2013학년도 제1학기
FM0004 프로그래밍 I 실습

디지털미디어학과

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Contents

1 LAB 1

1.1 1장 요약

- 컴퓨터는 stupid! - 01만을 이해. 그러나 사람은 언어를 사용.
- 프로그래밍언어는 컴퓨터-사람의 의사소통수단.
- 컴퓨터-사람 서로 이해하려면 encoding (decoding).
- 미디어는 아날로그, 디지털화는 01로.
- 컴퓨터과학을 비유하면 요리. 프로그래밍은 조리법(recipe).

1.2 1장 실습

1.2 웹에서 ASCII표를 찾아서, 자신의 영문이름을 ASCII로 변환.

1.3 웹에서 ASCII와 Unicode의 차이점을 찾아서 적으시오. 표현하는 문자가 몇 개인지? 한국어, 일본어를 double byte 문자라고 하는 이유는? 이런 double byte를 표현하려면 어느 방식이 적합한지?

1.4 이미지의 화소 하나를 저장하려면 3바이트가 필요하다 (1.4장 참조). 640 x 480 이미지를 저장하려면 몇 바이트가 필요한가? 1024 x 768 이미지는? 3메가픽슬 카메라는 어떤 뜻인가? CD한 장에 1024x768사진을 몇 장이나 저장할 수 있는지?

1.5 4비트로 나타낼 수 있는 경우의 수는? 8비트는? 2바이트는? 4바이트는?

1.6 소수점을 바이트로 어떻게 표현하는지? 몇 바이트가 필요한지? 웹에서 "floating point"를 검색해 보시오.

1.7 웹에서 Alan Kay와 Dynabook을 찾아보고, 오래 전 그의 생각이 요즘 출시되는 기기에서 구현되고 있는지?

1.3 환경

Install 파이썬 설치

윈도우
- 파이썬 공식 사이트 `http://www.python.org` 접속
- 윈도우 설치프로그램 다운로드 (Python 2.7.3 Windows Installer)
- 설치

리눅스 $ sudo apt-get install python3

Editor 수업에서는 JES 사용

IDLE (Interactive DeveLopment Environment) GUI환경의 대화식 프로그램 개발.
- 윈도우 시작 >프로그램 >Python3 >IDLE 실행
- >>>프롬프트에서 명령어를 입력
- 파이썬 해석기에서 처리, 결과를 출력.

JES `http://code.google.com/p/mediacomp-jes/downloads/list`

윈도우 jes-4-3.exe를 설치

리눅스 download and $ sh JES.sh

Media Files 수업에 필요한 미디어파일을 다운로드

`http://coweb.cc.gatech.edu/mediaComp-teach`

2 LAB 2

2.1 2장 요약

- 명명 "meaningful" naming for human
- 데이터 타잎 ingeger, float, objects, "strongly typed" vs "loosely typed"

```
>>> print int(4.0)
4
>>> print float(4)
4.0
```

- 에디터 JES - Program Area, Command Area, Help Area
- 프로그래밍 명령어 command (tell) the computer to do things
- 변수명, 변수값의 차이
- 함수 parameters

```
>>> print ord('a')
97
>>> print chr(97)
a
>>> print ord(u'\u2020')
8224
>>> print repr(unichr(8224))
u'\u2020'
```

- 이미지 선택해서 불러오기 - 함수화 (naming, sequence, parameters)
  - pickAFile()
  - makePicture(file)
  - show(pict)
  - 줄여서 show(makePicture(pickAFile())) 파일을 선택하라는 다이어로그가 나오면 JPEG파일을 선택한다.

```
>>> file=pickAFile()
>>> print file
/home/jss/Downloads/GuzEri/mediasources/matt-
   spaceman.jpg
>>> picture=makePicture(file)
>>> print picture
Picture, filename /home/jss/Downloads/GuzEri/
   mediasources/matt-spaceman.jpg height 232
```

```
   width 207
>>> show(picture)
}
```

- 사운드 선택해서 불러오기
  - makeSound(file)
  - play(sound)
  - 줄여서 play(makeSound(pickAFile()))

```
>>> file=pickAFile()
>>> print file
>>> sound=makeSound(file)
```

- 함수
  - Hello - Command Area에서 작성

```
>>> def hello():
...   print "Hello"
...
>>> hello()
Hello
```

  - Hello - Program Area에서 작성
    * 'Program Area'에 함수 작성
    * File >Save Program As 'hello.py'
    * Load Program
    * 'Command Area' hello()
  - pickAndShow()

```
def pickAndShow():
  myFile=pickAFile()
  myPict=makePicture(myFile)
  show(myPict)
======= Loading Progam =======
>>> pickAndShow()
```

  - pickAndPlay()
  - showNamed(myFile) 입력변수 파일을 불러오기

```
def showNamed(myFile):
  myPict=makePicture(myFile)
  show(myPict)
======= Loading Progam =======
```

```
>>> showNamed("/home/jss/Downloads/GuzEri/
    mediasources/matt-spaceman.jpg")
```

- playNamed(myFile)
- playAndShow(sFile, pFile) 입력변수가 복수

2.2 2장 실습

2.2.1 LAB 2-1

2.1 (PROBLEMS 2.4 2.6) 2.4와 2.6의 결과값은? 답이 서로 다르게 나오는 이유는?
2.2 (PROBLEMS 2.7 2.8) 2.7과 2.8의 결과값은? 답이 서로 다르게 나오는 이유는?
2.3 (PROBLEMS 2.9) 결과값은?
2.4 (PROBLEMS 2.14) 결과값은?
2.5 (PROBLEMS 2.15) 결과값은?
2.6 (PROBLEMS 2.17) 에러를 디버깅
2.7 (PROBLEMS 2.19) show(p)가 수행하는 작업은?
2.8 (PROBLEMS 2.20) 문자열 연산을 해보자. 3 x "Hello"는 어떤 결과? "a"x"b"는 어떤 결과
2.9 함수의 이름에 관해 생각해 보자. pickAFile()의 이름은? print pickAFile의 결과는? print makePicture의 결과는?

2.2.2 LAB 2-2

2.10 이름을 받아서 Hello를 출력 예: Hello 홍길동"
2.11 위 문제를 함수로 프로그램

2.3 과제제출

- ftp client: 윈도우 winSCP (`http://www.winscp.org`) 다운로드 설치
- ftp server
  - 호스트이름: uranus.smu.ac.kr
  - 포트번호: 22
  - 사용자이름: 학번
  - 비밀번호: p학번
- 과제명명
  - 텍스트: 분반_학번_챕터번호 (예: P1_201399999_2.txt)
  - 파이썬: 분반_학번_챕터번호 (예: P1_201399999_2.py)
  - 학생자신의 폴더로 제출

3 LAB 3

3.1 3장 요약

- Picture: 이미지 파일(jpg) 'w x h' canvas
- Pixels: Pixel배열, Pixels[0]는 이미지의 좌측 상단 Pixel값
- Pixel: 이미지 화소
- Color: RGB 3 x 8 = 24 bits, 0 255
- 함수
  - getPixel(myPict,0,0) getPixels(myPict)
  - getWidth(myPict) getHeight(myPict)
  - getX(pixel) getY(pixel)
  - getRed(pixel) getGreen getBlue
  - setRed(pixel,Color) setGreen setBlue
  - getColor(pixel) setColor makeColor pickAColor()
  - writePictureTo(myPict,filename) getMediaPath()의 상대적 경로에 씀.
  - explore(pict)

3.2 3장 실습

3.2.1 LAB 3-1

- explore(Picture) (p.40)
- pickAColor() (p.43)
- 이미지 Pixel, Color (p.44)

```
>>> file=pickAFile()
>>> print file
/home/jss/Downloads/GuzEri/mediasources/beach.
   jpg
>>> myPict=makePicture(file)
>>> print myPict
Picture, filename /home/jss/Downloads/GuzEri/
   mediasources/beach.jpg height 480 width 640
>>> show(myPict)
>>> getWidth(myPict)
640
>>> getHeight(myPict)
```

```
480
>>> pixel=getPixel(myPict,0,0)
>>> print pixel
Pixel red=2 green=4 blue=3
>>> pixels = getPixels(myPict)
>>> pixels[0]
Pixel red=2 green=4 blue=3
>>> print getX(pixel)
0
>>> print getRed(pixel)
2
>>> setRed(pixel,255)
>>> print getRed(pixel)
255
>>> color=getColor(pixel)
>>> print color
color r=255 g=4 b=3
>>> newColor=makeColor(0,100,0)
>>> print newColor
color r=0 g=100 b=0
>>> setColor(pixel,newColor)
>>> print getColor(pixel)
color r=0 g=100 b=0
>>> color2=pickAColor()
>>> print color2
color r=255 g=153 b=153
>>> writePictureTo(myPict,"/home/jss/changedPics
   .jpg")
```

- p.47 실행해서 caterpillar.jpg 좌측 상단 10개 화소가 변경되었는지 확인
- p.51 여러 setRed를 loop로 프로그램.

```
>>> fn="/home/jss/Downloads/GuzEri/mediasources/
   barbara.jpg"
>>> pic=makePicture(fn)
>>> for pixel in getPixels(pic):
...   red=getRed(pixel)
...   setRed(pixel,red*.5)
```

```
...
>>> show(pic)
```

- p.51 함수로 만들어, 이미지 색 변경

```
>>> file=pickAFile()
>>> picture=makePicture(file)
>>> explore(picture)
>>> decreaseRed(picture)
>>> explore(picture)

def makeSunset(picture):
  for p in getPixels(picture):
    value=getBlue(p)
    setBlue(p,value*0.7)
    value=getGreen(p)
    setGreen(p,value*0.7)
======= Loading Progam =======
>>> makeSunset(picture)
>>> explore(picture)
```

- 위 프로그램을 hierarchical decomposition (makeSunset2=reduceBlue+reduceGreen)
- 3.6 Negative

```
>>> print picture
Picture, filename /home/jss/Downloads/GuzEri/
   mediasources/beach.jpg height 480 width 640
>>> explore(picture)
======= Loading Progam =======
>>> negative(picture)
>>> repaint(picture)
```

- p.66 Grayscale

```
======= Loading Progam =======
>>> grayScale(picture)
>>> repaint(picture)
```

3.2.2 LAB 3-2

3.1 beach.jpg파일의 화소수를 구하고, 바이트수를 계산하는 프로그램. 저장되어 있는 파일 크기와 차이를 설명

3.2 (PROBLEMS 3.17) 이미지의 Blue, Red, Green을 제거하는 함수 각 각 3개 프로그램 함수를 합쳐서 프로그램.
3.3 (PROBLEMS 3.18) 이미지의 Blue, Red, Green을 최대화하는 함수 각 각 3개 프로그램. 함수를 합쳐서 프로그램.
3.4 (PROBLEMS 3.19) 프로그램.

