It’s about time!

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RFC 3339

2012-09-16T14:30:00.000+02:00

- current era
- stated offset
- universal time
- instant in time

"a profile of the ISO 8601 standard for representation of dates and times using the Gregorian calendar"

"does not cater to local time zone rules"

in Python

```
>>> from datetime import datetime
>>> datetime(
...     year=2012, month=9, day=16,
...     hour=14, minute=30, second=0,
...     microsecond=0,
...     tzinfo=
```

pip install pytz

"No concrete tzinfo classes are supplied by the datetime module."

in Python with pytz

```
>>> from pytz import FixedOffset
>>> from datetime import datetime
>>> datetime(
...     year=2012, month=9, day=16,
...     hour=14, minute=30, second=0,
...     microsecond=0,
...     tzinfo=FixedOffset(120))
datetime.datetime(2012, 9, 16, 14, 30,
tzinfo=pytz.FixedOffset(120))
>>> _.isoformat()
'2012-09-16T14:30:00+02:00'
```

human-friendly zones

```
>>> from pytz import timezone
>>> from datetime import datetime
>>> datetime(
...       year=2012, month=9, day=16,
...       hour=14, minute=30, second=0,
...       microsecond=0,
...       tzinfo=timezone("Europe/Paris"))
datetime.datetime(2012, 9, 16, 14, 30,
tzinfo=<DstTzInfo 'Europe/Paris'
PMT+0:09:00 STD>)
```

not CEST+2:00:00?

"To create local wallclock times, use the localize() method."

human-friendly zones

```
>>> from pytz import timezone
>>> from datetime import datetime
>>> tz = timezone("Europe/Paris")
>>> tz.localize(datetime(
...     year=2012, month=9, day=16,
...     hour=14, minute=30, second=0,
...     microsecond=0))
datetime.datetime(2012, 9, 16, 14, 30,
tzinfo=<DstTzInfo 'Europe/Paris'
CEST+2:00:00 DST>)
>>> _.isoformat()
'2012-09-16T14:30:00+02:00'
```

it’s complicated!

I don’t need that!

it’s complex

we shall see

aware vs. naive datetimes

```
>>> naive = datetime(2012, 9, 16, 14, 35)
>>> tz = timezone("Europe/Paris")
>>> aware = tz.localize(naive)
```

```
>>> naive == aware
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: can't compare offset-naive and
offset-aware datetimes
```

aware vs. naive datetimes

```
>>> naive = datetime(2012, 9, 16, 14, 35)
>>> tz = timezone("Europe/Paris")
>>> aware = tz.localize(naive)
```

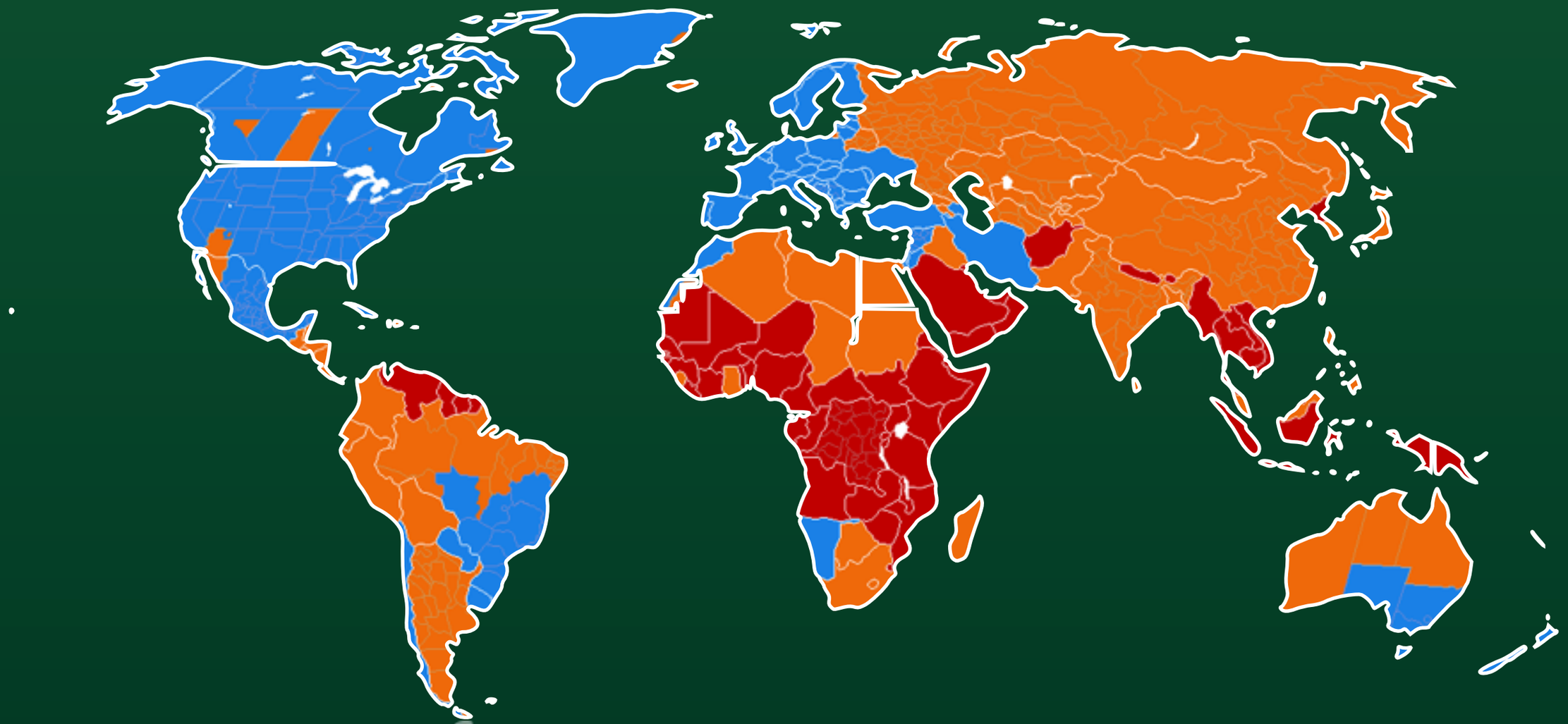
```
>>> naive - aware
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: can't subtract offset-naive
and offset-aware datetimes
```

