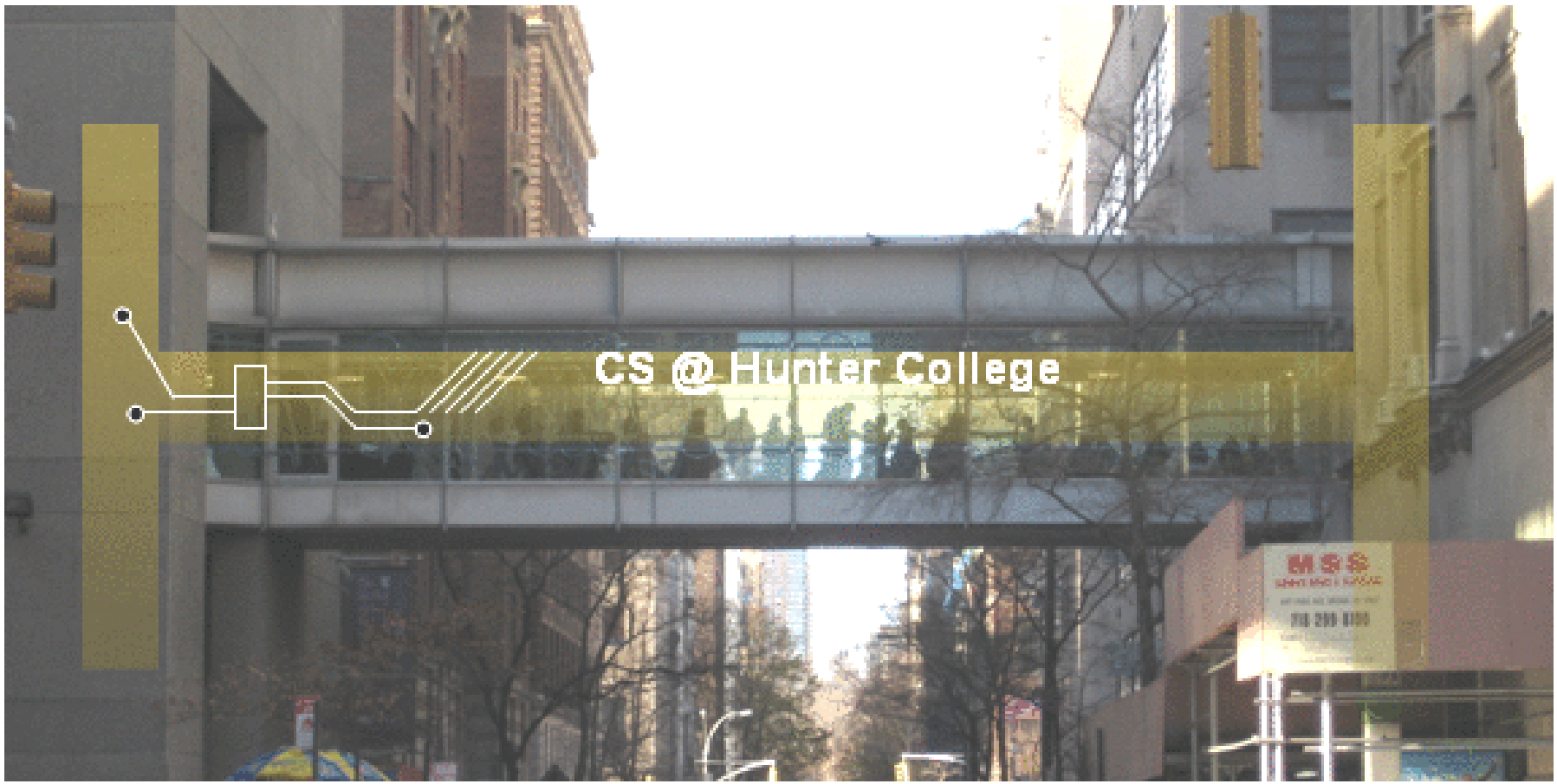
CSci 127: Introduction to Computer Science



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Frequently Asked Questions

From lecture slips & recitation sections.

- I didn't turn in a lecture slip last week. Did I miss it?
  No worries. If you miss a lecture slip, your final exam grade replaces that score.
- Can I get a copy of the lecture slides?
  Yes, the slides are posted on the class website.
- Where do I find the programs from lecture?
  These are also on the class website.
- I'm sure I did Problem 9 correctly, but Gradescope disagrees. Why?
  Some of the grading scripts are really finicky about spacing and new lines. Let us know– some we can fix, some have to match exactly.
- I'm confused by the reading– what should I be reading?
  For this week: Introductory chapters (1-4) and §8.10 on images.
- What's the best way to study for the final? What should I read?
  Do all the programming assignments & quizzes. Practice final exams will be available mid-March.

Today's Topics

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

Last Time: User Input

Covered in detail in Lab 2:

```
1 mess = input('Please enter a message: ')
2 print("You entered", mess)
```

(Demo with `pythonTutor`)

Side Note: '+' for numbers and strings

- `x = 3 + 5` stores the number 8 in memory location `x`.
- `x = x + 1` increases `x` by 1.
- `s = "hi" + "Mom"` stores "hiMom" in memory locations `s`.
- `s = s + "A"` adds the letter "A" to the end of the strings `s`.

In Pairs or Triples...

Let's start (mostly) with review review:

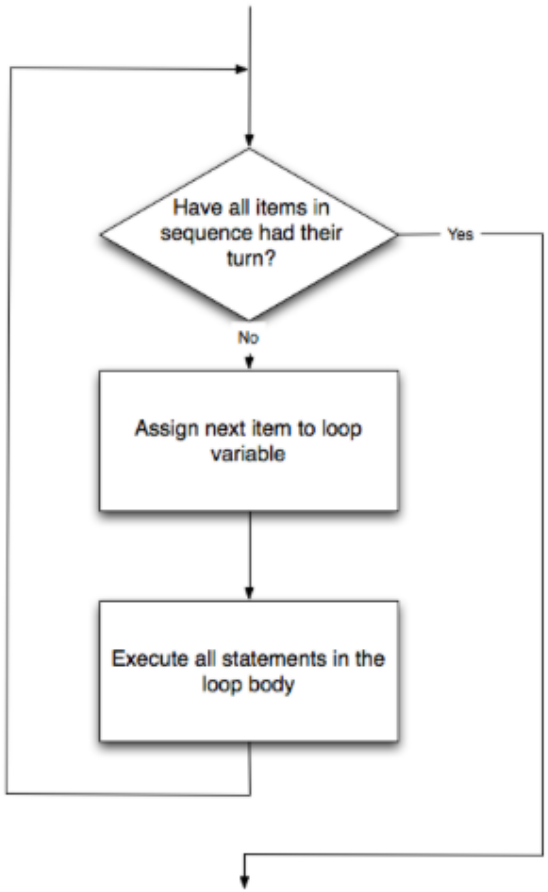
```
 1  for d in range(10, 0, -1):
 2      print(d)
 3  print("Blast off!")
 4
 5  for num in range(5,8):
 6      print(num, 2*num)
 7
 8  s = "City University of New York"
 9  print(s[3], s[0:3], s[:3])
10  print(s[5:8], s[-1])
11
12  names = ["Eleanor", "Anna", "Alice", "Edith"]
13  for n in names: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

Python Tutor

```
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)
```

(Demo with pythonTutor)

Review: `for`-loop



How to Think Like CS, §4.5

```
for  i in list:
     statement1
     statement2
     statement3
```

where `list` is a list of items:

- stated explicitly (e.g. [1,2,3]) or
- generated by a function, e.g. `range()`.

range()

```
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)
```

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 the list [5,10,...,50]
  you would write:

  `range(5,51,5)`

Slices

```
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)
```

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

  `s[start:stop]`

  gives [start,start+1,start+2...,stop-1].
- 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
Black	#000000	
Navy	#000080	
DarkBlue	#00008B	
MediumBlue	#0000CD	
Blue	#0000FF	

- 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

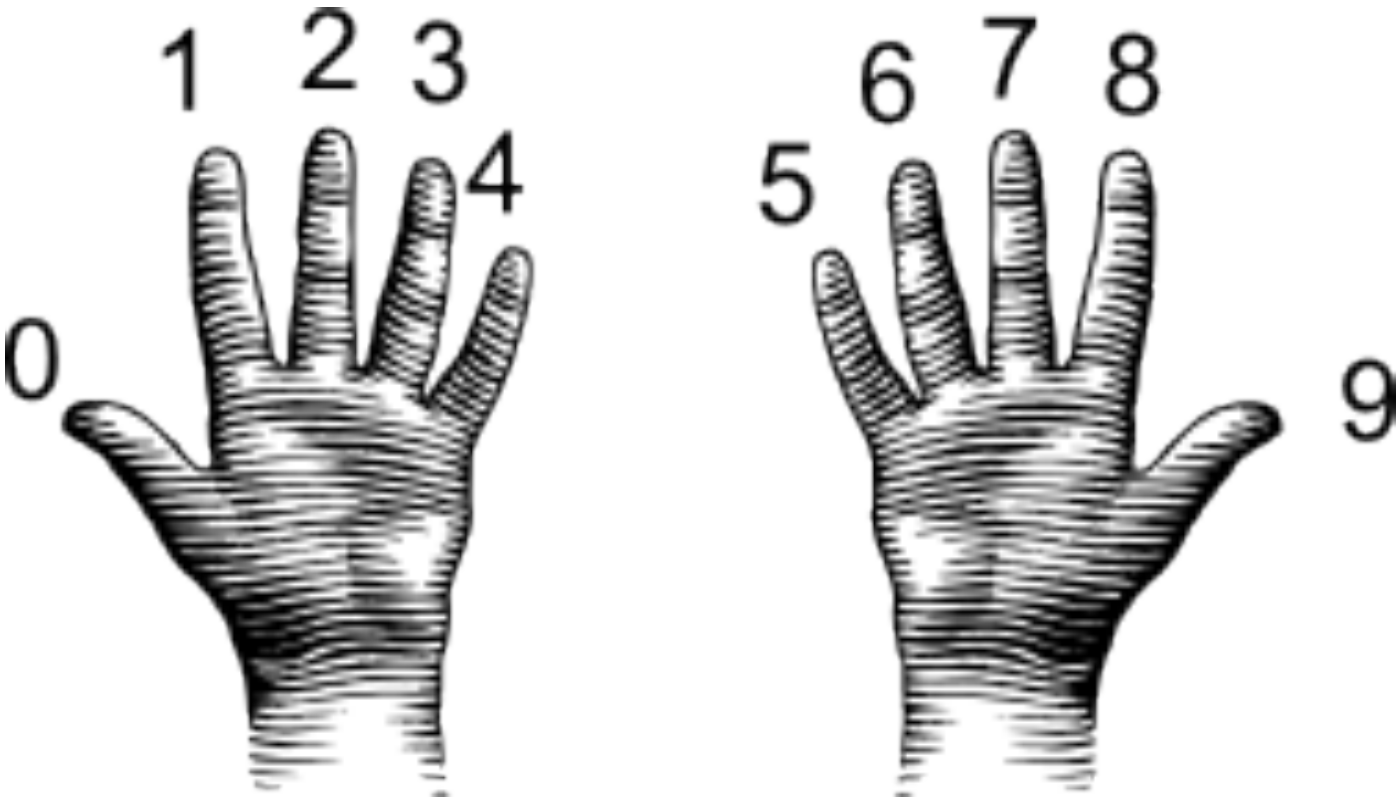
Colors

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

- 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)...

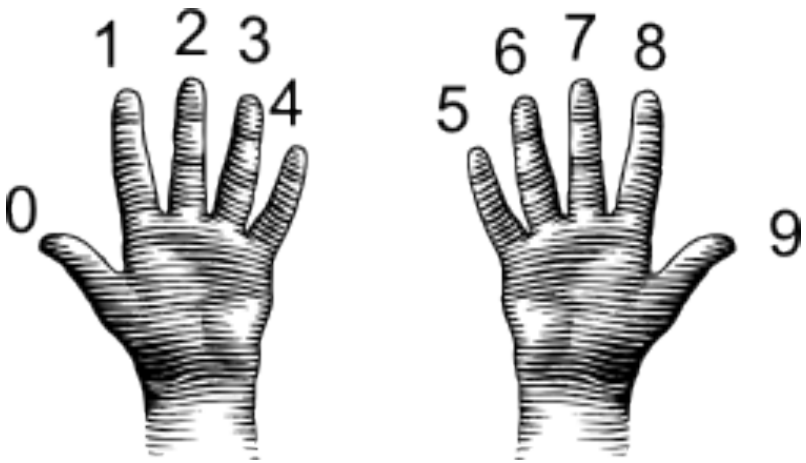
Decimal & Hexadecimal Numbers

Counting with 10 digits:



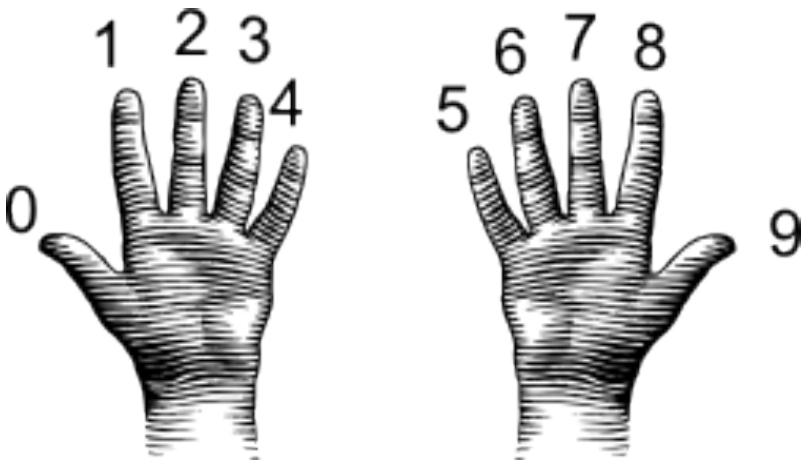
Decimal

00 01 02 03 04 05 06 07 08 09

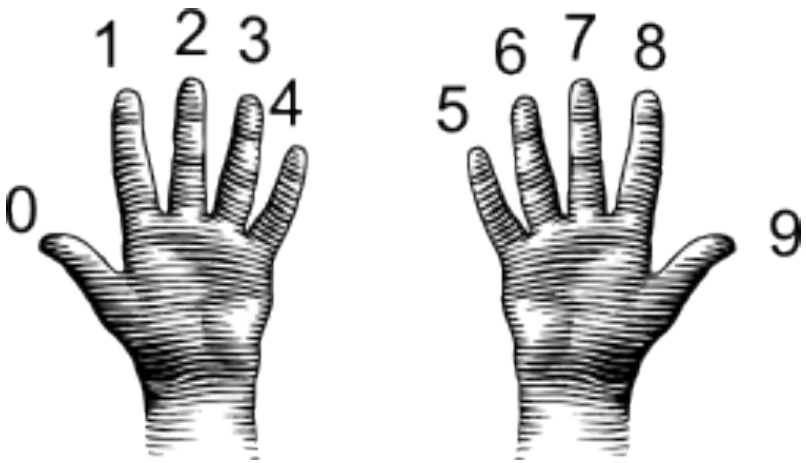


Decimal

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

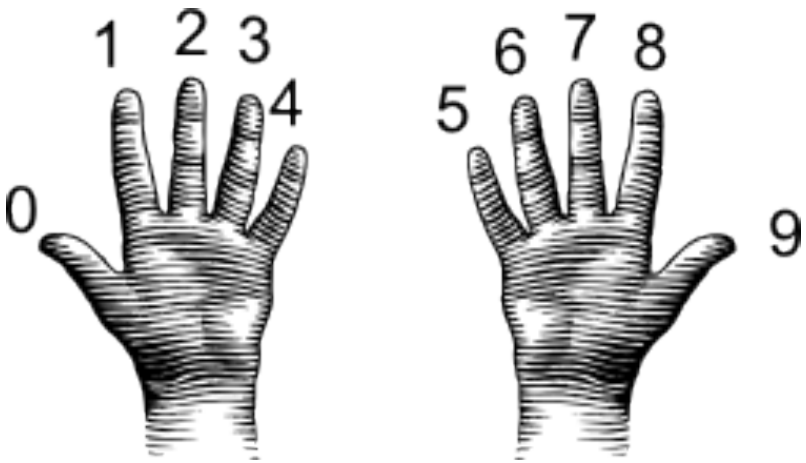


Decimal



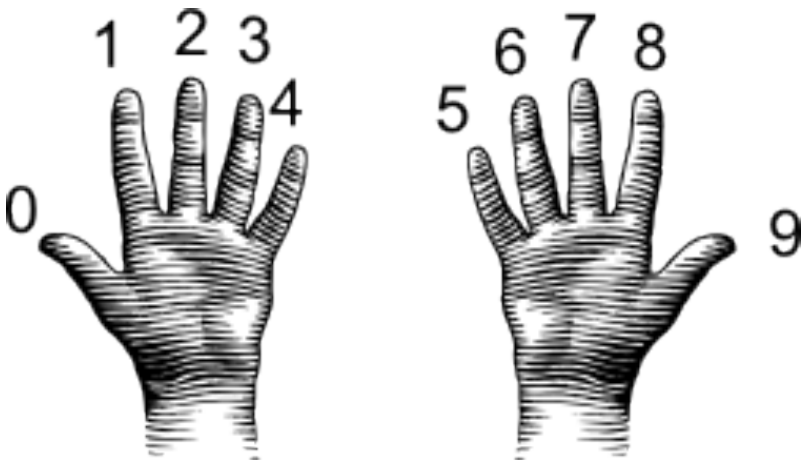
00 01 02 03 04 05 06 07 08 09
10 11 12 13 14 15 16 17 18 19
20 21 22 23 24 25 26 27 28 29

