NHẬP MÔN LẬP TRÌNH
(Introduction to Programming)

Chapter 5 – Command and Programming Control

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05 Oct. 2022

Programming

Hamilton was a self-taught programmer, working in the US in the 1960's. Owing to the success of her previous work, Hamilton was the first programmer to be hired for the Apollo project. She became the Director of Software Engineering at the MIT Instrumentation lab. Her lab developed the on-board flight software for NASA's Apollo space project, which took humankind to the moon.

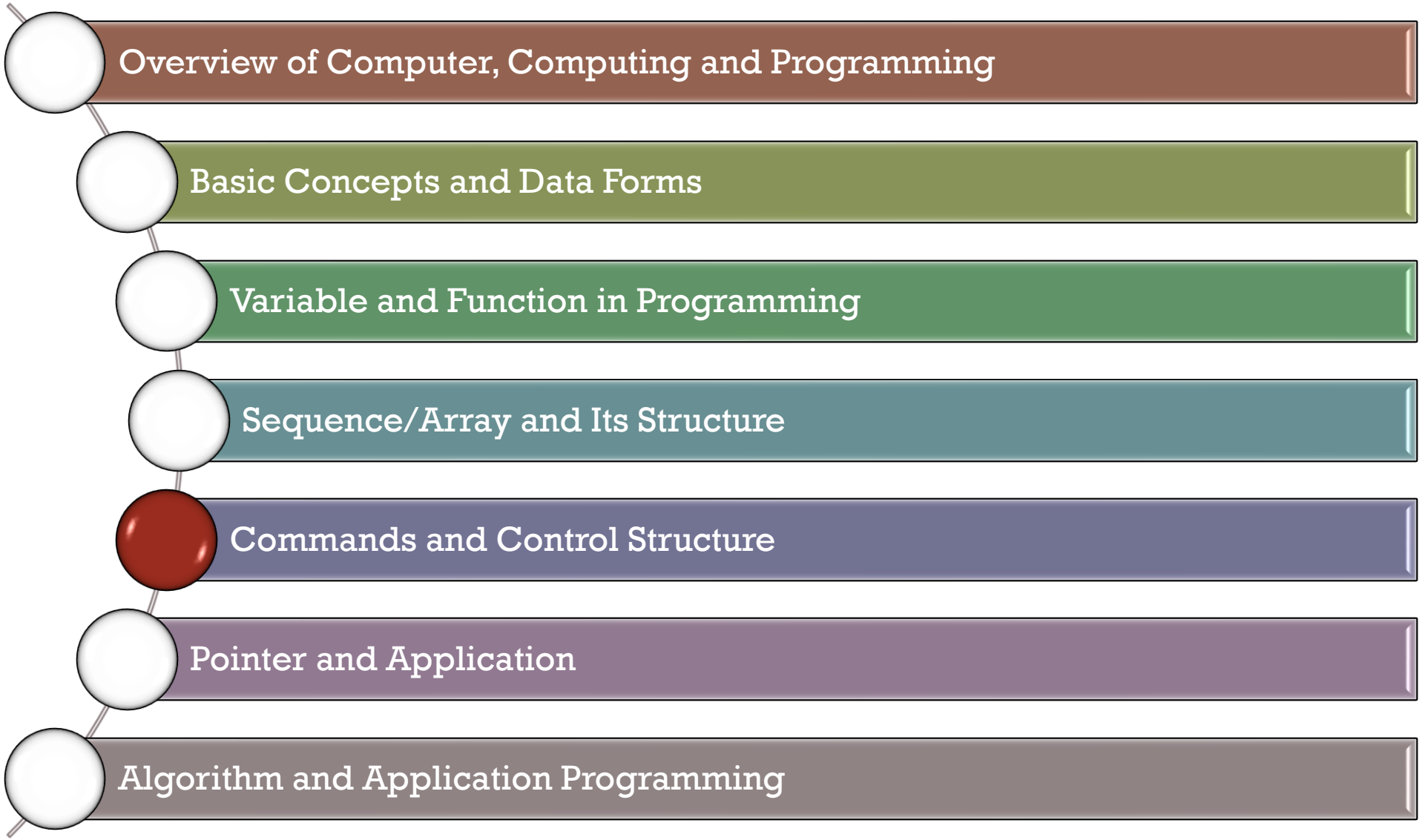
The achievement was a monumental task at a time when computer technology was in its infancy: The astronauts had access to only 72 kilobytes of computer memory (a 256-gigabyte cell phone today carries almost a million times more storage space). Programmers had to use paper punch cards to feed information into room-sized computers with no screen interface.

Margaret Hamilton, NASA's lead software engineer for the Apollo, stands next to the code she wrote by hand that took humanity to the moon in 1969.

Outline

- Tổng quan về máy tính, điện toán và lập trình
- Các nguyên lý, khái niệm cơ bản, kiểu dữ liệu
- Tham số, biến và hàm trong lập trình
- Chuỗi/Mảng và cấu trúc
- Lệnh và cấu trúc lệnh điều khiển
- Con trỏ và ứng dụng
- Giải thuật và Lập trình ứng dụng

Outline


Overview of Computer, Computing and Programming
Basic Concepts and Data Forms
Variable and Function in Programming
Sequence/Array and Its Structure
Commands and Control Structure
Pointer and Application
Algorithm and Application Programming

References

Main:

- Maurizio Gabbrielli and Simone Martini, 2010. *Programming Languages: Principles and Paradigms*, Springer.
- Cao Hoàng Trụ, 2004. *Ngôn ngữ lập trình- Các nguyên lý và mô hình*, Nhà xuất bản Đại học Quốc gia Tp. Hồ Chí Minh

