Concurrent programming lab01 - simon.barras

```python
import pokemon
import matplotlib.pyplot as plt
import matplotlib.gridspec as gridspec
import time

k_nb_td_max: int = 15
k_nb_td_min: int = 1
k_step = 1
args_ = {
    "min_pokemon": 1,
    "max_pokemon": 898,
    "tp": "T",
    "nbr_tp": 4,
    "path": "./tmp"
}
result_ = {
    "T": [],
    "T_key": [],
    "P": [],
    "P_key": [],
    "A_load": [],
    "Mi_load": [],
    "Ma_load": [],
}
color_ = {
    "T": "b",
    "P": "r"
}

def speed_thread( nb: int = k_nb_td_max):
    global result_
    args_['tp'] = "T"
    for i in range(k_nb_td_min, nb, k_step):
        args_['nbr_tp'] = i
        start = int(round(time.time()))
        results_load = pokemon.main(args_, True)
        end = int(round(time.time()))
        print(str(i) + " threads -> "+str(end- start) +" [s]")
        result_['T'].append(end - start)
        result_['T_key'].append(i)
        sum = 0
        min = results_load[0]
        max = results_load[0]
        for val in results_load:
            sum += val
            if min > val: min = val
            if max < val : max = val
        sum /= len(results_load)
        result_['A_load'].insert(i, sum)
        result_['Mi_load'].insert(i, min)
        result_['Ma_load'].insert(i, max)

    fig, (ax1, ax2) = plt.subplots(2, 1)
    fig.suptitle('Speed test threads')

    ax1.plot(result_['T_key'], result_['T'], c=color_['T'], label='Threads')

    ax1.set_ylabel('Time (s)')
    ax1.set_xlabel('Number of threads')

    ax2.plot(result_['T_key'], result_['A_load'], c='b', label='Load average')
    ax2.plot(result_['T_key'], result_['Ma_load'], 'g--', label='Max load')
    ax2.plot(result_['T_key'], result_['Mi_load'], 'r--', label='Min load')

    ax2.set_ylabel('Image by thread average')
    ax2.set_xlabel('Number of threads')
    return ax1, ax2

def speed_process( nb: int = k_nb_td_max):
    global result_
    args_['tp'] = "P"
    for i in range(k_nb_td_min, nb, k_step):
        args_['nbr_tp'] = i
        start = int(round(time.time()))
        results_load = pokemon.main(args_, True)
        end = int(round(time.time()))
        print(str(i) + " process -> "+str(end- start) +" [s]")
        result_['P'].append(end - start)
        result_['P_key'].append(i)

    fig, (ax1) = plt.subplots(1, 1)
    fig.suptitle('Speed test process')

    ax1.plot(result_['P_key'], result_['P'], c=color_['P'], label='Process')

    ax1.set_ylabel('Time (s)')
    ax1.set_xlabel('Number of process')
    return ax1

def load_experiment(type: str, number_of_tp: int = 4):
    args_["tp"] = type
    args_["nbr_tp"] = number_of_tp
    results = pokemon.main(args_, True)
    somme = 0
    for i in range(len(results)):
        somme += results[i]
```

```
 97:
 98:     plt.title("Load by " + type)
 99:     plt.ylabel("Number of images")
100:     plt.xlabel("Id")
101:     id = 0
102:     # for nb in results:
103:     #     plot.bar(id, somme / nb, str(results))
104:     #     id += 1
105:     plt.bar(range(len(results)), results)
106:
107:
108: if __name__ == '__main__':
109:     print("Speed test with threads...")
110:     speed_thread()
111:     #plt.show()
112:     print("Speed test with process...")
113:     speed_process()
114:     plt.show()
115:     print("Load test with threads...")
116:     #load_experiment("T", )
117:     #plt.show()
118:     print("Load test with process...")
119:     #load_experiment("P", )
120:     #plt.show()
121:
```

```python
# -*- coding: utf-8 -*-

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"""
This file contains a function, which downloads a specific Pokemon image from assets.pokemon.com website.
It is a helper funcition that wil be used in the Concurrent Systems lab01.
"""

__author__ = 'Michael Maeder'
__date__ = "04.10.2021"
__version__ = "1.1"
__email__ = "michael.maeder@hefr.ch"
__userid__ = "michael.maeder"


import cv2
import numpy as np
import urllib.request

URL = 'https://assets.pokemon.com/assets/cms2/img/pokedex/detail/'


def download_image(img_nbr: int, path: str, verbose_print: bool = False):
    """
    Downloads a specific pokemon image in PNG format. The function gets a index number and downloads the corresponding
    image. The PNG-converted image will be written to the given filesystem path

    :argument
        img_nbr         -- the number of the image (1 .. 898)
        path            -- the path where the image will be written to
        verbose_print   -- selector if some debugging information should be printed or not

    :exception
        urllib.error.HTTPError  -- will be raised by the request library. The exception will be forwarded to the caller
    """

    try:
        # creation of the request object with the given URL
        req = urllib.request.Request(URL + '{:03d}'.format(img_nbr) + '.png')
        response = urllib.request.urlopen(req)                          # response contains the raw response data
        raw_image_data = response.read()                                # get the bytes of the image
        image = np.asarray(bytearray(raw_image_data), dtype="uint8")    # convert it to an array of uint8s
        image = cv2.imdecode(image, cv2.IMREAD_UNCHANGED)               # the code the array as an image
        cv2.imwrite(path + "/" + '{:03d}'.format(img_nbr) + ".png", image)  # finally write the PNG to the given path
        if verbose_print:
            print("Saved " + '{:03d}'.format(img_nbr) + ".png")
    except Exception as e:
        print("Error occured for Pokemon " + '{:03d}'.format(img_nbr))
        raise e                                                         # forward the exception to the caller

