

Programming in Biology

MCDB 170

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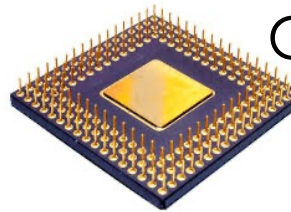
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Course objectives

- General working knowledge in Python (3 wks)
- DNA sequence analysis using string and Biopython (2 wks)
- Using Numpy and Scipy to simulate biological system (2 wks)
- Using Numpy and Scipy to perform statistical analyses of biological data (will be covered if time allows)
- Biological image analysis using scikit-image (will be covered if time allows)

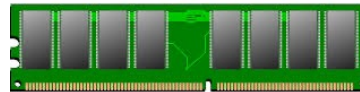
What is programming?

- Writing instructions for computers to perform tasks



CPU

Execute instructions

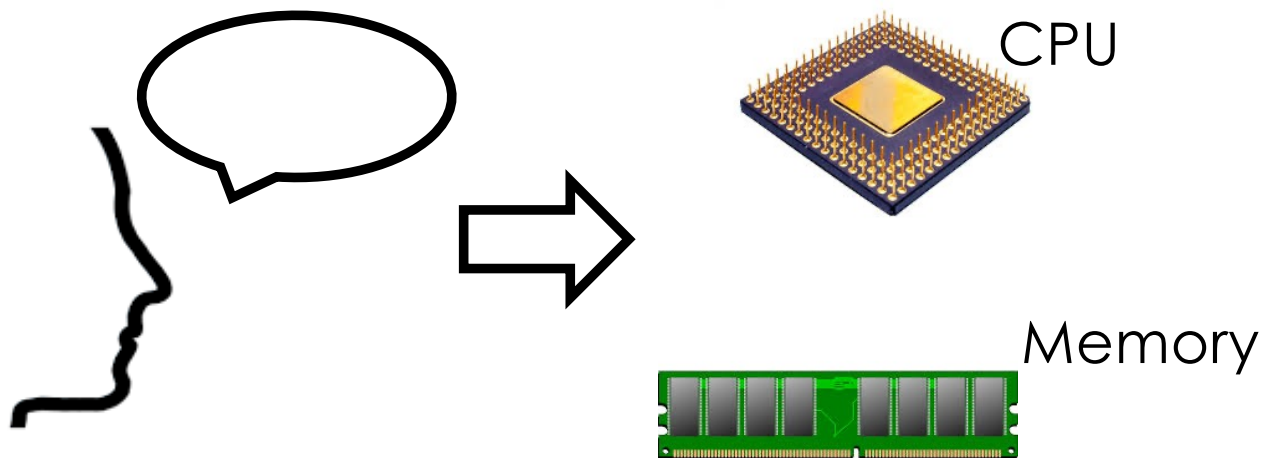


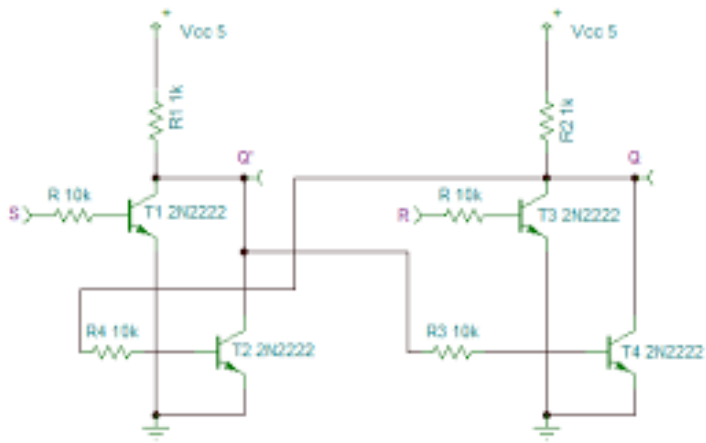
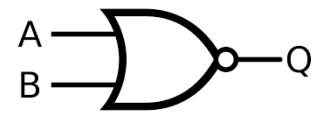
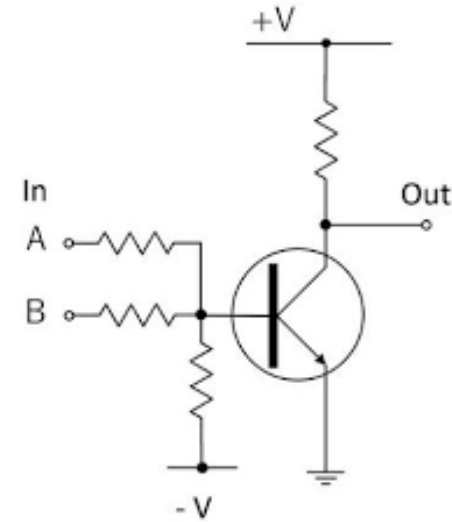
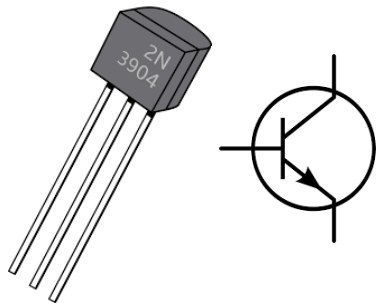
Memory