aware vs. naive datetimes

"Whether a naive datetime object represents Coordinated Universal Time (UTC), local time, or time in some other timezone is purely up to the program."

"Naive datetime objects are easy to understand and to work with, at the cost of ignoring some aspects of reality."

Image: http://en.wikipedia.org/wiki/Daylight_saving_time



countries with DST

DST transitions

spring

autumn

DST

```
>>> from datetime import datetime

>>> from datetime import timedelta
>>> hour = timedelta(hours=1)

>>> from pytz import timezone
>>> tz = timezone("Europe/Paris")
```

DST

```
>>> dt1 = datetime(2012, 3, 25, 1, 30)

>>> dt1
datetime.datetime(2012, 3, 25, 1, 30)

>>> _ + hour
datetime.datetime(2012, 3, 25, 2, 30)
```

DST

```
>>> tz.localize(dt1)
datetime.datetime(2012, 3, 25, 1, 30,
tzinfo=<DstTzInfo 'Europe/Paris' CET
+1:00:00 STD>)

>>> _ + hour
datetime.datetime(2012, 3, 25, 2, 30,
tzinfo=<DstTzInfo 'Europe/Paris' CET
+1:00:00 STD>)
```

this doesn’t actually exist!

“A normalize() method is provided to correct this.”

DST

```
>>> tz.localize(dt1)
datetime.datetime(2012, 3, 25, 1, 30,
tzinfo=<DstTzInfo 'Europe/Paris' CET
+1:00:00 STD>)

>>> tz.normalize(_ + hour)
datetime.datetime(2012, 3, 25, 3, 30,
tzinfo=<DstTzInfo 'Europe/Paris' CEST
+2:00:00 DST>)
```

DST

```
>>> dt2 = datetime(2012, 10, 28, 2, 30)

>>> dt2
datetime.datetime(2012, 10, 28, 2, 30)

>>> _ - hour
datetime.datetime(2012, 10, 28, 1, 30)
```

DST

```
>>> tz.localize(dt2)
datetime.datetime(2012, 10, 28, 2, 30,
tzinfo=<DstTzInfo 'Europe/Paris' CET
+1:00:00 STD>)
```

```
>>> tz.normalize(_ - hour)
datetime.datetime(2012, 10, 28, 2, 30,
tzinfo=<DstTzInfo 'Europe/Paris' CEST
+2:00:00 DST>)
```

