

A marble sculpture of Cupid and Psyche by Victor Stinner. Cupid, a winged cherub, is shown from the back, embracing Psyche. Psyche is reclining on a rock, looking down at her chest. The sculpture is set against a stone wall with a door visible on the right.

Python C API

Victor
Stinner

Problems



- **Cython, numpy, greenlet** frequently need changes when the C API changes
- C API exposes **implementation details**, structure members (optimizations)
- **Borrowed** references (Free Threading)
- Unknown impact on **3rd party projects** when CPython (C API) evolves



Red Hat

Remove private funcs



- Removed 300+ **private** functions in Python 3.13 alpha1 (October 2023)
- Some removals impacted **5-30 projects**
- As planned, removals causing most trouble have been **reverted** (mostly in alpha2)
- 3.13 beta1: **264** functions removed



Red Hat

Better public functions

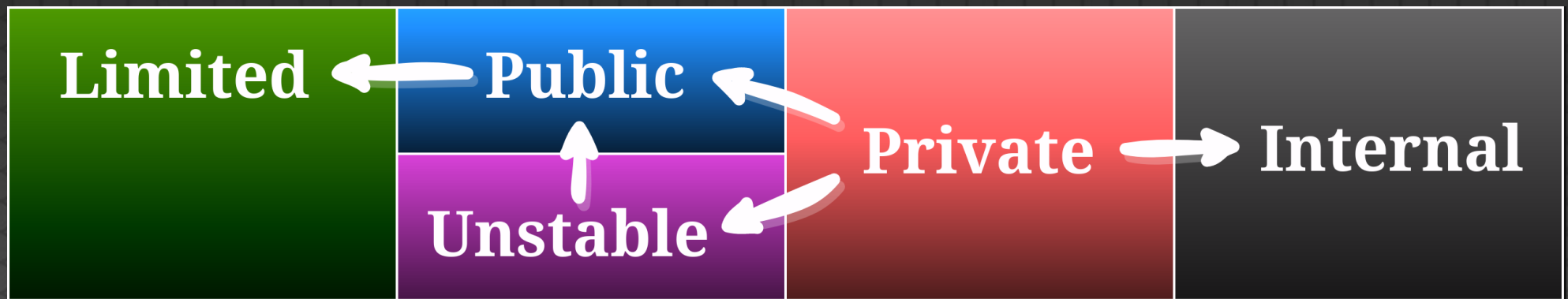


- Promote private to **public** functions
- Add **backward compatibility warranty**
- Add **documentation** and **tests**
- C API Working Group designs a **better** API
- Enforce error checking
- Avoid inefficient `PyErr_Occurred()` check



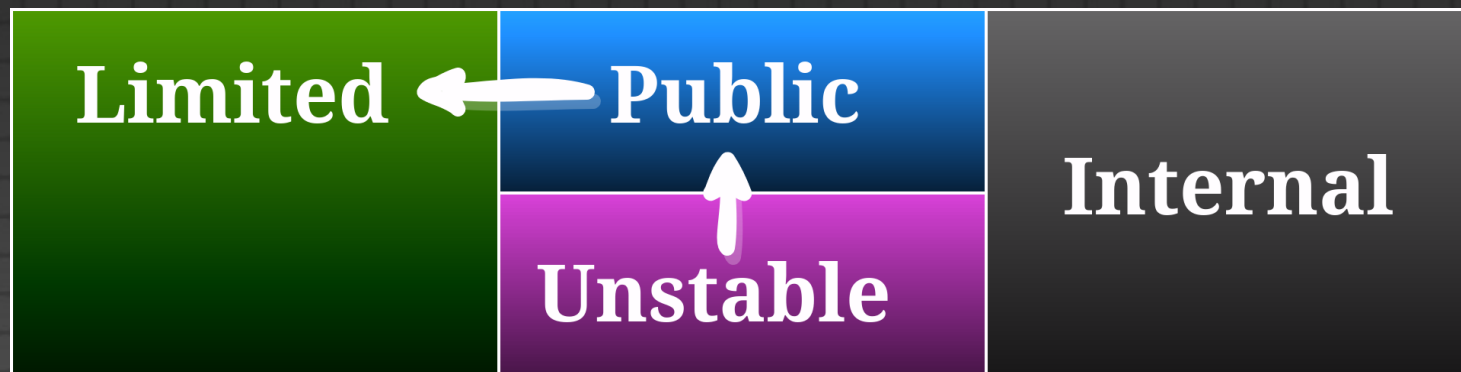
Red Hat

Remove private funcs



Red Hat

Remove private funcs



Red Hat

The background of the slide is a reproduction of the painting 'The Starry Night' by Vincent van Gogh. It depicts a night scene with a turbulent, swirling blue sky filled with bright, glowing yellow stars and a large, luminous crescent moon. In the foreground, a dark, jagged cypress tree stands on the left. Below the sky, a small village with a prominent church spire is nestled among rolling hills, all rendered with visible, expressive brushstrokes in various shades of blue and green.

