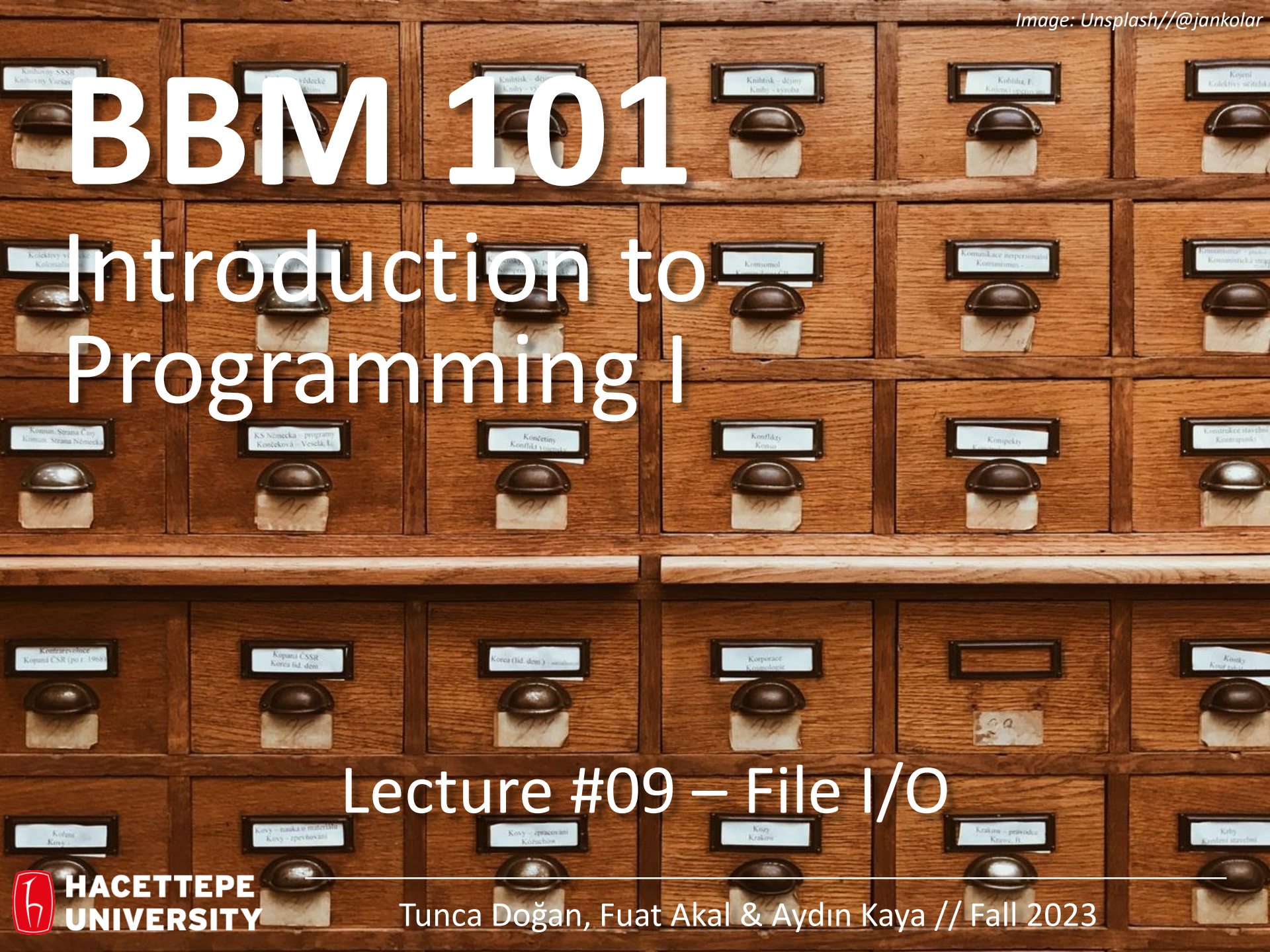


Image: Unsplash//@jankolar

BBM 101

Introduction to Programming I

Lecture #09 – File I/O

HACETTEPE UNIVERSITY

Tunca Doğan, Fuat Akal & Aydın Kaya // Fall 2023

Last time… **Tuples, Sets, and Dictionaries**

Tuples

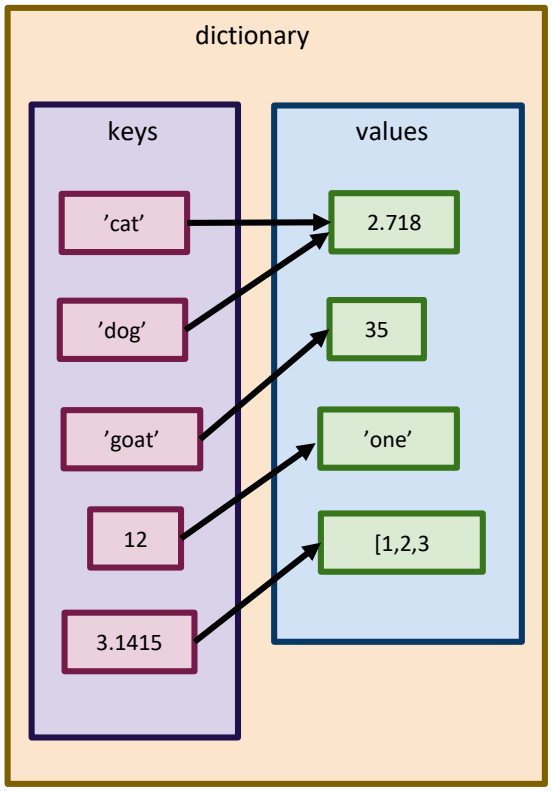
```
t1 = ()
t2 = (1, 'two', 3)
print(t1)
print(t2)

>> ()
>> (1, 'two', 3)
```