DST

```
>>> tz.localize(dt2, is_dst=False)
datetime.datetime(2012, 10, 28, 2, 30,
tzinfo=<DstTzInfo 'Europe/Paris' CET
+1:00:00 STD>)
```

```
>>> tz.localize(dt2, is_dst=True)
datetime.datetime(2012, 10, 28, 2, 30,
tzinfo=<DstTzInfo 'Europe/Paris' CEST
+2:00:00 DST>)
```

ambiguous time

```
>>> dt2
datetime.datetime(2012, 10, 28, 2, 30)
```

```
>>> tz.localize(_, is_dst=None)
Traceback (most recent call last):
  ...
pytz.exceptions.AmbiguousTimeError:
2012-10-28 02:30:00
```

non existent time

```
>>> dt1 + hour
datetime.datetime(2012, 3, 25, 2, 30)
```

```
>>> tz.localize(_, is_dst=None)
Traceback (most recent call last):
  ...
pytz.exceptions.NonExistentTimeError:
2012-03-25 02:30:00
```

leap years

```
>>> from datetime import date
>>> date(2012, 2, 29)
datetime.date(2012, 2, 29)
```

leap seconds

```
>>> from datetime import datetime
>>> datetime(2012, 6, 30, 23, 59, 60)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: second must be in 0..59
```

“I’ll use naive datetimes in UTC”

```
>>> import datetime
>>> datetime.datetime.utcnow()
datetime.datetime(2012, 9, 16, 12, 52,
25, 521458)
```

Will one of your libraries ever call datetime.datetime.now()?

“I’ll use naive datetimes in UTC”

```
>>> import datetime, os, time
>>> os.environ['TZ'] = 'UTC'
>>> time.tzset()
```

```
>>> datetime.datetime.now()
datetime.datetime(2012, 9, 16, 12, 52,
25, 521458)
```

Are you ever going to display or process a date and time in local time?

“I’ll use naive datetimes in UTC”

“I’ll use bytestrings encoded in UTF-8”

unicode vs. datetime

- “there ain’t no such thing as plain text”
  Joel Spolsky

- “software should only work with unicode strings internally, converting to a particular encoding on output”
  Python’s Unicode HOTWO

- “there ain’t no such thing as a naive datetime”
  yours truly

- “always work in UTC, converting to localtime only when generating output to be read by humans”
  pytz’ documentation

take advantage of the API safety

what about dates?

dates and datetimes

```
>>> from datetime import datetime
>>> from datetime import date, time
```

```
>>> issubclass(datetime, date)
True

>>> datetime.combine(
...     date(2012, 9, 16), time(14, 55))
datetime.datetime(2012, 9, 16, 14, 55)
```

dates and datetimes

```
>>> ny = timezone("America/New_York")
>>> in_ny = ny.localize(
...     datetime(2012, 9, 16, 1, 30))
```

```
>>> la = timezone("America/Los_Angeles")
>>> in_la = la.localize(
...     datetime(2012, 9, 15, 22, 30))

>>> in_ny == in_la
True
>>> in_ny.date() == in_la.date()
False
```

dates and datetimes

- dates are always naive
- depending on how you use them, this might be a problem
- using an aware datetime as a date is an accident waiting to happen
- Django supports mixing naive datetimes and dates (historically)

