

# Graded exercise 1

- Graded Exercise 1 will be available on moodle after today's lecture, and the solutions must be uploaded to moodle before **midnight Thursday, 16th October**
- Submit a single pdf document containing your hand-written work / scanned images / ipad pages
- Each person must submit their own solution, no photocopies, nor one person in a group submitting a single solution for several people
- All questions should be done by hand
- Submit early in case of glitches with the system

Dès aujourd'hui et jusqu'au dimanche 12 octobre à minuit, vous aurez l'occasion de recueillir l'avis des étudiantes et étudiants inscrits à vos cours Bachelor, Master, CMS et MAN, grâce à l'évaluation indicative sur l'enseignement.

Ce feedback indicatif invite les étudiantes et étudiants à répondre à une question unique ("Le déroulement du cours permet mon apprentissage et un climat de classe approprié"), en ajoutant, si souhaité, un commentaire. Les détails sur le fonctionnement du système de retour indicatif sont donnés ci-après. Veuillez noter que dès ce semestre, vous pourrez voir les résultats même si vous avez moins de 5 réponses.

Cette démarche a lieu en début de semestre, afin de vous laisser plus de temps pour pallier les éventuels problèmes qui vous seront rapportés. Il ne s'agit pas d'une évaluation de votre enseignement, mais seulement d'une opportunité d'obtenir un premier retour d'information.

Le retour de vos étudiantes et étudiants vous sera d'autant plus utile si le taux de réponse de votre classe est élevé, raison pour laquelle nous vous invitons à les motiver à se connecter à ISA pour donner leur feedback. En plus de ce retour d'information rapide, chaque cours fera l'objet d'une évaluation approfondie à la fin du semestre, pour laquelle vous recevrez plus d'informations au cours de la semaine 6.

Nous vous remercions de votre attention et vous souhaitons une bonne suite de semestre.

*Nicolas Grandjean, Vice-président associé pour l'Education*  
*Roland Tormey, Chef du CAPE*

#### Informations complémentaires sur le retour indicatif

Marche à suivre pour accéder au retour indicatif sur ISA:

- Connectez-vous au portail IS-Academia avec votre compte Gaspar : <https://isa.epfl.ch>
- Cliquez sur 'mes cours'
- La liste de vos cours apparaîtra sur le côté gauche de l'écran. Un lien vers 'comparaison' se trouve au haut du menu central
- Une fois la période du retour indicatif terminée, vous pourrez accéder à l'entier de vos statistiques
- Une liste complète des commentaires des [étudiant.es](#) est disponible au format html ou Excel
- Divers types de graphiques sont disponibles

Qui participe au feedback indicatif?

- Tout le corps étudiant de l'EPFL peut donner un feedback sur l'ensemble des cours de niveau Bachelor, Master et CMS.
- A condition d'être inscrit·es chez nous, les étudiantes et étudiants externes peuvent également participer à l'évaluation pour les cours suivis à l'EPFL.
- Les doctorantes et les doctorants qui suivent des cours de Master pourront s'exprimer, mais les cours de l'Ecole Doctorale font l'objet d'une autre procédure.

Caractéristiques du système :

- Le formulaire est disponible sur IS-Academia, en anglais. Pour en changer la langue, choisissez 'en' ou 'fr' au haut de la page d'accueil.

**indicative feedback**  
**1 question only,**  
**please answer it!**

**From today until midnight Sunday, 12 October**, you will have an opportunity to get feedback from students on your Bachelor, Master, CMS and MAN courses through the Indicative Student Feedback on Teaching.

This feedback system asks students to respond to a single question about the course (“The running of the course enables my learning and an appropriate class climate”), with an opportunity for students to provide comments. Details on the operation of the system are provided below. ~~Note that from this semester on, you will be able to see the results even if you have fewer than 5 responses.~~

The indicative feedback happens early in the semester in order to allow you time to address any possible issues coming up. It is not intended as an evaluation of your teaching - only as an opportunity for quick feedback. Student feedback is more likely to be useful to you if your class response rate is high, therefore it would be worthwhile for you to encourage your students to go to ISA and respond to the Indicative Feedback. Alongside this rapid feedback, each course will also have an in-depth evaluation at the end of the semester. You will receive more information on that in week 6.

