AGROPARISTECH AND AI

A set of multiple (unique) challenges

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AgroParisTech – INRAE – MIA Paris-Saclay

Challenges

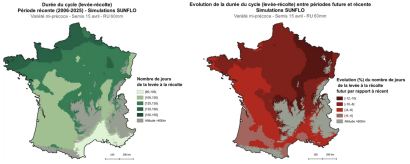
Challenges that are unique

- **Producing food in a changing environment**
  - Climate change
  - Changing expectations from the consumers
- **Modifying the consumption behavior of the consumers**
  - Over time: months to years
- **Analyzing and understanding ecosystems across a wide range of spatial and temporal scales**
  - From the cells to the biosphere
  - From days to decades
- **Adapting the manufacturing processes**
  - To new regulations and conditions

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2006–2025 ⟶ **2040–2059**

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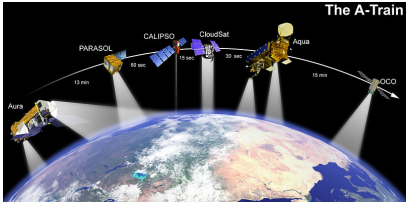
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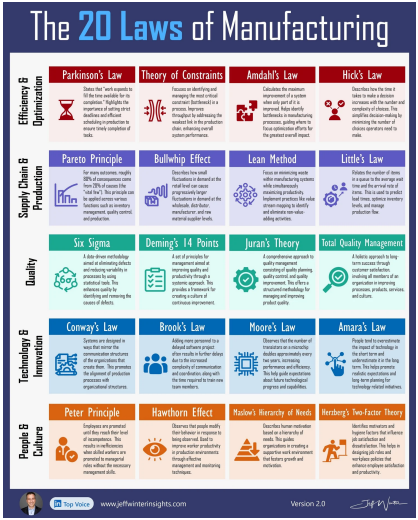
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Other challenges

- **Multiple sources of data**
  - Different sensors, different organizations
  - Data collected over time

  $\Rightarrow$ How to merge the data?
- **Multiple decision-making tools**
  - Interoperability?
- **Changing environment**
  - Which models to use?
  - Robustness?
- **From specific locations / products / times to new ones**
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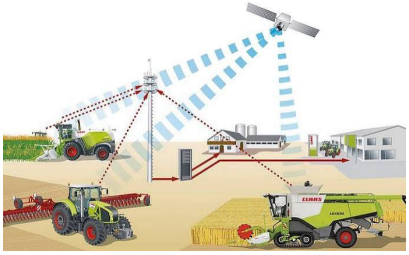






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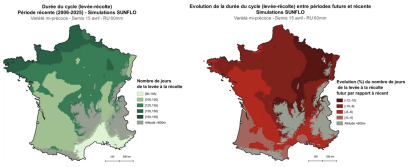
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Challenges . . . and AI

- **Data-driven modelling with experts**
  - Deep learning; foundational models
  - Physics-guided neural networks
  - Multi-modal learning
  - Transfer learning
- **Augmented Intelligence**
  - Iterative and interactive exchanges
  - Real-time adaptations and decisions
  - Digital twins and strategic decisions
  - Conception of new solutions (e.g. proteins, molecules, agricultural processes, . . .)
- **Inter-operability**
  - Multiple sensors
  - Multiple applications

AI: the foundational models

- **Foundational models**
  - A gigantic compilation of human productions
  - Infinitely adaptive using reasoned promptings
- **Their power**
  - Encyclopedic
  - Stupendous reasoning abilities in well-defined domains (cf. mathematics)
- **The risks**
  - To idolize them
    - Why should I make effort to learn and acquire knowledge?
    - Not acquiring and exercising critical thinking
  - Loss of sovereignty: on the models, on the data

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Very powerful assistants

Essential to learn to use them in the most productive, reasoned and ethical ways

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What to teach?
How to teach?
How to evaluate?

Beware

Foundational models are not
the ultimate and unique tools

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Day-to-day problem solving and research also has to do with other modeling techniques

Mathematics

- Linear algebra
- Differential equations
- Optimisation

Computer science

- Computational models (e.g. agent-based modeling)
- Organizing and optimising computations and data exchanges

Statistics

- Statistical tests
- Statistical models

Research topics

Research topics

1. Time series

- **Applications**: yields, early decision-making, animal performance, behaviors
- **Link with mechanistic models**: hybrid approaches, physical constraints

2. Profiling

- Food recommendation
- Sequential recommendation

3. NLP & knowledge management

- Grounding decisions in expert references
- Fostering dialogue
- Improving robustness

