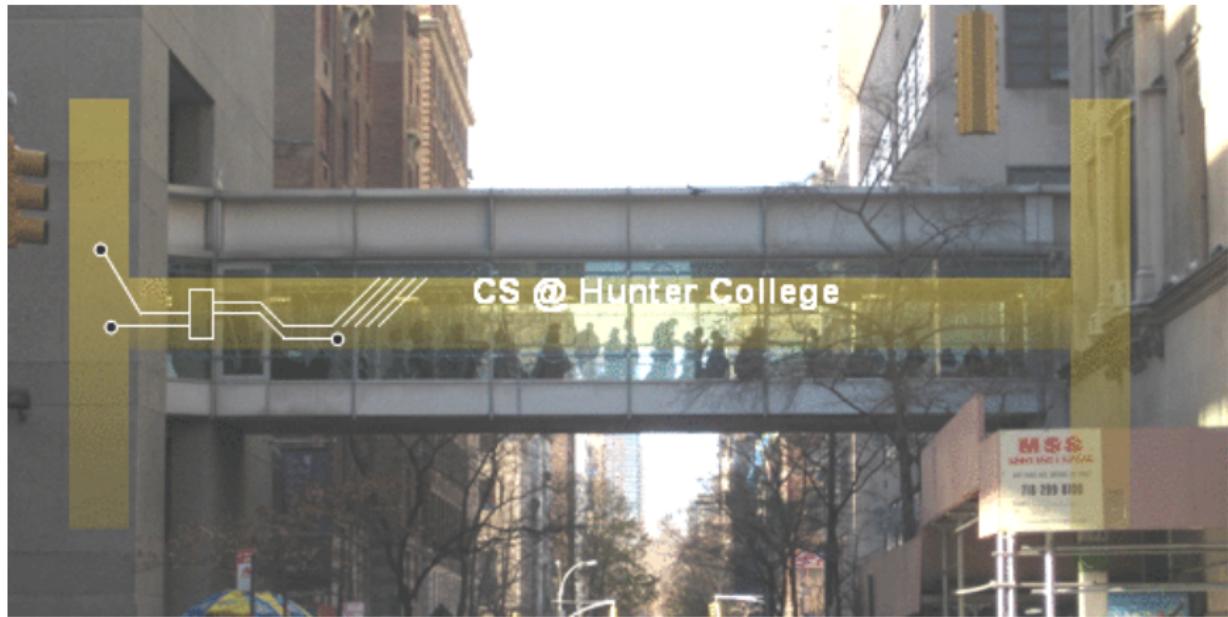


CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

Announcements

M	T	W	Th	F
8/27 L1	8/28 L1	8/29 L1 Lecture 1	8/30 L1	8/31 L1
Labor Day	9/4 L2	M L2	9/6 L2	9/8 L2
No class	No class	9/12 L2 Lecture 2	9/13 L3	9/14 L3
9/17 L3	No class	No class	9/20 L4	9/21 L4
9/24 L4	9/25 L3	9/26 L3 Lecture 3	9/27 L5	9/28 L5
10/1 L5	10/2 L4	10/3 L4 Lecture 5	10/4 L6	10/5 L6
Columbus Day	10/9 L5	10/10 L5 Lecture 5	10/11 L7	10/12 L7
10/15 L6	10/16 L6	10/17 L6 Lecture 6	10/18 L8	10/19 L8
10/22 L7	10/23 L7	10/24 L7 Lecture 7	10/25 L9	10/27 L9
10/29 L8	10/30 L8	10/31 L8 Lecture 8	11/1 L10	11/2 L10
11/5 L9	11/6 L9	11/7 L9 Lecture 9	11/8 L11	11/9 L11
11/12 L10	11/13 L10	11/14 L10 Lecture 10	11/15 L12	11/16 L12
11/19 L11	11/20 L11	11/21 L11 Lecture 11	TG Recess	TG Recess
11/26 L12	11/27 L12	11/28 L12 Lecture 12	11/29 L13	11/30 L13
12/3 L13	12/4 L13	12/5 L13 Lecture 13	12/6 L14	12/7 L14
12/10 L14	12/11 L14	12/12 L14 Lecture 14	Reading Day	

- No more holidays until October!

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- Starting this week, each lecture will include a survey of computing research and the tech industry in NYC.
- Today: Prof. William Sakas, Chair of Computer Science: Computational Linguistics.

Frequently Asked Questions

From lecture slips & recitation sections.

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- Could we do more final problems?

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We'll start with some today since we didn't get to them last lecture.



Today's Topics



- Arithmetic
- Indexing and Slicing Lists
- Colors
- Hexadecimal Notation
- 2D Arrays & Image Files

Practice Quiz & Final Questions



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 - ▶ write as much you can for 60 seconds;

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- We're starting with Spring 2018, Mock Exam.

Arithmetic

Some arithmetic operators in Python:

- Addition:



Arithmetic

Some arithmetic operators in Python:

- Addition: `sum = sum + 3`



Arithmetic

Some arithmetic operators in Python:

- Addition: `sum = sum + 3`
- Subtraction:



Arithmetic

Some arithmetic operators in Python:

- Addition: `sum = sum + 3`
- Subtraction: `deb = deb - item`



Arithmetic

Some arithmetic operators in Python:

- Addition: `sum = sum + 3`
- Subtraction: `deb = deb - item`
- Multiplication:



Arithmetic

Some arithmetic operators in Python:

- Addition: `sum = sum + 3`
- Subtraction: `deb = deb - item`
- Multiplication: `area = h * w`



Arithmetic



Some arithmetic operators in Python:

- Addition: `sum = sum + 3`
- Subtraction: `deb = deb - item`
- Multiplication: `area = h * w`
- Division:

Arithmetic



Some arithmetic operators in Python:

- Addition: `sum = sum + 3`
- Subtraction: `deb = deb - item`
- Multiplication: `area = h * w`
- Division: `ave = total / n`

Arithmetic



Some arithmetic operators in Python:

- Addition: `sum = sum + 3`
- Subtraction: `deb = deb - item`
- Multiplication: `area = h * w`
- Division: `ave = total / n`
- Floor or Integer Division:

Arithmetic



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- Floor or Integer Division:
`weeks = totalDays // 7`

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- Remainder or Modulus:

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`weeks = totalDays // 7`
- Remainder or Modulus:
`days = totalDays % 7`
- Exponentiation:
`pop = 2**time`

In Pairs or Triples...

