# CPE v1.2.1 Documentation

***Release 1.2.1***

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Contents

Welcome to cpe package documentation. In this pages you can find a tutorial about cpe package, that implements the validation of both CPE Names and platform (set of CPE Names) and the comparisons between them, corresponding to versions 1.1, 2.2 and 2.3 of CPE (Common Platform Enumeration) specification. Also, this package gives support to name and language matching algorithms.

This documentation contains a brief introduction about Common Platform Enumeration (CPE) specification, the CPE version list implemented and the compatibility among them, the class model designed, the steps to install and use the cpe package (with examples), and several important issues to consider associated with the functionality of the package.

For more information about cpe package implementation, please visite: https://github.com/nilp0inter/cpe.

Contents:

CHAPTER 1

# Introduction

Common Platform Enumeration (CPE) is a standardized method of describing and identifying classes of applications, operating systems, and hardware devices present among an enterprise's computing assets. CPE does not identify unique instantiations of products on systems, such as the installation of XYZ Visualizer Enterprise Suite 4.2.3 with serial number Q472B987P113. Rather, CPE identifies abstract classes of products, such as XYZ Visualizer Enterprise Suite 4.2.3, XYZ Visualizer Enterprise Suite (all versions), or XYZ Visualizer (all variations).

IT management tools can collect information about installed products, identifying these products using their CPE Names, and then use this standardized information to help make fully or partially automated decisions regarding the assets. For example, identifying the presence of XYZ Visualizer Enterprise Suite could trigger a vulnerability management tool to check the system for known vulnerabilities in the software, and also trigger a configuration management tool to verify that the software is configured securely in accordance with the organization's policies. This example illustrates how CPE Names can be used as a standardized source of information for enforcing and verifying IT management policies across tools [1].

CPE provides [2]:

- A standard machine-readable format for encoding names of IT products and platforms (naming).
- A set of procedures for comparing names (name matching).
- A language for constructing "applicability statements" that combine CPE Names with simple logical operators (language matching).
- A standard notion of a CPE Dictionary.

For more information, please visit the official website of CPE, maintained by MITRE: http://cpe.mitre.org/

## 1.1 Matching

Matching [5] is the process of determining if a given CPE Name or CPE Language statement specifies a platform that is defined by a set of known CPE Names. It helps define the relationship between different CPE Names (or language statements).

### 1.1.1 Conceptual model

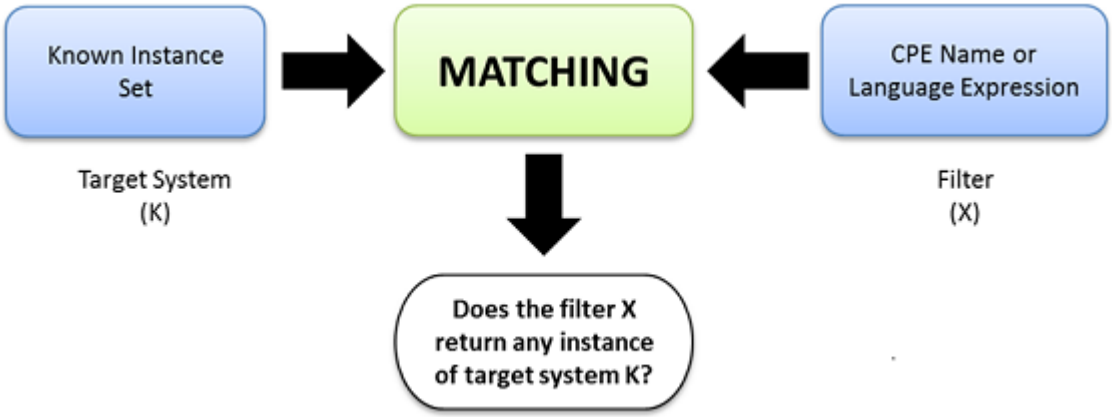
The conceptual model for matching consists of two steps:

1. Make a list of all the CPE Names and logical connections.
2. For each name, check whether the target system has the hardware, software, or operating system indicated by the name. If the check succeeds for all names, and satisfies the logical constraints, then the target is an instance of the CPE Name or Language representation.

### 1.1.2 Matching Algorithm: Known Instance Based Matching

Two elements participate in the matching process: the known instance set (CPE Names that define the target system) and the candidate CPE Name or Language expression. The algorithm applies the "filter" indicated by X and replies to the question: "Does the filter X return any instance of target system K?"

The figure bellow illustrates the basic concept of known instance based matching:




Matching consists of two algorithms.

- CPE_Name_Match:
  - This algorithm accepts a set of CPE Names K and a candidate CPE Name X.
  - It returns true if X matches any member of K, and false otherwise.
- CPE_Language_Match:
  - This algorithm accepts a set of CPE Names K and a candidate expression E.
  - It returns true if the expression can be satisfied by name matching against the members of K, and false otherwise.

CHAPTER 2

# List of implemented CPE versions

This package implements the validation of both CPE Names and platforms (set of CPE Names), and the comparisons between them, corresponding to some versions of CPE specification [3].

The functionality implemented in this package, associated with versions 1.1, 2.2 and 2.3 of CPE specification, is below:

- **Version 1.1** [4]:
  - CPE naming
  - CPE Name matching
- **Version 2.2** [5]:
  - CPE naming
  - CPE Name matching
  - CPE Language matching
- **Version 2.3**:
  - CPE naming [6]
  - CPE Name matching [7]
  - CPE Applicability Language matching [8]

The CPE naming of version 2.3 supports the definition of three different styles of CPE Name:

- **WFN**: Well-Formed Name
- **URI**: Uniform Resource Identifier
- **FS**: Formatted String

# Compatibility among CPE versions

| VER-SIONS | 1.1 | 2.2 | 2.3 WFN | 2.3 URI | 2.3 FS |
|---|---|---|---|---|---|
| 1.1 | Yes | Depends of count of parts | Depends of count of parts | Depends of count of parts | Depends of count of parts |
| 2.2 | Depends of characters | Yes | Yes | Yes | Yes |
| 2.3 WFN | Depends of characters | Depends of characters | Yes | Yes | Yes |
| 2.3 URI | Depends of characters | Depends of characters | Yes | Yes | Yes |
| 2.3 FS | Depends of characters | Depends of characters | Yes | Yes | Yes |

CHAPTER 4

# Model

This section shows the diagrams of model parts of cpe package. These diagrams have been generated with the PyNSource tool version 1.61 (https://code.google.com/p/pynsource/). Each model class is stored in a different file. The model parts are as follows.

## 4.1 CPE hierarchy

This section contains the classes associated with versions of CPE specification implemented in this package.

### 4.1.1 Class list

#### CPE class

**class** cpe.cpe.**CPE**(*cpe_str*, **args*, ***kwargs*)

Represents a generic CPE Name compatible with all versions of CPE specification.

Parts of CPE are stored in a dictionary.

**CPE structure (dictionary):**

**- part {hw, os, sw, undefined}**

**- element list (list)** - component list (dictionary)

**__eq__**(*other*)

Returns True if other (first element of operation) and self (second element of operation) are equal CPE Names, false otherwise.

**Parameters** **other** (CPE) – CPE Name to compare

**Returns** True if other == self, False otherwise

**Return type** boolean

**__getitem__**(*i*)

Returns the i'th component name of CPE Name.

**Parameters** **i** (*int*) – component index to find

**Returns** component string found

**Return type** *CPEComponent*

**Exception** IndexError - index not found in CPE Name

TEST: good index

```
>>> str = 'cpe:///sun_microsystem:sun@os:5.9:#update'
>>> c = CPE(str)
>>> c[0]
CPEComponent1_1(sun_microsystem)
```

**__init__**(*cpe_str*, **args*, ***kwargs*)
Store the CPE Name.

**Parameters** **cpe_str** (*string*) – CPE Name

**Returns** None

**__len__**()
Returns the number of components of CPE Name.

**Returns** count of components of CPE Name

**Return type** int

TEST: a CPE Name with two parts (hw and os) and some elements empty and with values

```
>>> str = "cpe:/cisco::3825/cisco:ios:12.3"
>>> c = CPE(str)
>>> len(c)
6
```

**static __new__**(*cpe_str*, *version=None*, **args*, ***kwargs*)
Generator of CPE Names.

**Parameters**

- **cpe_str** (*string*) – CPE Name string
- **version** (*string*) – version of CPE specification of CPE Name

**Returns** CPE object with version of CPE detected correctly

**Return type** *CPE*

**Exception** NotImplementedError - incorrect CPE Name or version of CPE not implemented

This class implements the factory pattern, that is, this class centralizes the creation of objects of a particular CPE version, hiding the user the requested object instance.

**__repr__**()
Returns a unambiguous representation of CPE Name.

**Returns** Representation of CPE Name as string

**Return type** string

**__str__**()
Returns a human-readable representation of CPE Name.

**Returns** Representation of CPE Name as string

**Return type** string

**__weakref__**
list of weak references to the object (if defined)

**as_dict**()
Returns the CPE Name dict as string.

**Returns** CPE Name dict as string

**Return type** string

**as_fs**()
Returns the CPE Name as formatted string of version 2.3.

**Returns** CPE Name as formatted string

**Return type** string

**Exception** TypeError - incompatible version

**as_uri_2_3**()
Returns the CPE Name as URI string of version 2.3.

**Returns** CPE Name as URI string of version 2.3

**Return type** string

**Exception** TypeError - incompatible version

**as_wfn**()
Returns the CPE Name as Well-Formed Name string of version 2.3.

**Returns** CPE Name as WFN string

**Return type** string

**Exception** TypeError - incompatible version

**get_edition**()
Returns the edition of product of CPE Name as a list. According to the CPE version, this list can contains one or more items.