```

```python
#!/usr/bin/env python3
# -*- coding: utf-8 -*-

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# distributed under the License is distributed on an "AS IS" BASIS,
# WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
# See the License for the specific language governing permissions and
# limitations under the License.


"""
Download a range of pokemon's picture.
The number of thread or process is configurable
"""

__author__ = "Simon Barras"
__date__ = "2021-10-15"
__version__ = "0.0.1"
__email__ = "simon.barras@edu.hefr.ch"
__userid__ = "simon.barras"

import time

from getpokemon import download_image
import sys
import threading
import multiprocessing


k_max_pokemon = 898
k_default_verbose = False
k_nb_args = 5
args_ = {
    "min_pokemon": 1,
    "max_pokemon": k_max_pokemon,
    "tp": "T",
    "nbr_tp": 6,
    "path": "./tmp"
}
tp_list_ = []
tp_result_ = []
count_ = 0
do_stats_ = False


# This method can have some concurrent problems -- why?
def worker_canHaveConcurrentProblem(index):
    global count_
    while count_ < args_['max_pokemon']:
        # Protection de la section critique
        count_ += 1
        #print("TD: " + str(index) + " is downloading " +str(count))
        try:
            download_image(count_, args_["path"], k_default_verbose)
        except Exception as e:
            continue
        if do_stats_:
            global tp_result_
            tp_result_[index] += 1


def worker(index):
    # Download all image from the beginning to the end
    # Increment value with the number of TP
    for i in range(1 + index, args_['max_pokemon'], args_['nbr_tp']):
        #print("TD: " + str(index) + " is downloading " +str(i))
        try:
            download_image(i, args_["path"], k_default_verbose)
        except Exception as e:
            continue
        if do_stats_:
            global tp_result_
            tp_result_[index] += 1


def initialize():
    global count_
    count_ = args_['min_pokemon'] - 1
    for i in range(0, args_["nbr_tp"]):
        if args_["tp"] == "T":
            tp = threading.Thread(target=worker, args=(i, ))
        else:
            tp = multiprocessing.Process(target=worker, args=(i, ))

        tp_list_.append(tp)


def clear():
```

Cmd : 1/1

Bug : 1

all that has to be documented & CONSTS ?

