目录

解放你的双手：自动化测试

- 最新版本：`v2.7`
- 更新时间：`20210730`

简介

介绍如何通过自动化测试，去解放你的双手，提高测试效率。包括进行概述，以及详细介绍PC端和移动端。包括PC端的Web端的Selenium、puppeteer、Playwright和移动端的常见框架，比如Android的uiautomator2、iOS的facebook-wda等自动化工具。

源码+浏览+下载

本书的各种源码、在线浏览地址、多种格式文件下载如下：

Gitbook源码

- crifan/free_hand_test_automation: 解放你的双手：自动化测试

如何使用此Gitbook源码去生成发布为电子书

详见：crifan/gitbook_template: demo how to use crifan gitbook template and demo

在线浏览

- 解放你的双手：自动化测试 book.crifan.com
- 解放你的双手：自动化测试 crifan.github.io

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鸣谢

感谢我的老婆**陈雪**的包容理解和悉心照料，才使得我 `crifan` 有更多精力去专注技术专研和整理归纳出这些电子书和技术教程，特此鸣谢。

更多其他电子书

本人 `crifan` 还写了其他 `100+` 本电子书教程，感兴趣可移步至：

crifan/crifan_ebook_readme: Crifan的电子书的使用说明

概述

- 自动化测试
  - = `test automation`
    - = `automation testing`
  - 根据目标平台和设备不同可分为
    - **PC端**
      - **Web领域=Web端=浏览器操作自动化**
        - 常见框架
          - `Selenium`
            - Selenium知识总结
          - `puppeteer`
            - Web前端自动化利器：puppeteer
          - `Playwright`
            - 跨平台Web自动化神器：Playwright
    - **移动端**
      - 概览
        - 移动端自动化测试概览
      - 常见框架
        - **Android**
          - `uiautomator2`
            - 安卓自动化测试利器：uiautomator2
        - **iOS**
          - `facebook-wda`
            - iOS自动化测试利器：facebook-wda
    - **跨平台**
      - Appium
        - 主流跨平台自动化框架：Appium

举例

下面通过实例例子来说明，自动化操作，对于不同平台大概是什么样的，以便于有个宏观的，具体的了解。

百度搜索自动化

下面就通过例子：**百度搜索自动化**，来说明不同平台的自动化具体是什么样子：

PC端

selenium

代码：

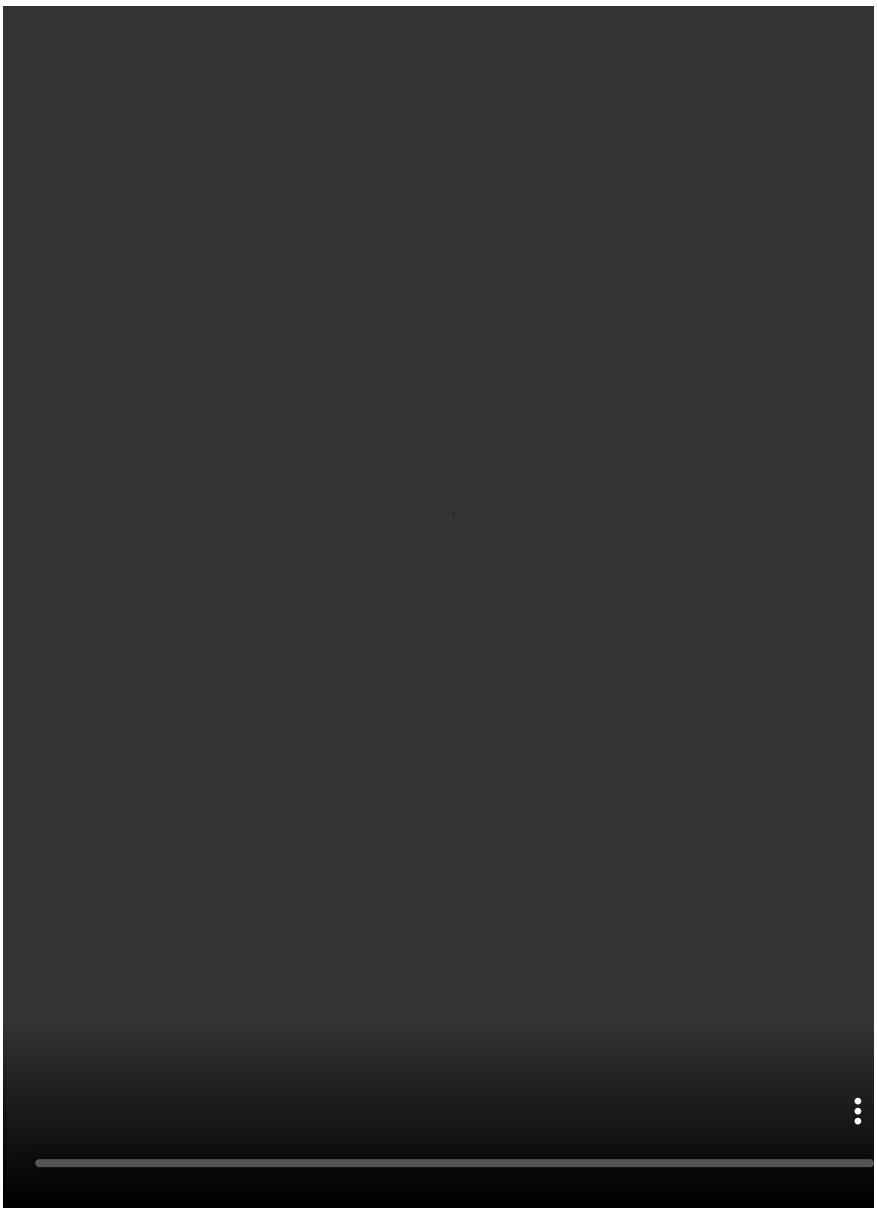
- 文件：seleniumDemoBaiduSearch.py
- 贴出来是

```
# Function: demo selenium do baidu search and extract r
# Author: Crifan Li
# Update: 20210327

from selenium import webdriver
from selenium.webdriver.common.keys import Keys
from selenium.webdriver.common.by import By
from selenium.webdriver.support.ui import WebDriverWait
from selenium.webdriver.support import expected_conditi

from bs4 import BeautifulSoup
import re

chromeDriver = webdriver.Chrome()

#############################################################
# Open url
#############################################################
baiduUrl = "https://www.baidu.com"
chromeDriver.get(baiduUrl)
print("title=%s" % chromeDriver.title)

assert chromeDriver.title == "百度一下，你就知道"
# assert '百度' in chromeDriver.title

#############################################################
# Find/Locate search button
#############################################################
SearchInputId = "kw"
searchInputElem = chromeDriver.find_element_by_id(Searc
print("searchInputElem=%s" % searchInputElem)
# searchInputElem=<selenium.webdriver.remote.webelement

#############################################################
# Input text
#############################################################
searchInputElem.clear()
print("Clear existed content")

searchStr = "crifan"
searchInputElem.send_keys(searchStr)
print("Entered %s to search box" % searchStr)

#############################################################
# Click button
#############################################################

# Method 1: emulate press Enter key
# searchButtonElem.send_keys(Keys.RETURN)
# print("Pressed Enter/Return key")
```

```
# Method 2: find button and click
BaiduSearchId = "su"
baiduSearchButtonElem = chromeDriver.find_element_by_id
print("baiduSearchButtonElem=%s" % baiduSearchButtonEle
baiduSearchButtonElem.click()
print("Clicked button %s" % baiduSearchButtonElem)

############################################################
# Wait page change/loading completed
#   -> following element makesure show = visible
#   -> otherwise possibly can NOT find elements
############################################################
MaxWaitSeconds = 10
numTextElem = WebDriverWait(chromeDriver, MaxWaitSecond
    EC.presence_of_element_located((By.XPATH, "//span[@
)
print("Search complete, showing: %s" % numTextElem)

############################################################
# Extract result
############################################################

# Method 1: use Selenium to extract title list
searchResultAList = chromeDriver.find_elements_by_xpath
print("searchResultAList=%s" % searchResultAList)
searchResultANum = len(searchResultAList)
print("searchResultANum=%s" % searchResultANum)
for curIdx, curSearchResultAElem in enumerate(searchRes
  curNum = curIdx + 1
  print("%s [%d] %s" % ("-"*20, curNum, "-"*20))
  baiduLinkUrl = curSearchResultAElem.get_attribute("hr
  print("baiduLinkUrl=%s" % baiduLinkUrl)
  title = curSearchResultAElem.text
  print("title=%s" % title)

# # Method 2: use BeautifulSoup to extract title list
# curHtml = chromeDriver.page_source
# curSoup = BeautifulSoup(curHtml, 'html.parser')
# beginTP = re.compile("^t.*")
# searchResultH3List = curSoup.find_all("h3", {"class":
# print("searchResultH3List=%s" % searchResultH3List)
# searchResultH3Num = len(searchResultH3List)
# print("searchResultH3Num=%s" % searchResultH3Num)
# for curIdx, searchResultH3Item in enumerate(searchRes
#   curNum = curIdx + 1
#   print("%s [%d] %s" % ("-"*20, curNum, "-"*20))
#   aElem = searchResultH3Item.find("a")
#   # print("aElem=%s" % aElem)
#   baiduLinkUrl = aElem.attrs["href"]
#   print("baiduLinkUrl=%s" % baiduLinkUrl)
```

```
#   title = aElem.text
#   print("title=%s" % title)

##############################################################
# End close
##############################################################
chromeDriver.close()
```