**Returns** Value of edition attribute as string list.

**Return type** list

**get_language**()
Returns the internationalization information of CPE Name as a list. According to the CPE version, this list can contains one or more items.

**Returns** Value of language attribute as string list.

**Return type** list

**get_other**()
Returns the other information part of CPE Name.

**Returns** Value of other attribute as string list.

**Return type** list

**get_part**()
Returns the part component of CPE Name as a list. According to the CPE version, this list can contains one or more items.

**Returns** Value of part attribute as string list.

**Return type** list

**get_product**()
Returns the product name of CPE Name as a list. According to the CPE version, this list can contains one or more items.

**Returns** Value of product attribute as string list.

**Return type** list

**get_software_edition**()
Returns the software edition of CPE Name.

**Returns** Value of sw_edition attribute as string list.

**Return type** list

**get_target_hardware**()
Returns the arquitecture of CPE Name.

**Returns** Value of target_hw attribute as string list.

**Return type** list

**get_target_software**()
Returns the software computing environment of CPE Name within which the product operates.

**Returns** Value of target_sw attribute as string list.

**Return type** list

**get_update**()
Returns the update or service pack information of CPE Name as a list. According to the CPE version, this list can contains one or more items.

**Returns** Value of update attribute as string list.

**Return type** list

**get_vendor**()
Returns the vendor name of CPE Name as a list. According to the CPE version, this list can contains one or more items.

**Returns** Value of vendor attribute as string list.

**Return type** list

**get_version**()
Returns the version of product of CPE Name as a list. According to the CPE version, this list can contains one or more items.

**Returns** Value of version attribute as string list.

**Return type** list

**is_application**()
Returns True if CPE Name corresponds to application elem.

**Returns** True if CPE Name corresponds to application elem, False otherwise.

**Return type** boolean

**is_hardware**()
Returns True if CPE Name corresponds to hardware elem.

**Returns** True if CPE Name corresponds to hardware elem, False otherwise.

**Return type** boolean

**is_operating_system**()
Returns True if CPE Name corresponds to operating system elem.

**Returns** True if CPE Name corresponds to operating system elem, False otherwise.

**Return type** boolean

### CPE1_1 class

**class** cpe.cpe1_1.**CPE1_1**(*cpe_str*, **args*, ***kwargs*)
Implementation of version 1.1 of CPE specification.

Basic structure of CPE Name:

•Hardware part: the physical platform supporting the IT system.

•Operating system part: the operating system controls and manages the IT hardware.

•Application part: software systems, services, servers, and packages installed on the system.

CPE Name syntax:

cpe:/ {hardware-part} [ / {OS-part} [ / {application-part} ] ]

**__getitem__**(*i*)
Returns the i'th component name of CPE Name.

**Parameters** **i** (*int*) – component index to find

**Returns** component string found

**Return type** *CPEComponent*

**Exception** IndexError - index not found in CPE Name

TEST: good index

```
>>> str = 'cpe:///sun_microsystem:sun@os:5.9:#update'
>>> c = CPE1_1(str)
>>> c[0]
CPEComponent1_1(sun_microsystem)
```

**__len__**()
Returns the number of components of CPE Name.

**Returns** count of components of CPE Name

**Return type** int

TEST: a CPE Name with two parts (hw and os) and some elements empty and with values

```
>>> str = "cpe:/cisco::3825/cisco:ios:12.3:enterprise"
>>> c = CPE1_1(str)
>>> len(c)
7
```

**static __new__**(*cpe_str*, **args*, ***kwargs*)
Create a new CPE Name of version 1.1.

**Parameters** **cpe_str** (*string*) – CPE Name string

**Returns** CPE object of version 1.1 of CPE specification.

**Return type** *CPE1_1*

**as_wfn**()
Returns the CPE Name as Well-Formed Name string of version 2.3.

**Returns** CPE Name as WFN string

**Return type** string

**Exception** TypeError - incompatible version

**get_attribute_values**(*att_name*)
Returns the values of attribute "att_name" of CPE Name. By default a only element in each part.

**Parameters** **att_name** (*string*) – Attribute name to get

**Returns** List of attribute values

**Return type** list

**Exception** ValueError - invalid attribute name

### CPE2_2 class

**class** cpe.cpe2_2.**CPE2_2**(*cpe_str*, **args*, ***kwargs*)
Implementation of version 2.2 of CPE specification.

A CPE Name is a percent-encoded URI with each name starting with the prefix (the URI scheme name) 'cpe:'.

Each platform can be broken down into many distinct parts. A CPE Name specifies a simple part and is used to identify any platform that matches the description of that part.

The distinct parts are:

- Hardware part: the physical platform supporting the IT system.
- Operating system part: the operating system controls and manages the IT hardware.
- Application part: software systems, services, servers, and packages installed on the system.

CPE Name syntax:

cpe:/{part}:{vendor}:{product}:{version}:{update}:{edition}:{language}

**__len__**()
Returns the number of components of CPE Name.

**Returns** count of components of CPE Name

**Return type** int

**static __new__**(*cpe_str*, **args*, ***kwargs*)
Create a new CPE Name of version 2.2.

**Parameters** **cpe_str** (*string*) – CPE Name string

**Returns** CPE object of version 2.2 of CPE specification.

**Return type** *CPE2_2*

**as_wfn**()
Returns the CPE Name as WFN string of version 2.3. Only shows the first seven components.

**Returns** CPE Name as WFN string

**Return type** string

**Exception** TypeError - incompatible version

**get_attribute_values**(*att_name*)
Returns the values of attribute "att_name" of CPE Name. By default a only element in each part.

**Parameters** **att_name** (*string*) – Attribute name to get

**Returns** List of attribute values

**Return type** list

**Exception** ValueError - invalid attribute name

### CPE2_3 class

**class** cpe.cpe2_3.**CPE2_3**(*cpe_str*, **args*, ***kwargs*)
Represents a generic CPE name compatible with all CPE name style of version 2.3 of CPE specification.

**static __new__**(*cpe_str*, **args*, ***kwargs*)
Generator of CPE Names according to version 2.3.

**Parameters** **cpe_str** (*string*) – CPE Name string

**Returns** CPE object of version 2.3 with style detected correctly

**Return type** *CPE2_3*

**Exception** NotImplementedError - incorrect CPE Name or version of CPE not implemented

This class implements the factory pattern, that is, this class centralizes the creation of objects of a particular CPE style of version 2.3, hiding the user the requested object instance.

**__str__**()
Returns a human-readable representation of CPE Name.

**Returns** Representation of CPE Name as string

**Return type** string

### CPE2_3_URI class

**class** cpe.cpe2_3_uri.**CPE2_3_URI**(*cpe_str*, **args*, ***kwargs*)
Implementation of binding style URI of version 2.3 of CPE specification.

A CPE Name is a percent-encoded URI with each name starting with the prefix (the URI scheme name) 'cpe:'.

Each platform can be broken down into many distinct parts. A CPE Name specifies a simple part and is used to identify any platform that matches the description of that part.

The distinct parts are:

- Hardware part: the physical platform supporting the IT system.
- Operating system part: the operating system controls and manages the IT hardware.
- Application part: software systems, services, servers, and packages installed on the system.

CPE Name syntax:

cpe:/{part}:{vendor}:{product}:{version}:{update}:{edition}:{language}

**__getitem__**(*i*)
Returns the i'th component name of CPE Name.

**Parameters** **i** (*int*) – component index to find

**Returns** component string found

**Return type** *CPEComponent*

**Exception** IndexError - index not found in CPE Name

**__len__**()
Returns the number of components of CPE Name.

**Returns** count of components of CPE Name

**Return type** int

**static __new__**(*cpe_str*, **args*, ***kwargs*)
Create a new CPE Name of version 2.3 with URI style.

**Parameters** **cpe_str** (*string*) – CPE Name string

**Returns** CPE object of version 2.3 of CPE specification with URI style.

**Return type** *CPE2_3_URI*

**as_wfn**()
Returns the CPE Name as Well-Formed Name string of version 2.3. If edition component is not packed, only shows the first seven components, otherwise shows all.

**Returns** CPE Name as WFN string

**Return type** string

**Exception** TypeError - incompatible version

**get_attribute_values**(*att_name*)
Returns the values of attribute "att_name" of CPE Name. By default a only element in each part.

**Parameters** **att_name** (*string*) – Attribute name to get

**Returns** List of attribute values

**Return type** list

**Exception** ValueError - invalid attribute name

### CPE2_3_WFN class

**class** cpe.cpe2_3_wfn.**CPE2_3_WFN**(*cpe_str*, **args*, ***kwargs*)

Implementation of WFN of version 2.3 of CPE specification.

A CPE Name is a percent-encoded WFN with each name starting with the prefix 'wfn:'.

Each platform can be broken down into many distinct parts. A CPE Name specifies a simple part and is used to identify any platform that matches the description of that part.

