# CMSC201
# Computer Science I for Majors

## Lecture 21 – Project 3
## and Miscellaneous Topics

# Last Class We Covered

- Dictionaries
  - Creating
  - Accessing
  - Manipulating
  - Methods
- Hashing
- Dictionaries vs Lists

# Any Questions from Last Time?

# Today's Objectives

- To understand more about how data is represented inside the computer
  - ASCII values
- To see the benefits of short circuit evaluation

- To discuss details of Project 3
  - Deep copying 2D lists

# ASCII Values

# ASCII Values

- ASCII is how text is represented in computers
  - Just like binary is how numbers are represented
- In ASCII, every character has a unique, individual numerical code
  - Lowercase and uppercase characters are separate
  - Codes go from 0 to 127
    - Why 127?

# ASCII TABLE

| Decimal | Hex | Char | Decimal | Hex | Char | Decimal | Hex | Char | Decimal | Hex | Char |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | [NULL] | 32 | 20 | [SPACE] | 64 | 40 | @ | 96 | 60 | ` |
| 1 | 1 | [START OF HEADING] | 33 | 21 | ! | 65 | 41 | A | 97 | 61 | a |
| 2 | 2 | [START OF TEXT] | 34 | 22 | " | 66 | 42 | B | 98 | 62 | b |
| 3 | 3 | [END OF TEXT] | 35 | 23 | # | 67 | 43 | C | 99 | 63 | c |
| 4 | 4 | [END OF TRANSMISSION] | 36 | 24 | $ | 68 | 44 | D | 100 | 64 | d |
| 5 | 5 | [ENQUIRY] | 37 | 25 | % | 69 | 45 | E | 101 | 65 | e |
| 6 | 6 | [ACKNOWLEDGE] | 38 | 26 | & | 70 | 46 | F | 102 | 66 | f |
| 7 | 7 | [BELL] | 39 | 27 | ' | 71 | 47 | G | 103 | 67 | g |
| 8 | 8 | [BACKSPACE] | 40 | 28 | ( | 72 | 48 | H | 104 | 68 | h |
| 9 | 9 | [HORIZONTAL TAB] | 41 | 29 | ) | 73 | 49 | I | 105 | 69 | i |
| 10 | A | [LINE FEED] | 42 | 2A | * | 74 | 4A | J | 106 | 6A | j |
| 11 | B | [VERTICAL TAB] | 43 | 2B | + | 75 | 4B | K | 107 | 6B | k |
| 12 | C | [FORM FEED] | 44 | 2C | , | 76 | 4C | L | 108 | 6C | l |
| 13 | D | [CARRIAGE RETURN] | 45 | 2D | - | 77 | 4D | M | 109 | 6D | m |
| 14 | E | [SHIFT OUT] | 46 | 2E | . | 78 | 4E | N | 110 | 6E | n |
| 15 | F | [SHIFT IN] | 47 | 2F | / | 79 | 4F | O | 111 | 6F | o |
| 16 | 10 | [DATA LINK ESCAPE] | 48 | 30 | 0 | 80 | 50 | P | 112 | 70 | p |
| 17 | 11 | [DEVICE CONTROL 1] | 49 | 31 | 1 | 81 | 51 | Q | 113 | 71 | q |
| 18 | 12 | [DEVICE CONTROL 2] | 50 | 32 | 2 | 82 | 52 | R | 114 | 72 | r |
| 19 | 13 | [DEVICE CONTROL 3] | 51 | 33 | 3 | 83 | 53 | S | 115 | 73 | s |
| 20 | 14 | [DEVICE CONTROL 4] | 52 | 34 | 4 | 84 | 54 | T | 116 | 74 | t |
| 21 | 15 | [NEGATIVE ACKNOWLEDGE] | 53 | 35 | 5 | 85 | 55 | U | 117 | 75 | u |
| 22 | 16 | [SYNCHRONOUS IDLE] | 54 | 36 | 6 | 86 | 56 | V | 118 | 76 | v |
| 23 | 17 | [ENG OF TRANS. BLOCK] | 55 | 37 | 7 | 87 | 57 | W | 119 | 77 | w |
| 24 | 18 | [CANCEL] | 56 | 38 | 8 | 88 | 58 | X | 120 | 78 | x |
| 25 | 19 | [END OF MEDIUM] | 57 | 39 | 9 | 89 | 59 | Y | 121 | 79 | y |
| 26 | 1A | [SUBSTITUTE] | 58 | 3A | : | 90 | 5A | Z | 122 | 7A | z |
| 27 | 1B | [ESCAPE] | 59 | 3B | ; | 91 | 5B | [ | 123 | 7B | { |
| 28 | 1C | [FILE SEPARATOR] | 60 | 3C | < | 92 | 5C | \ | 124 | 7C | \| |
| 29 | 1D | [GROUP SEPARATOR] | 61 | 3D | = | 93 | 5D | ] | 125 | 7D | } |
| 30 | 1E | [RECORD SEPARATOR] | 62 | 3E | > | 94 | 5E | ^ | 126 | 7E | ~ |
| 31 | 1F | [UNIT SEPARATOR] | 63 | 3F | ? | 95 | 5F | _ | 127 | 7F | [DEL] |