Decimal



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



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20	21	22	23	24	25	26	27	28	29
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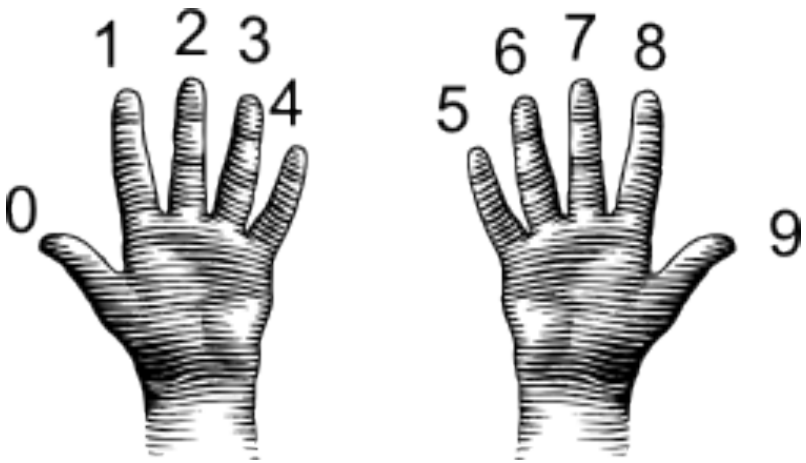
40	41	42	43	44	45	46	47	48	49

Decimal



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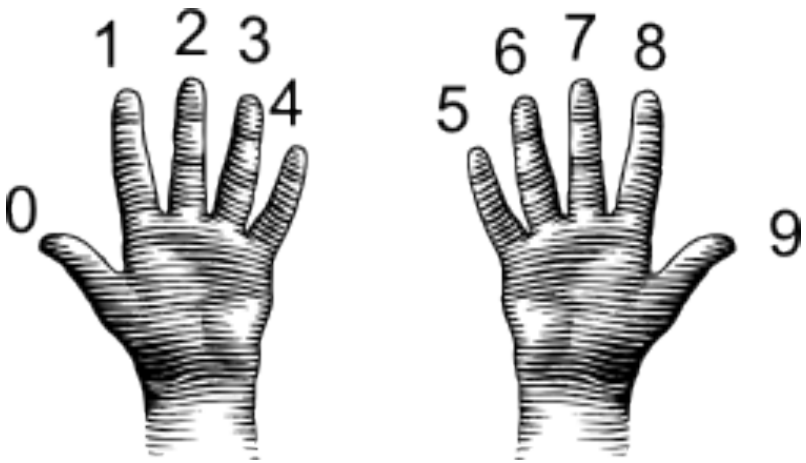
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59

Decimal



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40	41	42	43	44	45	46	47	48	49
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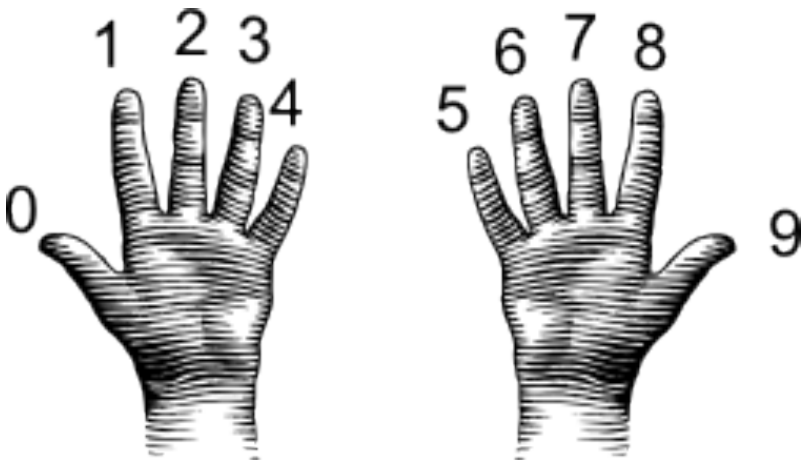
60	61	62	63	64	65	66	67	68	69

Decimal



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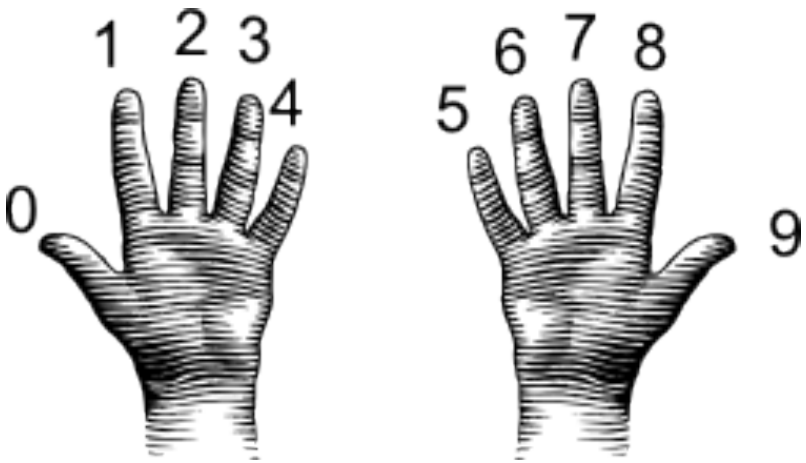
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79

Decimal



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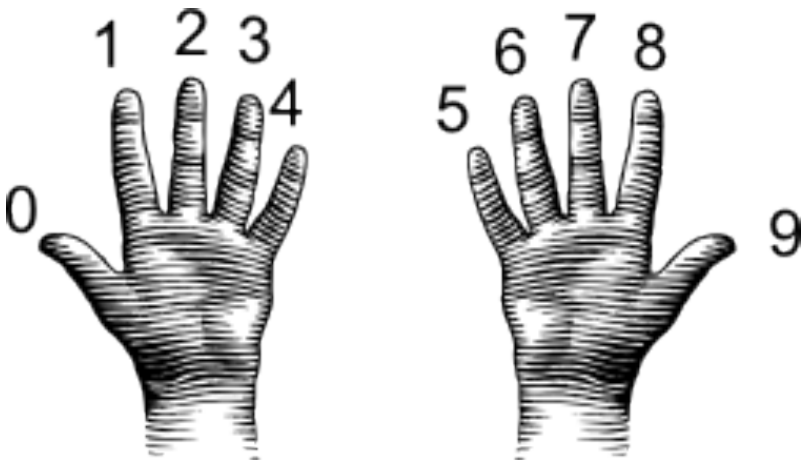
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89

Decimal



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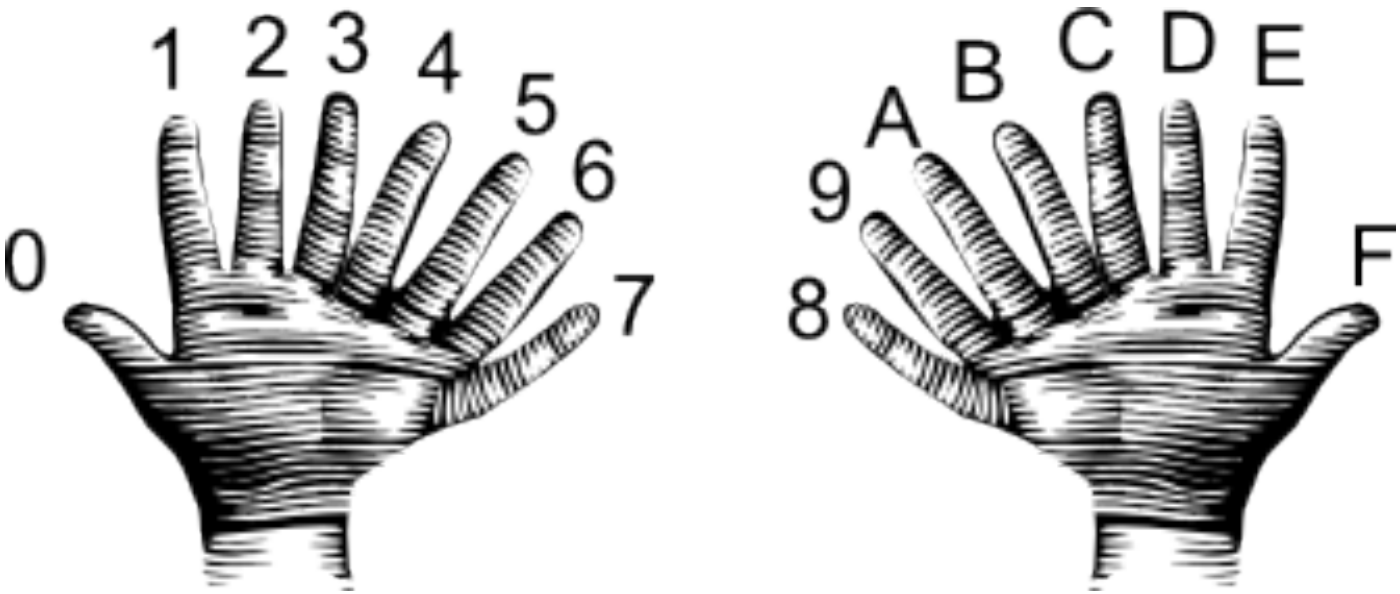
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

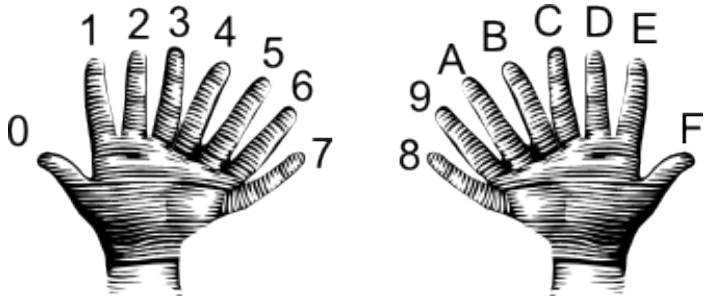
Decimal & Hexadecimal Numbers

Counting with 16 digits:



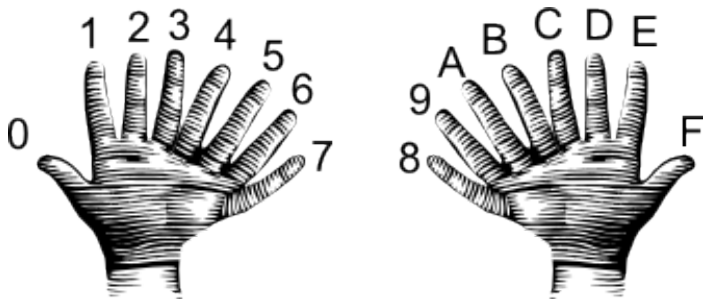
Hexadecimal

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



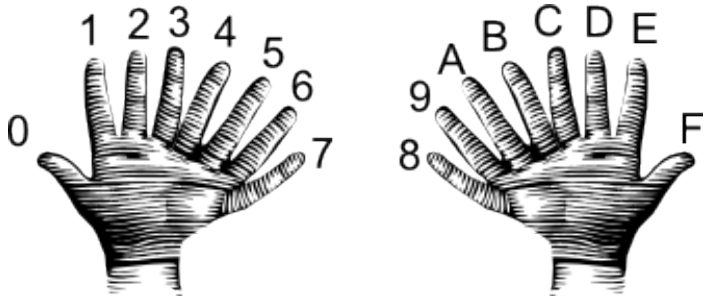
Hexadecimal

