A Day Has Only 24±1 Hours

import pytz

Miroslav Šedivý

eumiro

A Day Has Only 24±1 Hours

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- check the time

A Day Has Only 24±1 Hours

- check the time
- don't check the time too often

A Day Has Only 24±1 Hours

- check the time
- don't check the time too often
- check what your government does

A Day Has Only 24±1 Hours

- check the time
- don't check the time too often
- check what your government does
- TIME ZONES!

Miroslav Šedivý

['mɪrɔslaʊ 'ʃɛɟɪviː]

- `@eumiro`
- born in Bratislava, Czechoslovakia (`TZ=Europe/Bratislava`)
- M.Sc. at INSA Lyon, France (`TZ=Europe/Paris`)
- Senior Software Architect in Karlsruhe, Germany (`TZ=Europe/Berlin`)

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- @eumiro
- born in Bratislava, Czechoslovakia (`TZ=Europe/Bratislava`)
- M.Sc. at INSA Lyon, France (`TZ=Europe/Paris`)
- Senior Software Architect in Karlsruhe, Germany (`TZ=Europe/Berlin`)
- using Python to make the sun shine and the wind blow (in many timezones)

Friday, 2nd November 2018

15:03 MSK

(Saint Petersburg, Russia)

```
>>> import time
>>> time.time()
1541160180.0
```

```
>>> import time
>>> time.time()
1541160180.0
```

```
>>> import datetime
>>> datetime.datetime.now()
datetime.datetime(2018, 11, 2, 15, 3, 0, 0)
```

```
>>> import time
>>> time.time()
1541160180.0
```

```
>>> import datetime
>>> datetime.datetime.now()
datetime.datetime(2018, 11, 2, 15, 3, 0, 0)
```

```
datetime.datetime(2018, 11, 2, 12, 3, 0, 0)  # on a server set to UTC
```

```
>>> import time
>>> time.time()
1541160180.0
```

```
>>> import datetime
>>> datetime.datetime.now()
datetime.datetime(2018, 11, 2, 15, 3, 0, 0)
```

```
datetime.datetime(2018, 11, 2, 12, 3, 0, 0)  # on a server set to UTC
```

```
>>> datetime.datetime.utcnow()
datetime.datetime(2018, 11, 2, 12, 3, 0, 0)
```

```
>>> import time
>>> time.time()
1541160180.0
```

```
>>> import datetime
>>> datetime.datetime.now()
datetime.datetime(2018, 11, 2, 15, 3, 0, 0)
```

```
datetime.datetime(2018, 11, 2, 12, 3, 0, 0)  # on a server set to UTC
```

```
>>> datetime.datetime.utcnow()
datetime.datetime(2018, 11, 2, 12, 3, 0, 0)
```

```
>>> datetime.datetime.now(datetime.timezone.utc)
datetime.datetime(2018, 11, 2, 12, 3, 0, 0, tzinfo=datetime.timezone.utc)
```

```
>>> import time
>>> time.time()
1541160180.0
```

```
>>> import datetime
>>> datetime.datetime.now()
datetime.datetime(2018, 11, 2, 15, 3, 0, 0)
```

```
datetime.datetime(2018, 11, 2, 12, 3, 0, 0)  # on a server set to UTC
```

```
>>> datetime.datetime.utcnow()
datetime.datetime(2018, 11, 2, 12, 3, 0, 0)
```

```
>>> datetime.datetime.now(datetime.timezone.utc)
datetime.datetime(2018, 11, 2, 12, 3, 0, 0, tzinfo=datetime.timezone.utc)
```

```
>>> datetime.datetime.now(datetime.timezone(datetime.timedelta(hours=3)))
datetime.datetime(2018, 11, 2, 15, 3, 0, 0, tzinfo=datetime.timezone(datetime.timedelta(0, 10800)))
```

```
>>> import time
>>> time.time()
1541160180.0
```

```
>>> import datetime
>>> datetime.datetime.now()
datetime.datetime(2018, 11, 2, 15, 3, 0, 0)
```

```
datetime.datetime(2018, 11, 2, 12, 3, 0, 0)  # on a server set to UTC
```

```
>>> datetime.datetime.utcnow()
datetime.datetime(2018, 11, 2, 12, 3, 0, 0)
```

```
>>> datetime.datetime.now(datetime.timezone.utc)
datetime.datetime(2018, 11, 2, 12, 3, 0, 0, tzinfo=datetime.timezone.utc)
```

```
>>> datetime.datetime.now(datetime.timezone(datetime.timedelta(hours=3)))
datetime.datetime(2018, 11, 2, 15, 3, 0, 0, tzinfo=datetime.timezone(datetime.timedelta(0, 10800)))
```

```
>>> import pytz
>>> datetime.datetime.now(pytz.timezone('Europe/Moscow'))
datetime.datetime(2018, 11, 2, 15, 3, 0, 0, tzinfo=<DstTzInfo 'Europe/Moscow' MSK+3:00:00 STD>)
```

```
>>> today = datetime.datetime.utcnow().strftime('%Y-%m-%d')
2018-11-02
```

```
>>> today = datetime.datetime.utcnow().strftime('%Y-%m-%d')
2018-11-02
```

```
>>> yesterday = (datetime.datetime.utcnow() - datetime.timedelta(days=1)).strftime('%Y-%m-%d')
2018-11-01
```

```
>>> today = datetime.datetime.utcnow().strftime('%Y-%m-%d')
2018-11-02
```

```
>>> yesterday = (datetime.datetime.utcnow() - datetime.timedelta(days=1)).strftime('%Y-%m-%d')
2018-11-01
```

```
>>> now = datetime.datetime.utcnow()
>>> today = now.strftime('%Y-%m-%d')
>>> yesterday = (now - datetime.timedelta(days=1)).strftime('%Y-%m-%d')
2018-11-02
2018-11-01
```

```
>>> start = datetime.datetime.utcnow()
>>> expensive_operation()
>>> end = datetime.datetime.utcnow()
>>> elapsed = (end - start).total_seconds()
```

```
>>> start = datetime.datetime.utcnow()
>>> expensive_operation()
>>> end = datetime.datetime.utcnow()
>>> elapsed = (end - start).total_seconds()
```

```
>>> start = time.time()
>>> expensive_operation()
>>> end = time.time()
>>> elapsed = end - start
```

```
>>> start = datetime.datetime.utcnow()
>>> expensive_operation()
>>> end = datetime.datetime.utcnow()
>>> elapsed = (end - start).total_seconds()
```

```
>>> start = time.time()
>>> expensive_operation()
>>> end = time.time()
>>> elapsed = end - start
```

```
>>> start = time.monotonic()
>>> expensive_operation()
>>> end = time.monotonic()
>>> elapsed = end - start
```

```
>>> start = datetime.datetime.utcnow()
>>> expensive_operation()
>>> end = datetime.datetime.utcnow()
>>> elapsed = (end - start).total_seconds()
```

```
>>> start = time.time()
>>> expensive_operation()
>>> end = time.time()
>>> elapsed = end - start
```

```
>>> start = time.monotonic()
>>> expensive_operation()
>>> end = time.monotonic()
>>> elapsed = end - start
```

```
>>> time.monotonic_ns()  # Python 3.7+
```