3.3 과제제출

- id 비밀번호 변경 반드시
  - putty 설치 (http://www.winscp.org)
  - winscp 로그인 >명령(c) >PuTTY에서 열기(P) Ctrl+P
  - $ passwd
- 채점기준
  - 문제에 적합한 정상실행 100%
  - 오작동 미제출 0점 처리.
  - 제출시점 미준수: 24시간 내 제출 50% 감점. 24시간 이후 0점 처리.
  - 모든 Lab은 반드시 제출. 미제출 비율은 성적에 반영 (예: 20% 미제출 최대 성적은 B로 함)
- 과제프로그램 구조
  - 과제실행lab,main함수 작성 (주의: input없이 작성)
  - getMediaPath()로 파일 읽음 (단, setMediaPath()사용하지 말 것)
  - 설명은 # comment로 작성 (주의: 영어로 작성)
  - 구조

```
#2.1 comment in English
def lab2_1():
  foo()
#2.2 comment in English
def lab2_2():
  boo()
def main():
  lab2_1()
  lab2_2()
```

  - 구조의 예

```
#3.1
def lab3_1():
```

```
  pic=makePicture("c:/python27/p1/
     mediasources/beach.jpg")
  getBytesOf(pic)
def getBytesOf(pic):
  w=getWidth(pic)
  h=getHeight(pic)
  nBytes=w*h*3
  print nBytes
#3.2
def lab3_2():
  pic=makePicture("c:/python27/p1/
     mediasources/beach.jpg")
  decreaseRed(pic)
def decreaseRed(pic):
  for p in getPixels(pic):
    r=getRed(p)
    setRed(p,r*0.5)
  repaint(pic)
def main():
  lab3_1()
  lab3_2()
```

– 과제 테스트

```
======= Loading Progam =======
>>> lab3_1()
921600
>>> lab3_2()
>>> main()
921600
>>>
```

4 LAB 4

4.1 4장 요약

- range 수의 배열
- 함수
  - makeLighter(Color(10,100,200)) makeDarker(Color(10,100,200))
  - setMediaPath() getMediaPath(baseName)
  - makeEmptyPicture(width,height)

4.2 4장 실습

4.2.1 LAB 4-1

- Loop를 이용한 RGB 변경 (p.74 75)

```
>>> show(pic)
>>> for x in range(getWidth(pic)):
...   for y in range(getHeight(pic)):
...     px=getPixel(pic,x,y)
...     r=getRed(px)
...     setRed(px,r*1.5)
...
>>> repaint(pic)
```

- mirroring
  - vertical mirroring (p.77)

```
>> show(pic)
>>> w=getWidth(pic)
>>> pMirror=w/2
>>> for y in range(0,getHeight(pic)):
...   for x in range(0,pMirror):
...     lpx=getPixel(pic,x,y)
...     rpx=getPixel(pic,w-x-1,y)
...     c=getColor(lpx)
...     setColor(rpx,c)
...
>>> repaint(pic)
```

  - 다른 mirroring 프로그램 해보기 (horizontal, bottom to top)
- makeLighter 이미지 색 변경

```
def p19():
  fn="/home/jss/Downloads/GuzEri/mediasources/
     barbara.jpg"
  pic=makePicture(fn)
  show(pic)
  w=getWidth(pic)
  h=getHeight(pic)
  for x in range(0,w):
    for y in range(0,h):
```

```
      px=getPixel(pic,x,y)
      color=getColor(px)
      lightColor=makeLighter(makeLighter(color))
      setColor(px,lightColor)
  repaint(pic)
======= Loading Progam =======
>>> p19()
```

- path

```
>>> setMediaPath()
'/home/jss/Downloads/GuzEri/mediasources/'
>>> getMediaPath()
'/home/jss/Downloads/GuzEri/mediasources/'
>>> getMediaPath("barbara.jpg")
'/home/jss/Downloads/GuzEri/mediasources/barbara
   .jpg'

#import os
#os=java.lang.System.getProperty("os.name")
#if os=="Linux":
#    print "Linux"
#elif os=="Mac OS X"
#    print "Mac OS X"
#if getMediaPath() != mediaPath:
#    setMediaPath(mediaPath)
```

- Temple 부서진 부분 복원 (p.82)

```
>>> temple="temple.jpg"
>>> picTemple=makePicture(temple)
>>> explore(picTemple)
>>> mirrorpt=276
>>> for x in range(13,mirrorpt):
...   for y in range(27,97):
...     pleft=getPixel(picTemple,x,y)
...     pright=getPixel(picTemple,mirrorpt+
   mirrorpt-1-x,y)
...     setColor(pright,getColor(pleft))
...
```

```
>>> show(picTemple)
```

- 이미지pic1 복사해서 다른 이미지pic2에 출력 copyBarb() (p.84)
  - 같은 위치

```
>>> pic1=makePicture(getMediaPath("barbara.
   jpg"))
>>> show(pic1)

>>> pic2=makePicture(getMediaPath("7inX95in.
   jpg"))
>>> show(pic2)

>>> for p1 in getPixels(pic1):
...   cPic1=getColor(p1)
...   setColor(p2,cPic1)
NameError: p2

def copyBarbjsl():
  pic1=makePicture(getMediaPath("barbara.jpg"
     ))
  pic2=makePicture(getMediaPath("7inX95in.jpg
     "))
  for x1 in range(0,getWidth(pic1)):
    for y1 in range(0,getHeight(pic1)):
      p1=getPixel(pic1,x1,y1)
      p2=getPixel(pic2,x1,y1)
      c1=getColor(p1)
      setColor(p2,c1)
  repaint(pic2)
======= Loading Progam =======
>>> p24()
```

  - 다른 위치 - p2=getPixel(pic2,x1,y1)의 좌표 x1,y1 수정

```
def copyBarbMidwayjsl():
  pic1=makePicture(getMediaPath("barbara.jpg"
     ))
  pic2=makePicture(getMediaPath("7inX95in.jpg
     "))
```

```
  x2=100
  y2=200
  for x1 in range(0,getWidth(pic1)):
    for y1 in range(0,getHeight(pic1)):
      p1=getPixel(pic1,x1,y1)
      p2=getPixel(pic2,x1+x2,y1+y2)
      c1=getColor(p1)
      setColor(p2,c1)
  repaint(pic2)
======= Loading Progam =======
>>> copyBarbMidwayjsl()
```

– 일반화 (단순한 이동)

```
pic1=makePicture(getMediaPath("barbara.jpg"))
pic2=makePicture(getMediaPath("7inX95in.jpg")
   )
x2=100
y2=200
def copyjsl(pic1, pic2, x2, y2):
  for x1 in range(0,getWidth(pic1)):
    for y1 in range(0,getHeight(pic1)):
      p1=getPixel(pic1,x1,y1)
      p2=getPixel(pic2,x1+x2,y1+y2)
      c1=getColor(p1)
      setColor(p2,c1)
  repaint(pic2)
======= Loading Progam =======
>>> pic1
Picture, filename /home/jss/Downloads/GuzEri/
   mediasources/barbara.jpg height 294 width
   222
>>> pic2
Picture, filename /home/jss/Downloads/GuzEri/
   mediasources/7inX95in.jpg height 684 width
    504
>>> copyjsl(pic1,pic2,100,200)
>>>
```

– 일반화 (변수명의 일반화)

```
def copyjsl(subject, target, targetX, targetY
    ):
```

- Collages createCollage() (p.90)
- rotating
- Cropping copyBarbsFace()
- Scaling copyBarbsFaceSimilar() copyBarbsFaceLarger()
- Blurring

4.2.2 LAB 4-2

4.7
4.8

4.14
```
for y in range(0,5):
  for x in range(0,1+y):
    print "*",
  print ""

s=makePicture(getMediaPath("barbara.jpg"))
t=makePicture(getMediaPath("7inX95in.jpg"))
for y in range(0,100):
  for x in range(0,1+y):
    ps=getPixel(s,x,y)
    pt=getPixel(t,x,y)
    cs=getColor(ps)
    setColor(pt,cs)
    #print "(",x,y,")",
  #print ""
repaint(t)
```

4.18

5 LAB 5

5.1 5장 요약

- 함수
  - addText addLine addRect addRectFilled

5.2 5장 실습

5.2.1 LAB 5-1

- color replacement (p.106 머리색을 붉게)
  - 어떻게 처리할까 생각 끝에...
    S1 이미지의 화소 하나씩 읽어서 Brown색과 비교해서 그 차이를 확인
    S2 차이가 크면. 해당 화소의 RED를 읽어서 2배로
  - 종이 위에 스케치 (flowchart)
  - 이제 프로그래밍!

```
cBrown=makeColor(42,25,15)
setMediaPath("/home/jss/Downloads/GuzEri/
   mediasources")
fn=getMediaPath("KatieFancy.jpg")
pic=makePicture(fn)
show(pic)
for p in getPixels(pic):
  cThis=getColor(p)
  if distance(cBrown,cThis) < 50.0:
    pRed2=getRed(p)*2
    pGreen=getGreen(p)
    pBlue=getBlue(p)
    setColor(p, makeColor(pRed2,pGreen,pBlue)
       )

repaint(pic)
```

