

Nuevas clases: Los números racionales

Usando las ideas que hemos visto hasta ahora, es sencillo crear una clase de números racionales que tenga como atributos el numerador (llamado num en la clase) y el denominador (llamado den en la clase) y que muestre los objetos por pantalla con la notación "numerador/denominador":

```
In [1]: class Rational(object):
        def __init__(self, num, den):
            self.num = num
            self.den = den
        def __str__(self):
            return str(self.num)+'/'+str(self.den)
```

Podemos definir ahora las fracciones r1 y r2 y probar a imprimirlas por pantalla:

```
In [2]: r1 = Rational(1,2)
        r2 = Rational(9,3)
```

```
In [3]: print r1
```

1/2

```
In [4]: r1 + r2
```

```
-----
TypeError                                 Traceback (most recent call last)
<ipython-input-4-430dfacd9545> in <module>()
----> 1 r1 + r2
```

TypeError: unsupported operand type(s) for +: 'Rational' and 'Rational'

Una función interesante para los números racionales es la suma. Sin embargo, la notación que hemos visto hasta ahora resulta poco natural para definirla; sería mucho más interesante permitir sumar dos números racionales con el símbolo +, como ya hacemos para los enteros o los reales. Para ello, podemos usar la función **add**:

```
In [5]: class Rational(object):
        def __init__(self,num,den):
            self.num=num
            self.den=den
        def __str__(self):
            return str(self.num)+'/'+str(self.den)
        def __add__(self,other):
```

CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70

ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70

Al definir esta función podemos escribir la suma como hemos hecho hasta ahora con el resto de tipos numéricos:

```
In [8]: r1=Rational(1,2)
        r2=Rational(9,3)
        print r1+r2
```

21/6

El método `__init__` puede realizar tareas de "normalización" y de verificación. Para verificar, podemos lanzar una excepción cuando el denominador sea 0. Para normalizar, podemos definir previamente la función que calcula el máximo común entre dos números (gcd) y usarla para simplificar la fracción. Además, si el denominador es negativo podemos dejarlo positivo cambiando el signo del numerador.

The logo for Cartagena99 features the text 'Cartagena99' in a stylized, blue, serif font. The '99' is significantly larger and more prominent than the rest of the text. The logo is set against a light blue background with a white arrow pointing to the right, and a yellow shadow is cast beneath the text.

**CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70**

**ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70**

```

In [9]: def gcd(a,b):
        """
        Function that calculates the greatest common divisor of two integers.
        @type a: integer
        @type b:integer
        @rtype: integer
        """
        if b==0:
            return a
        else:
            return gcd(b,a%b)

class Rational(object):
    """
    Class to represent rationals: num/den.
    * den > 0
    * num and den do not have common divisors.
    * if num is 0, then den is 1
    """
    def __init__(self,num,den):
        """
        Builds a rational
        @type num: integer
        @type den: integer
        @raise Exception: if den==0
        """
        if den == 0:
            raise Exception('Division by zero when creating a Rational')
        d = gcd(num,den)
        self.num = num/d
        self.den = den/d
        if self.den < 0:
            self.num,self.den = -self.num,-self.den

    def __str__(self):
        return str(self.num)+'/'+str(self.den)
    def __add__(self,other):
        """
        Sum this rational to other
        @type other: Rational
        @rtype: Rational
        """
        num = self.num*other.den + other.num*self.den
        den = other.den * self.den
        return Rational(num,den)

```

CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
 LLAMA O ENVÍA WHATSAPP: 689 45 44 70

ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
 CALL OR WHATSAPP:689 45 44 70



Cartagena99

```
In [10]: r1=Rational(1,2)
         r2=Rational(9,3)
         print r1, r2
         print r1+r2
```

```
1/2 3/1
7/2
```

```
In [11]: print r1 + Rational(3,1)
```

```
7/2
```

También podemos ver que se lanza una excepción cuando intentamos crear el número 8/0:

```
In [12]: print Rational(8,0)
```

```
-----
Exception                                 Traceback (most recent call last)
<ipython-input-12-67d8ec7be4b3> in <module>()
----> 1 print Rational(8,0)

<ipython-input-9-2bd915daadd5> in __init__(self, num, den)
    26     """
    27     if den == 0:
--> 28         raise Exception('Division by zero when creating a Rational')
    29     d = gcd(num,den)
    30     self.num = num/d
```

```
Exception: Division by zero when creating a Rational
```

