Smooth sailing @A2I2 in a research-intensive environment

Why PhD?

Better answer it yourself!

Curiosity should be the main reason.

Imagination should be the main weapon.

Live in the future, 5-10 years ahead of our time.

Advanced jobs require PhD level

Think about research positions at DeepMind, Google Brain, Microsoft Research, Facebook AI Research

Seeking reputation, establish yourself in the field

Usually means 3-10 high quality papers (or a patent), hundreds of citations and **h-index** of 5-10 or more.

What is PhD training?

To produce an independent thinker and investigator

- Can write your own research statement
- Can supervise new students

Your training will get you there:

- **First year**: mostly under close supervision
- **Second year**: start injecting your own contributions.
  - By the end of 2nd year, meet standards for thesis content.
- **Last year**: pretty much on your own thinking

PhD thesis is just a by-product in the process. Not our primary goal!

Who is a CS/ML/AI/CV PhD?

Who satisfies TWO requirements:

- Original & substantial thesis
- Pass oral defence

This usually means:

- 3-5 papers of good international standing (e.g., CVPR/ICCV/ NIPS/ICML/AAAI/IJCAI/ECCV/BMVC/ICPR for AI/ML focus)
- 3-4 main chapters

BUT ultimately, an independent thinker and investigator

- Can build/realise a medium/long-term research program
- Has something beyond papers

Think how you will make a good use of the best 3-4 years in your life!

Picking the right topics

Doable within 3 years 6 months

- Most PhD think they will save the world, only to end up saving their PhD
- Some are scared of anything non-textbook
- CS/ML: doable within 6 months or a year

Best if it is still early, but not too early

- Set yourself up as expert by the end of PhD. Only if the field has not died!
- Competition is very high in CS/ML

Where do ideas come from?

- Mostly, your supervisors,
- You, if you're quite advanced,
- Random chats

What the third year will look like

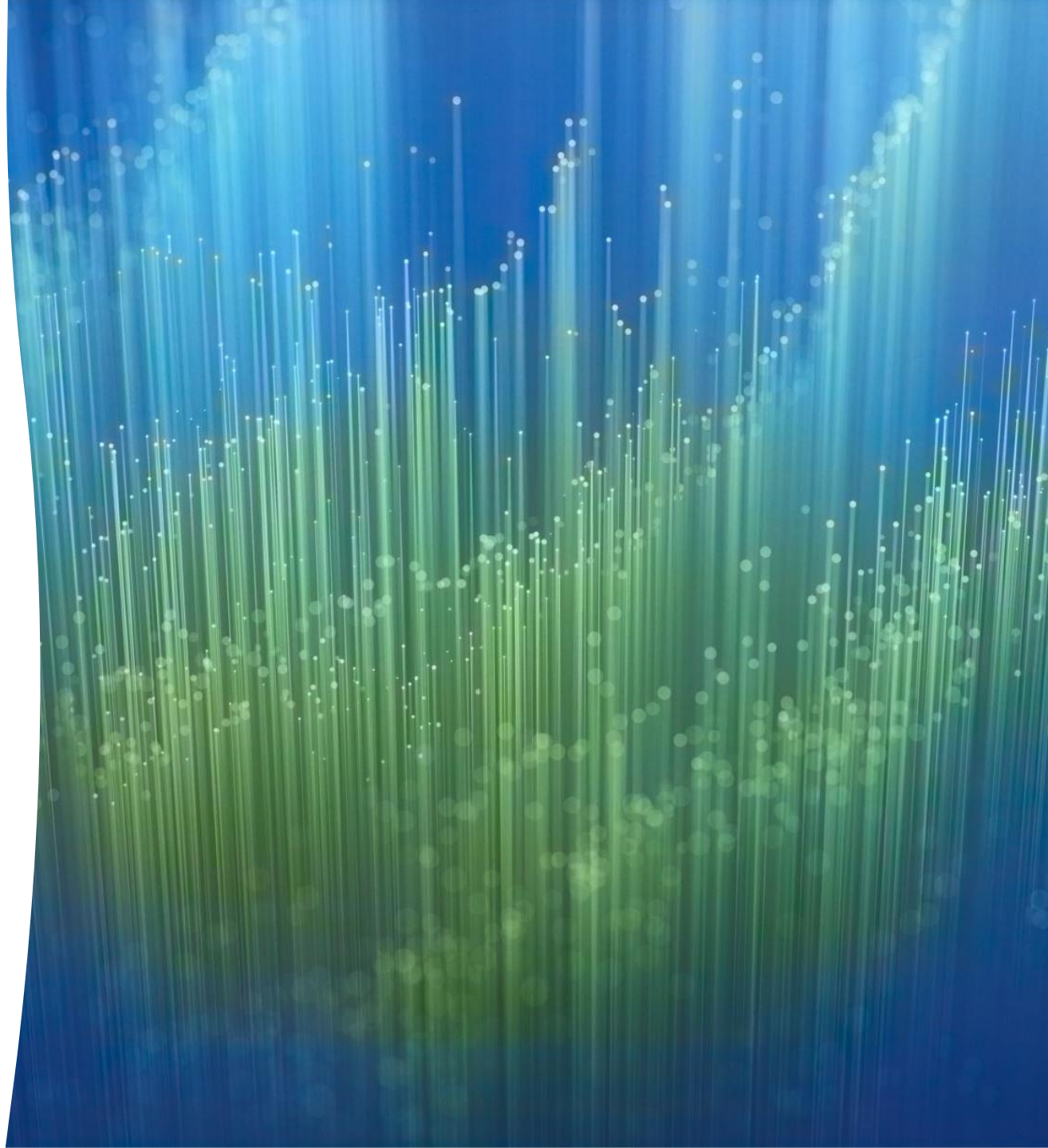
Jobs, postdoc, academic and industry

Resume, selling your work, be present

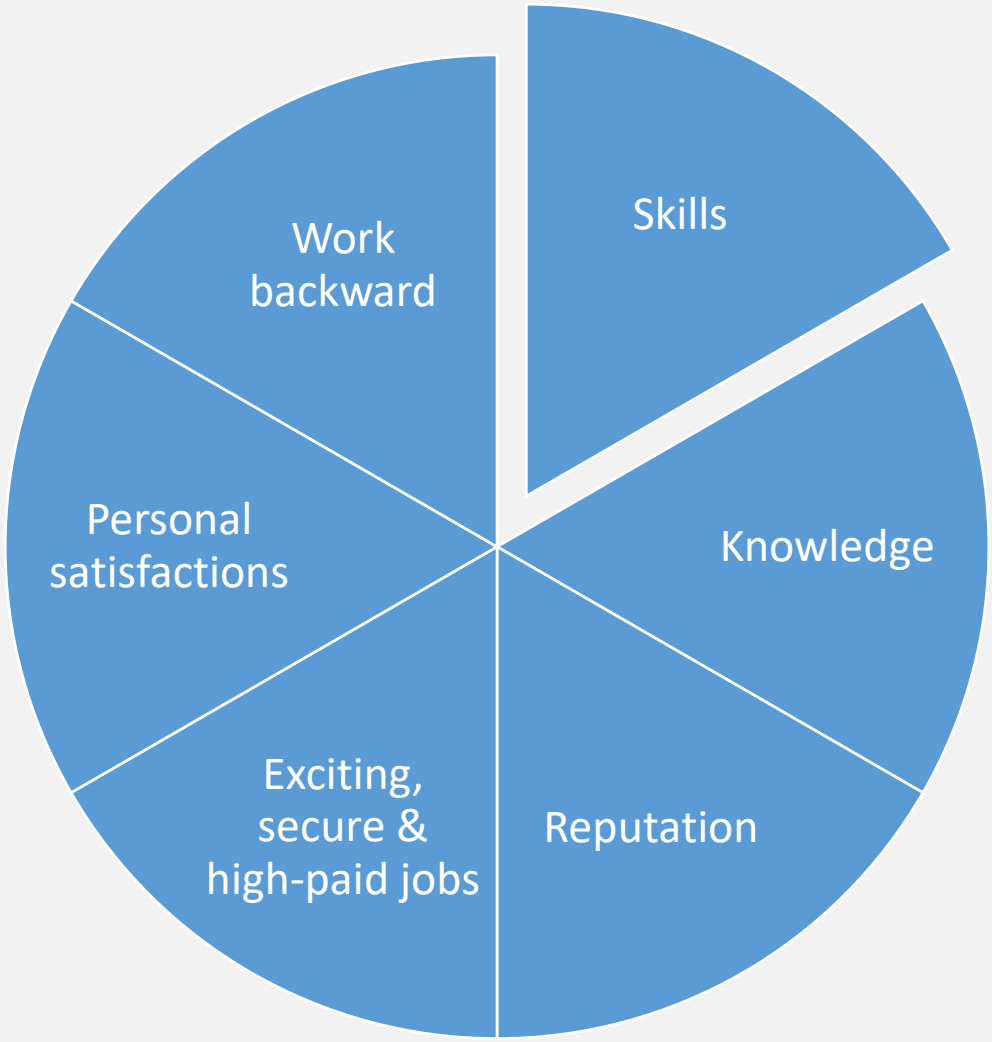
Collecting evidences

Start ups

You will be overwhelmed by the end of PhD. Better move fast NOW!