Sets

```
odd = set([1, 3, 5])
prime = set([2, 3, 5])
empty = set([])
```

Dictionaries



Lecture Overview

- File I/O
  - Basics of Files
  - File Access Modes
    - Sequential Access
    - Random Access

Disclaimer: Much of the material and slides for this lecture were borrowed from
—Ruth Anderson, Michael Ernst and Bill Howe's University of Washington CSE 140 class,
—Ana Bell, Eric Grimson, John Guttag's MIT 6.0001 class
—Keith Levin's University of Michigan STATS 507 class

Lecture Overview

- File I/O
  - Basics of Files
  - File Access Modes
    - Sequential Access
    - Random Access

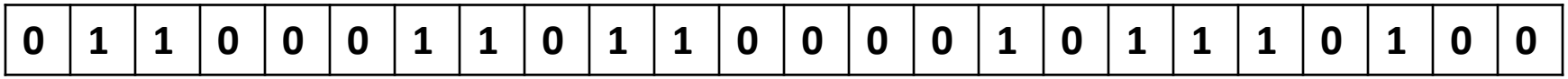
Persistent Data

- So far, we only know how to write “transient” programs
  - Data disappears once the program stops running
- Files allow for persistence
  - Work done by a program can be saved to disk... ...and picked up again later for other uses.
- Examples of persistent programs:
  - Operating systems
  - Databases
  - Servers

Key idea: Program information is stored permanently (e.g., on a hard drive), so that we can start and stop programs without losing **state** of the program (values of variables, where we are in execution, etc).

Reading and Writing Files

Underlyingly, every file on your computer is just a string of bits…



...which are broken up into (for example) bytes...

...groups of which correspond (in the case of text) to characters.

Files and Filenames

- A file object represents data on your disk drive
  - Can read from it and write to it
- A filename (usually a string) states where to find the data on your disk drive
  - Can be used to find/create a file
- Each operating system comes with its own file system for creating and accessing files:
  - Linux/Mac: "/home/rea/bbm101/lectures/file_io.pptx"
  - Windows: "C:\Users\rea\MyDocuments\cute_dog.jpg"

Two Types of Filenames

- An Absolute filename gives a specific location on disk:
  "/home/rea/bbm101/14wi/lectures/file_io.pptx" or
  "C:\Users\rea\MyDocuments\homework3\images\Husky.png"
  - Starts with "/" (Unix) or "C:\" (Windows)
  - Warning: code will fail to find the file if you move/rename files or run your program on a different computer
- A Relative filename gives a location relative to the *current working directory*:
  "lectures/file_io.pptx" or "images\Husky.png"
  - Warning: code will fail to find the file unless you run your program from a directory that contains the given contents
- *A relative filename is usually a better choice*

Examples

Linux/Mac: These *could* all refer to the same file:

"/home/rea/class/140/homework3/images/Husky.png"

"homework3/images/Husky.png"

"images/Husky.png"

"Husky.png"

Windows: These *could* all refer to the same file:

"C:\Users\rea\My Documents\class\140\homework3\images\Husky.png"

"homework3\images\Husky.png"

"images\Husky.png"

"Husky.png"

Depending on what your current working directory is

$ pwd -> print working directory

Locating files: the os module

```
>>> import os
>>> cwd = os.getcwd()
>>> cwd
'/Users/r2d2/'

>>> os.listdir()
['death_star_plans', 'princess_leia']

>>> os.listdir('princess_leia')
['Obi-Wan.txt', 'Anakin.txt']

>>> os.chdir('princess_leia')
>>> cwd
'/Users/r2d2/princess_leia'
```

Locating files: the os module

os module lets us interact with the operating system.
https://docs.python.org/3.6/library/os.html

```
>>> import os
>>> cwd = os.getcwd()
>>> cwd
'/Users/r2d2/'

>>> os.listdir()
['death_star_plans', 'princess_leia']

>>> os.listdir('princess_leia')
['Obi-Wan.txt', 'Anakin.txt']

>>> os.chdir('princess_leia')
>>> cwd
'/Users/r2d2/princess_leia'
```

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['Obi-Wan.txt', 'Anakin.txt']

>>> os.chdir('princess_leia')
>>> cwd
'/Users/r2d2/princess_leia'
```

os module lets us interact with the operating system.
https://docs.python.org/3.6/library/os.html

os.getcwd() returns a string corresponding to the **current working directory.**

Locating files: the os module

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>>> import os
>>> cwd = os.getcwd()
>>> cwd
'/Users/r2d2/'

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['death_star_plans', 'princess_leia']

>>> os.listdir('princess_leia')
['Obi-Wan.txt', 'Anakin.txt']

>>> os.chdir('princess_leia')
>>> cwd
'/Users/r2d2/princess_leia'
```

os module lets us interact with the operating system.
https://docs.python.org/3.6/library/os.html

os.getcwd() returns a string corresponding to the **current working directory.**

os.listdir() lists the contents of its argument, or the current directory if no argument.

