More For-Loops

Introduction to Computer Programming

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Forgot...

Definition (Signature)

The signature of a function defines its input and output.

Example

The following function definition includes a function signature:

```
def foo(x:int, y:str) -> bool:
```

Accumulating

Recall that we can use loops to accumulate something as in:

```
>>> ans = ""
... for x in "abcdef":
...     ans = ans + x
```

Because this is done so much there is a short form for it:

```
>>> ans = ""
... for x in "abcdef":
...     ans += x
```

Definition (Python Assignment Operators)

1. `x += y` is equivalent to `x = x + y`
2. `x *= y` is equivalent to `x = x * y`
3. `x /= y` is equivalent to `x = x / y`
4. `x %= y` is equivalent to `x = x % y`

Question

Write a function that removes spaces from a string.

Answer

See `strings.py` on course web-site.

When counting members of a group using a loop we often use a counting variable.

Question

Write a function that counts spaces from a string.

Answer

See `strings.py` on course web-site.

When searching for the largest/smallest of a group using a loop we often use a variable to remember our current largest/smallest candidate.

Question

Write a function that returns the largest character from a string.

Answer

See `strings.py` on course web-site.

Note: We just re-wrote a built-in function as `max("abc")` returns `"c"`.

Question

Write a function that removes all the largest characters from a string.

Answer

See `strings.py` on course web-site.

Strings as booleans

```
>>> bool("a")
True
>>> bool("Hello")
True
>>> bool("")
False
>>> "" < "A"
True
>>> "" < chr(0)
True
```

Empty string is "smaller" than every other character.

Definition (For All)

In mathematics the symbol $\forall$ reads "for-all" and is used to denote that every member of a set satisfies some condition as in:

$$\forall x \in X; P(x).$$

In the case where X is enumerable (e.g. $X = x_0x_1x_2\cdots$) this condition means

$$P(x_0) \texttt{ and } P(x_1) \texttt{ and } P(x_2)\cdots$$

Note: We are not going to test you on material from this slide.

Example

The boolean statement for every `x in X` we have that `x < "k"`:

$$\forall x \in X; x < \text{“}k\text{”} \tag{1}$$

is True for `X = "abc"` and False for `X = "jklm"`.

Question

Write a function `foo(X:str) -> bool` that checks the condition of (1) for X a string.

Answer

See `strings.py` on course web-site.

Definition (There-Exists)

In mathematics the symbol $\exists$ reads "there-exists" and is used to denote that there is a member of a set satisfying some condition as in

$$\exists x \in X : P(x).$$

In the case where X is enumerable (e.g. $X = x_0x_1x_2\cdots$) this condition means

$$P(x_0) \texttt{ or } P(x_1) \texttt{ or } P(x_2)\cdots$$

Note: We are not going to test you material from this slide.

Example

The boolean statement there is `x in X` such that `x < ``k"`:

$$\exists x \in X : x < \text{“}k\text{”} \tag{2}$$

is True for `X = "abc"` and True for `X = "jklm"`.

Question

Write a function `bar(X:str) -> bool` that checks the condition of (2) for X a string.

Answer

See `strings.py` on course web-site.

Higher-Order Functions (Advanced Material)

Because functions can take other functions as input we can generalize the last two functions we wrote.

Question

Implement functions `for_all(X:str, P:function)` and `there_exists(X:str, P:function)` that checks $\forall x \in X; P(x)$ and $\exists x \in X : P(x)$.

Use them to check the condition:

$$\forall \texttt{x in X};\ \exists \texttt{y in Y} : \texttt{x > y} \tag{3}$$

Note: We are not going to test you on material from this slide.

Next Time

1. We do many loop examples.