Smith College

Computer Science

CSC231 — Assembly

Week #8 — Fall 2017

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Useful Property

00000000
00000001
00000010
00000011
00000100
…
01111110
01111111
10000000
10000001
10000010
…
11111110
11111111

b_7 b_6 b_5 b_4 b_3 b_2 b_1 b_0

-2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

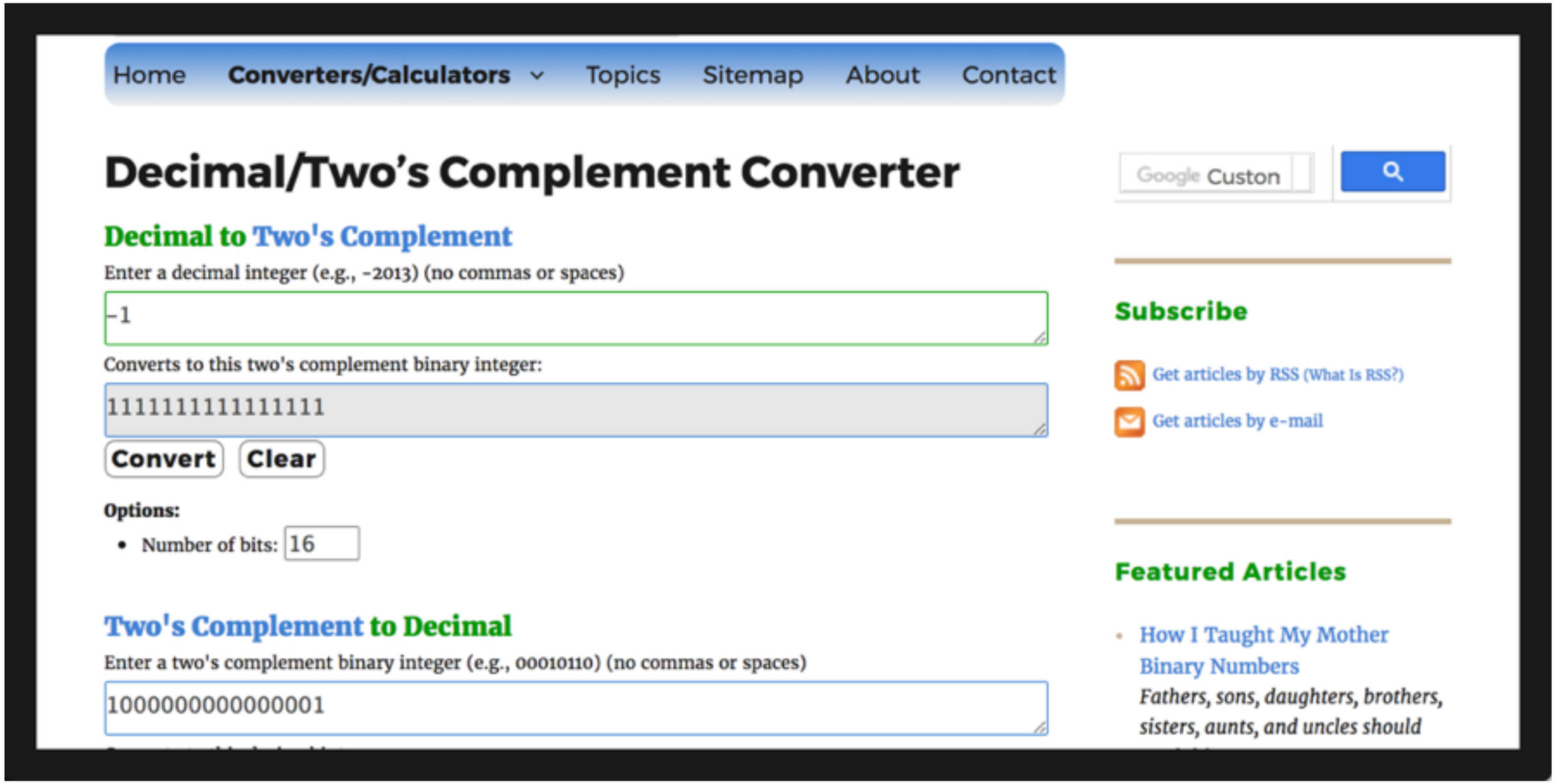
weights of bits for 2's complement

Exercises on Signed Numbers

http://www.science.smith.edu/dftwiki/index.php/CSC231_Exercises_on_Signed_Numbers

