全文检索

全文检索不同于特定字段的模糊查询，使用全文检索的效率再高，并且能够对于中文进行分词处理。

- haystack:全文检索框架，支持whoosh、solr、Xaplan、Elasticsearc四种全文检索引擎
- whoosh:纯python编写的全文搜索引擎，虽然 性能比不上sphinx、xapian、elasticsearc等，但是无二进制包，程序不会莫名其妙的崩溃，对于小型的站点，whoosh已经足够使用，
- jieba:中文分词包

安装包：

```
pip install django-haystack
pip install whoosh
pip install jieba
```

修改settings文件

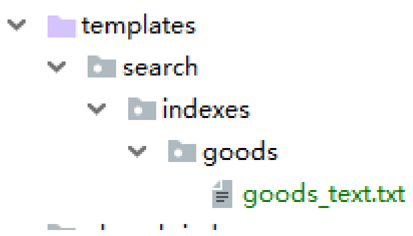
```
INSTALLWS_APPS = [
    'haystack',  # 全文检索框架
]


 全文检索框架的配置
HAYSTACK_CONNECTIONS = {
    'default': {
        # 使用whoosh搜索引擎
        'ENGINE': 'haystack.whoosh_cn_backend.WhooshEngine',
        # 索引文件的路径
        'PATH': os.path.join(BASE_DIR, 'whoosh_index'),
    },
}

# 当添加、修改、删除数据时，自动生成索引
HAYSTACK_SIGNAL_PROCESSOR = 'haystack.signals.RealtimeSignalProcessor'

# 设置每页显示的数目，默认为20，可以自己修改
HAYSTACK_SEARCH_RESULTS_PER_PAGE  =  8
```

在要检索的app下面，创建search_indexes.py文件

```
# 定义索引类
from haystack import indexes
from .models import Goods


# 索引类名格式：模型类名+Index
class GoodsIndex(indexes.SearchIndex, indexes.Indexable):
    """

    """
    # 索引字段：use_template 指定根据表中的哪些字段 建立索引文件
    # 把说明放在一个文件中
    text = indexes.CharField(document=True, use_template=True)

    # 建立检索字段，model_attr模型属性，如果需要多字段的话，在这里添加需要检索的字段
    goods_name = indexes.NgramField(model_attr="goods_name")

    def get_model(self):
        return Goods  # 返回的模型类

    def index_queryset(self, using=None):
        return self.get_model().objects.all()
```

在templates下面创建如下文件夹 search/indexes/goods,在这下面创建goods_text.txt（goods是需要检索的模型类的小写）

注：名称是固定的，不可随意更改



在goods_test.txt里面写入需要检索的字段

```
# 指定根据表中的哪些字段建立索引数据
{{object.goods_name}}  # 根据商品的名称建立索引
```

进入到项目所在的目录，创建索引文件：**python manage.py rebuild_index**

html下搜索框固定设置

```
<form action="" method="get">       <--form的method必须为get-->
    {% csrf_token %}
    <input type="text" placeholder="搜索品牌 店铺..." name="q">  <--inpu的name必须为q-->
    <input type="submit"  value="搜索" >
</form>
```

配置项目下的urls

```
from django.urls import path, include

urlpatterns = [
    path('search/', include('haystack.urls'))  # 全文检过框架
]
```

搜索出来的结果，haystack会把搜索结果传递给templates/search目录下的search.html，所以需要在templates的search文件夹下创建search.html文件。传递的上下文包括：

query: 搜索的关键字

page:当前页的page对象

serchResult类的实例对象，对象的属性是object

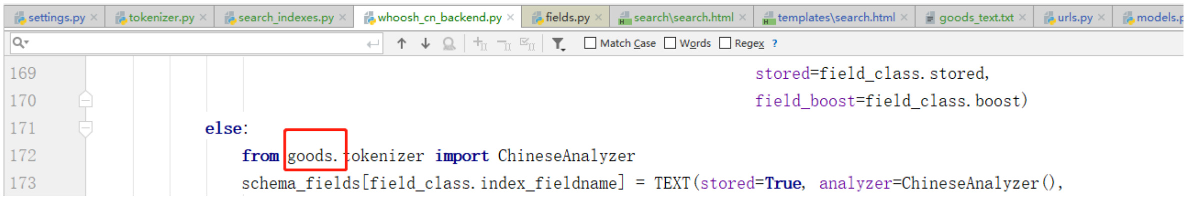
paginator：分页paginator对象

```
# 设置每页显示的数目，默认为20，可以自己修改
HAYSTACK_SEARCH_RESULTS_PER_PAGE  =  8
```