效果：



puppeteer

代码：

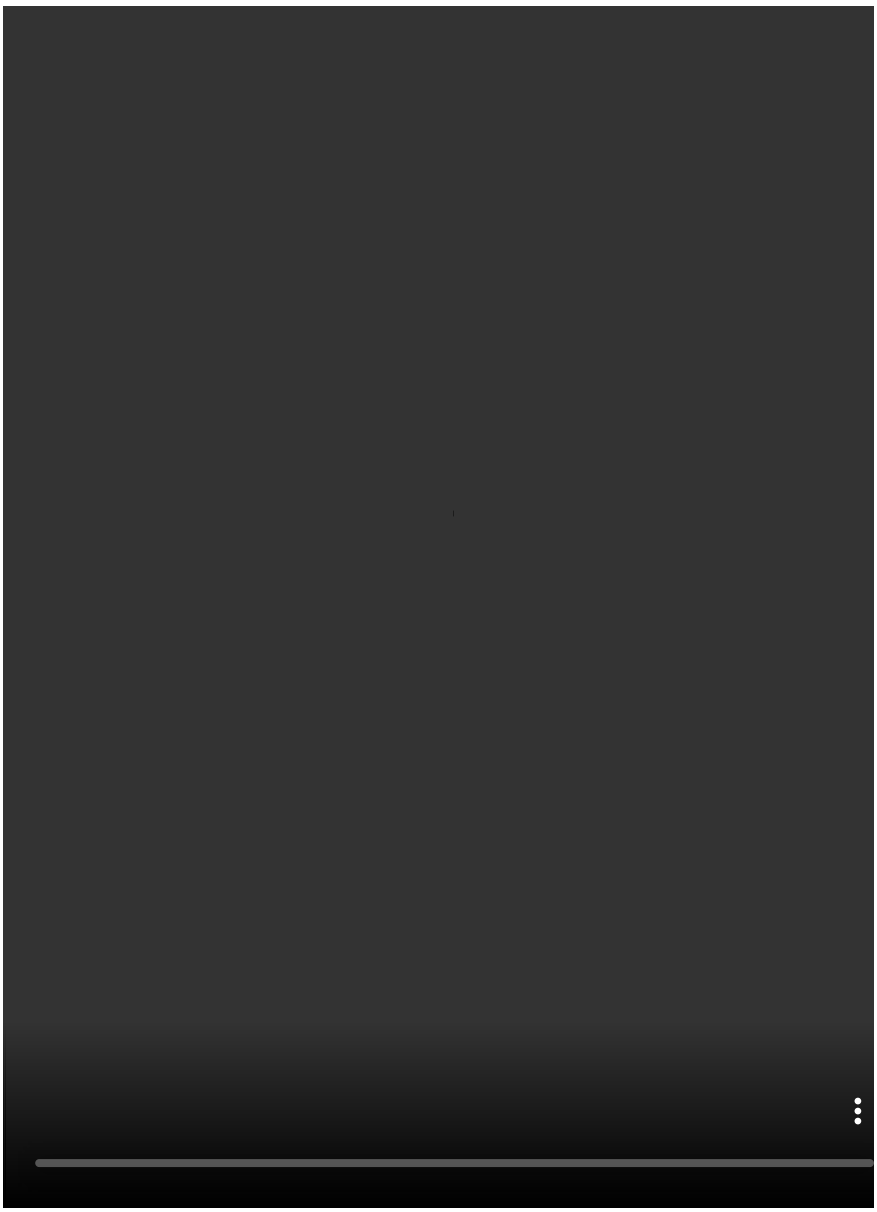
- 文件：puppeteerDemoBaiduSearch.py
- 贴出来是

```python
# Function: pyppeteer (python version puppeteer) do bai
# Author: Crifan Li
# Update: 20210330

import asyncio
from pyppeteer import launch

async def main():
    browser = await launch(headless=False)
    page = await browser.newPage()

    await page.setJavaScriptEnabled(enabled=True)

    baiduUrl = "https://www.baidu.com"
    await page.goto(baiduUrl)
    # await page.screenshot({'path': 'baidu.png'})

    ##########################################################
    # Input text
    ##########################################################
    searchStr = "crifan"

    # SearchInputSelector = "input[id=kw]"
    SearchInputSelector = "input[id='kw']"

    # SearchInputXpath = "//input[@id='kw']"
    # searchInputElem = page.xpath(SearchInputXpath)

    # # Input method 1: selector + click + keyboard typ
    # searchInputElem = await page.querySelector(Search
    # print("searchInputElem=%s" % searchInputElem)
    # await searchInputElem.click()
    # await page.keyboard.type(searchStr)

    # Input method 2: focus then type
    # await page.focus(SearchInputSelector)
    # await page.keyboard.type(searchStr)

    # Input method 3: selector and input once using typ
    await page.type(SearchInputSelector, searchStr, del

    ##########################################################
    # Trigger search
    ##########################################################

    # Method 1: press ENTER key
    await page.keyboard.press('Enter')

    # # Method 2: locator search button then click

    # SearchButtonSelector = "input[id='su']"
    # searchButtonElem = await page.querySelector(Searc
```

```
# searchButtonElem = await page.querySelector(Searc
# print("searchButtonElem=%s" % searchButtonElem)
# await searchButtonElem.click()
# # await searchButtonElem.press("Enter")

##################################################
# Wait page reload complete
##################################################
SearchFoundWordsSelector = 'span.nums_text'
SearchFoundWordsXpath = "//span[@class='nums_text']

# await page.waitForSelector(SearchFoundWordsSelect
# await page.waitFor(SearchFoundWordsSelector)
# await page.waitForXPath(SearchFoundWordsXpath)
# Note: all above exception: 发生异常: ElementHandle
#   so change to following

# # Method 1: just wait
# await page.waitFor(2000) # millisecond

# Method 2: wait element showing
SingleWaitSeconds = 1
while not await page.querySelector(SearchFoundWords
  print("Still not found %s, wait %s seconds" % (Se
  await asyncio.sleep(SingleWaitSeconds)
  # pass

##################################################
# Extract result
##################################################

resultASelector = "h3[class^='t'] a"
searchResultAList = await page.querySelectorAll(res
# print("searchResultAList=%s" % searchResultAList)
searchResultANum = len(searchResultAList)
print("Found %s search result:" % searchResultANum)
for curIdx, aElem in enumerate(searchResultAList):
  curNum = curIdx + 1
  print("%s [%d] %s" % ("-"*20, curNum, "-"*20))
  aTextJSHandle = await aElem.getProperty('textCont
  # print("type(aTextJSHandle)=%s" % type(aTextJSHa
  # type(aTextJSHandle)=<class 'pyppeteer.executior
  # print("aTextJSHandle=%s" % aTextJSHandle)
  # aTextJSHandle=<pyppeteer.execution_context.JSHa
  title = await aTextJSHandle.jsonValue()
  # print("type(title)=%s" % type(title))
  # type(title)=<class 'str'>
  print("title=%s" % title)

  baiduLinkUrl = await (await aElem.getProperty("hr

  print("baiduLinkUrl=%s" % baiduLinkUrl)
```

```
    await browser.close()

asyncio.get_event_loop().run_until_complete(main())
```

效果：



playwright

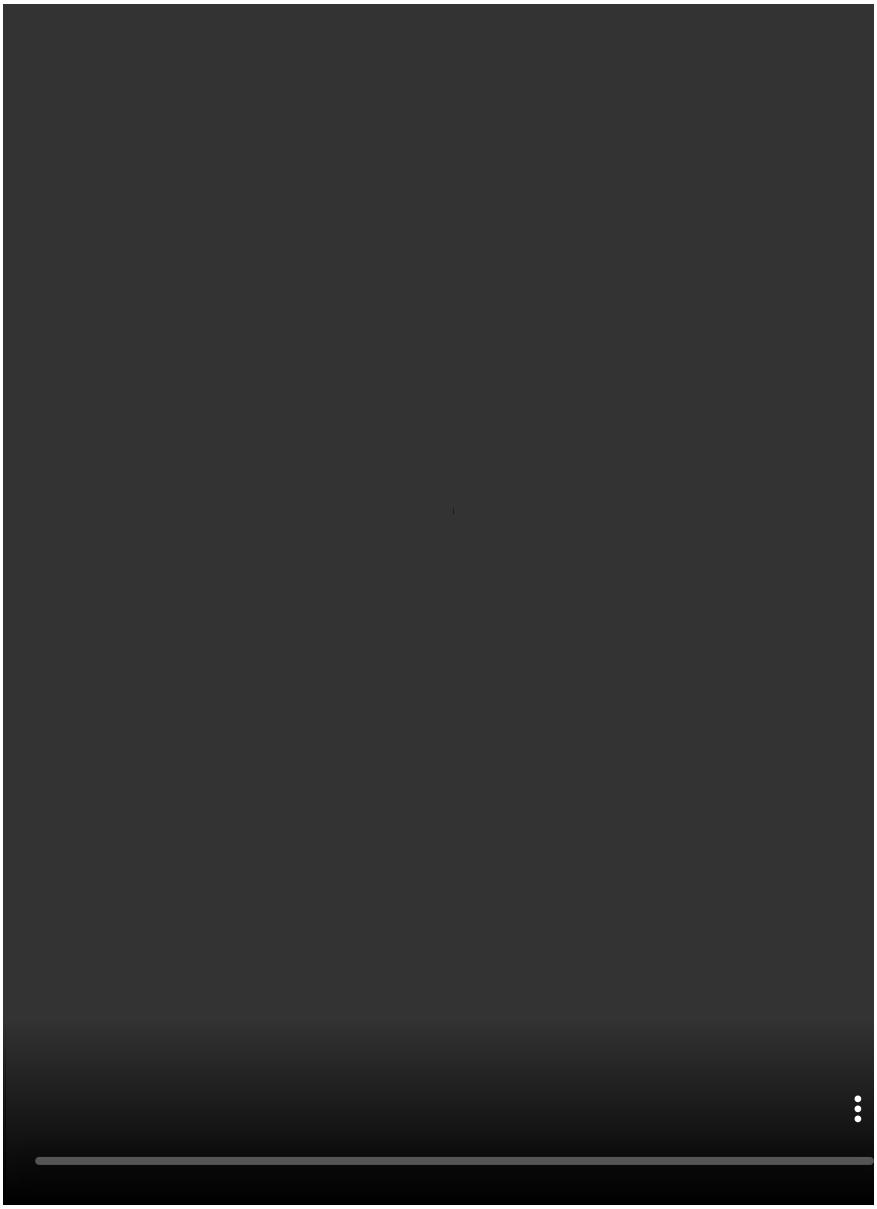
代码：

- 文件：playwrithDemoBaiduSearch.py
- 贴出来是

```python
# Function: Playwright demo baidu search
# Author: Crifan Li
# Update: 20210331

from playwright.sync_api import sync_playwright

# here use sync mode
with sync_playwright() as p:
    chromiumBrowserType = p.chromium
    print("chromiumBrowserType=%s" % chromiumBrowserTyp
    browser = chromiumBrowserType.launch(headless=False
    # chromiumBrowserType=<BrowserType name=chromium ex
    print("browser=%s" % browser)
    # browser=<Browser type=<BrowserType name=chromium
    page = browser.new_page()
    print("page=%s" % page)
    # page=<Page url='about:blank'>

    ######################################################
    # Open url
    ######################################################
    page.goto('http://www.baidu.com')
    print("page=%s" % page)
    # page=<Page url='https://www.baidu.com/'>

    ######################################################
    # Input text
    ######################################################
    searchStr = "crifan"
    SearchInputSelector = "input#kw.s_ipt"

    # page.click(SearchInputSelector)
    page.fill(SearchInputSelector, searchStr)

    ######################################################
    # Trigger search
    ######################################################
    EnterKey = "Enter"

    # Method 1: press Enter key
    # page.keyboard.press(EnterKey)

    # Method 2: locate element then click
    SearchButtonSelector = "input#su"
    page.press(SearchButtonSelector, EnterKey)

    # wait -> makesure element visible
    SearchFoundWordsSelector = 'span.nums_text'
    # SearchFoundWordsXpath = "//span[@class='nums_text
    page.wait_for_selector(SearchFoundWordsSelector, st
```

```
    ##################################################
    # Extract content
    ##################################################
    resultASelector = "h3[class^='t'] a"
    searchResultAList = page.query_selector_all(resultA
    print("searchResultAList=%s" % searchResultAList)
    # searchResultAList=[<JSHandle preview=JSHandle@<a
    searchResultANum = len(searchResultAList)
    print("Found %s search result:" % searchResultANum)
    for curIdx, aElem in enumerate(searchResultAList):
        curNum = curIdx + 1
        print("%s [%d] %s" % ("-"*20, curNum, "-"*20))
        title = aElem.text_content()
        print("title=%s" % title)
        # title=在路上on the way - 走别人没走过的路,让别人有
        baiduLinkUrl = aElem.get_attribute("href")
        print("baiduLinkUrl=%s" % baiduLinkUrl)
        # baiduLinkUrl=http://www.baidu.com/link?url=fB

    # do sceeenshot
    screenshotFilename = 'baidu_search_%s_result.png' %
    page.screenshot(path=screenshotFilename)

    browser.close()
```

效果:



移动端

Android端

uiautomator2

代码：

- 文件：uiautomator2DemoBaiduSearch.py
- 贴出来是

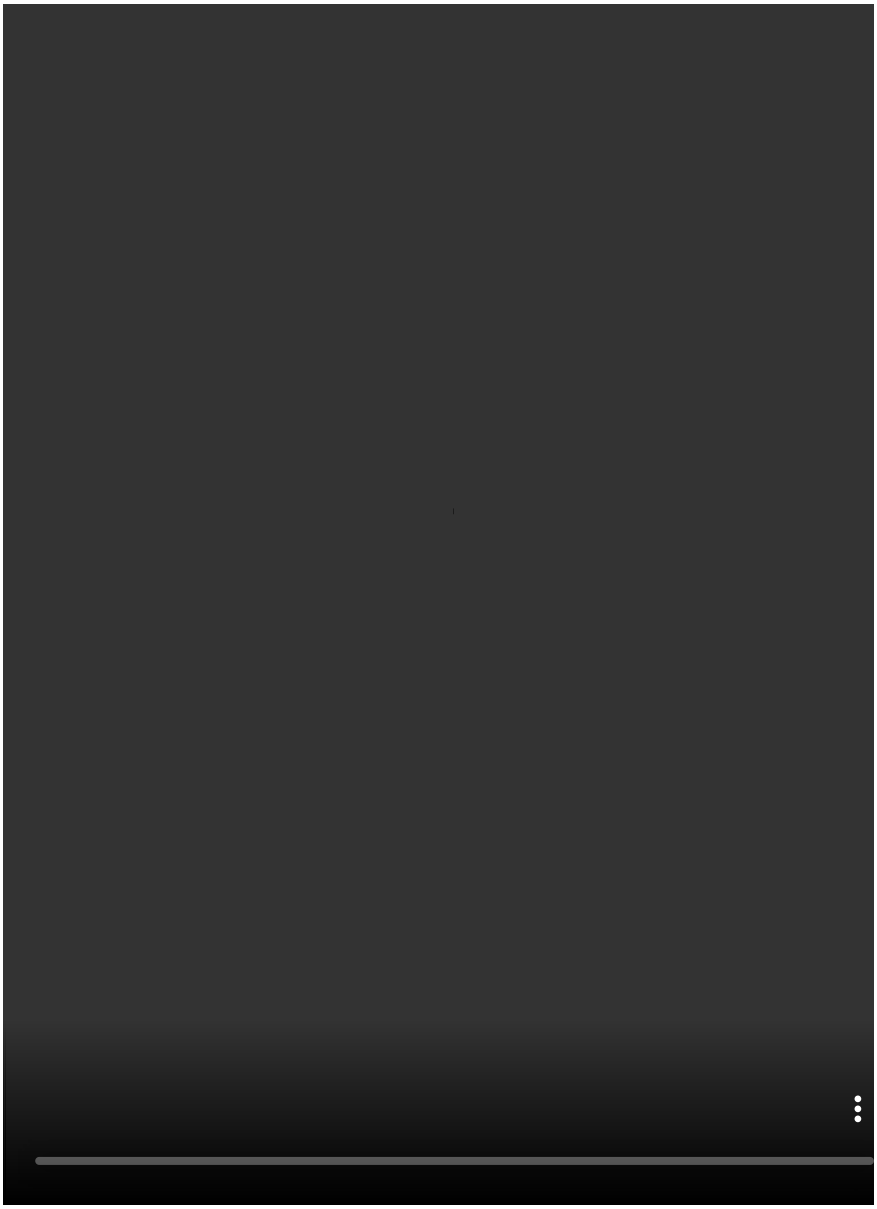
```
# Function: uiautomator2 demo baidu search
# Author: Crifan Li
# Update: 20210417

# import time
import uiautomator2 as u2

d = u2.connect() # connect to device
print("d.info=%s" % d.info)
# d.info={'currentPackageName': 'com.android.browser', 'dis

# for debug: get current app info
# curApp = d.app_current()
# print("curApp=%s" % curApp)

# for debug: get running app list
# activeAppList = d.app_list_running()
# print("activeAppList=%s" % activeAppList)

################################################################
# Launch browser
################################################################
Browser_XiaomiBuiltin = "com.android.browser"
browserPackage = Browser_XiaomiBuiltin
# d.app_start(browserPackage)
d.app_start(browserPackage, stop=True)

# wait util browser launch complete -> appear 我的 tab
# MustShowTabName = "主页"
MustShowTabName = "我的"
# d(text=MustShowTabName).exists(timeout=10)
d(text=MustShowTabName, packageName=browserPackage).exists
print("Browser homepage loaded")

################################################################
# Open baidu homepage
################################################################
SearchInputId = "com.android.browser:id/b4w"

# # open new window
# windowUiObj = d(resourceId="com.android.browser:id/dm")
# windowUiObj.click()

# # click add to new window
# addNewWindowUiObj = d(resourceId="com.android.browser:id/
# addNewWindowUiObj.click()


# for debug
# curPageXml = d.dump_hierarchy(compressed=False, pretty=Fa
```

```
# print("curPageXml=%s" % curPageXml)

# find input box inside address bar

# # Method 1: use driver pass in parameter
# inputUiObj = d(resourceId=SearchInputId, className="andro
# # inputUiObj = d(resourceId=SearchInputId)
# print("type(inputUiObj)=%s" % type(inputUiObj)) # type(in
# print("inputUiObj=%s" % inputUiObj) # inputUiObj=<uiautor
# inputUiObjectInfo = inputUiObj.info
# print("type(inputUiObjectInfo)=%s" % type(inputUiObjectIn
# print("inputUiObjectInfo=%s" % inputUiObjectInfo) # input
# isFoundInput = inputUiObj.exists # True

# # Method 2: use xpath
# inputXpathSelector = d.xpath("//android.widget.TextView[@
# # inputXpathSelector = d.xpath("//*[@resource-id=SearchIn
# print("type(inputXpathSelector)=%s" % type(inputXpathSele
# inputXpathElem = inputXpathSelector.get()
# print("type(inputXpathElem)=%s" % type(inputXpathElem)) #
# print("inputXpathElem=%s" % inputXpathElem) # inputXpathE
# print("type(inputXpathElem.attrib)=%s" % type(inputXpathE
# print("inputXpathElem.attrib=%s" % inputXpathElem.attrib)
# isFoundInput = inputXpathSelector.exists # True


# trigger into input page

# Method 1
inputUiObj = d(resourceId=SearchInputId, className="androi
inputUiObj.click()
print("Clicked search box")

# # Method 2
# inputXpathSelector = d.xpath("//android.widget.TextView[@
# inputXpathSelector.click()

# input baidu homr url
BaiduHomeUrl = "https://www.baidu.com/"
AddressInputId = "com.android.browser:id/bqi"
searchUiObj = d(resourceId=AddressInputId, className="andro
searchUiObj.set_text(BaiduHomeUrl)
print("Inputed baidu homepage url: %s" % BaiduHomeUrl)

# trigger jump to baidu home
EnterKey = "enter"
d.press(EnterKey)
print("Emulated press key %s" % EnterKey)

# wait util baidu home loaded
# d(text="百度一下", resourceId="com.android.browser:id/bq3"
```

```
d(text="百度一下,你就知道", className="android.view.View").ex
print("Baidu home loaded")

##############################################################
# Input text
##############################################################
searchStr = "crifan"

baiduSearchKeywordUiObj = d(resourceId="index-kw", classNar
baiduSearchKeywordUiObj.set_text(searchStr)
print("Inputed baidu search text %s" % searchStr)

##############################################################
# Trigger baidu search
##############################################################

# # Method 1: press key
# TriggerSearchKey = "enter" # work
# # TriggerSearchKey = "search" # not work
# # TriggerSearchKey = "go" # not work
# # TriggerSearchKey = "done" # not work
# d.press(TriggerSearchKey)
# print("Emulated press key %s" % TriggerSearchKey)

# Method 2: find 百度一下 button then click
baiduSearchButtonUiObj = d(resourceId="index-bn", classNam
baiduSearchButtonUiObj.click()
print("Clicked baidu search button")

##############################################################
# Extract search result content
##############################################################

# Special: for fixbug of get page xml is not latest, so us
d.service("uiautomator").stop()
d.service("uiautomator").start()
# time.sleep(1)

# for debug
# get page source xml
# curPageXml = d.dump_hierarchy(compressed=False, pretty=Fa
# print("curPageXml=%s" % curPageXml)
# with open("baidu_search_%s_result_pageSource_reloaded.xm
#     fp.write(curPageXml)

d(resourceId="results").exists(timeout=10)

# Note: following syntax can NOT find elements
# resultsSelector = d.xpath("//*[@resource-id='results']")
# titleButtonSelectorList = resultsSelector.xpath("//andro
# titleButtonSelectorList = resultsSelector.xpath(".//andr
```

```
# Xpath chain search can find elements
titleButtonElementList = d.xpath("//*[@resource-id='results
titleButtonNum = len(titleButtonElementList)
print("Found %s search result title" % titleButtonNum)

# descriptionElementList = d.xpath("//*[@resource-id='resu
descriptionElementList = d.xpath("//*[@resource-id='results
descriptionNum = len(descriptionElementList)
print("Found %s description" % descriptionNum)

# # sourceWebsiteElementList = d.xpath('//*[@resource-id="r
# sourceWebsiteElementList = d.xpath('//*[@resource-id="res
# sourceWebsiteNum = len(sourceWebsiteElementList)
# print("Found %s source website" % sourceWebsiteNum)

for curIdx, eachTitleButtonElement in enumerate(titleButtor
    curNum = curIdx + 1
    print("%s  [%d/%d] %s" % ("-"*20, curNum, titleButtonNu
    # eachTitleButtonElemAttrib = eachTitleButtonElement.at
    # print("title attrib: %s" % eachTitleButtonElemAttrib)
    # curTitle = eachTitleButtonElemAttrib["text"]
    curTitle = eachTitleButtonElement.text
    print("title=%s" % curTitle)

    curDescriptionElem = descriptionElementList[curIdx]
    curDescription = curDescriptionElem.text
    print("description=%s" % curDescription)

    # curSourceWebsiteElem = sourceWebsiteElementList[curId
    # curSourceWebsite = curSourceWebsiteElem.text
    # print("curSourceWebsite=%s" % curSourceWebsite)

print("Demo baidu search complete")
```

效果:



iOS端

facebook-wda

代码：

- 文件：facebookWdaDemoBaiduSearch.py
- 贴出来是

```
# Function: facebook-wda demo baidu search
# Author: Crifan Li
# Update: 20210410

import wda

# for debug
# Enable debug will see http Request and Response
# wda.DEBUG = True

c = wda.Client('http://localhost:8100')

curStatus = c.status()
print("curStatus=%s" % curStatus)
```

注：由于苹果开发者过期，导致：未完待续

详见：

【未解决】Mac中用facebook-wda自动操作安卓手机浏览器实现百度搜索

调试页面元素

在(用 `selenium` 、 `puppeteer` 、 `playwright` 等)自动化操作浏览器期间，往往涉及到：

搞清楚当前页面中的某些元素的html源码，以便于转换成 `xpath` 或 `css selector` 等方式去定位查找元素。

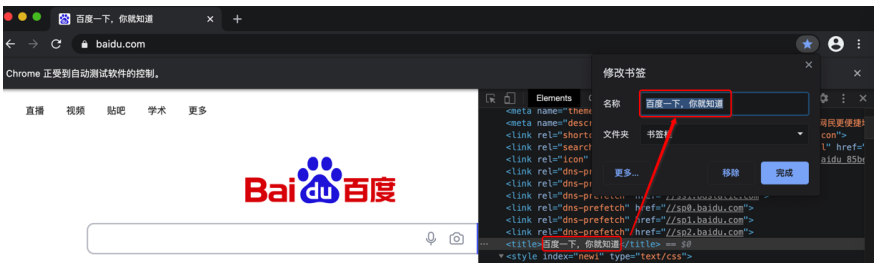
而调试页面元素的最常用办法就是： `Chrome` 的 `开发者工具`

其中： `Chrome` = `Chromium`

下面通过此处用到的实例例子来说明，具体如何操作。

用Chrome或Chromium查看百度首页中各元素的html源码

查看百度首页title标题

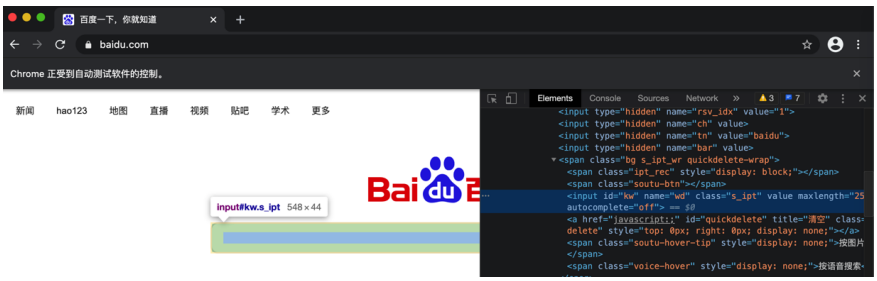


即： `百度一下，你就知道`

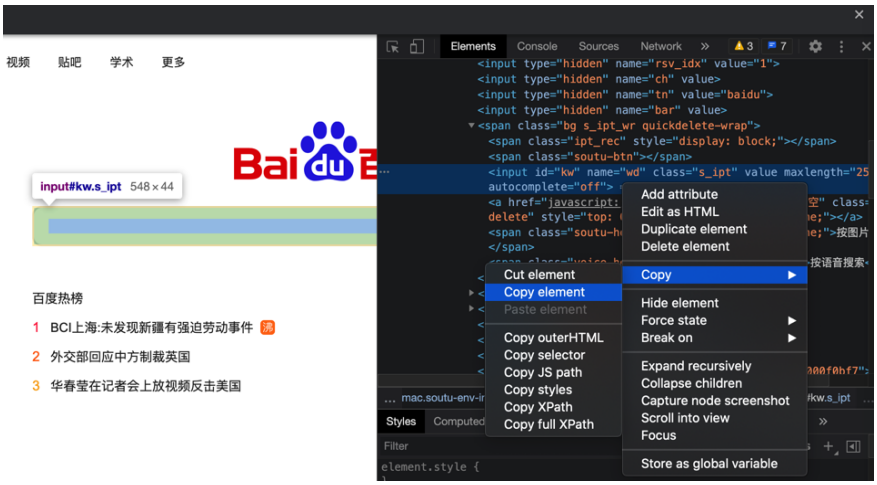
找到输入框对应的元素

可以右键 输入框 检查

打开 Chrome的 开发者工具



可以看到对应的html，且可以右键去Copy拷贝出来对应html



另外 Playwright调用的Chromium中效果是：

拷贝出来是：

```
<input id="kw" name="wd" class="s_ipt" value="" maxlength="
```

后来注意到：

Chromium中 调试工具已实时显示出 定位元素的Selector的，可以写成：

```
input#kw.s_ipt
```

其中：

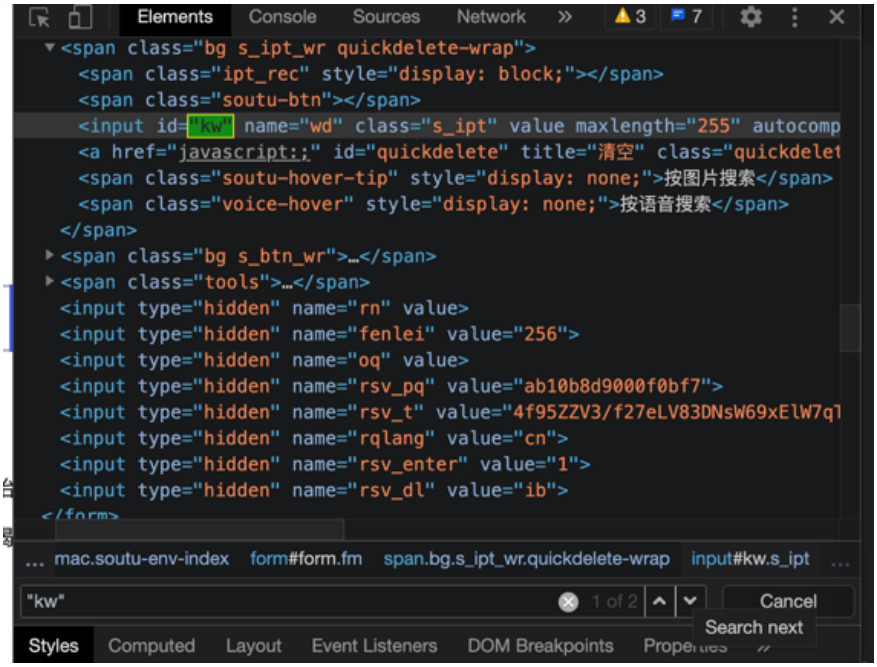
- `input` ：元素名 `tag`
- `kw` ：是 `id`
- `s_ipt` ：是 `class`

—> 后续代码中定位元素的CSS的Selector，则可以借鉴，甚至直接用这个写法

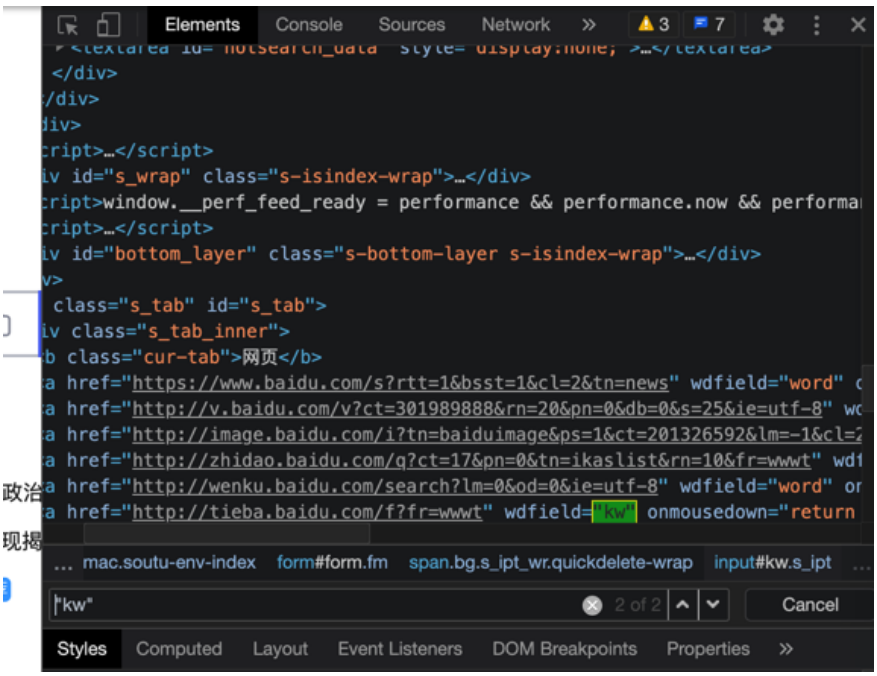
确认id是否唯一

此处可以通过查找，确认此处的id值 `kw` 是否唯一：

去搜一下此处的id： `kw`



此处可以看到搜到了2个，不过很明显，另外一个不是id：



证明对于： `id="kw"` 是唯一的

->后续代码，可以直接用 `id="kw"` 去定位元素（而可以不用其他属性，比如class等值）

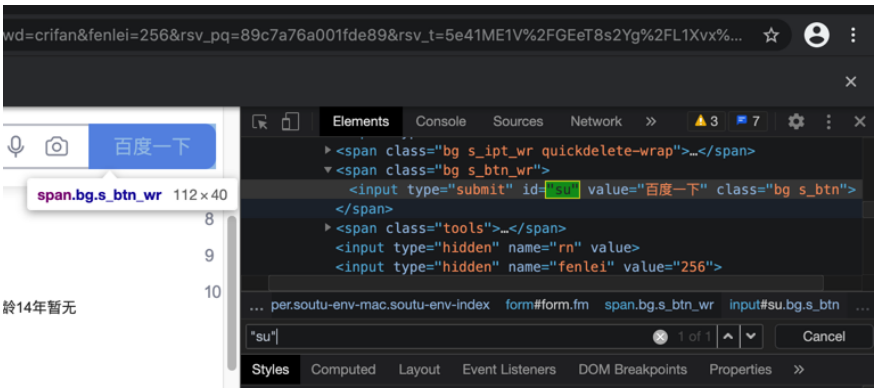
找 百度一下 按钮的html

找 百度一下 按钮，和之前类似，去 右键检查：

可以看到html是：

```
<input type="submit" id="su" value="百度一下" class="bg s_bt
```

且搜了下，确保只有一个："su"



找到百度搜索页面肯定会出现的元素：百度为您找到相关结果约

去找百度搜索后，确保会出现的内容

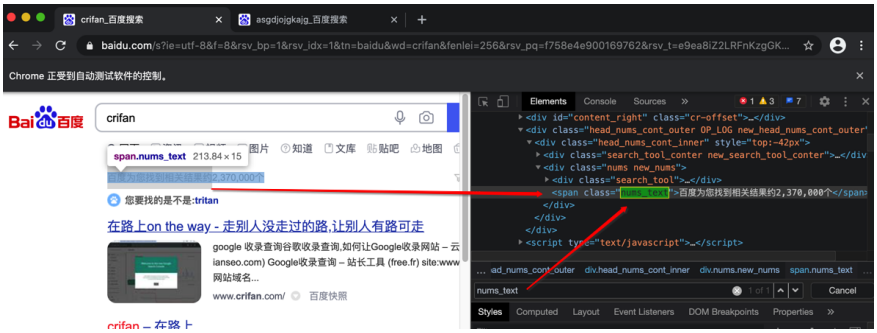
找到这个：

```
百度为您找到相关结果约xxx个
```

且去确认了，故意搜不到内容，页面也会出现这个：

去看看其html：

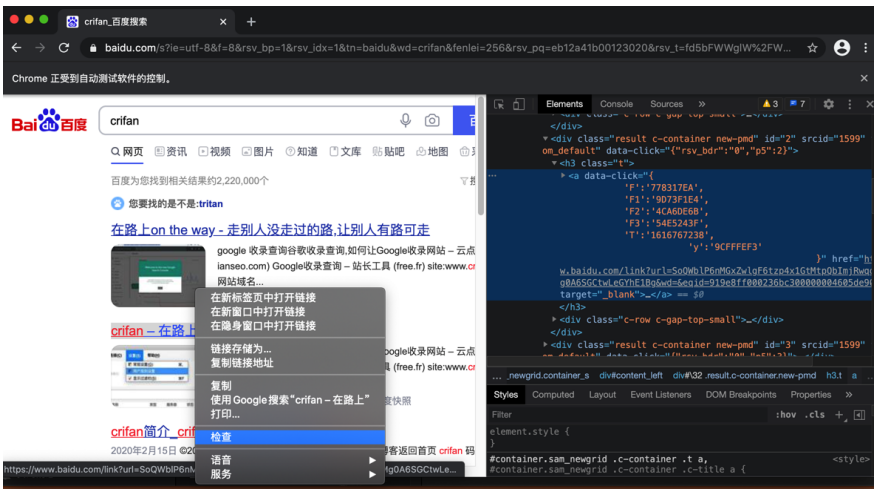
```
<span class="nums_text">百度为您找到相关结果约2,370,000个</spar
```



百度搜索的每条结果的html

去搞清楚，本身此处的每条搜索结果的内容的html是什么

右键 检查：

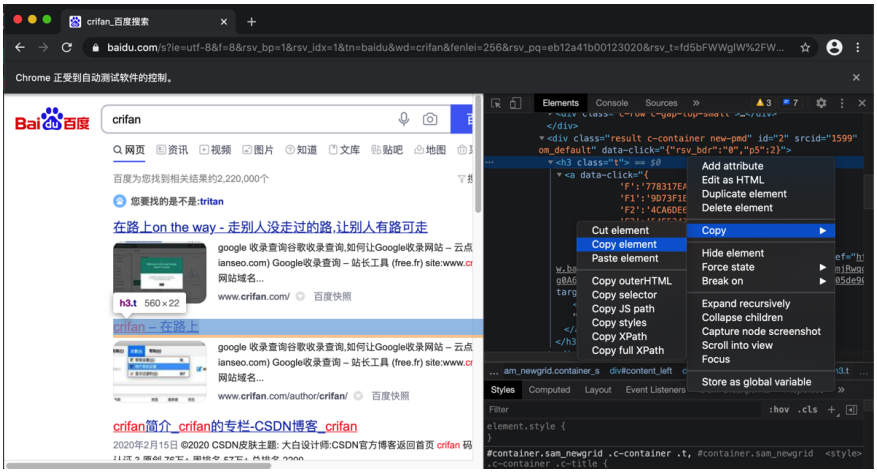


找到是：

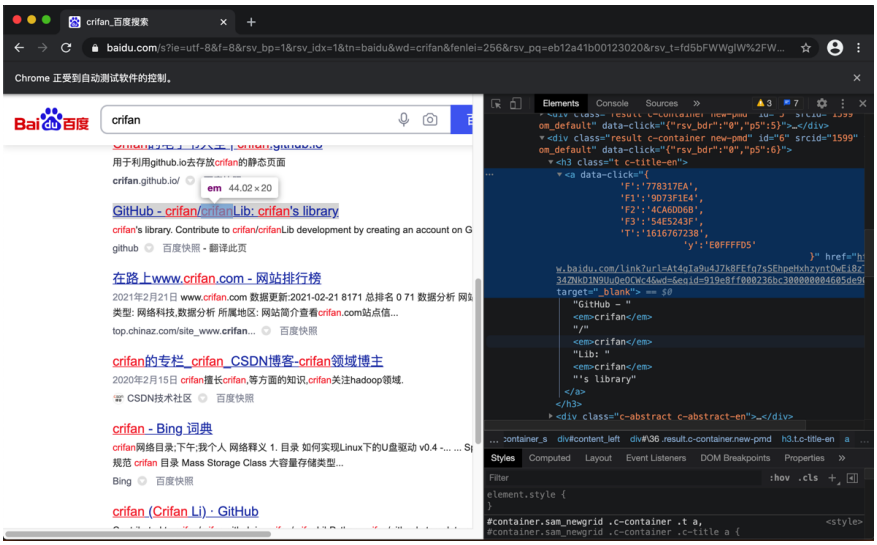
```
<a data-click="{
                'F':'778317EA',
                'F1':'9D73F1E4',
                'F2':'4CA6DE6B',
                'F3':'54E5243F',
                'T':'1616767238',
                    'y':'9CFFFEF3'
                                }" href="https://www.baidu.
```

上层父节点的元素是：

```
<h3 class="t"><a data-click="{
                'F':'778317EA',
                'F1':'9D73F1E4',
                'F2':'4CA6DE6B',
                'F3':'54E5243F',
                'T':'1616767238',
                    'y':'9CFFFEF3'
                                    }" href="https://www.baidu.
```



多看看几个结果，是否都是同样格式：

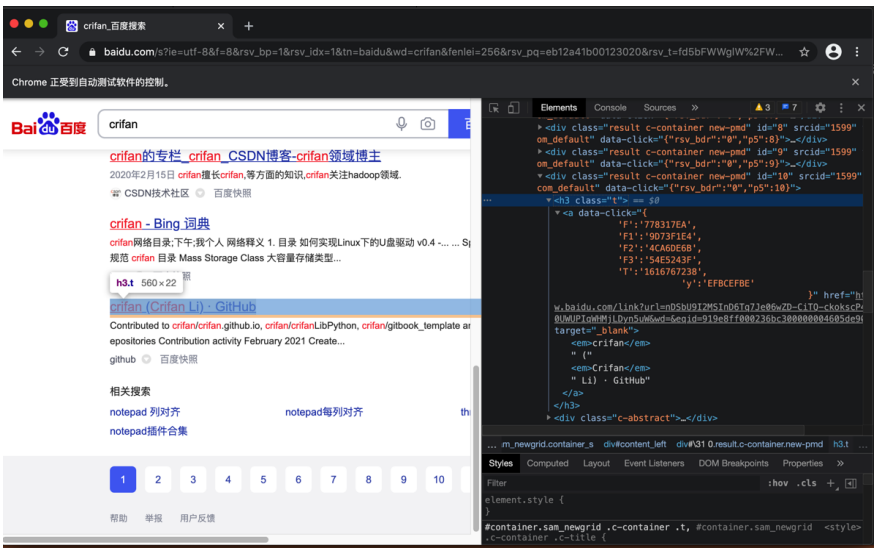


这个稍微复杂点：

```
<h3 class="t c-title-en"><a data-click="{
            'F':'778317EA',
            'F1':'9D73F1E4',
            'F2':'4CA6DD6B',
            'F3':'54E5243F',
            'T':'1616767238',
                    'y':'E0FFFFD5'
                                    }" href="ht
```

以及另外一个：

```
<h3 class="t"><a data-click="{
            'F':'778317EA',
            'F1':'9D73F1E4',
            'F2':'4CA6DE6B',
            'F3':'54E5243F',
            'T':'1616767238',
                    'y':'EFBCEFBE'
                                    }" href="ht
```