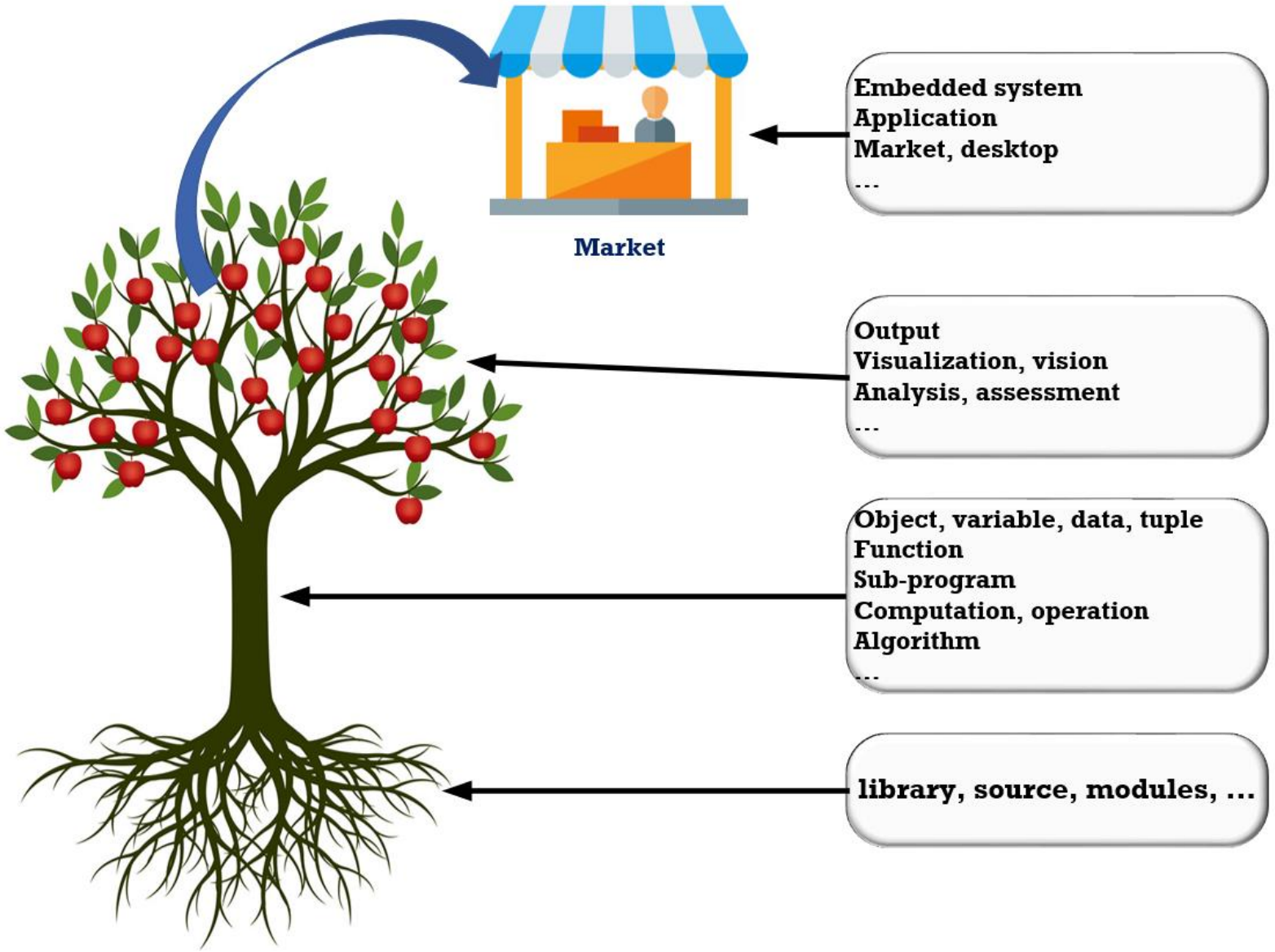
More:

- Wes McKinney, 2013. *Python for Data Analysis*, O'Reilly Media.
- Guido van Rossum, Fred L. Drake, Jr.,, 2012. *The Python Library Reference*, Release 3.2.3.

- Slides here are collected and modified from several sources in Universities and Internet.

Computer programs

- **General structure:**

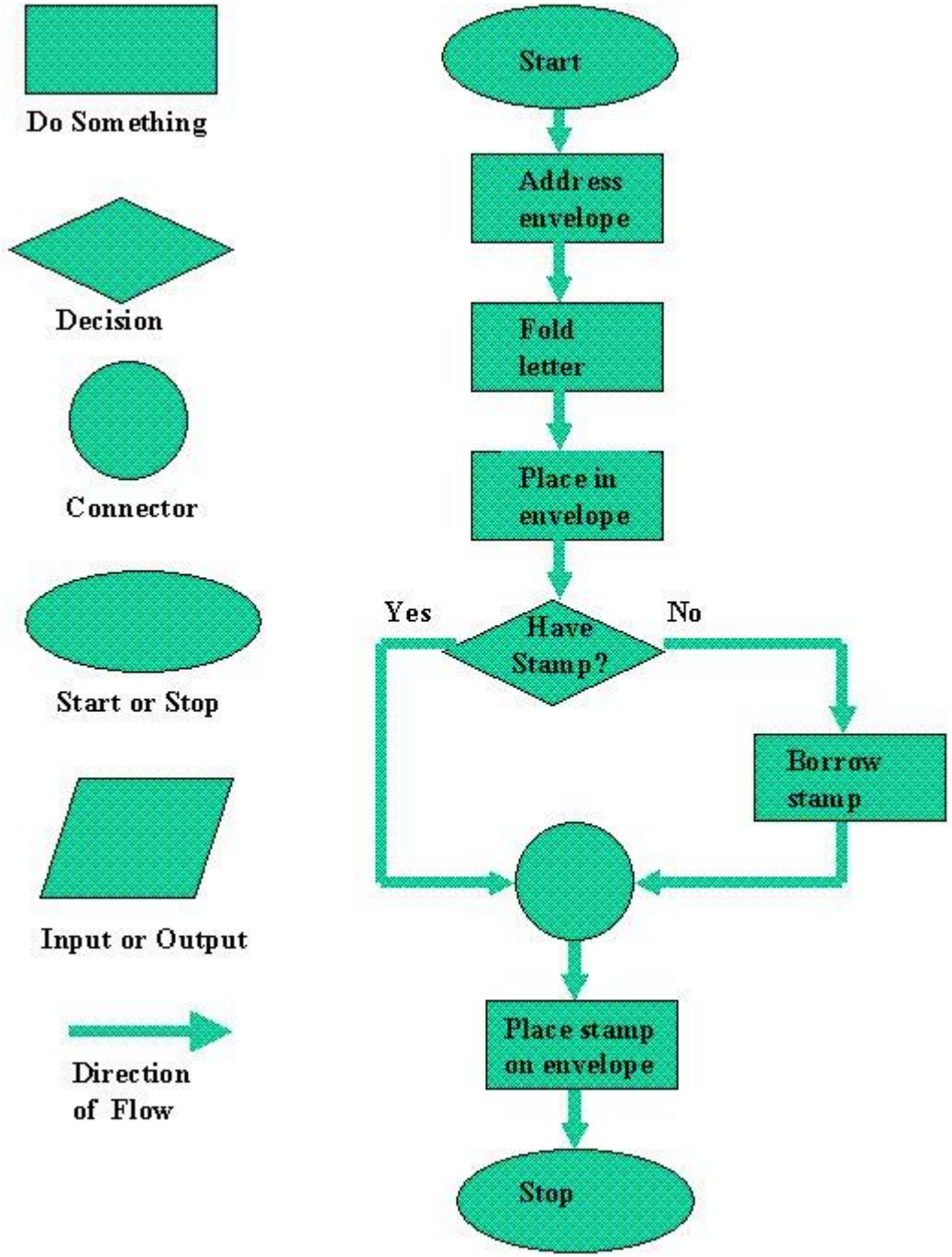


Content of Chapter 5

1. Commands in Python programming
2. Control programs: “for ...” loop and Examples (1 week)
3. Control programs: “while ... do" loop and Examples (1 week)
4. Control programs: “if ... else" statement and Examples (1 week)
5. **Examples and Practices: Combine Python loops (1 week)**

Structure of Computer programs

- **Computer programming:**
  - Objects
  - Types
  - Variables
  - Methods
  - Sequences/Arrays



The first STORY

A story of the first computer ...