# A TABLE

"control" characters

uppercase letters

| Decimal | Hex | Char | Decimal | Hex | Char | Decimal | Hex | Char | Decimal | Hex | Char |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | [NULL] | 32 | 20 | [SPACE] | 64 | 40 | @ | 96 | 60 | ` |
| 1 | 1 | [START OF HEADING] | 33 | 21 | ! | 65 | 41 | A | 97 | 61 | a |
| 2 | 2 | [START OF TEXT] | 34 | 22 | " | 66 | 42 | B | 98 | 62 | b |
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| 4 | 4 | [END OF TRANSMISSION] | 36 | 24 | $ | 68 | 44 | D | 100 | 64 | d |
| 5 | 5 | [ENQUIRY] | 37 | 25 | % | 69 | 45 | E | 101 | 65 | e |
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| 10 | A | [LINE FEED] | 42 | 2A | * | 74 | 4A | J | 106 | 6A | j |
| 11 | B | [VERTICAL TAB] | 43 | 2B | + | 75 | 4B | K | 107 | 6B | k |
| 12 | C | [FORM FEED] | 44 | 2C | , | 76 | 4C | L | 108 | 6C | l |
| 13 | D | [CARRIAGE RETURN] | 45 | 2D | - | 77 | 4D | M | 109 | 6D | m |
| 14 | E | [SHIFT OUT] | 46 | 2E | . | 78 | 4E | N | 110 | 6E | n |
| 15 | F | [SHIFT IN] | 47 | 2F | / | 79 | 4F | O | 111 | 6F | o |
| 16 | 10 | [DATA LINK ESCAPE] | 48 | 30 | 0 | 80 | 50 | P | 112 | 70 | p |
| 17 | 11 | [DEVICE CONTROL 1] | 49 | 31 | 1 | 81 | 51 | Q | 113 | 71 | q |
| 18 | 12 | [DEVICE CONTROL 2] | 50 | 32 | 2 | 82 | 52 | R | 114 | 72 | r |
| 19 | 13 | [DEVICE CONTROL 3] | 51 | 33 | 3 | 83 | 53 | S | 115 | 73 | s |
| 20 | 14 | [DEVICE CONTROL 4] | 52 | 34 | 4 | 84 | 54 | T | 116 | 74 | t |
| 21 | 15 | [NEGATIVE ACKNOWLEDGE] | 53 | 35 | 5 | 85 | 55 | U | 117 | 75 | u |
| 22 | 16 | [SYNCHRONOUS IDLE] | 54 | 36 | 6 | 86 | 56 | V | 118 | 76 | v |
| 23 | 17 | [ENG OF TRANS. BLOCK] | 55 | 37 | 7 | 87 | 57 | W | 119 | 77 | w |
| 24 | 18 | [CANCEL] | 56 | 38 | 8 | 88 | 58 | X | 120 | 78 | x |
| 25 | 19 | [END OF MEDIUM] | 57 | 39 | 9 | 89 | 59 | Y | 121 | 79 | y |
| 26 | 1A | [SUBSTITUTE] | 58 | 3A | : | 90 | 5A | Z | 122 | 7A | z |
| 27 | 1B | [ESCAPE] | 59 | 3B | ; | 91 | 5B | [ | 123 | 7B | { |
| 28 | 1C | [FILE SEPARATOR] | 60 | 3C | < | 92 | 5C | \ | 124 | 7C | \| |
| 29 | 1D | [GROUP SEPARATOR] | 61 | 3D | = | 93 | 5D | ] | 125 | 7D | } |
| 30 | 1E | [RECORD SEPARATOR] | 62 | 3E | > | 94 | 5E | ^ | 126 | 7E | ~ |
| 31 | 1F | [UNIT SEPARATOR] | 63 | 3F | ? | 95 | 5F | _ | 127 | 7F | [DEL] |