```
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
```



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
20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F
```



Hexadecimal

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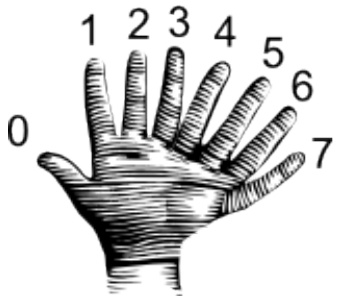
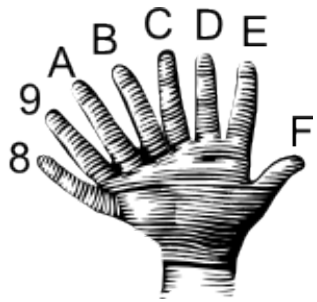
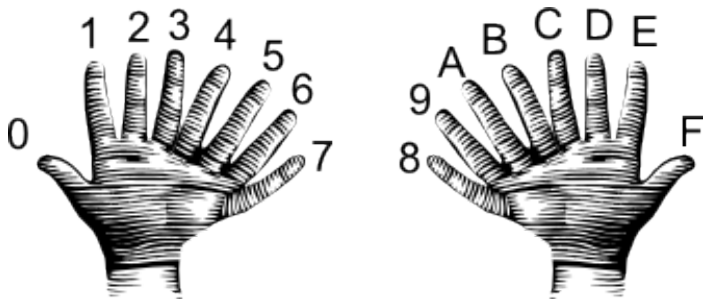
```





Hexadecimal

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```
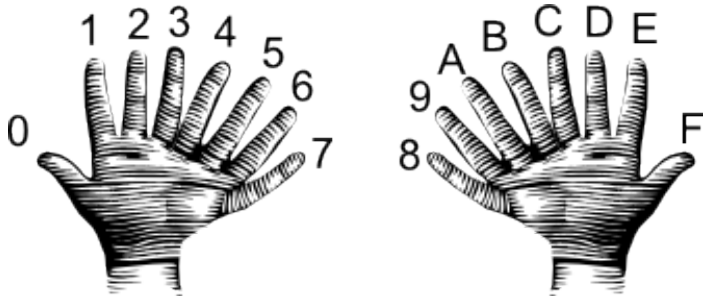

Hexadecimal

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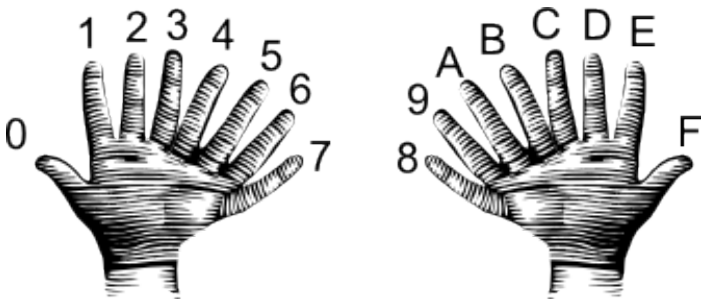
```

Hexadecimal




```
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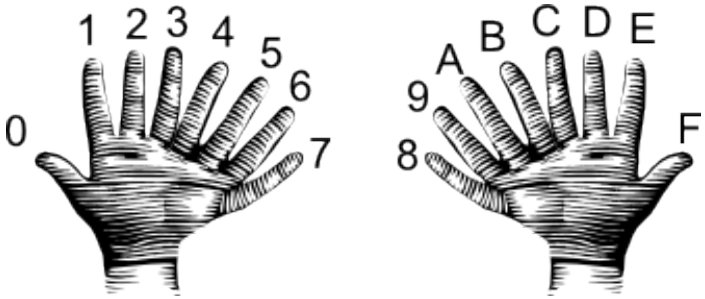
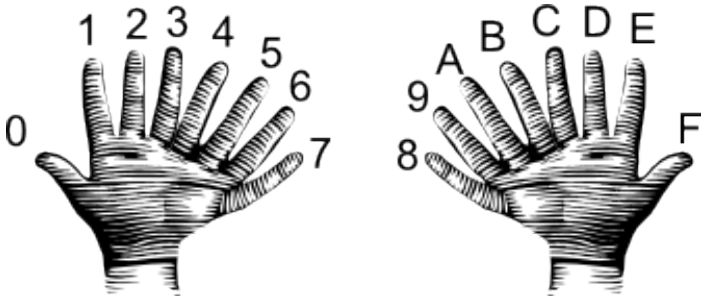
30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F
40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F
50 51 52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F
60 61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F
```

Hexadecimal




```
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




```
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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
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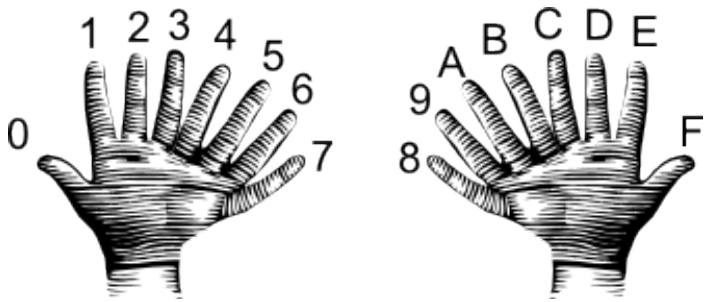
```

Hexadecimal




```
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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
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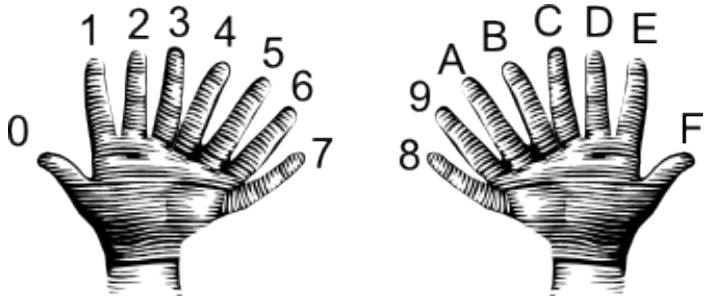
Hexadecimal




```
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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
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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
```
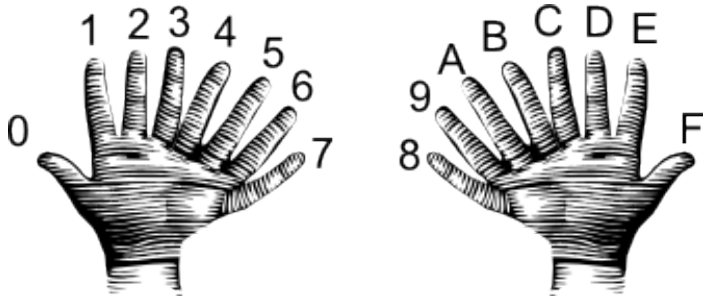

