ILP 2020 – W6S3
Final exam practice and end

Matthieu DE MARI – Singapore University of Technology and Design

Useful links

- ISTD catalogue
- https://istd.sutd.edu.sg/education/undergraduate/course-catalogue/

- DAI catalogue
- https://dai.sutd.edu.sg/education/undergraduate/courses/

Advanced Python

More advanced concepts in Python

- Object-oriented programming
- Visualization with Matplotlib (as displaying board in tic tac toe, but also visualizing functional graphs, etc.)
- User interfaces (graphical buttons and other things to ease the user interaction with your programs)
- Advanced algorithmics (how to decide and measure the quality of a function design)
- Etc.

Advanced Computer science

- Computational structures: understand the basic structure of computer and the behaviour of its components (CPU, memory, etc.)
- Software engineering: how to organize large scale projects and manage teams working in computer science projects.
- Networks and security: how is information exchanged over networks such as the internet, and how to protect systems from unwanted attacks.

Web design and software design

- Langagues for web programming and designing websites
- (HTML, CSS, PHP, Javascript, etc.)

- Databases management for storing and exploiting users data

- Etc.

Advanced Computer science

- Video games principles and design, 3D rendering: how are games built nowadays, and how to create graphical games, with rendering.
- Blockchain: understanding the technology behind cryptocurrencies and its opportunities.
- And many more!

A quick introduction to data science

- Data science has been recently trending, with many keyswords…
- But what is the core idea behind this data science concept?

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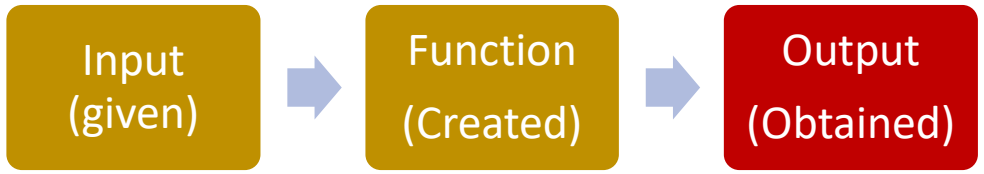
- But what is the core idea behind this data science concept?

- **Core ideas**
  - **make sense from data**
  - **and learn information from it.**

Core idea behind data science: find the missing function, based on available data

- What we have done in Programming so far was to design functions,
  - which would do **specific operations**
  - and return **outputs**
  - for any **input** we could give it



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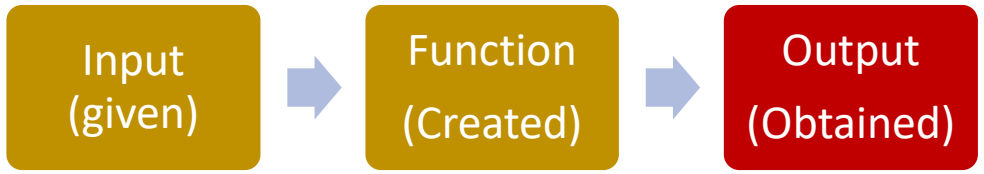
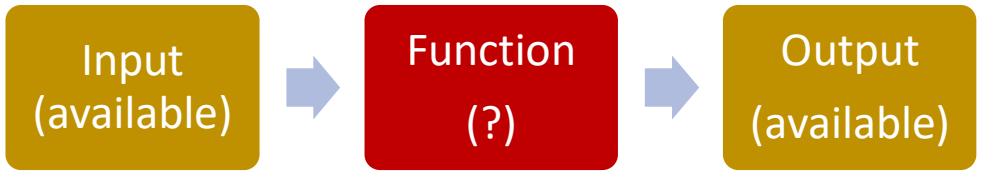
- But sometimes, we can encounter problems where
  - we can easily find **inputs** and **expected** outputs,
  - but the **function** to be coded is **not simple** to figure out.





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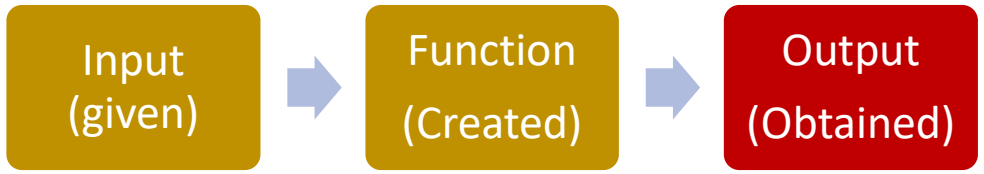
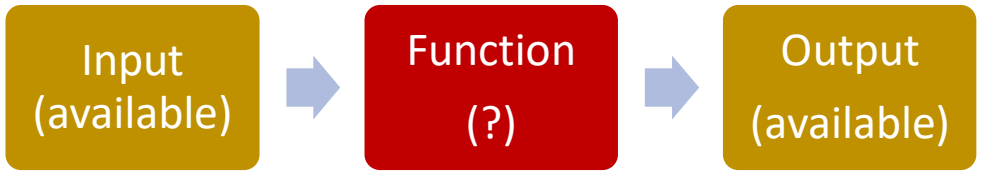