new in Django 1.4

time zone support

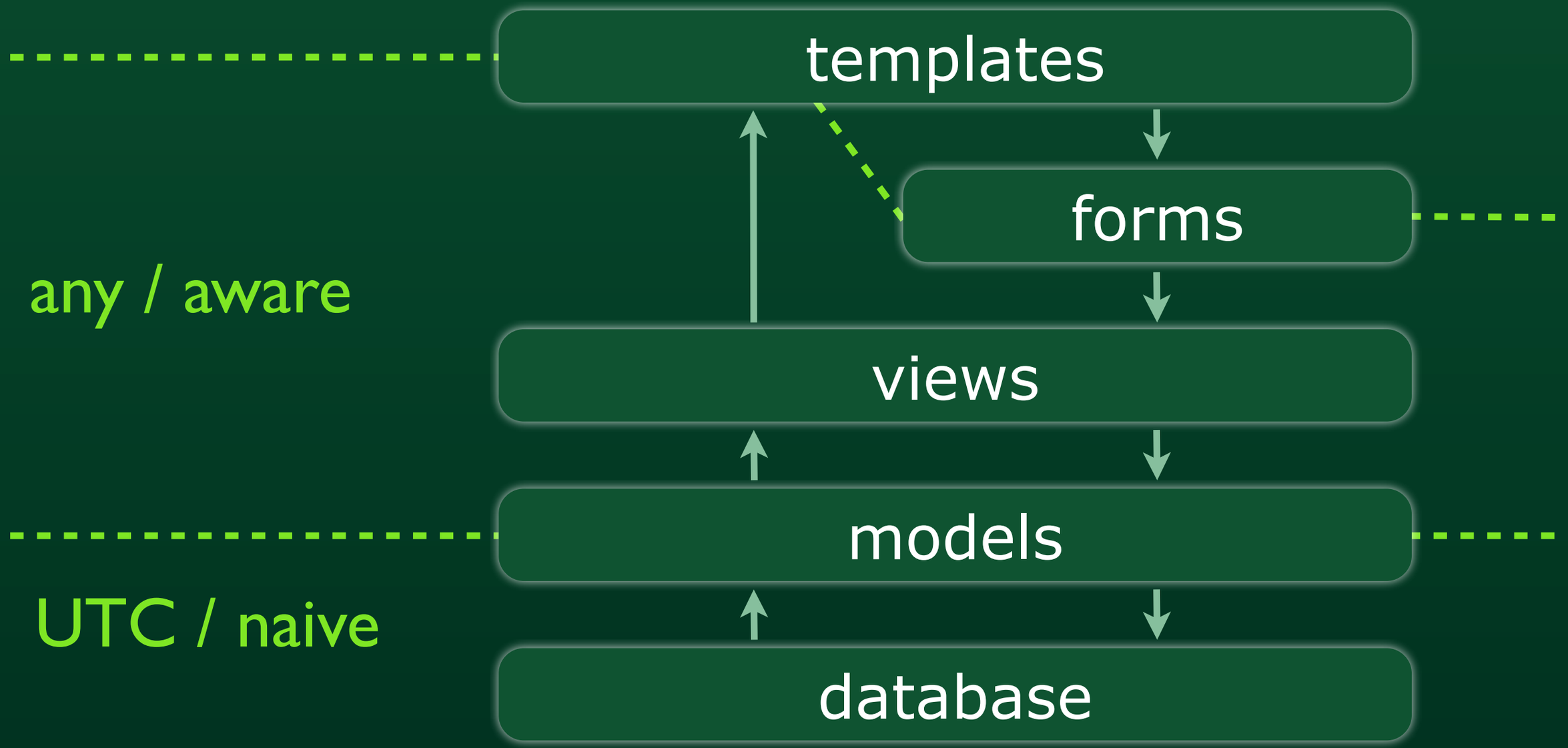
Django < 1.4
or USE_TZ = False

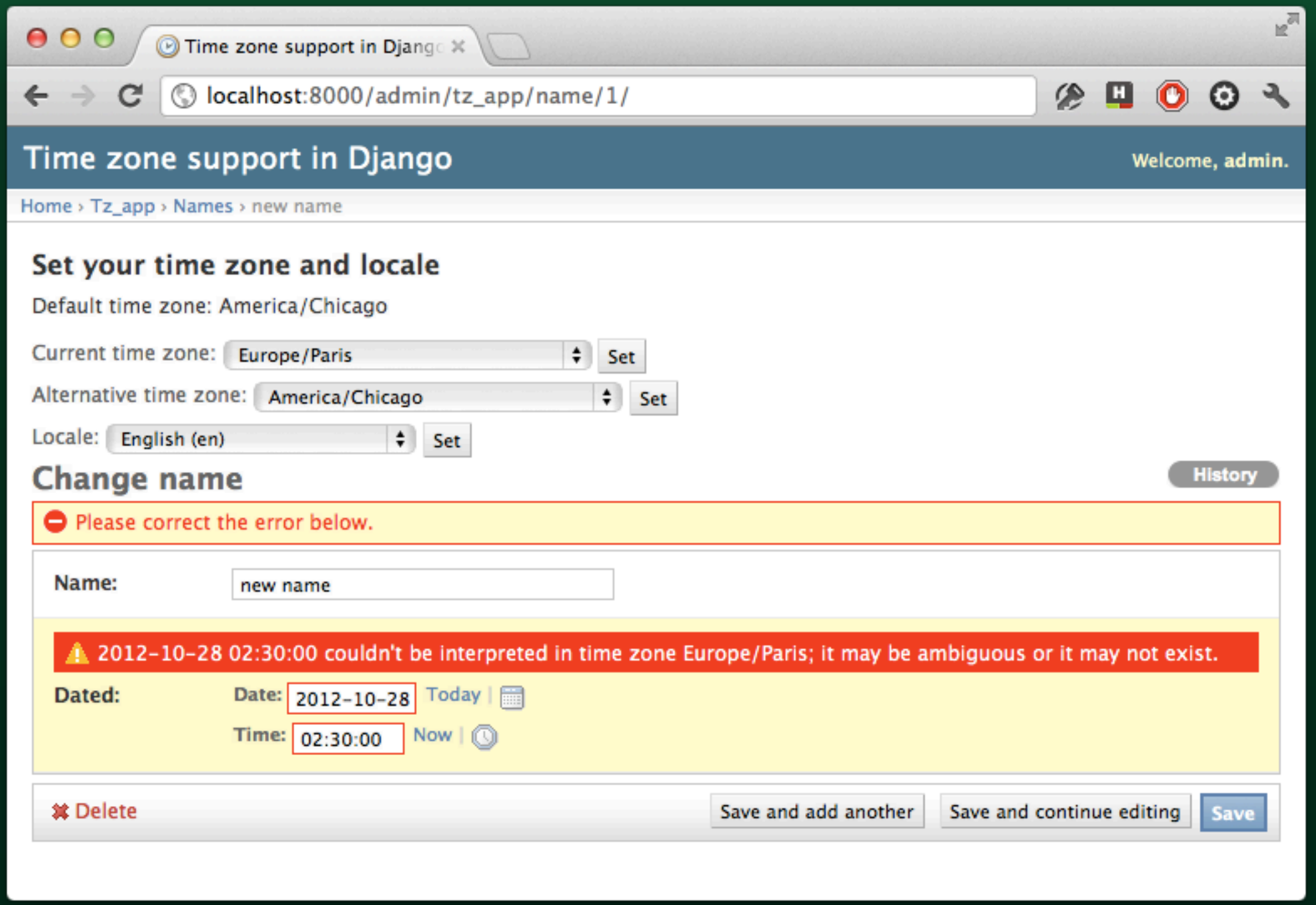
- uses naive datetimes in local time everywhere

Django >= 1.4 and USE_TZ = True

- uses aware datetimes in UTC internally
- stores naive datetimes in UTC in the database (except PostgreSQL)
- converts to aware datetimes in local time in forms and templates
- supports multiple time zones!

conversions at the borders




Time zone support in Djang
localhost:8000/admin/tz_app/name/1/
Time zone support in Django
Welcome, admin.
Home › Tz_app › Names › new name
Set your time zone and locale
Default time zone: America/Chicago
Current time zone: Europe/Paris Set
Alternative time zone: America/Chicago Set
Locale: English (en) Set
Change name
History
Please correct the error below.
Name: new name
2012-10-28 02:30:00 couldn't be interpreted in time zone Europe/Paris; it may be ambiguous or it may not exist.
Dated: Date: 2012-10-28 Today
Time: 02:30:00 Now
Delete
Save and add another
Save and continue editing
Save

default and current time zones

- default = settings.TIME_ZONE
  - used in models for conversions between naive and aware objects
- current = end user's time zone
  - used in templates and forms
  - for multiple time zones support

auto-conversions