Data
Instructions

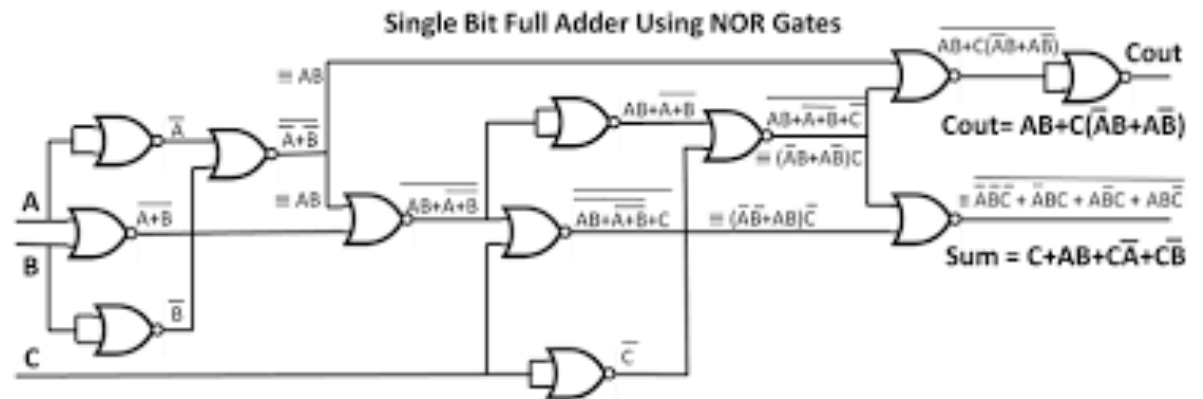
What is programming Language?