Locating files: the os module

```
>>> import os
>>> cwd = os.getcwd()
>>> cwd
'/Users/r2d2/'

>>> os.listdir()
['death_star_plans', 'princess_leia']

>>> os.listdir('princess_leia')
['Obi-Wan.txt', 'Anakin.txt']

>>> os.chdir('princess_leia')
>>> cwd
'/Users/r2d2/princess_leia'
```

os module lets us interact with the operating system.
https://docs.python.org/3.6/library/os.html

os.getcwd() returns a string corresponding to the **current working directory.**

os.listdir() lists the contents of its argument, or the current directory if no argument.

os.chdir() changes the working directory. After calling chdir(), we're in a different cwd.

Locating files: the os module

```
>>> import os
>>> cwd = os.getcwd()
>>> cwd
'/Users/r2d2/'

>>> os.listdir()
['death_star_plans', 'princess_leia']

>>> os.listdir('princess_leia')
['c3po', 'Obi-Wan.txt', 'Anakin.txt']

>>> os.path.abspath('princess_leia/Obi-Wan.txt')
'/Users/r2d2/princess_leia/Obi-Wan.txt'
```

Locating files: the os module

```
>>> import os
>>> cwd = os.getcwd()
>>> cwd
'/Users/r2d2/'

>>> os.listdir()
['death_star_plans', 'princess_leia']

>>> os.listdir('princess_leia')
['c3po', 'Obi-Wan.txt', 'Anakin.txt']

>>> os.path.abspath('princess_leia/Obi-Wan.txt')
'/Users/r2d2/princess_leia/Obi-Wan.txt'
```

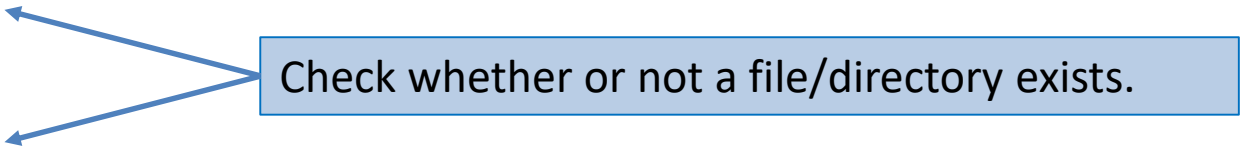
Use os.path.abspath to get the absolute path to a file or directory.

Locating files: the os module

```
>>> import os
>>> os.chdir('/Users/r2d2')
>>> os.listdir('princess_leia')
['c3po', 'Obi-Wan.txt', 'Anakin.txt']

>>> os.path.exists('princess_leia/Anakin.txt')
True

>>> os.path.exists('princess_leia/JarJarBinks.txt')
False

>>> os.path.isdir('princess_leia/c3po')
True

>>> os.path.isdir('princess_leia/Obi-Wan.txt')
False
```

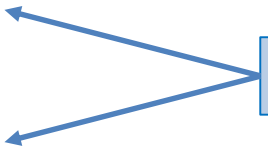
Locating files: the os module

```
>>> import os
>>> os.chdir('/Users/r2d2')
>>> os.listdir('princess_leia')
['c3po', 'Obi-Wan.txt', 'Anakin.txt']

>>> os.path.exists('princess_leia/Anakin.txt')
True

>>> os.path.exists('princess_leia/JarJarBinks.txt')
False

>>> os.path.isdir('princess_leia/c3po')
True

>>> os.path.isdir('princess_leia/Obi-Wan.txt')
False
```

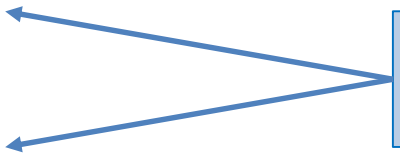


Locating files: the os module

```
>>> import os
>>> os.chdir('/Users/r2d2')
>>> os.listdir('princess_leia')
['c3po', 'Obi-Wan.txt', 'Anakin.txt']

>>> os.path.exists('princess_leia/Anakin.txt')
True

>>> os.path.exists('princess_leia/JarJarBinks.txt')
False

>>> os.path.isdir('princess_leia/c3po')
True

>>> os.path.isdir('princess_leia/Obi-Wan.txt')
False
```



Check whether or not a file/directory exists.



Check whether or not this is a directory.
os.path.isfile() works analogously

Lecture Overview

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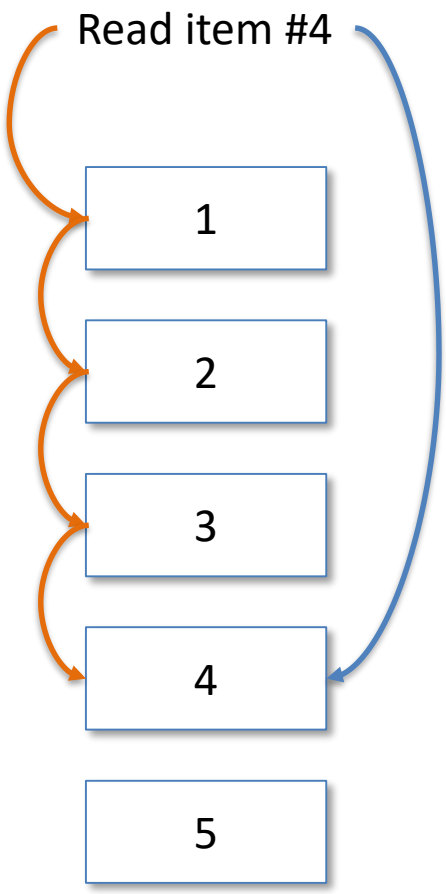
    - Random Access

Sequential vs. Random Access



Reading/Writing data sequentially

Reading/Writing data directly

Lecture Overview

- File I/O
  - Basics of Files
  - File Access Modes
    - Sequential Access
    - Random Access