We thank you for your attention and kind regards,

*Nicolas Grandjean, Associate Vice-President for Education*  
*Roland Tormey, Head of CAPE*

#### Additional Information on Indicative Feedback

How it works for teachers:

- Connect to IS-Academia portal using your Gaspar account: <https://isa.epfl.ch>
- Click on ‘my courses’
- Your courses will appear on the left-hand side of the screen.
- After the indicative feedback period, you will have access to the complete statistics in the tab “Comparaison”.
- A complete list of student comments can be obtained in html or Excel format.
- Multiple types of graphics can be obtained.

Who participates:

- Teachers of all Bachelor, Master and CMS courses get indicative student feedback every semester.
- External students, taking courses at EPFL, will be able to provide feedback as long as they are correctly registered. UNIL students taught in the same classes as EPFL students will also participate.
- PhD students will be able to give feedback on the master courses they are following, but courses of the Doctoral School are dealt with through another procedure.

Features of the system:

- The form is available in English within IS-Academia. To change the language, choose “en” or “fr” at the top of the home page.
- Student feedback is anonymous.
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In case of difficulties:

- External teachers without a computer account (GASPAR) need to contact their section and have their account set up.
- IS-Academia is a tool. Sections are responsible for the organization of the feedback.
- In case of technical problems: [1234@epfl.ch](mailto:1234@epfl.ch)

**indicative feedback**  
**1 question only**  
**please answer it!**

# Background quiz

Background quiz: [go.epfl.ch/turningpoint](https://go.epfl.ch/turningpoint)

Session Id: [julian23](#)



All input is anonymous; data are stored outside CH

Break

## Recipe for solving 2D linear problems: $d\mathbf{X}/dt = \mathbf{M} \mathbf{X}$

- 1) Find  $\tau = \text{Tr } M$  and  $\Delta = \det M$ , and locate the FP on the  $(\tau, \Delta)$  graph. Check for the marginal cases that lie on the curve  $\tau^2 - 4\Delta = 0$ .  
(stop here if all you need is the FP and its stability).
- 2) Find the nullclines where  $dx/dt = 0$  or  $dy/dt = 0$ . Find the sign of the other gradient along the nullclines, i.e., the places where  $dy/dt$  is positive / negative along the line  $dx/dt = 0$ . Mark the direction of the vector field on the nullclines.
- 3) Find eigenvalues and eigenvectors of  $\mathbf{M}$ . Note that eigenvectors (and nullclines) are always straight lines for linear problems.
- 4) On the phase portrait, draw and label the nullclines and the eigenvectors.
- 5) Sketch trajectories that fit with the nullclines and the eigenvectors in all relevant regions of the phase portrait  
(stop here if all you need is qualitative/pictorial solution.)
- 6) Find the complete trajectory from an initial point  $(x_0, y_0)$  by determining the constants  $c_1, c_2$  in the general solution.

## Recipe for solving 2D non-linear problems:

$$dx/dt = f(x, y)$$

$$dy/dt = g(x, y)$$

1. Find the nullclines:  $f(x,y) = 0$  or  $g(x,y) = 0$ .
2. Locate the FPs of the system (if any) from intersections of the nullclines
3. Find the Jacobian from a 2D Taylor expansion of the functions  $f(x, y)$  and  $g(x, y)$ :
4.  $J = \begin{pmatrix} df/dx & df/dy \\ dg/dx & dg/dy \end{pmatrix}$
5. Apply the linear recipe (  $d\mathbf{X}/dt = \mathbf{J} \mathbf{X}$  ) at each fixed point  $(x^*, y^*)$ , using  $\text{Tr } J$  and  $\det J$  to classify each FP, and find its eigenvalues/eigenvectors.
6. If eigenvalues for an FP are complex, it is a centre or spiral, where a trajectory rotates about the FP.
7. connect trajectories between the FPs using common sense.

The 2D linear system  $d\mathbf{X}/dt = \mathbf{M} \mathbf{X}$  has one isolated fixed point at the origin that determines trajectories for the WHOLE phase portrait (if  $\det \mathbf{M} \neq 0$ ).

The type of FP is determined by the trace and determinant of the matrix  $\mathbf{M}$  only.

If  $\det M < 0$ , it's a saddlepoint.

$\det M = 0$ , non-isolated FP.