The first story – A person ...

- **Information ...**

.

23 June 1912 – 7 June 1954

was an English mathematician, computer scientist, logician, cryptanalyst, philosopher, and theoretical biologist

born in Maida Vale, London, he was raised in southern England.
He graduated at King's College, Cambridge, with a degree in mathematics.

The first story – A person ...

- **Information ...**

.

He is widely considered to be the father of theoretical computer science and artificial intelligence

During the Second World War, he worked for the Government Code and Cypher School (GC&CS) at Bletchley Park, Britain's codebreaking centre that produced Ultra intelligence.

He devised a number of techniques for speeding the breaking of German ciphers, including improvements to the pre-war Polish bomba method, an electromechanical machine that could find settings for the Enigma machine

The first story – A person ...

- **Information ...**

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Thiên tài về mật mã, giải mã. Một tấn bị kịch về cuộc đời cho người được xem là "Cha đẻ" của ngành Khoa học máy tính

Cuộc đời thiên tài **của ông ấy** được dựng thành phim năm 2014.
"The Imitation Game" – "Người giải mã"

Phim thu về hơn 233 triệu đô la trên toàn thế giới với kinh phí sản xuất 14 triệu đô la, trở thành phim độc lập có doanh thu cao nhất năm 2014. Phim nhận được tám đề cử tại Lễ trao giải Oscar lần thứ 87, chiến thắng cho Kịch bản chuyển thể xuất sắc nhất; năm đề cử tại Lễ trao giải Quả cầu vàng lần thứ 72; và ba đề cử tại giải thưởng Screen Actors Guild Awards lần thứ 21. Phim cũng nhận được chín đề cử BAFTA, và giành được Giải thưởng People's Choice Award tại Liên hoan phim Quốc tế Toronto lần thứ 39.

Alan Turing

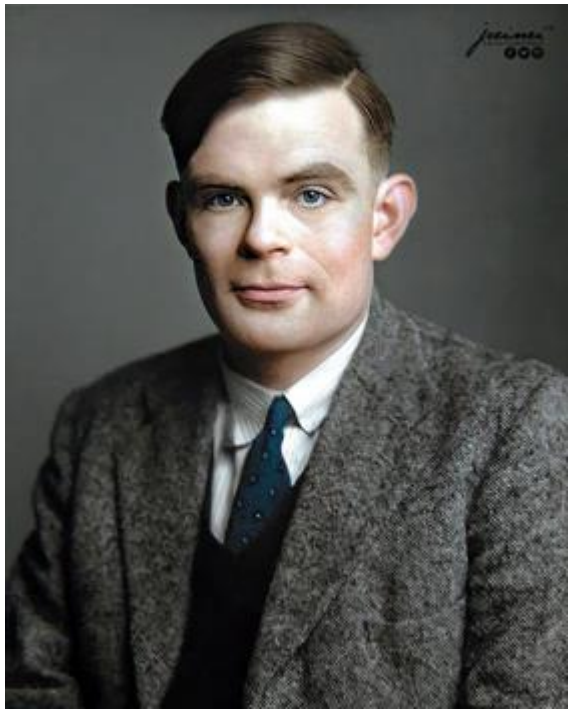
A person, who is
invented the first computing system

The first story – A person ...

- **Information ...**

.

Alan Mathison Turing
(23 June 1912 – 7 June 1954)



https://en.wikipedia.org/wiki/Alan_Turing

Turing Machine in Python

Một mô hình máy tính rất đơn giản, nhưng nó có khả năng tính toán hoàn chỉnh của một máy tính đa năng.

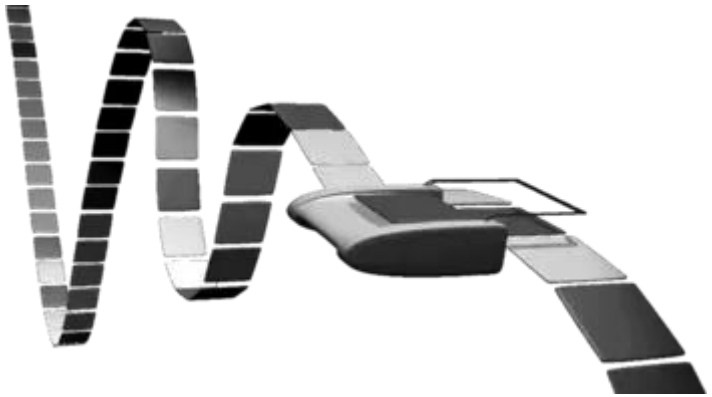
Máy Turing (TM) phục vụ hai nhu cầu trong khoa học máy tính lý thuyết:

- Lớp ngôn ngữ được xác định bởi TM, tức là ngôn ngữ có cấu trúc hoặc có thể liệt kê đệ quy
- Lớp hàm mà một TM có khả năng tính toán, tức là các hàm đệ quy từng phần.

Một máy Turing chỉ bao gồm một số thành phần:

Một băng ghi dữ liệu có thể được lưu trữ tuần tự. Băng bao gồm các trường, được sắp xếp theo thứ tự. Mỗi trường có thể chứa một ký tự của một bảng chữ cái hữu hạn. Cuốn băng này không có giới hạn, nó diễn ra vô tận theo cả hai hướng.

Chương trình Turing là một danh sách các chuyển đổi, xác định trạng thái và ký tự nhất định ("dưới" phần đầu) một trạng thái mới, một ký tự phải được ghi vào trường dưới phần đầu và hướng chuyển động cho phần đầu, tức là. hoặc trái, phải hoặc tĩnh (bất động).



Turing Machine in Python

Một mô hình máy tính rất đơn giản, nhưng nó có khả năng tính toán hoàn chỉnh của một máy tính đa năng.

Formal Definition of a Turing machine

A deterministic Turing machine can be defined as a 7-tuple

$M = (Q, \Sigma, \Gamma, \delta, b, q_0, q_f)$

with

- Q is a finite, non-empty set of states
- Γ is a finite, non-empty set of the tape alphabet
- Σ is the set of input symbols with $\Sigma \subset \Gamma$
- δ is a partially defined function, the transition function:
  $\delta : (Q \setminus \{q_f\}) \times \Gamma \rightarrow Q \times \Gamma \times \{L,N,R\}$
- b ∈ &Gamma \ Σ is the blank symbol
- $q_0 \in Q$ is the initial state
- $q_f \in Q$ is the set of accepting or final states

Practices

We implement a Turing Machine in Python as a class. We define another class for the read/write tape of the Turing Machine. The core of the tape inside the class Tape is a dictionary, which contains the entries of the tape. This way, we can have negative indices. A Python list is not a convenient data structure, because Python lists are bounded on one side, i.e. bounded by 0.