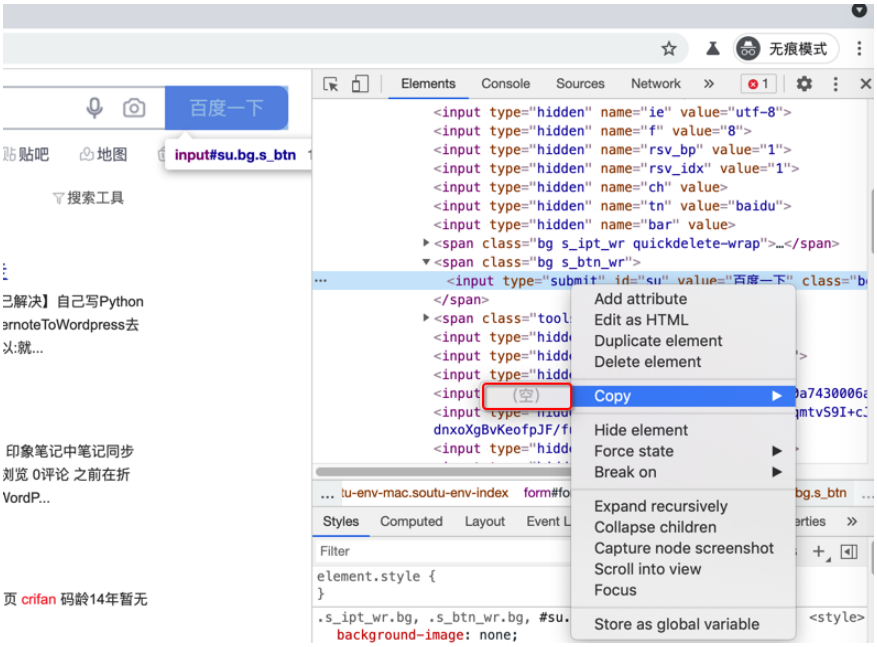


常见问题

Playwright的Chromium中无法右键拷贝元素html

Playwright的Chromium中，虽然能打开 `开发者工具`

但是，右键无法复制copy元素的html，右键的copy是空



PC端

PC端 = 电脑端，的自动化操作，此处主要指的是：

- Web端 = 浏览器

的自动化操作，代替人手，自动操作浏览器。

Web端

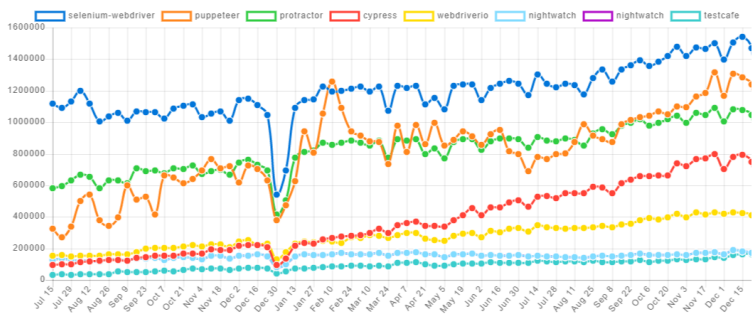
- Web端自动化操作
  - 目的：模拟人手工去操作浏览器
- 常见框架有
  - Selenium
  - puppeteer
  - Playwright

Selenium vs Playwright

- `Selenium`：
  - 优点：最流行，支持度最好
    - 网上还有些专门插件实现特定功能，比如：捕获http请求的selenium-wire
  - 缺点：被有些网站反爬（识别了特征？）
- `Playwright`：
  - 优点：简单好用
  - 缺点：打开页面速度比Selenium要慢
    - 之前测试过短链解析成长链期间的测试结果：
      - Selenium：**1.5**分钟
        - 模拟打开短链，跳转到长链，捕获特定http请求
      - Playwright：**5**分钟
        - 模拟google搜索，显示搜索结果

Selenium vs puppeteer

下面总结一下相关对比：

- 两者趋势
  - 

具体区别：

- `Selenium`
  - Logo

- 有些网站能检测到是WebDriver，就无法继续爬取了
  - 注：通过 `webdriver` 对浏览器的每一步操作都会留下特殊的痕迹，会被很多网站识别到
    - 规避办法：必须通过重新编译chrome的webdriver才能实现
      - 麻烦得让人想哭
  - 某人评论：Selenium速度慢，现在都改用 `puppeteer` 了
- 资料
  - 官网
    - SeleniumHQ Browser Automation
    - Python版本
      - PyPI
        - selenium · PyPI
      - 文档
        - Selenium with Python — Selenium Python Bindings 2 documentation
- `webdriver`
  - 常见
    - Phantomjs
      - 官网
  - 资料
    - selenium-webdriver
- 优势
  - 历史悠久：2004年发布
    - 目前最主流的浏览器（web页面）自动化工具
  - 支持众多浏览器：`Chrome` 、`Firefox` 、`Safari` 、`IE` 、`Opera` 等
  - 支持众多编程语言：`Java` 、`C#` 、`Python` 、`Ruby` 等
  - 通过 `Selenium IDE` 支持录制功能
  - 支持测试平台：`Web` 、（通过 `Appium` ）支持移动端
- 缺点
  - 速度相对(`Puppeteer`)慢一点
  - 安装和设置相对(`Puppeteer`)麻烦一些
  - 不支持跨平台
  - 截图只支持图片

- `Puppeteer`
  - Logo

- 发布时间：2017年
- 开发者：`Google`
- 目标：简化前端测试(front-end test)和开发
- 支持浏览器：`Chrome` 、`Chromium`
- 支持语言：`Javascript ( Node.js )`
- 优势
  - 速度相对快一些
  - 安装和设置相对简单
  - 支持跨平台
  - 截图支持图片和PDF
- 缺点
  - 测试平台只支持：`Web`
- 相关
  - `pyppeteer`
    - 是什么：`Puppeteer` 的 `python` 的 `binding`
      - Unofficial Python port of puppeteer JavaScript (headless) chrome/chromium browser automation library
    - 好处
      - 可以绕过很多网站对于WebDriver的检测
      - 可以对 `js加密` 降维打击
        - 完全无视 `js加密` 手段
    - 文档
      - API Reference — Pyppeteer 0.0.25 documentation
    - 官网
      - GitHub
        - miyakogi/pyppeteer: Headless chrome/chromium automation library (unofficial port of puppeteer)
        - 注：代码已归档，变只读了
      - pypi
        - pyppeteer · PyPI

Selenium

- 概述
  - 历史最悠久，用途最广的Web前端自动化工具
- 详见独立教程
  - Selenium知识总结

puppeteer

- 概述
  - 一句话描述
    - 用于替代 `PhantomJS` 和 `Selenium` 的前端自动化测试工具。特点是简单易用、速度快、支持屏幕截图和生成pdf文件。
- 详见独立教程
  - Web前端自动化利器：puppeteer
    - https://book.crifan.com/books/web_automation_tool_puppeteer/website/

Playwright

- 概述
  - 一句话简介：微软开源 `Python` 自动化神器 `Playwright`
    - 微软新出的 `Python` 库
      - 仅用一个API即可自动执行 `Chromium` 、 `Firefox` 、 `WebKit` 等主流浏览器自动化操作
    - 微软公司2020年初发布的新一代自动化测试工具，相较于目前最常用的Selenium，它仅用一个API即可自动执行Chromium、Firefox、WebKit等主流浏览器自动化操作。作为针对Python语言纯自动化的工具，在回归测试中可更快的实现自动化
- 详见独立教程
  - 跨平台Web自动化神器：Playwirght
    - https://book.crifan.com/books/web_automation_tool_playwright/website/

移动端

详见专门教程：

移动端自动化测试概览

Android

uiautomator2

详见专门教程：

安卓自动化测试利器：uiautomator2

iOS

facebook-wda

详见专门教程：

iOS自动化测试利器：facebook-wda

跨平台

此处介绍跨平台的自动化工具。

目前最主流的属于：

- Appium

Appium

详见专门教程：

主流跨平台自动化框架：Appium

通用逻辑

此处整理自动化操作领域，不论是PC端的Web自动化，还是移动端的设备的自动化，相对通用的一些逻辑。

定位元素方式

在模拟Web或设备自动化期间，往往涉及到元素的定位。

此处介绍元素定位的常见的方式：

- CSS选择器
- Xpath

CSS选择器

自动化期间，很多时候支持用CSS选择器的方式去查找和定位元素。

关于如何写 `CSS` 的 `Selector` 去定位（ `html` 等）元素，可参考：

- CSS选择器参考手册
  - https://www.w3school.com.cn/cssref/css_selectors.asp

举例

Xpath

自动化期间，很多时候支持用`Xpath`去查找和定位元素。

- XPath语法
  - 可参考
    - XPath 语法 | 菜鸟教程 (runoob.com)
    - XPath 教程 (w3school.com.cn)

详见独立教程：

XPath知识总结

附录

下面列出相关参考资料。

参考资料

- 【未解决】Mac中用facebook-wda自动操作安卓手机浏览器实现百度搜索
-
- XPath 语法 | 菜鸟教程 (runoob.com)
- XPath 教程 (w3school.com.cn)
-