In [1]:
```
import numpy as np
import pandas as pd
import requests
from bs4 import BeautifulSoup
from lolviz import *
```

Introduction to Hashtable

Nowadays, we are generating, referring, and using data every day. As data set getting tremendous, searching the intereted element can be extremly chanllenging. As a data scientist, to achieve the goals of efficient data retrieving, we can use hashtable, a mapping data structure and a simple algorithm.
Today we will cover the following topics:

- Set up a hashtable
- A good hash function
- An example of applying hasthtable in document searching

In [2]:
```
# an optional data set to use
url = 'https://wiki2.org/en/List_of_current_ships_of_the_United_States_Navy'
html = requests.get(url).content
df_list = pd.read_html(html, encoding = 'latin1')
dfo = df_list[0]
dfo.head(5)
```

Out[2]:

	Ship name	Hull number	Class	Type	Commission date	Homeport[2]	Note
0	USSÂ Abraham Lincoln	NaN	Nimitz	Aircraft carrier	11 November 1989	San Diego, CA	[3]
1	USSÂ Alabama	NaN	Ohio	Ballistic missile submarine	25 May 1985	Bangor, WA	[4]
2	USSÂ Alaska	NaN	Ohio	Ballistic missile submarine	25 January 1986	Kings Bay, GA	[5]
3	USSÂ Albany	NaN	Los Angeles	Attack submarine	7 April 1990	Norfolk, VA	[6]
4	USSÂ Alexandria	NaN	Los Angeles	Attack submarine	29 June 1991	San Diego, CA	[7] Scheduled for decommissioning 2026[8]

In [3]:
```
# randomly generated data indcluding id, name, email and gender
df = pd.read_csv('MOCK_DATA.csv')
df.head(5)
```

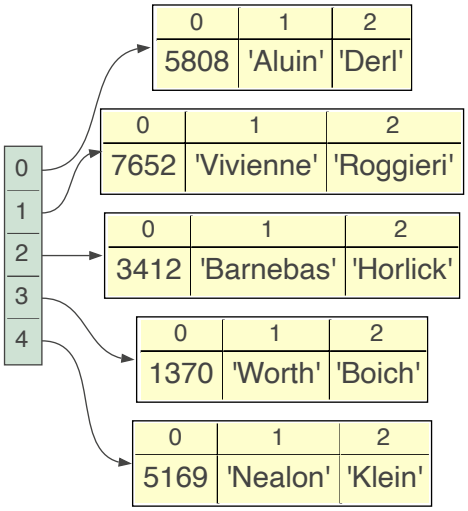
Out[3]:

	id_num	first_name	last_name	email	gender	id_char
0	5808	Aluin	Derl	aderl0@epa.gov	Male	tzs
1	7652	Vivienne	Roggieri	vroggieri1@chicagotribune.com	Female	sri
2	3412	Barnebas	Horlick	bhorlick2@umich.edu	Male	fwm
3	1370	Worth	Boich	wboich3@wikispaces.com	Male	bqt
4	5169	Nealon	Klein	nklein4@washington.edu	Male	cku

Linear Search throug List

In [4]:
```
# selecte the numeric id and name columns from the data set
data = np.array(df)
name_list = []
for record in data:
    name_list.append((record[0], record[1], record[2]))
objviz(name_list[:5])
```

Out[4]:



In [5]:
```
# the linear_search function look up the employee i through the entire data set

def linear_search(employee_id):
    for record in name_list:
        if record[0] == employee_id:
            return record
```

In [6]:
```
employee_id = 8550
linear_search(employee_id)
```

Out[6]:
```
(8550, 'Niven', 'Bester')
```

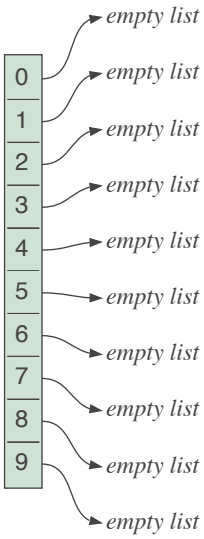
Steps to set up a hashtable

Use numeric keys to set up hashtable

Step 1: set up empty buckets

In [7]:
```
# set up 10 empty buckets
buckets = [[] for i in range(10)] # make sure each bucket is a separate list
objviz(buckets)
```

Out[7]:



Step 2: define a hush function

In [8]:
```
# set up a hash function to convert employee_id as key to index

def hash_n(key):
    return key % 10

[(k[0], hash_n(k[0])) for k in name_list[:5]]
```

