
ToscaWidgets2 Documentation

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ToscaWidgets is a HTML Widgets generation and management library.

It allows to create reusable widgets to show in web pages and manages the dependencies of the widgets like Javascript and CSS that those widgets might need to properly display and behave

```
class HelloWidget (twc.Widget) :
    inline_engine_name = "kajiki"
    template = """
        <i>Hello ${w.name}</i>
    """

    name = twc.Param(description="Name of the greeted entity")
```

Widgets can then be displayed within your web pages to create reusable components or forms:

```
>>> HelloWidget (name="World") .display ()
<i>Hello World</i>
```

Widgets have support for:

- Templating based on Kajiki, Mako, Genshi and Jinja2
- Resources, to bring in Javascript and CSS dependencies they need.
- Parameters, to configure their behaviour.
- Validation, to ensure proper data was provided and show validation errors to users.
- Hooks, to drive their behaviour at runtime.

ToscaWidgets2 also provides a `tw2.forms` package with ready to use widgets to display Forms with input validation.

1.1 Getting Started

1.1.1 Enabling ToscaWidgets

ToscaWidgets is designed to work within a web request life cycle, so some of its features rely on the a current request object to be able to work a keep track of the state of widgets or resources for the whole duration of the request.

For this reason, to start using ToscaWidgets you need to wrap your WSGI application in the `tw2.core.middleware.TwMiddleware`, which is also used to configure ToscaWidgets itself:

```
def application(environ, start_response):
    response_headers = [('Content-type', 'text/plain')]
    start_response("200 OK", response_headers)
    return [b"Hello World!"]

from tw2.core.middleware import TwMiddleware
application = TwMiddleware(application)

from wsgiref.simple_server import make_server
httpd = make_server('', 8000, application)
print("Serving on port 8000...")
httpd.serve_forever()
```

You can also provide all options available to configure ToscaWidgets (those listed in `tw2.core.middleware.Config`) to `TwMiddleware` as keyword arguments to change ToscaWidgets configuration:

```
from tw2.core.middleware import TwMiddleware
application = TwMiddleware(application, debug=False)
```

Note: Debug mode is enabled by default in ToscaWidgets, so make sure you provide `debug=False` on production to leverage templates caching and other speedups.

Now that the middleware is in place, you can easily display any widget you want into your application:

```
from tw2.forms import SingleSelectField

def application(environ, start_response):
    widget = SingleSelectField(options=[1, 2, 3])
    output = widget.display()

    response_headers = [('Content-type', 'text/html')]
    start_response("200 OK", response_headers)
    return [b"<h1>Hello World!</h1>",
            b"<p>Pick one of the options</p>",
            output.encode('ascii')]

from tw2.core.middleware import TwMiddleware
application = TwMiddleware(application)

from wsgiref.simple_server import make_server
httpd = make_server('', 8000, application)
print("Serving on port 8000...")
httpd.serve_forever()
```

See *Widgets* and *Forms* to get started creating widgets and forms.

```
class tw2.core.middleware.TwMiddleware(app, controllers=None, **config)
    ToscaWidgets middleware
```

This performs three tasks:

- Clear request-local storage before and after each request. At the start of a request, a reference to the middleware instance is stored in request-local storage.
- Proxy resource requests to ResourcesApp
- Inject resources

1.1.2 Configuration Options

```
class tw2.core.middleware.Config(**kw)
    ToscaWidgets Configuration Set
```

translator The translator function to use. (default: no-op)

default_engine The main template engine in use by the application. Widgets with no parent will display correctly inside this template engine. Other engines may require passing `displays_on` to `Widget.display()`. (default:string)

inject_resources Whether to inject resource links in output pages. (default: True)

inject_resources_location A location where the resources should be injected. (default: head)

serve_resources Whether to serve static resources. (default: True)

res_prefix The prefix under which static resources are served. This must start and end with a slash. (default: /resources/)

res_max_age The maximum time a cache can hold the resource. This is used to generate a Cache-control header. (default: 3600)

serve_controllers Whether to serve controller methods on widgets. (default: True)

controller_prefix The prefix under which controllers are served. This must start and end with a slash. (default: /controllers/)

bufsize Buffer size used by static resource server. (default: 4096)

params_as_vars Whether to present parameters as variables in widget templates. This is the behaviour from ToscaWidgets 0.9. (default: False)

debug Whether the app is running in development or production mode. (default: True)

validator_msgs A dictionary that maps validation message names to messages. This lets you override validation messages on a global basis. (default: {})

encoding The encoding to decode when performing validation (default: utf-8)

auto_reload_templates Whether to automatically reload changed templates. Set this to False in production for efficiency. If this is None, it takes the same value as debug. (default: None)

preferred_rendering_engines List of rendering engines in order of preference. (default: ['mako', 'genshi', 'jinja', 'kajiki'])

strict_engine_selection If set to true, TW2 will only select rendering engines from within your preferred_rendering_engines, otherwise, it will try the default list if it does not find a template within your preferred list. (default: True)

rendering_engine_lookup A dictionary of file extensions you expect to use for each type of template engine. Default:

```
{
    'mako': ['mak', 'mako'],
    'genshi': ['genshi', 'html'],
    'jinja': ['jinja', 'html'],
    'kajiki': ['kajiki', 'html'],
}
```

script_name A name to prepend to the url for all resource links (different from res_prefix, as it may be shared across and entire wsgi app. (default: ""))

1.2 Widgets

Widgets are small self-contained components that can be reused across the same web page or across multiple pages.

A widget typically has a state (its value) a configuration (its params) a template that describes what should be displayed, one ore more resources (javascript or CSS) needed during display and might have some logic that has to be executed every time the widget is displayed.

1.2.1 Using Widgets

A typical widget will look like:

```
class MyWidget(tw2.core.Widget):
    template = "mypackage.widgets.templates.mywidget"
```

Which will look for a template named `mywidget.html` into the `templates` python package within the `widgets` package of the `mypackage` application. The extension expected for the file depends on the template engine used:

- mako: `.mako`

- kajiki: .kajiki
- jinja: .jinja
- genshi: .genshi

The template engine used to render the provided template depends on the `default_engine` option provided when configuring `tw2.core.middleware.TwMiddleware`.

In case you don't want to save the template into a separate file you can also set the `inline_engine_name` option to one of the template engines and provide the template as a string:

```
class HelloWidgetTemplate(tw2.core.Widget):
    inline_engine_name = "kajiki"
    template = """
        <i>Hello <span py:for="i in range(1, 4)">${i}, </span></i>
    """
```

Displaying a widget is as simple as calling the `Widget.display()`:

```
HelloWidgetTemplate.display()
```

Widget value

Each Widget has a special parameter, which is `value`. This parameter contains the current state of the widget. Value will usually be a single value or a dictionary containing multiple values (in case of `tw2.core.widgets.CompoundWidget`).

You can use the value to drive what the widget should show once displayed:

```
class HelloWidgetValue(tw2.core.Widget):
    inline_engine_name = "kajiki"
    template = """
        <i>Hello ${w.value}</i>
    """

>>> HelloWidgetValue.display(value='World')
Markup('<i>Hello World</i>')
```

`tw2.core.CompoundWidget` can contain multiple subwidgets (children) and their value is typically a dict with values for each one of the children:

```
class CompoundHello(tw2.core.CompoundWidget):
    inline_engine_name = "kajiki"
    template = """
        <div py:for="c in w.children">
            ${c.display()}
        </div>
    """

    name = HelloWidgetValue()
    greeter = tw2.core.Widget(inline_engine_name="kajiki",
                              template="<span>From ${w.value}</span>")

>>> CompoundHello(value=dict(name="Mario", greeter="Luigi")).display()
Markup('<div><span>Hello Mario</span></div><div><span>From Luigi</span></div>')
```

Children of a compound widget (like *Forms*) can be accessed both as a list iterating over `w.children` or by name using `w.children.childname`.

Parameters

Widgets might require more information than just their value to display, or might allow more complex kind of configurations. The options required to configure the widget are provided through `tw2.core.Param` objects that define which options each widget supports.

If you want your widget to be configurable, you can make available one or more options to your Widget and allow any user to set them as they wish:

```
class HelloWidgetParam(tw2.core.Widget):
    inline_engine_name = "kajiki"
    template = """
        <i>Hello ${w.name}</i>
    """
    name = tw2.core.Param(description="Name of the greeted entity")
```

The parameters can be provided any time by changing configuration of a widget:

```
>>> w = HelloWidgetParam(name="Peach")
>>> w.display()
Markup('<i>Hello Peach</i>')
>>> w2 = w(name="Toad")
>>> w2.display()
Markup('<i>Hello Toad</i>')
```

Or can be provided at display time itself:

```
>>> HelloWidgetParam.display(name="Peach")
Markup('<i>Hello Peach</i>')
```

Deferred Parameters

When a widget requires a parameter that is not available before display time. That parameter can be set to a `tw2.core.Deferred` object.

Deferred objects will accept any callable and before the widget is displayed the callable will be executed to fetch the actual value for the widget:

```
>>> singleselect = SingleSelectField(options=tw2.core.Deferred(lambda: [1,2,3]))
>>> singleselect.options
<Deferred: <Deferred>>
>>> singleselect.display()
Markup('<select ><option value=""></option>\n <option value="1">1</option>\n <option_
↳value="2">2</option>\n <option value="3">3</option>\n</select>')
```

Deferred is typically used when loading data from the content of a database to ensure that the content is the one available at the time the widget is displayed and not the one that was available when the application started:

```
>>> userpicker = twf.SingleSelectField(
...     options=twc.Deferred(lambda: [(u.user_id, u.display_name) for u in model.
↳DBSession.query(model.User)])
... )
>>> userpicker.display()
Markup('<select ><option value=""></option>\n <option value="1">Example manager</
↳option>\n <option value="2">Example editor</option>\n</select>')
```

Builtin Widgets

The `tw2.core` packages comes with the basic builtin blocks needed to create your own custom widgets.

class `tw2.core.widgets.Widget` (**kw)

Base class for all widgets.

classmethod `req` (**kw)

Generate an instance of the widget.

Return the validated widget for this request if one exists.

classmethod `post_define` ()

This is a class method, that is called when a subclass of this `Widget` is created. Process static configuration here. Use it like this:

```
class MyWidget(LeafWidget):
    @classmethod
    def post_define(cls):
        id = getattr(cls, 'id', None)
        if id and not id.startswith('my'):
            raise pm.ParameterError("id must start with 'my'")
```

`post_define` should always cope with missing data - the class may be an abstract class. There is no need to call `super()`, the metaclass will do this automatically.

classmethod `get_link` ()

Get the URL to the controller . This is called at run time, not startup time, so we know the middleware if configured with the controller path. Note: this function is a temporary measure, a cleaner API for this is planned.

prepare ()

This is an instance method, that is called just before the `Widget` is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

iteritems ()

An iterator which will provide the params of the widget in key, value pairs.

controller_path = <functools.partial object>

add_call = <functools.partial object>

display = <functools.partial object>

generate_output (*displays_on*)

Generate the actual output text for this widget.

By default this renders the widget's template. Subclasses can override this method for purely programmatic output.

displays_on The name of the template engine this widget is being displayed inside.