symbols & numbers

lowercase letters

# Comparing Strings

- The values of the ASCII characters are used when comparing strings together
  - Which can lead to some "weird" results

```
>>> "cat" < "dog"
True
>>> "cat" < "Dog"
False
>>> "DOG" < "dog"
True
```

?

# More on Comparing Strings

- Gets even more complex when you start adding in numbers and symbols

```
>>> "2" < "one"
True
>>> "good?" < "good!"
False
>>> "UK" < "U.K."
False
```

# Rules for Comparisons

- To avoid (some) of these issues:

- Always use `.lower()` for comparing strings
- Pay attention to symbols
  - *e.g.*, spaces, hyphens, punctuation, etc.
  - Either remove them, or keep them in mind as part of the order

# ASCII Characters to ASCII Values

- We can convert between ASCII characters and their values using **`ord()`** and **`chr()`**

- The **`ord()`** function takes in a single character, and returns its ASCII value
- The **`chr()`** function takes in an integer, and returns its ASCII character

# Using `chr()` and `ord()`

```
>>> chr(65)
'A'
>>> chr(65+32)
'a'
>>> ord('?')
63
>>> ord("d")
100
>>> ord("e")
101
```

# "Short Circuit" Evaluation

# Review: Complex Expressions

- We can put multiple operators together!

```
bool4 = a and (b or c)
```

- What does Python do first?
  - Computes **`(b or c)`**
  - Computes **`a and`** the result

This isn't strictly true!

# Short Circuit Evaluation

- Python tries to be efficient (*i.e.*, lazy), and so it won't do any more work than necessary
  - If the remainder of an expression won't change the outcome, Python doesn't look at it

- This is called "short circuiting"
  - It's a powerful tool, and can simplify the conditionals in your programs

# Short Circuit Evaluation – Rules

- For obvious reasons, short circuiting behaves differently for **`and`** and **`or`** statements

- "**`and`**" statements short circuit as soon as an expression evaluates to **`False`**
- "**`or`**" statements short circuit as soon as an expression evaluates to **`True`**

# Short Circuiting – `and`

- Notice that in the expression:

```
bool1 = a and (b or c)
```

- If `a` is `False`
- The rest of the expression doesn't matter

- Python will realize this, and if `a` is `False` won't bother with the rest of the expression