Time

- local solar time (equation of time)

Time

- local solar time (equation of time)
- Greenwich

Time

- local solar time (equation of time)
- Greenwich
- France:
  - 1891: l'heure de Paris (railroads at -00:05)
  - 1911: Greenwich Time

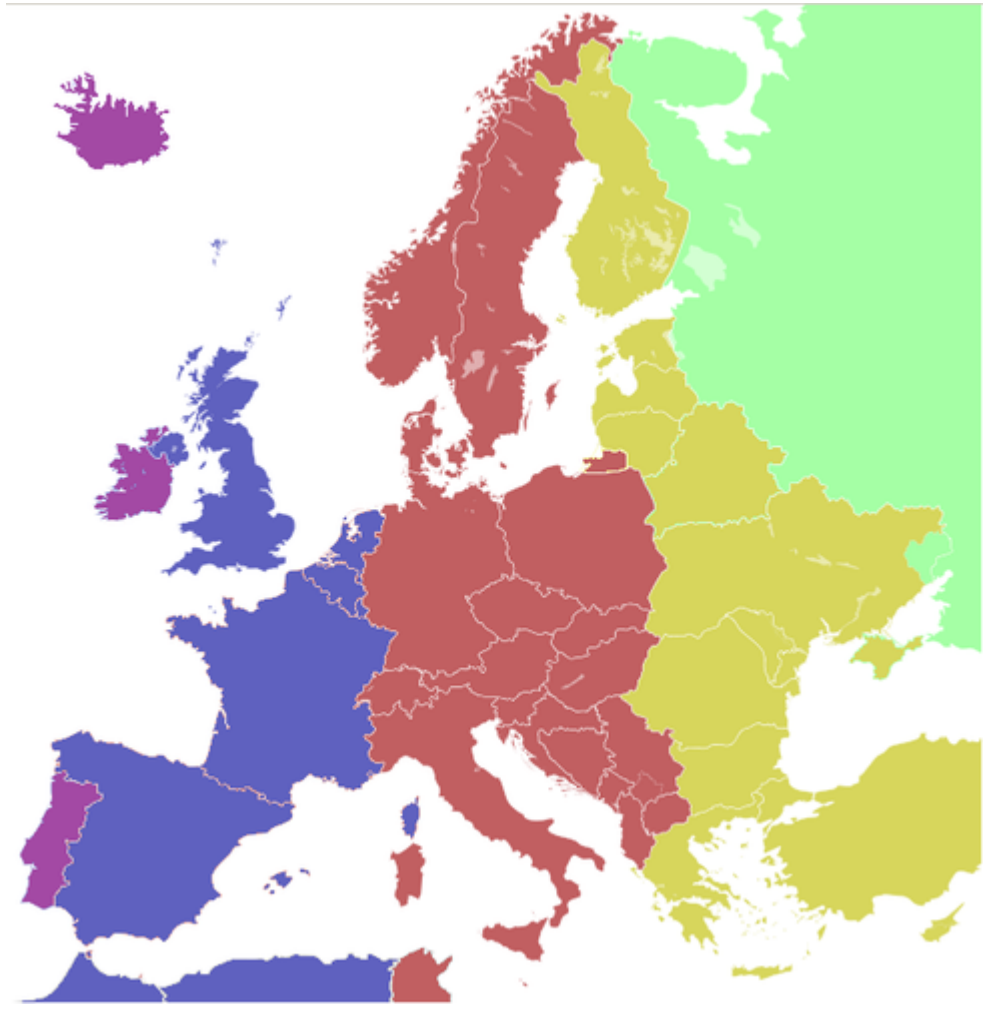
Time

- local solar time (equation of time)
- Greenwich

- France:

  - 1891: l'heure de Paris (railroads at -00:05)
  - 1911: Greenwich Time

- Greenwich and 25 time zones (-12 … +12)



Source: StuartBrady / Wikipedia, CC BY-SA 3.0

Time zones

- no central authority (countries, regions, counties, …)
- IANA.org (Internet Assigned Numbers Authority) → `tzdata`

Time zones

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- IANA.org (Internet Assigned Numbers Authority) → `tzdata`

```
>>> len(pytz.all_timezones)
591
```

Time zones

- no central authority (countries, regions, counties, …)
- IANA.org (Internet Assigned Numbers Authority) → `tzdata`

```
>>> len(pytz.all_timezones)
591
```

```
>>> len(pytz.common_timezones)
439
```