4. Explainability & causality

- Logical inference
- Hybrid methods

Preparing our students for these challenges

How to prepare our students for these challenges

- Curriculum
  - Computer science classes
    - **For all students**
    - **Elective courses**
  - "Brevet IA"
  - IODAA
    (from data to knowledge and decision)
    - Third year of study focused on AI (Master level)
- Digit InnLab

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Object-oriented programming
Data visualization
Statistics for life sciences
Introduction to Machine Learning
Introduction to Reinforcement Learning

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Supervised learning
Unsupervised learning
Deep learning
Optimization
Causality
Time series
Explainable AI
ML for pharma
Statistics for high-dimension data

AI in the curriculum, year by year

1st year

Welcome period

- Reflection on teaching & learning with generative AI
- Charter of uses, rules of the game

Core curriculum

- Project management in computer science (Python, SQL, . . .)
- Statistics
- Physical modeling

+ **Elective**: mobile development

2nd year

- Advanced statistics
- Machine Learning in practice

3rd year

- Bridging to **IODAA** (specialization in AI & data science)

AI user → **AI practitioner** → **AI expert**

IODAA

- Cursus combined with
  - Master of bioinformatics
  - Telecom Paris (starting 2027)
- Hands-on works
  - "Projets fil rouge"
  - 6-month internships in a wide range of domains
- A wide range of careers

205
alumni

∼50%
go on to pursue a PhD

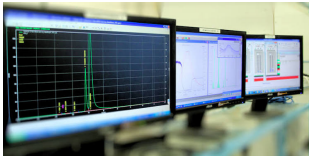
How to prepare our students for these challenges

- **Digit InnLab**
  - Participants
    - Students
    - Professors / Scientists
    - Companies
  - **A shared space with real-world problems**
    - For learning
    - For innovation
    - For exchange
    - E.g. “Projets fil rouge”



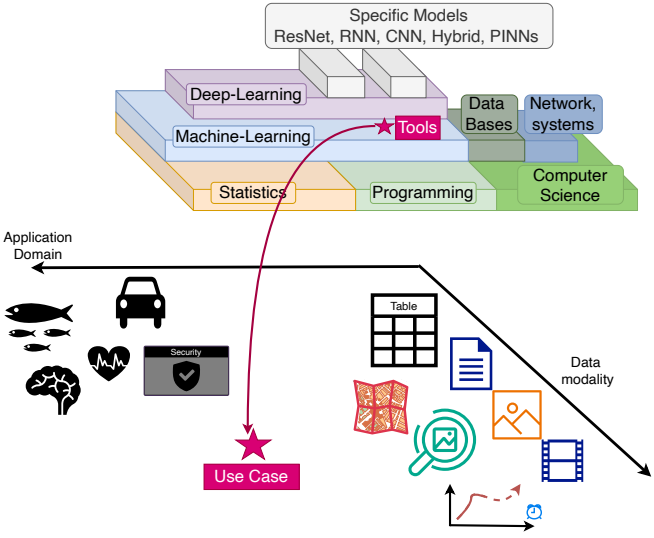
Farm’InnLab





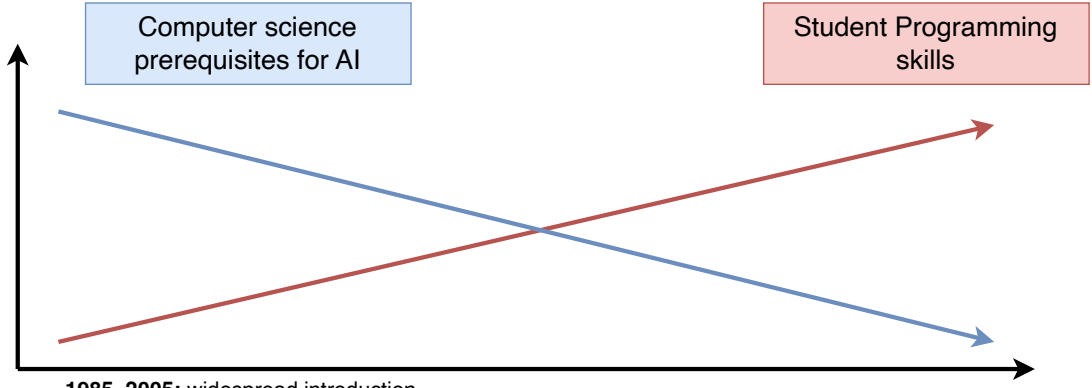
Acquiring AI skills

Teaching AI

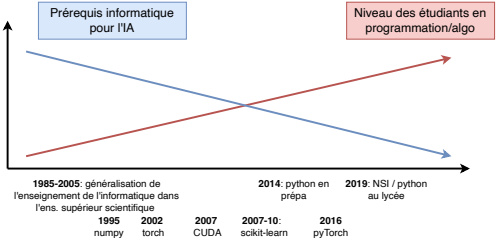


- Different levels of access (awareness, tool usage, development)
- Different data
- Different application domains