- color replacement (빨간색 눈동자를 검은색으로): 범위를 지정해서 중첩루프. 165보다 큰 경우에는 어떤 효과가 생기는지 (수배전단)?

```
def removeRedEyejsl(pic,x1,y1,x2,y2,
   replacementColor):
  for x in range(x1,x2):
    for y in range(y1,y2):
      p=getPixel(pic,x,y)
      d=distance(red,getColor(p))
      if d<165:
        setColor(p,replacementColor)
def main():
```

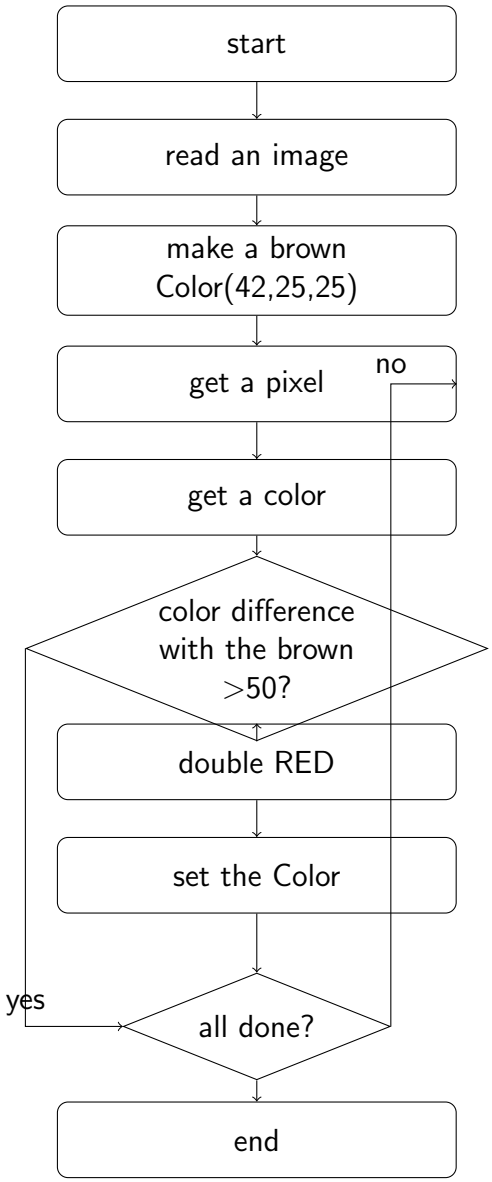
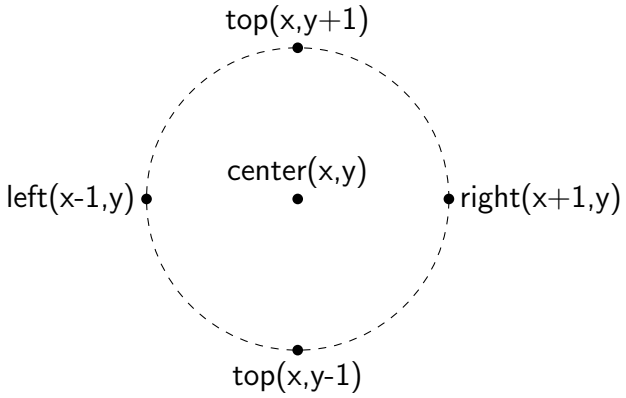


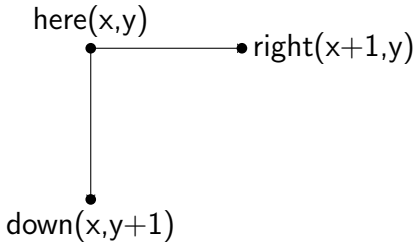
Figure 1: Flowchart

```
#test removeRedEyejsl
jenny=makePicture(getMediaPath("jenny-red.jpg"
   ))
removeRedEyejsl(jenny,109,91,202,107,makeColor
   (0,0,0))
repaint(jenny)
```

- color combination (blurring p.115): averaging the colors of the pixels (top, lef, bottom, right, itself) around each pixel



- color comparison (edge detection) here와 down, right의 luminance차이로 흑백처리 (100이상이면 black, 아니면 white)




```
def lineDetectjsl(fn):
  pic=makePicture(fn)
  show(pic)
  for x in range(0, getWidth(pic)-1):
    for y in range(0, getHeight(pic)-1):
      p=getPixel(pic,x,y)
      pRight=getPixel(pic,x+1,y)
      pBottom=getPixel(pic,x,y+1)
      pLum=(getRed(p)+getGreen(p)+getBlue(p))/3
```

```
        pRightLum=(getRed(pRight)+getGreen(pRight)
           +getBlue(pRight))/3
        pBottomLum=(getRed(pBottom)+getGreen(
           pBottom)+getBlue(pBottom))/3
        if abs(pLum-pRightLum)>0 and abs(pLum-
           pBottomLum)>10:
          colorTo=black
        else:
          colorTo=white
        setColor(p,colorTo)
    repaint(pic)
    return pic

  def main():
    fn=getMediaPath("butterfly1.jpg")
    lineDetectjsl(fn)
```

- blending pictures
- background subtraction
- chromakey: 배경색을 한 가지 색으로 정하고, 전경을 추출하여 합성.

```
  def chromakeyjsl(source, bg):
    for x in range(0,getWidth(source)):
      for y in range(0,getHeight(source)):
        p=getPixel(source,x,y)
        if (getRed(p)+getGreen(p))<getBlue(p):
          pBg=getPixel(bg,x,y)
          colorBg=getColor(pBg)
          setColor(p,colorBg)
    return source

  def main():
    s1=makePicture(getMediaPath("blue-mark.jpg"))
    s2=makePicture(getMediaPath("blue-mark.jpg"))
    bg1=makePicture(getMediaPath("moon-surface.jpg
       "))
    bg2=makePicture(getMediaPath("jungle2.jpg"))
    s1Bg1=chromakeyjsl(s1, bg1)
    s2Bg2=chromakeyjsl(s2, bg2)
```

```
show(s1Bg1)
show(s2Bg2)
```

- drawing on images
- programs as specifying drawing process

5.2.2 LAB 5-2

5.7
5.9
5.17
5.20

6 LAB 6

6.1 6장 요약

- Sounds: sound encodings (e.g., wav)
  - Sound is a sequence of waves of pressure that propagates through compressible media such as air or water. (Sound can propagate through solids as well, but there are additional modes of propagation). Sound that is perceptible by humans has frequencies from about 20 Hz to 20,000 Hz. (source: Wikipedia)
- Samples: Sample Objects
- Sample: sound digitizing (최대의 2배 샘플링, Nyquist theorem)
  - Mono 1 track or Stereo 2 tracks (right/left)
  - Sample rates=cycles per second, CD품질 44,100Hz(44.1kHz) (목소리 20KHz의 2배 샘플링)
  - 16비트 샘플: 16-bit 44.1 KHz = 176KB/Sec
  - 크기 계산
    sampleRates/s * bitsPerSample * channelCount * duration
  - 예: 1초 분량 스테레오 오디오파일 크기? (Full stereo CD quality)
    44,100 samples/s * 16 bits/sample * 2 tracks = 1,411,200 bits/s
    1,411,200 bps / 8 = 176,400 (176KB)
  - 1분 분량은? 176,400 x 60 = 10,584,000 bytes (약 10MB)
  - 30분 분량은? 약 300MB (317,520,000 bytes)
- 함수
  - makeSound(fname) getLength(sound) getSamples(sound) writeSoundTo(sound)
  - getSampleValueAt(sound,index) getSampleObjectAt(sound,index) getSound

6.2 6장 실습

6.2.1 LAB 6-1

- Fundamentals

```
>>> fn=getMediaPath('preamble.wav')
>>> sound=makeSound(fn)
>>> getLength(sound)
421110
>>> allSamples=getSamples(sound)
>>> allSamples[0]
Sample at 0 with value 36
>>> allSamples[421109]
Sample at 421109 with value -50
>>> s0=getSampleObjectAt(sound,0)
>>> getSampleValue(s0)
36
>>> getSampleValueAt(sound,0)
36
>>> setSampleValue(s0,100)
>>> getSampleValue(s0)
100
>>> getSamplingRate(sound)
22050.0
>>> duration=getLength(sound)/getSamplingRate(
   sound)
>>> print duration
19.0979591837
>>> play(sound)
>>> explore(sound)
blockingPlay(mysound)
```

- p.156 소리를 크게

```
for sample in getSamples(s):
  value=getSampleValue(sample)
  setSampleValue(sample,value*2)
play(s)
writeSoundTo(s,"/home/jss/louder.wav")
```

- p.156 일반화

```
def changeVolumeJsl(sound, factor):
  for sample in getSamples(s):
    value=getSampleValue(sample)
    setSampleValue(sample,value*factor)
```

- p.162 maxing (normalizing) $\frac{32767}{largest(=loudest)}$

```
def findMaxSample(sound):
  maxTemp=0
  for i in getSamples(sound):
    maxTemp=max(maxTemp, getSampleValue(i))
  maxSample=maxTemp
  return maxSample
def normaize(sound):
  maxSample=findMaxSample(sound)
  amplification=32767.0/maxSample
  changeVolumeJsl(sound,amplification)
======= Loading Progam =======
>>> f=getMediaPath("preamble.wav")
>>> sound=makeSound(f)
>>> findMaxSample(sound)
10216
>>> normalize(sound)
largest sample value in original sound was 10216
multiplier is  3.207419733750979
```

- p.163 clipping

6.2.2 LAB 6-2

6.9
6.12

6.2.3 소과제: 이미지(사운드) 콜라주Collage

(교재 문제 4.18참조)

- 창의적인 이미지(사운드)콜라주를 생성하는 프로그램 작성
- 같은 이미지(사운드)를 최소 3번 이상. 원본을 포함하면, 2번은 원본을 가공해야 함.