The distinct parts are:

- Hardware part: the physical platform supporting the IT system.
- Operating system part: the operating system controls and manages the IT hardware.
- Application part: software systems, services, servers, and packages installed on the system.

CPE Name syntax: wfn:[a1=v1, a2=v2, . . . , an=vn]

Only the following attributes SHALL be permitted in a WFN attribute-value pair:

1. part
2. vendor
3. product
4. version
5. update
6. edition
7. language
8. sw_edition
9. target_sw
10. target_hw
11. other

**static** **__new__**(*cpe_str*, **args*, ***kwargs*)

Create a new CPE Name of version 2.3 with WFN style.

**Parameters** **cpe_str** (*string*) – CPE Name string

**Returns** CPE object of version 2.3 of CPE specification with WFN style.

**Return type** *CPE2_3_WFN*

**get_attribute_values**(*att_name*)

Returns the values of attribute "att_name" of CPE Name. By default a only element in each part.

**Parameters** **att_name** (*string*) – Attribute name to get

**Returns** List of attribute values

**Return type** list

**Exception** ValueError - invalid attribute name

#### CPE2_3_FS class

**class** cpe.cpe2_3_fs.**CPE2_3_FS**(*cpe_str*, **args*, ***kwargs*)

Implementation of binding style formatted string of version 2.3 of CPE specification.

Each name starts with the prefix 'cpe:2.3:'.

Each platform can be broken down into many distinct parts. A CPE Name specifies a simple part and is used to identify any platform that matches the description of that part.

The distinct parts are:

- Hardware part: the physical platform supporting the IT system.
- Operating system part: the operating system controls and manages the IT hardware.
- Application part: software systems, services, servers, and packages installed on the system.

CPE Name syntax:

cpe:2.3:part:vendor:product:version:update:edition:language:sw_edition:target_sw:target_hw:other

**__len__**()

Returns the number of components of CPE Name. This CPE Name always have eleven components set.

**Returns** count of components of CPE Name

**Return type** int

**static __new__**(*cpe_str*, **args*, ***kwargs*)

Create a new CPE Name of version 2.3 with formatted string style.

**Parameters** **cpe_str** (*string*) – CPE Name string

**Returns** CPE object of version 2.3 of CPE specification with formatted string style.

**Return type** *CPE2_3_FS*

**get_attribute_values**(*att_name*)

Returns the values of attribute "att_name" of CPE Name. By default a only element in each part.

**Parameters** **att_name** (*string*) – Attribute name to get

**Returns** List of attribute values

**Return type** list

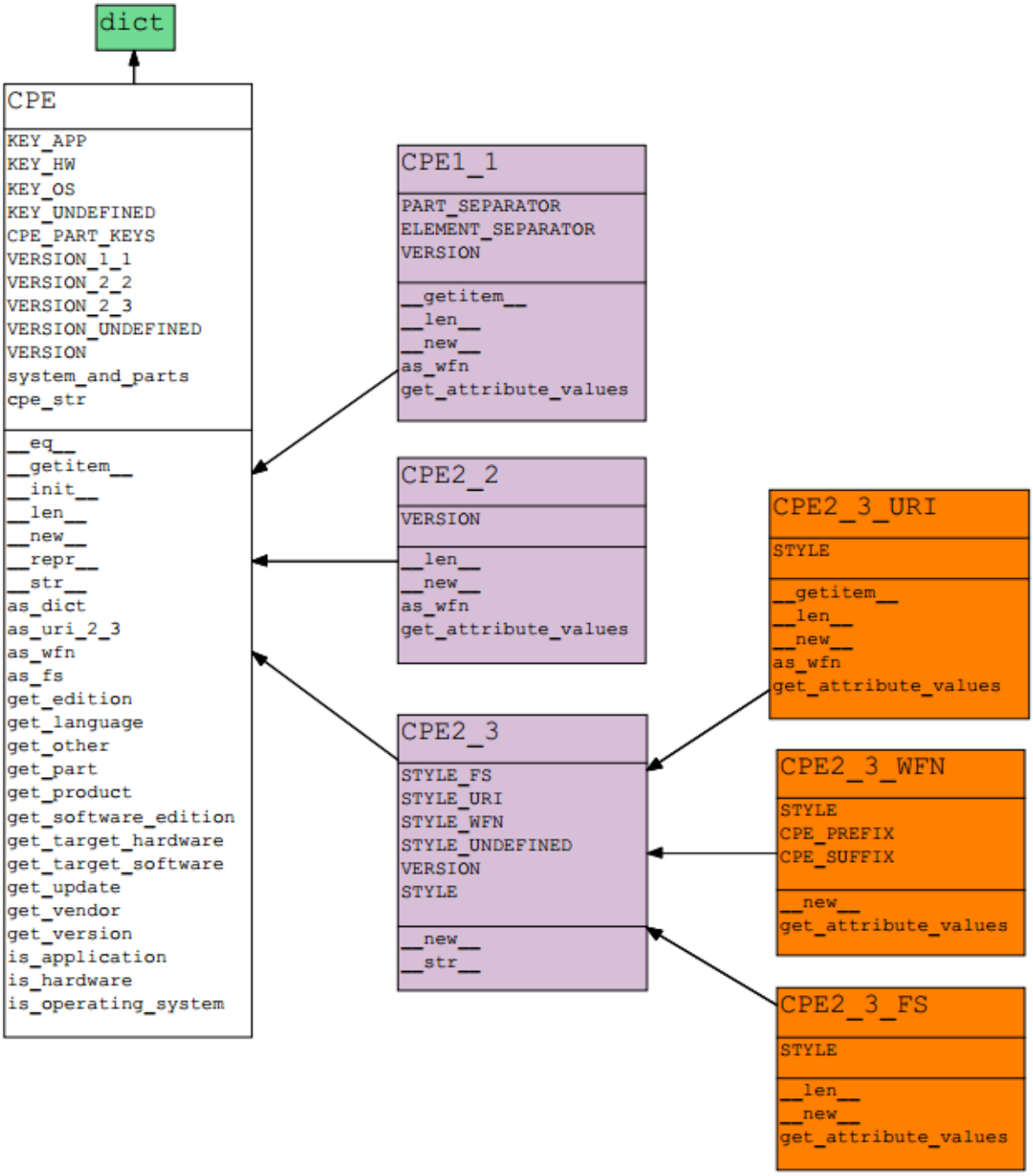
**Exception** ValueError - invalid attribute name

### 4.1.2 Class diagram

The class diagrams of CPE hierarchy are available in multiple format: PNG, PDF and PYNS (output format of PyNSource tool). Listed below are the download links of these diagrams and their formats:

- Classes with public and private attributes and methods:
  - Formato PNG
  - Formato PDF
  - Formato PYNS
- Classes with only public attributes and methods:
  - Formato PNG
  - Formato PDF
  - Formato PYNS

Next image presents the public attributes and methods of CPE classes:




## 4.2 CPESet hierarchy

This section contains the classes associated with the name matching algorithm of versions of CPE specification implemented in this package.

### 4.2.1 Class list

#### CPESet class

**class** cpe.cpeset.**CPESet**
Represents a set of CPE Names.

This class allows:

•create a set of CPE Names.

•match a CPE Name against a set of CPE Names.

**__getitem__**(*i*)
Returns the i'th CPE Name of set.

**Parameters** **i** (*int*) – CPE Name index to find

**Returns** CPE Name found

**Return type** *CPE*

**Exception** IndexError - list index out of range

**__init__**()
Creates an empty set of CPE Names.

**Returns** None

**__len__**()
Returns the count of CPE Names of set.

**Returns** count of components of CPE Name

**Return type** int

TEST: empty set

```
>>> from .cpeset1_1 import CPESet1_1
>>> s = CPESet1_1()
>>> len(s)
0
```

**__str__**()
Returns a human-readable representation of CPE set.

**Returns** Representation of CPE set as string

**Return type** string

**__weakref__**
list of weak references to the object (if defined)

**append**(*cpe*)
Adds a CPE Name to the set if not already.

**Parameters** **cpe** (CPE) – CPE Name to store in set

**Returns** None

**Exception** NotImplementedError - Method not implemented

**name_match**(*cpe*)
Accepts a set of known instances of CPE Names and a candidate CPE Name, and returns 'True' if the candidate can be shown to be an instance based on the content of the known instances. Otherwise, it returns 'False'.

**Parameters**

- **self** (CPESet) – A set of m known CPE Names K = {K1, K2, . . . , Km}.

- **cpe** (CPE) – A candidate CPE Name X.

**Returns** True if X matches K, otherwise False.

**Return type** boolean

### CPESet1_1 class

**class** cpe.cpeset1_1.**CPESet1_1**

Represents a set of CPE Names.

This class allows:

•create set of CPE Names.

•match a CPE element against a set of CPE Names.

**append**(*cpe*)

Adds a CPE Name to the set if not already.

**Parameters** **cpe** (CPE) – CPE Name to store in set

**Returns** None

**Exception** ValueError - invalid version of CPE Name

TEST:

```
>>> from .cpeset1_1 import CPESet1_1
>>> from .cpe1_1 import CPE1_1
>>> uri1 = 'cpe://microsoft:windows:xp!vista'
>>> c1 = CPE1_1(uri1)
>>> s = CPESet1_1()
>>> s.append(c1)
```

**name_match**(*cpe*)

Accepts a set of known instances of CPE Names and a candidate CPE Name, and returns 'True' if the candidate can be shown to be an instance based on the content of the known instances. Otherwise, it returns 'False'.