- ensure backwards compatibility
- avoid surprises for single time zone sites
- but support sloppy constructs, e.g.
  - filter a DateTimeField with a date
  - save a datetime in a DateField

utilities

```
>>> from django.conf import settings
>>> from django.utils import timezone

>>> settings.USE_TZ = True
>>> timezone.now()
datetime.datetime(2012, 9, 16, 12, 58,
39, 438148, tzinfo=<UTC>)
>>> settings.USE_TZ = False
>>> timezone.now()
datetime.datetime(2012, 9, 16, 14, 58,
40, 746120)
```

limitations

- the database works in UTC
  https://code.djangoproject.com/ticket/17260
  - QuerySet.dates()
  - __year/month/day/week_day
- authors of pluggable apps may have to handle two cases

key learnings

1. a datetime is a point in time
   a date is a calendaring concept
2. use aware datetimes in UTC and
   convert to local time for humans
3. learn how to use pytz properly
   especially localize and normalize

Time isn't as simple as it seems.
Learn and practice!

Questions

Further reading

http://docs.python.org/library/datetime
http://pytz.sourceforge.net/
https://docs.djangoproject.com/en/dev/topics/i18n/timezones/

https://bitbucket.org/aaugustin/django-tz-demo
http://groups.google.com/group/django-developers/browse_thread/thread/cf0423bbb85b1bbf
https://code.djangoproject.com/ticket/2626