- 이미지(사운드)는 어떤 것을 사용해도 좋음 (저작권 주의)
- 이미지 콜라주 결과물은 1장.
- 사운드 콜라주 결과물은 5초 이상.
- 과제제출
  - 서버업로드: 프로그램(py), 원본사진, 콜라주, PDF
  - PDF 목차
    * 프로그램 소스코드 (Courier)
    * 프로그램 설명: 5 문장 이상.
    * 사용할 사진(사운드): 2열 표
    * 콜라주 프로그램에서 jpg로 출력(writePictureTo, 현재디렉토리에)
- 제출기한: 6주(8주) (PDF출력물은 수업시간에 제출)
- 채점기준
  - 40점: 이미지(사운드) 4개.
  - 10점: 사용기법마다 (최대 50점)
  - 10점: 품질
- 출처: http://nifty.stanford.edu/2013/guzdial-collage/

7 LAB 7

7.1 7장 요약

- splice, reverse, mirror
- loop with range for Sound

7.2 7장 실습

7.2.1 LAB 7-1

- array

```
>>> s=makeSound(getMediaPath('a.wav'))
>>> samples=getSamples(s)
>>> getLength(s)
9508
>>> samples[0]
Sample at 0 with value -90
>>> samples[9507]
Sample at 9507 with value -147
```

- merge p.171-172 사운드길이를 측정하여 사운드 공파일을 생성

```
guzS=makeSound(getMediaPath('guzdial.wav'))
#play(guzS)
isS=makeSound(getMediaPath('is.wav'))
#play(isS)
silS=makeSound(getMediaPath('sec3silence.wav'))
target=silS
#or use by creating an empty sound
#sumLen=getLength(guzS)+int(0.1*getLength(silS))
   +getLength(isS)
#target=makeEmptySound(sumLen)
index=0
for s in range(0,getLength(guzS)):
  v=getSampleValueAt(guzS,s)
  setSampleValueAt(target,s,v)
  index=index+1

for s in range(0,int(0.1*getSamplingRate(target)
   )):
  setSampleValueAt(target,index,0)
  index=index+1

for s in range(0,getLength(isS)):
  v=getSampleValueAt(isS,s)
  setSampleValueAt(target,index,v)
```

```
    index=index+1

  play(target)
```

- splice (mixing) and p.178 clip/copy: taking a start and end index and returning it
  p.178 사운드길이 측정해서 공파일 생성

```
  def copy(source,target,fr,to):
    sample=getSampleValueAt(source,fr)
    setSampleValueAt(target,to,sample)

  fn=getMediaPath("preamble10.wav")
  source=makeSound(fn)
  target=makeSound(fn)
  #copy "United" after "We the"
  t=17408
  for s in range(33414,40052):
    copy(source,target,s,t)
    t=t+1

  #copy "People" after "We the United"
  #after the loop t=17408+(40052-33414)
     +(26726-17408)
  for s in range(17408,26726):
    copy(source,target,s,t)
    t=t+1

  #fill with 'no sound'
  for index in range(0,1000):
    setSampleValueAt(target,t,0)
    t=t+1

  play(target)
```

- p.179 reverse (index를 끝부터 시작해서 복사)
  실제 들어보면 거꾸로 된 이상한 소리를 들음.

```
  source=makeSound(getMediaPath("guzdial.wav"))
  target=makeEmptySound(getLength(source))
```

```
sIndex=getLength(source)-1
for i in range(0,getLength(source)):
  s=getSampleValueAt(source,sIndex)
  setSampleValueAt(target,i,s)
  sIndex=sIndex-1

print target
play(target)
```

- p.180 mirror (앞의 사진 mirroring 참조) 실제 소리를 들어봄.

```
len=getLength(source)
mirrorPt=len/2
for i in range(0,mirrorPt):
  left=getSampleObjectAt(source,i)
  right=getSampleObjectAt(source,len-i-1)
  v=getSampleValue(left)
  setSampleValue(right,v)

print source
play(source)
```

7.2.2 LAB 7-2

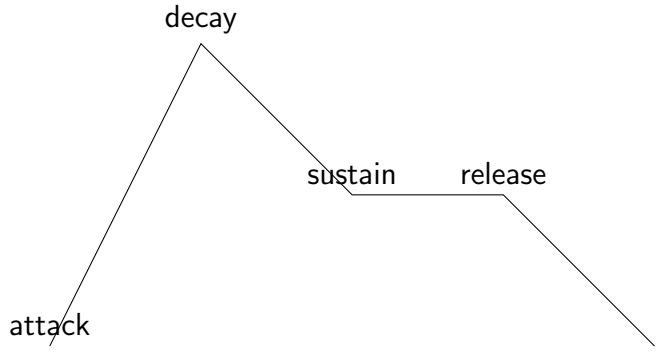
7.10
7.13
7.15

8 LAB 8

8.1 8장 요약

- blending, echoes, frequency (pitch)
- freqncy(pitch): Hertz(Hz)=cycles per second
  440 cycles per second (Hz): middle A
  880 cycles per second (Hz): an octave above middle A

- envelope



- Music synthesis: MIDI mp3
- 함수
  - playNote

8.2 8장 실습

8.2.1 LAB 8-1

- import 자신이 만든 라이브러리 사용하기 setLibPath(pickAFolder())

```
jsl@jslsmu-RT:~/Documents/Subjects/P1$ cat myHello.py
def hello():
    print "hello"
#1) 같은 디렉토리에 내가 만든 함수가 있는 경우
>>> import myHello
>>> myHello.hello()
hello
#2) sys.path.append를 이용
>>> import sys
>>> sys.path.append('/home/jss/Documents/Subjects/P1')
>>> import myHello
>>> myHello.hello()
hello:
#3) setLibPath를 이용
>>> setLibPath('/home/jss/Documents/Subjects/P1')
'/home/jss/Documents/Subjects/P1'
>>> import  myHello
>>> myHello.hello()
hello
  \end{verbatm}
 \item composing sounds: 단순히 더함.
  \begin{lstlisting}
  c4=makeSound(getMediaPath('bassoon-c4.wav'))
  e4=makeSound(getMediaPath('bassoon-e4.wav'))
  for i in range(0,getLength(c4)):
    vc4=getSampleValueAt(c4,i)
    ve4=getSampleValueAt(e4,i)
    setSampleValueAt(c4,i,vc4+ve4)
  #play(c4)
  \end{lstlisting}
 \item blending 50\%씩 평균
  \begin{lstlisting}
c4=makeSound(getMediaPath("bassoon-c4.wav"))
```

```
e4=makeSound(getMediaPath("bassoon-e4.wav"))
g4=makeSound(getMediaPath("bassoon-g4.wav"))
for i in range(0,getLength(c4)):
  s1=getSampleValueAt(c4,i)
  s2=getSampleValueAt(e4,i)
  s3=getSampleValueAt(g4,i)
  setSampleValueAt(c4,i,s1+s2+s3)
play(c4)
  \end{lstlisting}
 \item echo 멀리 떨어진 소리를 적게한 후 합성
  \begin{lstlisting}
s1=c4
s2=e4
delay=5
for i in range(delay, getLength(s1)):
  echo = 0.6*getSampleValueAt(s2, i-delay)
  combo = getSampleValueAt(s1, i) + echo
  setSampleValueAt(s1, i, combo)
play(s1)    #play(c4)와 비교.
  \end{lstlisting}
 \item makeChord C Major는 C E G를 합성 (Program 71, p.189)
  \begin{lstlisting}
  \end{lstlisting}
 \item shift half (shift 초과시 범위초과 오류 주의)
  \begin{lstlisting}
  #double 샘플값을 건너 가져옴으로, 시간의 1/2에 같은cycle수
  source=makeSound(getMediaPath('preamble.wav'))
  #play(source)
  len=getLength(source)/2+1
  target=makeEmptySound(len)
  targetIndex=0
  for i in range(0,getLength(source),2):
    v=getSampleValueAt(source,i)
    setSampleValueAt(target,targetIndex,v)
    targetIndex+=1
  play(target)
  \end{lstlisting}
 \item sine wave\\
```

```
    예: frequency=10 interval=$frac{1}{f}$=0.1\\
    sampling rate(frequency 2배)=20으로 하고\\
    그러면 사이클당샘플수는 0.1*20 = 2\\
  \begin{verbatim}
# Get a blank sound
from math import pi,sin
freq=440
amplitude=4000
mySound = getMediaPath('sec1silence.wav')
buildSin = makeSound(mySound)
# Set sound constant
sr = getSamplingRate(buildSin) # sampling rate
interval = 1.0/ freq # Make sure it's floating point
samplesPerCycle = interval * sr # samples per cycle
maxCycle = 2 * pi
for pos in range (0, getLength(buildSin )):
  rawSample = sin((pos / samplesPerCycle) * maxCycle)
  sampleVal = int(amplitude*rawSample)
  setSampleValueAt(buildSin ,pos ,sampleVal)

>>> f440=sineWave (440 ,2000)
>>> f880=sineWave (880 ,4000)
>>> f1320=sineWave (1320 ,8000)
>>> addSounds(f880 ,f440)
>>> addSounds(f1320 ,f440)
>>> play(f440)
>>> explore(f440)
>>> just440=sineWave (440 ,2000)
>>> play(just440)
>>> explore(f440)
```

- square wave 사이클의 반은 1값, 나머지는 -1값.
- triangular wave 사이클의 반은 증가, 나머지는 감소.