How to get there: Begin with an end



Research job - What they look for in an academic candidate

A career type of researchers

A long-term research program

Something beyond just papers

Acquiring the core AI/ML knowledge

AI: Learning, reasoning, acting, ethics

Machine learning:

- Statistical machine learning
- Deep learning
- Reinforcement learning
- Probabilistic methods, PGM

Modalities

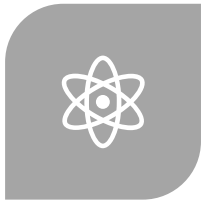
- Computer vision
- NLP
- Speech
- Time-series

Foundations

- Statistical foundations (All of statistics)
- Maths (linear algebra, optimization)

Know your research methods

WHAT IS RESEARCH



PHILOSOPHY OF SCIENCE

HOW TO APPROACH

HOW TO GENERATE IDEAS

READING, WRITING, TALKING, PUBLISHING

SCIENCE COMMUNICATION

Develop the skill set

Research

- Formulate ideas
- Ask right research questions
- Answer the questions (model building & programming)
- Write up papers (and thesis)
- Handle submission process

Conference presentation

- Command attention
- Generate follow ups
- Ask right/good questions

Develop the skill set (2)

Teaching

- Usually teaching assistant (called Casual Academic Job @ Deakin)
- But don’t do too much. It won’t get you a PhD.

Work-life balance

- Work like hell to meet deadlines.
- But don’t kill yourself!
- Learn to deal with rejections!
  - If your papers are not rejected, the venue quality is not good enough!

Be mindful of time allocation

Writing, writing and writing

It is a lifelong learning problem

Critical if English is not native to you

Writing contributes 50% of your publication acceptance.

Easy to read papers are cited more.

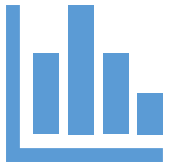
Writing aids your thinking.

It gives you freedom.

A2I2/Deakin may organise a writing series

Publication quality

CS conference ranking – conferences are more important than journal in CS!



Google Scholar Metric – fairly reliable indicator of quality

Journal impact factors – not reliable!

Improving citations

The citation game

Hot emerging areas are likely to generate citations

Rich gets richer

Citing like-mind authors

Easy papers, survey papers get cite more

Do not imply quality

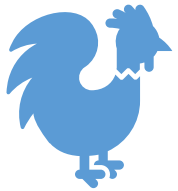
Make the impacts

Best if you find a universal law

Can be physical or computational	Change people's thinking	Anyone can use	Affect many people	Save a lot of money/time, improve quality

Andrew Ng's rule: only do something if it affects more than 100M people

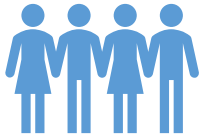
Be part of a community



Domain-specific

Language, style, expectation

Go to conferences



Follow top people

It is useful to have role models

Find high performers 2 years more senior than you

Learn from them

Avoid limiting growth factors

LIKE A TREE, NEEDS WATER, SUN LIGHT, SOIL, SPACE, FREE OF BUGS

SKILLS VERSUS POTENTIALS

SKILLS SHOULD BE MASTERED: WRITING, CODING, ASKING RIGHT QUESTIONS, TASTE OF RESEARCH PROBLEMS, PRESENTATION, RANDOM CHATS

Learn to avoid local minima

LIFECYCLE IN ML IS ABOUT 10 YEARS

YOUR OWN LOCAL MINIMA

TIME TO JUMP OUT OF THE BOX

RETURN ON INVESTMENT OF TIME AND EFFORT

Handle middle PhD crisis

By mid PhD, you have lost your momentum. Reality kicks in.

Look back, not much done

Look forward, only 1.5 years left

Competition is extremely high against top labs!

BUT ..

…

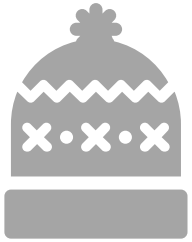
Don’t worry. By end of year 2, you will see how much you have achieved!