**Parameters**

- **self** (CPESet) – A set of m known CPE Names K = {K1, K2, . . . , Km}.
- **cpe** (CPE) – A candidate CPE Name X.

**Returns** True if X matches K, otherwise False.

**Return type** boolean

TEST: matching with identical CPE in set

```
>>> from .cpe1_1 import CPE1_1
>>> from .cpeset1_1 import CPESet1_1
>>> uri1 = 'cpe://microsoft:windows:xp!vista'
>>> uri2 = 'cpe:/cisco::3825;cisco:2:44/cisco:ios:12.3:enterprise'
>>> c1 = CPE1_1(uri1)
>>> c2 = CPE1_1(uri2)
>>> s = CPESet1_1()
>>> s.append(c1)
>>> s.append(c2)
>>> s.name_match(c2)
True
```

### CPESet2_2 class

**class** cpe.cpeset2_2.**CPESet2_2**
Represents a set of CPE Names.

This class allows:

•create set of CPE Names.

•match a CPE element against a set of CPE Names.

**append**(*cpe*)
Adds a CPE Name to the set if not already.

**Parameters** **cpe** (CPE) – CPE Name to store in set

**Returns** None

**Exception** ValueError - invalid version of CPE Name

TEST:

```
>>> from .cpeset2_2 import CPESet2_2
>>> from .cpe2_2 import CPE2_2
>>> uri1 = 'cpe:/h:hp'
>>> c1 = CPE2_2(uri1)
>>> s = CPESet2_2()
>>> s.append(c1)
```

**name_match**(*cpe*)
Accepts a set of known instances of CPE Names and a candidate CPE Name, and returns 'True' if the candidate can be shown to be an instance based on the content of the known instances. Otherwise, it returns 'False'.

**Parameters**

- **self** (CPESet) – A set of m known CPE Names K = {K1, K2, . . . , Km}.
- **cpe** (CPE) – A candidate CPE Name X.

**Returns** True if X matches K, otherwise False.

**Return type** boolean

TEST: matching with ANY values explicit

```
>>> from .cpe2_2 import CPE2_2
>>> uri1 = 'cpe:/o:microsoft:windows:vista'
>>> uri2 = 'cpe:/o:cisco:ios:12.3:enterprise'
>>> c1 = CPE2_2(uri1)
>>> c2 = CPE2_2(uri2)
>>> s = CPESet2_2()
>>> s.append(c1)
>>> s.append(c2)
>>> uri3 = 'cpe:/o:microsoft::vista'
>>> c3 = CPE2_2(uri3)
>>> s.name_match(c3)
True
```

### CPESet2_3 class

**class** cpe.cpeset2_3.**CPESet2_3**
Represents a set of CPEs.

This class allows:

•create set of CPE elements.

•match a CPE element against a set of CPE elements.

**append**(*cpe*)
Adds a CPE element to the set if not already. Only WFN CPE Names are valid, so this function converts the input CPE object of version 2.3 to WFN style.

**Parameters** **cpe** (CPE) – CPE Name to store in set

**Returns** None

**Exception** ValueError - invalid version of CPE Name

**classmethod compare_wfns**(*source*, *target*)
Compares two WFNs and returns a generator of pairwise attribute-value comparison results. It provides full access to the individual comparison results to enable use-case specific implementations of novel name-comparison algorithms.

Compare each attribute of the Source WFN to the Target WFN:

**Parameters**

- **source** (CPE2_3_WFN) – first WFN CPE Name
- **target** (CPE2_3_WFN) – seconds WFN CPE Name

**Returns** generator of pairwise attribute comparison results

**Return type** generator

**classmethod cpe_disjoint**(*source*, *target*)
Compares two WFNs and returns True if the set-theoretic relation between the names is DISJOINT.

**Parameters**

- **source** (CPE2_3_WFN) – first WFN CPE Name
- **target** (CPE2_3_WFN) – seconds WFN CPE Name

**Returns** True if the set relation between source and target is DISJOINT, otherwise False.

**Return type** boolean

**classmethod cpe_equal**(*source*, *target*)
Compares two WFNs and returns True if the set-theoretic relation between the names is EQUAL.

**Parameters**

- **source** (CPE2_3_WFN) – first WFN CPE Name
- **target** (CPE2_3_WFN) – seconds WFN CPE Name

**Returns** True if the set relation between source and target is EQUAL, otherwise False.

**Return type** boolean

**classmethod cpe_subset**(*source*, *target*)
Compares two WFNs and returns True if the set-theoretic relation between the names is (non-proper) SUBSET.

**Parameters**

- **source** (CPE2_3_WFN) – first WFN CPE Name
- **target** (CPE2_3_WFN) – seconds WFN CPE Name

**Returns** True if the set relation between source and target is SUBSET, otherwise False.

**Return type** boolean

**classmethod cpe_superset**(*source*, *target*)
Compares two WFNs and returns True if the set-theoretic relation between the names is (non-proper) SUPERSET.

**Parameters**

- **source** (CPE2_3_WFN) – first WFN CPE Name
- **target** (CPE2_3_WFN) – seconds WFN CPE Name

**Returns** True if the set relation between source and target is SUPERSET, otherwise False.

**Return type** boolean

**name_match**(*wfn*)

Accepts a set of CPE Names K and a candidate CPE Name X. It returns 'True' if X matches any member of K, and 'False' otherwise.

**Parameters**

- **self** (CPESet) – A set of m known CPE Names K = {K1, K2, . . . , Km}.
- **cpe** (CPE) – A candidate CPE Name X.

**Returns** True if X matches K, otherwise False.

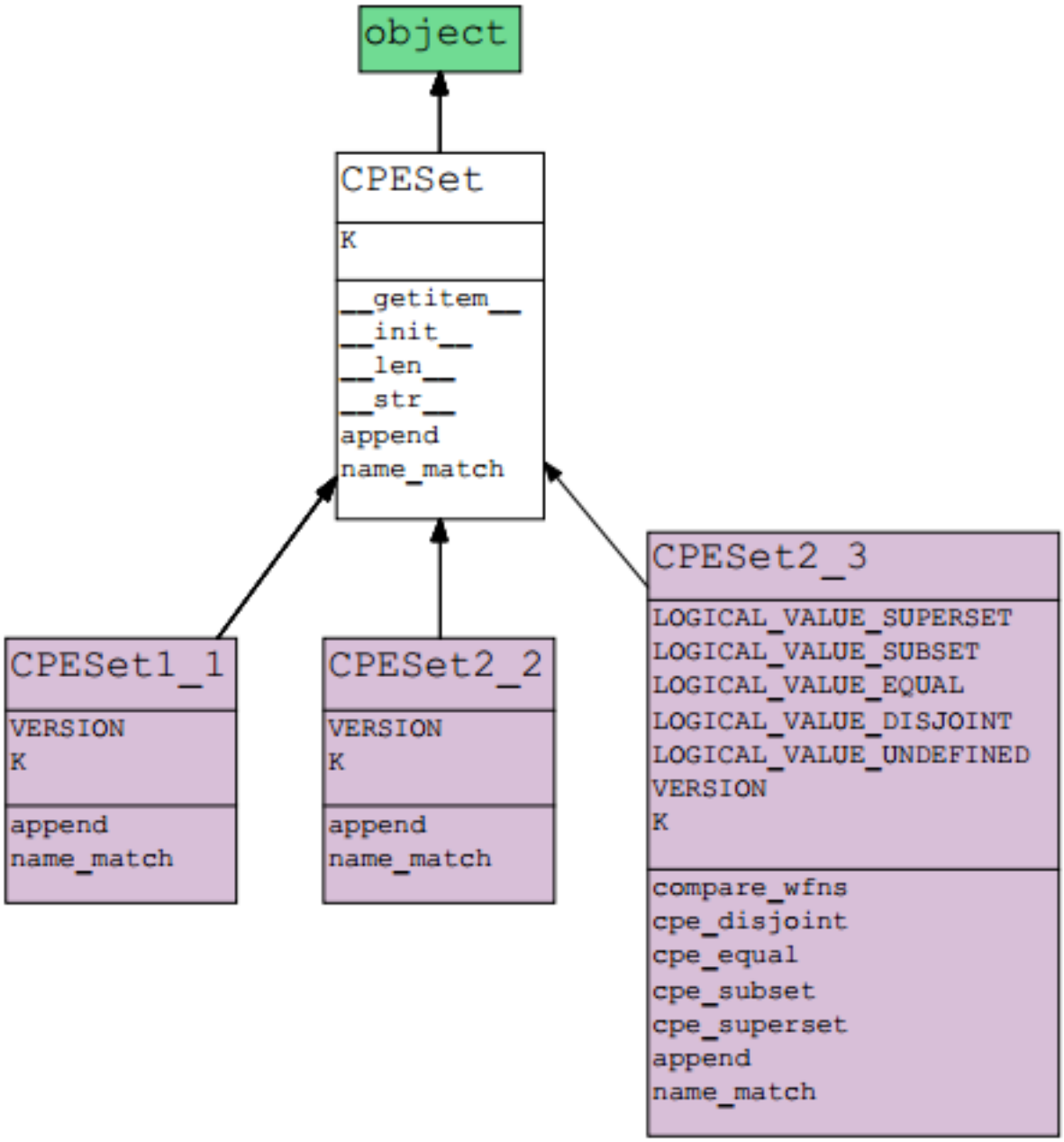
**Return type** boolean

### 4.2.2 Class diagram

The class diagrams of CPESet hierarchy are available in multiple format: PNG, PDF and PYNS (output format of PyNSource tool). Listed below are the download links of these diagrams and their formats:

- Classes with public and private attributes and methods:
  - Formato PNG
  - Formato PDF
  - Formato PYNS
- Classes with only public attributes and methods:
  - Formato PNG
  - Formato PDF
  - Formato PYNS

Next image presents the public attributes and methods of CPESet classes:




## 4.3 CPELanguage hierarchy

This section contains the classes associated with the language matching algorithm of versions of CPE specification implemented in this package.