Use it like this:

```
class MyWidget(LeafWidget):
    def generate_output(self, displays_on):
        return "<span {0}>{1}</span>".format(self.attrs, self.text)
```

classmethod validate (*params, state=None*)

Validate form input. This should always be called on a class. It either returns the validated data, or raises a `ValidationError` exception.

class `tw2.core.widgets.LeafWidget` (**kw)

A widget that has no children; this is the most common kind, e.g. form fields.

class `tw2.core.widgets.CompoundWidget` (**kw)

A widget that has an arbitrary number of children, this is common for layout components, such as `tw2.forms.TableLayout`.

classmethod post_define ()

Check children are valid; update them to have a link to the parent.

prepare ()

Propagate the value for this widget to the children, based on their id.

class `tw2.core.widgets.RepeatingWidget` (**kw)

A widget that has a single child, which is repeated an arbitrary number of times, such as `tw2.forms.GridLayout`.

classmethod post_define ()

Check child is valid; update with link to parent.

prepare ()

Propagate the value for this widget to the children, based on their index.

class `tw2.core.widgets.DisplayOnlyWidget` (**kw)

A widget that has a single child. The parent widget is only used for display purposes; it does not affect value propagation or validation. This is used by widgets like `tw2.forms.FieldSet`.

classmethod post_define ()

This is a class method, that is called when a subclass of this Widget is created. Process static configuration here. Use it like this:

```
class MyWidget(LeafWidget):
    @classmethod
    def post_define(cls):
        id = getattr(cls, 'id', None)
        if id and not id.startswith('my'):
            raise pm.ParameterError("id must start with 'my'")
```

`post_define` should always cope with missing data - the class may be an abstract class. There is no need to call `super()`, the metaclass will do this automatically.

prepare ()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

class `tw2.core.widgets.Page` (**kw)

An HTML page. This widget includes a `request()` method that serves the page.

classmethod post_define ()

This is a class method, that is called when a subclass of this Widget is created. Process static configuration here. Use it like this:

```
class MyWidget (LeafWidget):
    @classmethod
    def post_define(cls):
        id = getattr(cls, 'id', None)
        if id and not id.startswith('my'):
            raise pm.ParameterError("id must start with 'my'")
```

`post_define` should always cope with missing data - the class may be an abstract class. There is no need to call `super()`, the metaclass will do this automatically.

```
class tw2.core.Param (description=Default, default=Default, request_local=Default, at-
tribute=Default, view_name=Default)
```

A parameter for a widget.

description A string to describe the parameter. When overriding a parameter description, the string can include `$$` to insert the previous description.

default The default value for the parameter. If no default is specified, the parameter is a required parameter. This can also be specified explicitly using `tw.Required`.

request_local Can the parameter be overridden on a per-request basis? (default: True)

attribute Should the parameter be automatically included as an attribute? (default: False)

view_name The name used for the attribute. This is useful for attributes like `class` which are reserved names in Python. If this is `None`, the name is used. (default: `None`)

The class takes care to record which arguments have been explicitly specified, even if to their default value. If a parameter from a base class is updated in a subclass, arguments that have been explicitly specified will override the base class.

```
class tw2.core.Deferred (fn)
```

This class is used as a wrapper around a parameter value. It takes a callable, which will be called every time the widget is displayed, with the returned value giving the parameter value.

1.2.2 Resources

ToscaWidgets comes with resources management for widgets too.

Some widgets might be complex enough that they need external resources to work properly. Typically those are CSS stylesheets or Javascript functions.

The need for those can be specified in the `Widget.resources` param, which is a list of resources the widget needs to work properly

The `tw2.core.middleware.TwMiddleware` takes care of serving all the resources needed by a widget through a `tw2.core.resources.ResourcesApp`. There is not need to setup such application manually, having a `TwMiddleware` in place will provide support for resources too.

When a widget is being prepared for display, all resources that it requires (as specified by `tw2.core.Widget.resources`) are registered into the current request and while the response page output goes through the middleware it will be edited to add the links (or content) of those resources as specified by their location.

Note: If a resource was already injected into the page during current request and another widget requires it, it won't be injected twice. ToscaWidgets is able to detect that it's the same resource (thanks to the resource `id`) and only inject that once.

To add resources to a widget simply specify them in `tw2.core.Widget.resources`:

```

class HelloWidgetClass(twc.Widget):
    inline_engine_name = "kajiki"
    template = """
        <i class="{w.css_class}">Hello {w.name}</i>
    """

    name = twc.Param(description="Name of the greeted entity")
    css_class = twc.Param(description="Class used to display content", default="red")

    resources = [
        twc.CSSSource(src="""
            .red { color: red; }
            .green { color: green; }
            .blue { color: blue; }
        """)
    ]

```

Once the page where the widget is displayed is rendered, you will see that it begins with:

```

<!DOCTYPE html>
<html>
<head><style type="text/css">
    .red { color: red; }
    .green { color: green; }
    .blue { color: blue; }
</style>
<meta content="width=device-width, initial-scale=1.0" name="viewport">
<meta charset="utf-8">

```

Which contains the CSS resource you specified as a dependency of your widget.

In case you are using a solution to package your resources into bundles like WebPack, WebAssets or similar, you might want to disable resources injection using `inject_resources=False` option provided to `tw2.core.middleware.TwMiddleware` to avoid injecting resources that were already packed into your bundle.

Builtin Resource Types

class `tw2.core.resources.ResourceBundle` (**kw)

Just a list of resources.

Use it as follows:

```

>>> jquery_ui = ResourceBundle(resources=[jquery_js, jquery_css])
>>> jquery_ui.inject()

```

class `tw2.core.resources.Resource` (**kw)

A resource required by a widget being displayed.

location states where the resource should be injected into the page. Can be any of head, headbottom, bodytop or bodybottom or None.

class `tw2.core.resources.Link` (**kw)

A link to a file.

The link parameter can be used to specify the explicit link to a URL.

If omitted, the link will be built to serve filename from modname as a resource coming from a python distribution.

classmethod `guess_modname()`

Try to guess my modname.

If I wasn't supplied any modname, take a guess by stepping back up the frame stack until I find something not in `tw2.core`

classmethod `post_define()`

This is a class method, that is called when a subclass of this Widget is created. Process static configuration here. Use it like this:

```
class MyWidget(LeafWidget):
    @classmethod
    def post_define(cls):
        id = getattr(cls, 'id', None)
        if id and not id.startswith('my'):
            raise pm.ParameterError("id must start with 'my'")
```

`post_define` should always cope with missing data - the class may be an abstract class. There is no need to call `super()`, the metaclass will do this automatically.

class `tw2.core.resources.DirLink(**kw)`

A whole directory as a resource.

Unlike *JSLink* and *CSSLink*, this resource doesn't inject anything on the page.. but it does register all resources under the marked directory to be served by the middleware.

This is useful if you have a css file that pulls in a number of other static resources like icons and images.

class `tw2.core.resources.JSLink(**kw)`

A JavaScript source file.

By default is injected in whatever default place is specified by the middleware.

class `tw2.core.resources.CSSLink(**kw)`

A CSS style sheet.

By default it's injected at the top of the head node.

class `tw2.core.resources.JSSource(**kw)`

Inline JavaScript source code.

By default is injected before the `</body>` is closed

class `tw2.core.resources.CSSSource(**kw)`

Inline Cascading Style-Sheet code.

By default it's injected at the top of the head node.

1.3 Forms

ToscaWidgets provides all the widgets related to building HTML Forms in the `tw2.forms` package.

While `tw2.core` implements the foundation for declaring any kind of widget, the `tw2.forms` is specialised in widgets that are needed to create HTML forms.

1.3.1 Form

A form is usually created by declaring a subclass of a `tw2.forms.Form`. Within the form a `child` attribute that specifies the *Form Layout* (how the fields should be arranged graphically) through a subclass of `tw2.forms`.

Layout and then within `child` all the fields of the form can be declared:

```
import tw2.core as twc
import tw2.forms as twf

class MovieForm(twf.Form):
    class child(twf.TableLayout):
        title = twf.TextField()
        director = twf.TextField(value='Default Director')
        genres = twf.SingleSelectField(options=['Action', 'Comedy', 'Romance', 'Sci-fi
↵'])

        action = '/save_movie'
```

The form must also provide an `action` attribute to specify where the form should be submitted.

Note: If you are going to use ToscaWidgets with TurboGears you probably want the action to be a `tg.lurl` to ensure that prefix of your application is retained.

Form Buttons

By default, each form comes with a **submit** button.

The submit button can be replaced by setting the form `submit` attribute:

```
class NameForm(twf.Form):
    class child(twf.TableLayout):
        name = twf.TextField()

        action = '/save_name'
        submit = twf.SubmitButton(value="Save Name")
```

Multiple buttons can also be provided for the form by setting the `buttons` attribute:

```
class NameForm(twf.Form):
    class child(twf.TableLayout):
        name = twf.TextField()

        action = '/save_name'
        buttons = [
            twf.SubmitButton(value="Save Name"),
            twf.ResetButton(),
            twf.Button(value="Say Hi", attrs=dict(onclick="alert('hi')"))
        ]
```

Dynamic Forms

Children can be added and removed dynamically from forms using the `Widget.post_define()` and `Widget.prepare()` methods.

For example to change children of a form based on an option, `Widget.post_define()` can be used:

```
class GrowingMovieForm(twf.Form):
    class child(twf.TableLayout):
        @classmethod
        def post_define(cls):
            if not cls.parent:
                return

            children = []

            for count in range(cls.parent.num_contacts):
                class person_fieldset(twf.TableFieldSet):
                    id = "person_%s" % count
                    label = "Person #s" % count
                    name = twf.TextField(validator=twc.Validator(required=True))
                    surname = twf.TextField()

                    children.append(person_fieldset(parent=cls))

                cls.children = children

            action = '/save_contacts'
            num_contacts = twc.Param(default=1)

fivefieldsform = GrowingMovieForm(num_contacts=5)
```

Note: Use the same `fivefieldsform` object for both display and validation. Trying to make a new `GrowingMovieForm` might not work even though `num_contacts` is always set to 5.

This will not work btw if you need to take action at display time. In such case `Widget.prepare()` is needed, for example to have a text field that suggests the placeholder based on its original value:

```
class DynamicText(twf.Form):
    class child(twf.TableLayout):
        text = twf.TextField(placeholder="Put text here")

    action = "/save_movie"

    def prepare(self):
        super(DynamicText, self).prepare()

        if self.child.children.text.value:
            self.child.children.text.attrs = dict(
                self.child.children.text.attrs,
                placeholder="Put text here (was %s)" % self.child.children.text.value
            )
```

Note: `Widget.prepare()` is usually involved when setting a state that depends on the current request. For example current value of a field, or something else that is known only in current request. The resulting state of the widget is also only valid in current request, a different request might have nothing in common. Keep this in mind when using validation, as validation usually happens in a different request from the one that displayed the widget.

```
class tw2.forms.widgets.Form(**kw)
    A form, with a submit button. It's common to pass a TableLayout or ListLayout widget as the child.
```

classmethod `post_define()`

This is a class method, that is called when a subclass of this Widget is created. Process static configuration here. Use it like this:

```
class MyWidget(LeafWidget):
    @classmethod
    def post_define(cls):
        id = getattr(cls, 'id', None)
        if id and not id.startswith('my'):
            raise pm.ParameterError("id must start with 'my'")
```

`post_define` should always cope with missing data - the class may be an abstract class. There is no need to call `super()`, the metaclass will do this automatically.

prepare()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

submit

alias of `tw2.core.params.SubmitButton_s_s`

1.3.2 Validating Forms

When you submit a form, it will send its data to the endpoint you specified through the `action` parameter.

Before using it, you probably want to make sure that the data that was sent is correct and display back to the user error messages when it is not.

This can be done through *Validation* and thanks to the fact that Forms remember which form was just validated in the current request.

For each field in the form it is possible to specify a `validator=` parameter, which will be in charge of validation for that field:

```
class ValidatedForm(twf.Form):
    class child(twf.TableLayout):
        number = twf.TextField(placeholder="a number (1, 2, 3, 4)",
                               validator=twc.validation.IntValidator())
        required = twf.TextField(validator=twc.Required)
```

To validate the data submitted through this form you can use the `tw2.forms.widgets.Form.validate()` method.