Mostly review:

```
1 for d in range(10, 0, -1):
2     print(d)
3 print("Blast off!")
4
5 for num in range(5,8):
6     print(num, 2*num)
7
8 s = "City University of New York"
9 print(s[3], s[0:3], s[:3])
10 print(s[5:8], s[-1])
11
12 names = ["Eleanor", "Anna", "Alice", "Edith"]
13 for n in names:
14     print(n)
```

Python Tutor

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(Demo with pythonTutor)

Review: range()



The three versions:

Review: range()



The three versions:

- range(stop)

Review: range()



The three versions:

- `range(stop)`
- `range(start, stop)`

Review: range()



The three versions:

- `range(stop)`
- `range(start, stop)`
- `range(start, stop, step)`

range()

What if you wanted to count by twos, or some other number:

```
1 #Predict what will be printed:  
2  
3 for num in [2,4,6,8,10]:  
4     print(num)  
5  
6 sum = 0  
7 for x in range(0,12,2):  
8     print(x)  
9     sum = sum + x  
10  
11 print(x)  
12  
13 for c in "ABCD":  
14     print(c)
```

range()

What if you wanted to count by twos, or some other number:

- range(start, stop, step)

```
1 #Predict what will be printed:  
2  
3 for num in [2,4,6,8,10]:  
4     print(num)  
5  
6 sum = 0  
7 for x in range(0,12,2):  
8     print(x)  
9     sum = sum + x  
10  
11 print(x)  
12  
13 for c in "ABCD":  
14     print(c)
```

range()

What if you wanted to count by twos, or some other number:

- `range(start, stop, step)`
- Produces a list:
[start, start+step, start+2*step..., last]
(where last is the largest start+k*step less than stop)

```
1 #Predict what will be printed:
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3 for num in [2,4,6,8,10]:
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7 for x in range(0,12,2):
8     print(x)
9     sum = sum + x
10
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13 for c in "ABCD":
14     print(c)
```

range()

What if you wanted to count by twos, or some other number:

- `range(start, stop, step)`
- Produces a list:
[start, start+step, start+2*step..., last]
(where last is the largest start+k*step less than stop)
- For example, if you want the list [5,10,...,50]
you would write:

```
1 #Predict what will be printed:
2
3 for num in [2,4,6,8,10]:
4     print(num)
5
6 sum = 0
7 for x in range(0,12,2):
8     print(x)
9     sum = sum + x
10
11 print(x)
12
13 for c in "ABCD":
14     print(c)
```

range()

What if you wanted to count by twos, or some other number:

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1 #Predict what will be printed:  
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3 for num in [2,4,6,8,10]:  
4     print(num)  
5  
6 sum = 0  
7 for x in range(0,12,2):  
8     print(x)  
9     sum = sum + x  
10  
11 print(x)  
12  
13 for c in "ABCD":  
14     print(c)
```

- `range(start, stop, step)`
- Produces a list:
 $[start, start+step, start+2*step\dots, \text{last}]$
(where last is the largest $\text{start}+k*\text{step}$ less than stop)
- For example, if you want the list $[5,10,\dots,50]$
you would write:

`range(5,51,5)`

Slices

- Similar to `range()`, you can take portions or **slices** of lists and strings:

```
1 for d in range(10, 0, -1):
2     print(d)
3 print("Blast off!")
4
5 for num in range(5,8):
6     print(num, 2*num)
7
8 s = "City University of New York"
9 print(s[3], s[0:3], s[:3])
10 print(s[5:8], s[-1])
11
12 names = ["Eleanor", "Anna", "Alice", "Edith"]
13 for n in names:
14     print(n)
```

Slices

- Similar to `range()`, you can take portions or **slices** of lists and strings:

`s[5:8]`

gives: "Uni"

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1 for d in range(10, 0, -1):
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3 print("Blast off!")
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6     print(num, 2*num)
7
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9 print(s[3], s[0:3], s[:3])
10 print(s[5:8], s[-1])
11
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14     print(n)
```

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9 print(s[3], s[0:3], s[:3])
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11
12 names = ["Eleanor", "Anna", "Alice", "Edith"]
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14     print(n)
```

gives: "Uni"

- Also works for lists:

Slices

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`s[5:8]`

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1 for d in range(10, 0, -1):
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3 print("Blast off!")
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5 for num in range(5,8):
6     print(num, 2*num)
7
8 s = "City University of New York"
9 print(s[3], s[0:3], s[:3])
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12 names = ["Eleanor", "Anna", "Alice", "Edith"]
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```

gives: "Uni"

- Also works for lists:

`names[1:3]`

Slices

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`s[5:8]`

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1 for d in range(10, 0, -1):
2     print(d)
3 print("Blast off!")
4
5 for num in range(5,8):
6     print(num, 2*num)
7
8 s = "City University of New York"
9 print(s[3], s[0:3], s[:3])
10 print(s[5:8], s[-1])
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12 names = ["Eleanor", "Anna", "Alice", "Edith"]
13 for n in names:
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```

gives: "Uni"

- Also works for lists:

`names[1:3]`

gives: ["Anna", "Alice"]

Slices

- Similar to `range()`, you can take portions or **slices** of lists and strings:

`s[5:8]`

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1 for d in range(10, 0, -1):
2     print(d)
3 print("Blast off!")
4
5 for num in range(5,8):
6     print(num, 2*num)
7
8 s = "City University of New York"
9 print(s[3], s[0:3], s[:3])
10 print(s[5:8], s[-1])
11
12 names = ["Eleanor", "Anna", "Alice", "Edith"]
13 for n in names:
14     print(n)
```

gives: "Uni"

- Also works for lists:

`names[1:3]`

gives: ["Anna", "Alice"]

- Python also lets you “count backwards”: last element has index: `-1`.

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

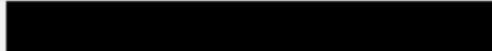
- Can specify by name.

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by name.
- Can specify by numbers:

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by name.
- Can specify by numbers:
 - ▶ Amount of Red, Green, and Blue (RGB).

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

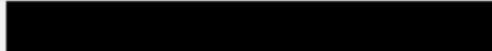
- Can specify by name.
- Can specify by numbers:
 - ▶ Amount of Red, Green, and Blue (RGB).
 - ▶ Adding light, not paint:

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by name.
- Can specify by numbers:
 - ▶ Amount of Red, Green, and Blue (RGB).
 - ▶ Adding light, not paint:
 - ★ Black: 0% red, 0% green, 0% blue

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by name.
- Can specify by numbers:
 - ▶ Amount of Red, Green, and Blue (RGB).
 - ▶ Adding light, not paint:
 - ★ Black: 0% red, 0% green, 0% blue
 - ★ White: 100% red, 100% green, 100% blue

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by numbers (RGB):

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by numbers (RGB):
 - ▶ Fractions of each:

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by numbers (RGB):
 - ▶ Fractions of each:
e.g. (1.0, 0, 0) is 100% red, no green, and no blue.

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by numbers (RGB):
 - ▶ Fractions of each:
e.g. (1.0, 0, 0) is 100% red, no green, and no blue.
 - ▶ 8-bit colors: numbers from 0 to 255:

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by numbers (RGB):
 - ▶ Fractions of each:
e.g. (1.0, 0, 0) is 100% red, no green, and no blue.
 - ▶ 8-bit colors: numbers from 0 to 255:
e.g. (0, 255, 0) is no red, 100% green, and no blue.