Useful On-Line Tool

http://www.exploringbinary.com/twos-complement-converter/



The **LOOP** Instruction

loop

loop label

```
loop      label
```

```
x       dd      1
sum     dd      0
```

```
        mov     ecx, 10
addUp:  mov     eax, dword[x]
        add     dword[sum], eax
        inc     dword[x]
        loop    addUp                   ;ecx<—ecx-1
                                        ;if ecx!=0,
                                        ; goto addUp
```

loop

loop label

```
loop      label
```

```
x       dd      1
sum     dd      0
        mov     ecx, 10
addUp:  mov     eax, dword[x]
        add     dword[sum], eax
        inc     dword[x]
        loop    addUp                   ;ecx<—ecx-1
                                        ;if ecx!=0,
                                        ; goto addUp
```

Label

loop

loop label

```
loop      label
 ;ecx <– ecx-1
 ;if ecx!= 0,
 ;  goto label
 ;else continue
```

```
x       dd      1
sum     dd      0
```

Label

```
        mov     ecx, 10
addUp:  mov     eax, dword[x]
        add     dword[sum], eax
        inc     dword[x]
        loop    addUp                   ;ecx<–ecx-1
                                        ;if ecx!=0,
                                        ; goto addUp
```

Labels

```
_start:     mov     eax, 4

            mov     ecx, 10
for1:       …
            …
            loop    for1

for2:       …
            …
            loop    for2
```

- Start with a **letter**
- End with a **colon** (when declared)
- Represent an **address** in the code section
- Must be **unique** in program

Tracing

One Example

eax

ecx

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for                 ;ecx<—ecx-1
                                    ;if ecx!=0,
                                    ; goto for
```

eax	**?**
ecx	**3**

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for                 ;ecx<—ecx-1
                                    ;if ecx!=0,
                                    ; goto for
```

eax 1

ecx 3

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for                 ;ecx<—ecx-1
                                    ;if ecx!=0,
                                    ; goto for
```

1

eax	**1**
ecx	**3**

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for             ;ecx<—ecx-1
                                ;if ecx!=0,
                                ; goto for
```

1

eax	~~1~~ 2
ecx	3

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for                 ;ecx<—ecx-1
                                    ;if ecx!=0,
                                    ; goto for
```

1

eax ~~1~~ 2

ecx ~~3~~ 2

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for
```

```
;ecx<—ecx-1
;if ecx!=0,
; goto for
```

12

eax	~~1~~ 2
ecx	~~3~~ 2

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for                 ;ecx<—ecx-1
                                    ;if ecx!=0,
                                    ; goto for
```

12

eax ~~1~~ ~~2~~ 3

ecx ~~3~~ 2

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for                 ;ecx<—ecx-1
                                    ;if ecx!=0,
                                    ; goto for
```

12

eax ~~1~~ ~~2~~ 3

ecx ~~3~~ ~~2~~ 1

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for
```

```
;ecx<—ecx-1
;if ecx!=0,
; goto for
```

123

eax ~~1~~ ~~2~~ 3

ecx ~~3~~ ~~2~~ 1

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for                ;ecx<—ecx-1
                                   ;if ecx!=0,
                                   ; goto for
```

123

eax ~~1~~ ~~2~~ ~~3~~ 4

ecx ~~3~~ ~~2~~ 1

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for                 ;ecx<—ecx-1
                                    ;if ecx!=0,
                                    ; goto for
```

123

eax ~~1~~ ~~2~~ ~~3~~ 4

ecx ~~3~~ ~~2~~ ~~1~~ 0

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for
```

```
;ecx<—ecx-1
;if ecx!=0,
; goto for
```

123

eax ~~1~~ ~~2~~ ~~3~~ 4

ecx ~~3~~ ~~2~~ ~~1~~ 0

```
        mov     ecx, 3
        mov     eax, 1
for:    call    _printDec
        inc     eax
        loop    for                 ;ecx<—ecx-1
        ????                        ;if ecx!=0,
                                    ; goto for
```