If  $\det M > 0$  and

If  $\text{Tr } M < 0$ , FP is stable; if  $\text{Tr } M > 0$ , FP is unstable. In both cases:

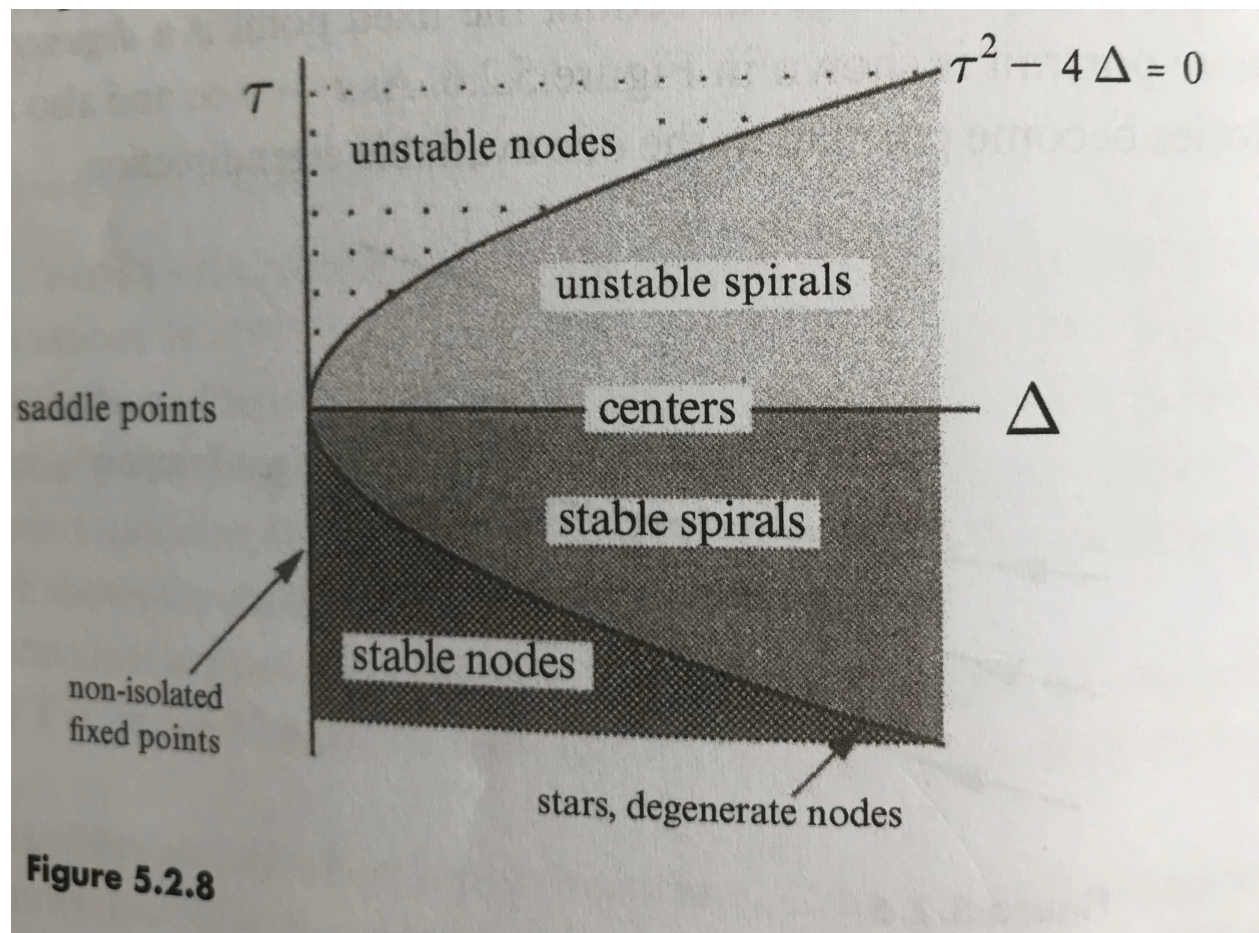
If  $\tau^2 - 4\Delta < 0$ , it's a spiral,

else if  $\tau^2 - 4\Delta > 0$ , it's a node,

else if  $\tau^2 - 4\Delta = 0$ , it's a star or degenerate node.

In all cases, the stability is given by the sign of  $\text{Tr } M$ .

If  $\det M > 0$  and  $\text{Tr } M = 0$ , it's a centre, i.e., circles/ellipses.



# Tricky points

- A nonlinear dynamical system can be treated as a set of (almost independent) linear systems obtained by linearising the Jacobian at each fixed point
- Eigenvectors are **linear only near a fixed point** in a nonlinear 2D system and are **not always the axes**
- Nullclines **are not always the axes** in linear and non-linear problems (but **DO** check the axes)
- Population models (and concentrations) must be positive or zero, they exist only in the first quadrant; **don't analyse fixed points / draw trajectories in the other quadrants**
- Be able to find the slope and direction of trajectories far from the origin or any fixed point