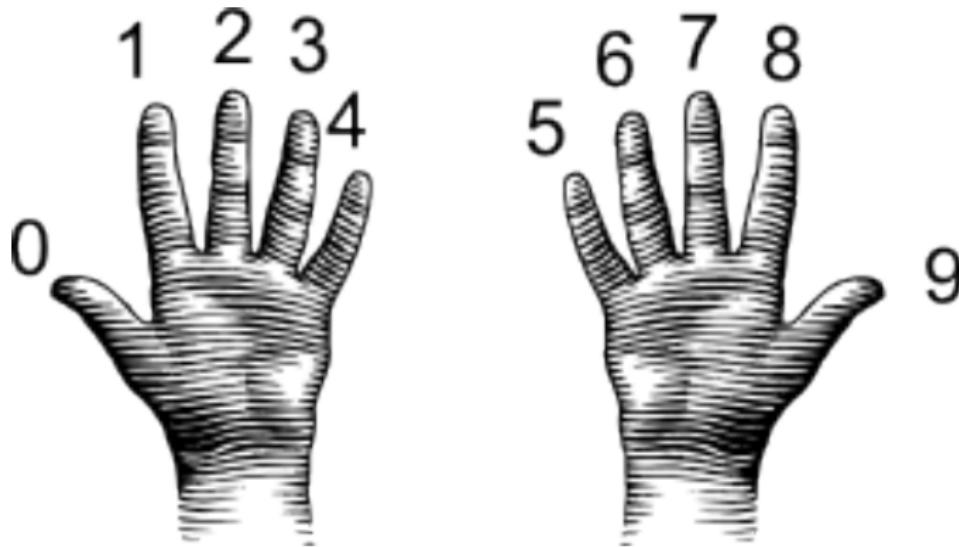
Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by numbers (RGB):
 - ▶ Fractions of each:
e.g. (1.0, 0, 0) is 100% red, no green, and no blue.
 - ▶ 8-bit colors: numbers from 0 to 255:
e.g. (0, 255, 0) is no red, 100% green, and no blue.
 - ▶ Hexcodes (base-16 numbers)...

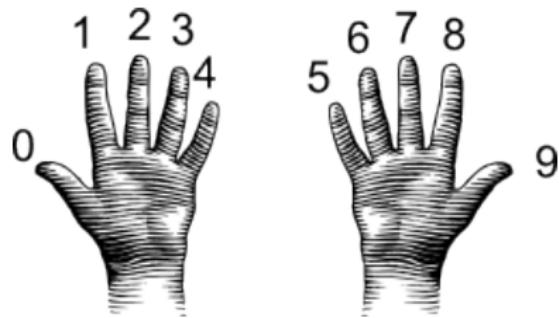
Decimal & Hexadecimal Numbers

Counting with 10 digits:



(from i-programmer.info)

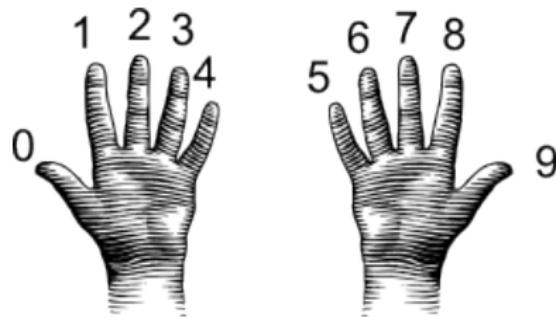
Decimal



(from i-programmer.info)

Decimal

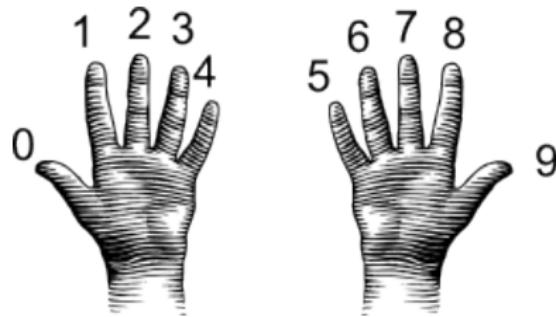
00 01 02 03 04 05 06 07 08 09



(from i-programmer.info)

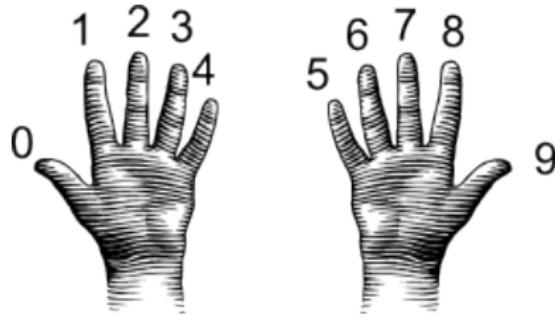
Decimal

00 01 02 03 04 05 06 07 08 09
10 11 12 13 14 15 16 17 18 19



(from i-programmer.info)

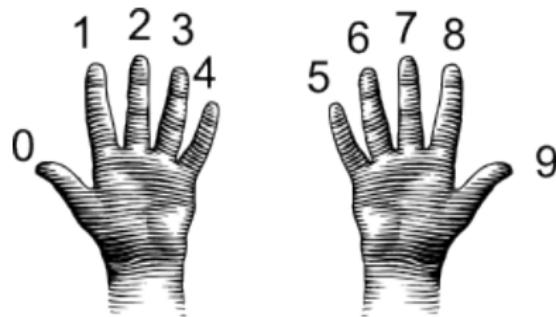
Decimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29

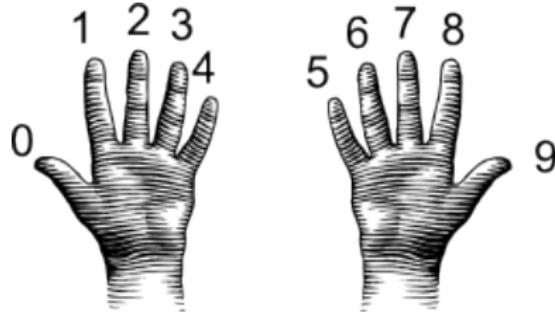
Decimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39

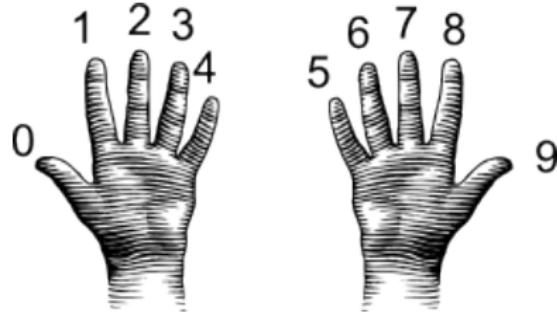
Decimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49

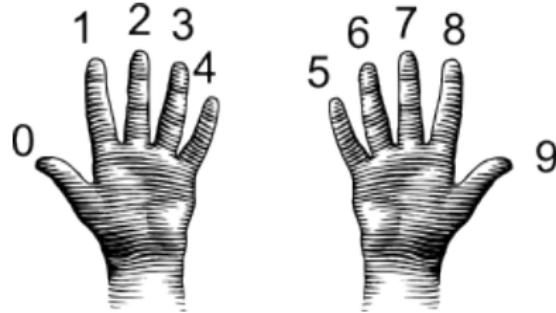
Decimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59

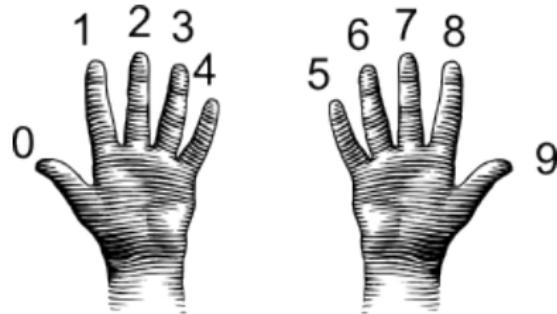
Decimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69