配置中文分词器，这里用到的模块为jieba,文件名为：tokenizer.py,把本文件放在与search_indexes.py同目录下，我这里放在了goods文件夹下

```
from jieba import cut_for_search
from whoosh.analysis import Tokenizer, Token


class ChineseTokenizer(Tokenizer):
    def __call__(self, value, positions=False, chars=False,
                 keeporiginal=False, removestops=True,
                 start_pos=0, start_char=0, mode='', **kwargs):

        t = Token(positions, chars, removestops=removestops, mode=mode,
                  **kwargs)
        # seglist = cut(value, cut_all=False)  # (精确模式)使用结巴分词库进行分词
        seglist = cut_for_search(value)  # (搜索引擎模式) 使用结巴分词库进行分词
        for w in seglist:
            t.original = t.text = w
            t.boost = 1.0
            if positions:
                t.pos = start_pos + value.find(w)
            if chars:
                t.startchar = start_char + value.find(w)
                t.endchar = start_char + value.find(w) + len(w)
            yield t  # 通过生成器返回每个分词的结果token


def ChineseAnalyzer():
    return ChineseTokenizer()
```

中文搜索引擎配置,文件名：whoosh_cn_backend.py，把本文件放在与search_indexes.py同目录下，我这里放在了goods文件夹下,修改172行的app名



```
169                                                 stored=field_class.stored,
170                                                 field_boost=field_class.boost)
171             else:
172                 from goods.tokenizer import ChineseAnalyzer
173                 schema_fields[field_class.index_fieldname] = TEXT(stored=True, analyzer=ChineseAnalyzer(),
```

```
# encoding: utf-8

from __future__ import absolute_import, division, print_function,
unicode_literals

import json
import os
import re
import shutil
```

```python
import threading
import warnings

from django.conf import settings
from django.core.exceptions import ImproperlyConfigured
from django.utils import six
from django.utils.datetime_safe import datetime
from django.utils.encoding import force_text

from haystack.backends import BaseEngine, BaseSearchBackend, BaseSearchQuery,
EmptyResults, log_query
from haystack.constants import DJANGO_CT, DJANGO_ID, ID
from haystack.exceptions import MissingDependency, SearchBackendError,
SkipDocument
from haystack.inputs import Clean, Exact, PythonData, Raw
from haystack.models import SearchResult
from haystack.utils import log as logging
from haystack.utils import get_identifier, get_model_ct
from haystack.utils.app_loading import haystack_get_model

try:
    import whoosh
except ImportError:
    raise MissingDependency(
        "The 'whoosh' backend requires the installation of 'Whoosh'. Please
refer to the documentation.")

# Handle minimum requirement.
if not hasattr(whoosh, '__version__') or whoosh.__version__ < (2, 5, 0):
    raise MissingDependency("The 'whoosh' backend requires version 2.5.0 or
greater.")

# Bubble up the correct error.
from whoosh import index
from whoosh.analysis import StemmingAnalyzer
from whoosh.fields import ID as WHOOSH_ID
from whoosh.fields import BOOLEAN, DATETIME, IDLIST, KEYWORD, NGRAM, NGRAMWORDS,
NUMERIC, Schema, TEXT
from whoosh.filedb.filestore import FileStorage, RamStorage
from whoosh.highlight import highlight as whoosh_highlight
from whoosh.highlight import ContextFragmenter, HtmlFormatter
from whoosh.qparser import QueryParser
from whoosh.searching import ResultsPage
from whoosh.writing import AsyncWriter

DATETIME_REGEX = re.compile(
    '^(?P<year>\d{4})-(?P<month>\d{2})-(?P<day>\d{2})T(?P<hour>\d{2}):(?
P<minute>\d{2}):(?P<second>\d{2})(\.\d{3,6}Z?)?$')
LOCALS = threading.local()
LOCALS.RAM_STORE = None


class WhooshHtmlFormatter(HtmlFormatter):
    """
    This is a HtmlFormatter simpler than the whoosh.HtmlFormatter.
    We use it to have consistent results across backends. Specifically,
    Solr, Xapian and Elasticsearch are using this formatting.
    """
    template = '<%(tag)s>%(t)s</%(tag)s>'


class WhooshSearchBackend(BaseSearchBackend):
    # Word reserved by Whoosh for special use.
    RESERVED_WORDS = (
        'AND',
        'NOT',
        'OR',
        'TO',
    )

    # Characters reserved by Whoosh for special use.
    # The '\\' must come first, so as not to overwrite the other slash
replacements.
    RESERVED_CHARACTERS = (
        '\\', '+', '-', '&&', '||', '!', '(', ')', '{', '}',
        '[', ']', '^', '"', '~', '*', '?', ':', '.',
    )

    def __init__(self, connection_alias, **connection_options):
        super(WhooshSearchBackend, self).__init__(connection_alias,
**connection_options)
        self.setup_complete = False
        self.use_file_storage = True
        self.post_limit = getattr(connection_options, 'POST_LIMIT', 128 * 1024 *
1024)
        self.path = connection_options.get('PATH')

        if connection_options.get('STORAGE', 'file') != 'file':
            self.use_file_storage = False

        if self.use_file_storage and not self.path:
            raise ImproperlyConfigured(
                "You must specify a 'PATH' in your settings for connection
'%s'." % connection_alias)

        self.log = logging.getLogger('haystack')

    def setup(self):
        """
        Defers loading until needed.
        """
