Today

- MIDI
- different ways of combining sounds
- fast talking
- Assignment 6
  - time warp to Chapter 10
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Figure 2.22 MIDI file producing a sinusoidal signal for the note G4 with a frequency of 392 Hz. The amplitude $A$ and period $T$ of the signal are shown.
MIDI

- represent the sound waves
  - .wav
  - our Jython sound functions
- OR represent the “instruments”
- MIDI: Musical Instrument Digital Interface
  - used to connect audio (and some video) devices
    - instruments: keyboards, synthesizers, drum machines
    - synchronize events
  - more compact representation - like vector graphics!
- Jython’s MIDI
  - just plays the notes (alas)
  - sounds like a piano
Playing MIDI notes

**recipe 74**

```python
def song() :
    playNote( 60, 200, 127 )
    playNote( 60, 500, 127 )
    playNote( 60, 800, 127 )
    playNote( 60, 600, 127 )
    for i in range( 1, 2 ) :
        playNote( 64, 120, 127 )
        playNote( 65, 120, 127 )
        playNote( 67, 60, 127 )
```

Can anyone explain this?
TODAY

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Adding

- recipe 71 (part 2)

```python
def addSounds( sound1, sound2) :
    for index in range( 1, getLength(sound1) + 1 ) :
        s1Sample = getSampleValueAt( sound1, index )
        s2Sample = getSampleValueAt( sound2, index )
        setSampleValueAt( sound2, index, s1Sample + s2Sample )
    return sound2
```

- NOTE: could also use average of s1Sample and s2Sample
Adding (50% of each)

- recipe 71 (part 2)

```python
def addSounds( sound1, sound2 ) :
    for index in range( 1, getLength(sound1) + 1 ) :
        s1Sample = getSampleValueAt( sound1, index ) * 0.5
        s2Sample = getSampleValueAt( sound2, index ) * 0.5
        setSampleValueAt( sound2, index, int( s1Sample + s2Sample ) )
    return sound2
```
Adding

- A more general addSounds()

```python
def addSounds2( sound1, sound2 ) :
    len1 = getLength( sound1 )
    len2 = getLength( sound2 )
    if len1 > len2 :
        longer = sound1
        shorter = sound2
        soundLen = len2
    else :
        longer = sound2
        shorter = sound1
        soundLen = len1

    for shorterIndex in range( 1, soundLen ) :
        setSampleValueAt( longer, shorterIndex, getSampleValueAt( longer, shorterIndex ) + getSampleValueAt( shorter, shorterIndex ) )

    return longer
```

Adding without side effect changes

- The more general addSounds() --> return sound

```python
def addSounds2( sound1, sound2) :
    len1 = getLength( sound1 )
    len2 = getLength( sound2 )
    if len1 > len2 :
        longer = sound1
        shorter = sound2
        soundLen = len2
        remainderLen = len1
    else :
        longer = sound2
        shorter = sound1
        soundLen = len1
        remainderLen = len2
    target = makeEmptySound( (soundLen), getSampleRate( longer ) )

    for shorterIndex in range( 1, soundLen ) :
        setSampleValueAt( target, shorterIndex, getSampleValueAt( longer, shorterIndex ) + getSampleValueAt( shorter, shorterIndex ) )

    for remainder in range( soundLen, remainderLen ) :
        setSampleValueAt( target, remainder, getSampleValueAt( longer, remainder ) )

    return target
```
Combining (alternating samples)

- not in book

```python
def combine( sound1, sound2 ) :
    len1 = getLength( sound1 )
    len2 = getLength( sound2 )
    if len1 > len2 :
        longer = sound1
        shorter = sound2
        soundLen = len2
    else :
        longer = sound2
        shorter = sound1
        soundLen = len1

    for shorterIndex in range( 1, soundLen, 2 ) :
        setSampleValueAt( longer, shorterIndex, getSampleValueAt( shorter, shorterIndex ) )

    return longer
```

Lets see how these combining ideas work with pictures
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Fast talking

not in book

```python
def fastTalk( sound, thresholdAmplitude, thresholdDuration ) :
    # this skips pauses between words
    sampleRate = getSamplingRate( sound )
    soundLen = getLength( sound )
    target = makeEmptySound( 1 + int(soundLen / sampleRate) )
    thresholdCount = int( sampleRate * thresholdDuration )
    targetIndex = 1
    count = 0
    targetJumpBackTo = 1

    for sourceIndex in range( 1, soundLen + 1 ) :
        sampleValue = getSampleValueAt( sound, sourceIndex )

        if abs(sampleValue) < thresholdAmplitude :
            count = count + 1
        else :
            if count > thresholdCount :
                targetIndex = targetJumpBackTo
                count = 0
                targetJumpBackTo = targetIndex

                setSampleValueAt( target, targetIndex, sampleValue )
                targetIndex = targetIndex + 1

    return target
```

Suggestion: normalize spoken sound, use a threshold = 800, duration = 0.01
Faster talking
not in book

```python
def fasterTalk(sound, thresholdAmplitude, thresholdDuration):
    # this skips pauses between words, overlaps words
    sampleRate = getSamplingRate(sound)
    soundLen = getLength(sound)
    target = makeEmptySound(1 + int(soundLen / sampleRate))
    thresholdCount = int(sampleRate * thresholdDuration)
    targetIndex = 1
    count = 0
    targetJumpBackTo = 1

    for sourceIndex in range(1, soundLen + 1):
        sampleValue = getSampleValueAt(sound, sourceIndex)

        if abs(sampleValue) < thresholdAmplitude:
            count = count + 1
            sampleValue = 0  # different than fT,
        else:
            if count > thresholdCount:
                targetIndex = max(1, targetJumpBackTo - thresholdCount)  # different than fT, overlap
                count = 0
                targetJumpBackTo = targetIndex

                setSampleValueAt(target, targetIndex, sampleValue + getSampleValueAt(target, targetIndex))
                # different than fT, add rather than replace

                targetIndex = targetIndex + 1

    return target
```

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ASSIGNMENT 6

- Speaking a phone number

- `readPhoneNumber(phoneNumber, path)`
  - `phoneNumber` is a string of characters (0 - 9)
  - `path` is path to the directory of 10 sound files

- Challenge
  - handle other characters like “(“, “-” and “ “
Assignment 6

- How to read a string of characters?
- Chapter 10!
- Strings

```python
>>> hello = "hello"
>>> for character in hello:
...    print character
...
hello
```
Assignment 6, more

- Strings are also arrays
  ```python
  >>> hello = "hello"
  >>> print hello[2]
  l
  >>> print hello[0]
  h
  ```
- Yup -- strings start at 0
- So we have a couple of ways to read individual characters from a string
- And file names are strings... ( "1.wav", "2.wav" ... )
- + concatenates strings
Questions?
COMING ATTRACTIONS

- Wednesday
  - HW Project 5 due 10:00 am
  - Extra credit reports in class on sound abstraction

- Friday:
  - come to class with Group Project 2 ideas
  - leave with specification for project
COMING ATTRACTIONS

- Next Monday
  - read quiz 8 due 10:00 AM

- Next Wednesday
  - HW 6 due 10:00 AM

- Friday:
  - Group Project 2 due 2:00 PM
  - Bring to Lab