8.2.2 LAB 8-2

8.3

8.10

9 LAB 9

9.1 LAB 9-1

8.14 Designing programs: 1) Top-down 2) Bottom-up
- Testing: 1) glass-box 2) black-box
- Debugging: 1) finding error statement (using #) 2) seeing variables (Watcher)
- Running programs outside of JES

10 LAB 10

10.1 10장 요약

- random os
- 함수
  - String
    - startswith endswith
    - find upper lower isalpha isdigit replace split
  - List
    - append remove
    - sort reverse count max min

10.2 10장 실습

10.2.1 LAB 10-1

- ASCII encoding
- Strings: set of characters

```
>>> str="Sangmyung"
>>> for c in str:
...   print ord(c)
...
83
97
110
103
109
121
117
110
103
```

- Escape characters

```
>>> print "This\tis\na\ttest"
This    is
a       test
>>> print r"This\tis\na\ttest"
This\tis\na\ttest
```

- functions

```
>>> Sangmyung="Sangmyung"
>>> print len(Sangmyung)
9
>>> print Sangmyung[1:3]
an
```

- Objects and dot notation

```
>>> fileName="barbara.jpg"
>>> if fileName.endswith(".jpg"):
...   s=fileName+" is a picture"
...
```

```
>>> print s
barbara.jpg is a picture
>>> s.capitalize()
'Barbara.jpg is a picture'
>>> s.find("jpg")
8
>>> s.title()
'Barbara.Jpg Is A Picture'
>>> s.title().swapcase()
'bARBARA.jPG iS a pICTURE'
>>> s.replace("b","!")
'!ar!ara.jpg is a picture'
>>> sList=s.split(" ")
>>> print sList
['barbara.jpg', 'is', 'a', 'picture']
>>> sList.sort()
>>> print sList
['a', 'barbara.jpg', 'is', 'picture']
>>> sList[1]
'barbara.jpg'
```

- Phonebook

```
def phonebookDB():
  return """
Mary:893-0234:Realtor:
Fred:897-2033:boulder Crusher:
Pat: 123-5678: Student:
Robert:789-1234: bartender:
Barney:234-2342:Professional bowler:"""
>>> phones=phonebookDB()
>>> phonelist=phones.split('\n')
>>> phonelist
['', 'Mary:893-0234:Realtor:', 'Fred:897-2033:
   boulder Crusher:', 'Pat:
123-5678: Student:', 'Robert:789-1234: bartender
   :',
'Barney:234-2342:Professional bowler:']
>>> phonelist[1]
```

```
'Mary:893-0234:Realtor:'
>>> newphonelist=[]
>>> for list in phonelist:
      newphonelist=newphonelist+[list.split(':')
         ]
>>> newphonelist
[ ''], ['Mary', '893-0234', 'Realtor', ''], ['
   Fred',
'897-2033', 'boulder Crusher', ''], ['Pat', '
   123-5678', '
Student', ''], ['Robert', '789-1234', '
   bartender', ''],
['Barney', '234-2342', 'Professional bowler', ''
   ]]
>>> namekey='Pat'
>>> for people in newphonelist:
      if people[0]&=& namekey:
        print namekey,`` phone number= '',people
           [1]

Pat  phone number=   123-5678
```

- file

```
>>> program=pickAFile()
>>> print program
/home/jss/DSP1/hello.py
>>> f=open(program,"r")
>>> contents=f.read()
>>> print contents
```

- replacing words. 파일을 한 줄씩 읽어서, 교체할 단어를 찾아 교체하고, 결과를 파일로 저장 (주의: readline은 한 줄씩)

```
fr=open("/home/jss/DSP1/hello.py","rt")
fw=open("/home/jss/DSP1/helloNew.py","wt")
wordsFind="get"
wordsReplace="gget"
for line in fr.readlines():
  print line
```

```
    lineNew=line.replace(wordsFind,wordsReplace);
    print "lineNew=",lineNew
    fw.write(lineNew)
  fr.close()
  fw.close()

  fr=open("/home/jss/DSP1/helloNew.py","r")
  fr.read()
  fr.close()
```

- Python standard library

```
  import os
  os.listdir(getMediaPath())

  import random
  for i in range(1,5):
    print random.random()
  for i in range(1,4):
    print random.choice (["Here","is","a","list","
       of","words", "in","random","order"])
```

- 파일목록

```
    os.chdir('/User/media/Downloads/mediasources')
    mfiles=os.listdir('.')
    >>> for i in range(0,len(mfiles)):
    ..  if mfiles[i]&=& 'fish.jpg':
    ..     print mfiles[i]
    fish.jpg
```

10.2.2 LAB 10-2

10.10

10.11

```
>>> s='Hello'
>>> tlist=[]
   >>> for i in range(0,len(s)):
      tlist+=[ord(s[i])+10]
   >>> tlist
   [82, 111, 118, 118, 121]
```

```
>>> for i in range(0,len(tlist)):
    print chr(tlist[i]-10),
H e l l o
```

```
#1)
>>> s=''
>>> s+=``Sangmyung''[8]
>>> s+=``Sangmyung''[7]
>>> s
'gn'
#2)
>>> list("Sangmyung")
['S', 'a', 'n', 'g', 'm', 'y', 'u', 'n', 'g']
>>> s1=list("Sangmyung")
>>> s1[8]=s1[0]
>>> s1
['S', 'a', 'n', 'g', 'm', 'y', 'u', 'n', 'S']
```

10.19

11 LAB 11

11.1 11장 요약

- network protocols: tcp/ip http ftp
- html `www.w3schools.com` 참조
- web text (mining)
- sound/picture from/to text, visualization
- 함수
  - urllib ftplib

11.2 11장 실습

11.2.1 LAB 11-1

- String methods
  - s.find(t) s에서 t의 위치를 찾음. 실패하면 -1
  - s.find(s,begin=0,end=len(s)) begin end사이의 s위치. 실패하면 -1
  - s.rfind(t)는 뒤부터

```
>>> str="Hello Python"
>>> str.find("o",0)
4
>>> str.rfind("o",0)
10
```

- 웹페이지에서 온도 추출 (offline)
  - 홈페이지

```
<font size="-1" face="Arial, Helvetica, sans-
   serif">
<b>Currently</b><br>Partly sunny<br>
<font size="+2">54<b>&deg;</b></font>
<font face="Arial, Helvetica, sans-serif"
   size="+1">F</font>
```

  - 찾을패턴: "Currently"찾은 후, end "<b>&deg" begin ">"
  - 구현

```
fin=open(getMediaPath("ajc-weather.html"))
weatherPage=fin.read()
# search for temperature
loc=weatherPage.find("Currently") #10764
if loc==-1:
  print "Not found"
else:
  locEnd=weatherPage.find("<b>&deg",loc) #
     10819
  locBegin=weatherPage.rfind(">",0,locEnd) #
     10816
  print "Current temperature: ",weatherPage[
     locBegin+1:locEnd]
```

- 웹페이지에서 온도 추출 (online)
  - 홈페이지 http://www.ajc.com/weather에서 이동 http://www.wsbtv.com/s/weather/

```
<p class="cmWeatherCurrentInfo">
 <span class="cmWeatherDescription">Cloudy</
    span>
 <span class="cmWeatherCurrentTemp">58&deg;</
    span>
 <span class="cmWeatherFeelsLike">Feels Like:
     58&deg;</span>
</p>
```

  - 찾을패턴: "cmWeatherDescription" 찾은 후 (>없어야), end "&deg" begin ">"
  - 구현

```
def lab11_getTempWeb():
    import urllib
    url=urllib.urlopen("http://www.ajc.com/
       weather")
    weatherPage=url.read()
    url.close()
    word="cmWeatherDescription"
    loc=weatherPage.find(word)
    #print weatherPage,word
    if loc==-1:
        print "Not found"
    else:
        locEnd=weatherPage.find("&deg",loc)
        locBegin=weatherPage.rfind(">",0,
           locEnd)
        print "Current temperature: ",
           weatherPage[locBegin+1:locEnd]
```

- FTP
  - 순서 1) login (username, pwd) 2) do something 3) logout
  - ftp raw commands
    - CWD - change working directory
    - LIST - list remote files

* PWD - print working directory
* STOR - store a file on the remote host

```
>>> import ftplib
>>> import getpass
>>> passw=getpass.getpass('Password:')
Password:
>>> ftp=ftplib.FTP('uranus.smu.ac.kr')
>>> ftp.login('lim',passw)
'230 Login successful.'
>>> ftp.dir()
drwxr-xr-x    2 820      820    4096 Mar 09
   10:07 public_html
>>> ftp.pwd()
'/pro1/lim'
>>> ftp.cwd('public_html')
'250 Directory successfully changed.'
>>> ftp.pwd()
'/pro1/lim/public_html'
>>> ftp.dir()
-rw-r--r--    1 820      820      56 Mar 09
   10:07 index.html
>>> ftp.retrlines('LIST') # same as ftp.dir()
-rw-r--r--    1 820      820      56 Mar 09
   10:07 index.html
'226 Directory send OK.'
>>> ftp.retrlines('RETR index.html')
<html>
  <body>
    <b1> Hello </b1>
  </body>
</html>
'226 File send OK.'
>>> import os
>>> os.getcwd()
'/home/jsl'
>>> f=open(os.getcwd()+'/jsl.txt','wt')
>>> f.write('hello from jsl.txt')
```

```
>>> f.close()
>>> f=open(os.getcwd()+'/jsl.txt','rt')
>>> ftp.storlines('STOR jsl.txt',f)
'226 File receive OK.'
>>> f.close()
>>> ftp.dir()
-rw-r--r--    1 820      820      56 Mar 09
   10:07 index.html
-rw-r--r--    1 820      820      20 May 12
   06:21 jsl.txt
>>> ftp.retrlines('RETR index.html')
hello from jsl.txt
'226 File send OK.'
>>> ftp.rename('jsl.txt','jslnew.txt')
'250 Rename successful.'
>>> ftp.dir()
-rw-r--r--    1 820      820      56 Mar 09
   10:07 index.html
-rw-r--r--    1 820      820      20 May 12
   06:21 jslnew.txt
>>> ftp.delete('jslnew.txt')
'250 Delete operation successful.'
>>> ftp.dir()
-rw-r--r--    1 820      820      56 Mar 09
   10:07 index.html
>>> ftp.quit()
'221 Goodbye.'
```

- crossing media
  - sound to picture

```
def lab11_soundToPicture():
    s=makeSound(getMediaPath('helloWorld.wav'
       ))
    pic=makePicture(getMediaPath('640x480.jpg
       '))
    sindex=0
    for p in getPixels(pic):
      if sindex==getLength(s):
```

```
            break
          sample=getSampleValueAt(s,sindex)
          if sample>1000:
            setColor(p,red)
          elif sample<-1000:
            setColor(p,blue)
          else:
            setColor(p,green)
          sindex+=1
        explore(pic)
```