- Writing instructions for computers to perform tasks



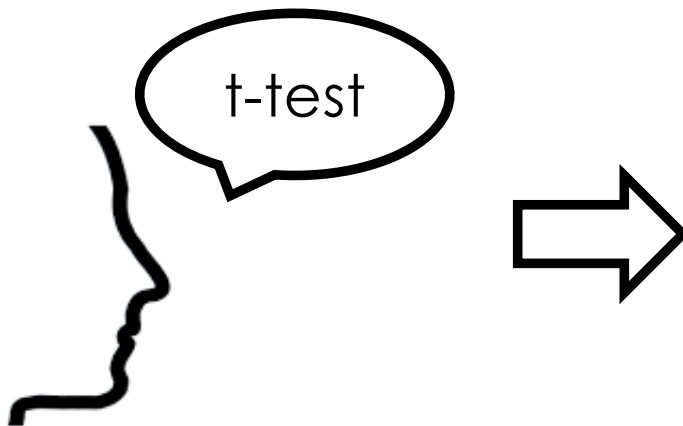


1-bit Memory

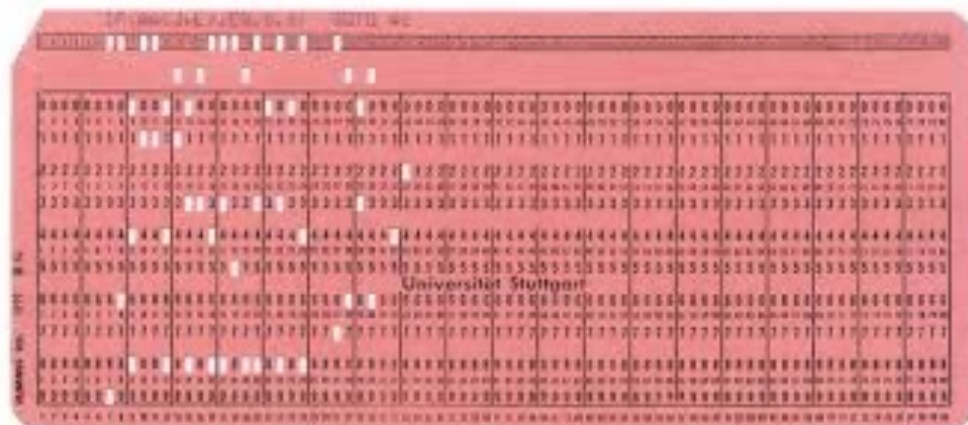


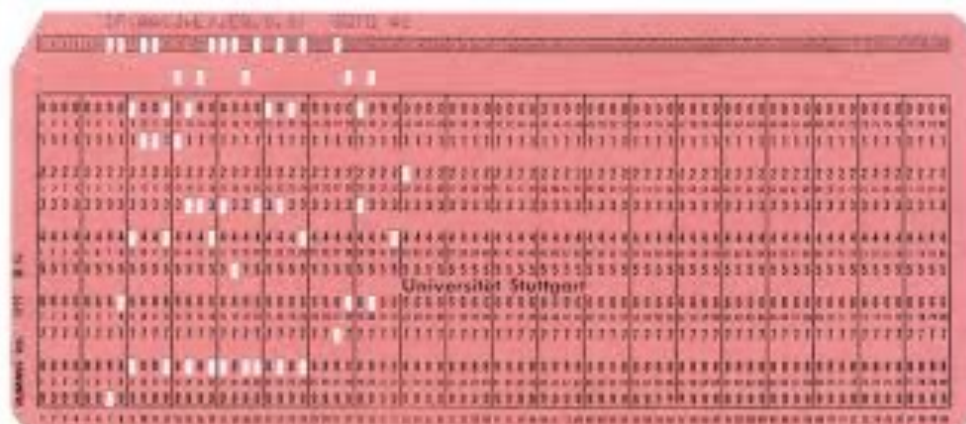
Unit of information: Bit 0 , 1

Computer operations are extremely simple (and bits)



```
00111110000001111001001100010111001010011111111101
1101111100001101011111011000111011111010101100110
110111100001100011010100101110100111100011000100010
11000110111011110111111111010001111101101111110
11111001101110111000111011101011101000111110111110
11001101111101100010010000001011101110111011111111
11111000111110001111111111100111100111110010111111
0111110110011011110111110101111101111110110011010
11111110001111100010100101000111101111011010011101
0001111111101100010100001111001000000011100100100011
1011111001111110101111100010111011100000100111110
01110000111011101111001111100111111100110000010111
101110110100001001100110001110111000011001000000110011
1101100110001010111011010001111010001101011110010111
111111110011000111100111101010000110100111000100100010
111010000101110011111100000111101111101111010111100
11100100110101111111100111111111111110010101111111
00000000011111110000110011110110010001101101101010001
01000100111111100111111111111001111100011110011110101
010001111001001111110000101111011100110111110110011111
```



```

push ebp
mov ebp, esp
mov eax, [ebp+0x08]
fld tword [eax]
mov ecx, [ebp+0x0C]
fld tword [ecx]
faddp
mov edx, [ebp+0x10]
fstp tword [edx]
fld tword [eax+0x0A]
fld tword [ecx+0x0A]
faddp
fstp tword [edx+0x0A]
pop ebp
ret 0x000C

```

```

PIN=0.02
IF (DDT.NE.0.0) THEN
DT=DDT
ELSE
DT=PIN
ENDIF
WRITE(*,'(A)') '      PLEASE ENTER NAME OF OUTPUT FILE
*  B:ZZ.DAT)'
READ(*,'(A)') FNAMEO
OPEN(6,FILE=FNAMEO,STATUS='UNKNOWN')
PV=WFLX/TH
RS=NEQ*ROU*KD/TH
C0=CS

```

```

#include <stdio.h>

```

```

main()
{
    printf("hello, world\n");
}

```

```

push ebp
mov ebp, esp
mov eax, [ebp+0x08]
fld tword [eax]
mov ecx, [ebp+0x0C]
fld tword [ecx]
faddp
mov edx, [ebp+0x10]
fstp tword [edx]
fld tword [eax+0x0A]
fld tword [ecx+0x0A]
faddp
fstp tword [edx+0x0A]
pop ebp
ret 0x000C

```

Compiled Languages

C/C++

Fortran

Java

etc

Interpretable Languages

Python – in almost all science

Matlab – Most engineering and some biology

R – in almost all statistics

Perl – Extensively used in Human Genome project

Ruby

etc

Why Python?

- Easy to learn: Syntax is very human friendly
- Extremely popular in every field of science
- Mature scientific libraries (Numpy, Scipy)
- Easy-to-learn programming environment (JupyterLab)

What you need to do Python programming

- Chrome browser
- UCSB NetID
- Connect to <http://mcdb170.isit.ucsb.edu/>

Required reading (& watching)

- JupyterLab basics
 - <https://youtu.be/A5YyoCKxEQU>
- Interface, file operations, and notebook basics.
 - <https://jupyterlab.readthedocs.io/en/stable/user/interface.html>
 - <https://jupyterlab.readthedocs.io/en/stable/user/files.html>
 - https://jupyterlab.readthedocs.io/en/stable/user/file_editor.html
 - <https://jupyterlab.readthedocs.io/en/stable/user/notebook.html>