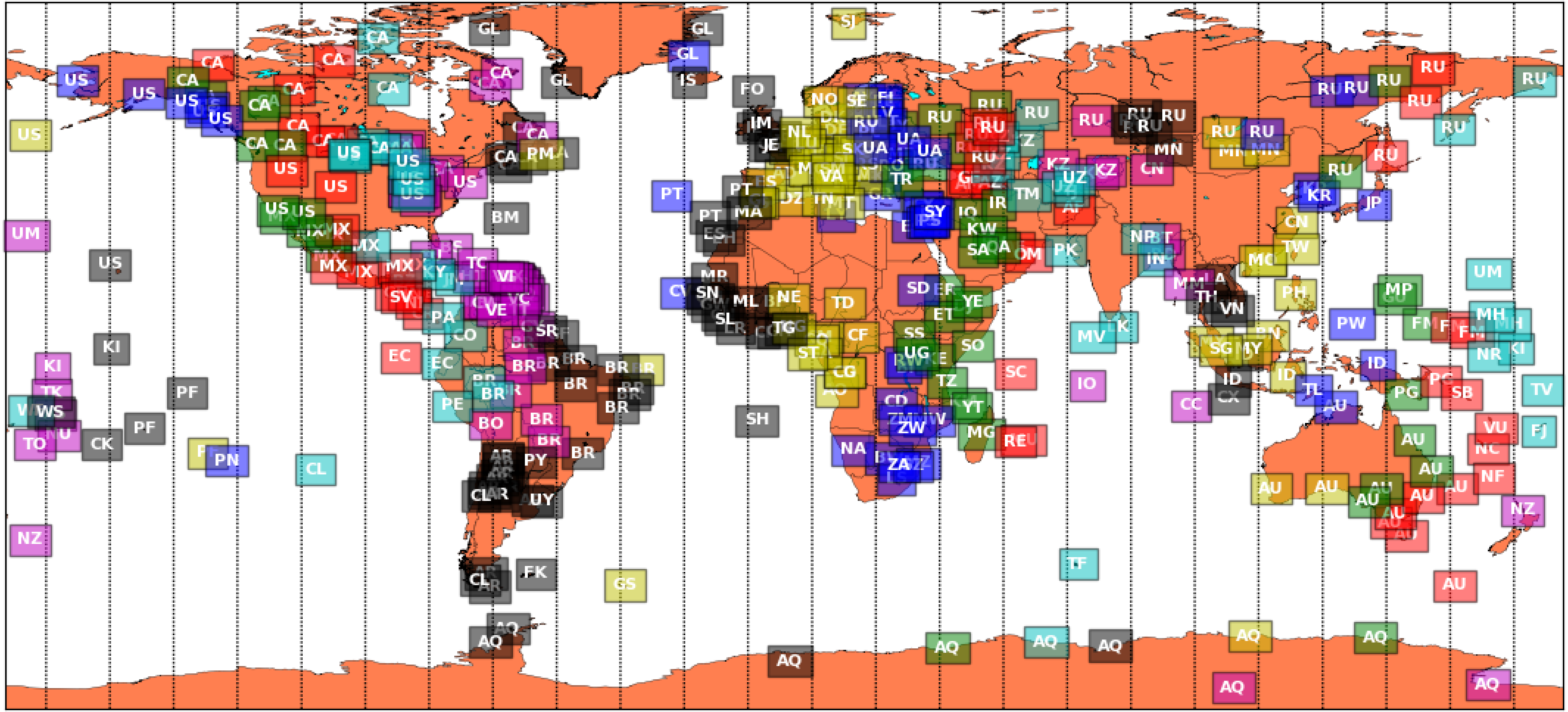
Time zones

- no central authority (countries, regions, counties, …)
- IANA.org (Internet Assigned Numbers Authority) → `tzdata`

```
>>> len(pytz.all_timezones)
591
```

```
>>> len(pytz.common_timezones)
439
```

- America (147), Asia (82), Europe (60), Africa (52), Australia (12), Antarctica (11)
- Pacific (38), Indian (11), Atlantic (10), Arctic (1)
- US (7), Canada (6)
- GMT, UTC



