Fast data structures and APIs

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Fast data structures

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- Lists
- Tuples
- Sets
- Dictionaries

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- Tuples
- Sets
- Dictionaries

These are all handy, but sometimes you need something special.

The Problem

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We have a list of numbers.

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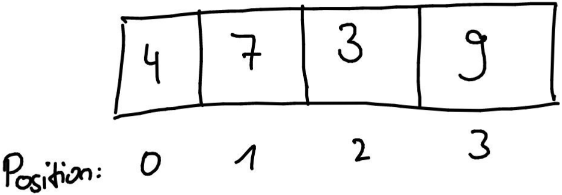
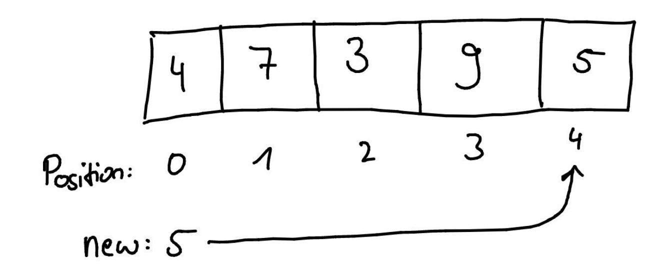


	4	7	3	9
Position:	0	1	2	3

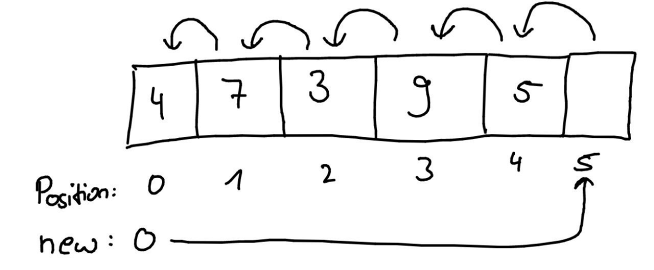
The Problem

We have a list of numbers.
And we want to add something to the end.



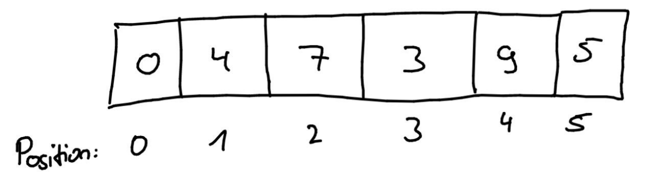
The Problem

We have a list of numbers.
Now we want to add something to the begin.



The Problem

We have a list of numbers.
With some more numbers now.



	0	4	7	3	9	5
Position:	0	1	2	3	4	5

The Problem

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Adding something to the begin is hard.

- We have to move all the other elements.
- This takes $O(n)$ time.
- pop(0) is the same.

Just reverse the list, stupid!

deque

There is a data structure that can do both in $O(1)$ time: deque

deque

There is a data structure that can do both in $O(1)$ time: **deque**

- It is short for **double ended queue**.
- It is a list that can be appended and prepended in $O(1)$ time.
- It is implemented as a doubly linked list.
- It is in the **collections** module.
- It is a bit slower than a list.

deque

Some examples:

```
from collections import deque
d = deque(range(1, 5))
d.append(5)     # append to the end
d.appendleft(0) # append to the begin
list(d)         # returns list of deque
d.rotate(1)     # rotate the deque
```

And an other one

New Problem

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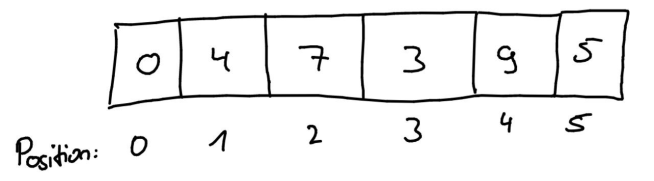
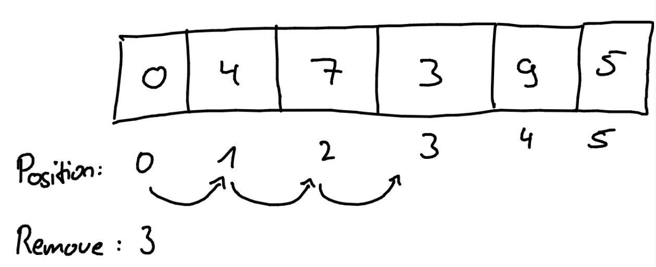


	0	4	7	3	9	5
Position:	0	1	2	3	4	5

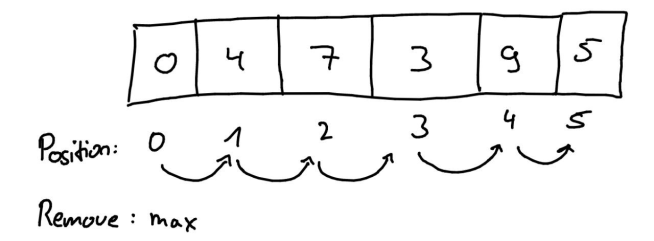
New Problem

We have a list of numbers.
And we want to find 3.



New Problem

We have a list of numbers.
Now we want to find the max element.



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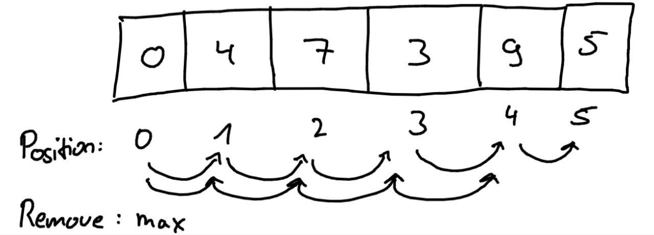
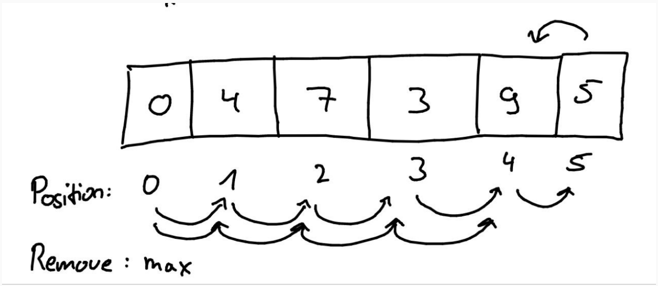


We have a list of numbers.
Finaly we have to shrink the list.



heapqueue

There is a data structure that can delete in $O(\log n)$ and find even in $O(1)$ time: **heapqueue**

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- It is a list that can be appended and prepended in $O(\log n)$ time.
- It is implemented as a binary heap.
- It is in the **heapq** module.
- It is a bit slower than a list.

heapqueue

Some examples:

```
from heapq import heappush, heappop, heapify
h = []
heappush(h, 5) # append to the end
heappush(h, 0) # append to the begin
heappop(h)     # pop the smallest element
```

Next Weeks

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2. Pandas (we have to store and sort our data)

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2. Pandas (we have to store and sort our data)
3. Tensorflow (we want to do some machine learning)

APIs

REST API

We want to get Data from a Website.

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- We use **requests** to get the data.
- We use **json** to parse the data.

REST API

Some examples:

```
import requests
import json
r = requests.get(’https://api.github.com/events’)
r.status_code # returns status code
r.json() # returns json
```

What happens here?

The requests module sends a GET request to the server.

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The **requests** module sends a **GET** request to the server.
We have different types of requests:

- **GET** - get data
- **POST** - send data
- **PUT** - update data
- **DELETE** - delete data

This requests are called **HTTP** requests.

The response

The server responds with a **status code** and some **data**.

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This status codes are common:

- **200** - OK
- **404** - Not Found
- **500** - Internal Server Error

The response

First we should check the status code:

```
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r.status_code # returns status code
```

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r = requests.get(’https://api.github.com/events’)
r.status_code # returns status code
```

Then we can parse the data:

```
r.text # returns the data (aka text) as string
r.json() # returns a json object of the text
```

json

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- **json.loads** - parse a string
- **json.dumps** - create a string

APIs for advanced users

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Maybe there is a nice website which contains a lot of data.

APIs for advanced users

Maybe there is a nice website which contains a lot of data.
And maybe there is no API or only a payed API.

scrapy

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Scrapy is a framework to scrape data from websites.

scrapy

Scrapy is a framework to scrape data from websites.

- It is a bit like a web browser.
- It can parse html.
- It can follow links.
- It can save the data.

Simple HTML parsing

We want to extract some information from a html document.

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Simple HTML parsing

We want to extract some information from a html document.
We need a parserand a way to identify the information.
We can use scrapy to parse the html and we will use XPATH to identify the information.

Simple HTML parsing

Some examples:

```
document = ”Some␣html␣document”
from scrapy.selector import Selector
sel = Selector(text=document)
sel.xpath(’//title/text()’).extract()
sel.xpath(’//title/*’).get_all()
```

Task

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- Read the data of a river
- https://www.pegelonline.wsv.de/webservice/ueberblick
- Create a plot of the water level over time

And if you are done:

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And if you are done:
Do the same with:
https://www.umwelt.sachsen.de/umwelt/infosysteme/hwims/portal/web/wasserstand-pegel-501010