C3

C6

describe C3

C3

describe C3

you're not distributing the work! ... not true my comment

```
 97:     global tp_result_
 98:     tp_list_.clear()
 99:     tp_result_.clear()
100:     tp_result_ = [0] * args_["nbr_tp"]
101:
102:
103: def main(args=args_, give_stat=False):
104:     """ main function """
105:     global args_
106:     args_ = args
107:     global do_stats_
108:     do_stats_ = give_stat
109:
110:     # Clear all residual values
111:     clear()
112:
113:     # Initialize return value if is not necessary
114:     if not do_stats_:
115:         tp_result_.append(0)
116:
117:     # Initialize all values
118:     #   Create thread/process
119:     initialize()
120:
121:     # Start threads/process
122:     for tp in tp_list_:
123:         tp.start()
124:
125:     # Wait until threads/process finish
126:     for tp in tp_list_:
127:         tp.join()
128:
129:     return tp_result_
130:
131:
132: # main program entry point
133: if __name__ == "__main__":
134:     for i in range(1, len(sys.argv)):
135:         if i == 1:
136:             args_["min_pokemon"] = int(sys.argv[i])
137:         elif i == 2:
138:             args_["max_pokemon"] = int(sys.argv[i])
139:         elif i == 3:
140:             args_["tp"] = sys.argv[i]
141:         elif i == 4:
142:             args_["nbr_tp"] = int(sys.argv[i])
143:         elif i == 5:
144:             args_["path"] = sys.argv[i]
145:     start = time.time()
146:     main()
147:     end = time.time()
148:     print("Time %f" % (end - start))
```

can throw exceptions !

CG

Git Logs

```
commit 7fbb461edec11afe0c0ffcb44b076832c23d2d17 (HEAD -> refs/heads/main,
refs/remotes/origin/main, refs/remotes/origin/HEAD)
Author: Simon Barras <simon.barras@edu.hefr.ch>
Date:   Fri, 15 Oct 2021 17:14:14 +0000

    Update README.md
```

```
commit 1cfeba08c8edacae0bba4d858de0126bcf43de00
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Fri, 15 Oct 2021 18:50:43 +0200

    add a little report
```

```
commit e03701968f3af11f796ffa42417a561839fbaf3c
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Fri, 15 Oct 2021 18:50:26 +0200

    finilasie experiment
```

```
commit 1655aabb3a13c69a15f684f8933953af4d8ea330
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Fri, 15 Oct 2021 13:36:17 +0200

    rename variable
```

```
commit 202114bad6a0dfe6e807a05771b6646da7913947
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Fri, 8 Oct 2021 13:11:20 +0200

    update result's graph
```

```
commit 9393ee14b247a64a7ad67eb972b3a3036e9250c5
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Fri, 8 Oct 2021 10:52:49 +0200

    Fix load graph bar
```

```
commit 096e2d5de4c13cc96890f549565396fe73f35fc5
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Fri, 8 Oct 2021 10:17:31 +0200

    Fix load average

commit 834e87d839a8d1085edabcc638df87560d799781
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Fri, 8 Oct 2021 09:39:34 +0200

    update test

commit d5e019bda734c88102cfafb924e0b5c4dad33907
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Tue, 5 Oct 2021 23:42:16 +0200

    first trytp work in same time

commit 54f45a04654bcd2ddc903542335eaf87d8515995
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Tue, 5 Oct 2021 22:46:43 +0200

    first try

commit b6e016b606ab4ee6b937b5b19b123932a354cd5c
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Tue, 5 Oct 2021 15:51:29 +0200

    downloading files

commit 60fcb53c196d05eee076a6028b71b2a027f04bf5
Merge: 6892738 a39309c
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date:   Tue, 5 Oct 2021 13:43:24 +0200

    Merge branch 'main' of https://gitlab.forge.hefr.ch/concurp/2021-
```

2022/concurp-student-labs

---

commit a39309cfa63e7882a5a9eb053a41ea5bf6cfb817
Author: Michael Mäder <michael.maeder@hefr.ch>
Date: Tue, 5 Oct 2021 11:42:16 +0000

img_nbr argument description fixed

.....

---

commit 68927386afb9226e35024dd494b6af27544b3ae5
Merge: 63b4c71 4420bdc
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date: Tue, 5 Oct 2021 13:35:04 +0200

Merge branch 'main' of https://gitlab.forge.hefr.ch/concurp/2021-2022/concurp-student-labs

---

commit 63b4c714df47a2a07588f16d32abec13faaf5b21
Author: Simon Barras <66463606+simbarras@users.noreply.github.com>
Date: Tue, 5 Oct 2021 13:32:14 +0200

add tests

.....