Python 3.13

Promote private funcs



- **PyTime** API
- **PyDict**_Pop(), PyDict_ContainsString()
- **PyList**_Extend/Clear()
- **PyLong**_AsInt(),
PyLong_As/FromNativeBytes()
- **Py_Hash**Pointer()
- **PyThreadState**_GetUnchecked()



Red Hat

PyDict_Pop()



- 3.12: **PyObject*** `_PyDict_Pop(PyObject *dict, PyObject *key, PyObject *default)`
→ NULL means "not found" **or** error
- Proposed API: **int** `PyDict_Pop(PyObject *op, PyObject *key, PyObject **result)`
→ Return **-1** on **error** and set an exception
→ Return **0** on success



Red Hat

PyDict_Pop()



- 3.13: **int** PyDict_Pop(PyObject *op, PyObject *key, **PyObject **result**)
 - Return **-1** on **error** and set an exception
 - Return **0** if **not found** (NULL result)
 - Return **1** if **found** (non-NULL result)



Red Hat

Strong references



- Motivation: Free Threading
- PyDict_GetItem**Ref**(), PyList_GetItem**Ref**()
- PyDict_SetDefault**Ref**()
- PyImport_AddModule**Ref**()
- PyWeakref_Get**Ref**()
→ **deprecate** PyWeakref_Get**Object**()



Red Hat

Build stdlib ext with limited



- **Build** 16 stdlib extensions with the **limited C API**
- errno, md5, resource, _uuid, ...
- **Test** our own **limited C API**
- PEP 737 "Unify type formatting" adds **%T** and **%N** formats for error messages



Red Hat

Backward compatibility



pythoncapi-compat provides new Python functions on Python 3.12 and older

- `PyDict_GetItemRef()`
- `PyLong_AsInt()`
- `PyUnicode_EqualToUTF8()`
- ...



Red Hat



Python 3.14

Promote private funcs



- **Py_Hash**Buffer()
- **Py_fopen**(), **Py_fclose**()
- **PyBytes**_Join()
- **PyImport**_ImportModuleAttr()
- **PyLong**_GetSign()
- **PyLong**_Export(), **PyLongWriter**_Create()
- **PyUnicode**_Equal()
- **PyUnicodeWriter** API



Red Hat

Py_HashPointer()



`Py_hash_t Py_HashPointer(const void *ptr)`

- Hash a pointer value: process the pointer value as an integer (cast it to `uintptr_t` internally). The pointer is **not dereferenced**.
- The function **cannot fail**: it cannot return -1.



Red Hat

PyTime API



PyTime_t is a number of nanoseconds.

```
int PyTime_Time(PyTime_t *result)
```

- Return **-1** on error and **set an exception**
- Return 0 on success

```
int PyTime_TimeRaw(PyTime_t *result)
```

- Return **-1** on **error**
- Return 0 on success

No need to hold the **GIL**



Red Hat

PEP 757: export-import ints



API for gmpy2, SAGE and Python-FLINT

- `PyLong_Export()`: export as `PyLongExport` (array of digits)
- `PyLong_FreeExport()`
- `PyLongWriter_Create()`: write digits
- `PyLongWriter_Finish()`



Red Hat

PyUnicodeWriter API



- `Create()`, `Finish()`
- `WriteASCII()`, `WriteUTF8()`
- `WriteChar()`
- `WriteStr()`, `WriteSubstring()`
- `WriteRepr()`
- `WriteUCS4()`, `WriteWideChar()`
- `Format()`



Red Hat

Deprecate private funcs



- **_PyBytes**_Join() → **PyBytes**_Join()
- **_PyDict**_GetItemString**WithError**() → **PyDict**_GetItemString**Ref**()
- **_PyDict**_Pop() → **PyDict**_Pop()
- **_PyLong**_Sign() → **PyLong**_GetSign()
- **_Py**_fopen_**obj**() → **Py**_fopen()
- (...)

Removal in Python **3.18**



Red Hat

PEP 741: Init config API



- `Py_InitializeFromInitConfig()`
- `PyInitConfig_Create()/Free()`
- `PyInitConfig_GetError()`
- `PyInitConfig_GetInt()/GetStr()/GetStrList()`
- `PyInitConfig_SetInt()/SetStr()/SetStrList()`
- `PyInitConfig_HasOption()`
- Use strings for option names (stable ABI)



Red Hat

PEP 741: Init config API



```
PyInitConfig *config = PyInitConfig_Create();  
if (config == NULL) goto error;  
  
if (PyInitConfig_SetInt(config,  
    "dev_mode", 1) < 0) goto error;  
  
if (Py_InitializeFromInitConfig(config) < 0)  
    goto error;  
  
PyInitConfig_Free(config);
```



Red Hat



Questions?