Ideas: How to get/generate them

Borrowing from other fields

E.g., statistical physics: entropy, free energy, energy, Boltzmann distribution

E.g., biology: neural networks



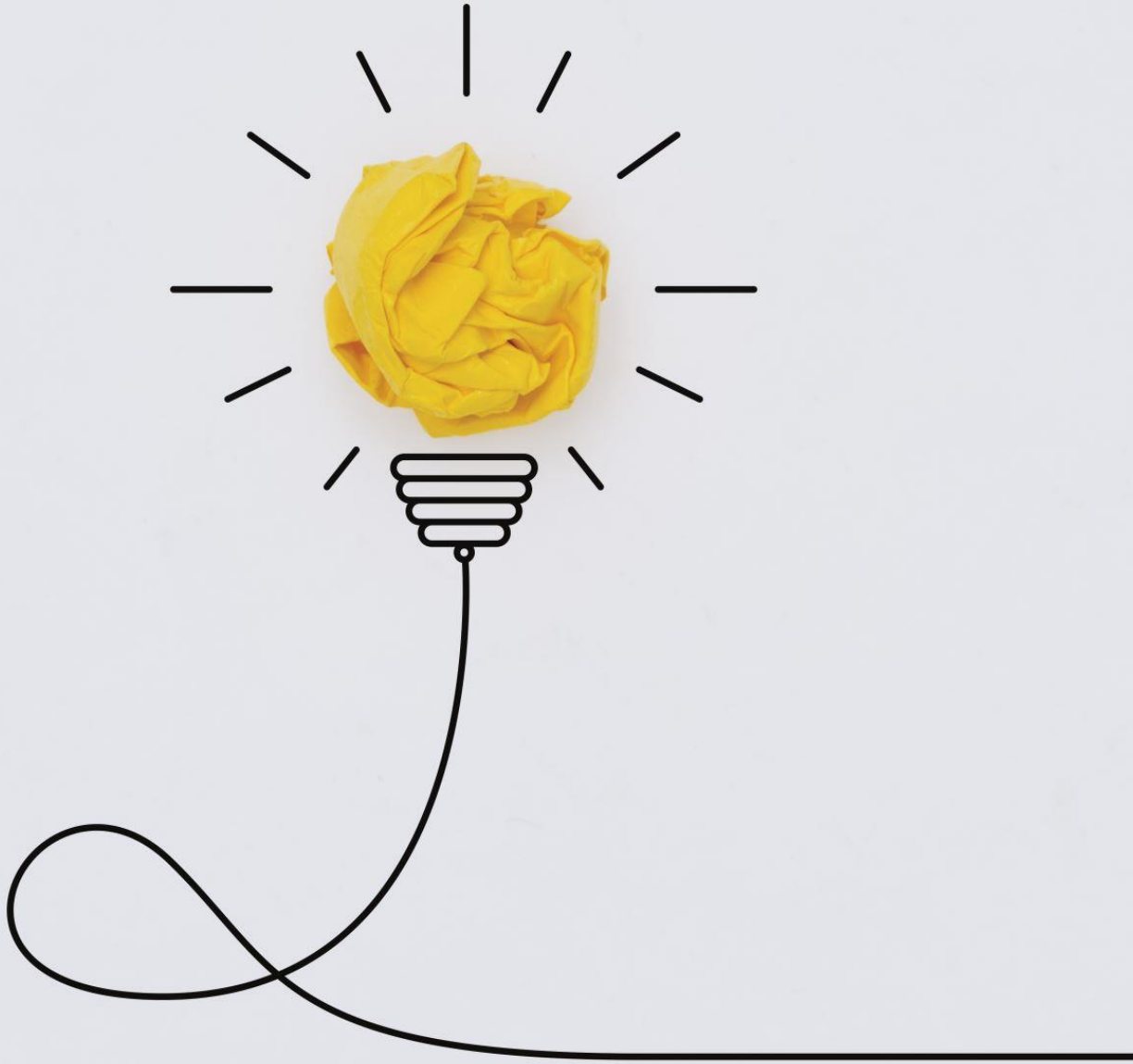
Put on different thinking hats (e.g., check the “Six thinking hats”)

If an idea is obvious, surely someone is doing it!

Parallel investigation

Ideas re-cycle

- After 15 years, new students come and unaware of previous work.



Leverage creativity and inventive thinking

TRIZ

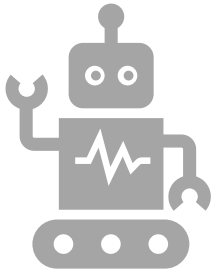
SIX THINKING HATS

+ LLMS

Know your types of researcher

Scientist – get into the fundamental of things, curious on how things work, without worrying about the application

Mostly single method/problem for a long time. Many possible applications can result.