- sound to text

```
>>> s=makeSound(getMediaPath('bassoon-c4.wav'
    ))
>>> str(getSample(getSamples(s)[10]))+'\n'
'9\n'
```

- list to/from sound or picture

```
#102
def soundToList(sound):
  list=[]
  for s in getSamples(sound):
    list=list+[getSample(s)]
  return list
#103
def pictureToList(picture):
  list = []
  for p in getPixels(picture):
    list = list + [[getX(p),getY(p),getRed(p),
       getGreen(p),getBlue(p)]]
  return list
#104
def listToPicture(list):
  picture = makeEmptyPicture(640,480)
  for p in list:
    if p[0] <= getWidth(picture) and p[1] <=
       getHeight(picture):
      setColor(getPixel(picture,p[0],p[1]),
```

```
            makeColor(p[2],p[3],p[4]))
    return picture
```

11.2.2 LAB 11-2

11.14
11.17
11.18

12 LAB 12

12.1 12장 요약

- HTML css XHTML
- HTML 생성: Python으로 HTML생성
- 사용자계정의 public_html/index.html (uranus.smu.ac.kr/ lim)
- 데이터베이스: 메모리, 파일에 데이터를 저장하는 방식에 비해 빠름. 또한 공용으로 사용하는 방식
- anydbm shelve SQLite, MySQL

12.2 12장 실습

12.2.1 LAB 12-1

- makeSamplePage

```
def makeHomePage(name, interest):
  import os
  fn=os.getcwd()+"/myHomePage.html"
  file=open(fn,"wt")
  #file=open("/Users/lab5/Documents/325/
     PythonText/homepage.html", "wt")
  file.write("""<!DOCTYPE HTML PUBLIC " -//W3C//
     DTD HTML 4.01 Transition//EN"
"http://www.w3.org/TR/htm14/loose.dtd">
<html>
  <head>
    <title>""" + name + """'s Home Page</title>
    <link rel="stylesheet" href="myCs325Style.
       css" type="text/css"/>
  </head>
  <body>
    <h1>Welcome to """+name+"""'s Home Page</h1>
    <p>Hi! I am """+name+""". This is my home
       page!
    I am interested in """ + interest + """ </p>
  </body>
</html>""")
  file.close()
    makeHomePage('jsl','programming')
```

- anydbm

```
>>> import anydbm
>>> db=anydbm.open("news","c")
>>> db["headline"]="katie turns 8"
>>> db["story"]="""Hello World"""
>>> db.close()
>>> db=anydbm.open("news","r")
>>> print db.keys()
['story', 'headline']
```

```
>>> print db['story']
Hello World
>>> for k in db.keys():
...   print db[k]
...
Hello World
katie turns 8
>>> db.close()
```

- shelve

```
>>> import shelve
>>> dbs=shelve.open('myS.db','c')
>>> dbs['s1']={'sid':'s1','item':'bag','price'
   :100, 'pid':'p1'}
>>> dbs['s2']={'sid':'s2','item':'chair','price'
   :50, 'pid':'p1'}
>>> dbs['s3']={'sid':'s3','item':'cup','price'
   :10, 'pid':'p2'}
>>> dbs.close()
>>> dbs=shelve.open('myS.db','r')
>>> sum=0
>>> for key in dbs.keys():
...   if dbs[key]['pid']=='p1':
...     print dbs[key]
...     sum=sum+dbs[key]['price']
...
{'item': 'chair', 'sid': 's2', 'price': 50, 'pid
   ': 'p1'}
{'item': 'bag', 'sid': 's1', 'price': 100, 'pid'
   : 'p1'}
>>> print "sum of all prices: ",sum
sum of all prices:  150
>>>
>>> dbp=shelve.open('myP.db','c')
>>> dbp['p1']={'pid':'p1','name':'jsl','weight'
   :70}
>>> dbp['p2']={'pid':'p2','name':'kim','weight'
   :65}
```

```
>>> dbp.close()
>>> dbp=shelve.open('myP.db','r')
>>> #read one by one
>>> print dbp['p1']
{'weight': 70, 'pid': 'p1', 'name': 'jsl'}
>>> print dbp['p1']['name']
jsl
>>> #read all items
>>> for key in dbp.keys():
...   print dbp[key]
...
{'weight': 65, 'pid': 'p2', 'name': 'kim'}
{'weight': 70, 'pid': 'p1', 'name': 'jsl'}
>>> sum=0
>>> for key in dbp.keys():
...   sum=sum+dbp[key]['weight']
...
>>> print "total weight is ",sum
total weight is  135
```

- sqlite: www.sqlite.org
  - Server설치가 필요없고, 설정이 없다는 점에서 lite.
  - 리눅스: 기본 설치되어 있슴.
  - 윈도우: 다운로드(ssqlite-shell-win32-x86-xxxxxxx.zip, Precompiled Binaries for Windows) 받아서 압축만 풀면 됨 (sqlite.exe) 그리고 Path setup
  - python에서 예제1 (sqlite not working for jython)

```
from sqlite3 import dbapi2 as sql
sql.sqlite_version
con = sql.connect("smu.db")
cur = con.cursor()
cur.execute("CREATE TABLE Program (id INTEGER
    PRIMARY KEY,name TEXT NOT NULL)")
cur.execute("INSERT INTO Program (id, name)
   values (1, 'History')")
con.commit()
cur.execute("select * from Program")
print cur.fetchall()
```

```
cur.close()
# $ sqlite3 smu.db
sqlite> .databases
sqlite> .tables
sqlite> .schema
sqlite> .q
```

- python에서 예제2

```
# $ vi p1-c12-ddl.sql
CREATE TABLE product (
    pid INTEGER NOT NULL PRIMARY KEY,
    p_name VARCHAR(50),
    p_price INTEGER );
CREATE TABLE customer (
    cid INTEGER NOT NULL PRIMARY KEY,
    c_name VARCHAR(50) );
CREATE TABLE jumun (
    cid INTEGER NOT NULL REFERENCES customer,
    oid INTEGER NOT NULL REFERENCES orderItem,
    PRIMARY KEY (cid, oid) );
CREATE TABLE orderItem (
    oid INTEGER NOT NULL PRIMARY KEY,
    pid INTEGER NOT NULL REFERENCES product );
INSERT INTO product VALUES (1,'computer',1000);
INSERT INTO customer VALUES (1,'Kim');
INSERT INTO jumun VALUES (1,1);
INSERT INTO orderItem VALUES (1,1);

# 윈도우에서도 동일하게 실행됨. 아래는 리눅스 사용예.
# $ sqlite3 p1-ch12.db < p1-c12-ddl.sql
# $ sqlite3 p1-ch12.db
sqlite> select * from product;
1|computer|1000
sqlite> select oid, sum(p_price) from orderItem, product
   ...> where orderItem.pid=product.pid;
1|1000

# p1-ch12.db있는 디렉토리로 변경
```

```
>>> con=sql.connect("p1-ch12.db")
>>> cur=con.cursor()
>>> cur.execute("select * from customer")
<sqlite3.Cursor object at 0x1016159d0>
[(1, u'Kim')]
>>> cur.execute("select oid, sum(p_price) from orderItem, product where c
<sqlite3.Cursor object at 0x1016158f0>
>>> cur.fetchall()
[(1, 1000)]
>>> cur.close()
```

- MySQL
  - mysql install
    - 윈도우는 installer
    - ubuntu
      - mysql server sudo apt-get install mysql-server mysql-client
      - security `sudo mysql_secure_installation`
      - configure `sudo vi /ect/mysql/my.cnf` bind-address는 127.0.01 localhost로 설정
      - mysql server sudo mysql stop—start—restart `/usr/sbin/mysqld --help --verbo`
      - mysql client: mysql -u root -p
      - MySQL Tools
        MySQL Work Bench: sudo apt-get install mysql-workbench
        MySQL Navigator: sudo apt-get install mysql-navigator
        Emma: sudo apt-get install emma
        MySQL Admin: sudo apt-get install mysql-admin
  - MySQL driver install (mysql server없이 driver만으로는 작동하지 않음)
    download Connector/J (5.1.24) JDBC driver for MySQL `http://www.mysql.com/downloads/`
    untar tar -zxvf mysql-connector-java-xxxx.tar.gz and find .jar file

```
>>> import sys
>>> sys.path.append('/home/jss/Downloads/
    mysql-connector-java-5.1.24/mysql-
    connector-java-5.1.24-bin.jar')
>>> import com.mysql
```

```
    *sys-package-mgr*: processing new jar, '/
    home/jss/Downloads/mysql-connector-java
    -5.1.24/mysql-connector-java-5.1.24-bin.
    jar'
>>> dir(com.mysql)
['__name__', 'jdbc']
```

– zxJDBC (Python wrapper around JDBC)

```
from com.ziclix.python.sql import zxJDBC
db =zxJDBC.connect("jdbc:mysql://localhost/
    test", "root", "password",
"com.mysql.jdbc.Driver")
con = db.cursor()
```

– java JDBC (sys.path.append하면 안되는듯. classpath에추가하면 됨)

```
# -*- coding: utf-8 -*-
from java.lang import *
from java.sql import *

driverName = "com.mysql.jdbc.Driver"

Class.forName(driverName)

url = "jdbc:mysql://localhost/test?user=root&
    password=XXXXX"
con = DriverManager.getConnection(url)
stmt = con.createStatement()

sql = "select * from TABLENAME"
rs = stmt.executeQuery(sql)
while (rs.next()):
    print rs.getString(1)

rs.close()
stmt.close()
con.close()
```