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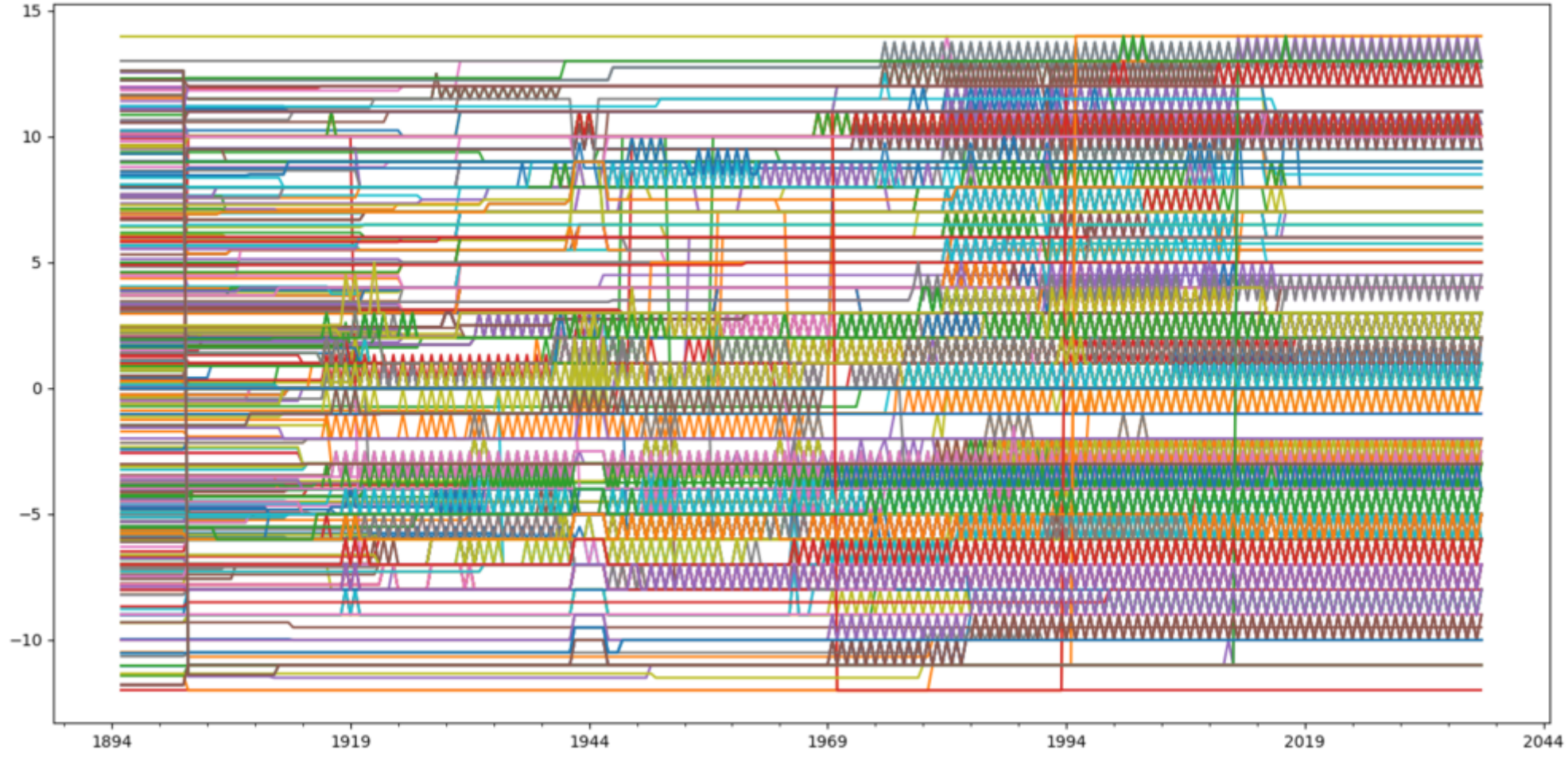
15
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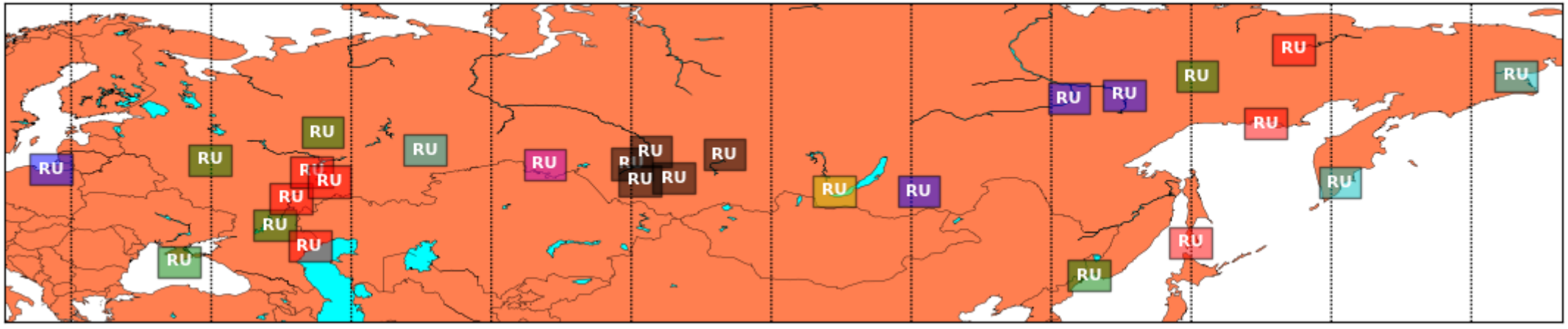
1894
1919
1944
1969
1994
2019
2044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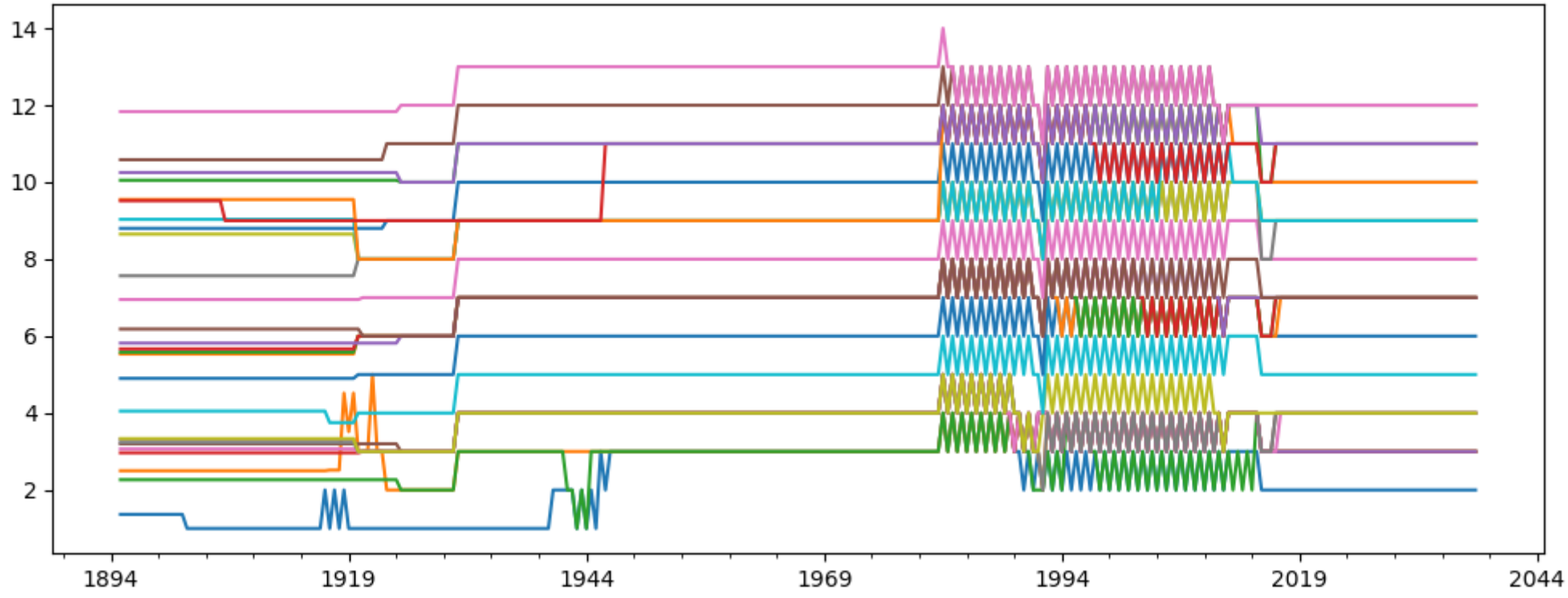
14
12
10
8
6
4
2
1894
1919
1944
1969
1994
2019
2044

```
>>> pytz.timezone('Europe/Moscow')
<DstTzInfo 'Europe/Moscow' LMT+2:30:00 STD>

>>> pytz.timezone('Europe/Berlin')
<DstTzInfo 'Europe/Berlin' LMT+0:53:00 STD>

>>> pytz.timezone('Europe/Paris')
<DstTzInfo 'Europe/Paris' LMT+0:09:00 STD>

>>> pytz.timezone('Europe/London')
<DstTzInfo 'Europe/London' LMT-1 day, 23:59:00 STD>
```

```
>>> pytz.timezone('Europe/Moscow')
<DstTzInfo 'Europe/Moscow' LMT+2:30:00 STD>

>>> pytz.timezone('Europe/Berlin')
<DstTzInfo 'Europe/Berlin' LMT+0:53:00 STD>

>>> pytz.timezone('Europe/Paris')
<DstTzInfo 'Europe/Paris' LMT+0:09:00 STD>