Reading files

```
erkut:~/demo$ cat demo.txt
This is a demo file.
It is a text file, containing three lines of text.
Here is the third line.
erkut:~/demo$
```

```
>>> f = open('demo.txt')
>>> type(f)
<type 'file'>

>>> f.readline()
'This is a demo file.\n'
```

Reading files

This is the command line. We'll see lots more about this later, but for now, it suffices to know that the command cat prints the contents of a file to the screen.

```
erkut:~/demo$ cat demo.txt
This is a demo file.
It is a text file, containing three lines of text.
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erkut:~/demo$
```

```
>>> f = open('demo.txt')
>>> type(f)
<type 'file'>

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Reading files

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```
erkut:~/demo$ cat demo.txt
This is a demo file.
It is a text file, containing three lines of text.
Here is the third line.
erkut:~/demo$
```

```
>>> f = open('demo.txt')
>>> type(f)
<type 'file'>
```

Open the file demo.txt. This creates a file object f
https://docs.python.org/3/glossary.html#term-file-object

```
>>> f.readline()
'This is a demo file.\n'
```

Reading files

```
erkut:~/demo$ cat demo.txt
This is a demo file.
It is a text file, containing three lines of text.
Here is the third line.
erkut:~/demo$
```

This is the command line. We'll see lots more about this later, but for now, it suffices to know that the command cat prints the contents of a file to the screen.

```
>>> f = open('demo.txt')
>>> type(f)
<type 'file'>
```

Open the file demo.txt. This creates a file object f
https://docs.python.org/3/glossary.html#term-file-object

```
>>> f.readline()
'This is a demo file.\n'
```

Provides a method for reading a single line from the file. The string '\n' is a **special character** that represents a new line. More on this soon.

Reading files

```
erkut:~/demo$ cat demo.txt
This is a demo file.
It is a text file, containing three lines of text.
Here is the third line.
erkut:~/demo$
```

```
>>> f = open('demo.txt')
>>> f.readline()
'This is a demo file.\n'

>>> f.readline()
'It is a text file, containing three lines of text.\n'

>>> f.readline()
'Here is the third line.\n'

>>> f.readline()
```

Reading files

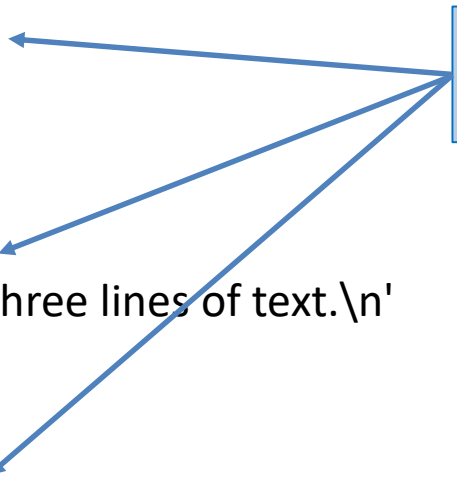
```
erkut:~/demo$ cat demo.txt
This is a demo file.
It is a text file, containing three lines of text.
Here is the third line.
erkut:~/demo$
```

```
>>> f = open('demo.txt')
>>> f.readline()
'This is a demo file.\n'

>>> f.readline()
'It is a text file, containing three lines of text.\n'

>>> f.readline()
'Here is the third line.\n'

>>> f.readline()
```



Each time we call f.readline(),
we get the next line of the file...

Reading files

```
erkut:~/demo$ cat demo.txt
This is a demo file.
It is a text file, containing three lines of text.
Here is the third line.
erkut:~/demo$
```

```
>>> f = open('demo.txt')
>>> f.readline()
'This is a demo file.\n'

>>> f.readline()
'It is a text file, containing three lines of text.\n'

>>> f.readline()
'Here is the third line.\n'

>>> f.readline()
```

Each time we call f.readline(), we get the next line of the file...

...until there are no more lines to read, at which point the readline() method returns the empty string whenever it is called

Reading files

```
>>> f = open('demo.txt')
>>> for line in f:
...     for wd in line.split():
...         print(wd.strip('.,'))
```

```
This
is
a
demo
file
It
is
a
text
file
containing
three
lines
of
text
Here
is
the
third
line
```

Reading files

We can treat f as an iterator, in which each iteration gives us a line of the file.

```
>>> f = open('demo.txt')
>>> for line in f:
...     for wd in line.split():
...         print(wd.strip('.,'))
```

```
This
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Here
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```

We can treat f as an iterator, in which each iteration gives us a line of the file.

Iterate over each word in the line (splitting on '' by default).

Reading files

```
>>> f = open('demo.txt')
>>> for line in f:
...     for wd in line.split():
...         print(wd.strip('.,'))
```

```
This
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```

We can treat f as an iterator, in which each iteration gives us a line of the file.

Iterate over each word in the line (splitting on '' by default).

Remove the trailing punctuation from the words of the file.

Reading files

```
>>> f = open('demo.txt')
>>> for line in f:
...     for wd in line.split():
...         print(wd.strip('.,'))
```

```
This
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```

We can treat f as an iterator, in which each iteration gives us a line of the file.

Iterate over each word in the line (splitting on '' by default).

Remove the trailing punctuation from the words of the file.

open() provides a bunch more (optional) arguments, some of which we'll discuss later.
https://docs.python.org/3/library/functions.html#open

Reading files

```
>>> with open('demo.txt') as f:
...     for line in f:
...         for wd in line.split():
...             print(wd.strip('.,'))
```

```
This
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```

Reading files

```
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...     for line in f:
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```
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Here
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```

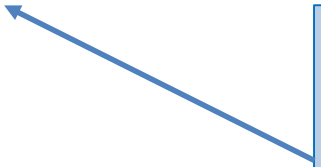

You may often see code written this way, using the with keyword. It suffices to know that this is equivalent to what we did on the previous slide.

Reading files

```
>>> with open('demo.txt') as f:
...     for line in f:
...         for wd in line.split():
...             print(wd.strip('.,'))
This
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Here
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```

You may often see code written this way, using the with keyword. It suffices to know that this is equivalent to what we did on the previous slide.

From the documentation: "It is good practice to use the with keyword when dealing with file objects. The advantage is that the file is properly closed after its suite finishes, even if an exception is raised at some point."
https://docs.python.org/3/reference/compound_stmts.html#with

In plain English: the with keyword does a bunch of error checking and cleanup for you, automatically.

Reading a File Example

```
# Count the number of words in a text file
in_file = "thesis.txt"
myfile = open(in_file)

num_words = 0
for line_of_text in myfile:
    word_list = line_of_text.split()
    num_words += len(word_list)

myfile.close()

print("Total words in file: ", num_words)
```

Reading a File Multiple Times

You can iterate over a list as many times as you like:

```
mylist = [ 3, 1, 4, 1, 5, 9 ]
for elt in mylist:
        process   elt
for elt in mylist:
        process   elt
```

Iterating over a file uses it up:

```
myfile = open("datafile.dat")
for line_of_text in myfile:
        process   line_of_text

for line_of_text in myfile:
        process   line_of_text
```

This loop body will never be executed!

How to read a file multiple times?

Solution 1: Read into a list, then iterate over it

```
myfile = open("datafile.dat")
mylines = []
for line_of_text in myfile:
        mylines.append(line_of_text)
        use   mylines
```

Solution 2: Re-create the file object (slower, but a better choice if the file does not fit in memory)

```
myfile = open("datafile.dat")
for line_of_text in myfile:
        process   line_of_text

myfile = open("datafile.dat")
for line_of_text in myfile:
        process   line_of_text
```

Writing files

```
>>> f = open('animals.txt', 'w')
>>> f.read()

Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
IOError: File not open for reading

>>> f.write('cat\n')
>>> f.write('dog\n')
>>> f.write('bird\n')
>>> f.write('goat\n')
```

Writing files

Open the file in write mode. If the file already exists, this creates it anew, deleting its old contents.

```
>>> f = open('animals.txt', 'w')
>>> f.read()

Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
IOError: File not open for reading

>>> f.write('cat\n')
>>> f.write('dog\n')
>>> f.write('bird\n')
>>> f.write('goat\n')
```

Writing files

Open the file in write mode. If the file already exists, this creates it anew, deleting its old contents.

```
>>> f = open('animals.txt', 'w')
>>> f.read()
```

If I try to read a file in write mode, I get an error.

```
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
IOError: File not open for reading
```

```
>>> f.write('cat\n')
>>> f.write('dog\n')
>>> f.write('bird\n')
>>> f.write('goat\n')
```

Writing files

```
>>> f = open('animals.txt', 'w')
>>> f.read()
```

Open the file in write mode. If the file already exists, this creates it anew, deleting its old contents.

If I try to read a file in write mode, I get an error.

```
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
IOError: File not open for reading
```

```
>>> f.write('cat\n')
>>> f.write('dog\n')
>>> f.write('bird\n')
>>> f.write('goat\n')
```

Write to the file. This method returns the number of characters written to the file. Note that `'\n'` counts as a single character, the new line.

Writing files

```
>>> f = open('animals.txt', 'w')
>>> f.write('cat\n')
>>> f.write('dog\n')
>>> f.write('bird\n')
>>> f.write('goat\n')
>>> f.close()

>>> f = open('animals.txt', 'r')
>>> for line in f:
...     print(line, end=’’)
cat
dog
bird
goat
```

Writing files

Open the file in write mode. This overwrites the version of the file created in the previous slide.

```
>>> f = open('animals.txt', 'w')
>>> f.write('cat\n')
>>> f.write('dog\n')
>>> f.write('bird\n')
>>> f.write('goat\n')
>>> f.close()

>>> f = open('animals.txt', 'r')
>>> for line in f:
...     print(line, end='')
cat
dog
bird
goat
```

Writing files

```
>>> f = open('animals.txt', 'w')
>>> f.write('cat\n')
>>> f.write('dog\n')
>>> f.write('bird\n')
>>> f.write('goat\n')
>>> f.close()

>>> f = open('animals.txt', 'r')
>>> for line in f:
...     print(line, end='')
cat
dog
bird
goat
```

Open the file in write mode. This overwrites the version of the file created in the previous slide.

Each write appends to the end of the file.

Writing files

```
>>> f = open('animals.txt', 'w')
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>>> f.write('dog\n')
>>> f.write('bird\n')
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```

Open the file in write mode. This overwrites the version of the file created in the previous slide.

Each write appends to the end of the file.

When we're done, we close the file. This happens automatically when the program ends, but its good practice to close the file as soon as you're done.

```
>>> f = open('animals.txt', 'r')
>>> for line in f:
...     print(line, end='')
cat
dog
bird
goat
```

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```
>>> f = open('animals.txt', 'r')
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...     print(line, end='')
cat
dog
bird
goat
```

Now, when I open the file for reading, I can print out the lines one by one.

Writing files

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```
>>> f = open('animals.txt', 'r')
>>> for line in f:
...     print(line, end='')
cat
dog
bird
goat
```

Now, when I open the file for reading, I can print out the lines one by one.

The lines of the file already include newlines on the ends, so override Python's default behavior of printing a newline after each line.

More Examples: Create a file

```
nameHandle = open('characters.txt', 'w')
for i in range(2):
    name = input('Enter name: ')
    nameHandle.write(name + '\n')
nameHandle.close()

nameHandle = open('characters.txt', 'r')
for line in nameHandle:
    print(line)
nameHandle.close()
```

- If we had typed in the names Rick and Morty, this will print

  Rick

  Morty

- The extra line between Rick and Morty is there because print starts a new line each time it encounters the '\n' at the end of each line in the file.

More Examples: Overwrite a file

```
nameHandle = open('characters.txt', 'w') nameHandle.write('Jerry\n')
nameHandle.write('Beth\n')
nameHandle.close()

nameHandle = open('characters.txt', 'r')
for line in nameHandle:
    print(line[:-1])
nameHandle.close()
```

- It will print
  Jerry
  Beth

- Notice that
  - we have overwritten the previous contents of the file.
  - print line[:-1] avoids extra newline in the output

More Examples: Append to a file

```
nameHandle = open('characters.txt', 'a') nameHandle.write('Rick\n')
nameHandle.write('Morty\n')
nameHandle.close()

nameHandle = open(characters.txt', 'r')
for line in nameHandle:
    print(line[:-1])
nameHandle.close()
```

- It will print

  Jerry
  Beth
  Rick
  Morty

- Notice that we can open the file for appending (instead of writing) by using the argument 'a'.

Common functions for accessing files

- **open(fn, 'w')** fn is a string representing a file name. Creates a file for writing and returns a file handle.
- **open(fn, 'r')** fn is a string representing a file name. Opens an existing file for reading and returns a file handle.
- **open(fn, 'a')** fn is a string representing a file name. Opens an existing file for appending and returns a file handle.
- **fn.close()** closes the file associated with the file handle fn.

Common functions for accessing files

- **fn.read()** returns a string containing the contents of the file associated with the file handle fn.
- **fn.readline()** returns the next line in the file associated with the file handle fn.
- **fn.readlines()** returns a list each element of which is one line of the file associated with the file handle fn.
- **fn.write(s)** write the string s to the end of the file associated with the file handle fn.
- **fn.writelines(S)** S is a sequence of strings. Writes each element of S to the file associated with the file handle fn.

Formatting Strings

```
>>> x = 23
>>> print(‘x = %d' % x)
x = 23

>>> animal = 'unicorn'
>>> print('My pet %s' % animal)
My pet unicorn

>>> x=2.718; y=1.618
>>> print('%f divided by %f is %f' % (x,y,x/y))
2.718000 divided by 1.618000 is 1.679852

>>> print('%.3f divided by %.3f is %.8f' % (x,y,x/y))
2.718 divided by 1.618 is 1.67985167
```

Formatting Strings

Python provides tools for formatting strings. Example: easier way to print an integer as a string.

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Python provides tools for formatting strings. Example: easier way to print an integer as a string.

%d: integer
%s: string
%f: floating point
More information:
https://docs.python.org/3/library/stdtypes.html#printf-style-string-formatting

Formatting Strings

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Can further control details of formatting, such as number of significant figures in printing floats.

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Python provides tools for formatting strings. Example: easier way to print an integer as a string.

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More information:
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Can further control details of formatting, such as number of significant figures in printing floats.

Newer features for similar functionality:
https://docs.python.org/3/reference/lexical_analysis.html#f-strings
https://docs.python.org/3/library/stdtypes.html#str.format

Formatting Strings

Note: Number of formatting arguments must match the length of the supplied tuple!

```
>>> x=2.718; y=1.618
>>> print('%f divided by %f is %f' % (x,y,x/y,1.0))
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError:not all arguments converted during string formatting


>>> x=2.718; y=1.618
>>> print('%f divided by %f is %f' % (x,y))
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: not enough arguments for format string
```

Formatted Output to a File

```
f = open("students.txt", 'w')
f.write("+--------------+--------------+----------+\n")
f.write("|First Name     |Last Name      |       GPA|\n")
f.write("+--------------+--------------+----------+\n")
f.write("|%-15s|%-15s|%10.2f|\n"%("Fuat", "Akal", 2.75))
f.write("|%-15s|%-15s|%10.2f|\n"%("Erkut", "Erdem", 3.90))
f.write("+--------------+--------------+----------+\n")
f.close()

r = open("students.txt", 'r')

for l in r:
    print(l[:-1])
```

```
+--------------+--------------+----------+
|First Name     |Last Name      |       GPA|
+--------------+--------------+----------+
|Fuat           |Akal           |      2.75|
|Erkut          |Erdem          |      3.90|
+--------------+--------------+----------+
```

```
$ ls
students.txt
$ more students.txt
+--------------+--------------+----------+
|First Name     |Last Name      |       GPA|
+--------------+--------------+----------+
|Fuat           |Akal           |      2.75|
|Erkut          |Erdem          |      3.90|
+--------------+--------------+----------+
$
```

Writing/Reading Binary

```
poem = "Yerin seni çektiği kadar ağırsın\nKanatların çırpındığı kadar hafif\nKalbinin attığı kadar canlısın\nGözlerinin uzağı gördüğü kadar genç"

binary_poem = bytes(poem, encoding="utf-8")

f = open("binary_poem", "wb")
f.write(binary_poem)
f.close()
```

```
$ ls
binary_poem     students.txt
$ more binary_poem
"binary_poem" may be a binary file.  See it anyway?
```

```
f = open("binary_poem", "rb")
data = f.read() # read whole file
print(data)
f.close()
```

b'Yerin seni \xc3\xa7ekti\xc4\x9fi kadar
a\xc4\x9f\xc4\xb1rs\xc4\xb1n\nKanatlar\xc4\xb1n
\xc3\xa7\xc4\xb1rp\xc4\xb1nd\xc4\xb1\xc4\x9f\xc4\xb1 kadar
hafif\nKalbinin att\xc4\xb1\xc4\x9f\xc4\xb1 kadar
canl\xc4\xb1s\xc4\xb1n\nG\xc3\xb6zlerinin uza\xc4\x9f\xc4\xb1
g\xc3\xb6rd\xc3\xbc\xc4\x9f\xc3\xbc kadar gen\xc3\xa7'

```
f = open("binary_poem", "rb")
chunk = 20 # read as chunks
while True:
   data = f.read(chunk)
   if not data:
      break
   print(data)
f.close()
```

b'Yerin seni \xc3\xa7ekti\xc4\x9fi'
b' kadar a\xc4\x9f\xc4\xb1rs\xc4\xb1n\nKa'
b'natlar\xc4\xb1n \xc3\xa7\xc4\xb1rp\xc4\xb1nd'
b'\xc4\xb1\xc4\x9f\xc4\xb1 kadar hafif\nK'
b'albinin att\xc4\xb1\xc4\x9f\xc4\xb1 ka'
b'dar canl\xc4\xb1s\xc4\xb1n\nG\xc3\xb6zl'
b'erinin uza\xc4\x9f\xc4\xb1 g\xc3\xb6rd'
b'\xc3\xbc\xc4\x9f\xc3\xbc kadar gen\xc3\xa7'

Lecture Overview

- File I/O
  - Basics of Files
  - File Access Modes
    - Sequential Access
    - Random Access

seek() and tell() Functions

- So far we have read and written files sequentially.
- It is also possible to read and write at specific locations in a file.
- To achieve this the file object provides following two methods:

fileObject.seek(offset[, whence]) : Sets the file's current position.

> **offset** − This is the position of the read/write pointer within the file.
> **whence** − This is optional and defaults to 0 which means absolute file positioning, other values are 1 which means seek relative to the current position and 2 means seek relative to the file's end.

fileObject.tell() : Returns an integer giving the file object's current position in the file represented as number of bytes from the beginning of the file when in binary mode and an opaque number when in text mode.

Random Access: Example

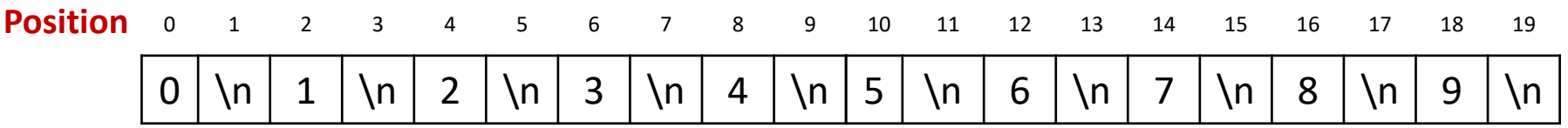
```
f = open("digits.txt", "w")
f.write("0\n1\n2\n3\n4\n5\n6\n7\n8\n9\n")
f.close()
```

```
f = open("digits.txt", "r")
print(f.read())
f.close()
```

This is how it looks when printed.

```
0
1
2
3
4
5
6
7
8
9
```

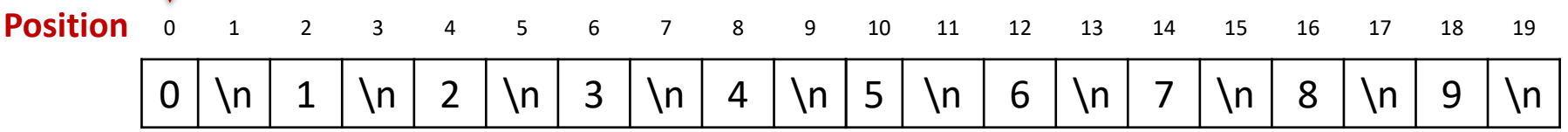
This is how it looks on the file.



Random Access: Example (cont'd)

The first byte is positioned when the file is opened.

```
f = open("digits.txt", "r")
l = f.readline()
print(f.tell())

f.seek(10)
print(f.readline())
print(f.tell())
f.close()

f = open("digits.txt", "r+")
f.seek(10)
f.write("*")
print(f.tell())

f.seek(10)
print(f.readline())
f.close()
```



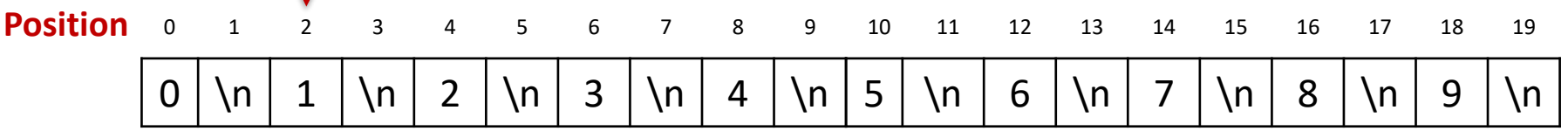
Random Access: Example (cont'd)