We define the method str(self) for the class Tape. str(self) is called by the built-in str() function. The print function uses also the str function to calculate the "informal" string representation of an object, in our case the tape of the TM. The method get_tape() of our class TuringMachine makes use of the str representation returned by str.

With the aid of the method getitem(), we provide a reading access to the tape via indices. The definition of the method setitem() allows a writing access as well, as we can see e.g. in the statement

Chúng tôi triển khai Máy Turing bằng Python dưới dạng một lớp. Chúng tôi định nghĩa một lớp khác cho băng đọc / ghi của Máy Turing. Phần lõi của băng bên trong lớp Tape là một từ điển, chứa các mục nhập của băng. Bằng cách này, chúng ta có thể có các chỉ số âm. Danh sách Python không phải là một cấu trúc dữ liệu thuận tiện, vì danh sách Python được giới hạn ở một phía, tức là bị giới hạn bởi 0.

Chúng tôi định nghĩa phương thức str (self) cho lớp Tape. str (self) được gọi bởi hàm str () có sẵn. Hàm print cũng sử dụng hàm str để tính toán biểu diễn chuỗi "không chính thức" của một đối tượng, trong trường hợp của chúng ta là băng của TM. Phương thức get_tape () của lớp TuringMachine sử dụng biểu diễn str được trả về bởi str.

Với sự hỗ trợ của phương thức getitem (), chúng tôi cung cấp quyền truy cập đọc vào băng thông qua các chỉ mục. Định nghĩa của phương thức setitem () cũng cho phép truy cập bằng văn bản, như chúng ta có thể thấy, ví dụ: trong tuyên bố

Practices

Example: Binary Complement function

Let's define a Turing machine, which complements a binary input on the tape, i.e. an input "1100111" e.g. will be turned into "0011000".

$\Sigma = \{0, 1\}$

$Q = \{init, final\}$

$q_0 = init$

$q_f = final$

Function Definition	Description
δ(init,0) = (init, 1, R)	If the machine is in state "init" and a 0 is read by the head, a 1 will be written, the state will change to "init" (so actually, it will not change) and the head will be moved one field to the right.
δ(init,1) = (init, 0, R)	If the machine is in state "init" and a 1 is read by the head, a 0 will be written, the state will change to "init" (so actually, it will not change) and the head will be moved one field to the right.
δ(init,b) = (final, b, N)	If a blank ("b"), defining the end of the input string, is read, the TM reaches the final state "final" and halts.

The second STORY

A story of the age of IT

The second story – A person ...

- **Information ...**

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October 28, 1955 – now

was born and raised in Seattle, Washington.

The second story – A person ...

- **Information ...**

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is an American business magnate, software developer, investor, author, and philanthropist

Since 1987, he has been included in the Forbes list of the world's wealthiest people.

From 1995 to 2017, he held the Forbes title of the richest person in the world every year except from 2010 to 2013.

The second story – A person ...

- **Information ...**

.

He is a co-founder of Microsoft, along with his late childhood friend Paul Allen.

During his career at Microsoft, he held the positions of chairman, chief executive officer (CEO), president and chief software architect, while also being the largest individual shareholder until May 2014.

Bill Gates

A person, who is

invented the complete operation system

The second story – A person ...

- **Information ...**

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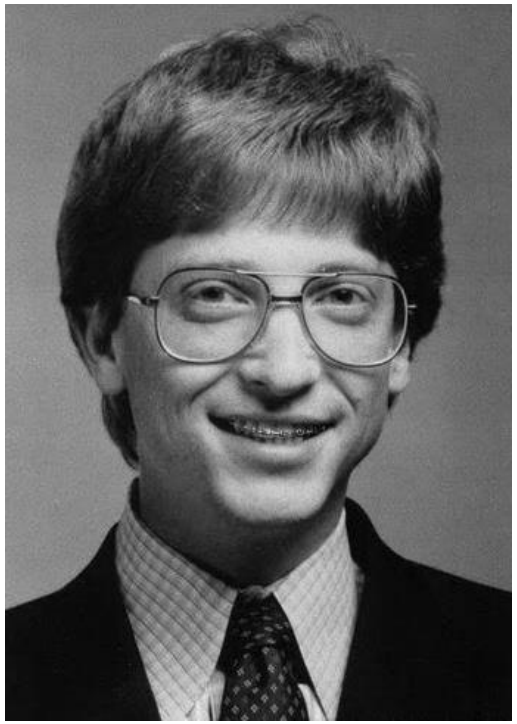
William Henry Gates III
(October 28, 1955 – now)