Access to AI: at a crossroads



Access to AI: at a crossroads



Three levels of access to AI:

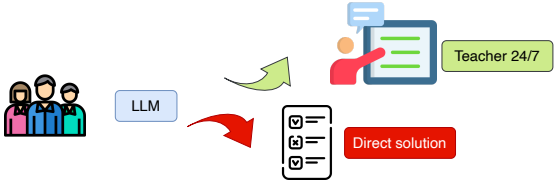
1. Leverage a chatbot... in an **optimal** and **responsible** way
2. Use tools, manipulate data
3. Develop tools



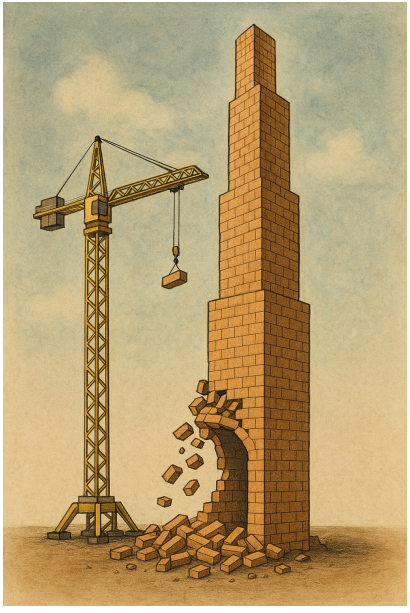
Educational challenges

- Redefine our educational priorities,
  subject by subject,
  as we did with Wikipedia/calculator/...
  - Accept the decline of certain skills
  - Re-ask those questions regularly!

- Train students in the use of LLMs, while managing to temporarily prohibit their use

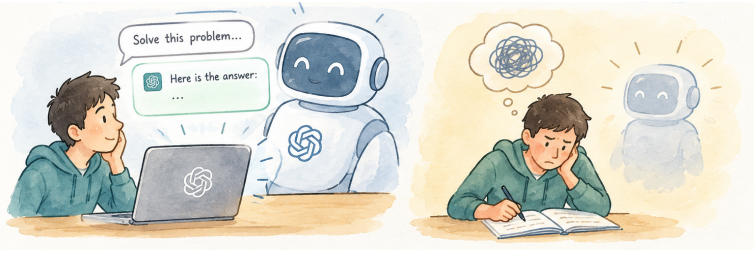


- Learn to recognize LLM-generated content
- Do not underestimate the psychological aspects



Psychological impact of AI

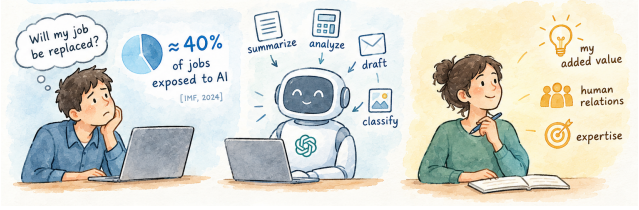
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   - Illusion of understanding, loss of self-confidence [& *cognitive debt*]



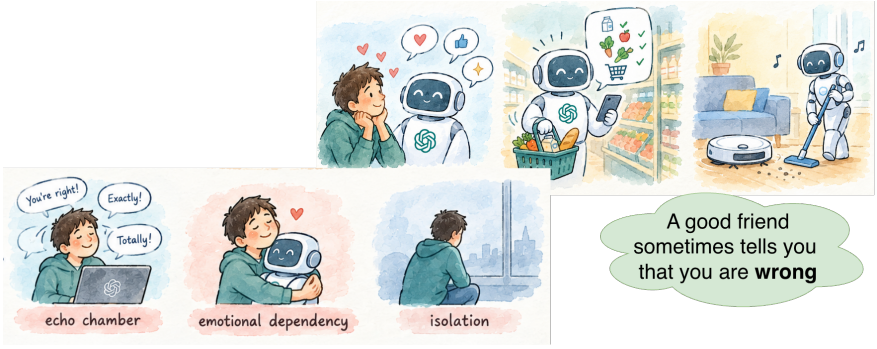
Psychological impact of AI

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2. **At work:** which work next to AI?
   - Anxiety about the future: ≈ 40% of jobs *exposed* to AI [IMF, 2024]
     ⇒ what is *my* added value?
   - Loss of meaning... or refocus on expertise, human relations



Psychological impact of AI



3 **In life:** *sycophancy*

- LLMs are trained to please: they agree, flatter, validate
- An always available, never contradicting confidant
- Risks: echo chamber, emotional dependency, isolation

@AgroParisTech: rules of the game

1 Preliminary charter of uses (rather minimal):

1. Utilisation responsable et éthique des outils d'IAG

- **Respect des droits d'auteur**
  Veillez à respecter les droits d'auteur et la propriété intellectuelle des sources consultées ou intégrées.
- **Transparence dans l'utilisation**
  Indiquez clairement lorsque vous utilisez un outil d'IAG pour produire une partie de votre travail (ex. : code généré, synthèse de texte), afin de favoriser la transparence dans les projets académiques et les travaux de groupe. Précisez la nature et l'étendue de la contribution de l'IAG[1].
- **Respect de la vie privée**
  Ne soumettez pas des données sensibles ou personnelles aux outils d'IAG, pour garantir la protection des informations personnelles et confidentielles.
- **Choix de l'outil approprié**
  Si des outils usuels peuvent répondre à votre besoin, utilisez ces outils plutôt qu'une IAG. Restez conscients des impacts environnementaux et économiques liés à l'utilisation des outils d'IAG.

https://intra.agroparistech.fr/spip.php?rubrique1817

@AgroParisTech: rules of the game

1. Preliminary charter of uses (rather minimal):

2. Promotion de l'esprit critique et de la vérification des informations

- **Vérification des contenus générés**
  Vérifiez toujours les contenus produits par les outils d'IAG, notamment en recoupant les données avec des sources fiables.
- **Développement de l'esprit critique**
  Évaluez la pertinence et la qualité des réponses fournies par les outils d'IAG. Restez critiques face aux contenus générés, notamment du fait des biais potentiels qui pourraient aboutir à des productions contraires aux valeurs d'AgroParisTech (ex : des contenus discriminants ou sexistes).

https://intra.agroparistech.fr/spip.php?rubrique1817

@AgroParisTech: rules of the game

1. Preliminary charter of uses (rather minimal):

3. Utilisation raisonnée pour favoriser l'apprentissage

- **Complément et non substitut à l'apprentissage**
  Utilisez l'IAG comme un complément pour approfondir la compréhension des sujets et non pour remplacer les efforts personnels de recherche et d'apprentissage actif.
- **Usage modéré pour éviter la dépendance et pour développer les compétences fondamentales**
  Continuez à développer vos capacités de résolution de problèmes et de raisonnement, indépendamment de l'IAG. Vous pouvez parfois utiliser l'IAG pour explorer des pistes de résolution de problèmes techniques ou pour générer des idées, mais vous devez ensuite vous engager activement dans le processus de réflexion et de résolution.

https://intra.agroparistech.fr/spip.php?rubrique1817

@AgroParisTech: rules of the game

1. Preliminary charter of uses (rather minimal):

4. Actualisation régulière des informations

- **Respect des directives de l'école**
  Tenez-vous informés des recommandations d'AgroParisTech et des directives de vos enseignants concernant l'utilisation des IAG dans les examens, les travaux de groupe, et les travaux individuels. Les IAG sont utiles dans certains travaux et à proscrire dans d'autres. Respectez impérativement les interdictions des enseignants sous peine de perdre tout l'intérêt pédagogique de certaines phases de cours.
- **Sensibilisation aux enjeux éthiques**
  Participez aux modules de sensibilisation proposés par l'école pour mieux comprendre les enjeux liés à l'utilisation de l'IAG.

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@AgroParisTech: rules of the game

1. Preliminary charter of uses (rather minimal):
   `https://intra.agroparistech.fr/spip.php?rubrique1817`
2. Study regulations:
   - Oral exams / resits may be required at the slightest doubt on the authenticity of an assignment
   - Heavy sanction: inappropriate use of AI = fraud

The teacher is in charge

- Says **which uses** are allowed / forbidden
- Explains **when** to use these tools and when NOT to use them
- Shows **how** to use these tools

AgroParisTech and AI

AgroParisTech and AI – *at the forefront*

- **Unique position**
  - Life science; agronomy; environmental science; food
  - With special demands in AI
- "Grande École" + operator of many Masters (graduate studies)
  - **Challenges in teaching**: curriculum, teaching approaches
  - **Potential pool of innovators and innovations**
- **A top research center**
  - **Very well-connected**
    - In the French scientific eco-system
    - Internationally

The eco-system relative to AI