12.2.2 LAB 12-2

12.15 정해진 디렉토리의 이미지파일을 읽어 링크를 넣은 index.html을 구현. 이미지 크기를 1/2로 줄임 (이미지 파일 이름은 half-) 아래 소스를 실행해 보고 index.html이 생성되었는지 확인하고, 웹브라우저에서 열어 확인해 본다.

```
>>> # select jpg files
>>> import os
>>> mediaDir=getMediaPath()
>>> print mediaDir
>>> allMediaFiles=os.listdir(mediaDir)
>>> print len(allMediaFiles)
184
>>> for f in allMediaFiles:
...   if f.startswith('a'):
...     print f
...
a.wav
a440.wav
aah.wav
about.wav
airplane.wav
ajc-weather.html
along.wav
always.wav
and.wav
anthony.jpg
antidisestablishmenterianism.wav
arch.jpg
around.wav
arthurs-seat.jpg
>>> for f in allMediaFiles:
...   if f.startswith('b'):
...     print f
...
backpack.wav
barbara.jpg
barbaraS.jpg
```

```
bassoon-c4.wav
bassoon-e4.wav
bassoon-g4.wav
beach.jpg
bgframe.jpg
bigben.jpg
blue-mark.jpg
blueMotorcycle.jpg
blueShrub.jpg
bridge.jpg
butterfly.jpg
butterfly1.jpg
butterfly2.jpg
>>> for f in allMediaFiles:
...    if f.startswith('b') and f.endswith('.jpg'
   ):
...      print f
...
barbara.jpg
barbaraS.jpg
beach.jpg
bgframe.jpg
bigben.jpg
blue-mark.jpg
blueMotorcycle.jpg
blueShrub.jpg
bridge.jpg
butterfly.jpg
butterfly1.jpg
butterfly2.jpg
>>> bFiles=[]
>>> for f in allMediaFiles:
...    if f.startswith('b') and f.endswith('.jpg'
   ):
...      bFiles+=[f]
...
>>> print len(bFiles)
12
```

```
>>> print bFiles
[u'barbara.jpg', u'barbaraS.jpg', u'beach.jpg',
   u'bgframe.jpg', u'bigben.jpg',
u'blue-mark.jpg', u'blueMotorcycle.jpg', u'
   blueShrub.jpg', u'bridge.jpg',
u'butterfly.jpg', u'butterfly1.jpg', u'
   butterfly2.jpg']
>>>
>>> # create html
>>> html=""
>>> html+="""<!DOCTYPE HTML PUBLIC " -//W3C//DTD
    HTML 4.01 Transition//EN"
>>> "http://www.w3.org/TR/htm14/loose.dtd"> <
   html> <head> <title>My Home
>>> Page</title> </head>"""
>>> html+="<body>"
>>> html+="<h1>Samples from "+mediaDir+" </h1>"
>>> for f in bFiles:
...    html+="<p>Filename: "+f
...    html+='<image src="'+f+'"height="100"/></p
   >'
...
>>> html+="</body>"
>>> html+="</html>"
>>> print html
<!DOCTYPE HTML PUBLIC " -//W3C//DTD HTML 4.01
   Transition//EN"
"http://www.w3.org/TR/htm14/loose.dtd"> <html> <
   head> <title>My Home
Page</title> </head><body><h1>Samples from /
   mediasources/
</h1><p>Filename: barbara.jpg<image
src="barbara.jpg"height="100"/></p><p>Filename:
   barbaraS.jpg<image
src="barbaraS.jpg"height="100"/></p><p>Filename:
    beach.jpg<image
src="beach.jpg"height="100"/></p><p>Filename:
   bgframe.jpg<image
```

```
src="bgframe.jpg"height="100"/></p><p>Filename:
   bigben.jpg<image
src="bigben.jpg"height="100"/></p><p>Filename:
   blue-mark.jpg<image
src="blue-mark.jpg"height="100"/></p><p>Filename
   : blueMotorcycle.jpg<image
src="blueMotorcycle.jpg"height="100"/></p><p>
   Filename: blueShrub.jpg<image
src="blueShrub.jpg"height="100"/></p><p>Filename
   : bridge.jpg<image
src="bridge.jpg"height="100"/></p><p>Filename:
   butterfly.jpg<image
src="butterfly.jpg"height="100"/></p><p>Filename
   : butterfly1.jpg<image
src="butterfly1.jpg"height="100"/></p><p>
   Filename: butterfly2.jpg<image
src="butterfly2.jpg"height="100"/></p></body></
   html>
>>>
>>> # create a HTML file at the current working
   dir
>>> import os
>>> print os.getcwd()
>>> dirSep="/"
>>> fn=os.getcwd()+dirSep+"index.html"
>>> print fn
>>> indexHtml=open(fn,"wt")
>>> indexHtml.write(html)
>>> indexHtml.close()
```

12.16 온도에 따라 적절한 이미지를 출력하는 html 생성

12.19 상품, 고객, 주문, 주문명세 테이블을 생성. 1) 고객이름을 입력하면 그 고객이 한 모든 주문을 출력하는 함수, 2) 주문금액이 일정 금액을 넘는 주문을 출력하는 함수를 구현. 아래는 문제를 푸는 도움 소스. 비용이 1000이 넘는 주문을 출력하는 예제. 문제에 맞게 수정해야 함.

```
>>> #product - pid, p_name, p_price
>>> import shelve
>>> dbp=shelve.open('product.db','c')
```

```
>>> dbp['p1']={'pid':'p1','p_name':'computer','
   p_price':1000}
>>> dbp['p2']={'pid':'p2','p_name':'monitor','
   p_price':200}
>>> dbp['p3']={'pid':'p3','p_name':'speaker','
   p_price':100}
>>> dbp['p4']={'pid':'p4','p_name':'handphone','
   p_price':500}
>>> dbp['p5']={'pid':'p5','p_name':'desk','
   p_price':300}
>>> dbp.close()
>>>
>>> #customer - cid, c_name,
>>> dbc=shelve.open('customer.db','c')
>>> dbc['c1']={'cid':'c1','c_name':'Kim'}
>>> dbc['c2']={'cid':'c2','c_name':'Lee'}
>>> dbc.close()
>>>
>>> #order - cid, oid
>>> dbo=shelve.open('order.db','c')
>>> dbo['c1o1']={'cid':'c1','oid':'o1'}
>>> dbo['c1o2']={'cid':'c1','oid':'o2'}
>>> dbo.close()
>>>
>>> #order item - oid, pid
>>> dboi=shelve.open('orderItem.db','c')
>>> dboi['o1p1']={'oid':'o1','pid':'p1'}
>>> dboi['o1p2']={'oid':'o1','pid':'p2'}
>>> dboi.close()
>>> #all orders greater than 1000
>>> dboi=shelve.open('orderItem.db','r')
>>> dbp=shelve.open('product.db','r')
>>> price={}
>>> for key in dboi.keys():
...   oid=dboi[key]['oid']
...   pid=dboi[key]['pid']
...   if oid in price:
...     for key in dbp.keys():
```

```
...         if dbp[key]['pid']==pid:
...           price[oid]+=dbp[key]['p_price']
...     else:
...       for key in dbp.keys():
...         if dbp[key]['pid']==pid:
...           price[oid]=dbp[key]['p_price']
...
>>> for key in price.keys():
...     if price[key] > 1000:
...       print price[key]
...
1200
>>> dboi.close()
>>> dbp.close()
```

13 LAB 13

13.1 13장 요약

- 90분 영화는 약150GB 90분 x 60s x 30fps x (640 x 380 pixels) x 24 bits/p
- MPEG QuickTime AVI JMV
- 함수
  - makeMovieFromInitialFile(jpg) playMovie(Movie)

13.2 13장 실습

13.2.1 LAB 13-1

- 어린아이 영화 실행해보기

```
>>> aFrame=getMediaPath()+"kid-in-bg-seq/"+"kid-
   in-frame  001.jpg"
>>> os.path.isfile(aFrame)
True
>>> aMovie=makeMovieFromInitialFile(aFrame)
>>> playMovie(aMovie)
```

- 물고기 영화 실행해보기

```
>>> aFrame=getMediaPath()+"fish/fishflurry 001.
   jpg"
>>> if os.path.isfile(aFrame):
...     aMovie=makeMovieFromInitialFile(aFrame)
>>> playMovie(aMovie)
```

- 프레임파일명 일련번호 생성

```
>>> num=1
>>> os.getcwd()+'/myFrame%03d.jpg' % num
'/home/jss/myFrame001.jpg'
```

- animation (directory생성) 주의:writePictureTo()는 getMediaPath()의 상대경로에 씀

```
def makeRectMovie(directory):
  for num in range (1,30): #29 frames (1 to 29)
    canvas = makeEmptyPicture(300 ,200)
    addRectFilled(canvas ,num * 10, num * 5,
       50,50, red)
    writePictureTo(canvas,directory+"/frame%03d.
       jpg" % num)
  return directory+"/frame%03d.jpg" % 1
>>> dirM=os.getcwd()+'/movie'
>>> if not os.path.exists(dirM):
...     os.mkdir(dirM)
>>> aFrame=makeRectMovie(dirM)
>>> aMovie=makeMovieFromInitialFile(aFrame)
```

```
>>> playMovie(aMovie)
```

- ticker tape

```
def tickertape(dirM,string):
  for num in range(1,10): #num of frames
    canvas = makeEmptyPicture(300,100)
    #Start at right, and move left
    addText(canvas,300-(num*10),50,string)
    writePictureTo(canvas,dirM+'/frame%03d.jpg'
       % num)
  return dirM+'/frame%03d.jpg' % num
>>> string='hello'
>>> aFrame=tickertape(dirM,string)
>>> dirT=makeMovieFromInitialFile(aFrame)
>>> playMovie(dirT)
```

- slow sunset 여기서는 프레임을 10개만 생성. not much effect with just 10 frames

```
def slowSunset(directory):
  #outside the loop!
  canvas = makePicture(getMediaPath("beach.jpg")
     )
  for num in range(1, 10): #99 frames
    makeSunset(canvas)
    writePictureTo(canvas,directory+"/frame%03d.
       jpg" % num)
  return directory+"/frame%03d.jpg" % 1
>>> aFrame=slowSunset(dirM)
>>> dirS=makeMovieFromInitialFile(aFrame)
>>> playMovie(dirS)
```