### 4.3.1 Class list

#### CPELanguage class

**class** cpe.cpelang.**CPELanguage**(*expression*, *isFile=False*)

Represents an expression in the CPE Language.

This class allows match a CPE element against an expression in the CPE Language, that is, a XML document format for binding descriptive prose and diagnostic test to a CPE Name (CPE Description Format).

**__init__** (*expression*, *isFile=False*)
Create an object that contains the input expression in the CPE Language (a set of CPE Names) and the DOM tree asociated with expression.

**Parameters**

- **expression** (*string*) – XML content in string or a path to XML file
- **isFile** (*strint*) – indicates whether expression is a XML file or XML content string

**Returns** None

**__str__** ()
Returns a human-readable representation of CPE Language expression.

**Returns** Representation of CPE Language expression as string

**Return type** string

**__weakref__**
list of weak references to the object (if defined)

**language_match** (*cpeset*, *cpel_dom=None*)
Accepts a set of known CPE Names and an expression in the CPE language, and delivers the answer True if the expression matches with the set. Otherwise, it returns False.

**Parameters**

- **self** (CPELanguage) – An expression in the CPE Language, represented as the XML infoset for the platform element.
- **cpeset** (CPESet) – CPE set object to match with self expression.
- **cpel_dom** (*string*) – An expression in the CPE Language, represented as DOM tree.

**Returns** True if self expression can be satisfied by language matching against cpeset, False otherwise.

**Return type** boolean

**Exception** NotImplementedError - Method not implemented

### CPELanguage2_2 class

**class** cpe.cpelang2_2.**CPELanguage2_2** (*expression*, *isFile=False*)
Represents an expression in the CPE Language.

This class allows match a CPE element against an expression in the CPE Language, that is, a XML document format for binding descriptive prose and diagnostic test to a CPE name (CPE Description Format).

**language_match** (*cpeset*, *cpel_dom=None*)
Accepts a set of known CPE Names and an expression in the CPE language, and delivers the answer True if the expression matches with the set. Otherwise, it returns False.

**Parameters**

- **self** (CPELanguage) – An expression in the CPE Applicability Language, represented as the XML infoset for the platform element.
- **cpeset** (CPESet) – CPE set object to match with self expression.
- **cpel_dom** (*string*) – An expression in the CPE Applicability Language, represented as DOM tree.

**Returns** True if self expression can be satisfied by language matching against cpeset, False otherwise.

**Return type** boolean

#### CPELanguage2_3 class

**class** cpe.cpelang2_3.**CPELanguage2_3**(*expression*, *isFile=False*)
Represents an expression in the CPE Language.

This class allows match a CPE element against an expression in the CPE Language, that is, a XML document format for binding descriptive prose and diagnostic test to a CPE name (CPE Description Format).

**language_match**(*cpeset*, *cpel_dom=None*)
Accepts a set of known CPE Names and an expression in the CPE language, and delivers the answer True if the expression matches with the set. Otherwise, it returns False.

**Parameters**

- **self** (CPELanguage) – An expression in the CPE Applicability Language, represented as the XML infoset for the platform element.
- **cpeset** (CPESet) – CPE set object to match with self expression.
- **cpel_dom** (*string*) – An expression in the CPE Applicability Language, represented as DOM tree.

**Returns** True if self expression can be satisfied by language matching against cpeset, False otherwise.

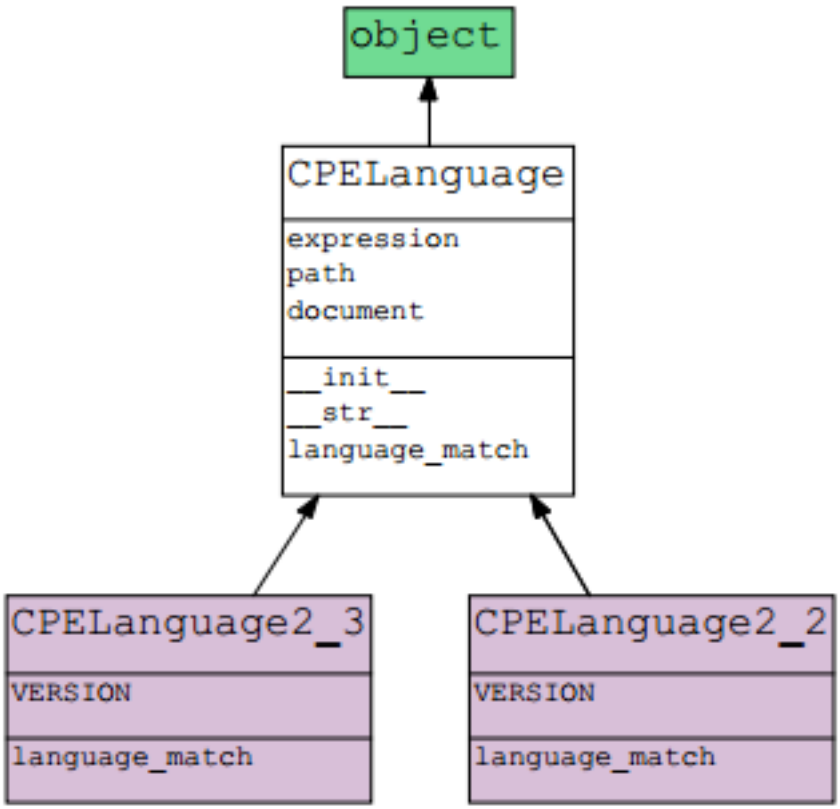
**Return type** boolean

### 4.3.2 Class diagram

The class diagrams of CPELanguage hierarchy are available in multiple format: PNG, PDF and PYNS (output format of PyNSource tool). Listed below are the download links of these diagrams and their formats:

- Classes with public and private attributes and methods:
  - Formato PNG
  - Formato PDF
  - Formato PYNS
- Classes with only public attributes and methods:
  - Formato PNG
  - Formato PDF
  - Formato PYNS

Next image presents the public attributes and methods of CPELanguage classes:




## 4.4 CPEComponent hierarchy

This section contains the classes associated with the types of components of versions of CPE Names implemented in this package: logical and simple.

### 4.4.1 Class list

The generic component class is:

#### CPEComponent class

**class** cpe.comp.cpecomp.**CPEComponent**(*comp_str*)

Represents a generic component of CPE Name, compatible with the components of all versions of CPE specification.

**__contains__**(*item*)

Returns True if item is included in set of values of self.

**Parameters** **item** (CPEComponent) – component to find in self

**Returns** True if item is included in set of self, otherwise False

**Return type** boolean

**__eq__**(*other*)

Returns True if other (first element of operation) and self (second element of operation) are equal components, false otherwise.

**Parameters** **other** (CPEComponent) – component to compare

**Returns** True if other == self, False otherwise

**Return type** boolean

**__init__**(*comp_str*)
Store the value of component.

**Parameters** **comp_str** (*string*) – value of component value

**Returns** None

**__ne__**(*other*)
Returns True if other (first element of operation) and self (second element of operation) are not equal components, false otherwise.

**Parameters** **other** (CPEComponent) – component to compare

**Returns** True if other != self, False otherwise

**Return type** boolean

**__repr__**()
Returns a unambiguous representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

**__weakref__**
list of weak references to the object (if defined)

**classmethod is_valid_attribute**(*att_name*)
Check if input attribute name is correct.

**Parameters** **att_name** (*string*) – attribute name to check

**Returns** True is attribute name is valid, otherwise False

**Return type** boolean

TEST: a wrong attribute

```
>>> from .cpecomp import CPEComponent
>>> att = CPEComponent.ATT_PRODUCT
>>> CPEComponent.is_valid_attribute(att)
True
```

The logical components classes are:

### CPEComponentLogical class

**class** cpe.comp.cpecomp_logical.**CPEComponentLogical**(*comp_str*)
Represents a generic logical component of CPE name, compatible with the components of all versions of CPE specification.

**__contains__**(*item*)
Returns True if item is included in set of values of self.

**Parameters** **item** (CPEComponent) – component to find in self

**Returns** True if item is included in set of self

**Return type** boolean

**__eq__**(*other*)
Returns True if other (first element of operation) and self (second element of operation) are equal components, false otherwise.