Además, la suma puede ser más *lista*: aunque ahora mismo solo podemos sumar un racional con otro racional, pero es interesante sumar nuestros racionales con, por ejemplo, los enteros predefinidos en Python. Para ello, necesitamos distinguir, usando la función `type`, el tipo del parámetro `other`: si es un racional (tipo `Rational`, es decir, el nombre de la clase) seguiremos usando las ideas anteriores, pero si es un entero (tipo `int`) primero tendremos que transformarlo en un racional con denominador 1. Cuando la operación no está definida se suele devolver el valor especial `NotImplemented`:

```
In [13]: type(r1), type(3), type(3.0), type("hola")
```

```
Out[13]: (__main__.Rational, int, float, str)
```

```
In [14]: isinstance(3,Rational)
```

```
Out[14]: False
```

The logo for Cartagena99 features the text 'Cartagena99' in a stylized, blue, serif font. The '99' is significantly larger and more prominent than 'Cartagena'. The text is set against a light blue background with a subtle gradient and a soft shadow effect.

CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70

ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70

```
In [15]: class Rational(object):
def __init__(self,num,den):
    """
    Class to represent rationals: num/den.
    * den > 0
    * num and den do not have common divisors.
    * if num is 0, then den is 1
    """
    if den==0:
        raise Exception('Division by zero when creating a Rational')
    d=gcd(num,den)
    self.num=num/d
    self.den=den/d
    if self.den<0:
        self.num,self.den=-self.num,-self.den

def __str__(self):
    return str(self.num)+'/'+str(self.den)
def __add__(self, other):
    """
    Sum this rational to other
    @type other: Rational
    @rtype: Rational or integer
    """
    if type(other) == Rational:
        num = self.num * other.den + other.num * self.den
        den = other.den * self.den
        return Rational(num,den)
    elif type(other) == int:
        other = Rational(other,1)
        return self + other
    else:
        return NotImplemented
```

De esta manera, la misma función nos sirve en ambos casos:

```
In [16]: r1=Rational(1,2)
r2=Rational(9,3)
print r1 + r2
print r1 + 2
```

```
7/2
5/2
```

**CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70**

**ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70**



The logo for 'Cartagena99' features the text 'Cartagena99' in a stylized, blue, serif font. The '99' is significantly larger and more prominent than the 'Cartagena' part. The text is set against a background of a light blue and white starburst or explosion shape, with a yellow and orange gradient bar at the bottom.

```
In [17]: print 1 + r1
```

```
-----  
TypeError                                Traceback (most recent call last)  
<ipython-input-17-3a0dd4469299> in <module>()  
----> 1 print 1 + r1  
  
TypeError: unsupported operand type(s) for +: 'int' and 'Rational'
```

De igual forma, fallará si intentamos sumar un real a un racional:

```
In [18]: r1 + 3.
```

```
-----  
TypeError                                Traceback (most recent call last)  
<ipython-input-18-521eac3e0b61> in <module>()  
----> 1 r1 + 3.  
  
TypeError: unsupported operand type(s) for +: 'Rational' and 'float'
```

Muchas otras funciones pueden definirse de esta manera: la resta (**sub**), la multiplicación (**mul**) devolverán nuevos racionales, la comparación (**cmp**) devuelve -1 si *self* es menor que *other*, 0 si son iguales y 1 si *other* es mayor que *self*. También podemos definir los operadores booleanos, por ejemplo **lt**, para lo que es conveniente tener definida la función de comparación:

The logo for Cartagena99 features the text 'Cartagena99' in a stylized, blue, serif font. The '99' is significantly larger and more prominent than the rest of the text. The logo is set against a light blue background with a white arrow pointing to the right, and a yellow and orange gradient bar at the bottom.

CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70

ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70

```
In [19]: class Rational(object):
def __init__(self,num,den):
    """
    Class to represent rationals: num/den.
    * den > 0
    * num and den do not have common divisors.
    * if num is 0, then den is 1
    """
    if den==0:
        raise Exception('Division by zero when creating a Rational')
    d=gcd(num,den)
    self.num=num/d
    self.den=den/d
    if self.den<0:
        self.num,self.den=-self.num,-self.den

def __str__(self):
    return str(self.num)+'/'+str(self.den)

def __add__(self, r):
    """
    Sum this rational to r
    @type other: Rational
    @rtype: Rational or integer
    """
    if type(r) == int:
        r = Rational(r,1)
        return self+r
    elif type(r) == Rational:
        num = self.num*r.den + r.num*self.den
        den = r.den * self.den
        return Rational(num,den)
    else:
        raise Exception('these types cannot be added')

def __sub__(self, r):
    """
    Substracts r to this rational
    @type other: Rational
    @rtype: Rational or integer
    """
    if type(r) == int:
        r = Rational(r,1)
        return self+r
```

CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70

ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70

Cartagena99

In [20]:

```
def __cmp__(self, other):
    """
    Method to compare two numbers. other can be an integer
    or a rational.
    @type other: Rational or integer
    @rtype: int
    @return: 0 if equals
             <0 if other is bigger than self
             >0 if self is bigger than other
    """
    if isinstance(other, Rational):
        return (self-other).num
    elif isinstance(other, int):
        diff = self - Rational(other,1)
        return diff.num
    else:
        return NotImplemented

def __lt__(self, other):
    """
    Method to implement the less than comparison operator.
    @type other: Rational or integer
    @rtype: boolean
    @return: True if self is lower than other
            False otherwise
    """
    return self.__cmp__(other) < 0
```

File "<ipython-input-20-9f1e4272d697>", line 2

```
def __cmp__(self, other):
    ^
```

IndentationError: unexpected indent

De esta forma podemos realizar estas operaciones de una manera más clara:

```
In [21]: r=Rational(3,4)
        s=Rational(7,8)
```

```
In [22]: print r-s,r<s,cmp(r,s)
```

```
-1/8 False 1
```

The logo for Cartagena99 features the text 'Cartagena99' in a stylized, blue, serif font. The '99' is significantly larger and more prominent than the word 'Cartagena'. The text is set against a background of a light blue sky with white clouds and a yellow sun or light source at the bottom.

CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70

ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70

• >=: con el método `__ge__`

objetos de la clase en la que se encuentra. Por ello, no necesitamos un Rational para aplicarla y no recibe el parámetro self. Este tipo de funciones recibe el nombre de *estáticas*:

```
In [23]: class Rational(object):
def __init__(self,num,den):
    """
    Class to represent rationals: num/den.
    * den > 0
    * num and den do not have common divisors.
    * if num is 0, then den is 1
    """
    if den==0:
        raise Exception('Division by zero when creating a Rational')
    d=gcd(num,den)
    self.num=num/d
    self.den=den/d
    if self.den<0:
        self.num,self.den=-self.num,-self.den

def __str__(self):
    return str(self.num)+'/'+str(self.den)

def __add__(self, r):
    """
    Sum this rational to r
    @type other: Rational
    @rtype: Rational or integer
    """
    if type(r) == int:
        r = Rational(r,1)
        return self+r
    elif type(r) == Rational:
        num = self.num*r.den + r.num*self.den
        den = r.den * self.den
        return Rational(num,den)
    else:
        return NotImplemented

def __sub__(self, r):
    """
    Subtracts r to this rational
    @type other: Rational
    @rtype: Rational or integer
    """
```

CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70

ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70

not implemented

Cartagena99

In [24]:

```
def __cmp__(self, other):
    """
    Method to compare two numbers. other can be an integer
    or a rational.
    @type other: Rational or integer
    @rtype: int
    @return: 0 if equals
             <0 if other is bigger than self
             >0 if self is bigger than other
    """
    if isinstance(other, Rational):
        return (self-other).num
    elif isinstance(other, int):
        diff = self - Rational(other,1)
        return diff.num
    else:
        return NotImplemented

def __lt__(self, other):
    """
    Method to implement the less than comparison operator.
    @type other: Rational or integer
    @rtype: boolean
    @return: True if self is lower than other
            False otherwise
    """
    return self.__cmp__(other) < 0

@staticmethod
def parse(s):
    """
    This static function builds a rational from a string. The
    rational can have the following forms:
    - <integer>
    - <integer>/<integer>
    @raise Exception: This function can raise an exception
    - There is no number at all
    - if the second integer is zero
    @type s: string
    @rtype rational
    """
    l = s.strip().split("/")
    num = int(l[0].strip())
```

CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70

ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70

IndentationError: unexpected indent

Las funciones estáticas se ejecutan poniendo el nombre de la clase seguida de un punto y el nombre de la función con los correspondientes argumentos:

```
In [25]: r=Rational.parse('3/4')
```

```
-----  
AttributeError                                Traceback (most recent call last)  
<ipython-input-25-d08d7333cb0a> in <module>()  
----> 1 r=Rational.parse('3/4')  
  
AttributeError: type object 'Rational' has no attribute 'parse'
```

```
In [26]: print r
```

```
3/4
```

```
In [26]:
```

```
In [26]:
```

The logo for Cartagena99 features the text 'Cartagena99' in a stylized, blue, serif font. The '99' is significantly larger and more prominent than the rest of the text. The logo is set against a light blue background with a white arrow pointing to the right, and a yellow and orange gradient bar at the bottom.

CLASES PARTICULARES, TUTORÍAS TÉCNICAS ONLINE
LLAMA O ENVÍA WHATSAPP: 689 45 44 70

ONLINE PRIVATE LESSONS FOR SCIENCE STUDENTS
CALL OR WHATSAPP:689 45 44 70