Example 1

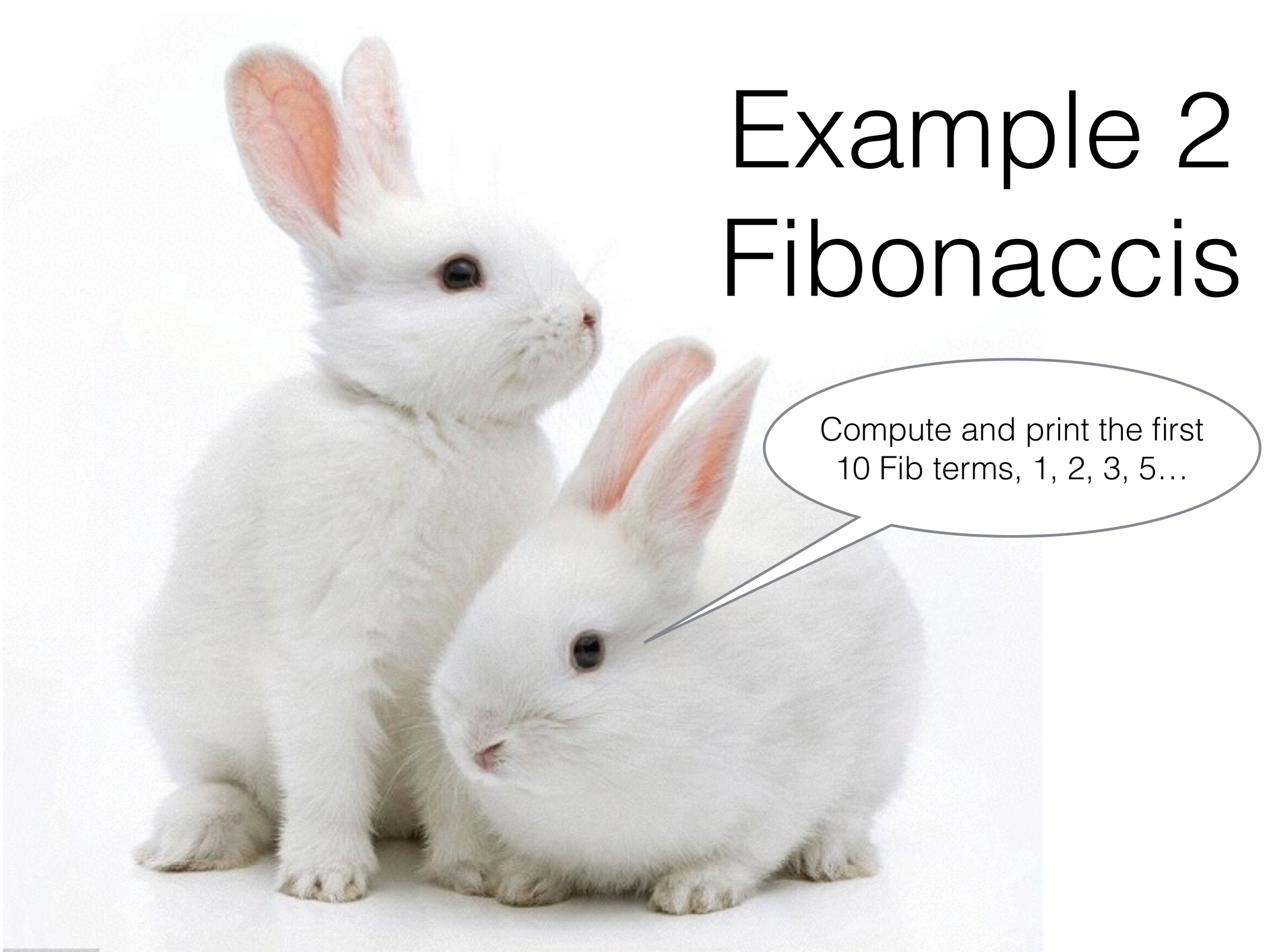
Sum of 1..10

```
; computes sum(x, x+1, x+2, x+9)
; x = x+10
x       dd      1
sum     dd      0

        mov     ecx, 10
        mov     eax, dword[x]
addUP:  add     dword[sum], eax
        inc     eax
        loop    addUp                   ;ecx<—ecx-1
                                        ;if ecx!=0,
                                        ; goto addUp

        mov     dword[x], eax
```

