x: x[2])
> a1


> a2 = sorted(a1, key = lambda x: x[1])
> a2
```

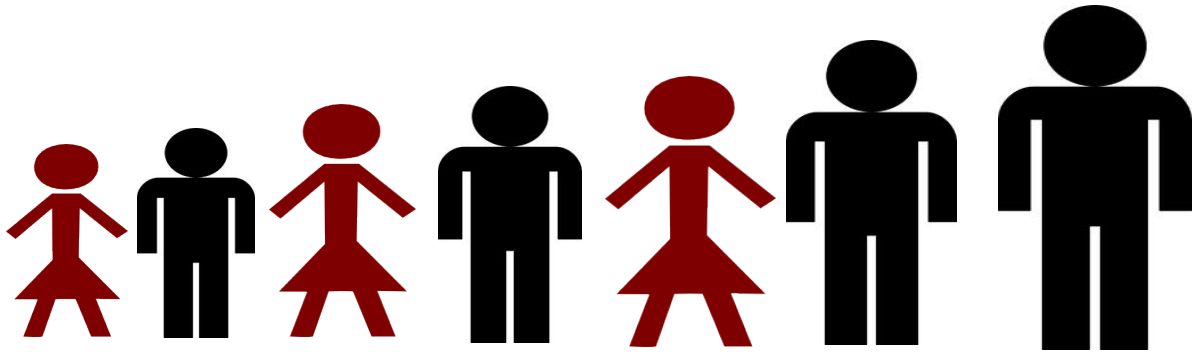
Understanding Multiple-Pass Sorting

```
> data
[('f', 2, 0), ('e', 1, 4), ('a', 2, 0),
 ('c', 2, 5), ('b', 3, 0), ('d', 2, 4)]
> a0 = sorted(data, key = lambda x: x[0])
> a0
[('a', 2, 0), ('b', 3, 0), ('c', 2, 5),
 ('d', 2, 4), ('e', 1, 4), ('f', 2, 0)]
> a1 = sorted(a0, key = lambda x: x[2])
> a1
[('a', 2, 0), ('b', 3, 0), ('f', 2, 0),
 ('d', 2, 4), ('e', 1, 4), ('c', 2, 5)]
> a2 = sorted(a1, key = lambda x: x[1])
> a2
```

Understanding Multiple-Pass Sorting

```
> data
[('f', 2, 0), ('e', 1, 4), ('a', 2, 0),
 ('c', 2, 5), ('b', 3, 0), ('d', 2, 4)]
> a0 = sorted(data, key = lambda x: x[0])
> a0
[('a', 2, 0), ('b', 3, 0), ('c', 2, 5),
 ('d', 2, 4), ('e', 1, 4), ('f', 2, 0)]
> a1 = sorted(a0, key = lambda x: x[2])
> a1
[('a', 2, 0), ('b', 3, 0), ('f', 2, 0),
 ('d', 2, 4), ('e', 1, 4), ('c', 2, 5)]
> a2 = sorted(a1, key = lambda x: x[1])
> a2
[('e', 1, 4), ('a', 2, 0), ('f', 2, 0),
 ('d', 2, 4), ('c', 2, 5), ('b', 3, 0)]
```

WOTO-3 Multipass Sorting
http://bit.ly/101s23-0404-3



WOTO-3 Q1: Unpack from Inside out

```
sorted(sorted(sorted(lst,key=sum),key=min),key=max)
```

lst = [[4, 6, 7], [5, 2], [3, 9], [6, 2, 9]

x = sorted(lst, key=sum)

y = sorted(x, key = min)

z = sorted(y, key=max)

WOTO-3 Q1: Unpack from Inside out

```
sorted(sorted(sorted(lst,key=sum),key=min),key=max)
```

lst = [[4, 6, 7], [5, 2], [3, 9], [6, 2, 9]

x = sorted(lst, key=sum)

x: [[5, 2], [3, 9], [4, 6, 7], [6, 2, 9]]

y = sorted(x, key = min)

y: [[5, 2], [6, 2, 9], [3, 9] , [4, 6, 7]]

z = sorted(y, key=max)

z: [[5, 2], [4, 6, 7], [6, 2, 9], [3, 9]]

Answer

WOTO-3 Q2

- **A dog show needs to order how they will give the awards. The data is a list of tuples. The tuples are (category, breed, score). What is the sort order in Python if using stable sorting (1) all dogs in the same category go together, (2) within a category dogs are ordered by breed, (3) within a breed dogs are ordered by score where the highest score goes first?**
- **If you do multiple-pass sorting use: score, breed, category**
- **If you do it in one line with lambda use: category, breed, score with -**