**Parameters** **other** (CPEComponent) – component to compare

**Returns** True if other == self, False otherwise

**Return type** boolean

**Exception** NotImplementedError - class method not implemented

**__str__**()
Returns a human-readable representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

**Exception** NotImplementedError - class method not implemented

### CPEComponentAnyValue class

**class** cpe.comp.cpecomp_anyvalue.**CPEComponentAnyValue**
Represents a component of CPE name without a particular value, compatible with the components of all versions of CPE specification.

For example, in version 2.3 of CPE specification, an component "any value" is other attribute in CPE name cpe:2.3:a:microsft:windows:xp:*:*:*:*:*:*:*.

**__eq__**(*other*)
Returns True if other (first element of operation) and self (second element of operation) are equal components, false otherwise.

**Parameters** **other** (CPEComponent) – component to compare

**Returns** True if other == self, False otherwise

**Return type** boolean

**__init__**()
Initializes the component.

**__str__**()
Returns a human-readable representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

### CPEComponentEmpty class

**class** cpe.comp.cpecomp_empty.**CPEComponentEmpty**
Represents an empty component of CPE name, compatible with the components of all versions of CPE specification.

For example, in version 1.1 of CPE specification, an empty component is version attribute in CPE name cpe:/microsft:windows::sp2.

**__eq__**(*other*)
Returns True if other (first element of operation) and self (second element of operation) are equal components, false otherwise.

**Parameters** **other** (CPEComponent) – component to compare

**Returns** True if other == self, False otherwise

**Return type** boolean

**__init__**()
Initializes the component.

**__str__**()
Returns a human-readable representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

### CPEComponentNotApplicable class

**class** cpe.comp.cpecomp_notapplicable.**CPEComponentNotApplicable**
Represents a component of CPE name with a not applicable value, compatible with the components of all versions of CPE specification.

For example, in version 2.3 of CPE specification, an component "not applicable" is update attribute in CPE name cpe:/a:microsft:windows:me:-.

**__contains__**(*item*)
Returns True if item is included in set of values of self.

**Parameters** **item** (CPEComponent) – component to find in self

**Returns** True if item is included in set of self

**Return type** boolean

**__eq__**(*other*)
Returns True if other (first element of operation) and self (second element of operation) are equal components, false otherwise.

**Parameters** **other** (CPEComponent) – component to compare

**Returns** True if other == self, False otherwise

**Return type** boolean

**__init__**()
Initializes the component.

**__str__**()
Returns a human-readable representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

### CPEComponentUndefined class

**class** cpe.comp.cpecomp_undefined.**CPEComponentUndefined**
Represents an undefined component of CPE name, compatible with the components of all versions of CPE specification.

For example, in version 1.1 of CPE specification, an undefined component is edition attribute in CPE name cpe:/microsft:windows:xp.

**__contains__**(*item*)
Returns True if item is included in set of values of self.

**Parameters** **item** (CPEComponent) – component to find in self

**Returns** True if item is included in set of self

**Return type** boolean

**__eq__**(*other*)
Returns True if other (first element of operation) and self (second element of operation) are equal components, false otherwise.

**Parameters** **other** (CPEComponent) – component to compare

**Returns** True if other == self, False otherwise

**__init__**()
Initializes the component.

**__str__**()
Returns a human-readable representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

The simple components classes are:

### CPEComponentSimple class

**class** cpe.comp.cpecomp_simple.**CPEComponentSimple**(*comp_str*, *comp_att*)
Represents a generic string component of CPE name, compatible with the components of all versions of CPE specification.

**__init__**(*comp_str*, *comp_att*)
Store the value of component.

**Parameters**

- **comp_str** (*string*) – value of component value
- **comp_att** (*string*) – attribute associated with component value

**Returns** None

**Exception** ValueError - incorrect value of component

**__str__**()
Returns a human-readable representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

**as_fs**()
Returns the value of component encoded as formatted string.

Inspect each character in value of component. Certain nonalpha characters pass thru without escaping into the result, but most retain escaping.

**Returns** Formatted string associated with component

**Return type** string

**as_uri_2_3**()
Returns the value of component encoded as URI string.

Scans an input string s and applies the following transformations:

•Pass alphanumeric characters thru untouched

•Percent-encode quoted non-alphanumerics as needed

•Unquoted special characters are mapped to their special forms.

**Returns** URI string associated with component

**Return type** string

**as_wfn**()
Returns the value of component encoded as Well-Formed Name (WFN) string.

**Returns** WFN string associated with component

**Return type** string

**get_value**()
Returns the encoded value of component.

**Returns** The encoded value of component

**Return type** string

**set_value**(*comp_str*, *comp_att*)
Set the value of component. By default, the component has a simple value.

**Parameters**

- **comp_str** (*string*) – new value of component
- **comp_att** (*string*) – attribute associated with value of component

**Returns** None

**Exception** ValueError - incorrect value of component

### CPEComponent1_1 class

**class** cpe.comp.cpecomp1_1.**CPEComponent1_1**(*comp_str*, *comp_att*)
Represents a component of version 1.1 of CPE specification.

TEST: simple value

```
>>> value = "microsoft"
>>> comp = CPEComponent1_1(value, CPEComponentSimple.ATT_VENDOR)
```

**__contains__**(*item*)
Returns True if item is included in set of values of self.

Comparatives in name matching of version 1.1 of CPE:

c = self._standard_value
d = item._standard_value

IF c is empty THEN match True.
ELSE IF c is a singleton AND c = d THEN match True.
ELSE IF c has form ~v AND v != d THEN match True.
ELSE IF c has form v1!v2!..!vn AND v = d for some v THEN match True.
ENDIF.

**Parameters** **item** (CPEComponent) – component to find in self

**Returns** True if item is included in set of self

**Return type** boolean

TEST: two different simple values

```
>>> comp1 = CPEComponent1_1('5.0', CPEComponentSimple.ATT_VERSION)
>>> comp2 = CPEComponent1_1('9.0', CPEComponentSimple.ATT_VERSION)
>>> comp1 in comp2
False
```

**__repr__**()
Returns a unambiguous representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

**as_fs**()
Returns the value of compoment encoded as formatted string.

Inspect each character in value of component. Certain nonalpha characters pass thru without escaping into the result, but most retain escaping.

**Returns** Formatted string associated with the component

**Return type** string

TEST:

```
>>> val = 'xp!vista'
>>> comp1 = CPEComponent1_1(val, CPEComponentSimple.ATT_VERSION)
>>> comp1.as_fs()
'xp\\!vista'
```

**as_uri_2_3**()
Returns the value of compoment encoded as URI string.

Scans an input string s and applies the following transformations:

•Pass alphanumeric characters thru untouched

•Percent-encode quoted non-alphanumerics as needed

•Unquoted special characters are mapped to their special forms.

**Returns** URI string

**Return type** string

TEST:

```
>>> val = '#nvidi@'
>>> comp1 = CPEComponent1_1(val, CPEComponentSimple.ATT_VENDOR)
>>> comp1.as_uri_2_3()
'%23nvidi%40'
```

**as_wfn**()
Returns the value of compoment encoded as Well-Formed Name (WFN) string.

**Returns** WFN string

**Return type** string

TEST:

```
>>> val = 'xp!vista'
>>> comp1 = CPEComponent1_1(val, CPEComponentSimple.ATT_VERSION)
>>> comp1.as_wfn()
'xp\\!vista'
```

**set_value**(*comp_str*, *comp_att*)
Set the value of component. By default, the component has a simple value.

**Parameters** **comp_att** (*string*) – attribute associated with value of component

**Returns** None

**Exception** ValueError - incorrect value of component

TEST:

```
>>> val = 'xp!vista'
>>> val2 = 'sp2'
>>> att = CPEComponentSimple.ATT_VERSION
>>> comp1 = CPEComponent1_1(val, att)
>>> comp1.set_value(val2, att)
```

```
        >>> comp1.get_value()
        'sp2'
```

### CPEComponent2_2 class

**class** cpe.comp.cpecomp2_2.**CPEComponent2_2**(*comp_str*, *comp_att*)
Represents a component of version 2.2 of CPE specification.

TEST: simple value

```
    >>> value = "microsoft"
    >>> comp = CPEComponent2_2(value, CPEComponentSimple.ATT_VENDOR)
```

**__repr__**()
Returns a unambiguous representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

### CPEComponent2_3 class

**class** cpe.comp.cpecomp2_3.**CPEComponent2_3**(*comp_str*, *comp_att*)
Represents a component of version 2.3 of CPE specification.

**__repr__**()
Returns a unambiguous representation of CPE component.

**Returns** Representation of CPE component as string

**Return type** string

### CPEComponent2_3_URI class

**class** cpe.comp.cpecomp2_3_uri.**CPEComponent2_3_URI**(*comp_str*, *comp_att*)
Represents a component of version 2.3 of CPE specification with URI style.

### CPEComponent2_3_edpacked class

**class** cpe.comp.cpecomp2_3_uri_edpacked.**CPEComponent2_3_URI_edpacked**(*comp_str*)
Represents a packd edition component of version 2.3 of CPE specification with URI style.