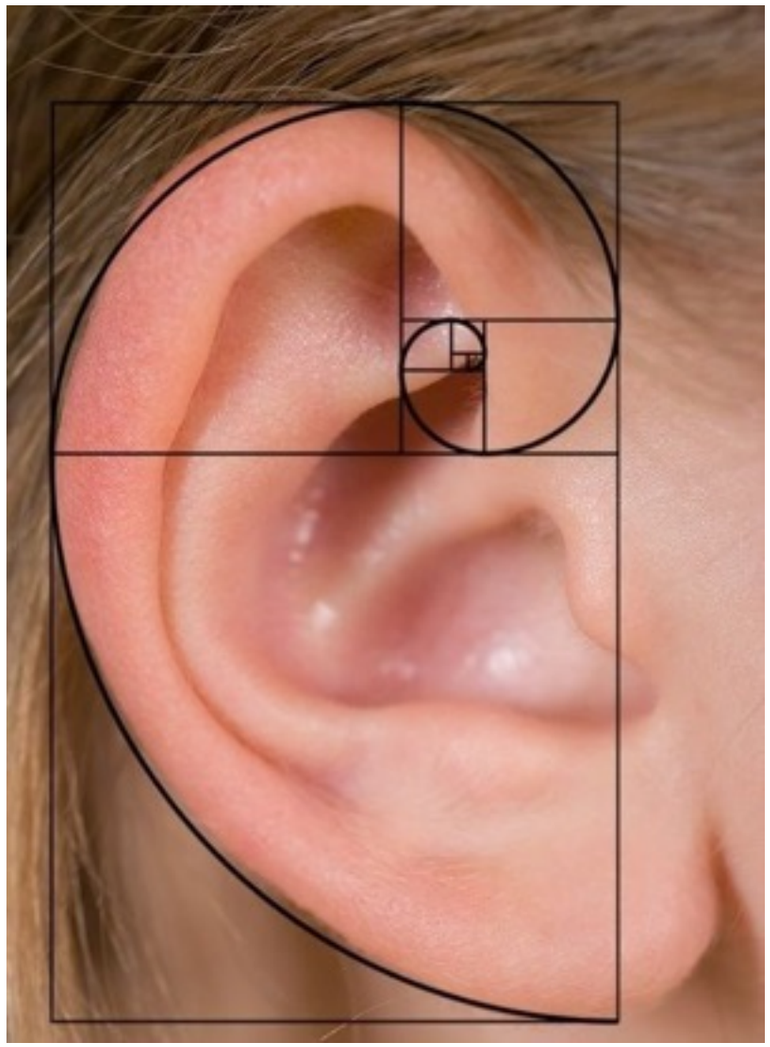
Example 2 Fibonaccis



http://i.dailymail.co.uk/i/pix/2016/07/17/13/1A32203E000005DC-3694326-image-m-17_1468760305397.jpg

https://i.pinimg.com/736x/90/64/7f/90647f600bac1b02927c73549ac3a5d2--fibonacci-spiral-in-nature-spirals-in-nature.jpg

Examples of Fibonacci Sequences



https://i.pinimg.com/736x/c5/e2/54/c5e25427f9eba020ecef6586f12f347d--fibonacci-in-nature-mathematics.jpg

First Step: Python

```
fibn = 1
fibn_1 = 1

print( fibn )

for i in range( 10-1 ):
    # pass down values
    fibn_2 = fibn_1
    fibn_1 = fibn

    # update fibn
    fibn = fibn_1 + fibn_2

    # print fibn
    print( fibn )
```

```
cs231a@aurora ~/$ ./fibonacci.py
1
2
3
5
8
13
21
34
55
89
```

getcopy fibonacci.py

```
_start:
        mov   eax, 1    ; eax is fibn
        mov   ebx, 1    ; ebx is fibn-1
                        ; edx is fibn-2

        call _printDec
        call _println

        mov   ecx, 10-1 ; we printed 1, 9 more to go

for:    mov   edx, ebx  ; fibn-2 <- fibn-1
        mov   ebx, eax  ; fibn-1 <- fibn
        add   eax, edx  ; fibn <- fibn-1 + fibn-2
        call _printDec
        call _println
        loop for
```

getcopy fib.asm