Engineer – want to solve real world problems

Single application for a long time. Many possible methods that apply.

Develop your research styles

Applied

- A single real problem, many techniques

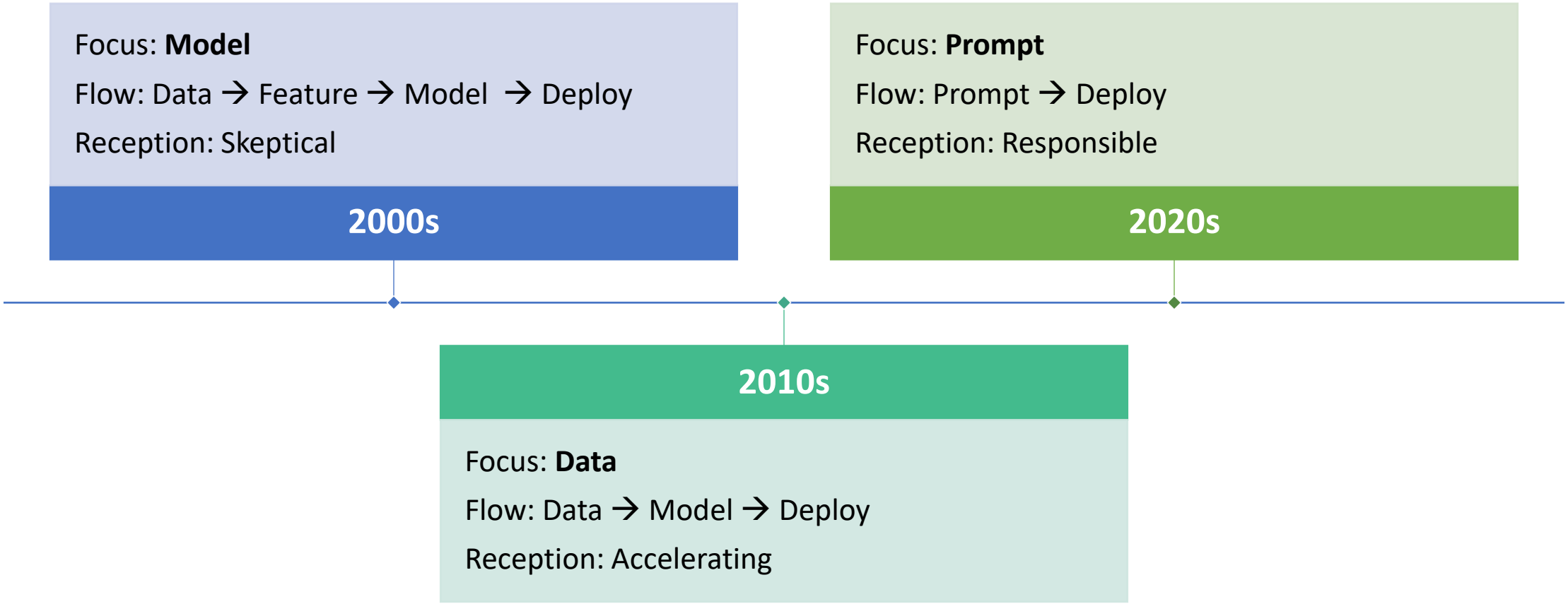
Theoretical

- A single model family, many applications

CS/ML research

- Algorithmic perspective
- Industry-linked
- More and more statistical
- But also more and more hypothetical, esp. in AI

Be mindful: The practice of AI is changing



Be mindful: The shifting AI research post 2020

Engineering

Design man-made systems

Generative AI

Discover emergent behaviours

Science

Discover laws in nature

Make the best use of resources

- Your supervisors
- Staff members
- Other students
- University/faculty/school resources
- The magical Internet
- LLMs
- Make sure you make the best out of our offering!

Leverage A2I2's strength

- AI Fundamental
  - Deep learning
  - Machine reasoning
  - Bayesian optimization
  - Reinforcement learning
  - Computer vision
  - Large Language Models

- AI Translation
  - Software
  - AI4Health
  - AI4Science
  - Defence
  - Manufacturing

More resources

- https://truyentran.github.io/phd.html
- http://karpathy.github.io/2016/09/07/phd/
- Empirical AI Research, Truyen Tran, 2019.
- https://medium.com/@tranthetruyen

Safe sailing!