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Proposition de sujet de stage de Master 2 en
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Proposition of subject for a work of formation in
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The work consists in the study of two well-known articles in the Theory of Partial Differential Equations. More precisely these papers deal with the nonlinear heat equation

$$\frac{\partial u}{\partial t} = \Delta u + |u|^{p-1} u$$

in $[0, +\infty) \times \mathbb{R}^N$, where u is real-valued and $p > 1$. Assuming that the function has a blow-up at a finite time $T > 0$, that means $T > 0$ is a maximal time of existence where u is bounded, the main goal is to characterize the behaviour of the solution as t tends to T : to have informations on an upper bound for the blowup rate, of the form

$$|u(t, x)| \leq C(T - t)^{-1/(p-1)}$$

and if the upper bound holds, to study the behaviour of the function $(T - t)^{1/(p-1)} |u(t, x)|$ near the time T . The notions required for this study are the knowledge of Sobolev Spaces, and elementary results on parabolic equations.

The two articles to be studied are the following:

1) **Giga, Y.; Kohn, R.** Asymptotically self-similar blow-up of semilinear heat equations. *Comm. Pure Appl. Math.* 38 (1985), no. 3, 297–319.

2) **Giga, Y.; Kohn, R.** Nondegeneracy of blowup for semilinear heat equations. *Comm. Pure Appl. Math.* 42 (1989), no. 6, 845–884.

Reference of books:

Cazenave T. and Haraux A., Introduction aux problèmes d'évolution semi-linéaires , Mathématiques et Applications 1, Ellipses, Paris, 1990.

Friedman, A. Partial differential equations of parabolic type. Prentice-Hall, Inc., Englewood Cliffs, N.J. 1964.

Brezis H. , Analyse fonctionnelle, théorie et applications, Masson, Paris, 1983 (exists in english version).