Out[8]:
```
[(5808, 8), (7652, 2), (3412, 2), (1370, 0), (5169, 9)]
```

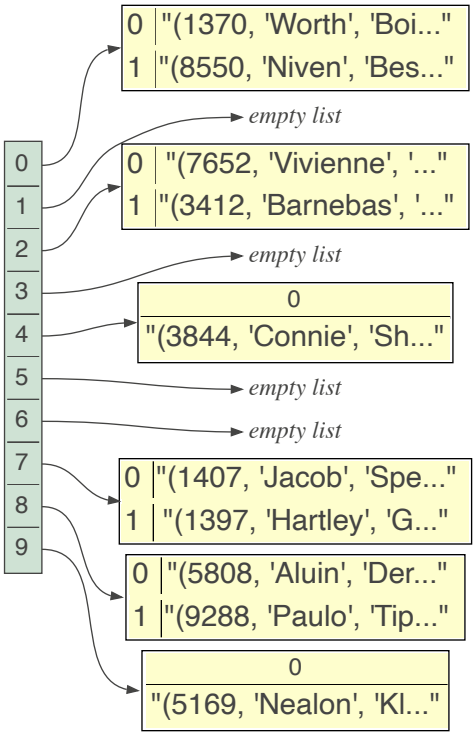
Step 3: Store data in buckets

In [9]:
```
# store data in the format of (key,value) pairs

for record in name_list[:10]:
    index = hash_n(record[0])
    buckets[index].append(record)
```

In [10]:
```
lolviz(buckets)
```

Out[10]:



Search in Hashtable

In [11]:
```
employee_id = 8550
# search employee id in the corresponding bucket
index = hash_n(employee_id)
result = 'No record found'
for record in buckets[index]:
    if record[0] == employee_id:
        result = record

print(result)
```

```
(8550, 'Niven', 'Bester')
```

Use string type key to set up hash table

In [12]:
```
# use english characters as employee id
name_list2 = []
for record in data:
    name_list2.append((record[5], record[1], record[2]))
name_list2[:5]
```

Out[12]:
```
[('tzs', 'Aluin', 'Derl'),
 ('sri', 'Vivienne', 'Roggieri'),
 ('fwm', 'Barnebas', 'Horlick'),
 ('bqt', 'Worth', 'Boich'),
 ('cku', 'Nealon', 'Klein')]
```

In [13]:
```
# convert letters to numbers then to index
def hash_c(key):
    return ord(key[0]) % 10

[(k[0], hash_c(k[0])) for k in name_list2[:5]]
```

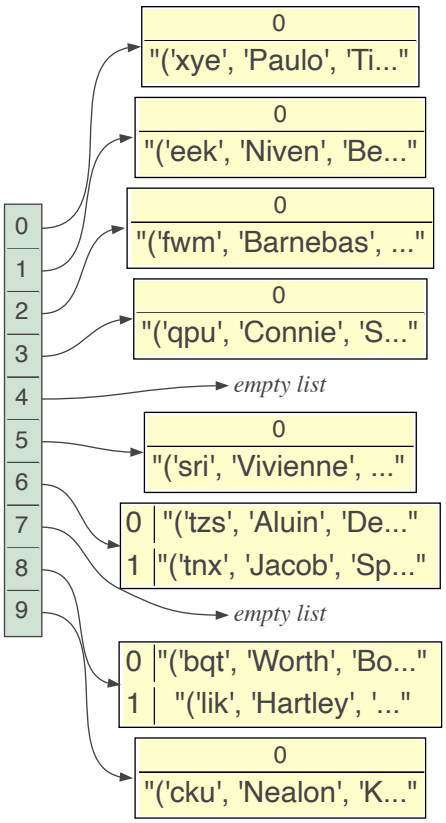
Out[13]:
```
[('tzs', 6), ('sri', 5), ('fwm', 2), ('bqt', 8), ('cku', 9)]
```

In [14]:
```
# set up buckets and store the first 10 records in the buckets
buckets = [[] for i in range(10)]

for record in name_list2[:10]:
    index = hash_c(record[0])
    buckets[index].append(record)

lolviz(buckets)
```

Out[14]:



In [15]:
```
employee_id = 'xye'
# search employee id in the corresponding bucket
index = hash_c(employee_id)
result = 'No record found'
for record in buckets[index]:
    if record[0] == employee_id:
        result = record

print(result)
```

```
('xye', 'Paulo', 'Tipping')
```

In [ ]: