A dictionary can be used to store data. Whereas a list stores an arbitrary collection of items, a dictionary stores key-value pairs. The running example here is a dictionary that maps stock ticker symbols to prices. The ticker symbol is the key, the price is the value.

- Keys must be unique. E.g., two stocks cannot have the same ticker symbol.
- Keys must be an immutable type. E.g., int, float, str but not list.
- Values are not necessarily unique. E.g., two stocks might have the same price.

To create an empty dictionary, use curly braces.

```python
>>> stocks = {}  # curly braces create an empty dictionary
```

To initialize a dictionary with a set of key value pairs, the syntax is this.

```python
>>> stocks = {'FB':20, 'MSFT':28, 'GOOG':652, 'AAPL':537}  # initialize w/ 4 stocks
```

```python
{'GOOG': 652, 'FB': 20, 'AAPL': 537, 'MSFT': 28}
```

Notice how python does not preserve the order of the stocks, nor are they sorted alphabetically. Unlike lists and strings, dictionaries are not ordered.

**Getting and modifying values**

```python
>>> stocks['FB']  # get value associated with key
20
>>> stocks['ZNGA'] = 2  # add new key, value pair
>>> stocks['ZNGA']
2
>>> stocks  # can see that ZNGA has been added
{'GOOG': 652, 'ZNGA': 2, 'FB': 20, 'AAPL': 537, 'MSFT': 28}
>>> stocks['ZNGA'] = 3  # replace value associated with key
>>> stocks['ZNGA']
3
>>> stocks  # still only one ZNGA, now with new price
{'GOOG': 652, 'ZNGA': 3, 'FB': 20, 'AAPL': 537, 'MSFT': 28}
>>> stocks['FB'] = stocks['FB'] + 9  # update value associated with key
>>> stocks['FB']
29
```

**Operators and methods**

```python
>>> len(stocks)  # returns number of key, value pairs
5
>>> 'GOOG' in stocks  # can use in operator, just like lists
True
>>> 'GOOGLE' in stocks  # in operator only checks keys, not values
False
>>> 652 in stocks
```

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False
>>> stocks.pop('ZNGA')  # remove key, value pair
3
>>> stocks
{'GOOG': 652, 'FB': 29, 'AAPL': 537, 'MSFT': 28}
>>> stocks.keys()       # returns list of keys
['GOOG', 'FB', 'AAPL', 'MSFT']
>>> stocks.values()     # returns list of values
[652, 29, 537, 28]
>>> stocks.items()      # returns list of (key, value) tuples
[('GOOG', 652), ('FB', 29), ('AAPL', 537), ('MSFT', 28)]

### Iteration

You can loop over the keys of a dictionary, like this.

```python
>>> stocks = {'FB':20, 'MSFT':28, 'GOOG':652}
```

```python
>>> for k in stocks:
...    print k,  # print just the key (ticker symbol)
GOOG FB MSFT
```

```python
>>> for k in stocks:
...    print stocks[k],  # print just the value (stock price)
652 20 28
```

```python
>>> for k in stocks:
...    print k, stocks[k]  # print both key (ticker symbol) and value (stock price)
GOOG 652
FB 20
MSFT 28
```

You can also loop over the lists returned by the keys, values, and items methods.

### Exercises

Some solutions are presented in class and also included in the moodle version of this handout.

1. Given a list of ticker symbols, add each ticker symbol to stocks with a price of 10.

```python
Solution:
stocks = {'FB':20, 'MSFT':28, 'GOOG':652, 'AAPL':537}
tickers = ['AMZN', 'NFLX']

for symbol in tickers:
    stocks[symbol] = 10
```
2. Increase the price of ‘GOOG’ price by 10%. However, if ‘GOOG’ is not in the dictionary, add it with a price of 1000.

Solution:

```python
stocks = { 'FB':20, 'MSFT':28, 'GOOG':652, 'AAPL':537 }

# write code to increase the price of 'GOOG' price by 10%.
# however, if 'GOOG' not in stocks, add it with a price of # 1000.
if 'GOOG' not in stocks:
    stocks['GOOG'] = 1000
else:
    stocks['GOOG'] = stocks['GOOG'] * 1.10
```

3. Write a function `max_price` that takes a dictionary of stocks and returns the highest stock price.

Solution:

```python
def max_price(stocks):
    '''(dict of {str:int}) -> int
    Given dictionary that maps stocks symbols to price, returns
    highest stock price.
    >>> stocks = { 'GOOG':652, 'FB':20, 'AAPL':537, 'MSFT':26 }
    >>> max_price(stocks)
    652
    '''
    return max(stocks.values())
```

4. Write a function `priciest_stock` that takes a dictionary of stocks and returns the ticker symbol of the stock with the highest stock price.

Solution:

```python
def priciest_stock(stocks):
    '''(dict of {str:int}) -> str
    Given dictionary that maps stocks symbols to price, returns
    the ticker symbol of the stock with the highest stock price.
    >>> stocks = { 'GOOG':652, 'FB':20, 'AAPL':537, 'MSFT':26 }
    >>> priciest_stock(stocks)
    'GOOG'
```
max_price = -1
priciest = None
for ticker in stocks:
    price = stocks[ticker]
    if price > max_price:
        max_price = price
        priciest = ticker
return priciest

5. Write a function pricey_stocks that takes a dictionary and a cutoff (an int) and returns a list of ticker symbols whose price is above the cutoff.

Solution:

def pricey_stocks(stocks, cutoff):
    '''(dict of {str:int}, int) -> list of str
    Given dictionary that maps stocks symbols to price, returns list of stocks whose price is above cutoff.
    >>> stocks = { 'GOOG':652, 'FB':20, 'AAPL':537, 'MSFT':26 }
    >>> pricey_stocks(stocks, 500)
    [ 'GOOG', 'AAPL']
    '''
    pricey = []
    for ticker in stocks:
        if stocks[ticker] > cutoff:
            pricey.append(ticker)
    return pricey