- But sometimes, we can encounter problems where
  - we can easily find **inputs** and **expected** outputs,
  - but the **function** to be coded is **not simple** to figure out.
- **Idea: What if the computer could learn the function on its own?**



A typical example

- For instance, if I were to give you this table of values…

Inputs x	Outputs y
1	1
2	4
3	9
4	16
5	25
7	49
8	64
9	81
10	100

A typical example

- For instance, if I were to give you this table of values…
- And then ask you to guess the expected output for the value **6**…

Inputs x	Outputs y
1	1
2	4
3	9
4	16
5	25
6	?
7	49
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A typical example

- For instance, if I were to give you this table of values…
- And then ask you to guess the expected output for the value **6**…
- You would probably guess, it is **36**.

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A typical example

- For instance, if I were to give you this table of values…
- And then ask you to guess the expected output for the value **6**…
- You would probably guess, it is **36**.
- Because you guessed, that the missing function $y = f(x)$, was $f(x) = x^2$.
- And $f(6) = 36$.

Inputs x	Outputs y
1	1
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Record/Experience, features/inputs and labels/outputs

- What just happened?

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Record/Experience, features/inputs and labels/outputs

- What just happened?
- You used your previous **experience/record**

Experience/Record

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Record/Experience, features/inputs and labels/outputs

- What just happened?
- You used your previous **experience/record**
- To "guess" what might be the **relationship/function f**
  - Between your **inputs/features x**
  - And their respective **outputs/labels y**

Experience/Record

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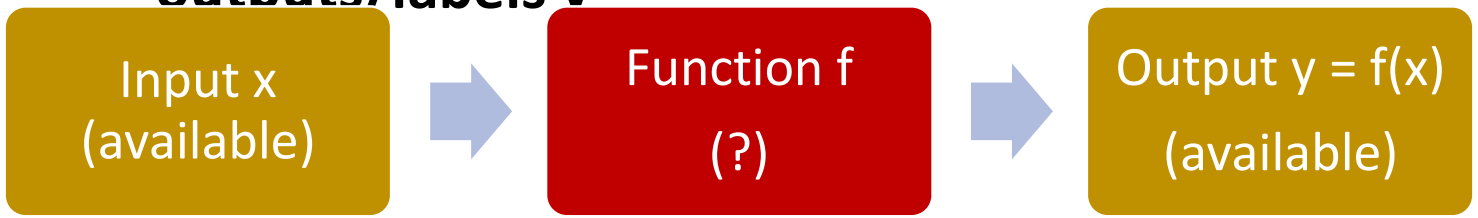