---

commit 4420bdc331f3756219fdbbe0a973c44e2de2d5d4
Merge: cb7835c e33f5b2
Author: Michael Mäder <michael.maeder@hefr.ch>
Date: Tue, 5 Oct 2021 09:28:53 +0200

Merge branch 'main' of https://gitlab.forge.hefr.ch/concurp/2021-2022/concurp-student-labs

---

commit cb7835c50510512efcd2773a3ca6132ca646ab76
Author: Michael Mäder <michael.maeder@hefr.ch>
Date: Tue, 5 Oct 2021 09:28:45 +0200

.gitignore for Python stuff.

```
    modified example script

                    ..........
```

```
commit e33f5b243a0934416bafe819fb3898d1105ec66f
Author: Michael Mäder <michael.maeder@hefr.ch>
Date:   Mon, 4 Oct 2021 15:46:55 +0000

    pip requirements for the helper function
```

```
commit 78181db37b4f31bbd7820b665bbd68fdc1d18a2e
Author: Michael Mäder <michael.maeder@hefr.ch>
Date:   Mon, 4 Oct 2021 15:29:09 +0000

    main program skeleton
```

```
commit d3c5201d25cc7163d96f367dcd5310b03e4cfab7
Author: Michael Mäder <michael.maeder@hefr.ch>
Date:   Mon, 4 Oct 2021 15:28:02 +0000

    Add new file
```

```
commit 628ee2696269da6283e79b242ab566ae2e605fb4
Author: Michael Mäder <michael.maeder@hefr.ch>
Date:   Mon, 4 Oct 2021 15:27:12 +0000

    Add new directory
```

```
commit 59a5d5681ba0eced659e4ca453a5336eedebe96d
Author: Michael Mäder <michael.maeder@hefr.ch>
Date:   Mon, 4 Oct 2021 14:51:37 +0000

    helpfer function for the Pokémon lab uploaded
```

```
commit 0a548c28737e4747255b6058c45c2d1bb543b552
Author: Michael Mäder <michael.maeder@hefr.ch>
Date:   Mon, 4 Oct 2021 14:50:04 +0000
```

```
    Add new directory
```

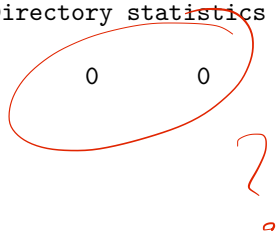
```
commit 46a33f06042a72406d72d7f8b69e84d04005f061
Author: Michael Mäder <michael.maeder@hefr.ch>
Date:   Mon, 4 Oct 2021 14:49:51 +0000

    Add new directory
```

Run params: 10-13-P-8–tmp-pokemon

```
Directory statistics for 10-13-P-8--tmp-pokemon

      0       0       0
```



Run params: 10-13-P-8–tmp-pokemon

should read only 4 images!

```
Time 18.815633
libpng warning: iCCP: known incorrect sRGB profile
libpng warning: iCCP: known incorrect sRGB profile
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```
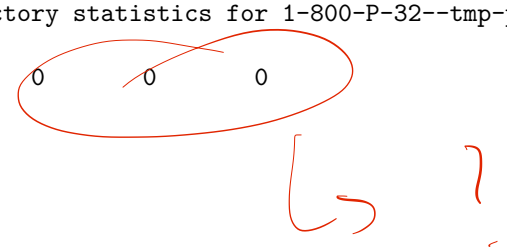

```
libpng warning: iCCP: known incorrect sRGB profile
libpng warning: iCCP: known incorrect sRGB profile
libpng warning: iCCP: known incorrect sRGB profile
```

Run params: 1-800-P-32–tmp-pokemon

```
Directory statistics for 1-800-P-32--tmp-pokemon
```



Run params: 1-800-P-32–tmp-pokemon

```
Time 28.269413
libpng warning: iCCP: known incorrect sRGB profile
libpng warning: iCCP: known incorrect sRGB profile
libpng warning: iCCP: known incorrect sRGB profile
libpng warning: iCCP: known incorrect sRGB profile
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Run params: 1-8-M-32–tmp-pokemon

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Directory statistics for 1-8-M-32--tmp-pokemon

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Run params: 1-8-M-32–tmp-pokemon

? what is used ?

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```

Run params: 1-8-P-0–tmp-pokemon

```
Directory statistics for 1-8-P-0--tmp-pokemon

       0       0       0
```

Run params: 1-8-P-0–tmp-pokemon

```
Time 0.000004
```

Run params: 30-47-T-8–tmp-pokemon

```
Directory statistics for 30-47-T-8--tmp-pokemon

    46       46     1012
```

Run params: 30-47-T-8–tmp-pokemon

```
Time 2.296827
```

Run params: default

```
Directory statistics for default

       0       0       0
```

Run params: default

```
Time 23.662107
libpng warning: iCCP: known incorrect sRGB profile
libpng warning: iCCP: known incorrect sRGB profile
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libpng warning: iCCP: known incorrect sRGB profile
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```

Lab01 - Pokémon figure scraper

This is the second TP of the lesson "Concurrent system". In this exercise we need to test threads and process to download quickly 900 pictures of pokemon. The guideline is available here.

This project is made by @Simon.barras

Launch app

`python3 pokemon.py [start_id [stop_id [tp [nbr_tp [out_dir]]]]]`

argument	description	default value
pokemon.py	name of the python program file that contains the main entry point	
start_id	the ID of the first image to download	1
stop_id	the ID of the last image to download (included → the image with this ID must also be downloaded)	898
tp	selector of multi-threading or multi-processing, T: threading, P: processing	T
nbr_tp	the number of threads or processes	4
out_dir	the directory, where the files are written to	/tmp/

pokemon.py

The code is documented but there is 2 workers. The used worker is *pokemon.worker(index)* and this how it work:

For example, we want to download 10 pictures with 4 threads

This is the load's repartition > Jump = number of thread/process

Threads / process	Image
TP 1	0, 4, 8
TP 2	1, 5, 9

Threads / process	Image
TP 3	2, 6
TP 4	3, 7

And here this is an example of the activity

Image	0	4	2	1	3	5	7	8	9	6
TP 1	-	-						-		
TP 2				-		-			-	
TP 3			-							-
TP 4					-		-			

Time ->

This version of the worker work well but if a process finish earlier as his *teammate* he can't help them. To fix this, I have think about an algorithm where thread ask about the next image to download. The effect is that the images are downloaded in order but the thread/process aren't downloading the same number of images. If we retake the previous example we can have something like this:

Image	0	1	2	3	4	5	6	7	8	9
TP 1	-	-						-		
TP 2				-		-			-	-
TP 3			-							
TP 4					-		-			

Time ->

The benefit is the time, if a thread is slower, all other may help him. The problem with this solution is the concurrent problem.

```
def worker_canHaveConcurrentProblem(index):
    global count_
    while count_ < args_['max_pokemon']:
        # Protection de la section critique
        count_ += 1
        #print("TD: " + str(index) + " is downloading " +str(count))
        try:
            download_image(count_, args_["path"], k_default_verbose)
        except Exception as e:
            continue
        if do_stats_:
```

```
global tp_result_
tp_result_[index] += 1
```

If there is a shift between `count_ += 1` and `download_image(count_, args_["path"], k_default_verbose)` the thread may not download the right

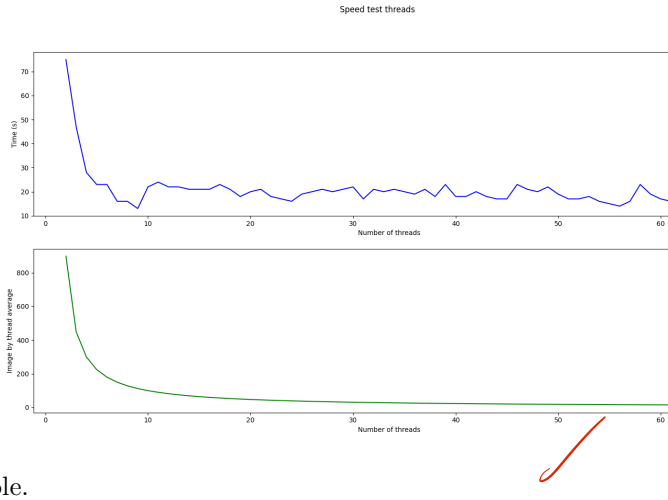
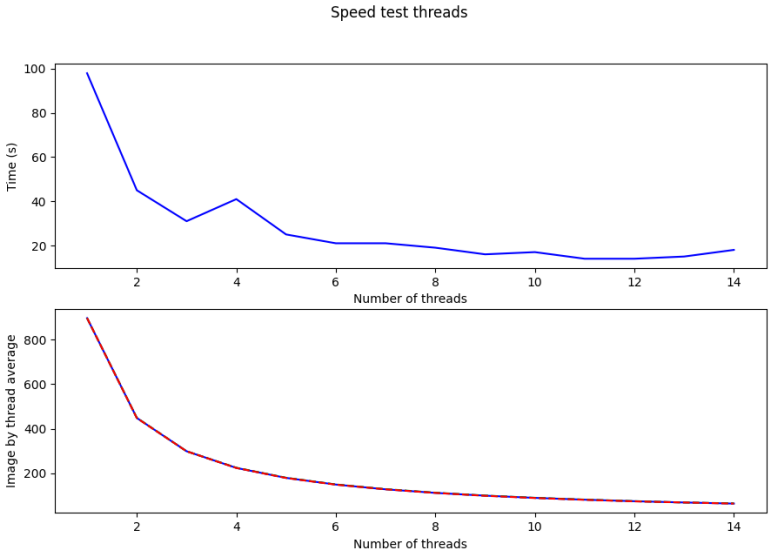


image. We can see this effect with this picture:
When there are to many threads, the time isn't stable.

Result

I have run experiment.py from my home and I have get this result:

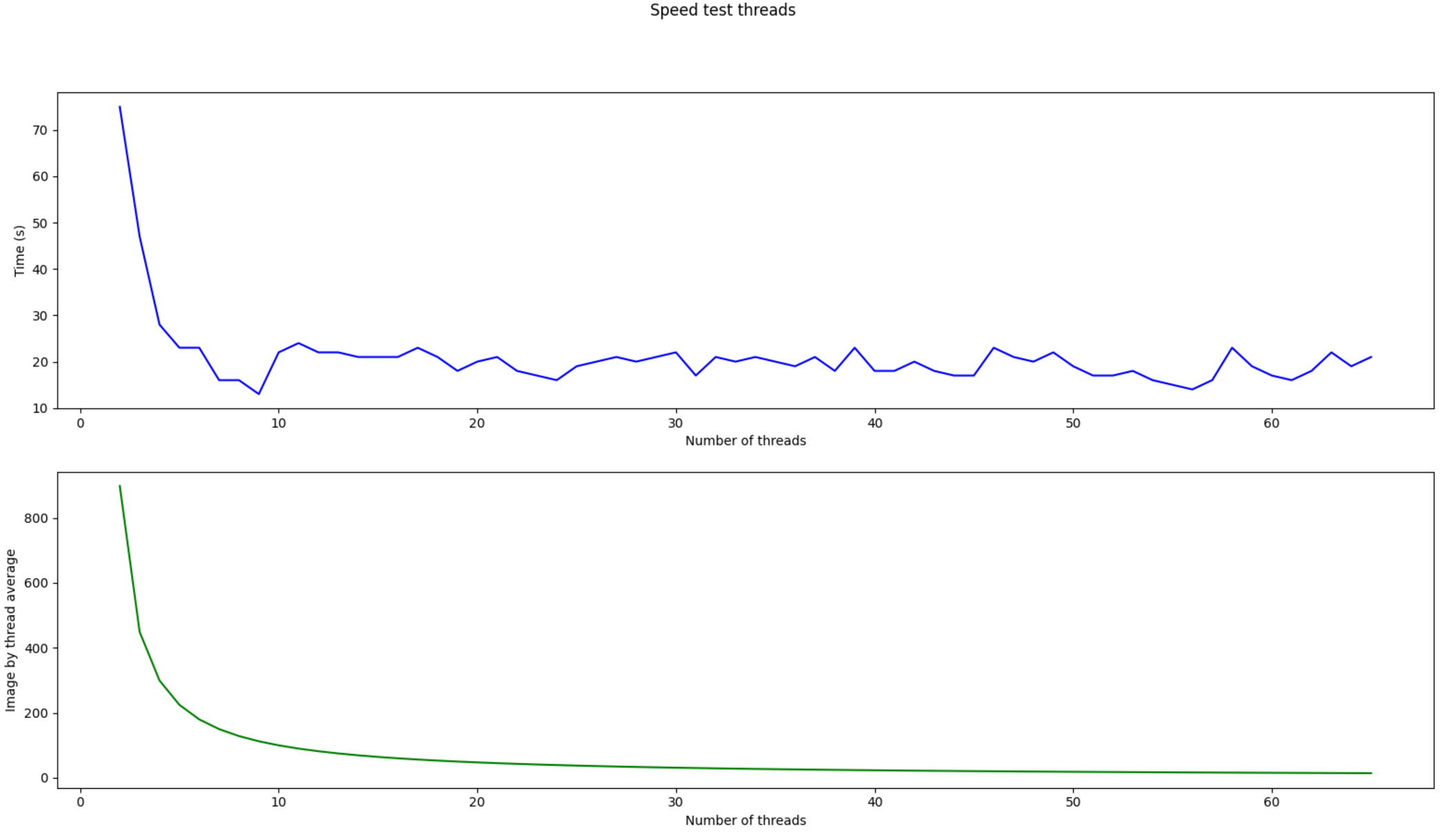


> I have use *matplotlib* to do this graph

For the threads, the time is always lower but from 8 there is no relevant improvement. This is due to the time to create the threads. Compared to the threads, the process is faster but we can quickly see that the performance decreases.

Conclusion

To summarize, we can save a lot of time with process and threads and the process are faster than threads but it's a big cost to create them. The last interrogation is, why 1 process is faster than 1 thread ?


Speed test threads
Time (s)
Number of threads
Image by thread average
Number of threads

Lab01 - Pokémon figure scraper

This is the second TP of the lesson "Concurrent system". In this exercise we need to test threads and process to download quickly 900 pictures of pokemon. The guideline is available here.

This project is made by @Simon.barras

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`python3 pokemon.py [start_id [stop_id [tp [nbr_tp [out_dir]]]]]`

argument	description	default value
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And here this is an example of the activity

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TP 1	-	-						-		
TP 2				-		-			-	
TP 3			-							-
TP 4					-		-			

Time ->

This version of the worker work well but if a process finish earlier as his *teammate* he can't help them. To fix this, I have think about an algorithm where thread ask about the next image to download. The effect is that the images are downloaded in order but the thread/process aren't downloading the same number of images. If we retake the previous example we can have something like this:

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global tp_result_
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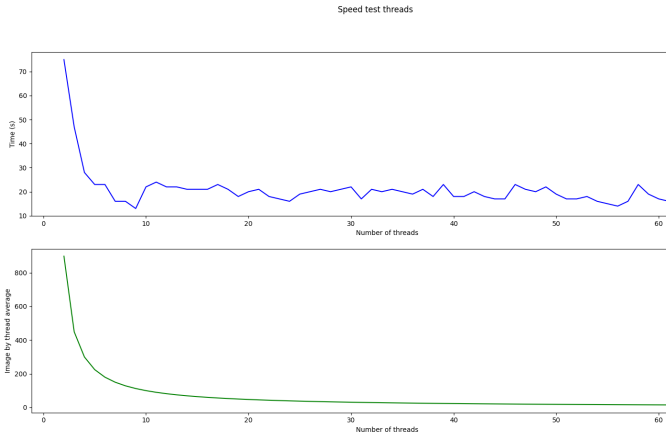
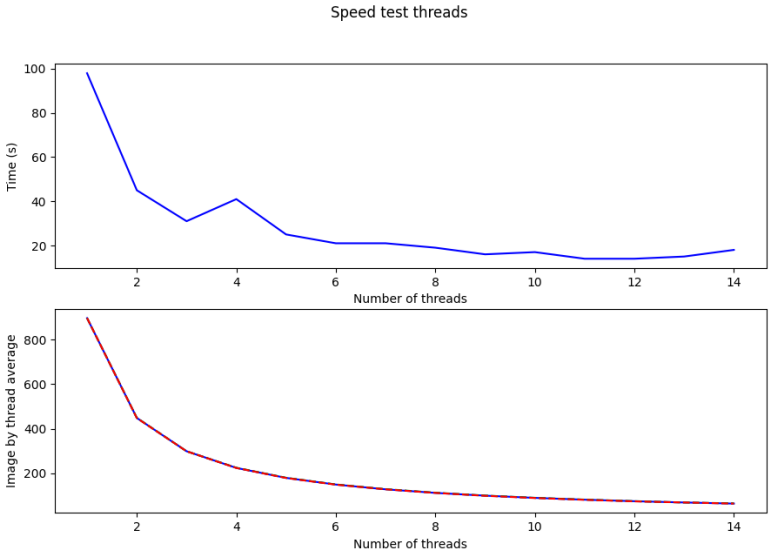


image. We can see this effect with this picture:
When there are to many threads, the time isn't stable.

Result

I have run experiment.py from my home and I have get this result:



> I have use *matplotlib* to do this graph

For the threads, the time is always lower but from 8 there is no relevant improvement. This is due to the time to create the threads. Compared to the threads, the process is faster but we can quickly see that the performance decreases.

Conclusion

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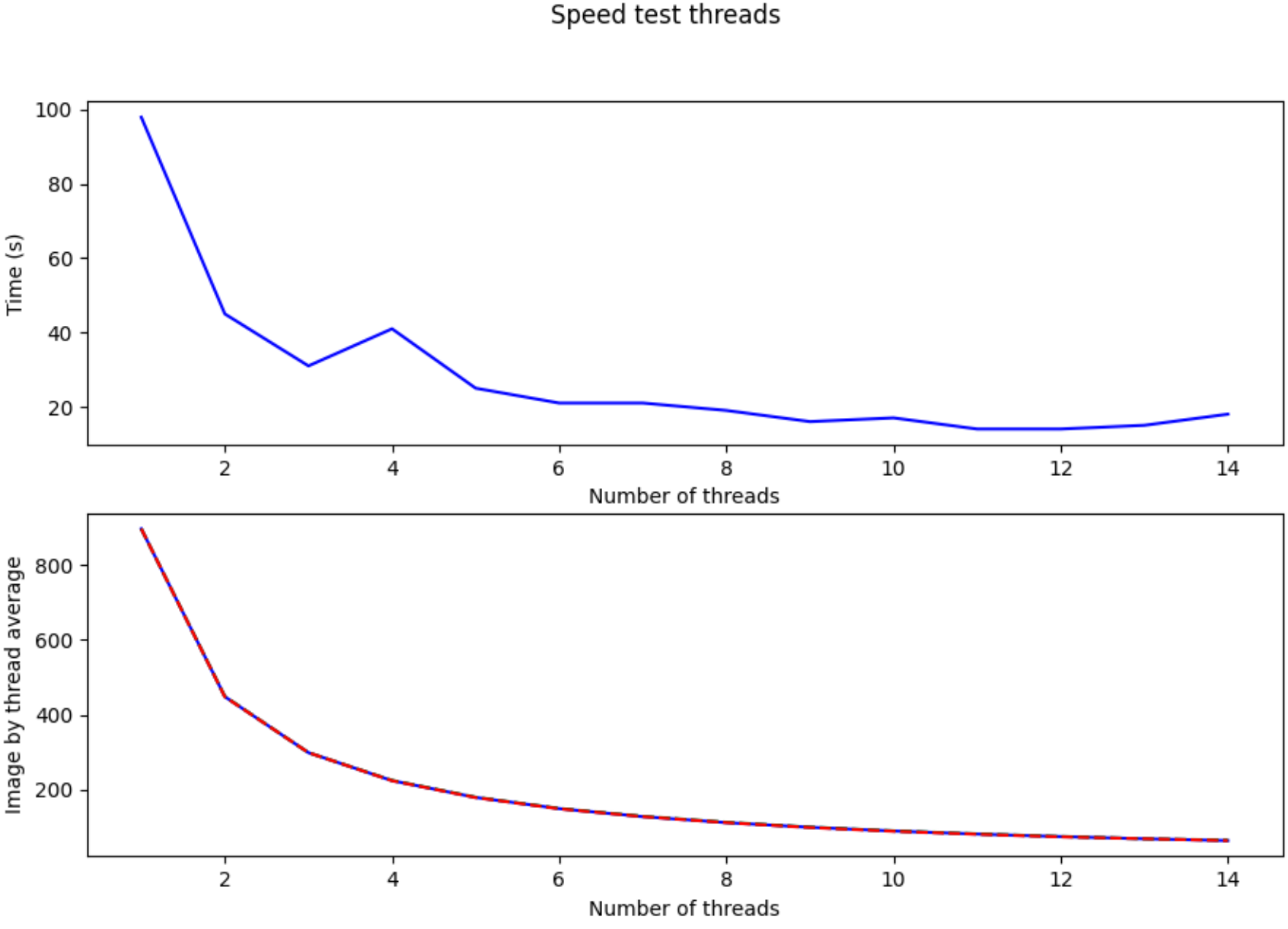
Speed test process
Time (s)
28
26
24
22
20
18
16
14
2
4
6
8
10
12
14
Number of process


Speed test threads
Time (s)
100
80
60
40
20
2
4
6
8
10
12
14
Number of threads
Image by thread average
800
600
400
200
2
4
6
8
10
12
14
Number of threads