Hexadecimal




```
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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
```
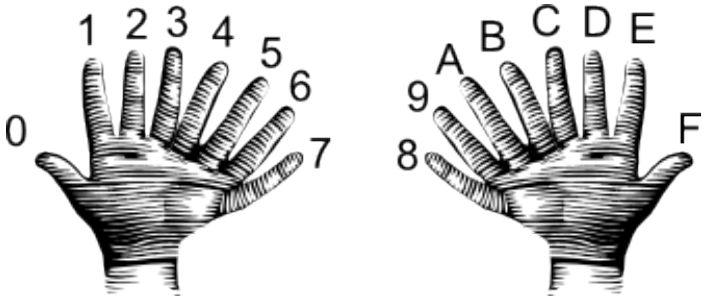
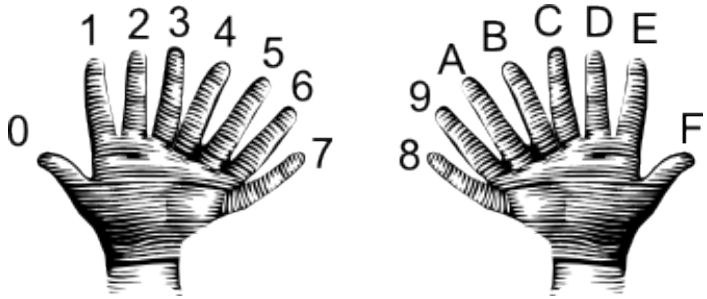

Hexadecimal



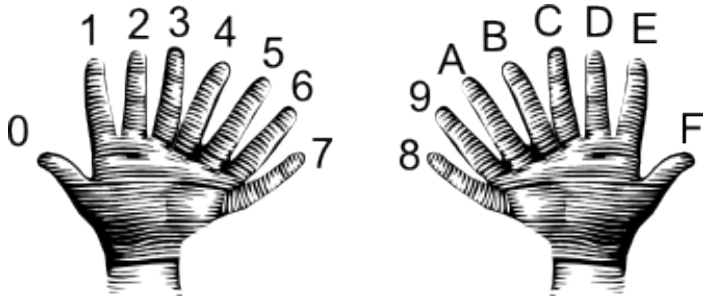

```
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F
30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F
40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F
50 51 52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F
60 61 62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



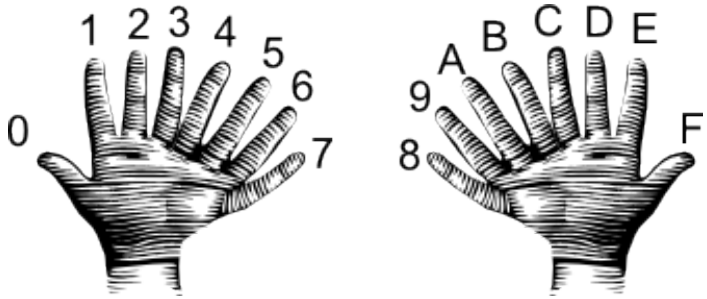

```
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F
30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F
40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F
50 51 52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F
60 61 62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

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
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
```

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
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
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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
```
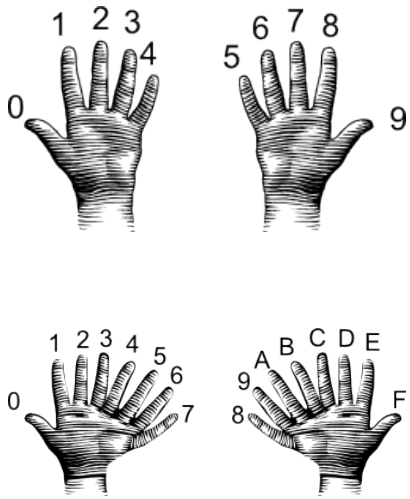

Side Note: Listing the numbers



Used Python:

```
base = 10
digits = "0123456789ABCDEF"

for i in digits[:base]:
    for j in digits[:base]:
        x = str(i) + str(j)
        print(x, end=" ")
    print()
```

Colors

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

- 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):
    e.g. `#0000FF` is no red, no green, and 100% blue.

In Pairs or Triples...

Some review and some novel challenges:

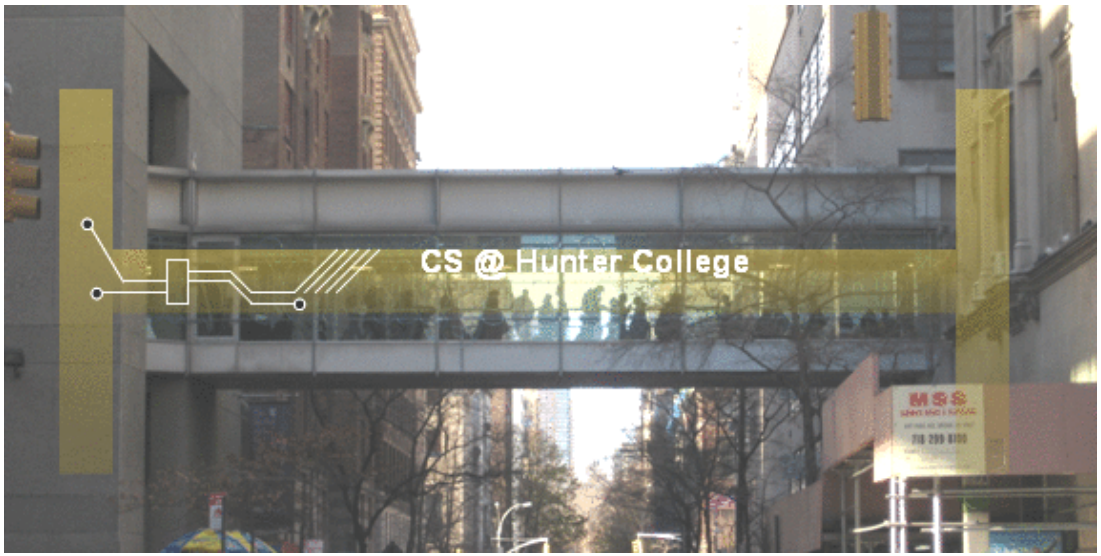
```
1  import turtle
2  teddy = turtle.Turtle()
3
4  names = ["violet", "purple", "indigo", "lavender"]
5  for c in names:
6    teddy.color(c)
7    teddy.left(60)
8    teddy.forward(40)
9    teddy.dot(10)
10
11 teddy.penup()
12 teddy.forward(100)
13 teddy.pendown()
14
15 hexNames = ["#FF00FF", "#990099",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

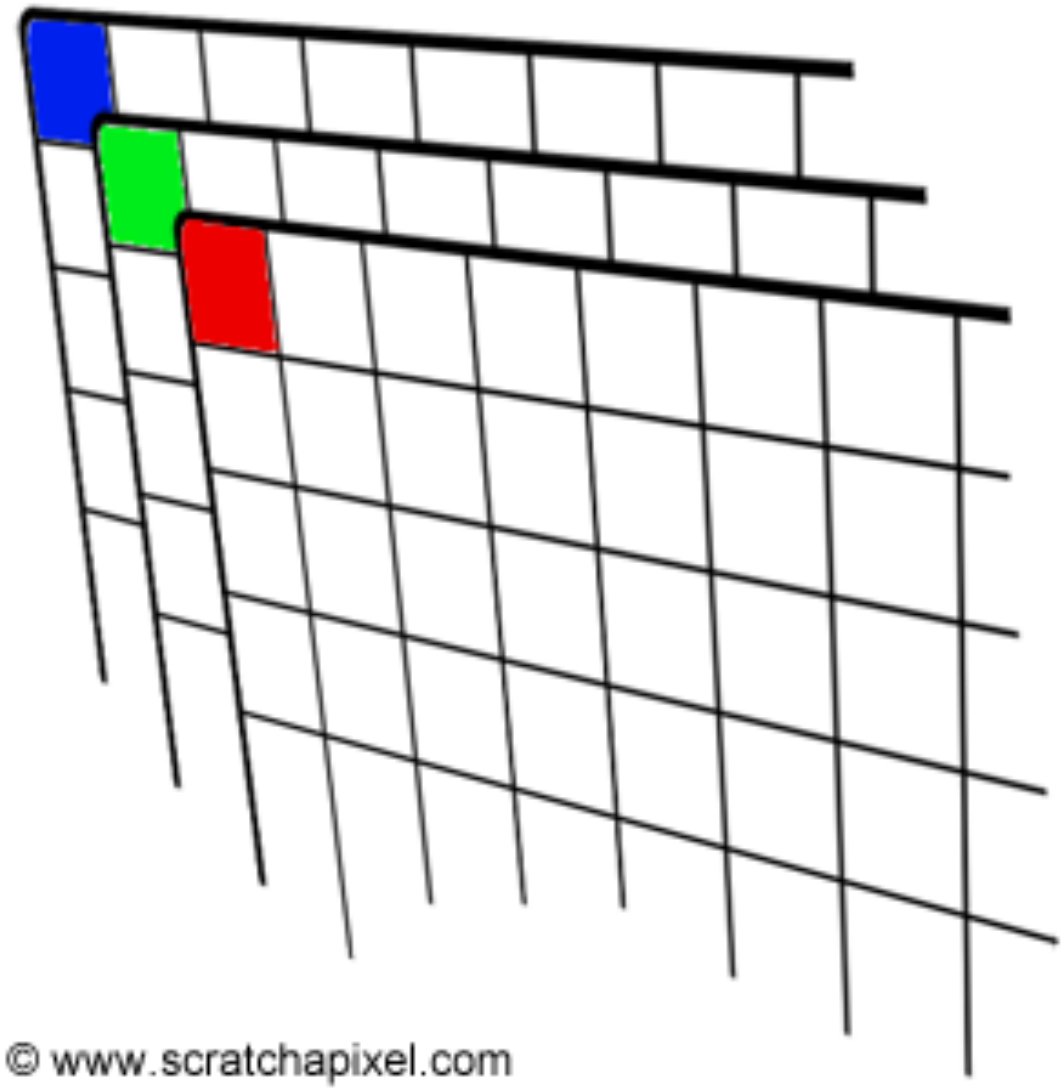
(Demo with `trinkets`)

Images

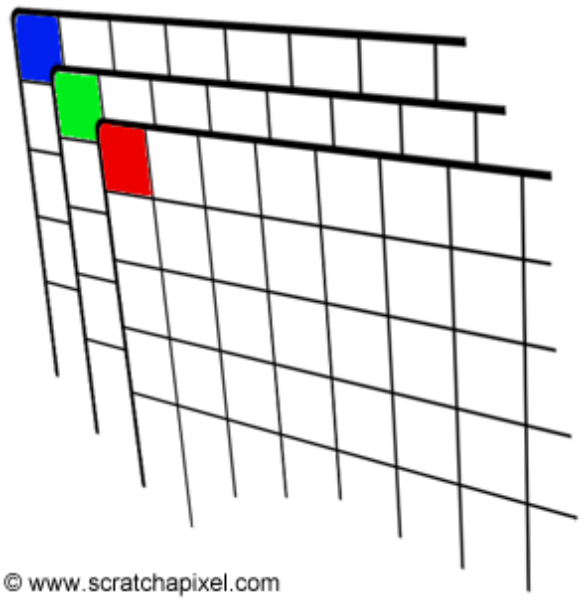


- We will use the standard portable network graphics (PNG) file format.
