Outline

1. Data on Files
   - data compression
   - data as text or bytes
2. File Methods in Python
   - format conversions and text encryption
   - using buffers to count and replace words

MCS 260 Lecture 17
Introduction to Computer Science
Jan Verschelde, 3 July 2023

compression and conversion using buffers

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data compression

Two different data compression schemes:

- lossless: no loss of information in compression,
- lossy: minor errors are tolerated (e.g. images).

Popular compression schemes use dictionary encoding.
For example: replace all `the`'s in a text file by a symbol.

The Lempel-Ziv encoding used in Gzip

- finds duplicated strings in the input data.
- The second occurrence of a string is replaced by a pointer to the previous string.

To create an archive of several files, we use `tar`.
`tar` is an archiving program to store and extract files from an archive, called a *tarfile*. The `t` in `tar` stands for "tape".

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data as text or bytes

Two main ways to open files:

1. Open with an encoding, such as `utf-8`.
   $\Rightarrow$ characters read are strings.
2. Open as a binary file, without encoding.
   $\Rightarrow$ data on the file are bytes:
   - bytes read from file must be decoded, from bytes to strings,
   - strings written to file must be encoded, from strings to bytes.

The distinction between a text and binary file is important:

1. Text files can be processed line by line,
   provided line breaks are present in the text file.
2. Binary files can be processed byte per byte.

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format conversions

Convert the ad hoc formatting of the file books.txt

```
1:1:Computer Science, an overview:
0:2:Python Programming in Context:
```

into one that uses lists

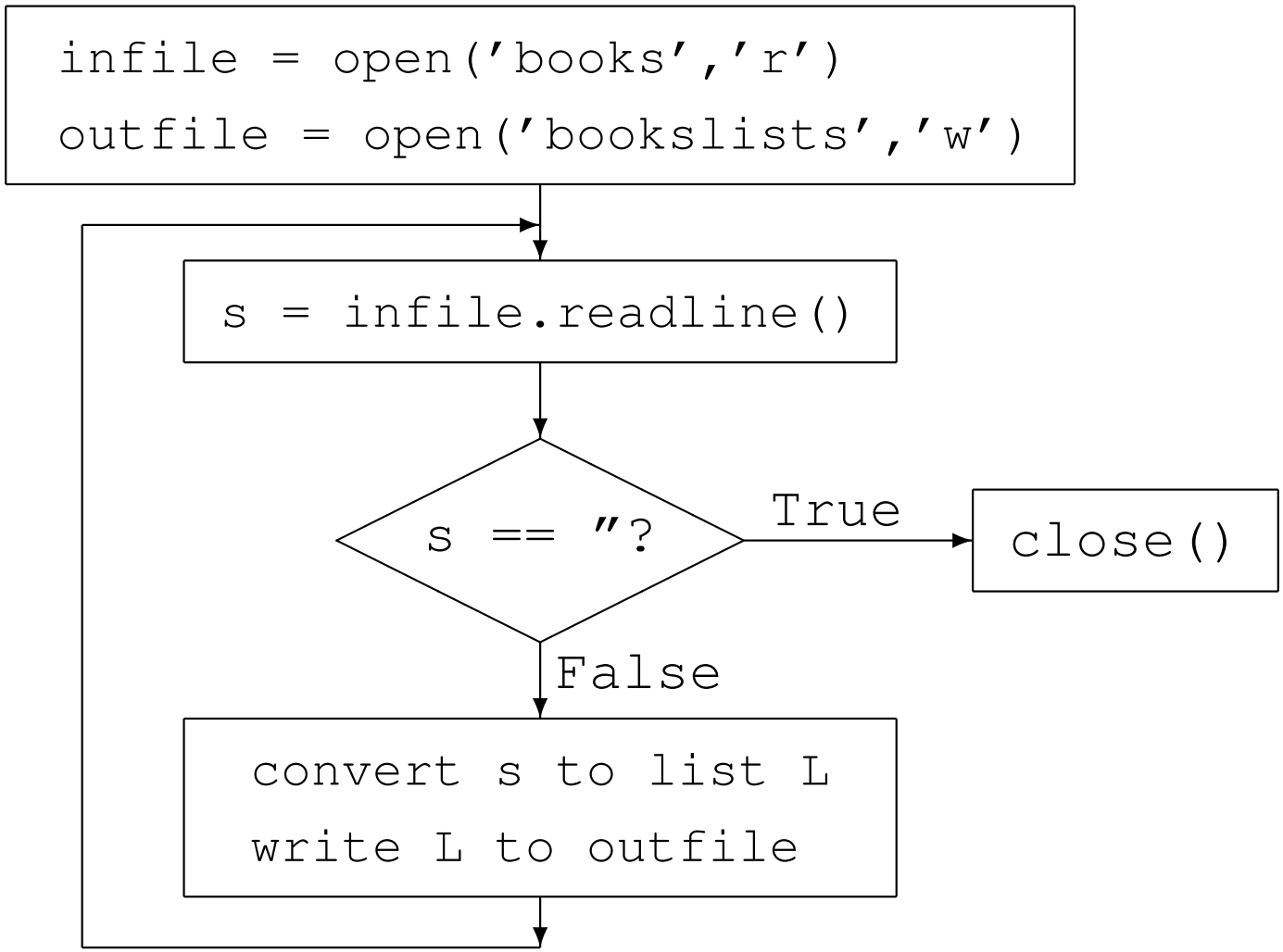
```
[True, 1, 'Computer Science, an overview']
[False, 2, 'Python Programming in Context']
```

and into using dictionaries

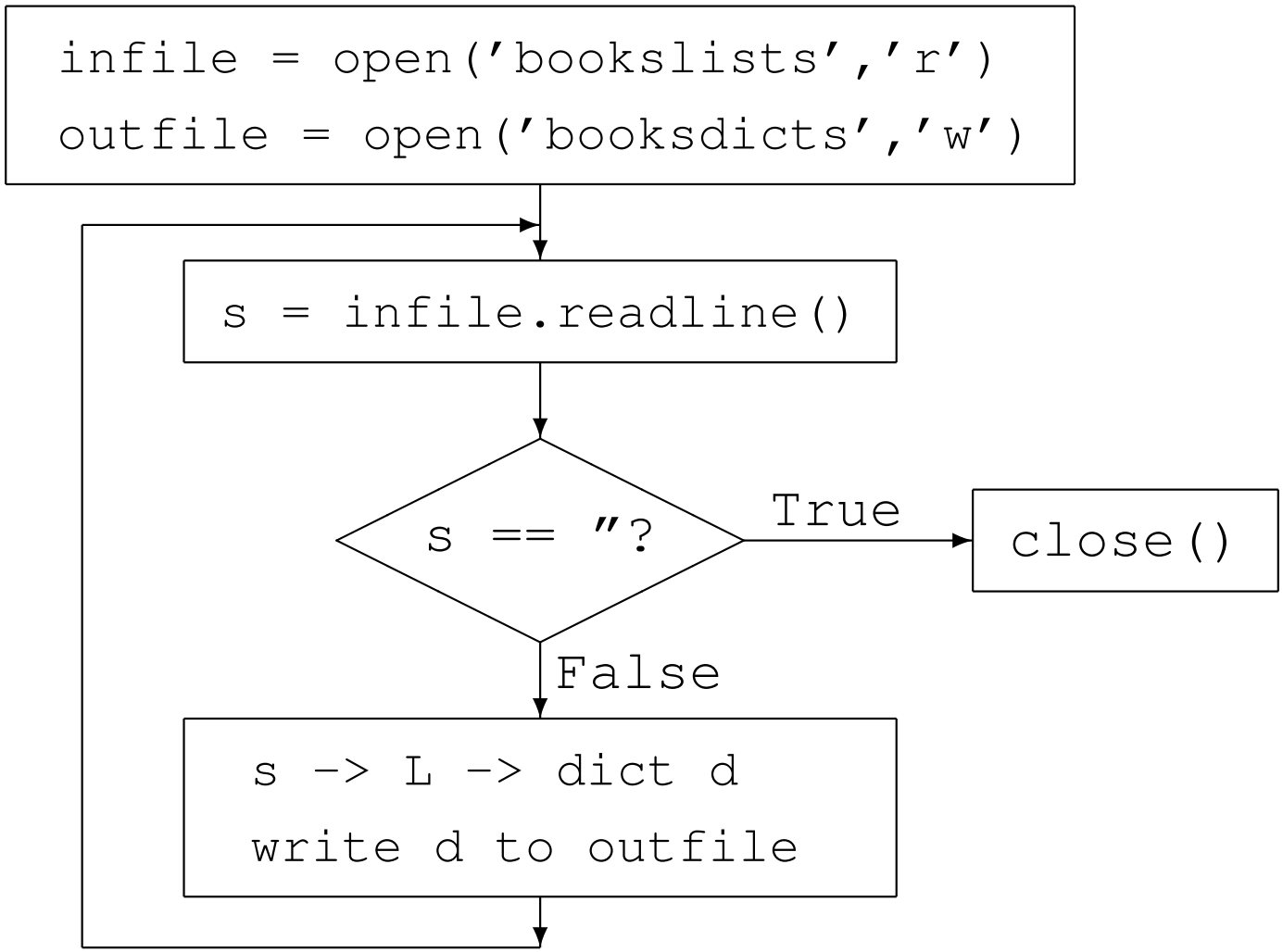
```
{'available': True, 'key': 1, \
'title': 'Computer Science, an overview}
{'available': False, 'key': 2, \
'title': 'Python Programming in Context'}
```