# Short Circuiting – `or`

- Notice that in the expression:

```
bool1 = a or (b or c)
```

- If `a` is `True`
- The rest of the expression doesn't matter

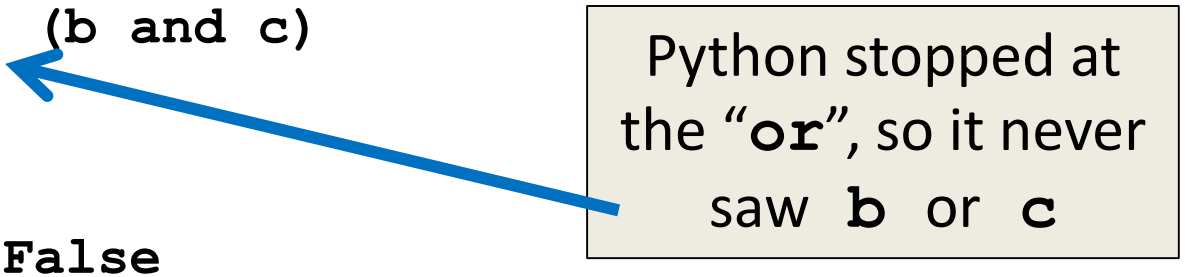
- Python will realize this, and if `a` is `True` won't bother with the rest of the expression

# Causing Errors

- This can lead to "new" errors in old code

```
>>> a = True
>>> # Variables b and c not defined
>>> a or (b and c)
True

>>> a = False
>>> a or (b and c)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'b' is not defined
```



# Simplifying Conditionals

- Order matters! You can use short circuiting to control what statements are reached

- While checking the validity of input, if the user can also enter a "Q" to quit

```
if num != QUIT and int(num) > MIN_VAL:
    return num
```

This will only be reached if num is not "Q", so the cast to int() won't cause a problem

# Project 3

# Do Not Cheat on Project 3

- Yes, this project has been given before
  - Yes, in this class
  - Yes, we have all of the old projects to compare it to
- Yes, this project has solutions on the internet
  - Yes, we have copies of all of them
  - Yes, we will go looking for new ones after it's due
- Yes, you could pay someone else to do it
  - Yes, we know of the sites where you can get this done
  - Yes, we will spot "elegant" code that you didn't write

# Deep Copying 2D Lists

- Why does this have to happen?
  - The path needs to be deep copied, so that it doesn't have any dead ends or backtracking in it

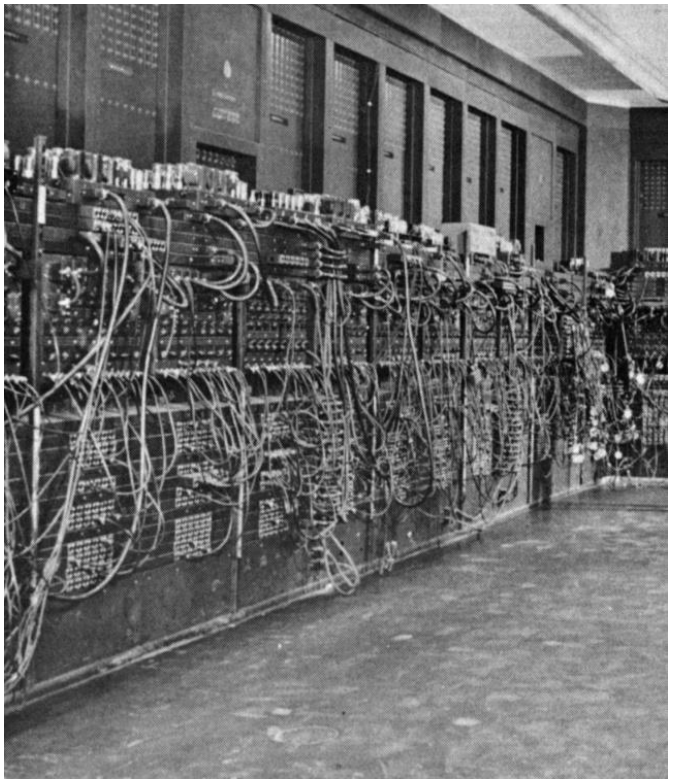
```
newPath = []
for i in range(len(path)):
    innerCopy = list( path[i] )
    newPath.append( innerCopy)
```