>>> pytz.timezone('Europe/London')
<DstTzInfo 'Europe/London' LMT-1 day, 23:59:00 STD>
```

```
>>> datetime.datetime(2018, 11, 2, 15, 3, tzinfo=pytz.timezone('Europe/Moscow')).astimezone(pytz.utc)
datetime.datetime(2018, 11, 2, 12, 33, tzinfo=<UTC>)
```

```
>>> pytz.timezone('Europe/Moscow')
<DstTzInfo 'Europe/Moscow' LMT+2:30:00 STD>

>>> pytz.timezone('Europe/Berlin')
<DstTzInfo 'Europe/Berlin' LMT+0:53:00 STD>

>>> pytz.timezone('Europe/Paris')
<DstTzInfo 'Europe/Paris' LMT+0:09:00 STD>

>>> pytz.timezone('Europe/London')
<DstTzInfo 'Europe/London' LMT-1 day, 23:59:00 STD>
```

```
>>> datetime.datetime(2018, 11, 2, 15, 3, tzinfo=pytz.timezone('Europe/Moscow')).astimezone(pytz.utc)
datetime.datetime(2018, 11, 2, 12, 33, tzinfo=<UTC>)
```

```
>>> pytz.timezone('Europe/Moscow').localize(datetime.datetime(2018, 11, 2, 15, 3)).astimezone(pytz.utc)
datetime.datetime(2018, 11, 2, 12, 3, tzinfo=<UTC>)
```