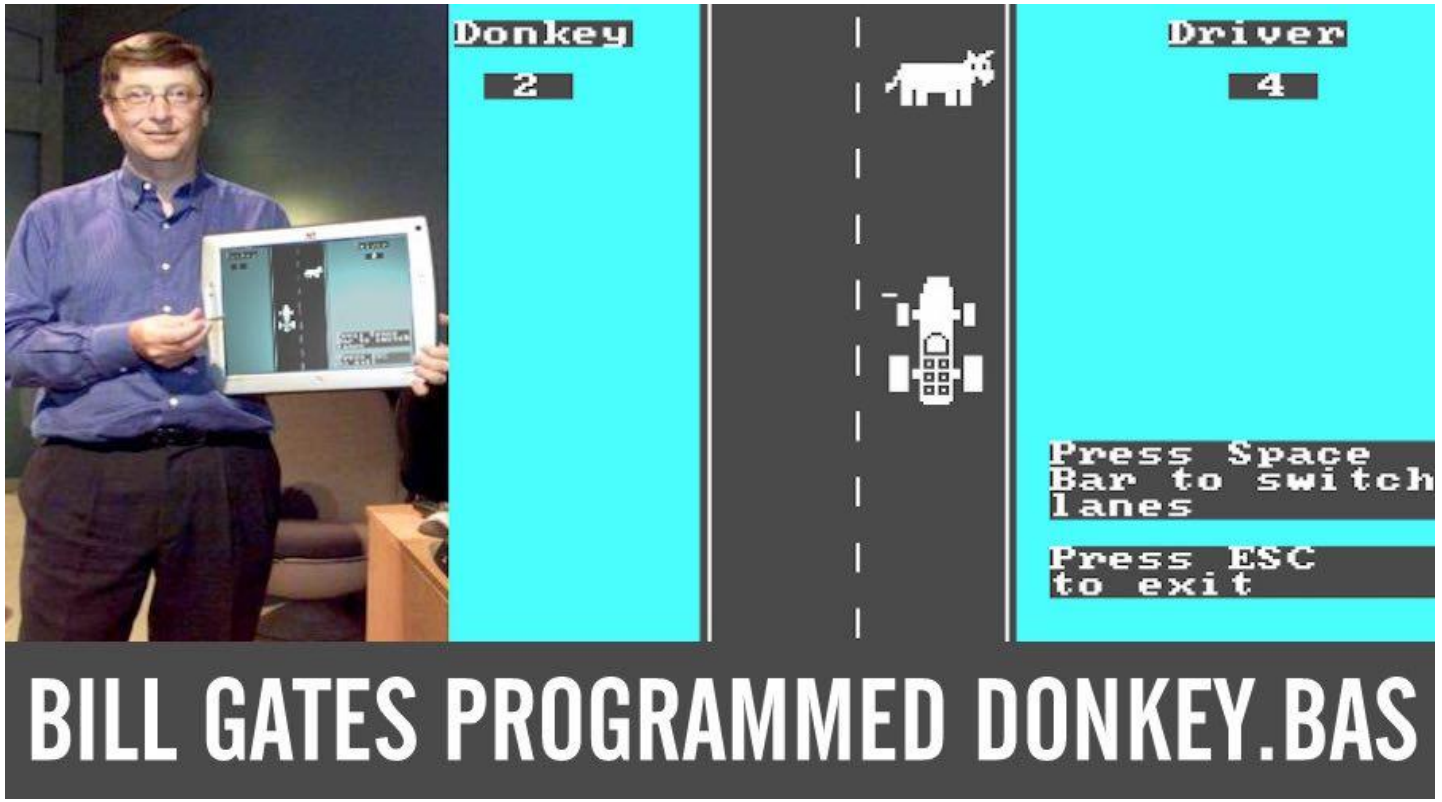


https://en.wikipedia.org/wiki/Bill_Gates

Donkey.bas: Bill Gates Programmed World's 1st PC Game In 1981

The first version of DONKEY.BAS was released in 1981. To showcase its new .NET platform and Visual Basic .NET programming language, Microsoft created a game named DONKEY.NET in 2001. It was a three-dimensional game that aimed to hit donkeys.

This simulation runs at 64Kb of RAM, a CGA display, and a clock speed of 4.77MHz–the original configuration of IBM PC Model 5150.



Top coding questions in the Microsoft interview

❑ Question 01: Set columns and rows as zeroes

Problem Statement: Given a two-dimensional array, if any element within is zero, make its whole row and column zero. Consider the matrix below.

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

5	0	3	0
0	0	0	0
0	0	0	0
9	0	3	0

Top coding questions in the Microsoft interview

❑ Question 02: Find the maximum single sell profit

Problem Statement: Given a list of daily stock prices (integers for simplicity), return the buy and sell prices that will maximize the single buy/sell profit. If you can't make any profit, try to minimize the loss.

For the below examples, buy (orange) and sell (green) prices for making a maximum profit are highlighted.

Practices

- Viết flow chart để mô tả quá trình thực hiện chương trình theo yêu cầu 2 Questions.
- Viết code Python để thực hiện và kiểm tra kết quả với inputs:

Question 01: Set columns and rows as zeroes

$$\begin{bmatrix} 5 & 4 & 3 & 9 \\ 2 & 7 & 0 & 6 \\ 1 & 3 & 4 & 4 \\ 8 & 9 & 0 & 3 \end{bmatrix}$$

Question 02: Find the maximum single sell profit

$$\begin{bmatrix} 12 & 15 & 19 & 14 & 11 & 9 & 10 & 6 & 17 & 3 \end{bmatrix}$$

The third STORY

A story of the smart of ...

The third story – A person ...

- **Information ...**

.

February 24, 1955 – October 5, 2011

was an American entrepreneur, industrial designer, business magnate, media proprietor, and investor

was born in San Francisco to a Syrian father and German-American mother.

The third story – A person ...

- **Information ...**

.

The Macintosh introduced the desktop publishing industry in 1985 …

In 1985, he was forced out of his company after a long power struggle with the company's board

Awards And Honors: Presidential Medal of Freedom (2022).

The third story – A person ...

- **Information ...**

.

beginning with the "Think different" advertising campaign and leading to the Apple Store, App Store (iOS), iMac, iPad, iPod, iPhone, iTunes, and iTunes Store.

Apple is the largest technology company by revenue (totaling US$365.8 billion in 2021, 154,000 employees) and, as of June 2022, is the world's biggest company by market capitalization, the fourth-largest personal computer vendor by unit sales and second-largest mobile phone manufacturer.

It is one of the Big Five American information technology companies, alongside Alphabet, Amazon, Meta, and Microsoft.

The third story – A person ...

- **Information ...**

.

He was the co-founder, chairman, and CEO of Apple;
the chairman and majority shareholder of Pixar;
a member of The Walt Disney Company's board of directors following its acquisition of Pixar;
and the founder, chairman, and CEO of NeXT.

Steve Jobs

A person, who is

Father of the smart phone

The third story – A person ...