```
f = open("digits.txt", "r")
l = f.readline()
print(f.tell())

f.seek(10)
print(f.readline())
print(f.tell())
f.close()

f = open("digits.txt", "r+")
f.seek(10)
f.write("*")
print(f.tell())

f.seek(10)
print(f.readline())
f.close()
```

2

First line is read (new line character is included).

File is positioned at line #2.

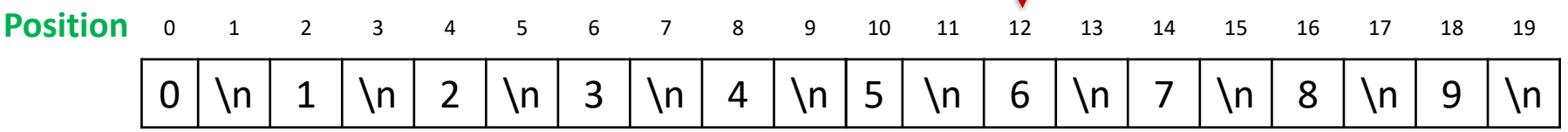


Random Access: Example (cont'd)

File is positioned at line #5, and then read.

File is positioned at line #6.

```
f = open("digits.txt", "r")
l = f.readline()
print(f.tell())                    2

f.seek(10)
print(f.readline())                5
print(f.tell())                    12
f.close()

f = open("digits.txt", "r+")
f.seek(10)
f.write("*")
print(f.tell())

f.seek(10)
print(f.readline())
f.close()
```

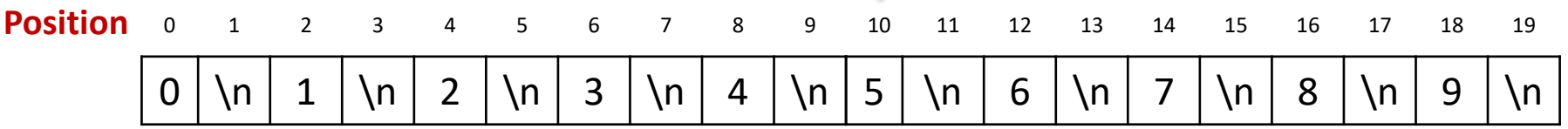


Random Access: Example (cont'd)

```
f = open("digits.txt", "r")
l = f.readline()
print(f.tell())                2

f.seek(10)
print(f.readline())            5
print(f.tell())                12
f.close()

f = open("digits.txt", "r+")
f.seek(10)
f.write("*")
print(f.tell())

f.seek(10)
print(f.readline())
f.close()
```

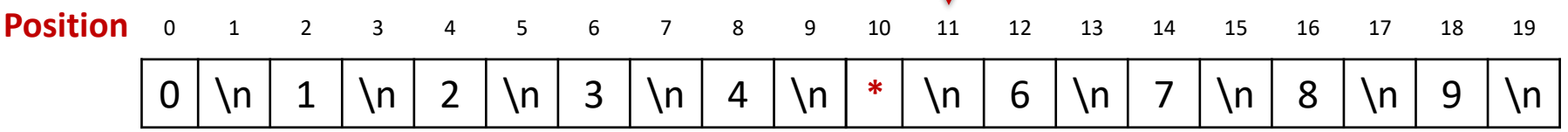
File is positioned at line #5 again.

File is positioned at line #6.



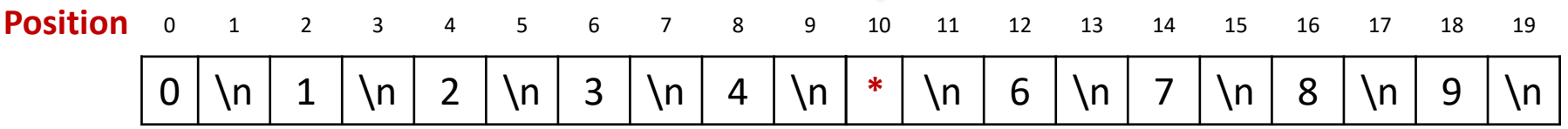
Random Access: Example (cont'd)

```
f = open("digits.txt", "r")
l = f.readline()
print(f.tell())                    2

f.seek(10)
print(f.readline())                5
print(f.tell())                    12
f.close()

f = open("digits.txt", "r+")
f.seek(10)
f.write("*")
print(f.tell())                    11

f.seek(10)
print(f.readline())
f.close()
```



Random Access: Example (cont'd)

```
f = open("digits.txt", "r")
l = f.readline()
print(f.tell())                    2

f.seek(10)
print(f.readline())                5
print(f.tell())                    12
f.close()

f = open("digits.txt", "r+")
f.seek(10)
f.write("*")
print(f.tell())                    11

f.seek(10)
print(f.readline())                *
f.close()
```



Example: Fixed Length Records

```
record_length = 40      # Length of a student record
search_term = "Erkut"   # student to be looked up in the file

f = open("grades.txt", "w")
f.write("%-15s%-15s%10.2f"%("Fuat", "Akal", 2.75))
f.write("%-15s%-15s%10.2f"%("Erkut", "Erdem", 3.90))
f.write("%-15s%-15s%10.2f"%("Aykut", "Erdem", 3.50))
f.close()
```

Position in the file →

Content of the file →

0 39	40 79	80 119
Fuat Akal 2.75	Erkut Erdem 3.90	Aykut Erdem 3.50

File: grades.txt

```
index = {"Fuat":0, "Erkut":1, "Aykut":2} # index students

f = open("grades.txt", "r")
f.seek(index[search_term] * record_length)
print(f.read(record_length))
f.close()
```

Output:

Erkut Erdem 3.90

Next time… **Testing, debugging, exceptions**

Exceptions


```
try:
        .....
        .....
except:
        .....
finally:
         .....
```

Debugging