tzdata2018e.tar.gz (346k)

```
 52800 Apr 23 01:52 africa
 12934 Mar 14 23:49 antarctica
138358 Apr 30 21:28 asia
 76124 Apr  1 18:27 australasia
  4543 Jul 16  2017 backward
 21945 Mar 18 22:48 backzone
  5567 Oct  2  2017 calendars
  1008 Jun  2  2017 checklinks.awk
  4203 Jan 30 18:16 checktab.awk
  2895 Mar  2 18:43 CONTRIBUTING
  2740 Aug 24  2016 etcetera
168081 Apr 23 01:52 europe
   367 Aug 24  2016 factory
  4445 Feb 28  2017 iso3166.tab
  2196 Jan 15 18:19 leapseconds
  2380 Jul 18  2017 leapseconds.awk
 10666 Jan 15 18:19 leap-seconds.list
   252 May 25  2017 LICENSE
 38969 Apr 30 21:46 Makefile
156727 May  2 08:44 NEWS
150084 Mar 20 23:31 northamerica
  1182 Jun 20  2014 pacificnew
  2340 Jan 13 08:05 README
 86505 Feb 21 00:50 southamerica
  1538 Jun 16  2014 systemv
 53216 Apr 15 20:02 theory.html
     6 May  2 08:44 version
   678 Jun 18  2014 yearistype.sh
  2869 Apr 23 01:52 ziguard.awk
  4207 Jan 23 23:54 zishrink.awk
 17781 Feb 16 22:59 zone1970.tab
  1409 Aug 17  2014 zoneinfo2tdf.pl
 19165 Feb 16 18:21 zone.tab
```

Europe/Moscow

```
Zone Europe/Moscow  2:30:17 -       LMT      1880
                    2:30:17 -       MMT      1916 Jul  3  # Moscow Mean Time
                    2:31:19 Russia  %s       1919 Jul  1  0:00u
                    3:00    Russia  %s       1921 Oct
                    3:00    Russia  MSK/MSD  1922 Oct
                    2:00    -       EET      1930 Jun 21
                    3:00    Russia  MSK/MSD  1991 Mar 31  2:00s
                    2:00    Russia  EE%sT    1992 Jan 19  2:00s
                    3:00    Russia  MSK/MSD  2011 Mar 27  2:00s
                    4:00    -       MSK      2014 Oct 26  2:00s
                    3:00    -       MSK
```