- **Information ...**

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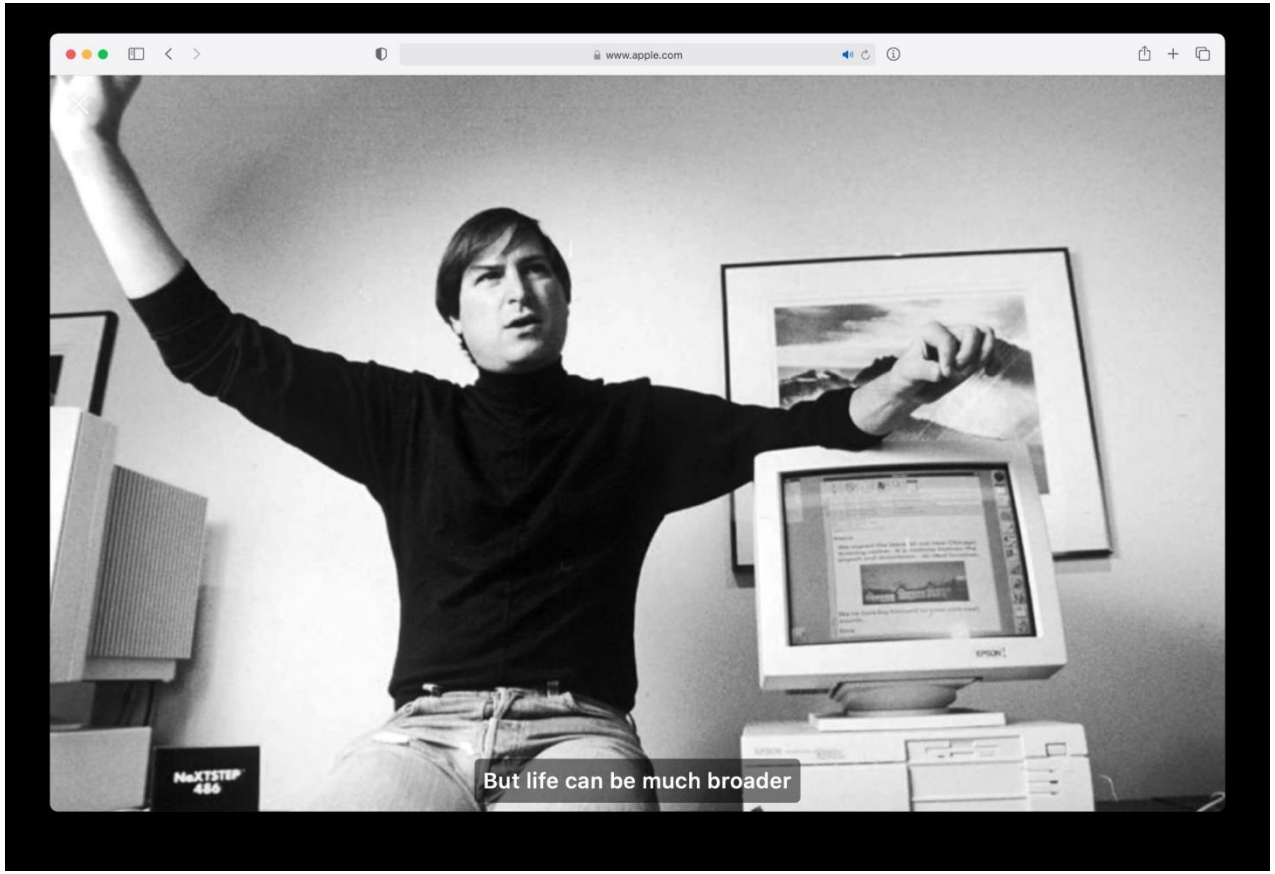
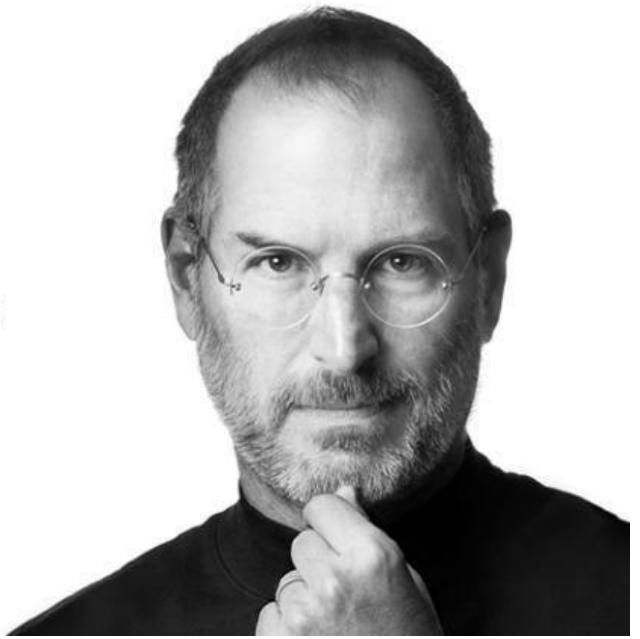
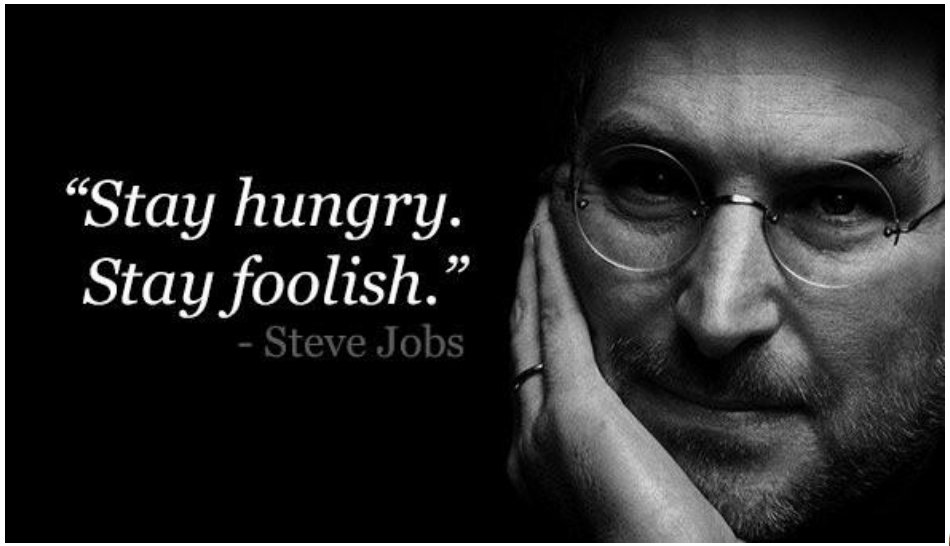
https://en.wikipedia.org/wiki/Steve_Jobs