# Daily CS History

- John von Neumann
  - Creator of merge sort
    - We'll learn this soon!
  - Helped develop what is now known as "von Neumann architecture" (not all his work)
  - Created a rigorous framework for quantum mechanics
  - Developed implosion mechanism for nuclear bombs

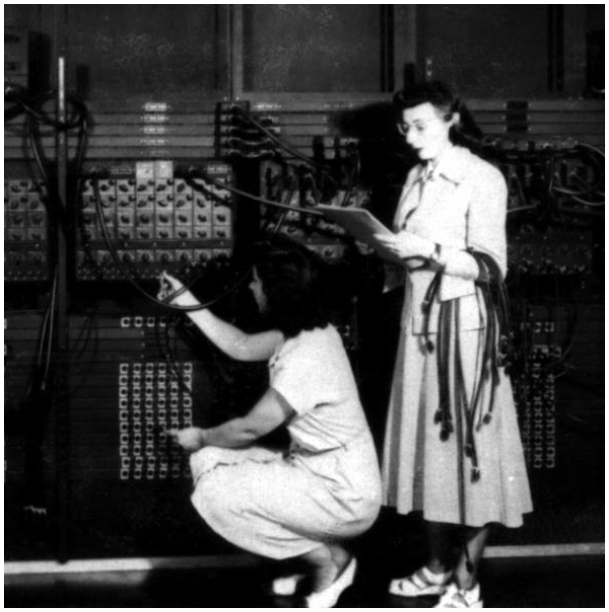
# More Daily CS History

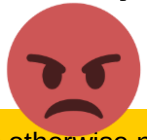
- ENIAC
  - Completed in 1946 at UPenn
    - Decommissioned in 1956
  - Computations were 2,400 times faster than humans
  - Cost $6.7 million to build
  - Meant to create artillery firing tables for the US Army
  - Also used for studying thermonuclear feasibility



# Even More Daily CS History

- ENIAC Programmers
  - Kay McNulty, Betty Jennings, Betty Snyder, Marlyn Meltzer, Fran Bilas, and Ruth Lichterman
  - These women turned abstract ideas into working, bug-free code
    - First program run on ENIAC had a million individual punchcards
  - Programming was seen back then as "easy" work, akin to typing up a handwritten letter





# Announcements

- Project 3 is due on Friday, December 8th
  - Design due on Friday, December 1st
- Survey #3 out on Friday, December 1st
  - Final exam metacognition quiz out on BB same day
- Exam wrappers handed back this week in lab
- Final exam is when?
- Friday, December 15th from 6 to 8 PM

# Final Exam Locations

- Find your room ahead of time!

- **ITE Building 102** - Sections 22, 28, 32
- **ITE Building 104** - Sections 2, 3, 4, 5, 6
- **Meyerhoff 030** - Sections 8, 9, 10, 11, 12, 14, 17, 18, 20
- **Performing Arts 132** - Sections 15, 16, 31
- **Sherman 003** - Sections 23, 26, 29, 30
- **Public Policy 105** - Sections 21, 24, 27

# Image Sources

- ASCII table (adapted from):
  - https://commons.wikimedia.org/wiki/File:ASCII-Table-wide.svg
- Generic kitten:
  - http://www.publicdomainpictures.net/view-image.php?image=87454
- Generic puppy:
  - http://www.publicdomainpictures.net/view-image.php?image=192231
- John von Neumann:
  - https://en.wikipedia.org/wiki/File:JohnvonNeumann-LosAlamos.gif
- ENIAC (adapted from):
  - https://commons.wikimedia.org/wiki/File:Eniac.jpg
- ENIAC programmers (adapted from):
  - https://commons.wikimedia.org/wiki/File:Reprogramming_ENIAC.png
- Mad emoji (adapted from):
  - https://commons.wikimedia.org/wiki/File:Twemoji_1f620.svg