Europe/Istanbul

```
Zone  Europe/Istanbul  1:55:52  -       LMT      1880
                       1:56:56  -       IMT      1910 Oct # Istanbul Mean Time?
                       2:00     Turkey  EE%sT    1978 Oct 15
                       3:00     Turkey  +03/+04  1985 Apr 20
                       2:00     Turkey  EE%sT    2007
                       2:00     EU      EE%sT    2011 Mar 27  1:00u
                       2:00     -       EET      2011 Mar 28  1:00u
                       2:00     EU      EE%sT    2014 Mar 30  1:00u
                       2:00     -       EET      2014 Mar 31  1:00u
                       2:00     EU      EE%sT    2015 Oct 25  1:00u
                       2:00     1:00    EEST     2015 Nov  8  1:00u
                       2:00     EU      EE%sT    2016 Sep  7
                       3:00     -       +03
```

Europe/Istanbul

```
Zone  Europe/Istanbul  1:55:52  -       LMT      1880
                       1:56:56  -       IMT      1910 Oct # Istanbul Mean Time?
                       2:00     Turkey  EE%sT    1978 Oct 15
                       3:00     Turkey  +03/+04  1985 Apr 20
                       2:00     Turkey  EE%sT    2007
                       2:00     EU      EE%sT    2011 Mar 27  1:00u
                       2:00     -       EET      2011 Mar 28  1:00u
                       2:00     EU      EE%sT    2014 Mar 30  1:00u
                       2:00     -       EET      2014 Mar 31  1:00u
                       2:00     EU      EE%sT    2015 Oct 25  1:00u
                       2:00     1:00    EEST     2015 Nov  8  1:00u
                       2:00     EU      EE%sT    2016 Sep  7
                       3:00     -       +03
```

(2011-03-10): […] Turkey will change into summer time zone (GMT+3) on March 28, 2011 at 3:00 a.m. instead of March 27. This change is due to a nationwide exam on 27th. [URL] Turkish: [URL]

```
2:00     EU      EE%sT    2014 Mar 30  1:00u
2:00     -       EET      2014 Mar 31  1:00u
```

[…] (2014-02-14): The DST for Turkey has been changed for this year because of the Turkish Local election.... [URL] ... so Turkey will move clocks forward one hour on March 31 at 3:00 a.m.

[…] (2014-04-15): Having landed on a flight from the states to Istanbul (via AMS) on March 31, I can tell you that NOBODY (even the airlines) respected this timezone DST change delay. Maybe the word just didn't get out in time.

[…] (2014-06-15): The press reported massive confusion, as election officials obeyed the rule change but cell phones (and airline baggage systems) did not. See: [URL from 2014-03-30] I guess the best we can do is document the official time.

```
2:00     EU      EE%sT    2015 Oct 25  1:00u
2:00     1:00    EEST     2015 Nov  8  1:00u
```

[…] (2015-09-29): It's officially announced now by the Ministry of Energy. Turkey delays winter time to 8th of November 04:00 [URL]

BBC News (2015-10-25): Confused Turks are asking "what's the time?" after automatic clocks defied a government decision … "For the next two weeks #Turkey is on EEST… Erdogan Engineered Standard Time," said Twitter user @aysekarahasan. [URL]

```
2:00     EU      EE%sT    2016 Sep  7
3:00     -       +03
```

[…] (2016-09-08): Turkey will stay in Daylight Saving Time even in winter…. [URL]

[…] (2016-09-07): The change is permanent, so this is the new standard time in Turkey. It takes effect today, which is not much notice.

[…] (2017-10-28): Turkey will go back to Daylight Saving Time starting 2018-10. [URL]

[…] (2017-11-08): … today it was announced that the DST will become "continuous": [URL]

[…] (2017-11-08): Although Google Translate misfires on that source, it looks like Turkey reversed last month's decision, and so will stay at +03.

America/Caracas

```
Zone  America/Caracas  -4:27:44  -  LMT    1890
                       -4:27:40  -  CMT    1912 Feb 12 # Caracas Mean Time?
                       -4:30     -  -0430  1965 Jan  1  0:00
                       -4:00     -  -04    2007 Dec  9  3:00
                       -4:30     -  -0430  2016 May  1  2:30
                       -4:00     -  -04
```

> […] (2016-04-15): Clocks advance 30 minutes on 2016-05-01 at 02:30.… […] [URL from Reuters]
>
> […] (2016-04-20): … published in the official Gazette [2016-04-18], here: [URL from .ve]