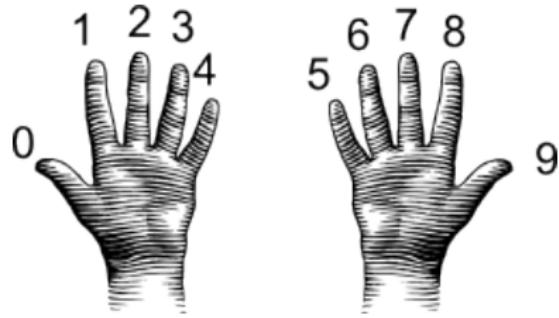
Decimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79

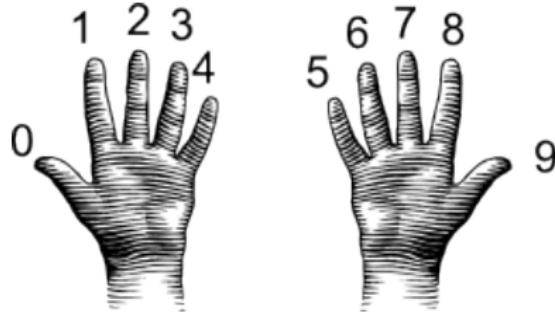
Decimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89

Decimal

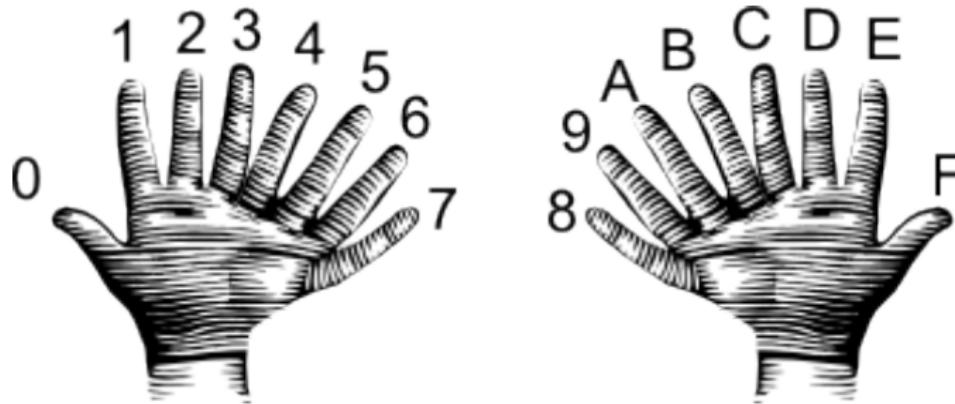


(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

Decimal & Hexadecimal Numbers

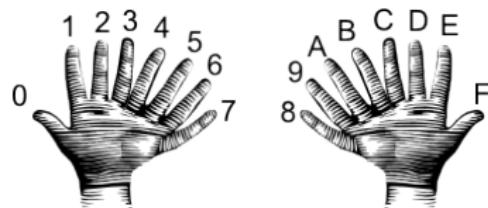
Counting with 16 digits:



(from i-programmer.info)

Hexadecimal

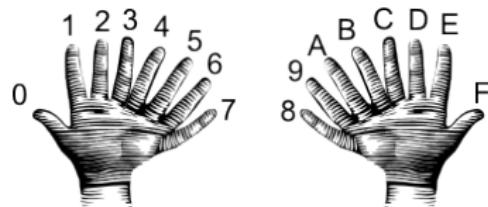
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F



(from i-programmer.info)

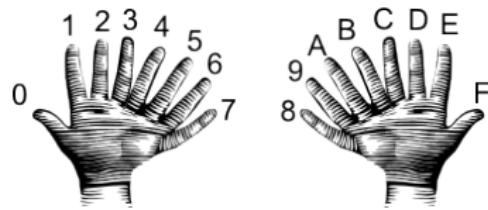
Hexadecimal

00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F



(from i-programmer.info)

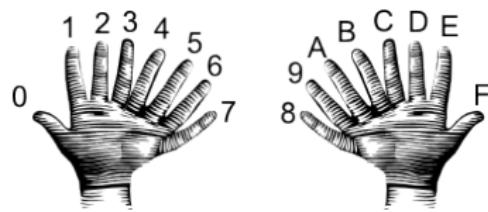
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F

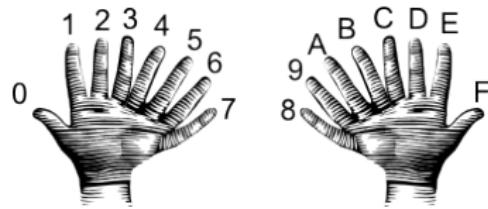
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F

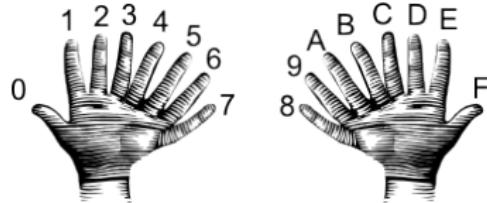
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

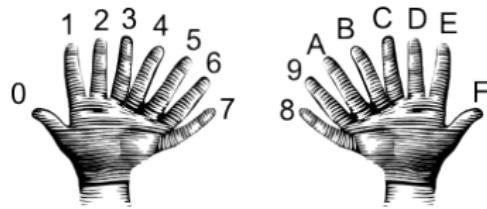
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F

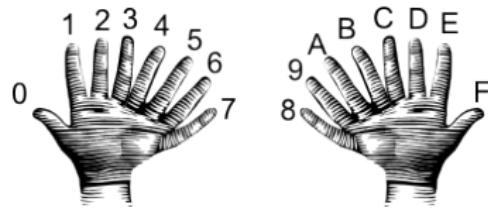
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F

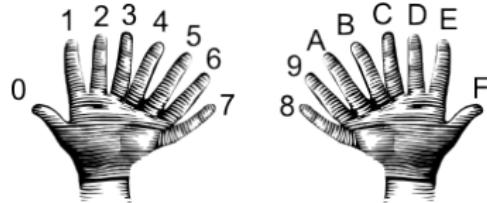
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F

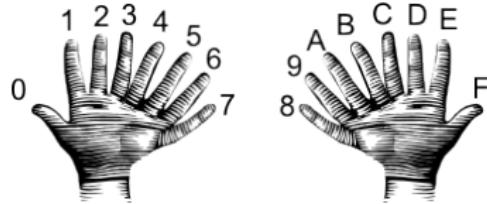
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F

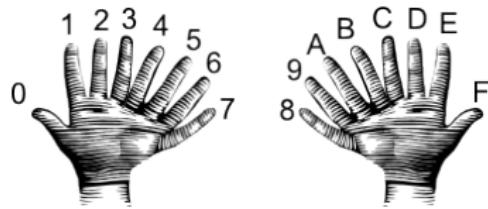
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F

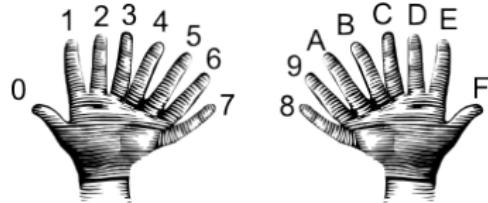
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F
A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF

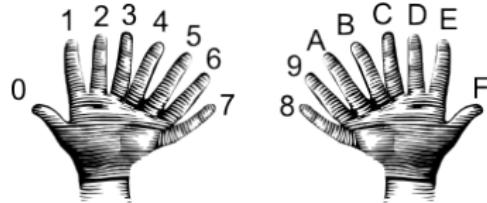
Hexadecimal



(from i-programmer.info)

00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F
30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F
40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F
50 51 52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F
60 61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F
70 71 72 73 74 75 76 77 78 79 7A 7B 7C 7D 7E 7F
80 81 82 83 84 85 86 87 88 89 8A 8B 8C 8D 8E 8F
90 91 92 93 94 95 96 97 98 99 9A 9B 9C 9D 9E 9F
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 AA AB AC AD AE AF
B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 BA BB BC BD BE BF

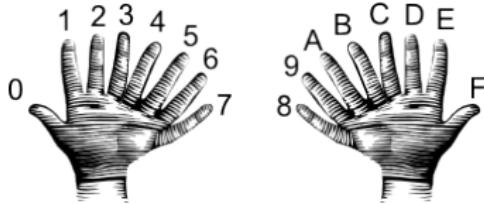
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F
A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF

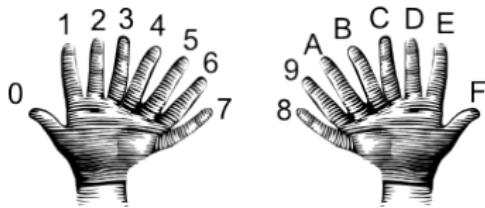
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
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90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F
A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF

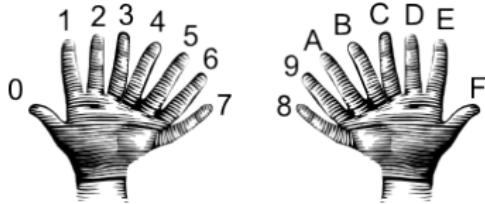
Hexadecimal



(from i-programmer.info)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
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80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F
A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF
E0	E1	E2	E3	E4	E5	E6	E7	E8	E9	EA	EB	EC	ED	EE	EF

Hexadecimal



(from i-programmer.info)

```
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F
30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F
40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F
50 51 52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F
60 61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F
70 71 72 73 74 75 76 77 78 79 7A 7B 7C 7D 7E 7F
80 81 82 83 84 85 86 87 88 89 8A 8B 8C 8D 8E 8F
90 91 92 93 94 95 96 97 98 99 9A 9B 9C 9D 9E 9F
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 AA AB AC AD AE AF
B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 BA BB BC BD BE BF
C0 C1 C2 C3 C4 C5 C6 C7 C8 C9 CA CB CC CD CE CF
D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 DA DB DC DD DE DF
E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF
F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 FA FB FC FD FE FF
```

Colors

Color Name	HEX	Color
<u>Black</u>	<u>#000000</u>	
<u>Navy</u>	<u>#000080</u>	
<u>DarkBlue</u>	<u>#00008B</u>	
<u>MediumBlue</u>	<u>#0000CD</u>	
<u>Blue</u>	<u>#0000FF</u>	

- Can specify by numbers (RGB):
 - ▶ Fractions of each:
e.g. (1.0, 0, 0) is 100% red, no green, and no blue.
 - ▶ 8-bit colors: numbers from 0 to 255:
e.g. (0, 255, 0) is no red, 100% green, and no blue.
 - ▶ Hexcodes (base-16 numbers):

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<u>Black</u>	<u>#000000</u>	
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e.g. (0, 255, 0) is no red, 100% green, and no blue.
 - ▶ Hexcodes (base-16 numbers):
e.g. #0000FF is no red, no green, and 100% blue.

In Pairs or Triples...

Some review and some novel challenges:

```
1 import turtle
2 teddy = turtle.Turtle()
3
4 names = ["violet", "purple", "indigo", "lavender"]
5 for c in names:
6     teddy.color(c)
7     teddy.left(60)
8     teddy.forward(40)
9     teddy.dot(10)
10
11 teddy.penup()
12 teddy.forward(100)
13 teddy.pendown()
14
15 hexNames = ["#FF00FF", "#990099", "#550055", "#111111"]
16 for c in hexNames:
17     teddy.color(c)
18     teddy.left(60)
19     teddy.forward(40)
20     teddy.dot(10)
```

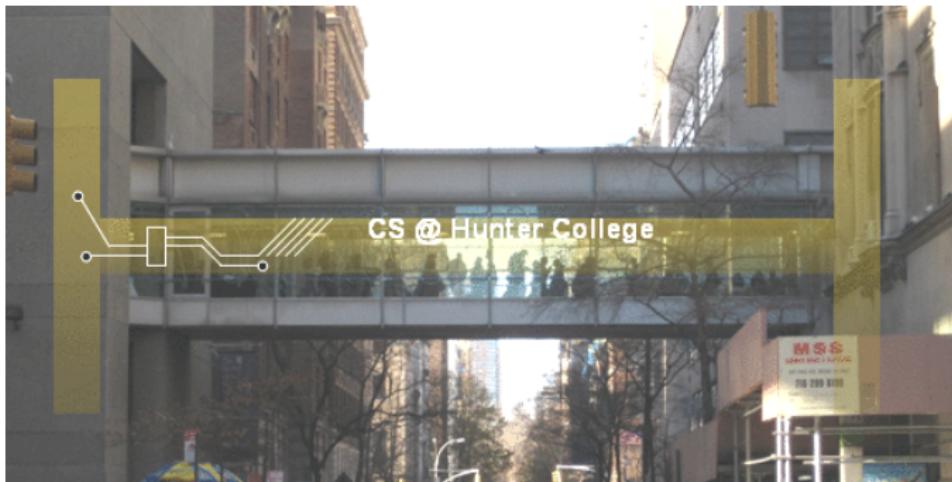


Trinkets

```
1 import turtle
2 teddy = turtle.Turtle()
3
4 names = ["violet", "purple", "indigo", "lavender"]
5 for c in names:
6     teddy.color(c)
7     teddy.left(60)
8     teddy.forward(40)
9     teddy.dot(10)
10
11 teddy.penup()
12 teddy.forward(100)
13 teddy.pendown()
14
15 hexNames = ["#FF00FF", "#990099", "#550055", "#111111"]
16 for c in hexNames:
17     teddy.color(c)
18     teddy.left(60)
19     teddy.forward(40)
20     teddy.dot(10)
```

(Demo with trinkets)

Images



Images



- We will use the standard portable network graphics (PNG) file format.