If the validation passes, the method will return the validated data:

```
>>> ValidatedForm.validate({'numer': 5, 'required': 'hello'})
{'numer': 5, 'required': 'hello'}
```

If the validation fails, it will raise a `tw2.core.validation.ValidationError` exception:

```
Traceback (most recent call last):
  File "/home/amol/wrk/tw2.core/tw2/core/validation.py", line 106, in wrapper
```

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```

    d = fn(self, *args, **kw)
    File "/home/amol/wrk/tw2.core/tw2/core/widgets.py", line 718, in _validate
        raise vd.ValidationError('childerror', exception_validator)
tw2.core.validation.ValidationError

```

Such error can be trapped to get back the validated widget, the value that was being validated and the error message for each of its children:

```

>>> try:
...     ValidatedForm.validate({'numer': 'Hello', 'required': ''})
... except tw2.core.validation.ValidationError as e:
...     print(e.widget.child.value)
...     for c in e.widget.child.children:
...         print(c.compound_key, ':', c.error_msg)

{'numer': 'Hello', 'required': ''}
numer : Must be an integer
required : Enter a value

```

Also, trying to display back the form that was just validated, will print out the error message for each field:

```

>>> try:
...     ValidatedForm.validate({'numer': 'Hello', 'required': ''})
... except tw2.core.validation.ValidationError as e:
...     print(e.widget.display())

<form enctype="multipart/form-data" method="post">
  <span class="error"></span>

  <table>
  <tr class="odd error" id="numer:container">
    <th><label for="numer">Numer</label></th>
    <td>
      <input id="numer" name="numer" placeholder="a number (1, 2, 3, 4)" type=
↪"text" value="Hello"/>
      <span id="numer:error">Must be an integer</span>
    </td>
  </tr><tr class="even required error" id="required:container">
    <th><label for="required">Required</label></th>
    <td>
      <input id="required" name="required" type="text" value=""/>
      <span id="required:error">Enter a value</span>
    </td>
  </tr>
  </table>
  <input type="submit" value="Save"/>
</form>

```

For convenience, you can also recover the currently validated instance of the form anywhere in the code. Even far away from the exception that reported the validation error.

This can be helpful when you are isolating validation into a separate Aspect of your application and then you need to recover the form instance that includes the errors to display into your views.

To retrieve the currently validated widget, you can just use `tw2.core.widget.Widget.req()`:

```
>>> try:
...     ValidatedForm.validate({'numer': 'Hello', 'required': ''})
... except tw2.core.validation.ValidationError as e:
...     print(e.widget)
...     print(ValidatedForm.req())

<__main__.ValidatedForm object at 0x7f9432e5e080>
<__main__.ValidatedForm object at 0x7f9432e5e080>
```

As you can see `ValidatedForm.req()` returns the same exact instance that `e.widget` was. That's because when `Widget.req()` is used and there is a validated instance of that same exact widget in the current request, ToscaWidgets will assume you are trying to access the widget you just validated and will return that one instance of building a new instance.

If you want a new instance, you can still do `ValidatedForm().req()` instead of `ValidatedForm.req()`:

```
>>> try:
...     ValidatedForm.validate({'numer': 'Hello', 'required': ''})
... except tw2.core.validation.ValidationError as e:
...     print(e.widget)
...     print(ValidatedForm().req())

<__main__.ValidatedForm object at 0x7f9432e5e080>
<tw2.core.params.ValidatedForm_d object at 0x7f9432420940>
```

Keep in mind that this only keeps memory of the *last* widget that failed validation. So in case multiple widgets failed validation in the same request, you must use `tw2.core.validation.ValidationError.widget` to access each one of them.

1.3.3 Form Layout

A layout specifies how the fields of the form should be arranged.

This can be specified by having `Form.child` inherit from a specific layout class:

```
class NameForm(twf.Form):
    class child(twf.TableLayout):
        name = twf.TextField()
```

or:

```
class NameForm(twf.Form):
    class child(twf.ListLayout):
        name = twf.TextField()
```

Custom Layouts

A custom layout class can also be made to show the children however you want:

```
class Bootstrap3Layout(twf.BaseLayout):
    inline_engine_name = "kajiki"
    template = """
<div py:attrs="w.attrs">
    <div class="form-group" py:for="c in w.children_non_hidden" title="{w.hover_help_
↵and c.help_text or None}" py:attrs="c.container_attrs" id="{c.compound_id}
↵:container">
```

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```

        <label for="{c.id}" py:if="c.label">{c.label}</label>
        {c.display(attrs={"class": "form-control"})}
        <span id="{c.compound_id}:error" class="error help-block" py:content="c.
↪error_msg"/>
    </div>
    <py:for each="c in w.children_hidden">{c.display()}</py:for>
    <div id="{w.compound_id}:error" py:content="w.error_msg"></div>
</div>"""

class BootstrapNameForm(twf.Form):
    class child(Bootstrap3Layout):
        name = twf.TextField()

        submit = twf.SubmitButton(css_class="btn btn-default")

```

Complex Layouts

In case of complex custom layouts, you can even specify the layout case by case in the form itself with each children in a specific position accessing the children using `w.children.child_name`:

```

class OddNameForm(twf.Form):
    class child(twf.BaseLayout):
        inline_engine_name = "kajiki"
        template = """
        <div py:attrs="w.attrs">
            <div py:with="c=w.children.name">
                {c.display()}
                <span id="{c.compound_id}:error" py:content="c.error_msg"/>
            </div>
            <div py:with="c=w.children.surname">
                {c.display()}
                <span id="{c.compound_id}:error" py:content="c.error_msg"/>
            </div>

            <py:for each="ch in w.children_hidden">{ch.display()}</py:for>
            <div id="{w.compound_id}:error" py:content="w.error_msg"></div>
        </div>
        """

        name = twf.TextField()
        surname = twf.TextField()

```

class `tw2.forms.widgets.BaseLayout` (***kw*)

The following CSS classes are used, on the element containing both a child widget and its label.

odd / even On alternating rows. The first row is odd.

required If the field is a required field.

error If the field contains a validation error.

prepare ()

Propagate the value for this widget to the children, based on their id.

class `tw2.forms.widgets.ListLayout` (***kw*)

Arrange widgets and labels in a list.

The following CSS classes are used, on the element containing both a child widget and its label.

odd / even On alternating rows. The first row is odd.

required If the field is a required field.

error If the field contains a validation error.

class `tw2.forms.widgets.TableLayout (**kw)`

Arrange widgets and labels in a table.

The following CSS classes are used, on the element containing both a child widget and its label.

odd / even On alternating rows. The first row is odd.

required If the field is a required field.

error If the field contains a validation error.

class `tw2.forms.widgets.GridLayout (**kw)`

Arrange labels and multiple rows of widgets in a grid.

child

alias of `tw2.core.params.RowLayout_s`

class `tw2.forms.widgets.RowLayout (**kw)`

Arrange widgets in a table row. This is normally only useful as a child to `GridLayout`.

prepare ()

Propagate the value for this widget to the children, based on their id.

1.3.4 Builtin Form Fields

`tw2.forms` package comes with a bunch of builtin widgets that can help you build the most common kind of forms.

class `tw2.forms.widgets.FormField (**kw)`

Basic Form Widget from which each other field will inherit

name

Name of the field

required

If the field is required according to its validator (read-only)

class `tw2.forms.widgets.TextFieldMixin (**kw)`

Misc mixin class with attributes for textual input fields

maxlength = None

Maximum length of the field

placeholder = None

Placeholder text, until user writes something.

class `tw2.forms.widgets.InputField (**kw)`

A generic `<input>` field.

Generally you won't use this one, but will rely on one of its specialised subclasses like `TextField` or `Checkbox`.

type = None

Input type

value = None

Current value of the input

required = None

Add required attributed to the input.

autofocus = None

Add autofocus attributed to the input.

prepare ()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget (Widget):
    def prepare (self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

class tw2.forms.widgets.**PostlabeledInputField** (**kw)

Inherits InputField, but with a text label that follows the input field

text = None

Text to display in the label after the field.

text_attrs = {}

Attributes of the label displayed after to the field.

class tw2.forms.widgets.**TextField** (**kw)

A simple text field where to input a single line of text

size = None

Add size attribute to the HTML field.

class tw2.forms.widgets.**TextArea** (**kw)

A multiline text area

rows = None

Add a rows= attribute to the HTML textarea

cols = None

Add a cols= attribute to the HTML textarea

class tw2.forms.widgets.**CheckBox** (**kw)

A single checkbox.

Its value will be True or False if selected or not.

prepare ()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget (Widget):
    def prepare (self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

class tw2.forms.widgets.**RadioButton** (**kw)

A single radio button

checked = False

If the radio button is checked or not.

class tw2.forms.widgets.**PasswordField** (**kw)

A password field. This never displays a value passed into the widget, although it does redisplay entered values on validation failure. If no password is entered, this validates as EmptyField.

prepare ()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

class `tw2.forms.widgets.FileValidator (**kw)`

Validate a file upload field

extension Allowed extension for the file

class `tw2.forms.widgets.FileField (**kw)`

A field for uploading files. The returned object has (at least) two properties of note:

- **filename:** the name of the uploaded file
- **value:** a bytestring of the contents of the uploaded file, suitable for being written to disk

prepare ()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

class `tw2.forms.widgets.HiddenField (**kw)`

A hidden field.

Typically this is used to bring around in the form values that the user should not be able to modify or see. Like the ID of the entity edited by the form.

class `tw2.forms.widgets.IgnoredField (**kw)`

A hidden field. The value is never included in validated data.

class `tw2.forms.widgets.LabelField (**kw)`

A read-only label showing the value of a field. The value is stored in a hidden field, so it remains through validation failures. However, the value is never included in validated data.

class `tw2.forms.widgets.LinkField (**kw)`

A dynamic link based on the value of a field. If either *link* or *text* contain a \$, it is replaced with the field value. If the value is None, and there is no default, the entire link is hidden.

prepare ()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

class `tw2.forms.widgets.Button (**kw)`

Generic button. You can override the text using *value* and define a JavaScript action using *attrs*['onclick'].

class `tw2.forms.widgets.SubmitButton (**kw)`

Button to submit a form.

class `tw2.forms.widgets.ResetButton (**kw)`
Button to clear the values in a form.

class `tw2.forms.widgets.ImageButton (**kw)`

prepare ()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

class `tw2.forms.widgets.HTML5PatternMixin (**kw)`
HTML5 mixin for input field regex pattern matching

See <http://html5pattern.com/> for common patterns.

TODO: Configure server-side validator

class `tw2.forms.widgets.HTML5MinMaxMixin (**kw)`
HTML5 mixin for input field value limits

TODO: Configure server-side validator

class `tw2.forms.widgets.HTML5StepMixin (**kw)`
HTML5 mixin for input field step size

class `tw2.forms.widgets.HTML5NumberMixin (**kw)`
HTML5 mixin for number input fields

class `tw2.forms.widgets.EmailField (**kw)`
An email input field (HTML5 only).

Will fallback to a normal text input field on browser not supporting HTML5.

class `tw2.forms.widgets.UrlField (**kw)`
An url input field (HTML5 only).

Will fallback to a normal text input field on browser not supporting HTML5.

class `tw2.forms.widgets.NumberField (**kw)`
A number spinbox (HTML5 only).

Will fallback to a normal text input field on browser not supporting HTML5.

class `tw2.forms.widgets.RangeField (**kw)`
A number slider (HTML5 only).

Will fallback to a normal text input field on browser not supporting HTML5.

class `tw2.forms.widgets.SearchField (**kw)`
A search box (HTML5 only).

Will fallback to a normal text input field on browser not supporting HTML5.

class `tw2.forms.widgets.ColorField (**kw)`
A color picker field (HTML5 only).

Will fallback to a normal text input field on browser not supporting HTML5.

```
class tw2.forms.widgets.SelectionField(**kw)
```

Base class for single and multiple selection fields.

The *options* parameter must be a list; it can take several formats:

- A list of values, e.g. [' ', 'Red', 'Blue']
- A list of (code, value) tuples, e.g. [(0, ' '), (1, 'Red'), (2, 'Blue')]
- A mixed list of values and tuples. If the code is not specified, it defaults to the value. e.g. [' ', (1, 'Red'), (2, 'Blue')]
- Attributes can be specified for individual items, e.g. [(1, 'Red', {'style': 'background-color: red'})]
- A list of groups, e.g. [('group1', [(1, 'Red')]), ('group2', ['Pink', 'Yellow'])]

Setting *value* before rendering will set the default displayed value on the page. In *ToscaWidgets1*, this was accomplished by setting *default*. That is no longer the case.

options = None

List of options to pick from in the form [(id, text), (id, text), ...]

prompt_text = None

Prompt to display when no option is selected. Set to *None* to disable this.

prepare()

This is an instance method, that is called just before the *Widget* is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

```
class tw2.forms.widgets.MultipleSelectionField(**kw)
```

item_validator = None

Validator that has to be applied to each item.

prepare()

This is an instance method, that is called just before the *Widget* is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

```
class tw2.forms.widgets.SingleSelectField(**kw)
```

Specialised *SelectionField* to pick one element from a list of options.

```
class tw2.forms.widgets.MultipleSelectField(**kw)
```

Specialised *SelectionField* to pick multiple elements from a list of options.

size = None

Number of options to show

```
class tw2.forms.widgets.SelectionList(**kw)
```

```
class tw2.forms.widgets.SeparatedSelectionTable(**kw)
```

```
class tw2.forms.widgets.RadioButtonList (**kw)
```

```
class tw2.forms.widgets.CheckBoxList (**kw)
```

```
class tw2.forms.widgets.SelectionTable (**kw)
```

prepare ()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget (Widget):
    def prepare (self):
        super (MyWidget, self).prepare ()
        self.value = 'My: ' + str (self.value)
```

```
class tw2.forms.widgets.VerticalSelectionTable (**kw)
```

prepare ()

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget (Widget):
    def prepare (self):
        super (MyWidget, self).prepare ()
        self.value = 'My: ' + str (self.value)
```

```
class tw2.forms.widgets.RadioButtonTable (**kw)
```

```
class tw2.forms.widgets.SeparatedRadioButtonTable (**kw)
```

```
class tw2.forms.widgets.VerticalRadioButtonTable (**kw)
```

```
class tw2.forms.widgets.CheckBoxTable (**kw)
```

```
class tw2.forms.widgets.SeparatedCheckBoxTable (**kw)
```

```
class tw2.forms.widgets.VerticalCheckBoxTable (**kw)
```

```
class tw2.forms.widgets.BaseLayout (**kw)
```

The following CSS classes are used, on the element containing both a child widget and its label.

odd / even On alternating rows. The first row is odd.

required If the field is a required field.

error If the field contains a validation error.

prepare ()

Propagate the value for this widget to the children, based on their id.

```
class tw2.forms.widgets.TableLayout (**kw)
```

Arrange widgets and labels in a table.

The following CSS classes are used, on the element containing both a child widget and its label.

odd / even On alternating rows. The first row is odd.

required If the field is a required field.

error If the field contains a validation error.

class `tw2.forms.widgets.ListLayout` (**kw)
 Arrange widgets and labels in a list.

The following CSS classes are used, on the element containing both a child widget and its label.

odd / even On alternating rows. The first row is odd.

required If the field is a required field.

error If the field contains a validation error.

class `tw2.forms.widgets.RowLayout` (**kw)
 Arrange widgets in a table row. This is normally only useful as a child to GridLayout.

prepare ()
 Propagate the value for this widget to the children, based on their id.

class `tw2.forms.widgets.StripBlanks` (**kw)

to_python (value, state=None)
 Convert an external value to Python and validate it.

class `tw2.forms.widgets.GridLayout` (**kw)
 Arrange labels and multiple rows of widgets in a grid.

child
 alias of `tw2.core.params.RowLayout_s`

class `tw2.forms.widgets.Spacer` (**kw)
 A blank widget, used to insert a blank row in a layout.

class `tw2.forms.widgets.Label` (**kw)
 A textual label. This disables any label that would be displayed by a parent layout.

class `tw2.forms.widgets.Form` (**kw)
 A form, with a submit button. It's common to pass a TableLayout or ListLayout widget as the child.

classmethod `post_define` ()
 This is a class method, that is called when a subclass of this Widget is created. Process static configuration here. Use it like this:

```
class MyWidget(LeafWidget):
    @classmethod
    def post_define(cls):
        id = getattr(cls, 'id', None)
        if id and not id.startswith('my'):
            raise pm.ParameterError("id must start with 'my'")
```

`post_define` should always cope with missing data - the class may be an abstract class. There is no need to call `super()`, the metaclass will do this automatically.

submit
 alias of `tw2.core.params.SubmitButton_s_s`

prepare ()
 This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

```
class tw2.forms.widgets.FieldSet (**kw)
    A field set. It's common to pass a TableLayout or ListLayout widget as the child.

class tw2.forms.widgets.TableForm (**kw)
    Equivalent to a Form containing a TableLayout.

    child
        alias of tw2.core.params.TableLayout_s

    submit
        alias of tw2.core.params.SubmitButton_s_s_s

class tw2.forms.widgets.ListForm (**kw)
    Equivalent to a Form containing a ListLayout.

    child
        alias of tw2.core.params.ListLayout_s

    submit
        alias of tw2.core.params.SubmitButton_s_s_s

class tw2.forms.widgets.TableFieldSet (**kw)
    Equivalent to a FieldSet containing a TableLayout.

    child
        alias of tw2.core.params.TableLayout_s

class tw2.forms.widgets.ListFieldSet (**kw)
    Equivalent to a FieldSet containing a ListLayout.

    child
        alias of tw2.core.params.ListLayout_s

class tw2.forms.widgets.FormPage (**kw)
    A page that contains a form. The request method performs validation, redisplaying the form on errors. On
    success, it calls validated_request.
```

1.4 Validation

ToscaWidgets provides validation support for all the data that needs to be displayed into widgets or that has to come from submitted forms.

Setting a validator for a widget (or a form field) can be done through the `tw2.core.Widget.validator` param.

Validators are typically used in the context of forms and can be used both to tell ToscaWidgets how a python object should be displayed in HTML result:

```
>>> import tw2.core as twc
>>> import tw2.forms as twf
>>>
>>> w = twf.TextField(validator=twc.validation.DateValidator(format="%Y/%m/%d"))
>>> w.display(datetime.datetime.utcnow())
Markup('<input value="2019/04/04" type="text"/>')
```

Or to tell ToscaWidgets how the data coming from a submitted form should be converted into Python:

```
>>> class MyDateForm(twf.Form):
...     class child(twf.TableLayout):
...         date = twf.TextField(validator=twc.validation.DateValidator(format="%Y/%m/%d
↪"))
```

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```
...
>>> MyDateForm.validate({'date': '2019/5/3'})
{'date': datetime.date(2019, 5, 3)}
```

1.4.1 Validators

A validator is a class in charge of two major concerns:

- Converting data from the web to python and back to the web
- Validating that the data is what you expected.

Both those step are performed through two methods:

`tw2.core.validation.Validator.to_python()` which is in charge of converting data from the web to Python:

```
>>> validator = twc.validation.DateValidator(required=True, format="%Y/%m/%d")
>>> validator.to_python('2019/10/3')
datetime.date(2019, 10, 3)
```

and `tw2.core.validation.Validator.from_python()` which is in charge of converting data from Python to be displayed on a web page:

```
>>> validator.from_python(datetime.datetime.utcnow())
"2019/04/04"
```

When converting data *to python* (so for data submitted from the web to your web application) the validator does three steps:

1. Ensures that the data is not empty through `tw2.core.validation.Validator._is_empty()` if `required=True` was provided
2. Converts data to Python through `tw2.core.validation.Validator._convert_to_python()`
3. Validates that the converted data matches what you expected through `tw2.core.validation.Validator._validate_python()`

All those three methods (`is_empty`, `_convert_to_python` and `_validate_python`) can be specialised in subclasses to implement your own validators.

For example the `tw2.core.validation.IntValidator` takes care of converting the incoming text to integers:

```
>>> twc.validation.IntValidator().to_python("5")
5
```

but also takes care of validating that it's within an expected range:

```
>>> twc.validation.IntValidator(min=1).to_python("0")
Traceback (most recent call last):
File "<stdin>", line 1, in <module>
File "/home/amol/wrk/tw2.core/tw2/core/validation.py", line 236, in to_python
    self._validate_python(value, state)
File "/home/amol/wrk/tw2.core/tw2/core/validation.py", line 376, in _validate_python
    raise ValidationError('toosmall', self)
tw2.core.validation.ValidationError: Must be at least 1
```

1.4.2 Custom Validators

You can write your own validators by subclassing `tw2.core.validation.Validator`.

Those should *at least* implement the custom conversion part, to tell toscawidgets how to convert the incoming data to the type you expect:

```
class TwoNumbersValidator(twc.validation.Validator):
    def _convert_to_python(self, value, state=None):
        try:
            return [int(v) for v in value.split(',')]
        except ValueError:
            raise twc.validation.ValidationError("Must be integers", self)
        except Exception:
            raise twc.validation.ValidationError("corrupt", self)
```

This is already enough to be able to convert the incoming data to a list of numbers:

```
>>> TwoNumbersValidator().to_python("5,3")
[5, 3]
```

and to detect that numbers were actually submitted:

```
>>> TwoNumbersValidator().to_python("5, allo")
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "/home/amol/wrk/tw2.core/tw2/core/validation.py", line 235, in to_python
    value = self._convert_to_python(value, state)
  File "<stdin>", line 6, in _convert_to_python
tw2.core.validation.ValidationError: Must be integers
```

and to detect malformed inputs:

```
>>> TwoNumbersValidator().to_python(datetime.datetime.utcnow())
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "/home/amol/wrk/tw2.core/tw2/core/validation.py", line 235, in to_python
    value = self._convert_to_python(value, state)
  File "<stdin>", line 8, in _convert_to_python
tw2.core.validation.ValidationError: Form submission received corrupted; please try_
↪again
```

But it doesn't perform validation on the converted data. It doesn't ensure that what was provided are really two numbers:

```
>>> TwoNumbersValidator().to_python("5")
[5]
```

To do so we need to implement the validation part of the validator, which is done through `_validate_python`:

```
class TwoNumbersValidator(twc.validation.Validator):
    def _convert_to_python(self, value, state=None):
        try:
            return [int(v) for v in value.split(',')]
        except ValueError:
            raise twc.validation.ValidationError("Must be integers", self)
        except Exception:
            raise twc.validation.ValidationError("corrupt", self)
```

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```
def _validate_python(self, value, state=None):
    if len(value) != 2:
        raise twc.validation.ValidationError("Must be two numbers", self)
```

To finally provide coverage for the case where a single number (or more than two numbers) were provided:

```
>>> TwoNumbersValidator().to_python("5")
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "/home/amol/wrk/tw2.core/tw2/core/validation.py", line 236, in to_python
    self._validate_python(value, state)
  File "<stdin>", line 11, in _validate_python
tw2.core.validation.ValidationError: Must be two numbers
```

You will notice by the way, that empty values won't cause validation errors:

```
>>> v = TwoNumbersValidator().to_python("")
```

Those will be converted to None:

```
>>> print(v)
None
```

Because by default validators have `required=False` which means that missing values are perfectly fine.

If you want to prevent that behaviour you can provide `required=True` to the validator:

```
>>> TwoNumbersValidator(required=True).to_python("")
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "/home/amol/wrk/tw2.core/tw2/core/validation.py", line 231, in to_python
    raise ValidationError('required', self)
tw2.core.validation.ValidationError: Enter a value
```

1.4.3 Internationalization

Validator error messages can be translated through the usage of the `msgs` lookup dictionary.

The `msgs` dictionary is a map from keywords to translated strings and it's used by ToscaWidgets to know which message to show to users:

```
from tw2.core.i18n import tw2_translation_string

class FloatValidator(twc.Validator):
    msgs = {
        "notfloat": tw2_translation_string("Not a floating point number")
    }

    def _convert_to_python(self, value, state):
        try:
            return float(value)
        except ValueError:
            raise twc.validation.ValidationError("notfloat", self)
```

You will see that when validation fails, the "notfloat" key is looked up into `msgs` to find the proper message:

```
>>> FloatValidator().to_python("Hello")
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "/home/amol/wrk/tw2.core/tw2/core/validation.py", line 235, in to_python
    value = self._convert_to_python(value, state)
  File "<stdin>", line 9, in _convert_to_python
tw2.core.validation.ValidationError: Not a floating point number
```

The entry in `msgs` is then wrapped in a `tw2.core.i18n.tw2_translation_string()` call to ensure it gets translated using the translated that was configured in `tw2.core.middleware.TwMiddleware` options.

Note: `tw2.core.i18n.tw2_translation_string()` is also available as `tw2.core.i18n._` so that frameworks that automate translatable strings collection like Babel can more easily find strings that need translation in ToscaWidgets validators.

The other purpose of `msgs` is to allow users of your validator to customise their error messages:

```
>>> FloatValidator(msgs={"notfloat": "Ahah! Gotcha!"}).to_python("Hello")
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "/home/amol/wrk/tw2.core/tw2/core/validation.py", line 235, in to_python
    value = self._convert_to_python(value, state)
  File "<stdin>", line 9, in _convert_to_python
tw2.core.validation.ValidationError: Ahah! Gotcha!
```

In such case (when `msgs` are customised) translation of the messages is up to the user customising them. Who might want to ensure the new provided messages are still wrapped in `tw2.core.i18n.tw2_translation_string()`.

1.4.4 Builtin Validators

exception `tw2.core.validation.ValidationError` (*msg*, *validator=None*, *widget=None*)
Invalid data was encountered during validation.

The constructor can be passed a short message name, which is looked up in a validator's `msgs` dictionary. Any values in this, like `$val`` are substituted with that attribute from the validator. An explicit validator instance can be passed to the constructor, or this defaults to `Validator` otherwise.

message

Added for backwards compatibility. Synonymous with `msg`.

`tw2.core.validation.catch`
alias of `tw2.core.validation.ValidationError`

`tw2.core.validation.unflatten_params` (*params*)

This performs the first stage of validation. It takes a dictionary where some keys will be compound names, such as "form:subform:field" and converts this into a nested dict/list structure. It also performs unicode decoding, with the encoding specified in the middleware config.

class `tw2.core.validation.Validator` (**kw)

Base class for validators

required Whether empty values are forbidden in this field. (default: False)

strip Whether to strip leading and trailing space from the input, before any other validation. (default: True)

To convert and validate a value to Python, use the `to_python()` method, to convert back from Python, use `from_python()`.

To create your own validators, subclass this class, and override any of `_validate_python()`, `_convert_to_python()`, or `_convert_from_python()`. Note that these methods are not meant to be used externally. All of them may raise `ValidationErrors`.

to_python (*value*, *state=None*)

Convert an external value to Python and validate it.

from_python (*value*, *state=None*)

Convert from a Python object to an external value.

validate_python (*value*, *state=None*)

“Deprecated, use `_validate_python()` instead.

This method has been renamed in FormEncode 1.3 and ToscaWidgets 2.2 in order to clarify that is an internal method that is meant to be overridden only; you must call `meth:to_python` to validate values.

class `tw2.core.validation.BlankValidator` (**kw)

Always returns `EmptyField`. This is the default for hidden fields, so their values are not included in validated data.

to_python (*value*, *state=None*)

Convert an external value to Python and validate it.

class `tw2.core.validation.LengthValidator` (**kw)

Confirm a value is of a suitable length. Usually you’ll use `StringLengthValidator` or `ListLengthValidator` instead.

min Minimum length (default: None)

max Maximum length (default: None)

class `tw2.core.validation.StringLengthValidator` (**kw)

Check a string is a suitable length. The only difference to `LengthValidator` is that the messages are worded differently.

class `tw2.core.validation.ListLengthValidator` (**kw)

Check a list is a suitable length. The only difference to `LengthValidator` is that the messages are worded differently.

class `tw2.core.validation.RangeValidator` (**kw)

Confirm a value is within an appropriate range. This is not usually used directly, but other validators are derived from this.

min Minimum value (default: None)

max Maximum value (default: None)

class `tw2.core.validation.IntValidator` (**kw)

Confirm the value is an integer. This is derived from `RangeValidator` so *min* and *max* can be specified.

class `tw2.core.validation.BoolValidator` (**kw)

Convert a value to a boolean. This is particularly intended to handle check boxes.

class `tw2.core.validation.OneOfValidator` (**kw)

Confirm the value is one of a list of acceptable values. This is useful for confirming that select fields have not been tampered with by a user.

values Acceptable values

class `tw2.core.validation.DateTimeValidator` (**kw)

Confirm the value is a valid date and time. This is derived from `RangeValidator` so `min` and `max` can be specified.

format The expected date/time format. The format must be specified using the same syntax as the Python `strftime` function.

class `tw2.core.validation.DateValidator` (**kw)

Confirm the value is a valid date.

Just like `DateTimeValidator`, but without the time component.

class `tw2.core.validation.RegexValidator` (**kw)

Confirm the value matches a regular expression.

regex A Python regular expression object, generated like `re.compile('^w+$')`

class `tw2.core.validation.EmailValidator` (**kw)

Confirm the value is a valid email address.

class `tw2.core.validation.UrlValidator` (**kw)

Confirm the value is a valid URL.

class `tw2.core.validation.IpAddressValidator` (**kw)

Confirm the value is a valid IP4 address, or network block.

allow_netblock Allow the IP address to include a network block (default: False)

require_netblock Require the IP address to include a network block (default: False)

class `tw2.core.validation.UUIDValidator` (**kw)

Confirm the value is a valid uuid and convert to `uuid.UUID`.

class `tw2.core.validation.MatchValidator` (*other_field*, *pass_on_invalid=False*, **kw)

Confirm a field matches another field

other_field Name of the sibling field this must match

pass_on_invalid Pass validation if sibling field is Invalid

class `tw2.core.validation.CompoundValidator` (*args, **kw)

Base class for compound validators.

Child classes `Any` and `All` take validators as arguments and use them to validate “value”. In case the validation fails, they raise a `ValidationError` with a compound message.

```
>>> v = All(StringLengthValidator(max=50), EmailValidator, required=True)
```

class `tw2.core.validation.All` (*args, **kw)

Confirm all validators passed as arguments are valid.

class `tw2.core.validation.Any` (*args, **kw)

Confirm at least one of the validators passed as arguments is valid.

1.5 Javascript Integration

ToscaWidget2 was designed to work with any Javascript framework and integrate Python and Javascript as well as possible, leading to a seamless development experience when you have to provide Javascript callbacks or functions to your Python declared widgets and forms.

1.5.1 Javascript on Display

Frequently, when a widget is displayed, you might have to run some form of initialization in JavaScript to attach dynamic behaviours to it.

This can be done by using `tw2.core.Widget.add_call()` to register a `tw2.core.js.js_function` that should be called.

A simple example might be to display a widget that shows an “Hello World” alert every time it renders:

```
import tw2.core as twc

class HelloJSWidget(twc.Widget):
    message = twc.Param(description="Message to display")
    template = "<div></div>"
    inline_engine_name = "kajiki"

    def prepare(self):
        super(HelloJSWidget, self).prepare()

        alert = twc.js.js_function("alert")
        if self.message:
            self.add_call(alert(self.message))
```

As you can see we define a new `tw2.core.js.js_function` named “alert” and we assign it to the python “alert” variable. If a message is provided, `tw2.core.Widget.add_call()` is used to register `alert(self.message)` as what should be called every time the widget is rendered.

Displaying the widget in a web page:

```
HelloJSWidget(message="Hello World").display()
```

will in fact open an alert box with the “Hello World” text.

But you are not constrained to use pre-existing Javascript functions (like `alert`), you can in fact declare your own function (or use one that was imported from a `tw2.core.resources.JSLink`).

For example we can change the previous widget to accept only the name of the person to greet instead of the whole message and display “Hello SOMEONE” always:

```
class HelloJSWidget(twc.Widget):
    greeted = twc.Param(description="Who to greet")
    template = "<div></div>"
    inline_engine_name = "kajiki"

    def prepare(self):
        super(HelloJSWidget, self).prepare()
        sayhello = twc.js.js_function('(function(target){ alert("Hello " + target); })
→ ')

        if self.greeted:
            self.add_call(sayhello(self.greeted))
```

As you could see, instead of having out `tw2.core.js.js_function` point to an already existing one, we declared a new one that accepts a `target` argument and displays an alert to greet the target.

The target of the greet message is then set in `HelloJSWidget.prepare` through the `greeted` param.

Displaying such widget will lead as expected to show an alert box with “Hello” plus the name of the greeted person:

```
HelloJSWidget(greeted="Mario").display()
```

It's also for example possible to run javascript that will target the widget itself by using the `Widget.id` and `Widget.compound_id` properties to know the unique identifier of the widget in the dom.

Using such tactic we could rewrite the previous widget to always read the greeted person from the content of the `div` instead of passing it as an argument:

```
class HelloJSWidget(twc.Widget):
    greeted = twc.Param(description="Who to greet")
    template = """<div id="$w.id">${w.greeted}</div>"""
    inline_engine_name = "kajiki"

    def prepare(self):
        super(HelloJSWidget, self).prepare()
        sayhello = twc.js.js_function('(function(widget_id){ var target = document.
↪getElementById(widget_id).innerText; alert("Hello " + target); })')
        self.add_call(sayhello(self.id))
```

Note: `compound_id` is safer to use, as it avoids collisions when widgets with the same `id` are used within different parents. But is mostly only available in form fields. On plain widgets you might need to use `id` itself.

1.5.2 Javascript Callbacks

While being able to call javascript every time the widget is displayed is essential to be able to attach advanced javascript behaviours to widgets, sometimes you will need to trigger Javascript callbacks when something happens on the widgets.

This can usually be done with `tw2.core.js.js_callback` to declare the javascript callback you care about.

A possible example is to run some javascript when the selected option is changed in a single select field:

```
alertpicker = twf.SingleSelectField(
    attrs={'onchange': twc.js.js_callback('alert("changed!")')},
    options=[(1, 'First'), (2, 'Second')]
)
```

1.5.3 Builtin Javascript Helpers

Python-JS interface to dynamically create JS function calls from your widgets.

This module doesn't aim to serve as a Python-JS "translator". You should code your client-side code in JavaScript and make it available in static files which you include as JSLinks or inline using JSSources. This module is only intended as a "bridge" or interface between Python and JavaScript so JS function **calls** can be generated programatically.

```
class tw2.core.js.js_callback(cb, *args)
```

A js function that can be passed as a callback to be called by another JS function

Examples:

```
>>> str(js_callback("update_div"))
'update_div'
```

```
>>> str(js_callback("function (event) { ... }"))
'function (event) { ... }'
```

Can also create callbacks for deferred js calls

```
>>> str(js_callback(js_function('foo')(1,2,3)))
'function(){foo(1, 2, 3)}'
```

Or equivalently

```
>>> str(js_callback(js_function('foo'), 1,2,3))
'function(){foo(1, 2, 3)}'
```

A more realistic example

```
>>> jQuery = js_function('jQuery')
>>> my_cb = js_callback('function() { alert(this.text)}')
>>> on_doc_load = jQuery('#foo').bind('click', my_cb)
>>> call = jQuery(js_callback(on_doc_load))
>>> print call
jQuery(function() {jQuery("#foo").bind(
    "click", function() { alert(this.text)}})
```

class `tw2.core.js.js_function` (*name*)

A JS function that can be “called” from python and added to a widget by `widget.add_call()` so it gets called every time the widget is rendered.

Used to create a callable object that can be called from your widgets to trigger actions in the browser. It's used primarily to initialize JS code programatically. Calls can be chained and parameters are automatically json-encoded into something JavaScript understands. Example:

```
>>> jQuery = js_function('jQuery')
>>> call = jQuery('#foo').datePicker({'option1': 'value1'})
>>> str(call)
'jQuery("#foo").datePicker({"option1": "value1"})'
```

Calls are added to the widget call stack with the `add_call` method.

If made at Widget initialization those calls will be placed in the template for every request that renders the widget:

```
>>> import tw2.core as twc
>>> class SomeWidget(twc.Widget): ...
pickerOptions = twc.Param(default={})
>>> SomeWidget.add_call( ...
    jQuery('#%s' % SomeWidget.id).datePicker(SomeWidget.pickerOptions)
    ... )
```

More likely, we will want to dynamically make calls on every request. Here we will call `add_calls` inside the `prepare` method:

```
>>> class SomeWidget(Widget):
...     pickerOptions = twc.Param(default={})
...     def prepare(self):
...         super(SomeWidget, self).prepare()
...         self.add_call(
...             jQuery('#%s' % d.id).datePicker(d.pickerOptions)
...         )
```

This would allow to pass different options to the datePicker on every display.

JS calls are rendered by the same mechanisms that render required css and js for a widget and places those calls at bodybottom so DOM elements which we might target are available.

Examples:

```
>>> call = js_function('jQuery')("a .async")
>>> str(call)
'jQuery("a .async")'
```

js_function calls can be chained:

```
>>> call = js_function('jQuery')("a .async").foo().bar()
>>> str(call)
'jQuery("a .async").foo().bar()'
```

class `tw2.core.js.js_symbol` (*name=None, src=None*)

An unquoted js symbol like `document` or `window`

1.6 Design

1.6.1 Widget Overview

The main purpose of a widget is to display a functional control within an HTML page. A widget has a template to generate its own HTML, and a set of parameters that control how it will be displayed. It can also reference resources - JavaScript or CSS files that support the widget.

When defining Widgets, some parameters will be static - they will stay constant for the whole lifetime of the application. Some parameters are dynamic - they may change for every request. To ensure thread-safety, a separate widget instance is created for every request, and dynamic parameters are only set on an instance. Static parameters are set by subclassing a widget. For example:

```
# Initialisation
class MyWidget(Widget):
    id = 'myid'

# In a request
my_widget = MyWidget.req()
my_widget.value = 'my value'
```

To make initialisation more concise, the `__new__` method on `Widget` is overridden, so it creates subclasses, rather than instances. The following code is equivalent to that above:

```
# Initialisation
MyWidget = Widget(id='myid')
```

In practice, you will rarely need to explicitly create an instance, using `req()`. If the `display` or `validate` methods are called on a `Widget` class, they automatically create an instance. For example, the following are equivalent:

```
# Explicit creation
my_widget = MyWidget.req()
my_widget.value = 'my value'
my_widget.display()
```

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```
# Implicit creation
MyWidget.display(value='my value')
```

Parameters

The parameters are how the user of the widget controls its display and behaviour. Parameters exist primarily for documentation purposes, although they do have some run-time effects. When creating widgets, it's important to decide on a convenient set of parameters for the user of the widget, and to document these.

A parameter definition looks like this:

```
import tw2.core as twc
class MyTextField(twc.Widget):
    size = twc.Param('The size of the field', default=30)
    validator = twc.LengthValidator(max=30)
    highlight = twc.Variable('Region to highlight')
```

In this case, `TextField` gets all the parameters of its base class, `tw2.core.widget` and defines a new parameter - `size`. A widget can also override parameter in its base class, either with another `tw2.core.Param` instance, or a new default value.

```
class tw2.core.Param(description=Default, default=Default, request_local=Default,
                    attribute=Default, view_name=Default)
```

A parameter for a widget.

description A string to describe the parameter. When overriding a parameter description, the string can include `$$` to insert the previous description.

default The default value for the parameter. If no default is specified, the parameter is a required parameter. This can also be specified explicitly using `tw.Required`.

request_local Can the parameter be overridden on a per-request basis? (default: True)

attribute Should the parameter be automatically included as an attribute? (default: False)

view_name The name used for the attribute. This is useful for attributes like `class` which are reserved names in Python. If this is `None`, the name is used. (default: `None`)

The class takes care to record which arguments have been explicitly specified, even if to their default value. If a parameter from a base class is updated in a subclass, arguments that have been explicitly specified will override the base class.

```
class tw2.core.Variable(description=Default, **kw)
```

A variable - a parameter that is passed from the widget to the template, but cannot be controlled by the user. These do not appear in the concise documentation for the widget.

```
class tw2.core.ChildParam(description=Default, default=Default, request_local=Default,
                          attribute=Default, view_name=Default)
```

A parameter that applies to children of this widget

This is useful for situations such as a layout widget, which adds a `label` parameter to each of its children. When a `Widget` subclass is defined with a parent, the widget picks up the defaults for any child parameters from the parent.

```
class tw2.core.ChildVariable(description=Default, **kw)
```

A variable that applies to children of this widget

Code Hooks

Subclasses of Widget can override the following methods. It is not recommended to override any other methods, e.g. `display`, `validate`, `__init__`.

`classmethod` `Widget.post_define()`

This is a class method, that is called when a subclass of this Widget is created. Process static configuration here. Use it like this:

```
class MyWidget(LeafWidget):
    @classmethod
    def post_define(cls):
        id = getattr(cls, 'id', None)
        if id and not id.startswith('my'):
            raise pm.ParameterError("id must start with 'my'")
```

`post_define` should always cope with missing data - the class may be an abstract class. There is no need to call `super()`, the metaclass will do this automatically.

`Widget.prepare()`

This is an instance method, that is called just before the Widget is displayed. Process request-local configuration here. For efficiency, widgets should do as little work as possible here. Use it like this:

```
class MyWidget(Widget):
    def prepare(self):
        super(MyWidget, self).prepare()
        self.value = 'My: ' + str(self.value)
```

`Widget.generate_output(displays_on)`

Generate the actual output text for this widget.

By default this renders the widget's template. Subclasses can override this method for purely programmatic output.

displays_on The name of the template engine this widget is being displayed inside.

Use it like this:

```
class MyWidget(LeafWidget):
    def generate_output(self, displays_on):
        return "<span {0}>{1}</span>".format(self.attrs, self.text)
```

Mutable Members

If a widget's `prepare()` method modifies a mutable member on the widget, it must take care not to modify a class member, as this is not thread safe. In general, the code should call `self.safe_modify(member_name)`, which detects class members and creates a copy on the instance. Users of widgets should be aware that if a mutable is set on an instance, the widget may modify this. The most common case of a mutable member is `attrs`. While this arrangement is thread-safe and reasonably simple, copying may be bad for performance. In some cases, widgets may deliberately decide not to call `safe_modify()`, if the implications of this are understood.

1.6.2 Widget Hierarchy

Widgets can be arranged in a hierarchy. This is useful for applications like layouts, where the layout will be a parent widget and fields will be children of this. There are four roles a widget can take in the hierarchy, depending on the base class used:

```
class tw2.core.Widget (**kw)
```

Base class for all widgets.

```
class tw2.core.CompoundWidget (**kw)
```

A widget that has an arbitrary number of children, this is common for layout components, such as `tw2.forms.TableLayout`.

```
class tw2.core.RepeatingWidget (**kw)
```

A widget that has a single child, which is repeated an arbitrary number of times, such as `tw2.forms.GridLayout`.

```
class tw2.core.DisplayOnlyWidget (**kw)
```

A widget that has a single child. The parent widget is only used for display purposes; it does not affect value propagation or validation. This is used by widgets like `tw2.forms.FieldSet`.

Value Propagation

An important feature of the hierarchy is value propagation. When the value is set for a compound or repeating widget, this causes the value to be set for the child widgets. In general, a leaf widget takes a scalar type as a value, a compound widget takes a dict or an object, and a repeating widget takes a list.

The hierarchy also affects the generation of compound ids, and validation.

Identifier

In general, a widget needs to have an identifier. Without an id, it cannot participate in value propagation or validation, and it does not get an HTML id attribute. There are some exceptions to this:

- Some widgets do not need an id (e.g. Label, Spacer) and provide a default id of None.
- The child of a RepeatingWidget must not have an id.
- An id can be specified either on a DisplayOnlyWidget, or it's child, but not both. The widget that does not have the id specified automatically picks it up from the other.

Compound IDs are formed by joining the widget's id with those of its ancestors. These are used in two situations:

- For the HTML id attribute, and also the name attribute for form fields
- For the URL path a controller widget is registered at

The separator is a colon (:), resulting in compound ids like "form:sub_form:field". **Note** this causes issues with CSS and will be changed shortly, and made configurable.

In general, the id on a DisplayOnlyWidget is not included in the compound id. However, when generating the compound id for a DisplayOnlyWidget, the id is included. In addition `id_suffix` is appended, to avoid generating duplicate IDs. The `id_suffix` is not appended for URL paths, to keep the paths short. There is a risk of duplicate IDs, but this is not expected to be a problem in practice.

For children of a RepeatingWidget, the repetition is used instead of the id, for generating the compound HTML id. For the URL path, the element is skipped entirely.

Deep Children

This is a feature that helps have a form layout that doesn't exactly match the database layout. For example, we might have a single database table, with fields like title, customer, start_date, end_date. We want to display this in a Form that's broken up into two FieldSets. Without deep children, the FieldSets would have to have ids, and field makes would be dotted, like info.title. The deep children feature lets us set the id to None:

```
class MyForm(twf.Form):
    class child(twc.CompoundWidget):
        class info(twf.TableFieldSet):
            id = None
```

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```
title = twf.TextField()
customer = twf.TextField()
class dates(twf.TableFieldSet):
    id = None
    start_date = twf.TextField()
    end_date = twf.TextField()
```

When a value like `{'title': 'my title'}` is passed to `MyForm`, this will propagate correctly.

1.6.3 Template

Every widget can have a template. `ToscaWidgets` has some template-language hooks which currently support `Genshi`, `Mako`, `Jinja2`, `Kajiki`, and `Chameleon`.

At one point, `ToscaWidgets2` aimed to support any templating engine that supported the `buffet` interface, (an initiative by the `TurboGears` project to create a standard interface for template libraries). In practice though, there are more differences between template engines than the `buffet` interface standardises so this approach has been dropped.

The `template` parameter takes the form `engine_name:template_path`. The `engine_name` is the name that the template engine defines in the `python.templating.engines` entry point, e.g. `genshi`, `mako`, or `jinja`. The `template_path` is a string the engine can use to locate the template; usually this is dot-notation that mimics the semantics of Python's `import` statement, e.g. `myapp.templates.mytemplate`. Templates also allow specifications like `./template.html` which is beneficial for simple applications.

It is also possible to allow your widget to utilize multiple templates, or to have `TW2` support any template language you provide a template for. To do this, simply leave the name of the template engine off of the `template` parameter, and `TW2` will select the appropriate template, based on specifications in the `TW2` middleware.

For instance, you might have a `form.mak` and a `form.html` template (`mako` and `genshi`). `TW2` will render the `mako` template if `mako` is listed ahead of `genshi` in the middleware config's `preferred_rendering_engines`. See the documentation regarding *Enabling `ToscaWidgets`* for more information on how to set up your middleware for desired output.

1.6.4 Non-template Output

Instead of using a template, a widget can also override the `generate_output` method. This function generates the HTML output for a widget; by default, it renders the widget's template as described in the previous section, but can be overridden by any function that returns a string of HTML.

1.6.5 Resources

Widgets often need to access resources, such as JavaScript or CSS files. A key feature of widgets is the ability to automatically serve such resources, and insert links into appropriate sections of the page, e.g. `<HEAD>`. There are several parts to this:

- Widgets can define resources they use, using the `resources` parameter.
- When a resource is defined, it is registered with the resource server.
- When a Widget is displayed, it registers resources in request-local storage.
- The resource injection middleware detects resources in request-local storage, and rewrites the generated page to include appropriate links.
- The resource server middleware serves static files used by widgets

- Widgets can also access resources at display time, e.g. to get links
- Resources can themselves declare dependency on other resources, e.g. `jquery-ui.js` depends on `jquery.js` and must be included on the page subsequently.

Defining Resources

To define a resource, just add a `tw2.core.Resource` subclass to the widget's `resources` parameter. It is also possible to append to `resources` from within the `prepare()` method. The following resource types are available:

See *Resources*

Resources are widgets, but follow a slightly different lifecycle. Resource subclasses are passed into the `resources` parameter. An instance is created for each request, but this is only done at the time of the parent Widget's `display()` method. This gives widgets a chance to add dynamic resources in their `prepare()` method.

Using Your Own Resources

Resources that are defined by pre-existing `tw2` packages can be altered globally. For instance, say that you want to use your own patched version of `jquery` and you want all `tw2` packages that require `jquery` to use your version, and not the one already packaged up in `tw2.jquery`. The following code will alter `jquery_js` in not just the local scope, but also in all other modules that use it (including `tw2.jqplugins.ui`):

```
import tw2.jquery
tw2.jquery.jquery_js.link = "/path/to/my/patched/jquery.js"
```

Deploying Resources

If running behind `mod_wsgi`, `tw2` resource provisioning will typically fail. Resources are only served when they are registered with the request-local thread, and resources are only registered when their dependant widget is displayed in a request. An initial page request may make available resource A, but the subsequent request to actually retrieve resource A will not have that resource registered.

To solve this problem (and to introduce a speed-up for production deployment), `ToscaWidgets2` provides an `archive_tw2_resources` distutils command:

```
$ python setup.py archive_tw2_resources \
  --distributions=myapplication \
  --output=/var/www/myapplication
```

1.6.6 Declarative Instantiation

Instantiating compound widgets can result in less-than-beautiful code. To help alleviate this, widgets can be defined declaratively, and this is the recommended approach. A definition looks like this:

```
class MovieForm(twf.TableForm):
    id = twf.HiddenField()
    year = twf.TextField()
    desc = twf.TextArea(rows=5)
```

Any class members that are subclasses of `Widget` become children. All the children get their `id` from the name of the member variable. Note: it is important that all children are defined like `id = twf.HiddenField()` and not `id = twf.HiddenField`. Otherwise, the order of the children will not be preserved.

It is possible to define children that have the same name as parameters, using this syntax. However, doing so does prevent a widget overriding a parameter, and defining a child with the same name. If you need to do this, you must use a throwaway name for the member variable, and specify the `id` explicitly, e.g.:

```
class MovieForm(twf.TableForm):
    resources = [my_resource]
    id = twf.HiddenField()
    noname = twf.TextArea(id='resources')
```

Nesting and Inheritance

Nested declarative definitions can be used, like this:

```
class MyForm(twf.Form):
    class child(twf.TableLayout):
        b = twf.TextArea()
        x = twf.Label(text='this is a test')
        c = twf.TextField()
```

Inheritance is supported - a subclass gets the children from the base class, plus any defined on the subclass. If there's a name clash, the subclass takes priority. Multiple inheritance resolves name clashes in a similar way. For example:

```
class MyFields(twc.CompoundWidget):
    b = twf.TextArea()
    x = twf.Label(text='this is a test')
    c = twf.TextField()

class TableFields(MyFields, twf.TableLayout):
    pass

class ListFields(MyFields, twf.ListLayout):
    b = twf.TextField()
```

Proxying children

Without this feature, double nesting of classes is often necessary, e.g.:

```
class MyForm(twf.Form):
    class child(twf.TableLayout):
        b = twf.TextArea()
```

Proxying children means that if `RepeatingWidget` or `DisplayOnlyWidget` have children set, this is passed to their child. The following is equivalent to the definition above:

```
class MyForm(twf.Form):
    child = twf.TableLayout()
    b = twf.TextArea()
```

And this is used by classes like `TableForm` and `TableFieldSet` to allow the user more concise widget definitions:

```
class MyForm(twf.TableForm):
    b = twf.TextArea()
```

Automatic ID

Sub classes of `Page` that do not have an `id`, will have the `id` automatically set to the name of the class. This can be disabled by setting `_no_autoid` on the class. This only affects that specific class, not any subclasses.

1.6.7 Widgets as Controllers

Sometimes widgets will want to define controller methods. This is particularly useful for Ajax widgets. Any widget can have a `request()` method, which is called with a `WebOb Request` object, and must return a `WebOb`

Response object, like this:

```
class MyWidget (twc.Widget) :
    id = 'my_widget'
    @classmethod
    def request (cls, req) :
        resp = webob.Response (request=req, content_type="text/html; charset=UTF8")
        # ...
        return resp
```

For the `request ()` method to be called, the widget must be registered with the `ControllersApp` in the middleware. By default, the path is constructed from `/controllers/`, and the widget's id. A request to `/controllers/` refers to a widget with id index. You can specify `controllers_prefix` in the configuration.

For convenience, widgets that have a `request ()` method, and an `id` will be registered automatically. By default, this uses a global `ControllersApp` instance, which is also the default controllers for `make_middleware ()`. If you want to use multiple controller applications in a single python instance, you will need to override this.

You can also manually register widgets:

```
twc.core.register_controller (MyWidget, 'mywidget')
```

Sometimes it is useful to dynamically acquire what URL path a Widget's controller is mounted on. For this you can use:

```
MyWidget.controller_path ()
```

Methods to override

view_request Instance method - get self and req. load from db

validated_request Class method - get cls and validated data

ajax_request Return python data that is automatically converted to an ajax response

1.6.8 Validation

One of the main features of any forms library is the validation of form input, e.g checking that an email address is valid, or that a user name is not already taken. If there are validation errors, these must be displayed to the user in a helpful way. Many validation tasks are common, so these should be easy for the developer, while less-common tasks are still possible.

We can configure validation on form fields like this:

```
class child (twf.TableForm) :
    name = twf.TextField (validator=twc.Required)
    group = twf.SingleSelectField (options=['', 'Red', 'Green', 'Blue'])
    notes = twf.TextArea (validator=twc.StringLengthValidator (min=10))
```

To enable validation we also need to modify the application to handle POST requests:

```
def app (environ, start_response) :
    req = wo.Request (environ)
    resp = wo.Response (request=req, content_type="text/html; charset=UTF8")
    if req.method == 'GET':
        resp.body = MyForm.display ().encode ('utf-8')
    elif req.method == 'POST':
        try:
```

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```

        data = MyForm.validate(req.POST)
        resp.body = 'Posted successfully ' + wo.html_escape(repr(data))
    except twc.ValidationError, e:
        resp.body = e.widget.display().encode('utf-8')
    return resp(environ, start_response)

```

If you submit the form with some invalid fields, you should see error messages side up to each relevant field.

Whole Form Message

If you want to display a message at the top of the form, when there are any errors, define the following validator:

```

class MyFormValidator(twc.Validator):
    msgs = {
        'childerror': ('form_childerror', 'There were problems with the details you_
↪entered. Review the messages below to correct your submission.'),
    }

```

And in your form:

```

validator = MyFormValidator()

```

Conversion

Validation is also responsible for conversion to and from python types. For example, the DateValidator takes a string from the form and produces a python date object. If it is unable to do this, that is a validation failure.

To keep related functionality together, validators also support conversion from python to string, for display. This should be complete, in that there are no python values that cause it to fail. It should also be precise, in that converting from python to string, and back again, should always give a value equal to the original python value. The converse is not always true, e.g. the string “1/2/2004” may be converted to a python date object, then back to “01/02/2004”.

Validation Errors

When there is an error, all fields should still be validated and multiple errors displayed, rather than stopping after the first error.

When validation fails, the user should see the invalid values they entered. This is helpful in the case that a field is entered only slightly wrong, e.g. a number entered as “2,000” when commas are not allowed. In such cases, conversion to and from python may not be possible, so the value is kept as a string. Some widgets will not be able to display an invalid value (e.g. selection fields); this is fine, they just have to do the best they can.

When there is an error in some fields, other valid fields can potentially normalise their value, by converting to python and back again (e.g. 01234 -> 1234). However, it was decided to use the original value in this case.

In some cases, validation may encounter a major error, as if the web user has tampered with the HTML source. However, we can never be completely sure this is the case, perhaps they have a buggy browser, or caught the site in the middle of an upgrade. In these cases, validation will produce the most helpful error messages it can, but not attempt to identify which field is at fault, nor redisplay invalid values.

Required Fields

If a field has no value, it defaults to `None`. It is down to that field’s validator to raise an error if the field is required. By default, fields are not required. It was considered to have a dedicated `Missing` class, but this was decided against, as `None` is already intended to convey the absence of data.

Security Consideration

When a widget is redisplayed after a validation failure, it’s value is derived from unvalidated user input. This means widgets must be “safe” for all input values. In practice, this is almost always the case without great care, so widgets are assumed to be safe.

Warning: If a particular widget is not safe in this way, it must override `_validate()` and set `value` to `None` in case of error.

Validation Messages

When validation fails, the validator raises `ValidationError`. This must be passed the short message name, e.g. “required”. Each validator has a dictionary mapping short names to messages that are presented to the user, e.g.:

```
msgs = {
    'tooshort': 'Value is too short',
    'toolong': 'Value is too long',
}
```

Messages can be overridden on a global basis, using `validator_msgs` on the middleware configuration. For example, the user may prefer “Value is required” instead of the default “Enter a value” for a missing field.

A `Validator` can also rename messages, by specifying a tuple in the `msgs` dict. For example, `ListLengthValidator` is a subclass of `LengthValidator` which raises either `tooshort` or `toolong`. However, it’s desired to have different message names, so that any global override would be applied separately. The following `msgs` dict is used:

```
msgs = {
    'tooshort': ('list_tooshort', 'Select at least $min'),
    'toolong': ('list_toolong', 'Select no more than $max'),
}
```

Within the messages, tags like `$min` are substituted with the corresponding attribute from the validator. It is not possible to specify the value in this way; this is to discourage using values within messages.

FormEncode

Earlier versions of `ToscaWidgets` used `FormEncode` for validation and there are good reasons for this. Some aspects of the design work very well, and `FormEncode` has a lot of clever validators, e.g. the ability to check that a post code is in the correct format for a number of different countries.

However, there are challenges making `FormEncode` and `ToscaWidgets` work together. For example, both libraries store the widget hierarchy internally. This makes implementing some features (e.g. `strip_name` and `tw2.dynforms.HidingSingleSelectField`) difficult. There are different needs for the handling of unicode, leading `ToscaWidgets` to override some behaviour. Also, `FormEncode` just does not support client-side validation, a planned feature of `ToscaWidgets 2`.

`ToscaWidgets 2` does not rely on `FormEncode`. However, developers can use `FormEncode` validators for individual fields. The API is compatible in that `to_python()` and `from_python()` are called for conversion and validation, and `formencode.Invalid` is caught. Also, if `FormEncode` is installed, the `ValidationError` class is a subclass of `formencode.Invalid`.

Using Validators

There’s two parts to using validators. First, specify validators in the widget definition, like this:

```
class RegisterUser(twf.TableForm):
    validator = twc.MatchValidator('email', 'confirm_email')
    name = twf.TextField()
    email = twf.TextField(validator=twc.EmailValidator)
    confirm_email = twf.PasswordField()
```

You can specify a validator on any widget, either a class or an instance. Using an instance lets you pass parameters to the validator. You can code your own validator by subclassing `tw2.core.Validator`. All validators have at least these parameters:

class `tw2.core.Validator` (***kw*)

Base class for validators

required Whether empty values are forbidden in this field. (default: False)

strip Whether to strip leading and trailing space from the input, before any other validation. (default: True)

To convert and validate a value to Python, use the `to_python()` method, to convert back from Python, use `from_python()`.

To create your own validators, subclass this class, and override any of `_validate_python()`, `_convert_to_python()`, or `_convert_from_python()`. Note that these methods are not meant to be used externally. All of them may raise `ValidationErrors`.

Second, when the form values are submitted, call `validate()` on the outermost widget. Pass this a dictionary of the request parameters. It will call the same method on all contained widgets, and either return the validated data, with all conversions applied, or raise `tw2.core.ValidationError`. In the case of a validation failure, it stores the invalid value and an error message on the affected widget.

Chaining Validators

In some cases you may want validation to succeed if any one of a number of checks pass. In other cases you may want validation to succeed only if the input passes *all* of a number of checks. For this, `tw2.core` provides the `Any` and `All` validators which are subclasses of the extendable `CompoundValidator`.

Implementation

A two-pass approach is used internally, although this is generally hidden from the developer. When `Widget.validate()` is called it first calls:

`tw2.core.validation.unflatten_params` (*params*)

This performs the first stage of validation. It takes a dictionary where some keys will be compound names, such as “form:subform:field” and converts this into a nested dict/list structure. It also performs unicode decoding, with the encoding specified in the middleware config.

If this fails, there is no attempt to determine which parameter failed; the whole submission is considered corrupt. If the root widget has an `id`, this is stripped from the dictionary, e.g. `{'myid': {'param': 'value', ...}}` is converted to `{'param': 'value', ...}`. A widget instance is created, and stored in request local storage. This allows compatibility with existing frameworks, e.g. the `@validate` decorator in TurboGears. There is a hook in `display()` that detects the request local instance. After creating the instance, `validate` works recursively, using the `_validate()`.

`Widget._validate` (**args, **kw*)

Inner validation method; this is called by `validate` and should not be called directly. Overriding this method in widgets is discouraged; a custom validator should be coded instead. However, in some circumstances overriding is necessary.

`RepeatingWidget._validate` (**args, **kw*)

The value must either be a list or `None`. Each item in the list is passed to the corresponding child widget for validation. The resulting list is passed to this widget’s validator. If any of the child widgets produces a validation error, this widget generates a “childerror” failure.

`CompoundWidget._validate` (**args, **kw*)

The value must be a dict, or `None`. Each item in the dict is passed to the corresponding child widget for validation, with special consideration for `_sub_compound` widgets. If a child returns `vd.EmptyField`, that value is not included in the resulting dict at all, which is different to including `None`. Child widgets with a key are

passed the validated value from the field the key references. The resulting dict is validated by this widget's validator. If any child widgets produce an errors, this results in a "childerror" failure.

Both `_validate()` and `to_python()` take an optional state argument. `CompoundWidget` and `RepeatingWidget` pass the partially built dict/list to their child widgets as state. This is useful for creating validators like `MatchValidator` that reference sibling values. If one of the child widgets fails validation, the slot is filled with an `Invalid` instance.

1.6.9 General Considerations

Request-Local Storage

ToscaWidgets needs access to request-local storage. In particular, it's important that the middleware sees the request-local information that was set when a widget is instantiated, so that resources are collected correctly.

The function `tw2.core.request_local` returns a dictionary that is local to the current request. Multiple calls in the same request always return the same dictionary. The default implementation of `request_local` is a thread-local system, which the middleware clears before and after each request.

In some situations thread-local is not appropriate, e.g. `twisted`. In this case the application will need to monkey patch `request_local` to use appropriate `request_local` storage.

pkg_resources

`tw2.core` aims to take advantage of `pkg_resources` where it is available, but not to depend on it. This allows `tw2.core` to be used on Google App Engine. `pkg_resources` is used in two places:

- In `ResourcesApp`, to serve resources from modules, which may be zipped eggs. If `pkg_resources` is not available, this uses a simpler system that does not support zipped eggs.
- In `EngineManager`, to load a templating engine from a text string, e.g. "genshi". If `pkg_resources` is not available, this uses a simple, built-in mapping that covers the most common template engines.

Framework Interface

ToscaWidgets is designed to be standalone WSGI middleware and not have any framework interactions. However, when using ToscaWidgets with a framework, there are some configuration settings that need to be consistent with the framework, for correct interaction. Future versions of ToscaWidgets may include framework-specific hooks to automatically gather this configuration. The settings are:

- `default_view` - the template engine used by the framework. When root widgets are rendered, they will return a type suitable for including in this template engine. This setting is not needed if only Page widgets are used as root widgets, as there is no containing template in that case.
- `translator` - needed for `ToscaWidget` to use the same `i18n` function as the framework.

Unit Tests

To run the tests, in `tw2.devtools/tests` issue:

```
nosetests --with-doctest --doctest-extension=.txt
```

1.7 Changelog

1.7.1 2.2.9

- Fix loading of templates on some systems where system encoding is not UTF8 (templates are always loaded as utf8)

1.7.2 2.2.7

- Fix support for Python3.8 removing `cgi.escape`
- Fix deprecated support for absolute paths in `resource_filename`

1.7.3 2.2.6

- New Documentation

1.7.4 2.2.5

- Added english translation, so that the gettext translator finds it and prefers english when multiple languages are involved and english is the favourite one.
- Fixed an issue with i18n translator on Python3

1.7.5 2.2.4

- Templating now uses `render_unicode` to render mako templates and avoid unicode dance [ecc33fc](#)
- Avoid modifying validation messages dict while iterating on it [66c7e3d](#)
- Fix Genshi relative imports when running test suite on top directory

1.7.6 2.2.3

- Kajiki Template Engine Support
- Disallow `DisplayOnlyWidget` as child of `RepeatingWidget` as it doesn't work anyways [4c15c5a](#)
- Flush memoization cache when `auto_reload_templates` in the middleware is enabled
- Fix `safe_validate` with `FormEncode` validators [3fa88ac](#)

1.7.7 2.2.2

- Fix `CompoundWidget` and `MatchValidator`
- Fix `archive_tw2_resources` [8956e83](#)
- Fix `DateValidator` and `DateTimeValidator` to be in sync with `tw2.forms` [06da5b9](#)

1.7.8 2.2.1

- Merge branch 'hotfix/2.1.6' [a699822e5](#)
- `compound_key` was ignoring key for `RepeatingWidget` [ed0946146](#)
- Fix for `DisplayOnlyWidget` in `compound_id` regression [11570e42e](#)
- All and Any validators didn't work with unicode error messages [3c177ad8d](#)
- Merge branch 'master' of @amol-/tw2.core into develop [5254065c0](#)

1.7.9 2.2.0.8

- Fix duplicate class name [1c133c907](#)
- Be able to put an HTML separator between the children of a RepeatingWidget. We also need to support it for the CompoundWidget since it uses the same template [db717642d](#)
- Merge pull request #96 from LeResKP/develop [41229bf01](#)
- Re-enable archive_tw2_resources on Python 2 [56215397a](#)

1.7.10 2.2.0.7

- – Clean up cache * Hack to fix the tests with empty value attributes for genshi [cd5febe2b](#)
- Merge pull request #95 from LeResKP/develop [9f54d72be](#)
- Merge branch 'develop' of github.com:toscawidgets/tw2.core into develop [9142fe165](#)

1.7.11 2.2.0.6

1.7.12 2.2.0.5

- Add a setUp method back to another base test that's missing it. [55b6061ed](#)

1.7.13 2.2.0.4

- Restore an old setUp method for tw2.core.testbase.WidgetTest [da2d9bab2](#)

1.7.14 2.2.0.3

- Added a new validator *UUIDValidator* (+test) for UUID/GUIDs [ebea7f30b](#)
- Merge pull request #92 from RobertSudwarts/amol [481926de6](#)
- Call me picky, but I think license belongs up there [de9d87587](#)
- Merge branch 'amol' into develop [46d68b792](#)
- pep8 [5896d4db0](#)
- Fix tests for UUIDValidator [bfc4531ec](#)
- Handle case where response.charset is None. [e1fe13460](#)
- Merge branch 'develop' of github.com:toscawidgets/tw2.core into develop [4fec80d22](#)

1.7.15 2.2.0.2

- Update one test now that the error message has changed. [c31f52732](#)
- Catch if a template is None. [a159b6cf1](#)
- Remove direct dependence on unittest so we can get test-generators working again. Relates to #88. [f561ef33d](#)
- Turn the css/js escaping tests into generators per engine too. [c43bd4d7f](#)

- Kajiki expects unicode these days. [16f6508c2](#)
- Mark this test really as skipping. [b59d1ff05](#)
- Skip tests on weird kajiki behavior. ... [11285aa68](#)
- Drop python-3.2 support since our deps dont support it. [0f777ea68](#)
- Kill kajiki. [ea14b79f1](#)
- Merge pull request #94 from toscawidgets/feature/yielding-again [30e4c4b3d](#)
- Metadata fixups, #90 [38e306f88](#)
- Imported doc fragments from tw2.forms [894b28540](#)

1.7.16 2.2.0.1

- Provide more info in this traceback. [77efa240f](#)
- Variable, not Param. [03991510e](#)
- Update TG2 tutorial to current state of affairs [cb481999a](#)
- Make some things non-required that were newly required. [14507319d](#)
- Merge branch 'develop' of github.com:toscawidgets/tw2.core into develop [f5a00e83d](#)

1.7.17 2.2.0

- Support more webob versions. Fixes #77 [e071e9d33](#)
- Constrain webtest version for py2.5. [1214057c1](#)
- Port to python2/python3 codebase. [c1d2b7721](#)
- Travis-CI config update. [21a35d470](#)
- Some py3 fixes for tw2.forms. [c82fb090f](#)
- @moschlar on the ball. [8b5cdcb81](#)
- Some setup for a port of tw2.devtools to gearbox. [08fd64a11](#)
- Merge branch 'feature/2.2' into develop [4aef579c7](#)
- Mention tw2.core.DirLink in the docs. Fixes #69. [dce1db697](#)
- Reference gearbox tw2.browser in the docs. [2562933ee](#)
- Include translations in distribution. [2791169fa](#)
- Merge pull request #82 from Cito/develop [f6d1f0502](#)
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CHAPTER 2

Online Resources

ToscaWidgets, as it was originally born from TurboGears Widgets, shares many online resources with TurboGears. If you have questions on how to use TW2 feel free to ask them in TurboGears channel or Mailing List.

- Bug tracker: [GitHub](#).
- Gitter Channel: [TurboGears Channel](#)
- Mailing List: [TurboGears Users](#)

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