America/Port-au-Prince

```
Rule  Haiti  2005  2006  -  Apr Sun>=1  0:00  1:00  D
Rule  Haiti  2005  2006  -  Oct lastSun 0:00  0     S
Rule  Haiti  2012  2015  -  Mar Sun>=8  2:00  1:00  D
Rule  Haiti  2012  2015  -  Nov Sun>=1  2:00  0     S
Rule  Haiti  2017  max   -  Mar Sun>=8  2:00  1:00  D
Rule  Haiti  2017  max   -  Nov Sun>=1  2:00  0     S
```

> […] (2005-04-15) […] wrote me that Haiti is now on DST. I searched for confirmation, and I found a press release on the Web page of the Haitian Consulate in Chicago (2005-03-31), […]
>
> […] (2006-04-04) I have been informed by users that Haiti observes DST this year like last year […]
>
> […] (2012-03-11) According to several news sources, Haiti will observe DST this year, apparently using the same start and end date as USA/Canada. […]
>
> […] (2013-03-10) It appears that Haiti is observing DST this year as well, same rules as US/Canada. They did it last year as well, and it looks like they are going to observe DST every year now… […]
>
> […] (2016-03-12) […] informed us that Haiti are not going on DST this year. […]
>
> […] (2017-03-12) We have received 4 mails from different people telling that Haiti has started DST again today, and this source seems to confirm that, I have not been able to find a more authoritative source: [URL]

America/Montevideo

[…] (1993-11-18) Uruguay wins the prize for the strangest peacetime manipulation of the rules.

1974: Decreto […], citing "the international rise in the price of oil", advanced clocks by 90 minutes (to UT-01:30). Decreto […] returned 60 of those minutes (to UT-02:30), and the remaining 30 minutes followed in Decreto […].

1987: "better use of national tourist attractions" to advance clocks one hour from Monday 1987-12-14 00:00.

(2005-03-11): Uruguay's DST was scheduled to end on Sunday, 2005-03-13, but in order to save energy … it was postponed two weeks….

(2015-06-30): … it looks like they will not be using DST the coming summer: Apparently restaurateurs complained that DST caused people to go to the beach instead of out to dinner.

Asia/Pyongyang

[…] (2015-08-07) According to many news sources, North Korea is going to change to the 8:30 time zone on August 15

[…] (2015-08-15) Bells rang out midnight (00:00) Friday as part of the celebrations. […]

[…] (2018-04-29) North Korea will revert its time zone from UTC+8:30 (PYT; Pyongyang Time) back to UTC+9 (KST; Korea Standard Time).

[…] (2018-04-30) […] It appears to be the front page story at the top in the right-most column.

Asia/Pyongyang

```
>>> datetime.datetime.now(pytz.timezone('Asia/Pyongyang'))
datetime.datetime(2018, 10, 25, 20, 28, 0, tzinfo=<DstTzInfo 'Asia/Pyongyang' KST+8:30:00 STD>)
```

Asia/Pyongyang

```
>>> datetime.datetime.now(pytz.timezone('Asia/Pyongyang'))
datetime.datetime(2018, 10, 25, 20, 28, 0, tzinfo=<DstTzInfo 'Asia/Pyongyang' KST+8:30:00 STD>)
```

```
$ TZ='Asia/Pyongyang' date
Thu Oct 25 20:58:00 KST 2018
```

Asia/Pyongyang

```
>>> datetime.datetime.now(pytz.timezone('Asia/Pyongyang'))
datetime.datetime(2018, 10, 25, 20, 28, 0, tzinfo=<DstTzInfo 'Asia/Pyongyang' KST+8:30:00 STD>)
```

```
$ TZ='Asia/Pyongyang' date
Thu Oct 25 20:58:00 KST 2018
```

```
$ pacman -Qs tz
community/python-pytz 2018.4-1
    Cross platform time zone library for Python
core/tzdata 2018e-1
    Sources for time zone and daylight saving time data
```

Asia/Pyongyang

```
>>> datetime.datetime.now(pytz.timezone('Asia/Pyongyang'))
datetime.datetime(2018, 10, 25, 20, 28, 0, tzinfo=<DstTzInfo 'Asia/Pyongyang' KST+8:30:00 STD>)
```

```
$ TZ='Asia/Pyongyang' date
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```
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community/python-pytz 2018.4-1
    Cross platform time zone library for Python
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    Sources for time zone and daylight saving time data
```

- Android 7: 2016f

Reading data

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datetime.datetime(2018, 11, 2, 15, 3, tzinfo=datetime.timezone(datetime.timedelta(seconds=10800)))
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>>> tzinfos = {'SP': tz.gettz('Europe/Moscow')}
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- if you have some solar data, match sunrise/sunset

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- AoE (Anywhere on Earth)
  - “2018-11-02 AoE”
  - 2018-11-02 23:59:59 Pacific/Samoa
  - 2018-11-02 10:59:59 UTC
  - 2018-11-02 13:59:59 MSK

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- AVOID TIME ZONES IF YOU CAN!

“The enjoyment of one's tools

is an essential ingredient of successful work.”

Donald E. Knuth

Miroslav Šedivý

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