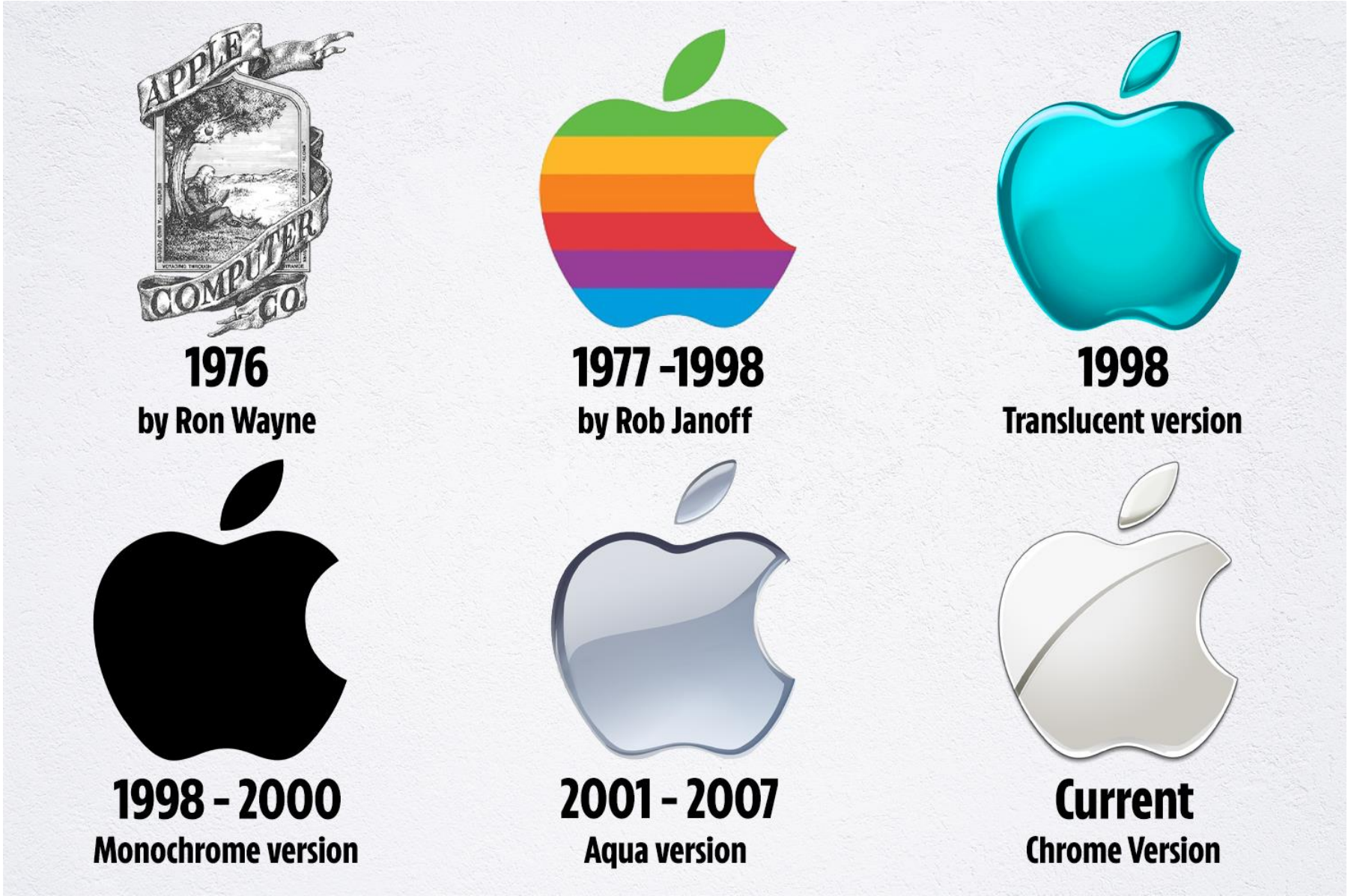


Steven Paul Jobs



Apple LOGO

A history ...



Apple Logo

Steve Job's Love for the Fruit

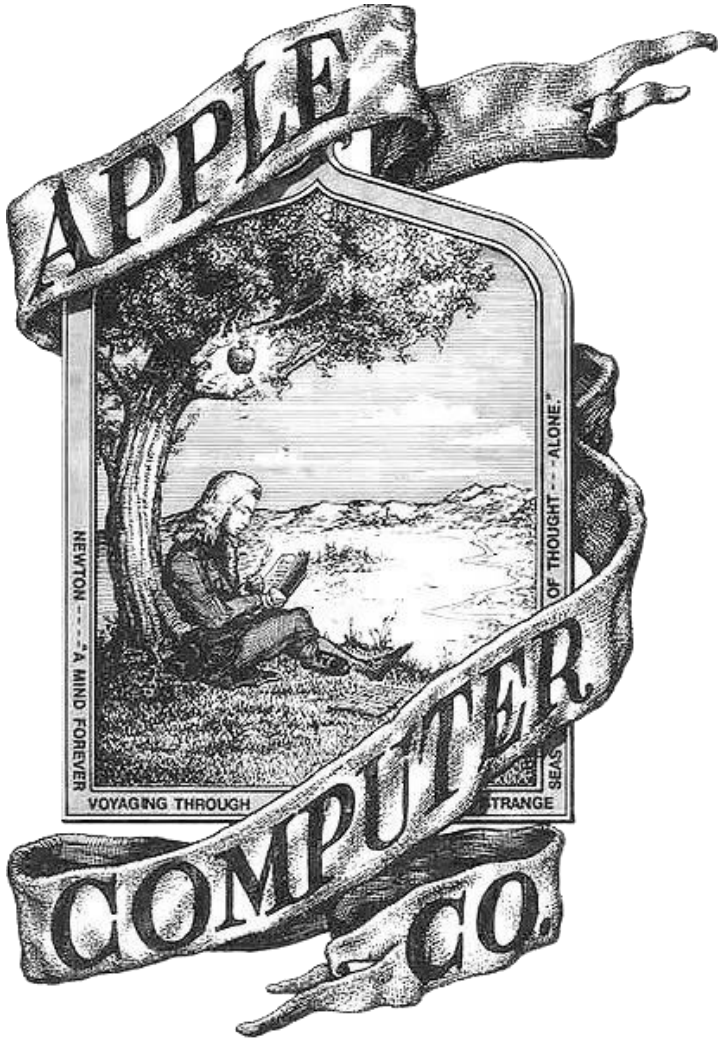
Jobs had a penchant for the apple.

As noted earlier, the tech pioneer even got the inspiration for the brand's name after one of his trips to apple orchard communes in Oregon. So, it's no surprise that the company's logo is an apple.

Apple Logo

Apple Computer Co. Newton Plaque – 1976

The Newton Plaque from 1976 was the first-ever Apple logo. It was designed by Wayne and was an image of Isaac Newton sitting under a tree with a book when an apple fell on his head.



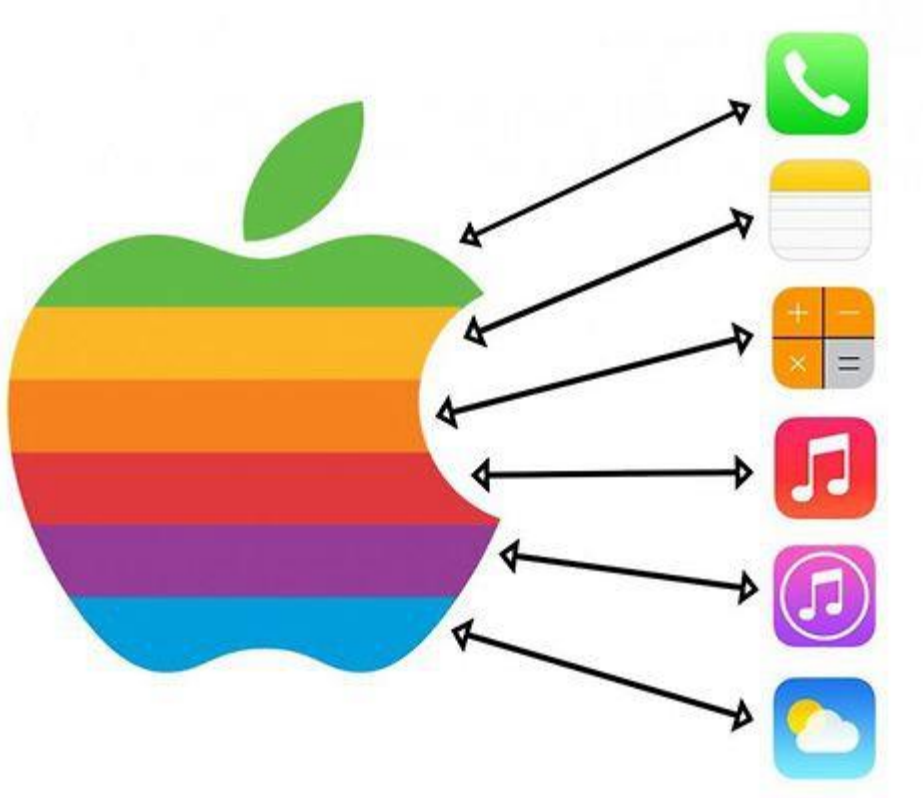
The image depicts Newton discovering gravity and even includes a poem quote by William Wordsworth.

Apple Logo

Rainbow Strip Apple – 1977-1998

Although the Newton plaque was meaningful, Jobs wanted to create a simple, modern logo to reflect the company's business in modern computers and devices.

He also wanted something more compelling to invoke user curiosity to improve brand identity and awareness. The rainbow-striped logo and every other Apple logo have since met this purpose.



Apple Logo

Black Apple – 1998

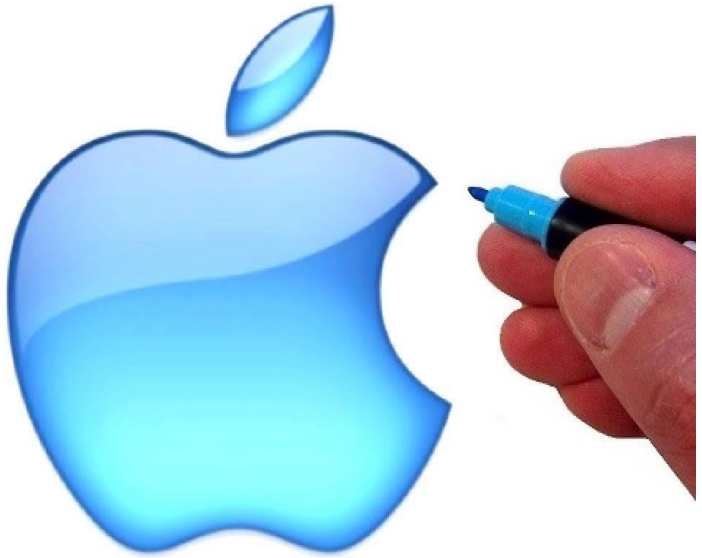
The rainbow-striped Apple logo stayed on until 1998 when Jobs changed it upon returning to the company. During this time, Apple was losing money fast and at risk of closing.

The tech pioneer wanted to portray Apple as a luxury brand and changed the rainbow logo to a blue and translucent emblem, and then in 1998, switched it to plain black. This time, the logo was also thinner and looked more like the company's current emblem.

Apple Logo

The Skeuomorphic Plastic Translucent Apple – 1998

The iMac G3 produced in 1998 instantly stood out for the black apple logo and its blue color and distinct translucent plastic case. It later rolled out in other colors, from lime to tangerine, covering the whole scope of a bright color palette..



Apple Logo

Monochrome Plastic Skeuomorphic Apple – 2001-2007

In 2001, Apple released Cheetah, a MacOS X with a slightly embossed aqua Apple logo.

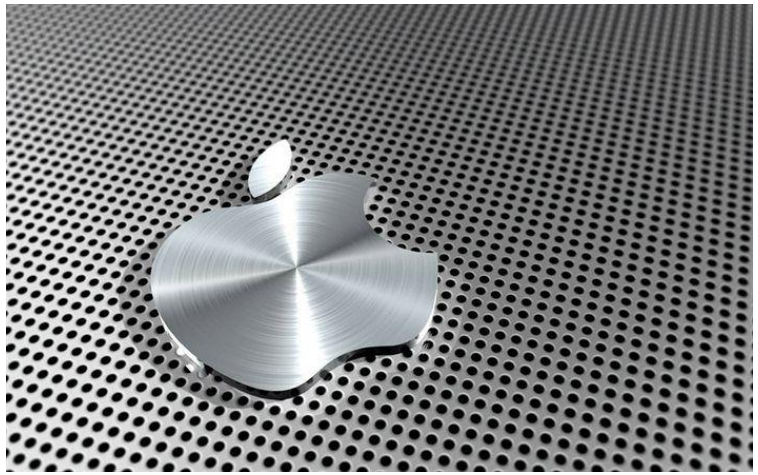
The aqua design lasted until 2007 when Apple switched from a glass-themed to a chrome textured interface signifying the brand's shift toward aluminum-based device models.

Apple Logo

Metallic Apple – 2007-2015

Besides the Apple logo, Apple's approach to computer design has been evolving, too. In 2003, Apple released the Aluminum PowerBook G4, shifting its low-carbon aluminum enclosures from plastic.

After that, the company released the MacBook Air to the MacBook Pro series, all featuring a custom aluminum enclosure. The move was inspired by the desire to achieve a greener Apple, and its success has since seen many other tech companies join in.



Application

How to draw the Apple logo using python turtle with code, so follow this tutorial till the end

Using the turtle module to draw the Apple logo in python.

Turtle is a GUI library with the help of this library you can draw anything in python.

The above command will run the program and it will open a new window and it will start drawing the Apple Logo and below is the finished drawing of the logo.

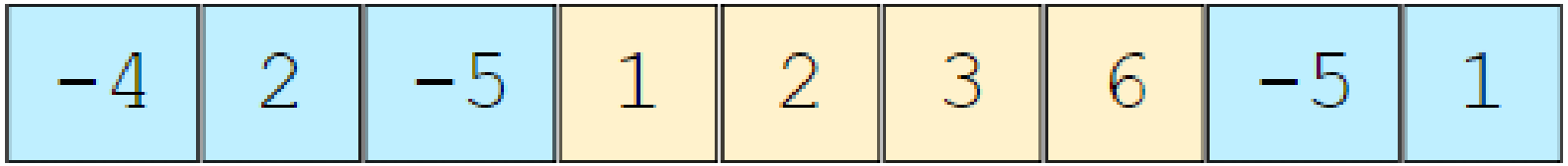
https://pythondex.com/draw-apple-logo-using-python

Top coding questions in the Apple interview

❑ Question 01: Largest Sum Subarray

The goal of this exercise is to use your dynamic programming skills and Kadane's algorithm to find the largest sum subarray.

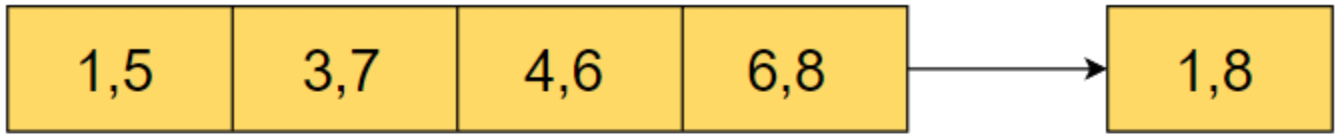
Problem statement: Find the largest sum subarray. In the array below, the largest sum subarray starts at index 3 and ends at 6, and with the largest sum being 12.

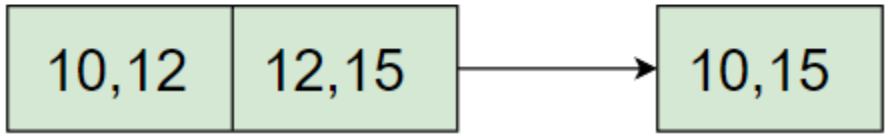


❑ Question 02: Merge overlapping intervals

The goal of this exercise is to merge all the overlapping intervals of a given list to produce a list that has only mutually exclusive intervals.

Problem statement: You have an array (list) of interval pairs as input where each interval has a start and end timestamp, sorted by starting timestamps. Merge the overlapping intervals and return a new output array.





Practices

- Viết flow chart để mô tả quá trình thực hiện chương trình Questions 02.
- Viết code Python để thực hiện và kiểm tra kết quả với input:

Question 02: Merge overlapping intervals

2 4	1 2	4 9	0 3	2 7