COL1000
Introduction to Programming

Priyanka Golia

Most (if not all) of the content is borrowed from Prof. Subodh Kumar's slides

Nested For loop

```
1 for i in range(1,3):
2     for j in range(1,3):
3         print("i:",i,"j:",j)
```

Outer for loop

Inner for loop

All loops must terminate

```
i: 1 j: 1
i: 1 j: 2
i: 2 j: 1
i: 2 j: 2
```

For the same value of i, values of j is updating

Outer loop: $i = 1$

Inner loop: $j = 1$

$..= 2$

Outer loop: $i = 2$

Inner loop: $j = 1$

$..= 2$

Nested For loop

Given an integer n and print the multiplication tables for all numbers from 2 to n.

```
1 n = int(input("enter a number"))
2 print(f"tables for 2 to {n} is as follows:")
3 for i in range(2,n+1):
4     for j in range(1,6):
5         print(i," x ", j, " = ", i*j)
```

Notice the syntax, print(f "..{variable}")

f-string (f"...") allows you to directly embed variables inside curly braces {}.

Same as print("tables for 2 to", n, "is as follows")

```
enter a number4
tables for 2 to 4 is as follows:
2  x  1  =  2
2  x  2  =  4
2  x  3  =  6
2  x  4  =  8
2  x  5  =  10
3  x  1  =  3
3  x  2  =  6
3  x  3  =  9
3  x  4  =  12
3  x  5  =  15
4  x  1  =  4
4  x  2  =  8
4  x  3  =  12
4  x  4  =  16
4  x  5  =  20
```

Nested Loops

Find if any element of list 1 equals any element of list 2

i takes values from list p, one at a time

For each i, j takes values from list q

Recall, "==" compares values, not types

```
1 p = [2,4,6,8]
2 q = [3,6,9,12]
3 for i in p:
4     for j in q:
5         if i == j:
6             print("found the common element", i)
7
```

```
found the common element 6
```

What if none of the elements are equal? The program doesn't tell you that

```
1 p = [2,4,6,8]
2 q = [3,9,12]
3 for i in p:
4     for j in q:
5         if i == j:
6             print("found the common element", i)
7
```

Nested Loops

Find if any element of list 1 equals any element of list 2

```
1  p = [2,4,6,8]
2  q = [3,6,9]
3  equal = None
4  for i in p:
5      for j in q:
6          print("i,j", i,j)
7          if i == j:
8              equal = i
9              break
10     if equal != None:
11         print("found the common element ",equal )
12         break
13 if equal == None:
14     print("no common element found")
```

None is a special value, like True.

We found the common element.

break— Come out of inner loop.

break— Come out of outer loop.

```
i,j 2 3
i,j 2 6
i,j 2 9
i,j 4 3
i,j 4 6
i,j 4 9
i,j 6 3
i,j 6 6
found the common element  6
```

Notice, after i, j is 6,6

j didn't take value 9 because of inner-loop break.

i didn't take value 8, because of outer-loop break

Nested Loops

Find if any element of list 1 equals any element of list 2

```
1  p = [2,4,6,8]
2  q = [3,9]
3  equal = None
4  for i in p:
5      for j in q:
6          print("i,j", i,j)
7          if i == j:
8              equal = i
9              break
10     if equal != None:
11         print("found the common element ",equal )
12         break
13 if equal == None:
14     print("no common element found")
```

```
i,j 2 3
i,j 2 9
i,j 4 3
i,j 4 9
i,j 6 3
i,j 6 9
i,j 8 3
i,j 8 9
no common element found
```

Nested Loops

Are there duplicates in list?

```
1  p = [11,12,12,13]
2  print(p)
3  flag = False
4  for i in range(len(p)):
5      print("i, p[i]", i, p[i])
6      for j in range(i+1,len(p)):
7          print("j, p[j]", j, p[j])
8          if p[i] == p[j]:
9              flag = True
10             print("found the common element",p[j])
11             break
12     if flag:
13         break
14 if not flag:
15     print("no duplicates")
```

Just some print statements

Range from $i + 1$ (optimization)

Notice the range in inner loop. We should check elements after i^{th} index

Break to come out of inner loop

Break to come out of outer loop. Notice, flag only gets updated to True inside “if” condition at line 8.

Nested Loops

Are there duplicates in list?

```
1  p = [11,12,12,13]
2  print(p)
3  flag = False
4  for i in range(len(p)):
5      print("i, p[i]", i, p[i])
6      for j in range(i+1,len(p)):
7          print("j, p[j]", j, p[j])
8          if p[i] == p[j]:
9              flag = True
10             print("found the common element",p[j])
11             break
12     if flag:
13         break
14 if not flag:
15     print("no duplicates")
```

```
[11, 12, 12, 13]
i, p[i] 0 11
j, p[j] 1 12
j, p[j] 2 12
j, p[j] 3 13
i, p[i] 1 12
j, p[j] 2 12
found the common element 12
```

Notice the values of i & j.

as soon as common value (12) is found, it just came out of both inner and outer loop

Nested Loops

Find the number of unique elements in list

```
1  p = [11,12,11]
2  print(p)
3  unique = 0
4  duplicates = []
5  for i in range(len(p)):
6      flag = False
7      print("i, p[i]", i, p[i])
8      for j in range(i+1,len(p)):
9          print("j, p[j]", j, p[j])
10         if p[i] == p[j]:
11             flag = True
12             if p[i] not in duplicates:
13                 duplicates.append(p[i])
14             break
15     if not flag and p[i] not in duplicates:
16         unique += 1
17 print("number of unique elements in list", unique)
18 print("duplicate entries", duplicates)
```

Initiation

Flag — reset, for every item in list.

Keeps track of duplicates found so far!

Unique gets updated

Nested Loops

Find the number of unique elements in list

```
p = [11,12,11]
print(p)
unique = 0
duplicates = []
for i in range(len(p)):
    flag = False
    print("i, p[i]", i, p[i])
    for j in range(i+1,len(p)):
        print("j, p[j]", j, p[j])
        if p[i] == p[j]:
            flag = True
            if p[i] not in duplicates:
                duplicates.append(p[i])
            break
    if not flag and p[i] not in duplicates:
        unique += 1
print("number of unique elements in list", unique)
print("duplicate entries", duplicates)
```

I= 0 p[I] = 11	J=1 p[j]= 12	J=2 p[j] =11 flag = True duplicates = [11]	Flag is True and 11 is in duplicates: Unique = 0
I= 1 p[I] = 12	-	j=2 p[j] = 11	Flag = False and 12 is not in duplicates: unique = 1
I = 2 p[I] = 11	-	-	Flag = False, but 11 is in duplicates, therefore no update in unique.

Nested Loops

Find the number of unique elements in list

```
p = [11,12,11]
print(p)
unique = 0
duplicates = []
for i in range(len(p)):
    flag = False
    print("i, p[i]", i, p[i])
    for j in range(i+1,len(p)):
        print("j, p[j]", j, p[j])
        if p[i] == p[j]:
            flag = True
            if p[i] not in duplicates:
                duplicates.append(p[i])
            break
    if not flag and p[i] not in duplicates:
        unique += 1
print("number of unique elements in list", unique)
print("duplicate entries", duplicates)
```

```
[11, 12, 11]
i, p[i] 0 11
j, p[j] 1 12
j, p[j] 2 11
i, p[i] 1 12
j, p[j] 2 11
i, p[i] 2 11
number of unique elements in list 1
duplicate entries [11]
```