- 이미 있는 프레임에 이미지를 잘라 붙여서 움직이기

```
def lab13_mommyWatchingTest():
    """
    1) clip the face of getMediaPath('barbaraS.
       jpg')
    2) copy it onto the frames under kids-blue/
    3) generate frames (under /movie)
```

```
either oneFrame001.jpg or allFrame001~009.
   jpg
4) returns allFrame001.jpg
"""
#read mommy face
barb=makePicture(getMediaPath('barbaraS.jpg'
   ))
x1=22
y1=9
x2=93
y2=97
mFace=makeEmptyPicture(x2-x1+1,y2-y1+1)
mx=0
for x in range(x1,x2):
  my=0
  for y in range(y1,y2):
    p=getPixel(barb,x,y)
    m=getPixel(mFace,mx,my)
    setColor(m,(getColor(p)))
    my+=1
  mx+=1
s=mFace  #contains only mommy's face
#read a frame and place the face on it
path=os.getcwd()+'/movie'
if not os.path.exists(path):
  os.mkdir(path)
dirM=os.getcwd()+'/movie'
dirT=getMediaPath()+'kids-blue'
aFrame=os.listdir(dirT)[0] #NOTE: unsorted
   listdir
#--begin A--
t=makePicture(dirT+'/'+aFrame)
tnum=1  #only one frame
tx=0
for sx in range(0,getWidth(s)):
  ty=0
  for sy in range(0,getHeight(s)):
    sp=getPixel(s,sx,sy)
```

```
      tp=getPixel(t,tx,ty)
      setColor(tp,getColor(sp))
      ty+=1
    tx+=1
  frameName=dirM+'/oneFrame%03d.jpg' % tnum
  writePictureTo(t,frameName)
  #--end A--

  #iterate over all frames
  tnum=0
  for aFrame in os.listdir(dirT)[:10]:
    #copy from A (except tnum*10)
    t=makePicture(dirT+'/'+aFrame)
    tnum+=1
    tx=0
    for sx in range(0,getWidth(s)):
        ty=0
        for sy in range(0,getHeight(s)):
          sp=getPixel(s,sx,sy)
          tp=getPixel(t,tx+tnum*10,ty+tnum*10)
          setColor(tp,getColor(sp))
          ty+=1
        tx+=1
    frameName=dirM+'/allFrame%03d.jpg' % tnum
    writePictureTo(t,frameName)
  return dirM+'/allFrame%03d.jpg' % 1

>>> aFrame=lab13_mommyWatchingTest()
>>> dirMW=makeMovieFromInitialFile(aFrame)
>>> playMovie(dirMW)
```

13.2.2 LAB 13-2

13.14 텍스트가 아래에서 떠서 위로 움직이면서 작아짐. 폰트도 변경.

```
style=makeStyle(sansSerif, bold, 12)
addTextWithStyle(pic,xpos,ypos,text,style)
```

13.15 녹색배경으로 친구가 춤추는 장면을 찍고, chromakey기법을 사용하여 바닷가에서 춤추는 것처럼 프로그래밍.
13.19 천천히 사라지는 사람을 담은 영화. slowFadeout함수 참조 (p.308)

13.2.3 소과제: 뉴스헤드라인 ticker tape

(교재 문제 13.18참조)
- 창의적인 ticker tape를 생성하는 프로그램 작성
- 뉴스사이트의 헤드라인 5개를 scraping (사진 있는 기사)
- 헤드라인을 기사에 포함된 사진에 ticker tape으로 프로그래밍
- ticker tape 결과물은 5초.
- 매 1초의 화면, 총 5장을 하나의 jpg로 저장 (이미지 콜라주)
- 과제제출
  - 서버업로드: 프로그램(py), PDF, mpeg
  - PDF 목차
    - 프로그램 소스코드 (Courier)
    - 프로그램 설명: 5 문장 이상.
    - 매 1초의 화면이 담긴 1장의 jpg
- 제출기한: 15주 (PDF출력물은 수업시간에 제출)
- 채점기준
  - 30점: 헤드라인 기사+사진 scraping 5개.
  - 30점: 기사 사진 ticker tape 5초
  - 30점: 매 1초 jpg
  - 10점: 품질

```
<img src="http://a.abcnews.com/images/GMA/
   abc_gma_sligh_130524_me.jpg"
>>> fn=os.getcwd()+'/movie//myPic.jpg'
>>> f=open(fn,'wb')
>>> f.write(urllib.urlopen('http://a.abcnews.com
   /images/GMA/abc_gma_sligh_130524_me.jpg').
   read())
>>> f.close()
```

14 LAB 14

14.1 14장 요약

- What makes program fast?
  - Machine Language에 얼마나 가까운가? Compilers (C) vs Interpreters (Java, Python). Jython은 (1) 자바로 변환 (2) 자바를 컴파일하는 2단계 과정.

```
LOAD #10,R0
LOAD #12,R1
SUM R0,R1
STOR R1,#45
```

  - Big-O notation - O(n) Loop를 최소화하도록 함.
  - 효과적인 알고리듬 (heuristics)
- What makes computers fast? - CPU clock rates, Storage (Cache¡RAM¡HD), display

14.2 14장 실습

14.2.1 LAB 14-1

14.8 nested for statment의 O(n)?
14.12 binary search algorithm
14.19 Heuristics로 해를 푸는 이유는?

15 LAB 15

15.1 15장 요약

- 함수를 쓰는 이유? divide and conquer. 함수의 granularity?
- map and reduce
  - map과 filter: 함수와 여러 입력값을 받아서 하나씩 처리.

```
>>> map(hello, [‘‘Mark’’,‘‘Betty’’,‘‘Matthew’’, ‘‘Jenny’’])
```

  - reduce: 처리결과를 통합.
- Recursion - self-call

```
def printAllFiles(directory):
    import os
    files = os.listdir(directory)
    for file in files:
        fullname = directory+"/"+file
        if isDirectory(fullname):
            printAllFiles(fullname)
        else:
            print fullname
def isDirectory(filename):
    import java.io.File as File
    filestatus = File(filename)
    return filestatus.isDirectory()

import os
printAllFiles(os.getcwd())
```

15.2 15장 실습

15.2.1 LAB 15-1

15.14
15.15
15.16

16 LAB 16

16.1 16장 요약

- 객체지향. 다형성, 캡슐화, 상속 등의 특징을 활용.
- 함수
  - Turtle을 이용해 객체생성, 객체간 메시지 실행.
  - 리스트에 객체를 담고, 다형적으로 실행.

16.2 16장 실습

16.2.1 LAB 16-1

- Turtle이 실행되는 객체지향방식.

```
>>> earth=makeWorld()
>>> t1=makeTurtle(earth)
>>> t2=makeTurtle(earth)
>>> t1.forward()
>>> t1.turnRight()
>>> t2.turnRight()
>>> t2.forward(50)
>>> t1.turn(-45)
>>> t1.forward()
>>> t1.penUp()
>>> t1.moveTo(0,0)
>>> t1.penDown()
>>> t1.moveTo(639,479)
```

- 객체지향방식의 코드중복 줄이기. 다형적으로 show()함수 실행.

```
class slide:
  def __init__(self,pictureFile,soundFile):
    self.picture = makePicture(pictureFile)
    self.sound = makeSound(soundFile)
  def show(self):
    show(self.picture)
    blockingPlay(self.sound)
def showSlide(aSlide):
    aSlide.show()
def playslideshow2():
    s1=slide(getMediaPath("barbara.jpg"),getMediaPath("bassoon-c4.wav"))
    s2=slide(getMediaPath("beach.jpg"),getMediaPath("bassoon-e4.wav"))
    s3=slide(getMediaPath("swan.jpg"),getMediaPath("bassoon-g4.wav"))
    s4=slide(getMediaPath("jungle2.jpg"),getMediaPath("bassoon-c4.wav"))
    slideList=[s1,s2,s3,s4]
    #1) apply function to each item
    #map(showSlide,slideList)
```

```
    #2) polymorphic
    for s in slideList:
        s.show()
```

- Joe the Box 객체지향으로 정사각형 그리기.

```
class Box:
    def __init__(self):
        self.setDefaultColor()
        self.size=10
        self.pos=(10,10)
    def setDefaultColor(self):
        self.color=red
    def draw(self,canvas):
        addRectFilled(canvas,self.pos[0],self.pos[1],
                self.size,self.size,self.color)
        repaint(canvas)
def lab16_19():
    canvas=makeEmptyPicture(200,300)
    b1=Box()
    b1.draw(canvas)
```

- 객체지향의 다형성

```
class Animal:
    def __init__(self,name):
        self.name=name
    def talk(self):
        raise NotImplementedError("Imlement Subclass")
class Cat(Animal):
    def talk(self):
        return 'Meow!'
class Dog(Animal):
    def talk(self):
        return 'Woof!'
def lab16_testPoly():
    animals=[Cat('Nabi'),Dog('Badugi'),Cat('Mimi')]
```

```
    for animal in animals:
        print animal.name+' '+animal.talk()
```

16.2.2 LAB 16-2

16.4 Turtle 클래스에 drawRect(width,height)추가

16.13 Student 클래스 구현. show()함수를 구현해서 이름과 사진을 출력.

16.15 PlayList 클래스 구현. 사운드 목록을 하나 씩 play.

```
def lab16_15():
    soundList=[]
    soundList+=[getMediaPath("bassoon-c4.wav")]
    soundList+=[getMediaPath("bassoon-e4.wav")]
    soundList+=[getMediaPath("bassoon-g4.wav")]
    soundList+=[getMediaPath("bassoon-c4.wav")]
    p=PlayList(soundList)
    p.play()
```

16.19 Box 클래스의 setColor, setSize, setPosition를 구현. 이 함수를 사용하도록 init 함수를 수정.

```
def lab16_19():
    canvas=makeEmptyPicture(200,300)
    b1=Box()
    b1.draw(canvas)
    bPos=[20,30]
    b2=myBox(blue,10,bPos)
    b2.draw(canvas)
```