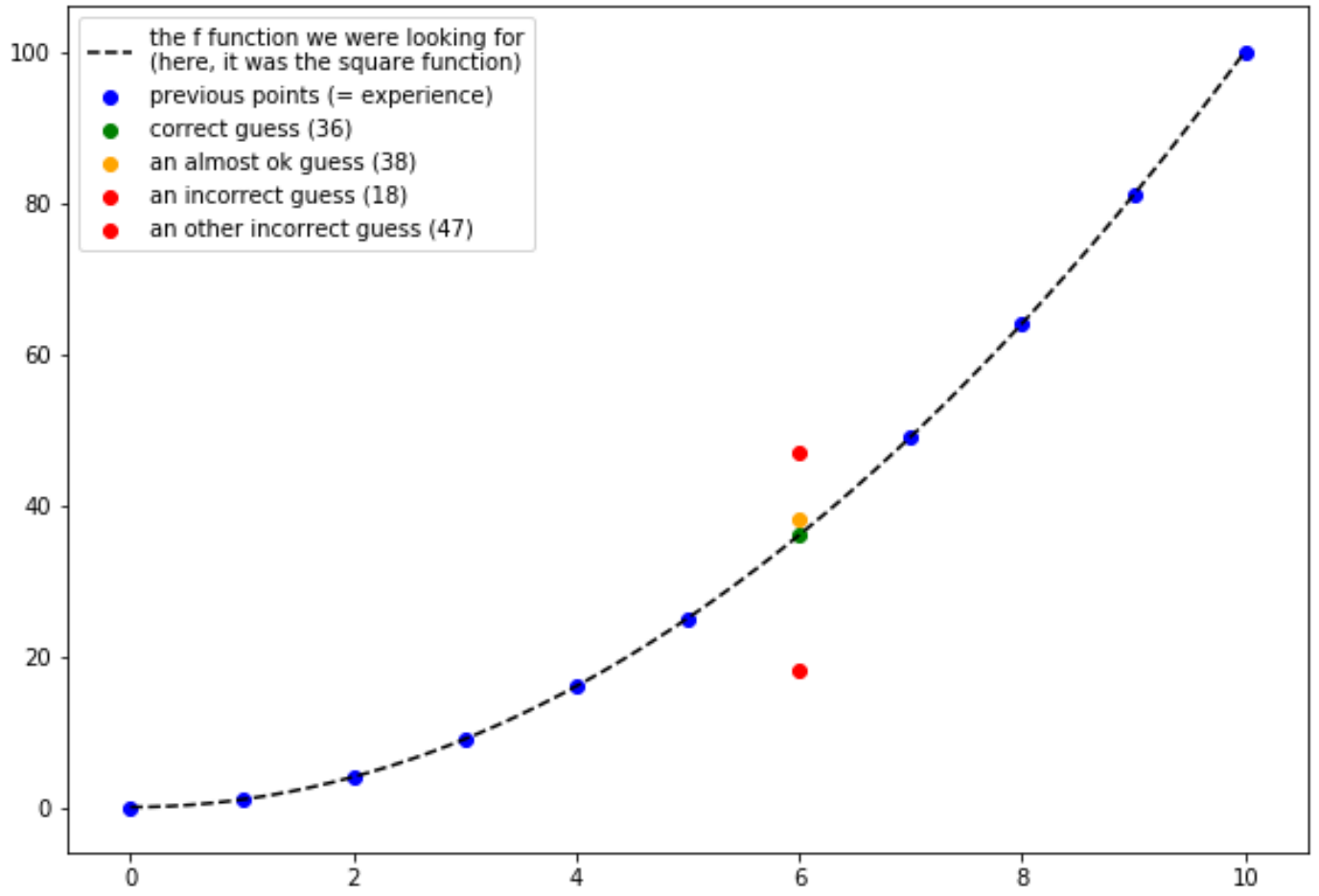
About regression

- That is a very common problem in data science, called **regression**.

About regression

```
1 x = [0, 1, 2, 3, 4, 5, 7, 8, 9, 10]
2 y = [0, 1, 4, 9, 16, 25, 49, 64, 81, 100]
```

- That is a very common problem in data science, called **regression**.
- Mathematically speaking, it consists of **finding the curve** that covers the points **(x,y)** you have in your **record/experience**.
- So that you could later **predict** the **outputs** of **unseen input values**.



Typical problems in regression

- Typically, our squares example

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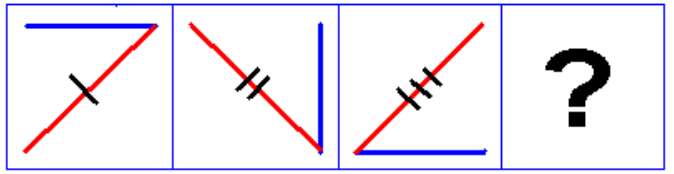
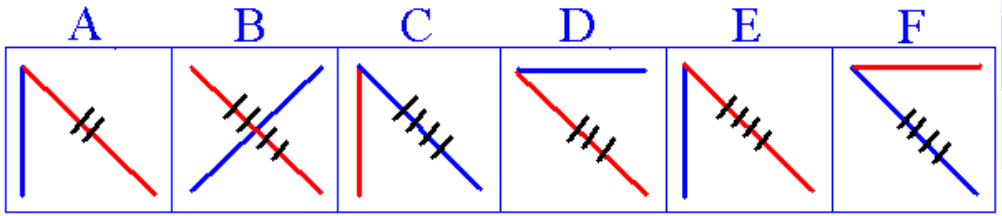
- Typically, our squares example
- The IQ tests: « guess the element that comes next in the sequence »





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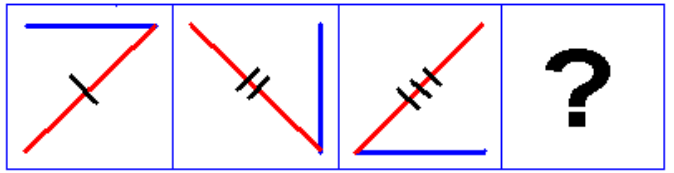
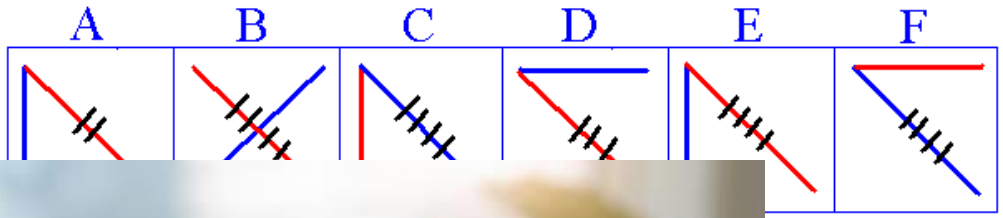
- Exemple with appartment selling
  - Guessing the selling price of an appartment based on its size and your previous sales.