Benefit: the module `bkform.py` is no longer needed.

format conversion algorithm



converting lists into dictionaries



scrambling text – encrypting information

The content of the file sometext.txt:

```
This is a sample text, used as an example
for a message whose vowels will be scrambled.
```

After scrambling vowels, we obtain codetext.txt:

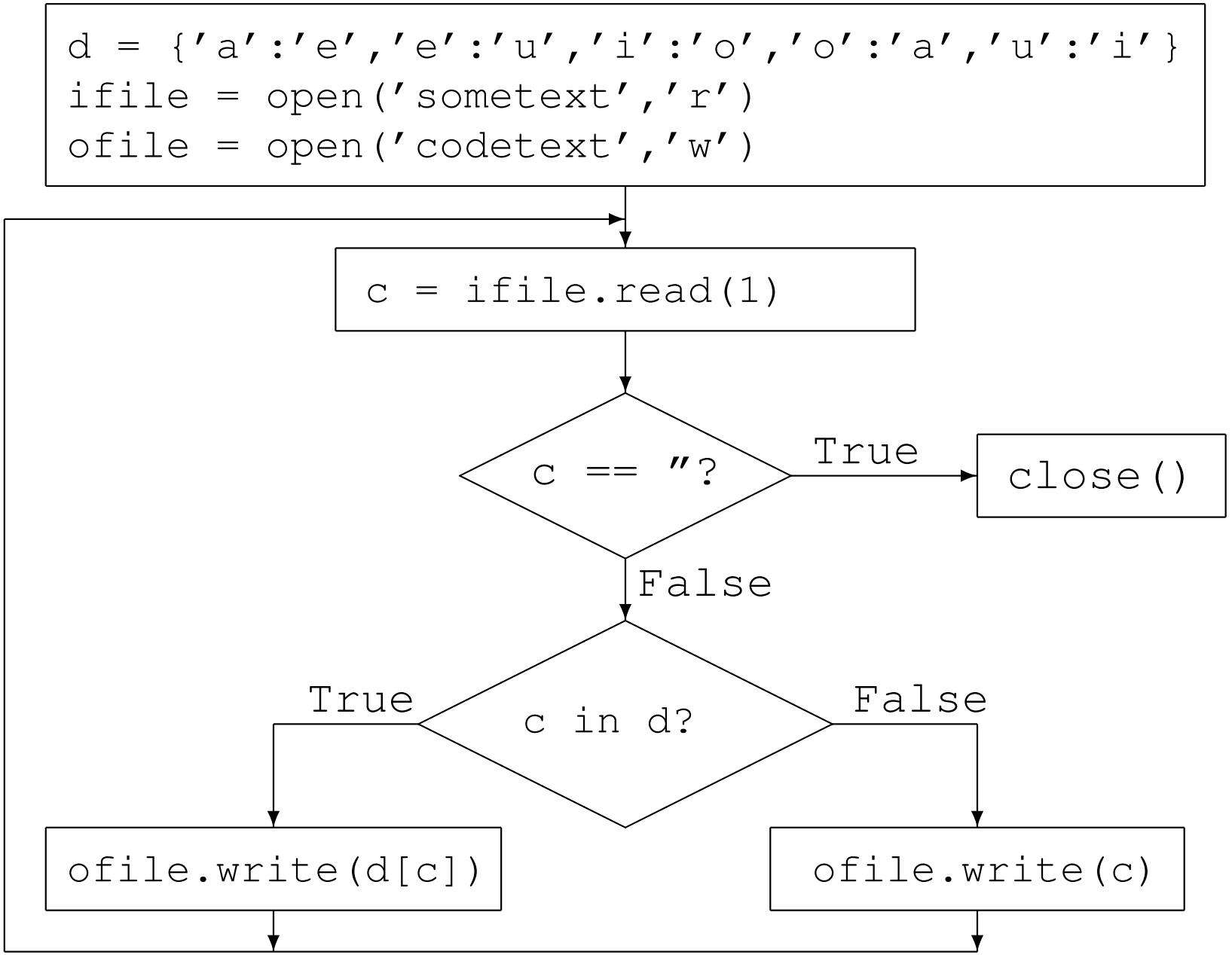
```
Thos os e semplu tuxt, isud es en uxemplu
far e mussegu whasu vawuls woll bu scremblud.
```

The cipher used:

```
['a','i','e','u','o'] -> ['e','o','u','i','a']
```

Python: file.read(1) returns one byte read from file.

the scrambling algorithm



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counting words in a text

Problem: count number of times `the` occurs.

For example: if the file sometext2.txt has content

```
At the end of the lecture we go home,
taking the bus or the train.
```

then the number of times we count `the` is 4.

Algorithm:

1. maintain a buffer of 3 consecutive letters on file;
2. after each new byte read, compare with `the`.

Using lists and tuple assignments:

1. the buffer is stored as a list,
2. a tuple assignment shifts the characters in the buffer.

Moving the Cursor

The *cursor* indicates the current position in a file.

Let `F` be a file object.

- `F.tell()` returns the current position in the file.
- `F.seek(nbr)` moves the cursor with `nbr` positions.
  1. The file must be opened in binary mode.
  2. Characters read must be decoded.
  3. Strings written to file must be encoded.

Exercises

1. Write a program `bkform2dict.py` to convert the formatting in the file books directly to booksdicts.
2. Rewrite the program `library.py` of the previous lecture, using dictionaries as formats for the file books.
3. Modify the `wordcount.py` so that it considers a word as separated from others by spaces or commas and other punctuation symbols, i.e.: the `the` in `there` or `then` does not count as an occurrence of `the`.
4. Design a permutation of the vowels so that after applying `scramblevowels.py` twice we get the original message.

more exercises

5. Download “Macbeth” of William Shakespeare as plain UTF-8 text from `http://www.gutenberg.org`
   and write a script to count the number of occurrences of the strings `"LADY MACBETH"` and `"MACBETH"`.
6. From `https://finance.yahoo.com`, download the historical values of the IBM stock as a file in csv (comma separated value) format. Write a script to find the days at which IBM stock was valued at its highest and lowest price.