**__init__**(*comp_str*)
Store the value of component.

**Parameters** **comp_str** (*string*) – value of component value

**Returns** None

**Exception** ValueError - incorrect value of component

**set_value**(*comp_str*)
Set the value of component.

**Parameters** **comp_str** (*string*) – value of component

**Returns** None

**Exception** ValueError - incorrect value of component

#### CPEComponent2_3_WFN class

**class** cpe.comp.cpecomp2_3_wfn.**CPEComponent2_3_WFN**(*comp_str*, *comp_att*)
Represents a component of version 2.3 of CPE specification with WFN style.

**get_value**()
Returns the encoded value of component.

**Returns** encoded value of component

**Return type** string

**set_value**(*comp_str*, *comp_att*)
Set the value of component.

**Parameters**

- **comp_str** (*string*) – value of component
- **comp_att** (*string*) – attribute associated with comp_str

**Returns** None

**Exception** ValueError - incorrect value of component

#### CPEComponent2_3_FS class

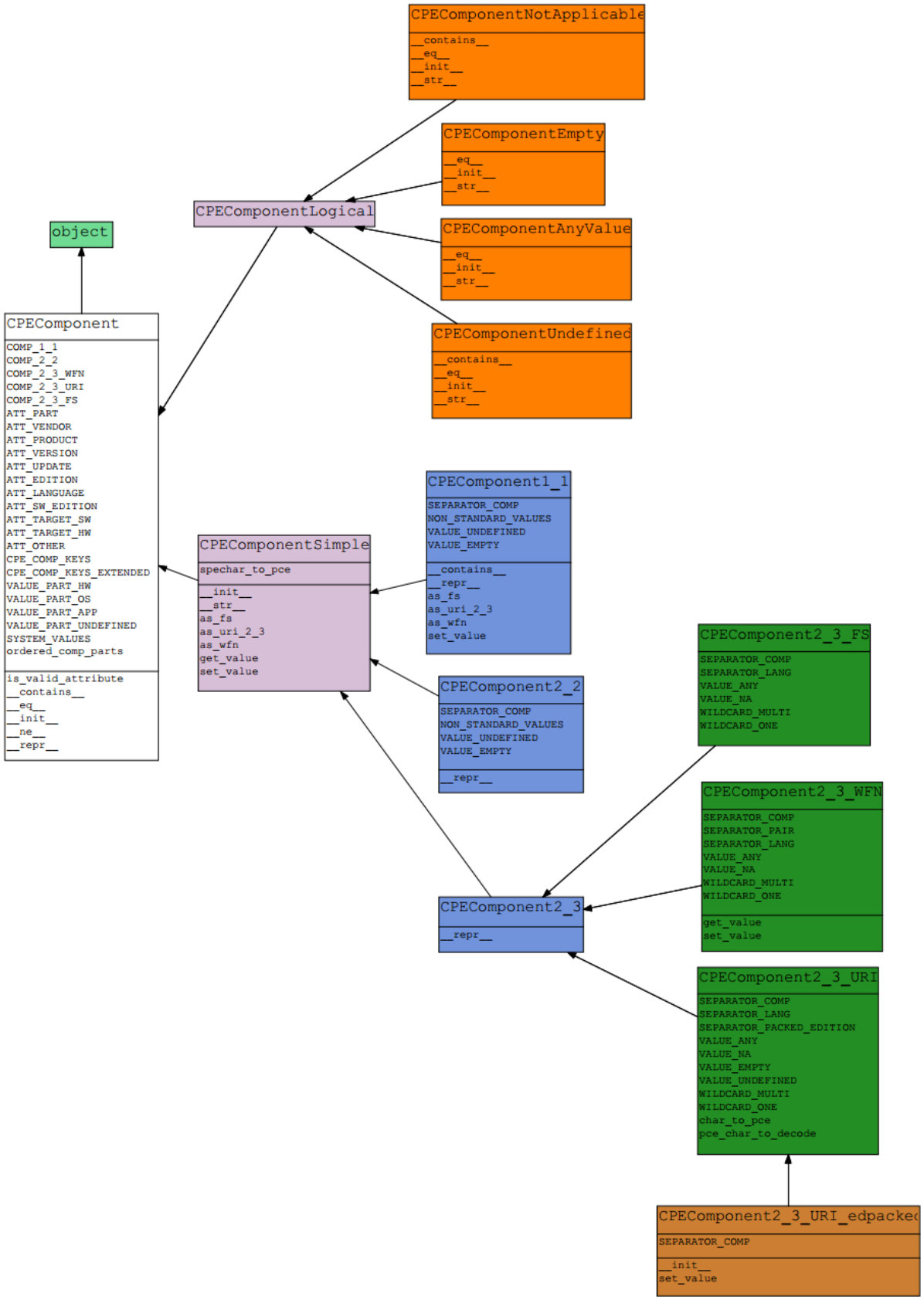
**class** cpe.comp.cpecomp2_3_fs.**CPEComponent2_3_FS**(*comp_str*, *comp_att*)
Represents a component of version 2.3 of CPE specification with URI style.

### 4.4.2 Class diagram

The class diagrams of CPE component hierarchy are available in multiple format: PNG, PDF and PYNS (output format of PyNSource tool). Listed below are the download links of these diagrams and their formats:

- Classes with public and private attributes and methods:
  - Formato PNG
  - Formato PDF
  - Formato PYNS
- Classes with only public attributes and methods:
  - Formato PNG
  - Formato PDF
  - Formato PYNS

Next image presents the public attributes and methods of CPE component classes:


CPEComponentNotApplicable
__contains__
__eq__
__init__
__str__
CPEComponentEmpty
__eq__
__init__
__str__
CPEComponentLogical
object
CPEComponentAnyValue
__eq__
__init__
__str__
CPEComponentUndefined
__contains__
__eq__
__init__
__str__
CPEComponent
COMP_1_1
COMP_2_2
COMP_2_3_WFN
COMP_2_3_URI
COMP_2_3_FS
ATT_PART
ATT_VENDOR
ATT_PRODUCT
ATT_VERSION
ATT_UPDATE
ATT_EDITION
ATT_LANGUAGE
ATT_SW_EDITION
ATT_TARGET_SW
ATT_TARGET_HW
ATT_OTHER
CPE_COMP_KEYS
CPE_COMP_KEYS_EXTENDED
VALUE_PART_HW
VALUE_PART_OS
VALUE_PART_APP
VALUE_PART_UNDEFINED
SYSTEM_VALUES
ordered_comp_parts
is_valid_attribute
__contains__
__eq__
__init__
__ne__
__repr__
CPEComponent1_1
SEPARATOR_COMP
NON_STANDARD_VALUES
VALUE_UNDEFINED
VALUE_EMPTY
__contains__
__repr__
as_fs
as_uri_2_3
as_wfn
set_value
CPEComponentSimple
specharacter_to_pce
__init__
__str__
as_fs
as_uri_2_3
as_wfn
get_value
set_value
CPEComponent2_2
SEPARATOR_COMP
NON_STANDARD_VALUES
VALUE_UNDEFINED
VALUE_EMPTY
__repr__
CPEComponent2_3_FS
SEPARATOR_COMP
SEPARATOR_LANG
VALUE_ANY
VALUE_NA
WILDCARD_MULTI
WILDCARD_ONE
CPEComponent2_3_WFN
SEPARATOR_COMP
SEPARATOR_PAIR
SEPARATOR_LANG
VALUE_ANY
VALUE_NA
WILDCARD_MULTI
WILDCARD_ONE
get_value
set_value
CPEComponent2_3
__repr__
CPEComponent2_3_URI
SEPARATOR_COMP
SEPARATOR_LANG
SEPARATOR_PACKED_EDITION
VALUE_ANY
VALUE_NA
VALUE_EMPTY
VALUE_UNDEFINED
WILDCARD_MULTI
WILDCARD_ONE
char_to_pce
pce_char_to_decode
CPEComponent2_3_URI_edpacked
SEPARATOR_COMP
__init__
set_value

## 4.5 Categories of main classes

The main classes of model can be grouped in four categories:

- Auto version (classes to create CPE Names without setting their version of CPE specification associated):
  - **cpe.py** (generic auto version class)
  - **cpe2_3.py** (auto version class of version 2.3)
- Manual version (classes to create CPE Names of particular version of CPE specification):
  - **cpe1_1.py** (version 1.1)
  - **cpe2_2.py** (version 2.2)
  - **cpe2_3_wfn.py** (version 2.3 with WFN style)
  - **cpe2_3_uri,py** (version 2.3 with URI style)
  - **cpe2_3_fs.py** (version 2.3 with formatted style style)
- CPE Name matching (classes to realize the name matching of CPE specification):
  - **cpeset1_1.py** (version 1.1)
  - **cpeset2_2.py** (version 2.2)
  - **cpeset2_3.py** (version 2.3)
- CPE Language matching (classes to realize the language matching of CPE specification):
  - **cpelang2_2.py** (version 2.2)
  - **cpelang2_3.py** (version 2.3)

CHAPTER 5

# Installation

Install the package using pip:

```
pip install cpe
```

or execute the setup.py file in package:

```
python setup.py install
```

CHAPTER 6

# Usage examples

This section explains with several examples how to use this package to create both CPE Names and platforms in a particular version of CPE specification.

## 6.1 Naming

To create a new CPE Name, the cpe package provides a generating class of CPE objects called CPE. It implements the factory pattern and receive two parameters: version of CPE specification and URI associated with CPE Name. Also, it is possible create a instance of a particular version of CPE Name directly using the class associated with the version.