Images



- We will use the standard portable network graphics (PNG) file format.
- Saves every picture element (or 'pixel') –

Images



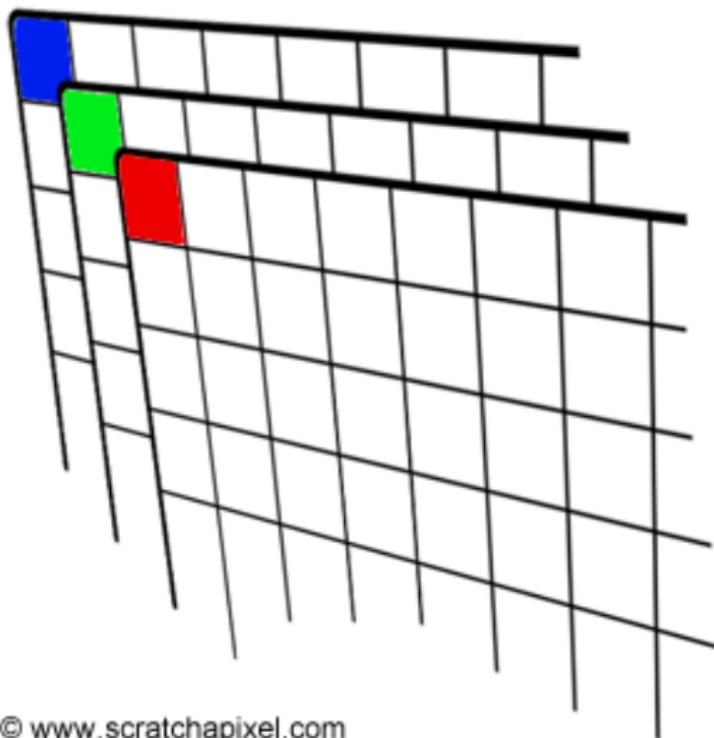
- We will use the standard portable network graphics (PNG) file format.
- Saves every picture element (or 'pixel')— often called a lossless format.

Images



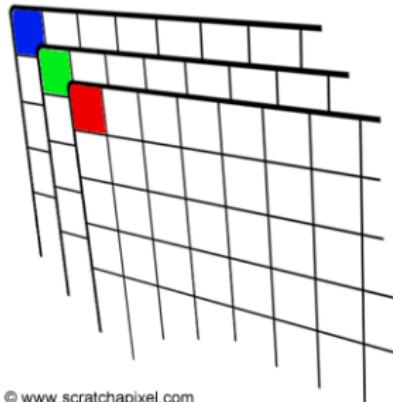
- We will use the standard portable network graphics (PNG) file format.
- Saves every picture element (or 'pixel')— often called a lossless format.
- Keeps track of the amount of red, blue, and green of each pixel.