        from haystack import connections
        new_index = False

        # Make sure the index is there.
        if self.use_file_storage and not os.path.exists(self.path):
            os.makedirs(self.path)
            new_index = True

        if self.use_file_storage and not os.access(self.path, os.W_OK):
            raise IOError("The path to your Whoosh index '%s' is not writable
for the current user/group." % self.path)

        if self.use_file_storage:
            self.storage = FileStorage(self.path)
        else:
            global LOCALS

            if getattr(LOCALS, 'RAM_STORE', None) is None:
                LOCALS.RAM_STORE = RamStorage()

            self.storage = LOCALS.RAM_STORE

        self.content_field_name, self.schema = self.build_schema(

 connections[self.connection_alias].get_unified_index().all_searchfields())
        self.parser = QueryParser(self.content_field_name, schema=self.schema)

        if new_index is True:
            self.index = self.storage.create_index(self.schema)
        else:
            try:
                self.index = self.storage.open_index(schema=self.schema)
            except index.EmptyIndexError:
                self.index = self.storage.create_index(self.schema)

        self.setup_complete = True

    def build_schema(self, fields):
        schema_fields = {
            ID: WHOOSH_ID(stored=True, unique=True),
            DJANGO_CT: WHOOSH_ID(stored=True),
            DJANGO_ID: WHOOSH_ID(stored=True),
        }
        # Grab the number of keys that are hard-coded into Haystack.
        # We'll use this to (possibly) fail slightly more gracefully later.
        initial_key_count = len(schema_fields)
        content_field_name = ''

        for field_name, field_class in fields.items():
            if field_class.is_multivalued:
                if field_class.indexed is False:
                    schema_fields[field_class.index_fieldname] =
IDLIST(stored=True, field_boost=field_class.boost)
                else:
                    schema_fields[field_class.index_fieldname] =
KEYWORD(stored=True, commas=True, scorable=True,

field_boost=field_class.boost)
            elif field_class.field_type in ['date', 'datetime']:
                schema_fields[field_class.index_fieldname] =
DATETIME(stored=field_class.stored, sortable=True)
            elif field_class.field_type == 'integer':
                schema_fields[field_class.index_fieldname] =
NUMERIC(stored=field_class.stored, numtype=int,

field_boost=field_class.boost)
            elif field_class.field_type == 'float':
                schema_fields[field_class.index_fieldname] =
NUMERIC(stored=field_class.stored, numtype=float,

field_boost=field_class.boost)
            elif field_class.field_type == 'boolean':
                # Field boost isn't supported on BOOLEAN as of 1.8.2.
                schema_fields[field_class.index_fieldname] =
BOOLEAN(stored=field_class.stored)
            elif field_class.field_type == 'ngram':
                schema_fields[field_class.index_fieldname] = NGRAM(minsize=3,
maxsize=15, stored=field_class.stored,

field_boost=field_class.boost)
            elif field_class.field_type == 'edge_ngram':
                schema_fields[field_class.index_fieldname] =
NGRAMWORDS(minsize=2, maxsize=15, at='start',

 stored=field_class.stored,

 field_boost=field_class.boost)
            else:
                from goods.tokenizer import ChineseAnalyzer
                schema_fields[field_class.index_fieldname] = TEXT(stored=True,
analyzer=ChineseAnalyzer(),

 field_boost=field_class.boost, sortable=True)
            if field_class.document is True:
                content_field_name = field_class.index_fieldname
                schema_fields[field_class.index_fieldname].spelling = True

        # Fail more gracefully than relying on the backend to die if no fields
        # are found.
        if len(schema_fields) <= initial_key_count:
            raise SearchBackendError(
                "No fields were found in any search_indexes. Please correct this
before attempting to search.")

        return (content_field_name, Schema(**schema_fields))

    def update(self, index, iterable, commit=True):
        if not self.setup_complete:
            self.setup()

        self.index = self.index.refresh()
        writer = AsyncWriter(self.index)

        for obj in iterable:
            try:
                doc = index.full_prepare(obj)
            except SkipDocument:
                self.log.debug(u"Indexing for object `%s` skipped", obj)
            else:
                # Really make sure it's unicode, because Whoosh won't have it
any
                # other way.
                for key in doc:
                    doc[key] = self._from_python(doc[key])

                # Document boosts aren't supported in Whoosh 2.5.0+.
                if 'boost' in doc:
                    del doc['boost']

                try:
                    writer.update_document(**doc)
                except Exception as e:
                    if not self.silently_fail:
                        raise

                    # We'll log the object identifier but won't include the
actual object
                    # to avoid the possibility of that generating encoding
errors while
                    # processing the log message:
                    self.log.error(u"%s while preparing object for update" %
e.__class__.__name__,
                                   exc_info=True, extra={"data": {"index":
index,
                                                                  "object":
get_identifier(obj)}})

        if len(iterable) > 0:
            # For now, commit no matter what, as we run into locking issues
otherwise.
            writer.commit()

    def remove(self, obj_or_string, commit=True):
        if not self.setup_complete:
            self.setup()

        self.index = self.index.refresh()
        whoosh_id = get_identifier(obj_or_string)

        try:
            self.index.delete_by_query(q=self.parser.parse(u'%s:"%s"' % (ID,
whoosh_id)))
        except Exception as e:
            if not self.silently_fail:
                raise

            self.log.error("Failed to remove document '%s' from Whoosh: %s",
whoosh_id, e, exc_info=True)

    def clear(self, models=None, commit=True):
        if not self.setup_complete:
            self.setup()

        self.index = self.index.refresh()

        if models is not None:
            assert isinstance(models, (list, tuple))

        try:
            if models is None:
                self.delete_index()
            else:
                models_to_delete = []

                for model in models:
                    models_to_delete.append(u"%s:%s" % (DJANGO_CT,
get_model_ct(model)))
```

```
                self.index.delete_by_query(q=self.parser.parse(u" OR
".join(models_to_delete)))
        except Exception as e:
            if not self.silently_fail:
                raise

            if models is not None:
                self.log.error("Failed to clear Whoosh index of models '%s':
%s", ','.join(models_to_delete),
                               e, exc_info=True)
            else:
                self.log.error("Failed to clear Whoosh index: %s", e,
exc_info=True)

    def delete_index(self):
        # Per the Whoosh mailing list, if wiping out everything from the index,
        # it's much more efficient to simply delete the index files.
        if self.use_file_storage and os.path.exists(self.path):
            shutil.rmtree(self.path)
        elif not self.use_file_storage:
            self.storage.clean()

        # Recreate everything.
        self.setup()

    def optimize(self):
        if not self.setup_complete:
            self.setup()

        self.index = self.index.refresh()
        self.index.optimize()

    def calculate_page(self, start_offset=0, end_offset=None):
        # Prevent against Whoosh throwing an error. Requires an end_offset
        # greater than 0.
        if end_offset is not None and end_offset <= 0:
            end_offset = 1

        # Determine the page.
        page_num = 0

        if end_offset is None:
            end_offset = 1000000

        if start_offset is None:
            start_offset = 0

        page_length = end_offset - start_offset

        if page_length and page_length > 0:
            page_num = int(start_offset / page_length)

        # Increment because Whoosh uses 1-based page numbers.
        page_num += 1
        return page_num, page_length

    @log_query
    def search(self, query_string, sort_by=None, start_offset=0,
end_offset=None,
               fields='', highlight=False, facets=None, date_facets=None,
query_facets=None,
               narrow_queries=None, spelling_query=None, within=None,
               dwithin=None, distance_point=None, models=None,
               limit_to_registered_models=None, result_class=None, **kwargs):
        if not self.setup_complete:
            self.setup()

        # A zero length query should return no results.
        if len(query_string) == 0:
            return {
                'results': [],
                'hits': 0,
            }

        query_string = force_text(query_string)

        # A one-character query (non-wildcard) gets nabbed by a stopwords
        # filter and should yield zero results.
        if len(query_string) <= 1 and query_string != u'*':
            return {
                'results': [],
                'hits': 0,
            }

        reverse = False

        if sort_by is not None:
            # Determine if we need to reverse the results and if Whoosh can
            # handle what it's being asked to sort by. Reversing is an
            # all-or-nothing action, unfortunately.
            sort_by_list = []
            reverse_counter = 0

            for order_by in sort_by:
                if order_by.startswith('-'):
                    reverse_counter += 1

            if reverse_counter and reverse_counter != len(sort_by):
                raise SearchBackendError("Whoosh requires all order_by fields"
                                         " to use the same sort direction")

            for order_by in sort_by:
                if order_by.startswith('-'):
                    sort_by_list.append(order_by[1:])

                    if len(sort_by_list) == 1:
                        reverse = True
                else:
                    sort_by_list.append(order_by)

                    if len(sort_by_list) == 1:
                        reverse = False

            sort_by = sort_by_list
        if facets is not None:
            warnings.warn("Whoosh does not handle faceting.", Warning,
stacklevel=2)

        if date_facets is not None:
            warnings.warn("Whoosh does not handle date faceting.", Warning,
stacklevel=2)

        if query_facets is not None:
            warnings.warn("Whoosh does not handle query faceting.", Warning,
stacklevel=2)

        narrowed_results = None
        self.index = self.index.refresh()

        if limit_to_registered_models is None:
            limit_to_registered_models = getattr(settings,
'HAYSTACK_LIMIT_TO_REGISTERED_MODELS', True)

        if models and len(models):
            model_choices = sorted(get_model_ct(model) for model in models)
        elif limit_to_registered_models:
            # Using narrow queries, limit the results to only models handled
            # with the current routers.
            model_choices = self.build_models_list()
        else:
            model_choices = []

        if len(model_choices) > 0:
            if narrow_queries is None:
                narrow_queries = set()

            narrow_queries.add(' OR '.join(['%s:%s' % (DJANGO_CT, rm) for rm in
model_choices]))

        narrow_searcher = None

        if narrow_queries is not None:
            # Potentially expensive? I don't see another way to do it in
Whoosh...
            narrow_searcher = self.index.searcher()

            for nq in narrow_queries:
                recent_narrowed_results =
narrow_searcher.search(self.parser.parse(force_text(nq)),
                                                                  limit=None)

                if len(recent_narrowed_results) <= 0:
                    return {
                        'results': [],
                        'hits': 0,
                    }

                if narrowed_results:
                    narrowed_results.filter(recent_narrowed_results)
                else:
                    narrowed_results = recent_narrowed_results
        self.index = self.index.refresh()

        if self.index.doc_count():
            searcher = self.index.searcher()
            parsed_query = self.parser.parse(query_string)

            # In the event of an invalid/stopworded query, recover gracefully.
            if parsed_query is None:
                return {
                    'results': [],
                    'hits': 0,
                }

            page_num, page_length = self.calculate_page(start_offset,
end_offset)

            search_kwargs = {
                'pagelen': page_length,
                'sortedby': sort_by,
                'reverse': reverse,
            }

            # Handle the case where the results have been narrowed.
            if narrowed_results is not None:
                search_kwargs['filter'] = narrowed_results

            try:
                raw_page = searcher.search_page(
                    parsed_query,
                    page_num,
                    **search_kwargs
                )
            except ValueError:
                if not self.silently_fail:
                    raise

                return {
                    'results': [],
                    'hits': 0,
                    'spelling_suggestion': None,
                }

            # Because as of Whoosh 2.5.1, it will return the wrong page of
            # results if you request something too high. :(
            if raw_page.pagenum < page_num:
                return {
                    'results': [],
                    'hits': 0,
                    'spelling_suggestion': None,
                }

            results = self._process_results(raw_page, highlight=highlight,
query_string=query_string,
                                            spelling_query=spelling_query,
result_class=result_class)
            searcher.close()

            if hasattr(narrow_searcher, 'close'):
                narrow_searcher.close()

            return results
        else:
            if self.include_spelling:
                if spelling_query:
                    spelling_suggestion =
self.create_spelling_suggestion(spelling_query)
                else:
                    spelling_suggestion =
self.create_spelling_suggestion(query_string)
            else:
                spelling_suggestion = None

            return {
                'results': [],
                'hits': 0,
                'spelling_suggestion': spelling_suggestion,
            }

    def more_like_this(self, model_instance, additional_query_string=None,
                       start_offset=0, end_offset=None, models=None,
                       limit_to_registered_models=None, result_class=None,
**kwargs):
        if not self.setup_complete:
            self.setup()

        field_name = self.content_field_name
        narrow_queries = set()
        narrowed_results = None
        self.index = self.index.refresh()

        if limit_to_registered_models is None:
            limit_to_registered_models = getattr(settings,
'HAYSTACK_LIMIT_TO_REGISTERED_MODELS', True)

        if models and len(models):
            model_choices = sorted(get_model_ct(model) for model in models)
        elif limit_to_registered_models:
            # Using narrow queries, limit the results to only models handled
            # with the current routers.
            model_choices = self.build_models_list()
        else:
            model_choices = []

        if len(model_choices) > 0:
            if narrow_queries is None:
                narrow_queries = set()

            narrow_queries.add(' OR '.join(['%s:%s' % (DJANGO_CT, rm) for rm in
model_choices]))

        if additional_query_string and additional_query_string != '*':
            narrow_queries.add(additional_query_string)

        narrow_searcher = None

        if narrow_queries is not None:
            # Potentially expensive? I don't see another way to do it in
Whoosh...
            narrow_searcher = self.index.searcher()

            for nq in narrow_queries:
                recent_narrowed_results =
narrow_searcher.search(self.parser.parse(force_text(nq)),
                                                                    limit=None)

                if len(recent_narrowed_results) <= 0:
                    return {
                        'results': [],
                        'hits': 0,
                    }

                if narrowed_results:
                    narrowed_results.filter(recent_narrowed_results)
                else:
                    narrowed_results = recent_narrowed_results

        page_num, page_length = self.calculate_page(start_offset, end_offset)

        self.index = self.index.refresh()
        raw_results = EmptyResults()

        searcher = None
        if self.index.doc_count():
            query = "%s:%s" % (ID, get_identifier(model_instance))
            searcher = self.index.searcher()
            parsed_query = self.parser.parse(query)
            results = searcher.search(parsed_query)

            if len(results):
                raw_results = results[0].more_like_this(field_name,
top=end_offset)

            # Handle the case where the results have been narrowed.
            if narrowed_results is not None and hasattr(raw_results, 'filter'):
                raw_results.filter(narrowed_results)

        try:
            raw_page = ResultsPage(raw_results, page_num, page_length)
        except ValueError:
            if not self.silently_fail:
                raise

            return {
                'results': [],
                'hits': 0,
                'spelling_suggestion': None,
            }

        # Because as of Whoosh 2.5.1, it will return the wrong page of
        # results if you request something too high. :(
        if raw_page.pagenum < page_num:
            return {
                'results': [],
                'hits': 0,
                'spelling_suggestion': None,
            }

        results = self._process_results(raw_page, result_class=result_class)

        if searcher:
            searcher.close()

        if hasattr(narrow_searcher, 'close'):
            narrow_searcher.close()

        return results

    def _process_results(self, raw_page, highlight=False, query_string='',
spelling_query=None, result_class=None):
        from haystack import connections
        results = []

        # It's important to grab the hits first before slicing. Otherwise, this
        # can cause pagination failures.
        hits = len(raw_page)

        if result_class is None:
            result_class = SearchResult

        facets = {}
        spelling_suggestion = None
        unified_index = connections[self.connection_alias].get_unified_index()
        indexed_models = unified_index.get_indexed_models()

        for doc_offset, raw_result in enumerate(raw_page):
            score = raw_page.score(doc_offset) or 0
            app_label, model_name = raw_result[DJANGO_CT].split('.')
            additional_fields = {}
            model = haystack_get_model(app_label, model_name)

            if model and model in indexed_models:
                for key, value in raw_result.items():
                    index = unified_index.get_index(model)
                    string_key = str(key)

                    if string_key in index.fields and
hasattr(index.fields[string_key], 'convert'):
                        # Special-cased due to the nature of KEYWORD fields.
                        if index.fields[string_key].is_multivalued:
                            if value is None or len(value) is 0:
                                additional_fields[string_key] = []
                            else:
                                additional_fields[string_key] = value.split(',')
                        else:
                            additional_fields[string_key] =
index.fields[string_key].convert(value)
                    else:
                        additional_fields[string_key] = self._to_python(value)

                del (additional_fields[DJANGO_CT])
                del (additional_fields[DJANGO_ID])
                if highlight:
                    sa = StemmingAnalyzer()
                    formatter = WhooshHtmlFormatter('em')
                    terms = [token.text for token in sa(query_string)]

                    whoosh_result = whoosh_highlight(
                        additional_fields.get(self.content_field_name),
                        terms,
                        sa,
                        ContextFragmenter(),
                        formatter
                    )
                    additional_fields['highlighted'] = {
                        self.content_field_name: [whoosh_result],
                    }

                result = result_class(app_label, model_name,
raw_result[DJANGO_ID], score, **additional_fields)
                results.append(result)
            else:
                hits -= 1

        if self.include_spelling:
            if spelling_query:
                spelling_suggestion =
self.create_spelling_suggestion(spelling_query)
            else:
                spelling_suggestion =
self.create_spelling_suggestion(query_string)

        return {
            'results': results,
            'hits': hits,
            'facets': facets,
            'spelling_suggestion': spelling_suggestion,
        }

    def create_spelling_suggestion(self, query_string):
        spelling_suggestion = None
        reader = self.index.reader()
        corrector = reader.corrector(self.content_field_name)
        cleaned_query = force_text(query_string)

        if not query_string:
            return spelling_suggestion

        # Clean the string.
        for rev_word in self.RESERVED_WORDS:
            cleaned_query = cleaned_query.replace(rev_word, '')

        for rev_char in self.RESERVED_CHARACTERS:
            cleaned_query = cleaned_query.replace(rev_char, '')

        # Break it down.
        query_words = cleaned_query.split()
        suggested_words = []

        for word in query_words:
            suggestions = corrector.suggest(word, limit=1)

            if len(suggestions) > 0:
                suggested_words.append(suggestions[0])

        spelling_suggestion = ' '.join(suggested_words)
        return spelling_suggestion

    def _from_python(self, value):
        """
        Converts Python values to a string for Whoosh.

        Code courtesy of pysolr.
        """
        if hasattr(value, 'strftime'):
            if not hasattr(value, 'hour'):
                value = datetime(value.year, value.month, value.day, 0, 0, 0)
        elif isinstance(value, bool):
            if value:
                value = 'true'
            else:
                value = 'false'
        elif isinstance(value, (list, tuple)):
            value = u','.join([force_text(v) for v in value])
        elif isinstance(value, (six.integer_types, float)):
            # Leave it alone.
            pass
        else:
            value = force_text(value)
        return value

    def _to_python(self, value):
        """
        Converts values from Whoosh to native Python values.

        A port of the same method in pysolr, as they deal with data the same
way.
        """
        if value == 'true':
            return True
        elif value == 'false':
            return False

        if value and isinstance(value, six.string_types):
            possible_datetime = DATETIME_REGEX.search(value)

            if possible_datetime:
                date_values = possible_datetime.groupdict()

                for dk, dv in date_values.items():
                    date_values[dk] = int(dv)

                return datetime(date_values['year'], date_values['month'],
date_values['day'], date_values['hour'],
                                date_values['minute'], date_values['second'])

        try:
            # Attempt to use json to load the values.
            converted_value = json.loads(value)

            # Try to handle most built-in types.
            if isinstance(converted_value, (list, tuple, set, dict,
six.integer_types, float, complex)):
                return converted_value
        except:
            # If it fails (SyntaxError or its ilk) or we don't trust it,
            # continue on.
            pass

        return value


class WhooshSearchQuery(BaseSearchQuery):
    def _convert_datetime(self, date):
        if hasattr(date, 'hour'):
            return force_text(date.strftime('%Y%m%d%H%M%S'))
        else:
            return force_text(date.strftime('%Y%m%d000000'))

    def clean(self, query_fragment):
        """
        Provides a mechanism for sanitizing user input before presenting the
        value to the backend.

        Whoosh 1.X differs here in that you can no longer use a backslash
        to escape reserved characters. Instead, the whole word should be
        quoted.
        """
        words = query_fragment.split()
        cleaned_words = []

        for word in words:
            if word in self.backend.RESERVED_WORDS:
                word = word.replace(word, word.lower())

            for char in self.backend.RESERVED_CHARACTERS:
                if char in word:
                    word = "'%s'" % word
                    break

            cleaned_words.append(word)

        return ' '.join(cleaned_words)

    def build_query_fragment(self, field, filter_type, value):
        from haystack import connections
        query_frag = ''
        is_datetime = False

        if not hasattr(value, 'input_type_name'):
            # Handle when we've got a ``ValuesListQuerySet``...
            if hasattr(value, 'values_list'):
                value = list(value)

            if hasattr(value, 'strftime'):
                is_datetime = True
            if isinstance(value, six.string_types) and value != ' ':
                # It's not an ``InputType``. Assume ``Clean``.
                value = Clean(value)
            else:
                value = PythonData(value)

        # Prepare the query using the InputType.
        prepared_value = value.prepare(self)

        if not isinstance(prepared_value, (set, list, tuple)):
            # Then convert whatever we get back to what pysolr wants if needed.
            prepared_value = self.backend._from_python(prepared_value)

        # 'content' is a special reserved word, much like 'pk' in
        # Django's ORM layer. It indicates 'no special field'.
        if field == 'content':
            index_fieldname = ''
        else:
            index_fieldname = u'%s:' %
connections[self._using].get_unified_index().get_index_fieldname(field)

        filter_types = {
            'content': '%s',
            'contains': '*%s*',
            'endswith': "*%s",
            'startswith': "%s*",
            'exact': '%s',
            'gt': "{%s to}",
            'gte': "[%s to]",
            'lt': "{to %s}",
            'lte': "[to %s]",
            'fuzzy': u'%s~',
        }

        if value.post_process is False:
            query_frag = prepared_value
        else:
            if filter_type in ['content', 'contains', 'startswith', 'endswith',
'fuzzy']:
                if value.input_type_name == 'exact':
                    query_frag = prepared_value
                else:
                    # Iterate over terms & incorportate the converted form of
each into the query.
                    terms = []

                    if isinstance(prepared_value, six.string_types):
                        possible_values = prepared_value.split(' ')
                    else:
                        if is_datetime is True:
                            prepared_value =
self._convert_datetime(prepared_value)

                        possible_values = [prepared_value]

                    for possible_value in possible_values:
                        terms.append(filter_types[filter_type] % 
self.backend._from_python(possible_value))

                    if len(terms) == 1:
                        query_frag = terms[0]
                    else:
                        query_frag = u"(%s)" % " AND ".join(terms)
            elif filter_type == 'in':
                in_options = []

                for possible_value in prepared_value:
                    is_datetime = False

                    if hasattr(possible_value, 'strftime'):
                        is_datetime = True

                    pv = self.backend._from_python(possible_value)

                    if is_datetime is True:
                        pv = self._convert_datetime(pv)

                    if isinstance(pv, six.string_types) and not is_datetime:
                        in_options.append('"%s"' % pv)
                    else:
                        in_options.append('%s' % pv)

                query_frag = "(%s)" % " OR ".join(in_options)
            elif filter_type == 'range':
                start = self.backend._from_python(prepared_value[0])
                end = self.backend._from_python(prepared_value[1])

                if hasattr(prepared_value[0], 'strftime'):
                    start = self._convert_datetime(start)

                if hasattr(prepared_value[1], 'strftime'):
                    end = self._convert_datetime(end)

                query_frag = u"[%s to %s]" % (start, end)
            elif filter_type == 'exact':
                if value.input_type_name == 'exact':
                    query_frag = prepared_value
                else:
                    prepared_value = Exact(prepared_value).prepare(self)
                    query_frag = filter_types[filter_type] % prepared_value
            else:
                if is_datetime is True:
                    prepared_value = self._convert_datetime(prepared_value)

                query_frag = filter_types[filter_type] % prepared_value

        if len(query_frag) and not isinstance(value, Raw):
            if not query_frag.startswith('(') and not query_frag.endswith(')'):
                query_frag = "(%s)" % query_frag

        return u"%s%s" % (index_fieldname, query_frag)


class WhooshEngine(BaseEngine):
    backend = WhooshSearchBackend
    query = WhooshSearchQuery
```