In the following example, some CPE Names of different versions of CPE specification are created:

- Imports the class:

```
>>> from cpe import CPE
```

- Creates a CPE Name of version 1.1 with an operating system and an application parts, without setting the version directly (auto version):

```
>>> str11 = 'cpe://redhat:enterprise_linux:3:as/apache:httpd:2.0.52'
>>> c11 = CPE(str11)
```

- Creates a CPE Name of version 2.2 with an operating system where the version is set (manual version):

```
>>> str22 = 'cpe:/o:redhat:enterprise_linux:4:update4'
>>> c22 = CPE(str22, CPE.VERSION_2_2)
```

- Creates a CPE Name of version 2.3 (URI style) with an application system where the value of edition component is packed:

```
>>> str23_uri = 'cpe:/a:hp:insight_diagnostics:8::~~online~win2003~x64~'
>>> c23_uri = CPE(str23_uri)
```

- Creates a CPE Name of version 2.3 (WFN style) with an application system where some values have wildcards:

```
>>> str23_wfn = 'wfn:[part="a", vendor="hp", product="?insight_diagnostics?", version="8\.*",
>>> c23_wfn = CPE(str23_wfn)
```

- Creates a CPE Name of version 2.3 (formatted string style) with a hardware system:

```
>>> str23_fs = 'cpe:2.3:h:cisco:ios:12.3:enterprise:*:*:*:*:*:*'
>>> c23_fs = CPE(str23_fs)
```

The cpe package provides methods to get the value of components of a CPE Name (these functions always return a string list) and identify the type of system associated with it (hardware, operating system or application):

```
>>> c11.get_product()                    # Compound product attribute (v1.1)
['enterprise_linux', 'httpd']
>>> c22.get_update()                     # Simple Update attribute (v2.2)
['update4']
>>> c23_uri.get_target_hardware()        # Simple Target_hw attribute (v2.3, URI style)
['x64']
>>> c23_wfn.get_target_hardware()        # Simple Target_hw attribute (v2.3, WFN style)
['"x32"']
>>> c23_wfn.get_target_software()        # Target_sw attribute with logical value(v2.3, WFN style)
['ANY']
>>> c23_fs.is_hardware()                 # Type of system (v2.3, formatted string style)
True
```

Finally, the cpe package contains methods to convert any CPE Name defined under a particular style (URI version 2.3, WFN or formatted string) in other different styles:

```
>>> c22.as_wfn()
'wfn:[part="o", vendor="redhat", product="enterprise_linux", version="4", update="update4"]'
>>> c23_uri.as_uri_2_3()
'cpe:/a:hp:insight_diagnostics:8::~~online~win2003~x64~'
>>> c23_wfn.as_fs()
'cpe:2.3:a:hp:?insight_diagnostics?:8.*:*:*:*:*:*:x32:*'
```

## 6.2 Name matching

To create a set of CPE Name the package cpe provides the CPESetX_Y class, where X_Y is the target version of CPE specification. The *name_match* function of set allows do the name matching of CPE specification.

In the following example, a set of CPE Names of version 2.2 is created and the name matching is realized:

- Imports the classes of version:

```
>>> from cpe.cpe2_2 import CPE2_2
>>> from cpe.cpeset2_2 import CPESet2_2
```

- Creates the CPE Names of target system:

```
>>> c1 = CPE2_2('cpe:/o:microsoft:windows_2000::sp3:pro')
>>> c2 = CPE2_2('cpe:/a:microsoft:ie:5.5')
```

- Creates a set that contains the above CPE Names (known instances): K = {“cpe:/o:microsoft:windows_2000::sp3:pro”, “cpe:/a:microsoft:ie:5.5”}:

```
>>> K = CPESet2_2()
>>> K.append(c1)
>>> K.append(c2)
```

- Create the candidate CPE Name. It represents a rule in a security guidance checklist describes some settings to check on a system running Microsoft Windows 2000: X = “cpe:/o:microsoft:windows_2000”:

```
>>> X = CPE2_2('cpe:/o:microsoft:windows_2000')
```

- Does the name matching:

```
>>> K.name_match(X)
True
```

There are three components in X: C1=o, C2=microsoft, C3=windows_2000. Each component matches the corresponding component of the first CPE Name in K. So, the algorithm returns true and the rule can be applied to the target system.

## 6.3 Language matching

To create an expression of CPE Language the cpe package provides the CPELanguageX_Y class, where X_Y is the version of CPE specification used. The *language_match* function of class allows do the language matching of CPE specification.

In the following example, an expression of CPE Language of version 2.2 is created and the language matching is done:

- Imports the classes of version:

```
>>> from cpe import CPE
>>> from cpe.cpeset2_2 import CPESet2_2
>>> from cpe.cpelang2_2 import CPELanguage2_2
```

- Creates the CPE Names of target system:

```
>>> c1 = CPE('cpe:/o:sun:solaris:5.9:::en-us', CPE.VERSION_2_2)
>>> c2 = CPE('cpe:/a:bea:weblogic:8.1', CPE.VERSION_2_2)
```

- Creates a set that contains the above CPE Names (known instances): K = {“cpe:/o:sun:sunos:5.9:::en-us”, “cpe:/a:bea:weblogic:8.1”}:

```
>>> K = CPESet2_2()
>>> K.append(c1)
>>> K.append(c2)
```

- Creates the expression in XML of candidate CPE Language statement:

  **X = <cpe:platform id=”123”>**

  <cpe:title>Sun Solaris 5.8 or 5.9 with BEA Weblogic 8.1 installed</cpe:title>

  <cpe:logical-test operator=”AND” negate=”FALSE”>

  <cpe:logical-test operator=”OR” negate=”FALSE”>

  <cpe:fact-ref name=”cpe:/o:sun:solaris:5.8” />

  <cpe:fact-ref name=”cpe:/o:sun:solaris:5.9” />

  </cpe:logical-test>

  <cpe:fact-ref name=”cpe:/a:bea:weblogic:8.1” />

  </cpe:logical-test>

  </cpe:platform>

```
>>> It is necessary specify the "cpe:platform-specification" tag
>>> document = '''<?xml version="1.0" encoding="UTF-8"?><cpe:platform-specification xmlns:cpe
```

- Does the language matching:

```
>>> X = CPELanguage2_2(document)
>>> X.language_match(K)
True
```

CHAPTER 7

# Important issues

- The **auto version classes** receive an CPE Name and try to find out what version is associated.
- The **functions to get the values of attributes of a CPE Name** always return a list of string. That is so because the attributes of version 1.1 of CPE specification can be linked with several system and elements. For example, the attribute *vendor* in CPE Name *cpe://sun:sunos:5.9/bea:weblogic:8.1;mysql:server:5.0* get three values: *sun*, *bea* and *mysql*.
- The **not logical values of the attributes in version 2.3** of CPE specification always start and end with double quotes. For example, the value of attribute *product* in CPE Name *wfn:[part="a", vendor="microsoft", product="internet_explorer", version="8", update="beta"]* is *"internet_explorer"*, not *internet_explorer* without double quotes.
- Some **CPE Names of version 1.1 with several systems or elements defined** cannot convert into other CPE versions, for example, the CPE Name *cpe://sun:sunos:5.9/bea:weblogic:8.1;mysql:server:5.0*
- **Comparing a CPE Name of version 1.1 with others**, if versions are incompatible, then the return value is *False* instead of raising an exception.
- The methods `ovalcheck()` and `ocilcheck()` of `CPELanguage2_3` class is **not implemented**.
- The language attribute of CPE Names only allow the normal language tags according to the shortest ISO 639 code in language part and the ISO 3166-1 and UN M.49 code in region part. The extended, registered or reserved subtags are not supported.

CHAPTER 8

# Bugtracker

If you have any suggestions, bug reports or annoyances please report them to the issue tracker at https://github.com/nilp0inter/cpe/issues

CHAPTER 9

# TODO

- Implement methods *ovalcheck* and *ocilcheck* of `CPELanguage2_3` class.
- Implement versions 2.0 and 2.1 of CPE specification.
- Implement methods *as_uri_1_1* and *as_uri_2_2* to convert any CPE Name into a CPE Name of versions 1.1 and 2.2 respectively.

CHAPTER 10

# References


- [1] CPE: http://scap.nist.gov/specifications/cpe/
- [2] About CPE: http://cpe.mitre.org/about/
- [3] CPE Archive: http://cpe.mitre.org/cpe/archive/
- [4] CPE 1.1: http://cpe.mitre.org/specification/1.1/cpe-specification_1.1.pdf
- [5] CPE 2.2: http://cpe.mitre.org/specification/2.2/cpe-specification_2.2.pdf
- [6] CPE 2.3 - Naming Specification: http://csrc.nist.gov/publications/nistir/ir7695/NISTIR-7695-CPE-Naming.pdf
- [7] CPE 2.3 - Name Matching Specification: http://csrc.nist.gov/publications/nistir/ir7696/NISTIR-7696-CPE-Matching.pdf
- [8] CPE 2.3 - Applicability Language Specification: http://csrc.nist.gov/publications/nistir/ir7698/NISTIR-7698-CPE-Language.pdf

CHAPTER 11

# Indices and tables

- genindex
- search

## Symbols

## A



## C



## G



## I

## L



## N



## S