Images



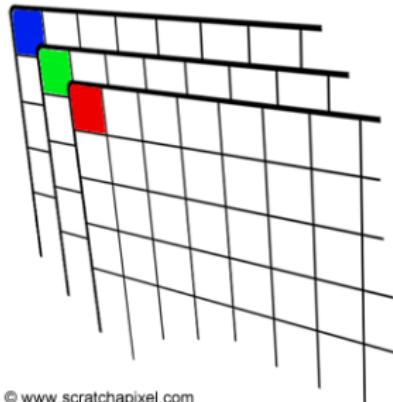
© www.scratchapixel.com

Images



© www.scratchapixel.com

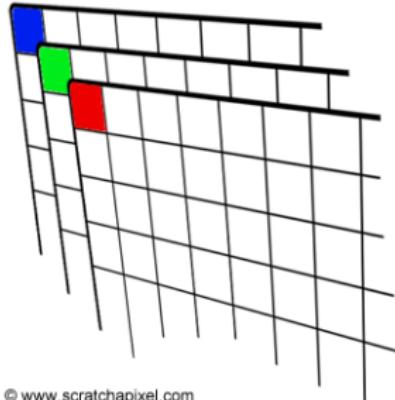
Images



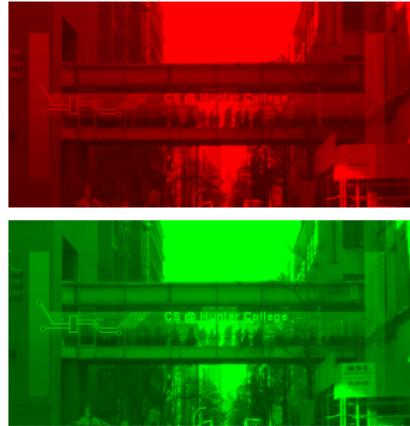
© www.scratchapixel.com



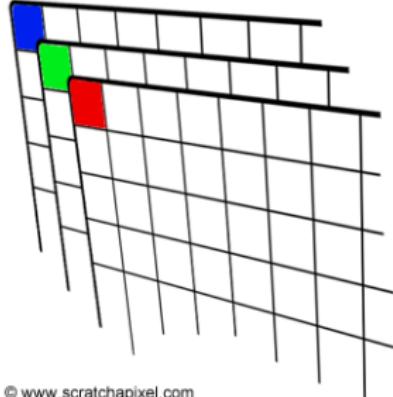
Images



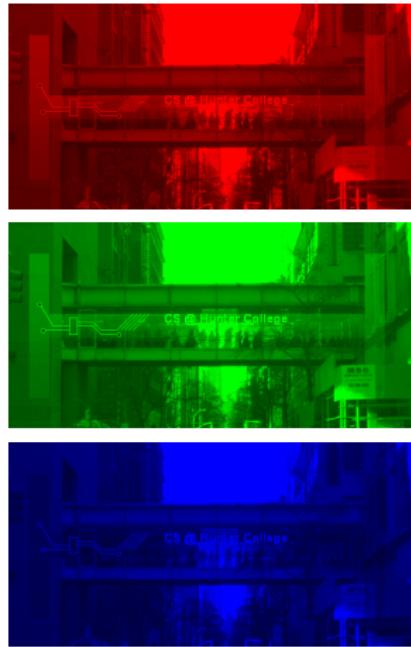
© www.scratchapixel.com



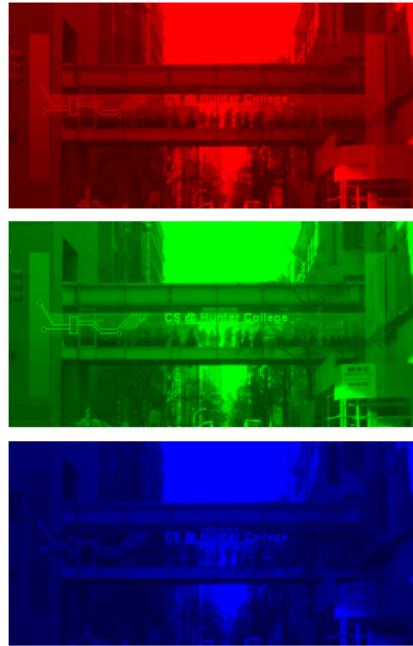
Images



© www.scratchapixel.com

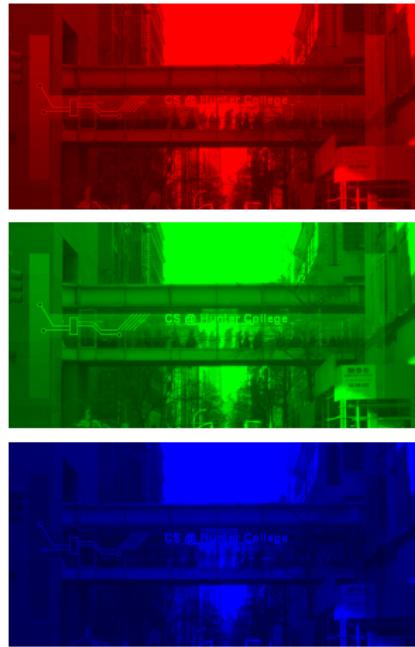


Useful Packages



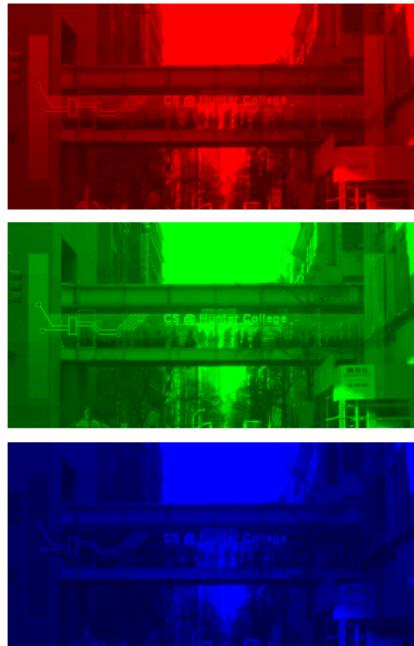
- We will use 2 useful packages for images:

Useful Packages



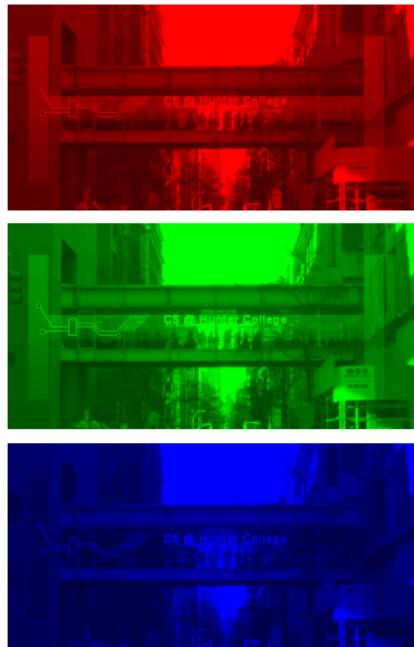
- We will use 2 useful packages for images:
 - ▶ numpy: numerical analysis package

Useful Packages



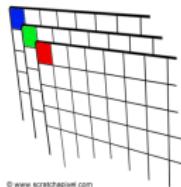
- We will use 2 useful packages for images:
 - ▶ numpy: numerical analysis package
 - ▶ pyplot: part of matplotlib for making graphs and plots

Useful Packages



- We will use 2 useful packages for images:
 - ▶ numpy: numerical analysis package
 - ▶ pyplot: part of matplotlib for making graphs and plots
- See lab notes for installing on your home machine.

Images with pyplot and numpy



© www.scratchapixel.com

```
#Import the packages for images and arrays:  
import matplotlib.pyplot as plt  
import numpy as np  
  
img = plt.imread('csBridge.png')      #Read in image from csBridge.png  
plt.imshow(img)                      #Load image into pyplot  
plt.show()                           #Show the image (waits until close)  
  
img2 = img.copy()                   #make a copy of our image  
img2[:, :, 1] = 0                  #Set the green channel to 0  
img2[:, :, 2] = 0                  #Set the blue channel to 0  
  
plt.imshow(img2)                   #Load our new image into pyplot  
plt.show()                           #Show the image (waits until closed to continue)  
  
plt.imsave('reds.png', img2)        #Save the image we created to the file:
```

More on numpy arrays

```
>>> a[0,3:5]
```

```
array([3,4])
```

```
>>> a[4:,:4]
```

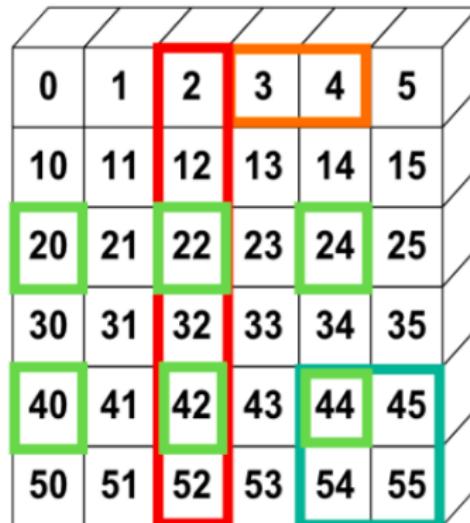
```
array([[44, 45],  
       [54, 55]])
```

```
>>> a[:,2]
```

```
array([2,12,22,32,42,52])
```

```
>>> a[2::2,:,:2]
```

```
array([[20,22,24],  
      [40,42,44]])
```



numpy tutorial

In Pairs or Triples...

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

- ① Design a 10 by 10 logo for Hunter College that contains a purple 'H'.

In Pairs or Triples...

	0	1	2	3	4	5	6	7	8	9
0										
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- ① Design a 10 by 10 logo for Hunter College that contains a purple 'H'.
- ② Your logo should only contain the colors purple and white.

In Pairs or Triples...

	0	1	2	3	4	5	6	7	8	9
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- ① Design a 10 by 10 logo for Hunter College that contains a purple 'H'.
- ② Your logo should only contain the colors purple and white.
- ③ How can you make Python draw the logo?
Write down a "To Do" list of things you need to do.

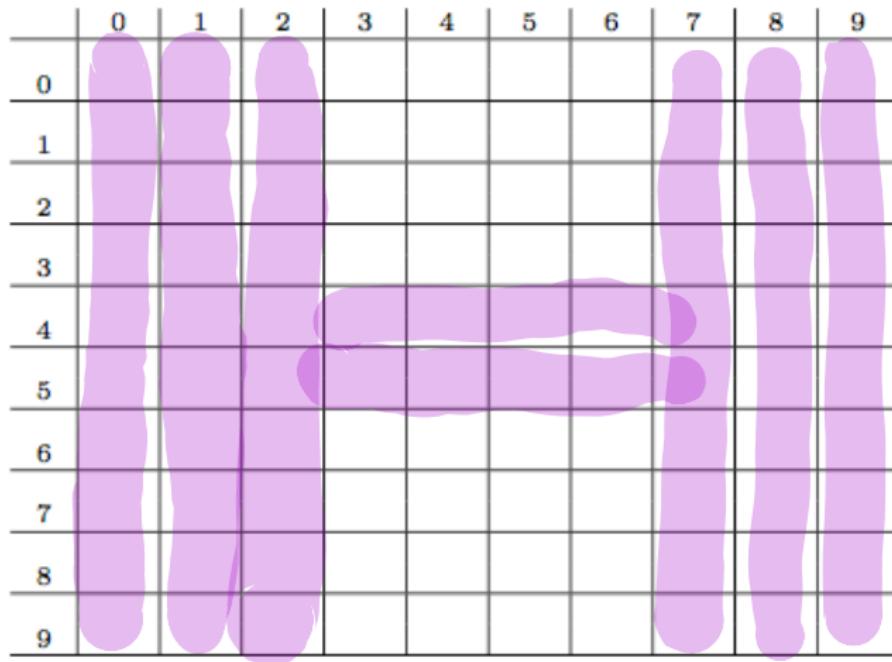
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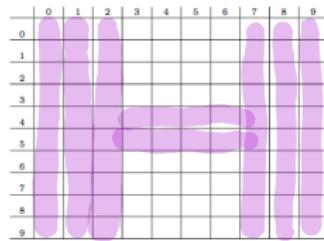
- ① Design a 10 by 10 logo for Hunter College that contains a purple 'H'.
- ② Your logo should only contain the colors purple and white.
- ③ How can you make Python draw the logo?
Write down a "To Do" list of things you need to do.
- ④ If time, refine your steps above into a Python program.