- Saves every picture element (or 'pixel')– often called a lossless format.
- Keeps track of the amount of red, blue, and green of each pixel.

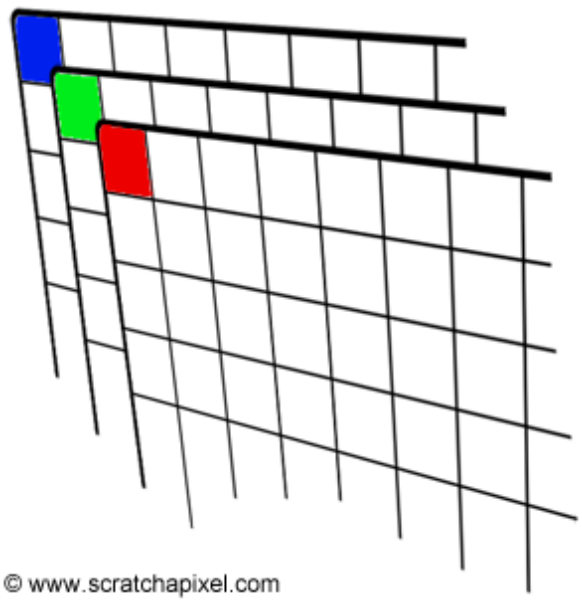
Images

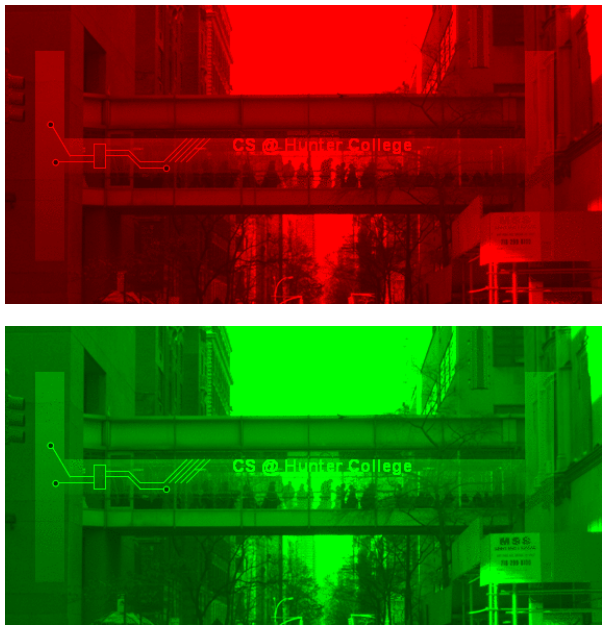


Images

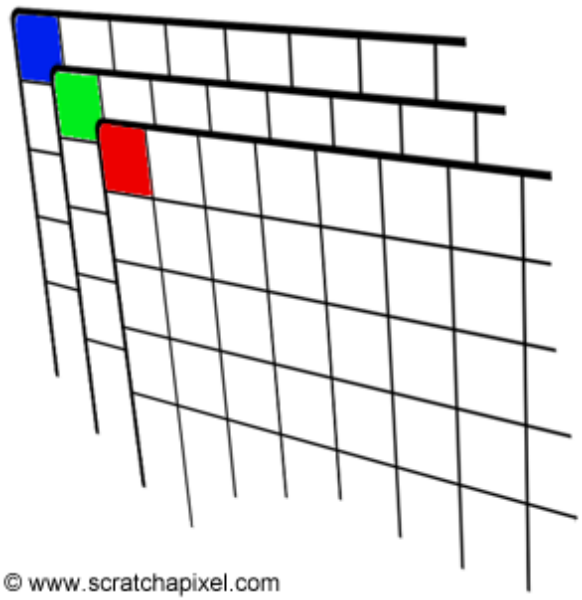


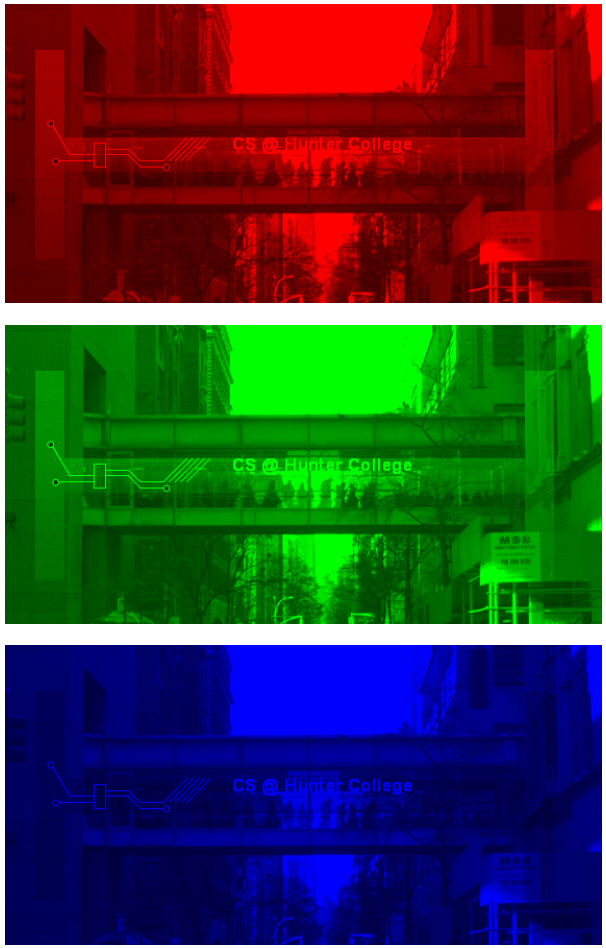
Images





Images


© www.scratchapixel.com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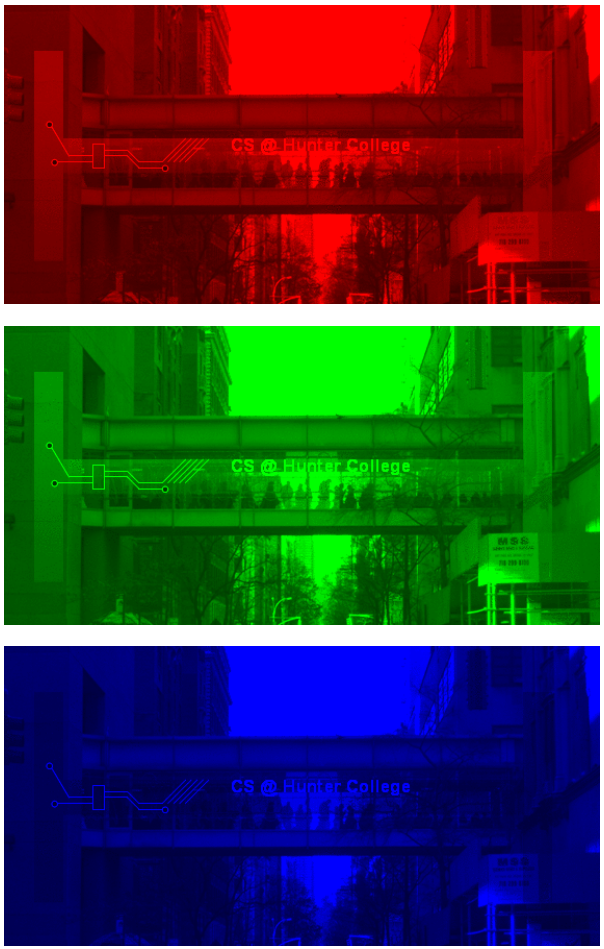
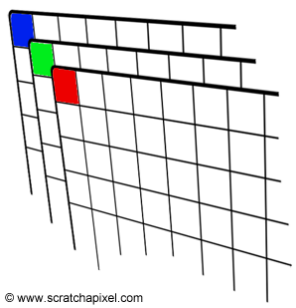
Useful Packages



- 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




```
#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 closed t

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: re
```

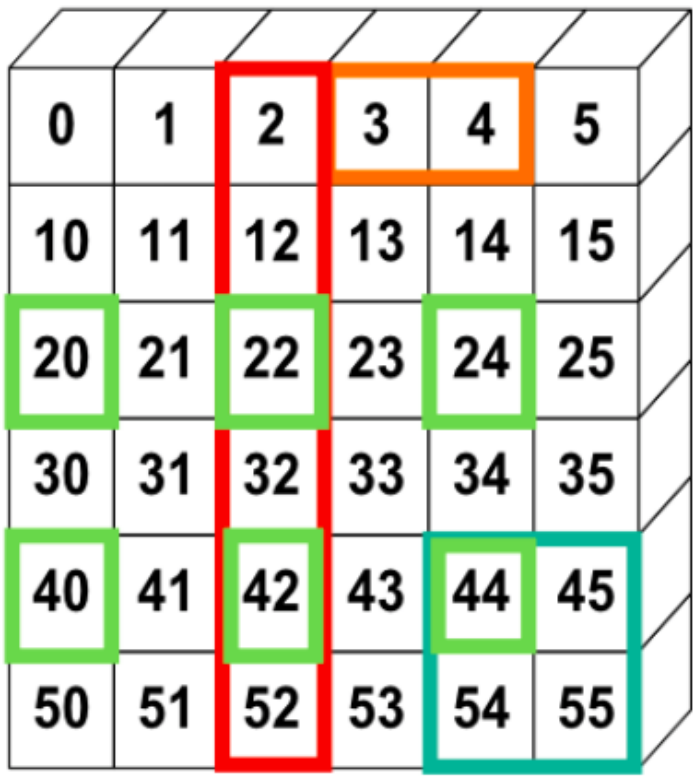
More on numpy arrays

```
>>> 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...

Some review and
some novel challenges:

1. Fill in the values in the array:

```
import numpy as np

A = np.zeros( (4,5) )
A[0,0] = 1.0
A[:,1] = 0.75
A[3,:] = 0.5
```


(If a cell has value 0, you can leave it blank.)

2. Write code that will generate the array with the following values:

Your code here:

1.0				1.0
1.0				1.0
1.0	1.0	1.0	1.0	1.0
1.0				1.0
1.0				1.0

Python Tutor

1. Fill in the values in the array:

```
import numpy as np

A = np.zeros( (4,5) )
A[0,0] = 1.0
A[:,1] = 0.75
A[3,:] = 0.5
```


(If a cell has value 0, you can leave it blank.)

(Demo with `idle3`)

2. Write code that will generate the array with the following values:

Your code here:

1.0				1.0
1.0				1.0
1.0	1.0	1.0	1.0	1.0
1.0				1.0
1.0				1.0

Recap

- On lecture slip, write down a topic you wish we had spent more time (and why).
- In Python, we introduced:
  - Indexing and Slicing Lists
  - Colors
  - Hexadecimal Notation
  - 2D Arrays & Image Files

Lecture 3, CSci 127
Spring 2018

Name:	
EmpID:	

1. Fill in the values in the array:

```
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A[0,0] = 1.0
A[:,1] = 0.75
A[3,:] = 0.5
```


(If a cell has value 0, you can leave it blank.)

2. 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".

Input:

Output: