NPB_statistics - Frederico

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1 NPB Statistics

1.1 Utils

1.1.1 Imports

[3]:

```
import sys
import argparse
import math
import numpy as np
from scipy.stats import t
import scipy.stats as stats
import csv
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker
```

[4]:

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

1.1.2 Global variables

[5]:

```
##Global variables
#VER_PYTHON_SERIAL="PYTHON-SERIAL"
#VER_CPP_SERIAL="CPP-SERIAL"
#VER_PYTHON_CUDA="PYTHON-CUDA"
#VER_CUDA="CPP-CUDA"
#VER_OPENACC="CPP-OPENACC"
VER_RTM_INTEL="RTM-INTEL"
VER_STM_TINY="STM-TINY"
VER_STM_SWISS="STM-SWISS"
VER_SEQ="SEQ"

#VERSIONS_SERIAL = [VER_PYTHON_SERIAL, VER_CPP_SERIAL]
#VERSIONS_GPU = [VER_PYTHON_CUDA, VER_CUDA, VER_OPENACC]
```

```
#VERSIONS = [VER_HTM_INTEL, VER_STM_TINY]
#VERSIONS = [VER_RTM_INTEL, VER_SEQ]
VERSIONS = []
fullVerList = [VER_RTM_INTEL, VER_STM_TINY, VER_STM_SWISS, VER_SEQ]

#----Talvez trocar os nomes pra só "Lo" e "Hi" pra parar de ficar torto as␣
 ↪tabelas----
##CLASSES = ["B", "C"]
#CLASSES = ["LoContention", "HiContention"]
CLASSES = []
fullClssList = ["LoContention", "HiContention"]

##BENCHS = ["BT", "CG", "EP", "FT", "IS", "LU", "MG", "SP"]
#BENCHS = ["bayes", "genome", "intruder", "kmeans", "labyrinth", "ssca2",␣
 ↪"vacation", "yada"]
#BENCHS = ["bayes", "genome", "kmeans", "labyrinth", "intruder", "yada"]
BENCHS = []
fullBnchList = ["bayes", "genome", "intruder", "kmeans", "labyrinth", "ssca2",␣
 ↪"vacation", "yada"]

#Para facilmente poder remover algum, listar os que devem ser ignorados da␣
 ↪lista criada com base no arquivo
#ignoreVer = [VER_RTM_INTEL, VER_STM_TINY]
#ignoreClss = ["LoContention"]
#ignoreBnch = ["bayes", "genome", "kmeans", "labyrinth", "ssca2", "vacation"]
ignoreVer = []
ignoreClss = []
ignoreBnch = []

fileName = "/content/drive/MyDrive/Colab Notebooks/Arquivos/tratado"
with open(fileName) as f:
  file = f.read()
  if(("RTM-INTEL" in file) and not("RTM-INTEL" in ignoreVer)):
    VERSIONS.append(VER_RTM_INTEL)
  if(("STM-TINY" in file) and not("STM-TINY" in ignoreVer)):
    VERSIONS.append(VER_STM_TINY)
  if(("STM-SWISS" in file) and not("STM-SWISS" in ignoreVer)):
    VERSIONS.append(VER_STM_SWISS)
  if(("SEQ" in file) and not("SEQ" in ignoreVer)):
    VERSIONS.append(VER_SEQ)

  for clss in fullClssList:
    if((clss in file) and not(clss in ignoreClss)):
      CLASSES.append(clss)
  for Bnch in fullBnchList:
    if((Bnch in file) and not(Bnch in ignoreBnch)):
      BENCHS.append(Bnch)
```

```
dic_dados = {}
dic_dados_bench = {}
g_bench = ""
```

1.1.3 Statistical methods

[6]:

```
# CSV
def le_csv_desempenho(arquivos, prefixo, array_dados):
        if len(arquivos) < 1:
                return
        for a in arquivos:
                with open(a) as f:
                        reader = csv.reader(f, delimiter=';', quoting=csv.
 ↪QUOTE_NONE)
                        filtro = list(filter(lambda x: len(x) > 0 and x[0] ==␣
 ↪prefixo, reader))

                        for linha in filtro:
                                array_dados.append(linha[1:])
#END

def split(dado):
        aux = dado.split("=")
        if len(aux) == 2:
                return aux[1]
        return dado
#END

# DICTIONARY
def name_versao(versao):
        if "RTM" in versao:
                if "INTEL" in versao:
                        return "RTM"
                elif "IBM" in versao:
                        return "IBM"
        elif "STM" in versao:
                if "TINY" in versao:
                        return "TinySTM"
                elif "SWISS" in versao:
                        return "SwissTM"
        elif "SEQ" in versao:
                return "Sequential"

        #if "PYTHON" in versao:
        #         if "SERIAL" in versao:
```

```
        #                return "Python"
        #        elif "CUDA" in versao:
        #                return "Numba"
        #elif "OPENACC" in versao:
        #        return "OpenACC"
        #elif "CPP" in versao:
        #        if "SERIAL" in versao:
        #                return "C++"
        #        elif "CUDA" in versao:
        #                return "Cuda"

        return ""
 #END

def idx_dicionario(versao, classe):
        return versao + "_$$_" + classe

##Classe, size e gpus acho que não é necessário
def add_dicionario(dic, idx, desc, classe, size, iteraction, cpus, gpus, times):
        dic[idx] = {}
        dic[idx]["desc"] = desc
        dic[idx]["class"] = classe
        dic[idx]["size"] = size
        dic[idx]["iteraction"] = iteraction
        dic[idx]["cpus"] = cpus
        dic[idx]["gpus"] = gpus
        dic[idx]["times"] = times
#END

#Statiscs
def calc_stats(amostra):
        # confidence interval of 95%
        tdist = t.ppf(0.95, len(amostra)-1)
        mean = np.mean(amostra)
        std = np.std(amostra)
        error = tdist*(std/math.sqrt(len(amostra)))
        return mean, std, error

def report_df(data):
        mean, std, error = calc_stats(data)
        data_sort = sorted(data)
        sz = len(data)

        ks_stat, ks_p, ks_p_ok = ks_gaussian_test(data)
        sw_stat, sw_p, sw_p_ok = shapiro_wilk_gaussian_test(data)

        print("%12s %15.8f" %("count", sz))
        print("%12s %15.8f" %("mean", mean))
        print("%12s %15.8f" %("std", std))
        print("%12s %15.8f" %("error (95%)", error))
        print("%12s %15.8f" %("min", min(data)))
        print("%12s %15.8f" %("25%", max(data_sort[: (int(sz*0.25) if int(sz*0.
 ↪25) > 1 else 1)]) ) )
        print("%12s %15.8f" %("50%", max(data_sort[:int(sz*0.50)]) ) )
        print("%12s %15.8f" %("75%", max(data_sort[:int(sz*0.75)]) ) )
        print("%12s %15.8f" %("max", max(data)))
        print("%12s %15.8f" %("KS stat", ks_stat))
        print("%12s %15.8f" %("KS p", ks_p))
        print("%12s %15s" %( ("KS p>0.05", "Sample OK" if ks_p_ok else "Sample␣
 ↪Bad") ))
        print("%12s %15.8f" %("SW stat", sw_stat))
        print("%12s %15.8f" %("SW p", sw_p))
        print("%12s %15s" %( ("SW p>0.05", "Sample OK" if sw_p_ok else "Sample␣
 ↪Bad") ))
#END

def report_df_all(dic):
        column_0 = ["count", "mean", "std", "error (95%)", "min", "25%", "50%",␣
 ↪"75%", "max",
                                "KS stat", "KS p", "KS p>0.05", "SW stat", "SW␣
 ↪p", "SW p>0.05"]

        rows = []
        rows.append([])
        i = 0
        for c in column_0:
                rows[i].append("%12s" % (c))
                rows.append([])
                i += 1

        header = []
        header.append("%12s" % (""))
        for idx, dados in dic.items():
                header.append("%15s" % (dados["desc"] + " - " + dados["class"]))

                data = dados["times"]
                mean, std, error = calc_stats(data)
                data_sort = sorted(data)
                sz = len(data)

                ks_stat, ks_p, ks_p_ok = ks_gaussian_test(data)
                sw_stat, sw_p, sw_p_ok = shapiro_wilk_gaussian_test(data)

                rows[0].append("%15.8f" %(sz))
                rows[1].append("%15.8f" %(mean))
                rows[2].append("%15.8f" %(std))
                rows[3].append("%15.8f" %(error))
                rows[4].append("%15.8f" %(min(data)))
                rows[5].append("%15.8f" %(max(data_sort[: (int(sz*0.25) if int(sz*0.25) > 1 else 1)])))
                rows[6].append("%15.8f" %(max(data_sort[:int(sz*0.50)])))
                rows[7].append("%15.8f" %(max(data_sort[:int(sz*0.75)])))
                rows[8].append("%15.8f" %(max(data)))
                rows[9].append("%15.8f" %(ks_stat))
                rows[10].append("%15.8f" %(ks_p))
                rows[11].append("%15s" %( ("Sample OK" if ks_p_ok else "Sample Bad") ))
                rows[12].append("%15.8f" %(sw_stat))
                rows[13].append("%15.8f" %(sw_p))
                rows[14].append("%15s" %( ("Sample OK" if sw_p_ok else "Sample Bad") ))

        for i in range(len(column_0)):
                if i == 0:
                        print(header[0], end="")
                        j = 1
                        for idx in dic.items():
                                print(header[j], end="")
                                j += 1
                        print()

                j = 0
                for idx, dados in dic.items():
                        if j == 0:
                                print(rows[i][j], end="")
                                j += 1

                        print(rows[i][j], end="")
                        j += 1
                print()
#END


def ks_gaussian_test(data):
        loc, scale = stats.norm.fit(data)
        n = stats.norm(loc=loc, scale=scale)

        stat, p = stats.kstest(data, n.cdf)

        alpha = 0.05
        return stat, p, (p > alpha)
```

```
#END

def ks_gaussian_teste_chart(data):
        loc, scale = stats.norm.fit(data)
        n = stats.norm(loc=loc, scale=scale)

        plt.hist(data, rwidth=0.5)
        #x = numpy.arange(min(data), max(data) + 0.2, 0.02)
        #plt.plot(x, data.mean()*n.pdf(x))
        plt.title('Comparação Entre Histograma e Projeção da Distribuição Normal')
        plt.title('Histograma da Distribuição')
        plt.xlabel('Tempo de Execução')
        plt.ylabel('Número de Ocorrências')

        plt.show()

        stat, p = stats.kstest(data, n.cdf)
        print('Statistics=%.5f, p=%.5f' % (stat, p))

        alpha = 0.05
        if p > alpha:
                print('Sample looks Gaussian (fail to reject H0)')
        else:
                print('Sample does not look Gaussian (reject H0)')
#END

def shapiro_wilk_gaussian_test(data):
        stat, p = stats.shapiro(data)

        alpha = 0.05
        return stat, p, (p > alpha)
#END

# generate boxplot containing all columns from two dataframes (side by side comparison)
def boxplot_chart(data, version):
        data_set = [data]
        fig, ax = plt.subplots()

        #Plot boxplot
        bp = ax.boxplot(data_set, widths=0.25, patch_artist = True)

        # changing color and linewidth of whiskers
        for whisker in bp['whiskers']:
                whisker.set(color ='#8B008B', linewidth = 1.5, linestyle =":")
        # changing color and linewidth of caps
        for cap in bp['caps']:
                cap.set(color ='#8B008B', linewidth = 2)

        # changing color and linewidth of medians
        for median in bp['medians']:
                median.set(color ='red', linewidth = 3)

        # changing style of fliers
        for flier in bp['fliers']:
                flier.set(marker ='D', color ='#e7298a', alpha = 0.5)

        # changing color
        colors = ['#0000FF', '#00FF00', '#FFFF00', '#FF00FF'] #Support for 4␣
 ↪series
        for patch, color in zip(bp['boxes'], colors):
                patch.set_facecolor(color)

        plt.xticks([1], [version])
        plt.ylabel('Execution time (s)')

        fig.tight_layout()
        plt.show()
#END


# apply student t test comparing two statistics
# Null Hypothesis (H0): μa = μb (the means of both populations are equal)
# Alternate Hypothesis (Ha): μa   μb (the means of both populations are not␣
 ↪equal)
def student_t_test(pop_a, pop_b):
        t_stat, p_value = stats.ttest_ind(pop_a, pop_b, equal_var=False)
        return t_stat, p_value, (p_value <= 0.05)
#END

def student_t_test_report(pop_a, pop_b):
        t_stat, p_value, p_value_ok = student_t_test(pop_a, pop_b)

        print("P-Value={0} T-Statistic={1}".format(p_value, t_stat))

        #if p_value <= 0.05:
        if p_value_ok:
                print('The mean of the samples is different (reject H0)')
        else:
                print('The mean of the samples is equal (fail to reject H0)')
#END
```

```
def mann_whitney_u_test(pop_a, pop_b):
        t_stat, p_value = stats.mannwhitneyu(pop_a, pop_b,␣
 ↪use_continuity=False, alternative='two-sided')
        return t_stat, p_value, (p_value <= 0.05)
#END

def mann_whitney_u_test_report(pop_a, pop_b):
        t_stat, p_value, p_value_ok = mann_whitney_u_test(pop_a, pop_b)

        print("P-Value={0} T-Statistic={1}".format(p_value,t_stat))

        #if p_value <= 0.05:
        if p_value_ok:
                print('The mean of the samples is different (reject H0)')
        else:
                print('The mean of the samples is equal (fail to reject H0)')
#END

def t_u_tests_report_all(dic, versions): #Versions is a matrix [[v1, v2], [v2,␣
 ↪v3]...]
        column_0 = ["KS OK?", "T-Test p", "T-Test stat", "T-Test p<=0.05",
                                                "U-Test p", "U-Test stat",␣
 ↪"U-Test p<=0.05"]

        rows = []
        rows.append([])
        i = 0
        for c in column_0:
                rows[i].append("%15s" % (c))
                rows.append([])
                i += 1

        header = []
        header.append("%15s" % (""))
        for v in versions:
                dic_a = dic[v[0]]
                pop_a = dic_a["times"]

                dic_b = dic[v[1]]
                pop_b = dic_b["times"]

                head = "(" + dic_a["desc"] + "[" + dic_a["class"] + "]) x (" +␣
 ↪dic_b["desc"] + "[" + dic_b["class"] + "])"
                header.append("%27s" % (head))


                a_ks_stat, a_ks_p, a_ks_p_ok = ks_gaussian_test(pop_a)
                b_ks_stat, b_ks_p, b_ks_p_ok = ks_gaussian_test(pop_b)
                ks_ok = (a_ks_p_ok and b_ks_p_ok)

                t_stat, t_p_value, t_p_value_ok = student_t_test(pop_a, pop_b)

                u_stat, u_p_value, u_p_value_ok = mann_whitney_u_test(pop_a,␣
↪pop_b)

                rows[0].append("%27s" % ( ("Yes" if ks_ok else "No") ))
                rows[1].append("%27.12e" % (t_p_value))
                rows[2].append("%27.8f" % (t_stat))
                t_test_app = ("T-Test OK" if t_p_value_ok else "T-Test Failed")␣
↪if ks_ok else "Not normally distrib."
                rows[3].append("%27s" % ( t_test_app ))
                rows[4].append("%27.12e" % (u_p_value))
                rows[5].append("%27.8f" % (u_stat))
                rows[6].append("%27s" % ( ("U-Test OK" if u_p_value_ok else␣
↪"U-Test Failed") ))

        for i in range(len(column_0)):
                if i == 0:
                        print(header[0], end="")
                        for j in range(1, len(versions)+1):
                                print(header[j], end="")
                        print()

                for j in range(0, len(versions)+1):
                        print(rows[i][j], end="")

                print()
#END
```

1.1.4 Load dictionary

[7]:

```
def load_data_dictionary(bench):
    global g_bench
    g_bench = bench

    # Load dictionary
    dados = [] # array das linhas

    #le_csv_desempenho(["sample_data/exec_20220224_BT.txt", "sample_data/
↪exec_20210924_EP.txt",
    #                   "sample_data/exec_20210929_CG.txt", "sample_data/
↪exec_20210930_FT.txt",
    #                    "sample_data/exec_20211001_MG.txt", "sample_data/
↪exec_20220227_LU.txt",
    #                    "sample_data/exec_20211001_IS.txt", "sample_data/
↪exec_20220226_SP.txt"], "BENCH=" + bench, dados)
    #le_csv_desempenho(["/content/sample_data/exec_20210924_EP.txt"], "BENCH="␣
↪+ bench, dados)
    #le_csv_desempenho(["/content/sample_data/tratado"], "BENCH=" + bench,␣
↪dados)

    le_csv_desempenho(["/content/drive/MyDrive/Colab Notebooks/Arquivos/
↪tratado"], "BENCH=" + bench, dados)

    bench_process_data(dados, bench)
```

1.1.5 Benchmark Methods

[8]:

```
def bench_time_chart():
        times = []
        class_ids = range(1, len(CLASSES)+2, 2)

        max_time = 0
        #for v in VERSIONS_GPU:
        for v in VERSIONS:
                #if g_bench == "IS" and "OPENACC" in v:
                #         continue

                v_time = []

                time, a, b = calc_stats(dic_dados[idx_dicionario(v,␣
↪"LoContention")]["times"])
                v_time.append(time)
                max_time = max(time, max_time)

                if "HiContention" in CLASSES:
                        time, a, b = calc_stats(dic_dados[idx_dicionario(v,␣
↪"HiContention")]["times"])
                        v_time.append(time)
                        max_time = max(time, max_time)

                times.append(v_time)

        #Chart
        #desenha as barras no gráfico
        fig, ax = plt.subplots()
        bars = []
        idx = -0.3
        for t in times:
                bar = ax.bar(np.array(class_ids)+idx, np.array(t), width=0.25)
                bars.append(bar)
                idx += 0.3

        ax.set_xlabel('Classes')
        ax.set_ylabel('Execution time (s)')
        ax.set_xlim(0, 4)
        ax.set_ylim(0, math.ceil(max_time))

        #ax.title('Execution time')
        ax.legend(tuple(map(name_versao, VERSIONS)))

        ax.set_xticks(class_ids)
        ax.set_xticklabels(CLASSES)

        #for b in bars:
        #        ax.bar_label(b, padding=3, fmt='%5.3f')

        fig.tight_layout()

        plt.show() #mostra o gráfico
#END

def bench_speedup_chart(version_serial, versions_gpu):
        speedups = []
        class_ids = range(1, len(CLASSES)+1)

        #time_serial_B, a, b =␣
 ↪calc_stats(dic_dados[idx_dicionario(version_serial, "B")]["times"])
        #time_serial_C, a, b =␣
 ↪calc_stats(dic_dados[idx_dicionario(version_serial, "C")]["times"])
        if "LoContention" in CLASSES:
                time_serial_Lo, a, b =␣
 ↪calc_stats(dic_dados[idx_dicionario(version_serial,␣
 ↪"LoContention")]["times"])
        if "HiContention" in CLASSES:
                time_serial_Hi, a, b =␣
 ↪calc_stats(dic_dados[idx_dicionario(version_serial,␣
 ↪"HiContention")]["times"])

        max_speedup = 0
        for v in versions_gpu:
                v_speedup = []
                if "LoContention" in CLASSES:
                        time, a, b = calc_stats(dic_dados[idx_dicionario(v,␣
↪"LoContention")]["times"])
                        speedup = time_serial_Lo/time
                        v_speedup.append(speedup)
                        max_speedup = max(speedup, max_speedup)

                if "HiContention" in CLASSES:
                        time, a, b = calc_stats(dic_dados[idx_dicionario(v,␣
↪"HiContention")]["times"])
                        speedup = time_serial_Hi/time
                        v_speedup.append(speedup)
                        max_speedup = max(speedup, max_speedup)

                speedups.append(v_speedup)

        #Chart
        #desenha as barras no gráfico
        fig, ax = plt.subplots()

        bars = []
        idx = 0.15 if len(speedups) > 1 else 0.0
        value = idx * -1
        for s in speedups:
                bar = ax.bar(np.array(class_ids)+value, np.array(s), width=0.25)
                bars.append(bar)
                value *= -1

        ax.set_xlabel('Classes')
        ax.set_ylabel('Speedup')
        ax.set_xlim(0, 3)
        ax.set_ylim(0, math.ceil(max_speedup*1.1))

        #ax.title('Speedup')
        ax.legend(tuple(map(name_versao, versions_gpu)))

        ax.set_xticks(class_ids)
        ax.set_xticklabels(CLASSES)

        #for b in bars:
        #        ax.bar_label(b, padding=3)

        fig.tight_layout()

        plt.show() #mostra o gráfico
#END
```

```
def bench_report_t_u_tests(classe):
        versoes_comp = []

        #versoes_comp.append([idx_dicionario(VER_PYTHON_SERIAL, classe),␣
 ↪idx_dicionario(VER_PYTHON_CUDA, classe)])
        #versoes_comp.append([idx_dicionario(VER_RTM_INTEL, classe),␣
 ↪idx_dicionario(VER_SEQ, classe)])

        #versoes_comp.append([idx_dicionario(VER_RTM_INTEL, classe),␣
 ↪idx_dicionario(VER_STM_TINY, classe)])
        versoes_comp.append([idx_dicionario(VERSIONS[0], classe),␣
 ↪idx_dicionario(VERSIONS[1], classe)])
        #for v in VERSIONS:
        #        versoes_comp.append(idx_dicionario(v, classe))

        #versoes_comp.append([idx_dicionario(VER_CPP_SERIAL, classe),␣
 ↪idx_dicionario(VER_CUDA, classe)])
        #if g_bench != "IS":
        #        versoes_comp.append([idx_dicionario(VER_CPP_SERIAL, classe),␣
 ↪idx_dicionario(VER_OPENACC, classe)])
        #        versoes_comp.append([idx_dicionario(VER_CUDA, classe),␣
 ↪idx_dicionario(VER_OPENACC, classe)])
        #versoes_comp.append([idx_dicionario(VER_PYTHON_CUDA, classe),␣
 ↪idx_dicionario(VER_CUDA, classe)])
        #if g_bench != "IS":
        #        versoes_comp.append([idx_dicionario(VER_PYTHON_CUDA, classe),␣
 ↪idx_dicionario(VER_OPENACC, classe)])

        #print(versoes_comp)
        #print(dic_dados)
        t_u_tests_report_all(dic_dados, versoes_comp)
#END

def bench_calc_stats(dados, versao, classe, threads=0, gpus=0):
        global dic_dados

        idx_versao = 0
        idx_classe = 1
        idx_size = 2
        idx_iter = 3
        idx_threads = 4
        idx_gpus = 5
        idx_time = 6
        linhas = list(filter(lambda x: versao in split(x[idx_versao]) and␣
 ↪classe in split(x[idx_classe]), dados))
```

```
        if len(linhas) > 0:
                times = [float(split(l[idx_time])) for l in linhas]
                add_dicionario(dic_dados, idx_dicionario(versao, classe),␣
 ↪name_versao(versao), classe,
#                               split(linhas[0][idx_size]),␣
 ↪split(linhas[0][idx_iter]), threads, gpus, times)
                               split(linhas[0][idx_size]),␣
 ↪split(linhas[0][idx_iter]), split(linhas[0][idx_threads]), gpus, times)
#END

def bench_process_data(dados, bench):
        print("Gerando", bench, "...")

        for c in CLASSES:
                for v in VERSIONS:
                        bench_calc_stats(dados, v, c, 1, 0)

                #for v in VERSIONS_GPU:
                #        if bench == "IS" and "OPENACC" in v:
                #                continue
                #        bench_calc_stats(dados, v, c, 0, 1)

        print(bench, "OK")
#END

def bench_apply_ks_tests(classe):
        for idx, value in dic_dados.items():
                if value["class"] == classe:
                        print('----------', value["desc"], "-", value["class"],␣
 ↪'----------')
                        ks_gaussian_teste_chart(value["times"])
                        print()
#END

def bench_apply_boxplots(classe):
        for idx, value in dic_dados.items():
                if value["class"] == classe:
                        print('----------', value["desc"], "-", value["class"],␣
 ↪'----------')
                        boxplot_chart(value["times"], value["desc"] + " - " +␣
 ↪value["class"])
                        print()
#END
```

1.2 Main Benchmark

[9]:
```
##Parameter: BT | CG | EP | FT | IS | LU | MG | SP
##load_data_dictionary("EP")

for b in BENCHS:
  load_data_dictionary(b)
```

```
Gerando bayes …
bayes OK
Gerando genome …
genome OK
Gerando intruder …
intruder OK
Gerando kmeans …
kmeans OK
Gerando labyrinth …
labyrinth OK
Gerando ssca2 …
ssca2 OK
Gerando vacation …
vacation OK
Gerando yada …
yada OK
```

1.2.1 Report DF

[10]:
```
report_df_all(dic_dados)
```

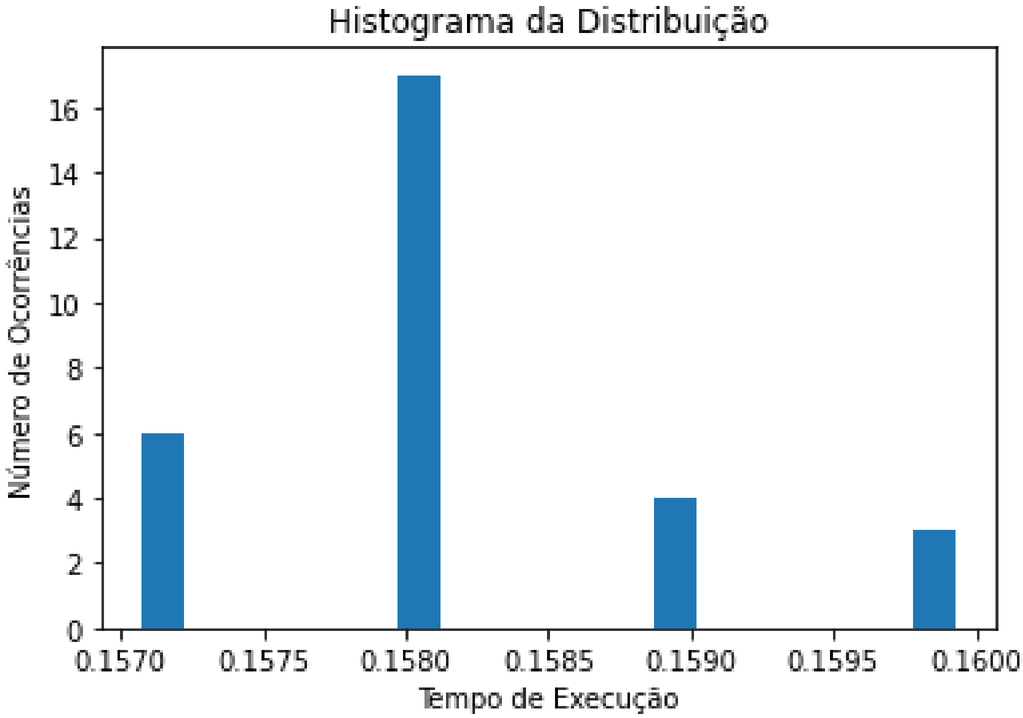
```
            RTM - LoContentionTinySTM - LoContentionRTM - HiContentionTinySTM -
HiContention
       count    30.00000000    30.00000000    30.00000000    30.00000000
        mean     0.15813333     0.09640000     8.06883460    17.55868447
         std     0.00084591     0.00055377     0.07509578     0.12975196
 error (95%)     0.00026241     0.00017179     0.02329597     0.04025123
         min     0.15700000     0.09600000     7.97327700    17.38628100
         25%     0.15800000     0.09600000     8.01037900    17.44124400
         50%     0.15800000     0.09600000     8.02558100    17.52216600
         75%     0.15800000     0.09700000     8.10682000    17.60505800
         max     0.16000000     0.09800000     8.21485600    17.82436600
     KS stat     0.32928937     0.39828295     0.21768535     0.19473709
        KS p     0.00212453     0.00008335     0.09966094     0.17978156
   KS p>0.05     Sample Bad     Sample Bad      Sample OK      Sample OK
     SW stat     0.81561947     0.66927099     0.85799658     0.89850789
        SW p     0.00012799     0.00000057     0.00091592     0.00772318
   SW p>0.05     Sample Bad     Sample Bad     Sample Bad     Sample Bad
```

1.2.2 KS Test

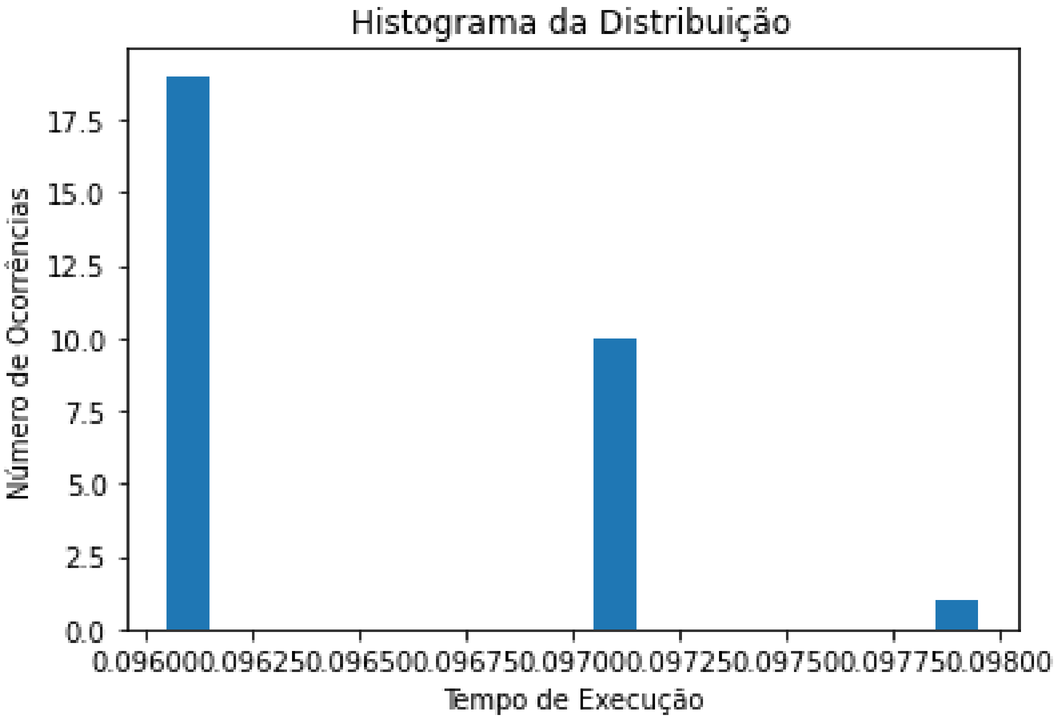
Low Contention

```
[11]: #bench_apply_ks_tests("B")
      bench_apply_ks_tests("LoContention")
```

```
---------- RTM - LoContention ----------
```



```
Statistics=0.32929, p=0.00212
Sample does not look Gaussian (reject H0)

---------- TinySTM - LoContention ----------
```



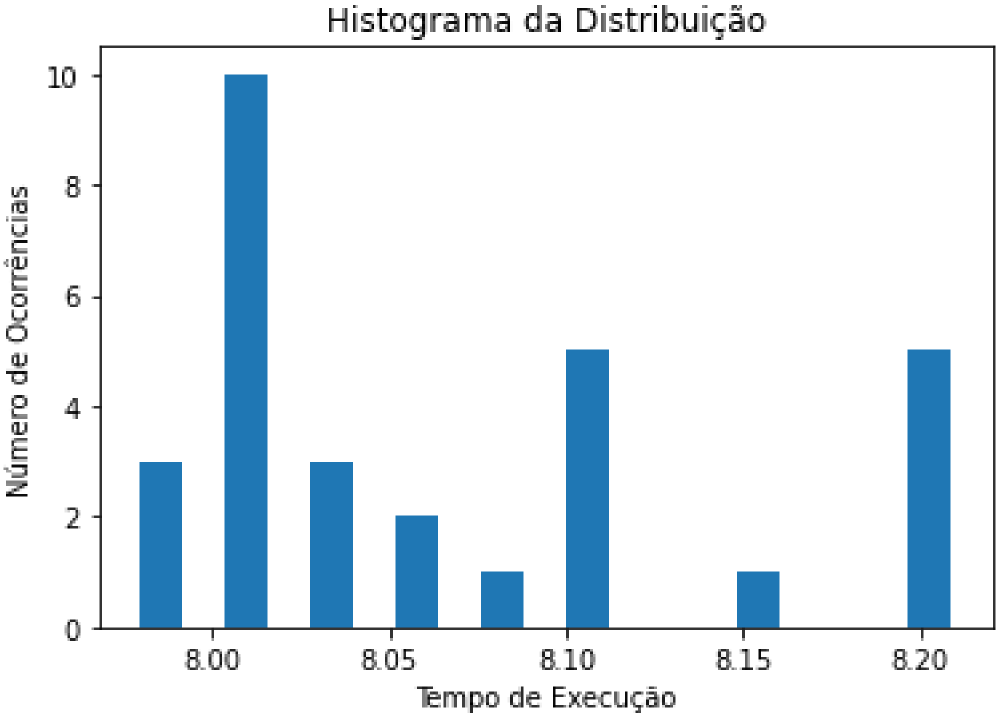
```
Statistics=0.39828, p=0.00008
Sample does not look Gaussian (reject H0)
```

High Contention

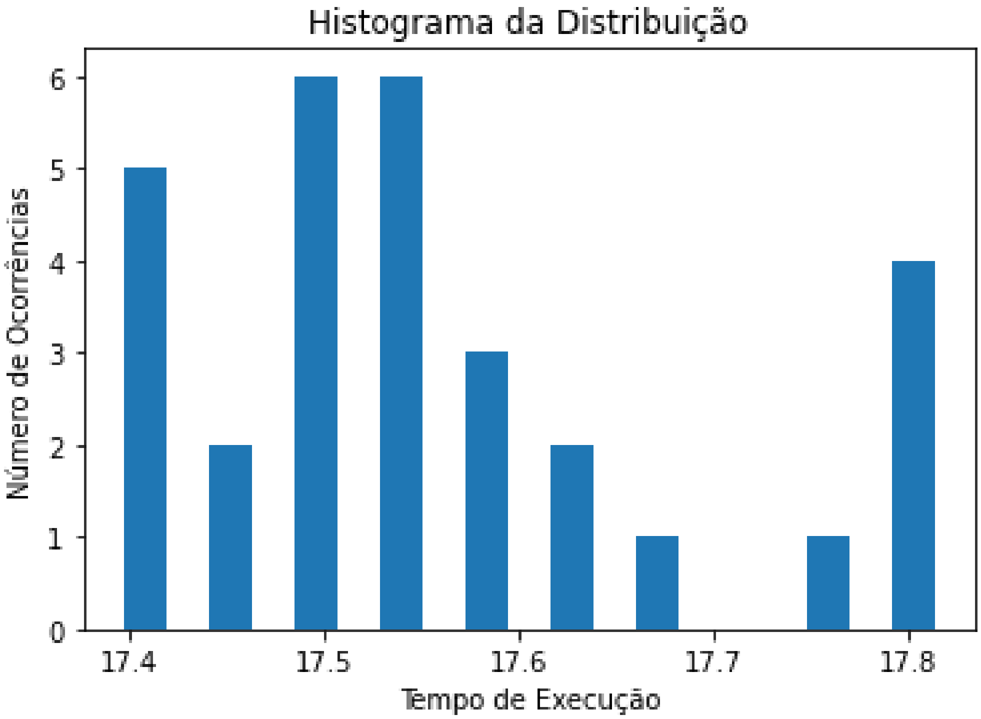
[12]:

```
##bench_apply_ks_tests("C")
bench_apply_ks_tests("HiContention")
```

```
---------- RTM - HiContention ----------
```



```
Statistics=0.21769, p=0.09966
Sample looks Gaussian (fail to reject H0)

---------- TinySTM - HiContention ----------
```



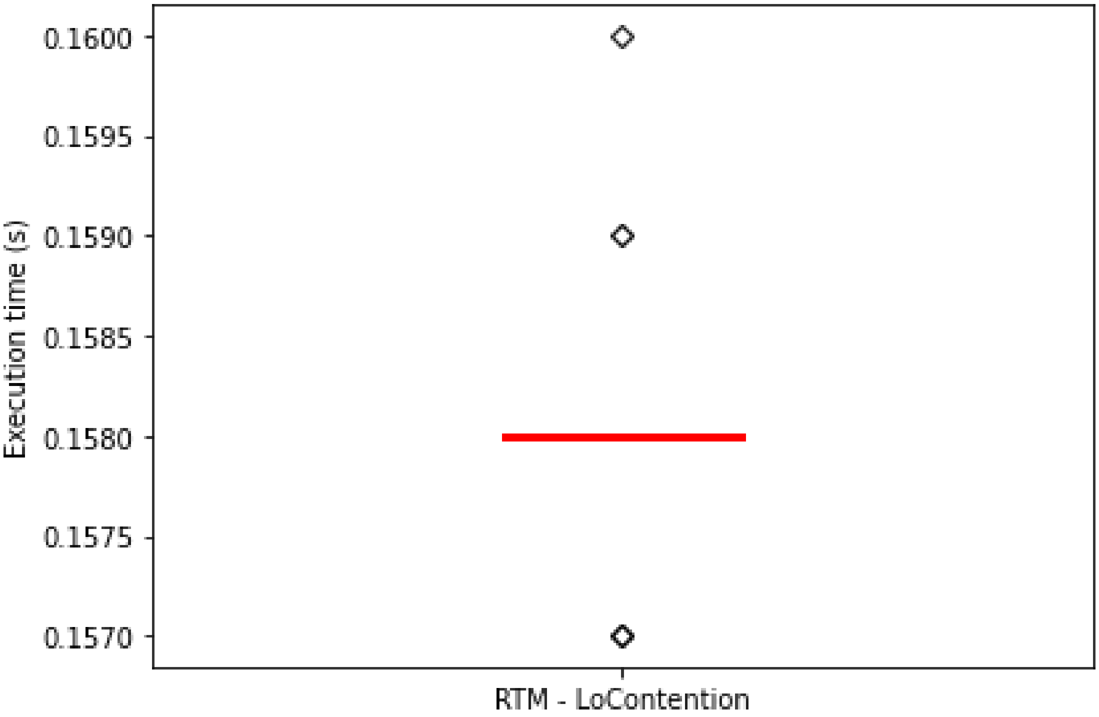
```
Statistics=0.19474, p=0.17978
Sample looks Gaussian (fail to reject H0)
```

1.2.3 Boxplots

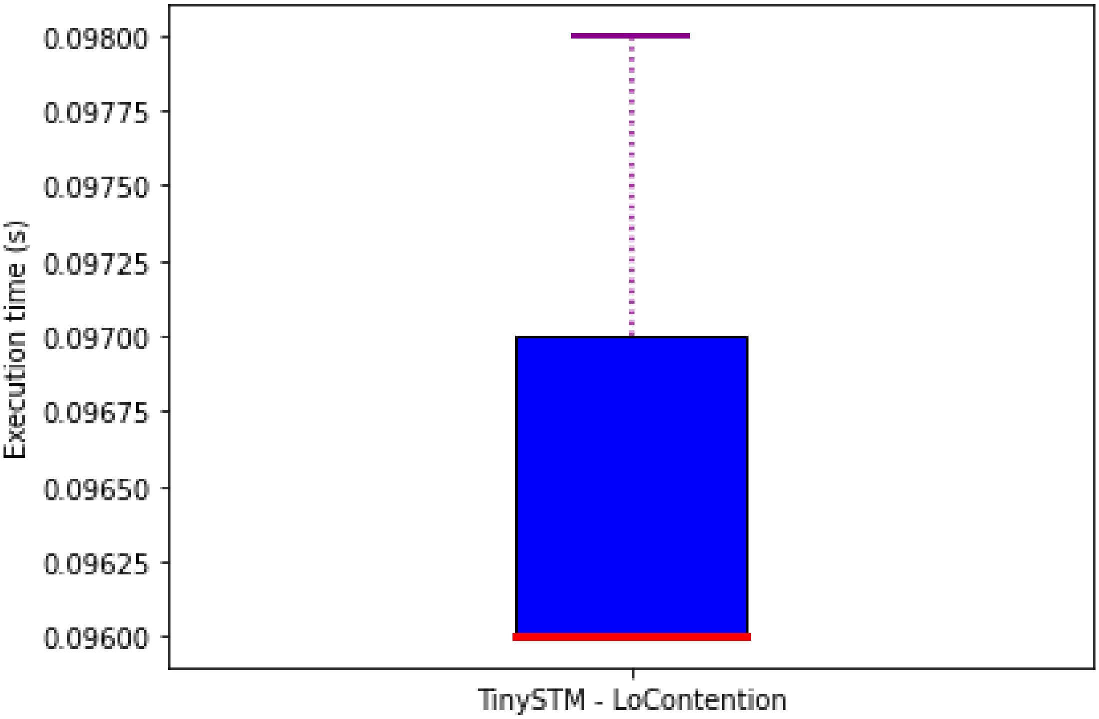
Low Contention

[13]:
```
#bench_apply_boxplots("B")
bench_apply_boxplots("LoContention")
```

```
---------- RTM - LoContention ----------
```



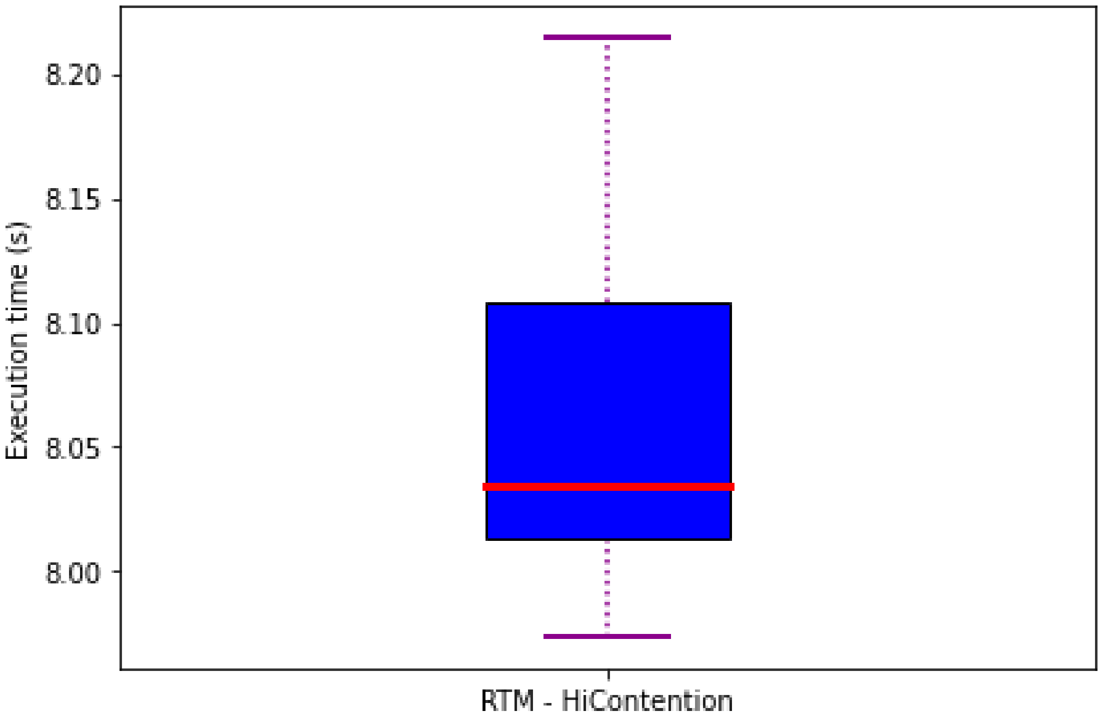
```
---------- TinySTM - LoContention ----------
```



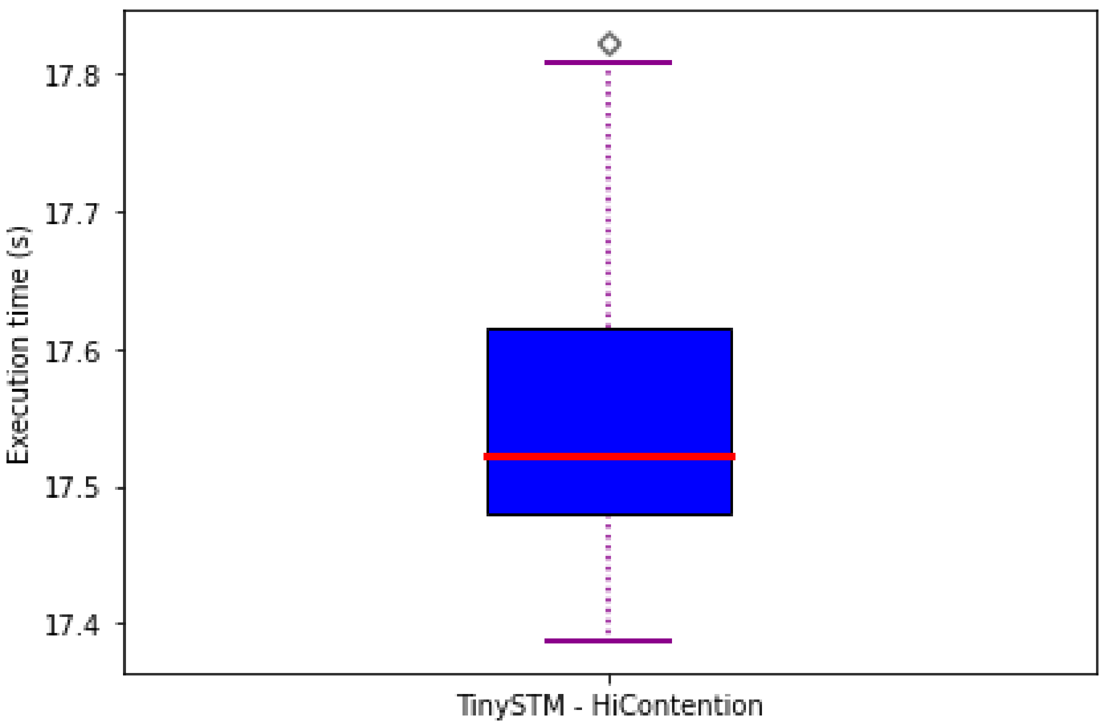
High Contention

```
[14]: ##bench_apply_boxplots("C")
      bench_apply_boxplots("HiContention")
```

```
---------- RTM - HiContention ----------
```



```
---------- TinySTM - HiContention ----------
```



1.2.4 T-Test and U-Test

Low Contention

```
[15]: #bench_report_t_u_tests("B")
      if("LoContention" in CLASSES):
        bench_report_t_u_tests("LoContention")
```

```
               (RTM[LoContention]) x (TinySTM[LoContention])
        KS OK?                              No
      T-Test p            4.702264111288e-85
   T-Test stat                  328.81079534
T-Test p<=0.05          Not normally distrib.
      U-Test p            6.737635900891e-12
   U-Test stat                  900.00000000
U-Test p<=0.05                     U-Test OK
```

High Contention

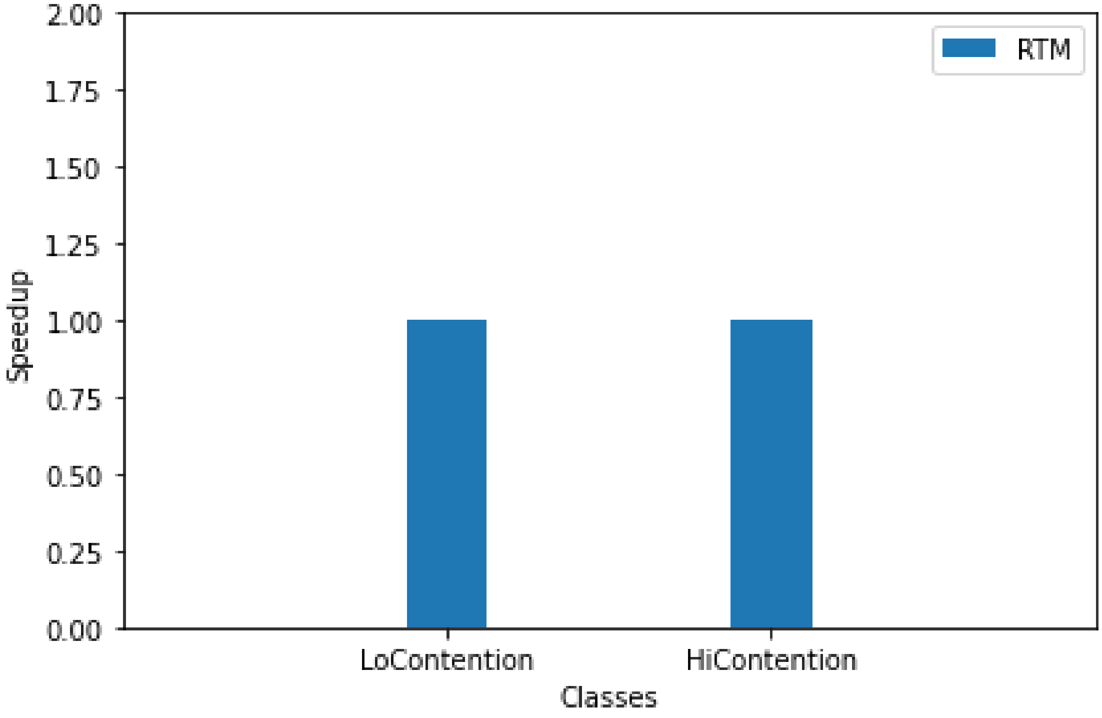
```
[16]: ##bench_report_t_u_tests("C")
      if "HiContention" in CLASSES:
        bench_report_t_u_tests("HiContention")
```

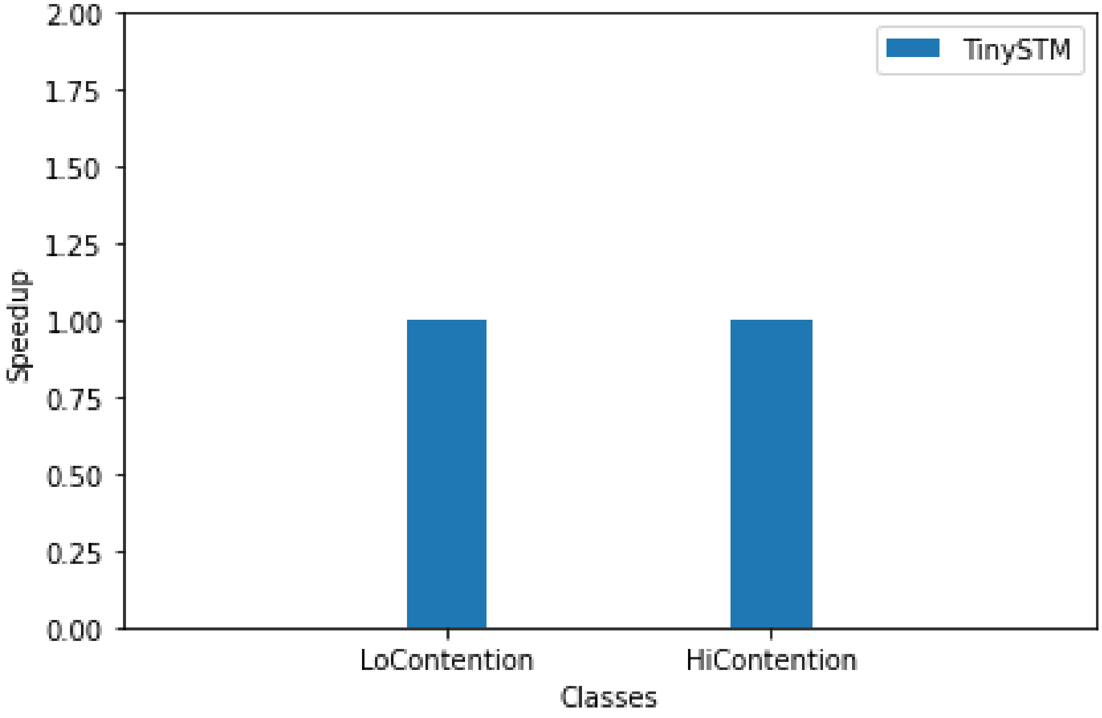
```
               (RTM[HiContention]) x (TinySTM[HiContention])
        KS OK?                                          Yes
      T-Test p                           1.291906743302e-80
   T-Test stat                                -340.88587149
T-Test p<=0.05                                    T-Test OK
      U-Test p                           2.871949066320e-11
   U-Test stat                                   0.00000000
U-Test p<=0.05                                    U-Test OK
```

1.2.5 Speedup charts

[17]:

```
##Aqui provavelmente tenha que mudar
##Aqui usa as questões de versão e classe que não sei se traduzi corretamente␣
 ↪pro meu caso
#print('----------', "Python", '----------')
#versions_gpu = [VER_PYTHON_CUDA]
versions = [VER_RTM_INTEL]

#bench_speedup_chart(VER_PYTHON_SERIAL, versions_gpu)
bench_speedup_chart(VER_RTM_INTEL, versions)

#print("\n\n", '----------', "C++", '----------')
#if g_bench == "IS":
#    versions_gpu = [VER_CUDA]
#else:
#    versions_gpu = [VER_CUDA, VER_OPENACC]
#versions = [VER_SEQ]
versions = [VER_STM_TINY]

#bench_speedup_chart(VER_CPP_SERIAL, versions_gpu)
#bench_speedup_chart(VER_SEQ, versions)
bench_speedup_chart(VER_STM_TINY, versions)
```

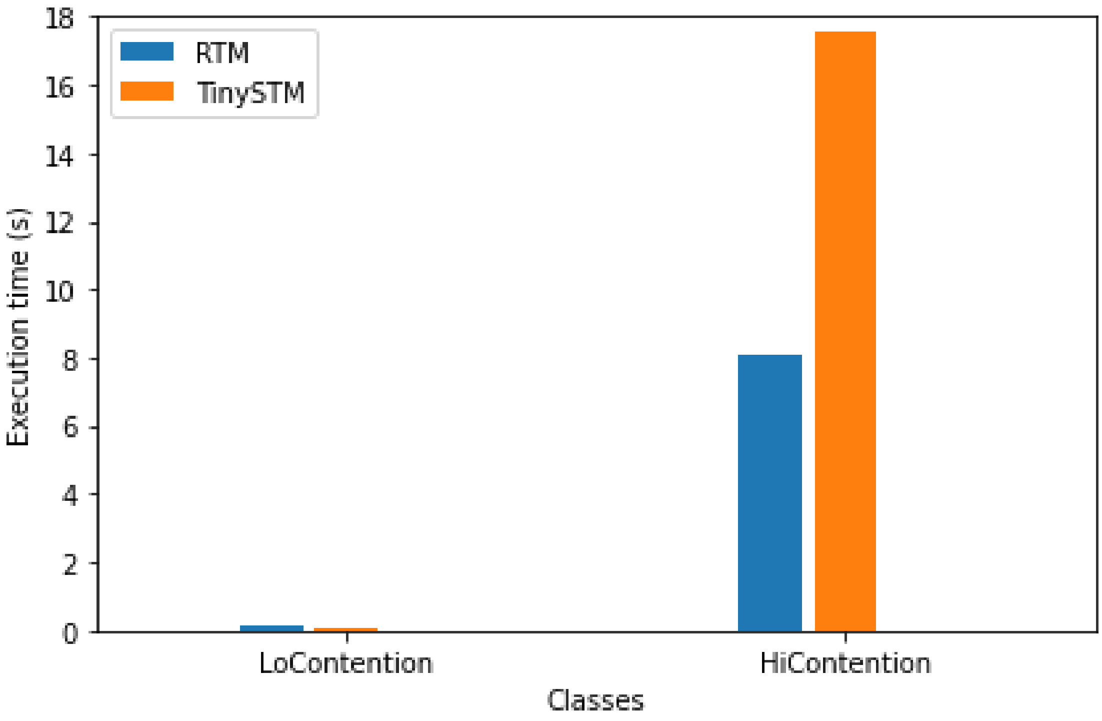

2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Speedup
RTM
LoContention
HiContention
Classes


2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Speedup
TinySTM
LoContention
HiContention
Classes

1.2.6 GPU comparison chart

[18]:

```
bench_time_chart()
```



1.3 Main general view

1.3.1 Utils

[19]:

```
def load_npb_data_dictionary():
    global dic_dados_bench
    global dic_dados
    for b in BENCHS:
        dic_dados = {}
        load_data_dictionary(b)
        dic_dados_bench[b] = dict(dic_dados)
#END
```

[20]:

```
##Aqui também tive que mudar bastante coisa com classes e versões e não sei se␣
 ↪tá correto
def npb_time_chart(classe):
        times = []
        bench_ids = range(1, len(BENCHS)*2+1, 2)
```

```python
        #for v in VERSIONS_GPU:
        for v in VERSIONS:
                v_time = []

                for bench in BENCHS:
                        dic_bench = dic_dados_bench[bench]
                        if idx_dicionario(v, classe) in dic_bench.keys():
                                time, a, b = calc_stats(dic_bench[idx_dicionario(v, classe)]["times"])
                        else:
                                time = 0.0
                        v_time.append(time)

                times.append(v_time)

        #Chart
        #desenha as barras no gráfico
        fig, ax = plt.subplots()

        bars = []
        idx = -0.5
        for t in times:
                bar = ax.bar(np.array(bench_ids)+idx, np.array(t), width=0.45)
                bars.append(bar)
                idx += 0.5

        ax.set_xlabel('Benchmark')
        ax.set_ylabel('Execution time (s)')
        ax.set_xlim(0, 16)
        ax.set_ylim(0.01, 60)

        ax.set_title('Execution time')
        ax.legend(tuple(map(name_versao, VERSIONS)))

        ax.set_xticks(bench_ids)
        ax.set_xticklabels(BENCHS)

        #ax.set_yscale('log', base=2)
        ax.set_yscale('log')

        locs = [0.05, 0.1, 0.5, 1, 5, 10, 20, 40, 60]
        ax.yaxis.set_minor_locator(ticker.FixedLocator(locs))
        ax.yaxis.set_major_locator(ticker.NullLocator())

        ax.yaxis.set_minor_formatter(ticker.ScalarFormatter())
        #for b in bars:
        #        ax.bar_label(b, padding=3, fmt='%4.2f')

        fig.tight_layout()

        plt.show() #mostra o gráfico
#END

def npb_speedup_chart(classe):
        speedups = []
        bench_ids = range(1, len(BENCHS)*2+1, 2)

        #for v in VERSIONS_GPU:
        for v in VERSIONS:
                v_speedup = []

                for bench in BENCHS:
                        dic_bench = dic_dados_bench[bench]

                        if idx_dicionario(v, classe) in dic_bench.keys():
                                time_serial = 1.0
                                #if "PYTHON" in v:
                                #        time_serial, a, b = calc_stats(dic_bench[idx_dicionario(VER_PYTHON_SERIAL, classe)]["times"])
                                time_serial, a, b = calc_stats(dic_bench[idx_dicionario(VER_RTM_INTEL, classe)]["times"])
                                #else:
                                #        time_serial, a, b = calc_stats(dic_bench[idx_dicionario(VER_CPP_SERIAL, classe)]["times"])
                                #
                                #if idx_dicionario(v, classe) in dic_bench.keys():
                                time, a, b = calc_stats(dic_bench[idx_dicionario(v, classe)]["times"])
                                v_speedup.append(time_serial/time)
                        else:
                                v_speedup.append(-100.0)

                speedups.append(v_speedup)

        #Chart
        #desenha as barras no gráfico
        fig, ax = plt.subplots()

        bars = []
        idx = -0.5
        for s in speedups:
                bar = ax.bar(np.array(bench_ids)+idx, np.array(s), width=0.45)
                bars.append(bar)
                idx += 0.5

        ax.set_xlabel('Benchmark')
        ax.set_ylabel('Speedup')
        ax.set_xlim(0, 16)
        ax.set_ylim(1, 2000)

        ax.set_title('Speedup')
        ax.legend(tuple(map(name_versao, VERSIONS)))

        ax.set_xticks(bench_ids)
        ax.set_xticklabels(BENCHS)

        ax.set_yscale('log')

        locs = [1, 5, 10, 50, 100, 500, 1000, 1500, 2000]
        ax.yaxis.set_minor_locator(ticker.FixedLocator(locs))
        ax.yaxis.set_major_locator(ticker.NullLocator())

        ax.yaxis.set_minor_formatter(ticker.ScalarFormatter())

        #for b in bars:
        #        ax.bar_label(b, padding=3, fmt='%4.1f')

        fig.tight_layout()

        plt.show() #mostra o gráfico
#END
```

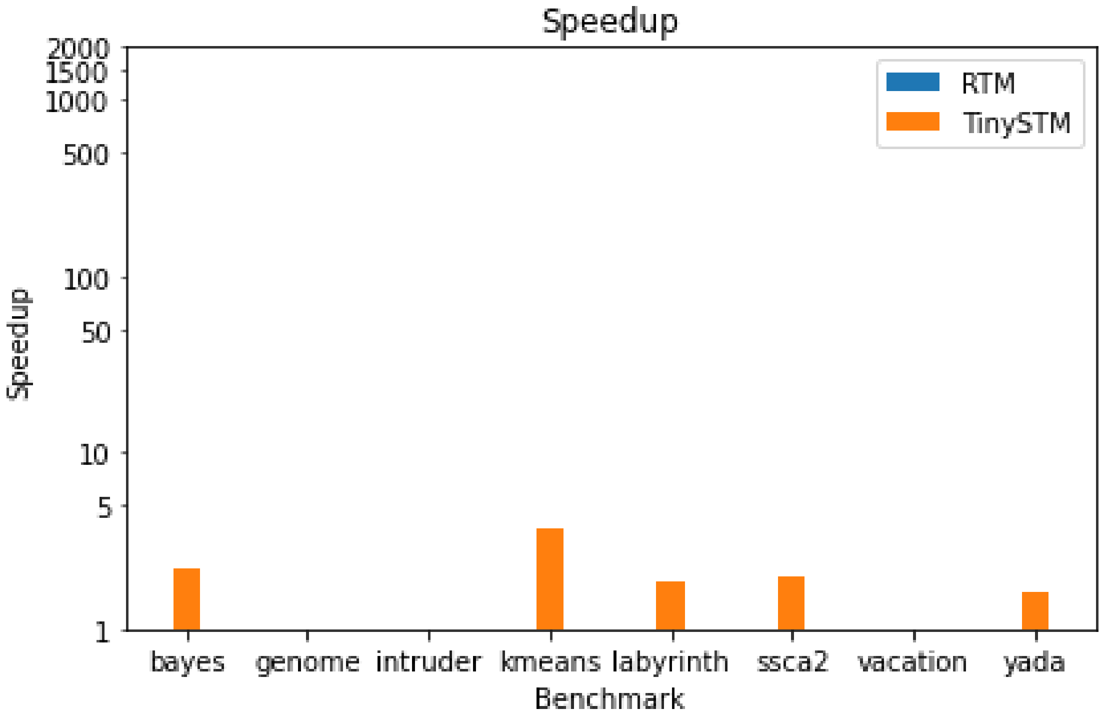
1.3.2 Charts

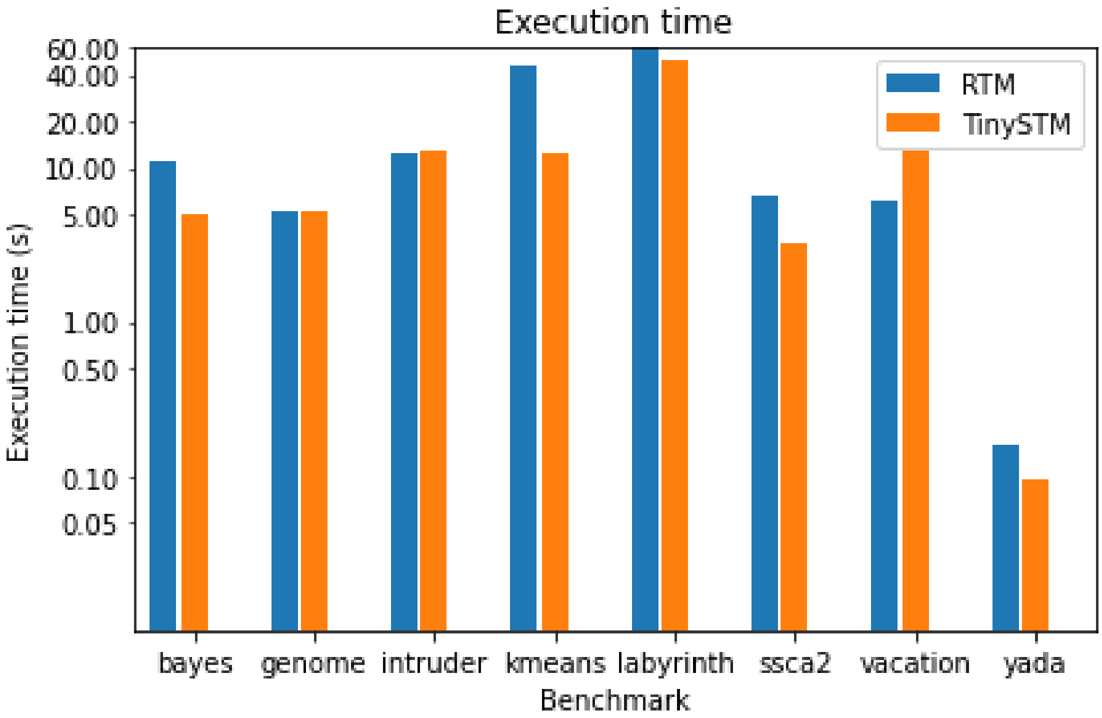
[21]:

```
load_npb_data_dictinary()

#print('\n', '----------', "Class B", '----------')
#npb_speedup_chart("B")
npb_speedup_chart("LoContention")

#npb_time_chart("B")
npb_time_chart("LoContention")
```

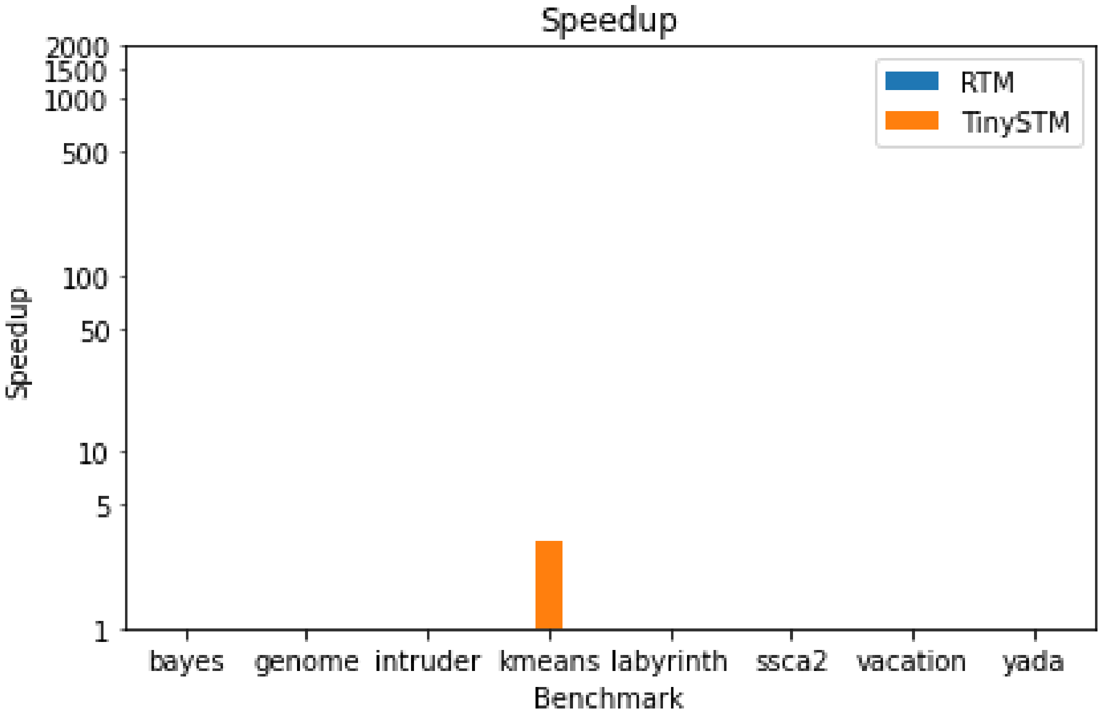
```
Gerando bayes …
bayes OK
Gerando genome …
genome OK
```

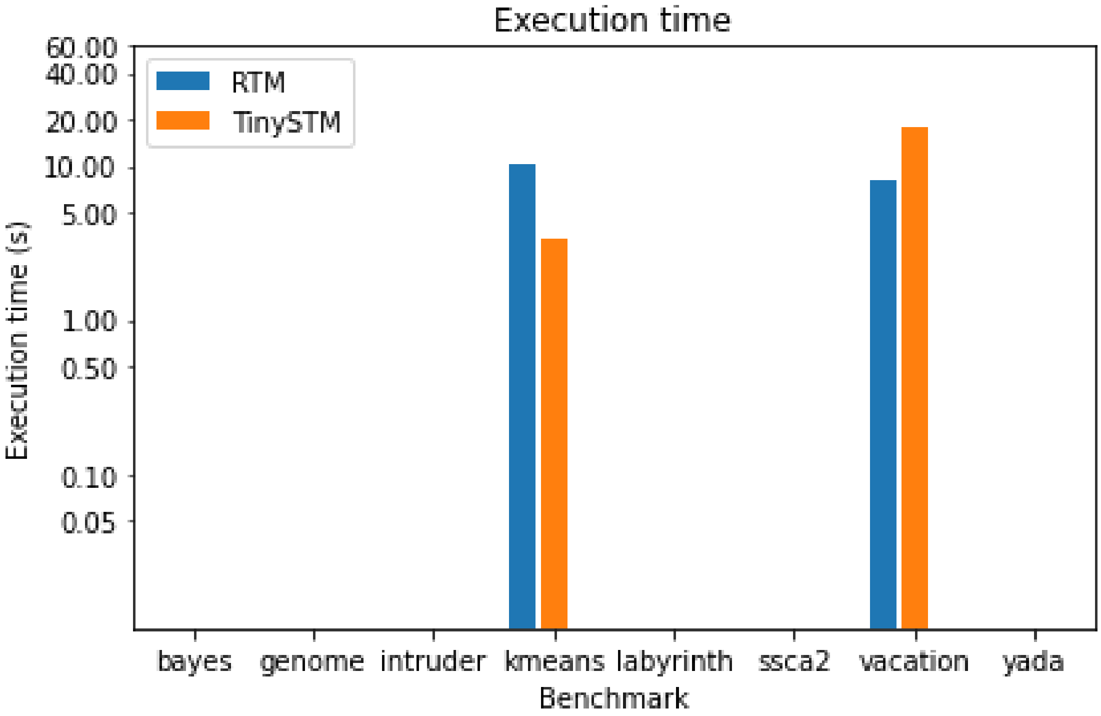
```
Gerando intruder …
intruder OK
Gerando kmeans …
kmeans OK
Gerando labyrinth …
labyrinth OK
Gerando ssca2 …
ssca2 OK
Gerando vacation …
vacation OK
Gerando yada …
yada OK
```





[22]:
```
##print('\n', '----------', "Class C", '----------')
##npb_speedup_chart("C")
if "HiContention" in CLASSES:
  npb_speedup_chart("HiContention")

##npb_time_chart("C")
  npb_time_chart("HiContention")
```


Speedup
2000
1500
1000
500
100
50
10
5
1
Speedup
RTM
TinySTM
bayes
genome
intruder
kmeans
labyrinth
ssca2
vacation
yada
Benchmark


Execution time
60.00
40.00
20.00
10.00
5.00
1.00
0.50
0.10
0.05
Execution time (s)
RTM
TinySTM
bayes
genome
intruder
kmeans
labyrinth
ssca2
vacation
yada
Benchmark

[9]:

```
import os
#get_ipython().system(
#    "apt update >> /dev/null && apt install texlive-xetex␣
 ↪texlive-fonts-recommended texlive-generic-recommended >> /dev/null"
#)

notebookpath="/content/drive/MyDrive/Colab Notebooks/"
file_name = "NPB_statistics - Frederico.ipynb"
drive_mount_point = "/content/drive/"
gdrive_home = os.path.join(drive_mount_point, "My Drive/Colab Notebooks/
 ↪Arquivos")

if not os.path.isfile(os.path.join(notebookpath, file_name)):
  raise ValueError(f"file '{file_name}' not found in path '{notebookpath}'.")

pdfNum = 0
while os.path.isfile(os.path.join(gdrive_home, file_name.split(".")[0] +␣
 ↪str(pdfNum) + ".pdf")):
  pdfNum = pdfNum + 1
filename = file_name.split(".")[0] + str(pdfNum)# + ".pdf"

# Attempt to convert to pdf and save it in Gdrive home dir using jupyter␣
 ↪nbconvert command.
try:
    get_ipython().system(
        #"jupyter nbconvert --output-dir='$gdrive_home'␣
 ↪'$notebookpath''$file_name' --to pdf"
        "jupyter nbconvert --output-dir=\""+gdrive_home+"\"␣
 ↪\""+notebookpath+file_name+"\" --to pdf --output=\"filename"\""
    )
except:
    print("nbconvert error")

# Attempt to download the file to system.
try:
    from google.colab import files

    file_name = file_name.split(".")[0] + ".pdf"
    files.download(gdrive_home + file_name)
except:
    print("File Download Unsuccessful. Saved in Google Drive")

print("File ready to be Downloaded and Saved to Drive")
```

```
[NbConvertApp] WARNING | pattern '/content/drive/MyDrive/Colab
Notebooks/NPB_statistics - Frederico0.ipynb' matched no files
This application is used to convert notebook files (*.ipynb)
```

```
        to various other formats.

        WARNING: THE COMMANDLINE INTERFACE MAY CHANGE IN FUTURE RELEASES.

Options
=======
The options below are convenience aliases to configurable class-options,
as listed in the "Equivalent to" description-line of the aliases.
To see all configurable class-options for some <cmd>, use:
    <cmd> --help-all

--debug
    set log level to logging.DEBUG (maximize logging output)
    Equivalent to: [--Application.log_level=10]
--show-config
    Show the application's configuration (human-readable format)
    Equivalent to: [--Application.show_config=True]
--show-config-json
    Show the application's configuration (json format)
    Equivalent to: [--Application.show_config_json=True]
--generate-config
    generate default config file
    Equivalent to: [--JupyterApp.generate_config=True]
-y
    Answer yes to any questions instead of prompting.
    Equivalent to: [--JupyterApp.answer_yes=True]
--execute
    Execute the notebook prior to export.
    Equivalent to: [--ExecutePreprocessor.enabled=True]
--allow-errors
    Continue notebook execution even if one of the cells throws an error and
include the error message in the cell output (the default behaviour is to abort
conversion). This flag is only relevant if '--execute' was specified, too.
    Equivalent to: [--ExecutePreprocessor.allow_errors=True]
--stdin
    read a single notebook file from stdin. Write the resulting notebook with
default basename 'notebook.*'
    Equivalent to: [--NbConvertApp.from_stdin=True]
--stdout
    Write notebook output to stdout instead of files.
    Equivalent to: [--NbConvertApp.writer_class=StdoutWriter]
--inplace
    Run nbconvert in place, overwriting the existing notebook (only
            relevant when converting to notebook format)
    Equivalent to: [--NbConvertApp.use_output_suffix=False
--NbConvertApp.export_format=notebook --FilesWriter.build_directory=]
--clear-output
    Clear output of current file and save in place,
            overwriting the existing notebook.
    Equivalent to: [--NbConvertApp.use_output_suffix=False
--NbConvertApp.export_format=notebook --FilesWriter.build_directory=
--ClearOutputPreprocessor.enabled=True]
--no-prompt
    Exclude input and output prompts from converted document.
    Equivalent to: [--TemplateExporter.exclude_input_prompt=True
--TemplateExporter.exclude_output_prompt=True]
--no-input
    Exclude input cells and output prompts from converted document.
            This mode is ideal for generating code-free reports.
    Equivalent to: [--TemplateExporter.exclude_output_prompt=True
--TemplateExporter.exclude_input=True]
--log-level=<Enum>
    Set the log level by value or name.
    Choices: any of [0, 10, 20, 30, 40, 50, 'DEBUG', 'INFO', 'WARN', 'ERROR',
'CRITICAL']
    Default: 30
    Equivalent to: [--Application.log_level]
--config=<Unicode>
    Full path of a config file.
    Default: ''
    Equivalent to: [--JupyterApp.config_file]
--to=<Unicode>
    The export format to be used, either one of the built-in formats
            ['asciidoc', 'custom', 'html', 'latex', 'markdown', 'notebook',
'pdf', 'python', 'rst', 'script', 'slides']
            or a dotted object name that represents the import path for an
            `Exporter` class
    Default: 'html'
    Equivalent to: [--NbConvertApp.export_format]
--template=<Unicode>
    Name of the template file to use
    Default: ''
    Equivalent to: [--TemplateExporter.template_file]
--writer=<DottedObjectName>
    Writer class used to write the
                                        results of the conversion
    Default: 'FilesWriter'
    Equivalent to: [--NbConvertApp.writer_class]
--post=<DottedOrNone>
    PostProcessor class used to write the
                                        results of the conversion
    Default: ''
    Equivalent to: [--NbConvertApp.postprocessor_class]
--output=<Unicode>
    overwrite base name use for output files.
                can only be used when converting one notebook at a time.
    Default: ''
    Equivalent to: [--NbConvertApp.output_base]
--output-dir=<Unicode>
    Directory to write output(s) to. Defaults
                                  to output to the directory of each notebook.
To recover
                                  previous default behaviour (outputting to the
current
                                  working directory) use . as the flag value.
    Default: ''
    Equivalent to: [--FilesWriter.build_directory]
--reveal-prefix=<Unicode>
    The URL prefix for reveal.js (version 3.x).
            This defaults to the reveal CDN, but can be any url pointing to a
copy
            of reveal.js.
            For speaker notes to work, this must be a relative path to a local
            copy of reveal.js: e.g., "reveal.js".
            If a relative path is given, it must be a subdirectory of the
            current directory (from which the server is run).
            See the usage documentation
            (https://nbconvert.readthedocs.io/en/latest/usage.html#reveal-js-
html-slideshow)
            for more details.
    Default: ''
    Equivalent to: [--SlidesExporter.reveal_url_prefix]
--nbformat=<Enum>
    The nbformat version to write.
            Use this to downgrade notebooks.
    Choices: any of [1, 2, 3, 4]
    Default: 4
    Equivalent to: [--NotebookExporter.nbformat_version]

Examples
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    The simplest way to use nbconvert is

            > jupyter nbconvert mynotebook.ipynb

            which will convert mynotebook.ipynb to the default format (probably
HTML).

            You can specify the export format with `--to`.
            Options include ['asciidoc', 'custom', 'html', 'latex', 'markdown',
'notebook', 'pdf', 'python', 'rst', 'script', 'slides'].

            > jupyter nbconvert --to latex mynotebook.ipynb
            Both HTML and LaTeX support multiple output templates. LaTeX
includes
            'base', 'article' and 'report'.  HTML includes 'basic' and 'full'.
You
            can specify the flavor of the format used.

            > jupyter nbconvert --to html --template basic mynotebook.ipynb

            You can also pipe the output to stdout, rather than a file

            > jupyter nbconvert mynotebook.ipynb --stdout

            PDF is generated via latex

            > jupyter nbconvert mynotebook.ipynb --to pdf

            You can get (and serve) a Reveal.js-powered slideshow

            > jupyter nbconvert myslides.ipynb --to slides --post serve

            Multiple notebooks can be given at the command line in a couple of
            different ways:

            > jupyter nbconvert notebook*.ipynb
            > jupyter nbconvert notebook1.ipynb notebook2.ipynb

            or you can specify the notebooks list in a config file, containing::

                c.NbConvertApp.notebooks = ["my_notebook.ipynb"]

            > jupyter nbconvert --config mycfg.py

To see all available configurables, use `--help-all`.

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```