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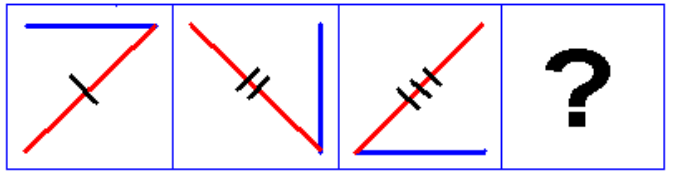
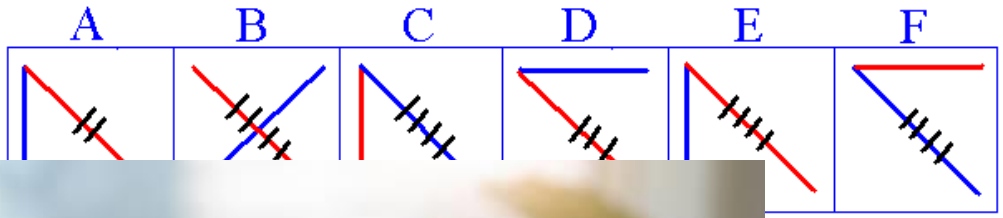
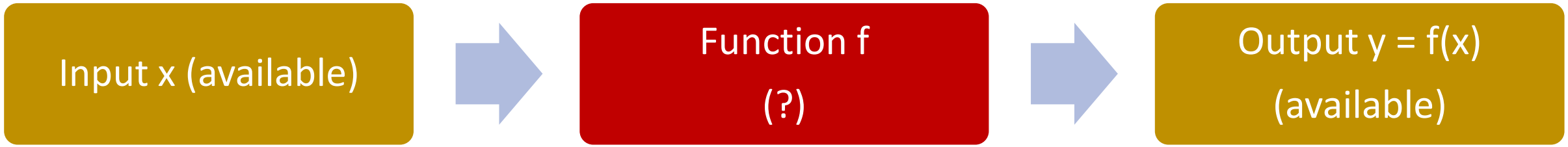




Regression and classification

- Regression problems are very common in real-life.
- Other very common problems are classification ones.



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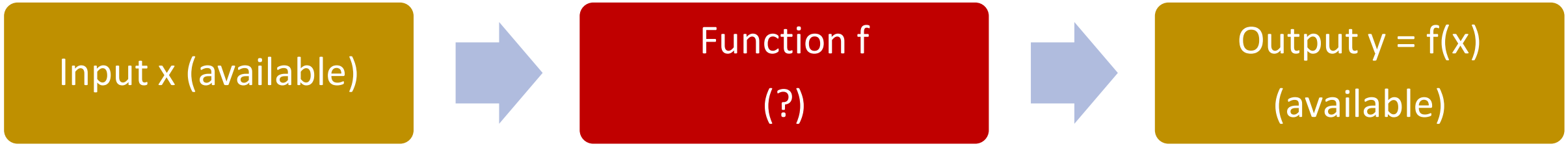

Very easy for a human…

It’s a cat!

Regression and classification

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- Other very common problems are classification ones.
- Typically used in computer vision.

Input x (available) → Function f (?) → Output y = f(x) (available)

Very easy for a human…
How would we do it with a computer?

It’s a cat!

Classification are very common in computer vision

- Computer vision problems:
  - Image recognition: given a picture, tell me what it is (cats/dogs, name of the person)

It’s a cat!

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  - Image recognition: given a picture, tell me what it is (cats/dogs, name of the person)
  - Image classification: given a CT scan, tell me if there is a cancer/not cancer

That's cancerous

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- Computer vision problems:
  - Image recognition: given a picture, tell me what it is (cats/dogs, name of the person)
  - Image classification: given a CT scan, tell me if there is a cancer/no cancer
  - Image recognition + segmentation:
    - find if there is a pedestrian in the picture
    - and if so, where he/she is,
    - And what its movement is.

Recap for data science

- Machine learning foundations (mathematical and computational)
- Advanced machine learning and AI
- Convolutional neural networks for image processing.
- Recurrent neural networks and Natural Language Processing
- Generative Adversarial Networks (technology behind deepfakes).
- Image processing and computer vision
- Robotics
- Reinforcement learning (technology behind Alpha Go Zero)