

# RAPPORT DE STAGE

du 4 Mai au 26 Juin

Les designs combinatoires et le logiciel Sage

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LaBRI

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# Le LaBRI



- 113 enseignant-e-s chercheu-r-ses
- 37 chercheu-r-ses
- 140 doctorant-e-s et ingénieur-e-s

université  
de BORDEAUX

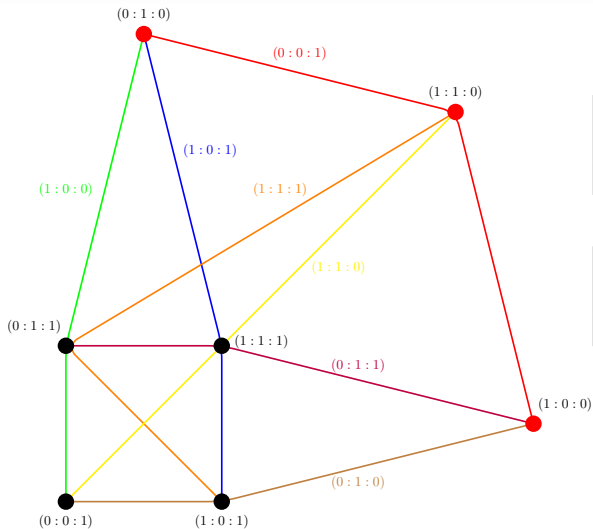


# Les plans projectifs finis

## Définition

On dit que le couple  $(P,D)$  où  $P$  est un ensemble de *points* et  $D$  un ensemble de *droites* est un *plan projectif fini* si et seulement si :

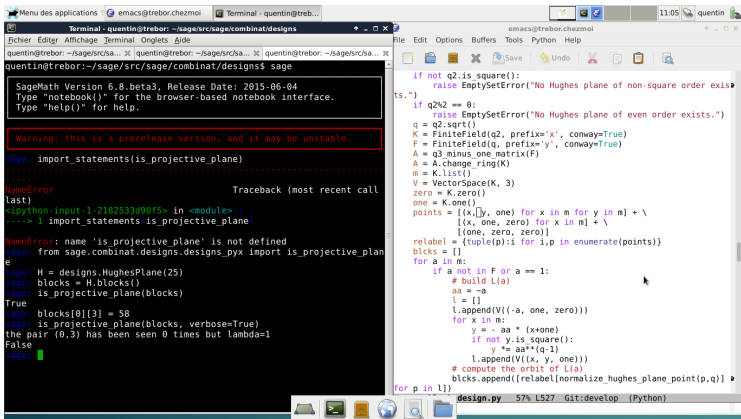
- Par deux points distincts passe une unique droite.
- Deux droites distinctes se coupent en un unique point.
- Il existe un quadrilatère.



|          |          |          |
|----------|----------|----------|
| +        | <b>0</b> | <b>1</b> |
| <b>0</b> | 0        | 1        |
| <b>1</b> | 1        | 0        |

|          |          |          |
|----------|----------|----------|
| $\times$ | <b>0</b> | <b>1</b> |
| <b>0</b> | 0        | 0        |
| <b>1</b> | 0        | 1        |

# Mon travail au LaBRI



The screenshot shows a terminal window and an Emacs editor window. The terminal window displays the SageMath version (6.8.beta3) and a warning message: "Warning: this is a prerelease version, and it may be unstable." The Emacs editor window shows a Python script named `design.py` with a 57% completion status. The script defines a function `is_projective_plane` that checks if a given matrix `A` represents a projective plane. The function uses SageMath's `FiniteField` and `VectorSpace` classes. The terminal window shows the execution of the script, which results in a `NameError` because the variable `is_projective_plane` is not defined.

```
SageMath Version 6.8.beta3, Release Date: 2015-06-04
Type "notebook()" for the browser-based notebook interface.
Type "help()" for help.

Warning: this is a prerelease version, and it may be unstable.

sage: import statements(is_projective_plane)
-----
NameError                                Traceback (most recent call
last)
<ipython-input-1-2182533d90f5> in <module>()
----> 1 import statements(is_projective_plane)

NameError: name 'is_projective_plane' is not defined
sage: from sage.combinat.designs.designs_pyx import is_projective_pla
e
sage: H = designs.HughesPlane(25)
sage: blocks = H.blocks()
sage: is_projective_plane(blocks)
True
sage: blocks[0][3] = 58
sage: is_projective_plane(blocks, verbose=True)
the pair (0,3) has been seen 0 times but lambda=1
False
sage: 
```

```
if not q2.is_square():
    raise EmptySetError("No Hughes plane of non-square order exists")
ts.)
if q2%2 == 0:
    raise EmptySetError("No Hughes plane of even order exists.")
q = q2.sqrt()
K = FiniteField(q2, prefix='x', Conway=True)
F = FiniteField(q, prefix='y', Conway=True)
A = q3.minus_one_matrix(F)
A = A.change_ring(K)
m = K.List()
V = VectorSpace(K, 3)
zero = K.zero()
one = K.one()
points = [(x,[y, one) for x in m for y in m] + \
          [(x, one, zero) for x in m] + \
          [(one, zero, zero)])
relabel = [(tuple(p):i for i,p in enumerate(points))]
blcks = []
for a in m:
    if a not in F or a == 1:
        # build L(a)
        aa = -a
        l = []
        l.append(V((-a, one, zero)))
        for x in m:
            y = -aa * (x+one)
            if not y.is_square():
                y = aa*(q-1)
            l.append(V((x, y, one)))
        # compute the orbit of L(a)
        blcks.append([relabel[normalize_hughes_plane_point(p,q)]
for p in l])
```