Design a Hunter Logo

One possible solution:

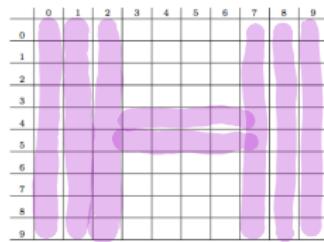


Design a Hunter Logo



- ① Create a 10 by 10 array, logo, that starts out as all white pixels.

Design a Hunter Logo



- ① Create a 10 by 10 array, logo, that starts out as all white pixels.
- ② Set the 3 left columns to be purple.

Design a Hunter Logo

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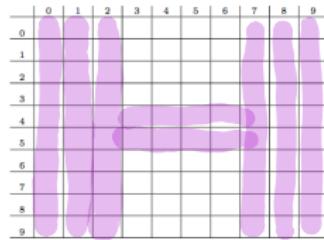
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Design a Hunter Logo



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- ② Set the 3 left columns to be purple.
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- ⑤ Save logo array to a file.

Translating the Design to Code

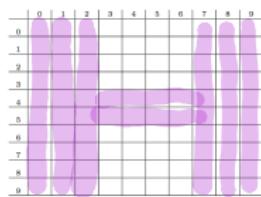
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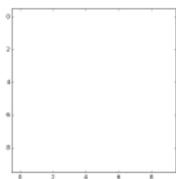
```
import matplotlib.pyplot as plt #import libraries for plotting
import numpy as np #and for arrays (to hold images)
logoImg = np.ones((10,10,3)) #10x10 array with 3 sheets of 1's
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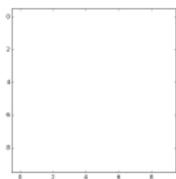


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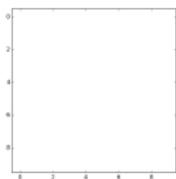
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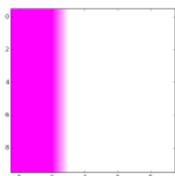
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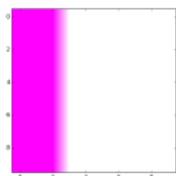
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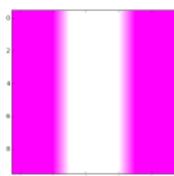
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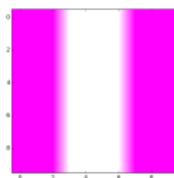
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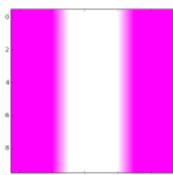
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```
logoImg[4:6, :, 1] = 0 #Turn the green to 0 for middle rows
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- ① Create a 10 by 10 array, logo, that starts out as all white pixels.

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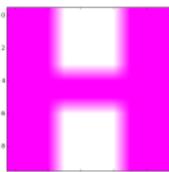
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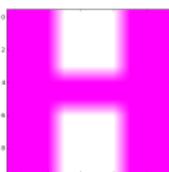
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```
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```

- ⑤ Save logo array to file.

```
plt.imsave("logo.png", logoImg) #Save the image to logo.png
```

CS Survey: Prof. Sakas, Computational Linguistics



Language is Hard for Computers

Learning Language is Easy for my 3-year-old twins

CSCI 12700 Guest Bullet Talk

William Gregory Sakas



M.A./Ph.D. Program in Linguistics
@ The City University of New York





Language is Hard

- *Buffalo buffalo, Buffalo buffalo buffalo, buffalo, Buffalo buffalo*
- *Someone shot the servant of the actress who was on the balcony. Who was on the balcony?*
- *Who do you think Mary kissed?*
- *Who do you think **that** Mary kissed?*
- *Who do you think bought a radio?*
- * *Who do you think **that** bought a radio?*





So how to explain language?

Treat Language as a **scientific field - like Physics.**

Example: A scientific principle about sentences:

Given $\langle p \rangle = [\alpha [H \beta]]$,
where $\alpha = \text{edge}(\text{Spec}'s)$ β then:
the head H of $\langle p \rangle$ is inert after the phase is completed, triggering no further grammatical operations.

Language is complex!!!
Understanding how language works is hard!!!

Unless you're 3.



CS Survey: Prof. Sakas, Computational Linguistics



Linguistic experts!

4



Lecture Slip



Linguistic experts!

Design a program that counts the number of plural nouns in a list of nouns. Think about:

- what the input is,
- what the output is, and
- how you can determine if a noun is plural.

Note: To simplify the problem, assume all plural nouns end in “s”.

Recap

- On lecture slip, write down a topic you wish we had spent more time (and why).



Recap

- On lecture slip, write down a topic you wish we had spent more time (and why).
- In Python, we introduced:



Recap



- On lecture slip, write down a topic you wish we had spent more time (and why).
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Recap



- On lecture slip, write down a topic you wish we had spent more time (and why).
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Recap



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Recap



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 - ▶ 2D Arrays & Image Files

Recap



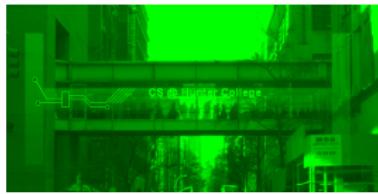
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- In Python, we introduced:
 - ▶ Indexing and Slicing Lists
 - ▶ Colors
 - ▶ Hexadecimal Notation
 - ▶ 2D Arrays & Image Files
- Pass your lecture slips to the end of the rows for the UTA's to collect.

Practice Quiz & Final Questions



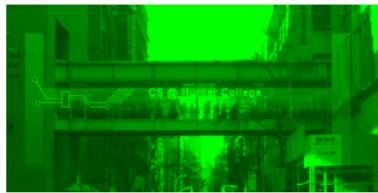
- Since you must pass the final exam to pass the course, we end every lecture with final exam review.

Practice Quiz & Final Questions



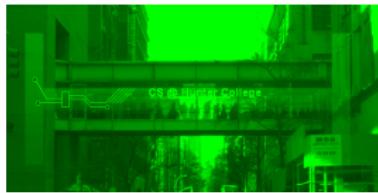
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- Pull out something to write on (not to be turned in).

Practice Quiz & Final Questions



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- Lightning rounds:

Practice Quiz & Final Questions



- Since you must pass the final exam to pass the course, we end every lecture with final exam review.
- Pull out something to write on (not to be turned in).
- Lightning rounds:
 - ▶ write as much you can for 60 seconds;

Practice Quiz & Final Questions



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- Pull out something to write on (not to be turned in).
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- Past exams are on the webpage ([under Final Exam Information](#)).
- We're starting with Fall 2017, Version 2.

Writing Boards



- Return writing boards as you leave...