

# Foundations of *Artificial* Intelligence (FAI)

DAI03DSAI

FAI or  $\Phi$

Jul - Nov 2025

Mehta Family School of DSAI, IIT Guwahati

Instructor(s): Neeraj Sharma, IIT Guwahati



# Lecture | 05





# The Timeless Workflow: From Invention to Machine Learning



# Inventing/Discovering

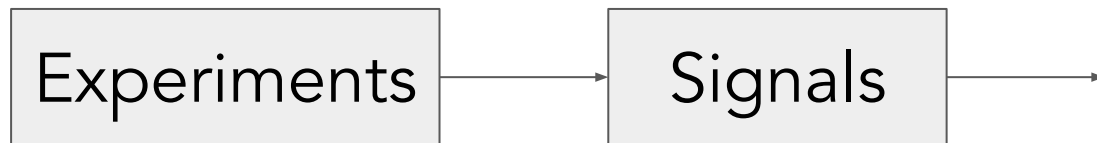
Humans have always sought to understand and create

— from the wheel to the steam engine to electricity.

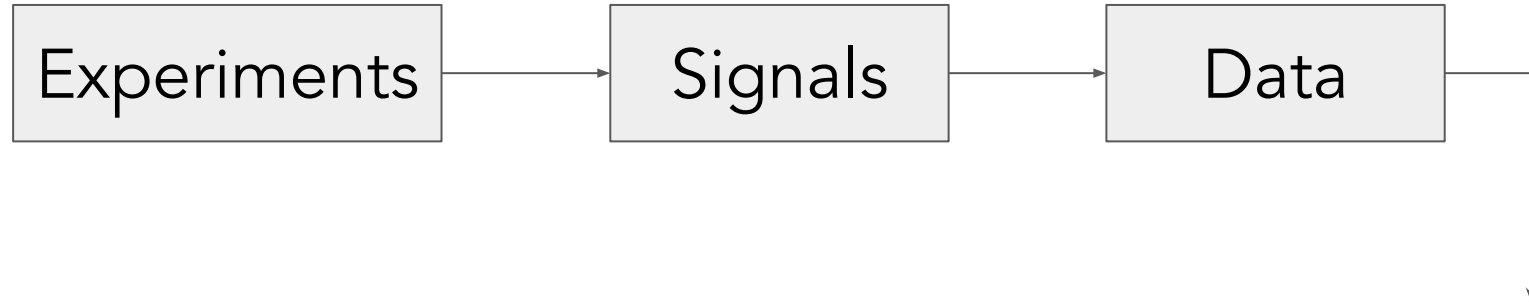
# Inventing/Discovering

Experiments

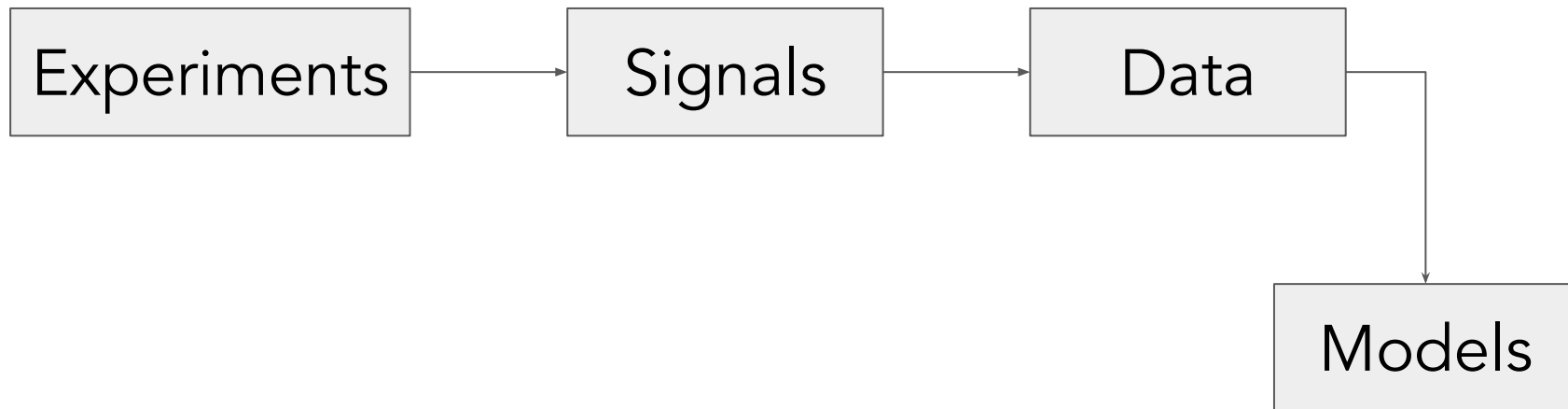
# Inventing/Discovery



# Inventing/Discovery

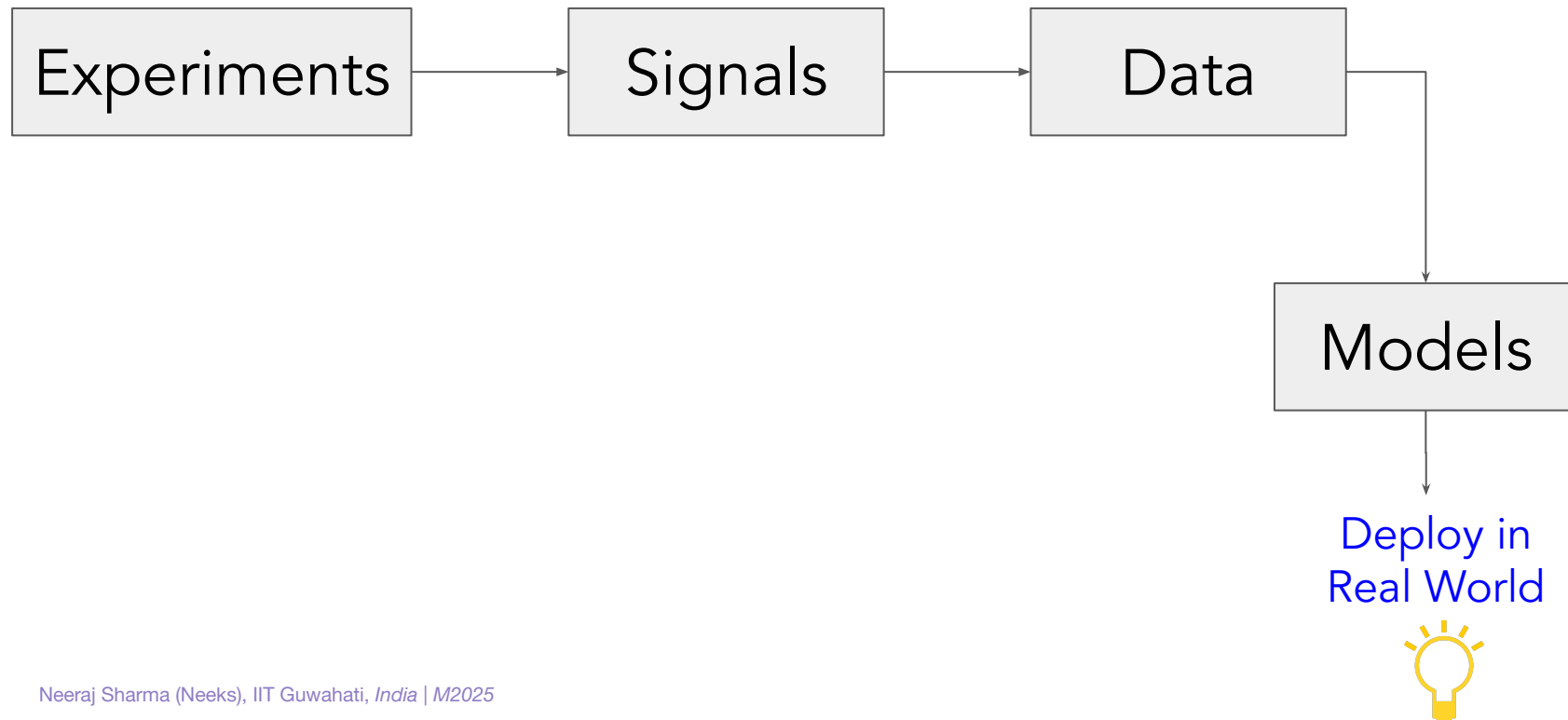


# Inventing/Discovery

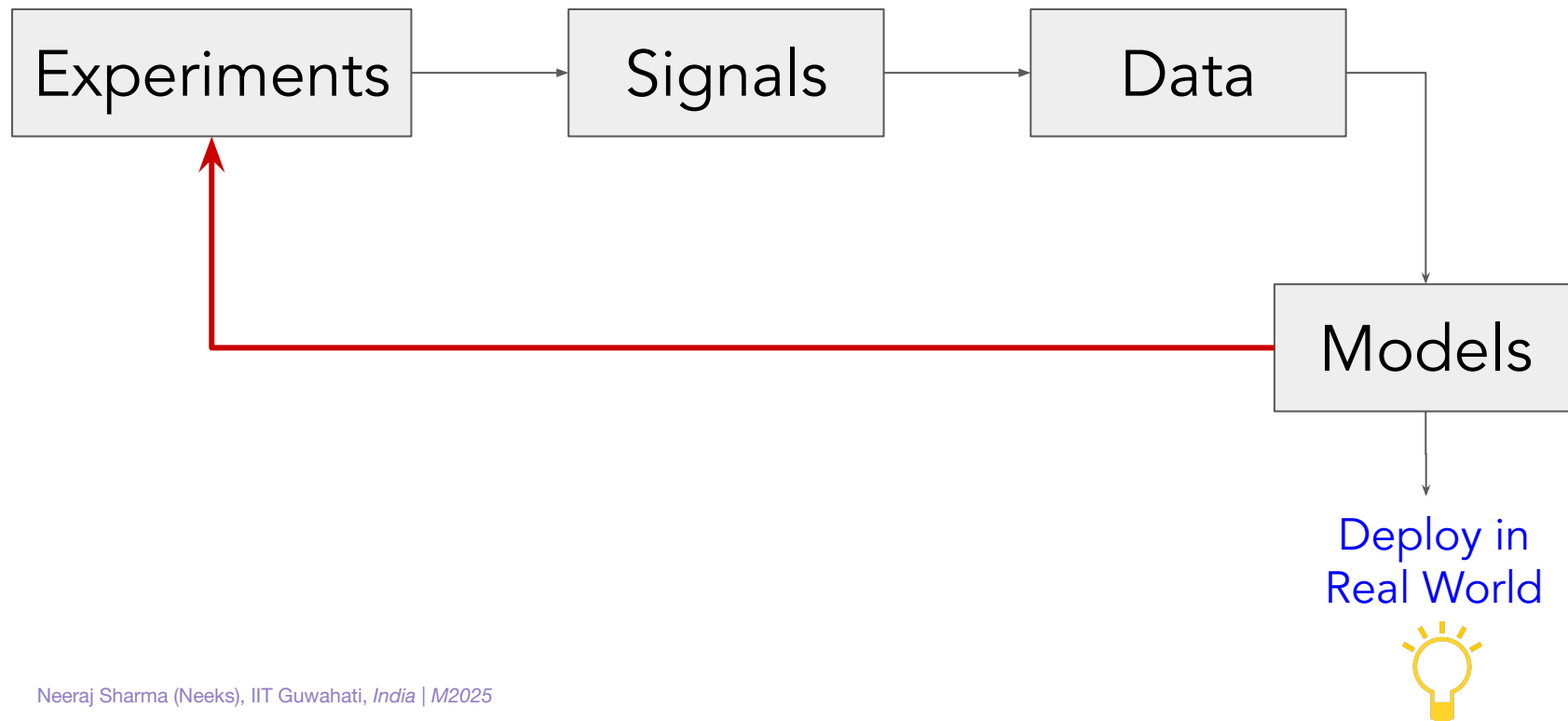




# Inventing/Discovery



# Inventing/Discovery



# Experiment

Can you provide an estimate of this guy's

- Height
- Weight
- Age



# Experiment

Can you provide an estimate of this guy's height, weight, and age?



# Data

**Cool! Let's download the data we collected.**  
Below is a screenshot of the CSV file that got generated.

Height (in cms)	Weight (in kgs)	Age (in years)
165	75	28
165	90	25
170	62	18
177	63	24
180	65	21
190	70	22
175	75	22
172	55	25
150	55	25
160	60	21
172	67	24
165	55	25
156	55	23
160	53	27
170	65	20
158	55	19
174	62	22
150	45	23
180	65	21
173	54	23
170	70	22
153	52	22

**Great!**

Thankfully, here, everyone has followed the instructions and entered the data in the desired format.

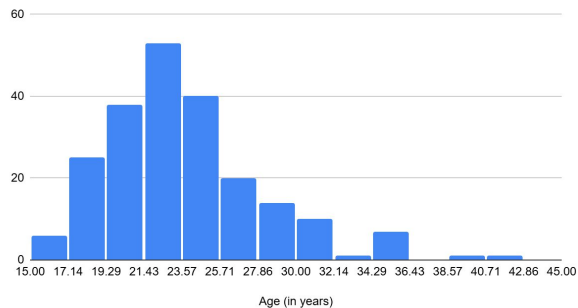
In a more practical world, people might not follow our instructions, resulting in noisy data.

# Data

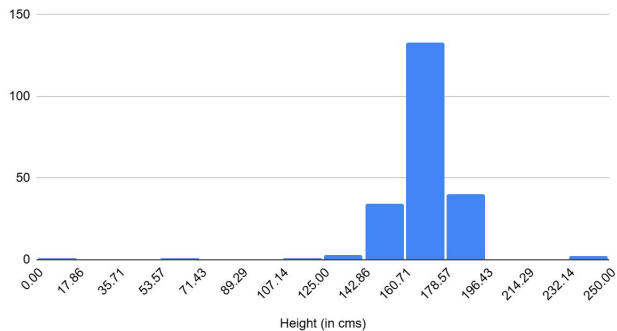
Let's visualize the data we collected.

(Pooling from several instances of this experiment, we have 216 data points)

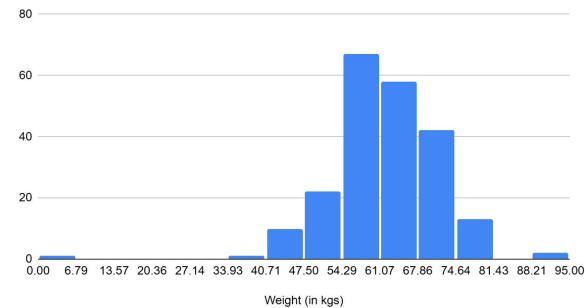
Histogram of Age (in years)



Histogram of Height (in cms)



Histogram of Weight (in kgs)

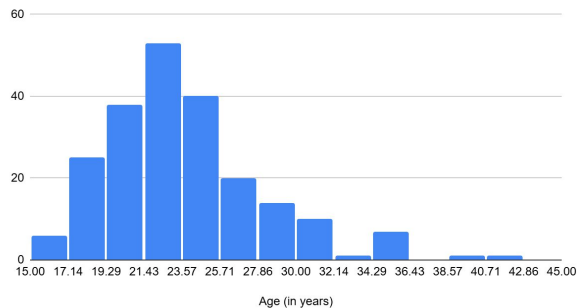


# Data

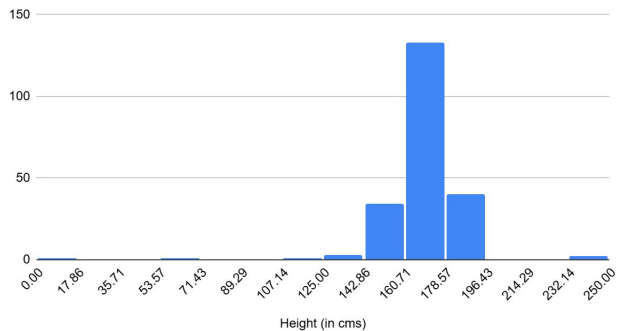
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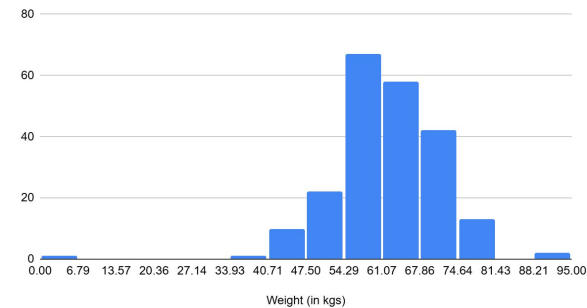
Histogram of Age (in years)



Histogram of Height (in cms)



Histogram of Weight (in kgs)



Murali Sreeshankar  
Indian Athlete (Long Jump),  
Ground Truth for height (as in Wikipedia) = 180 cms

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On average, human prediction was not bad - it was close to 175 cms!

# Data

Let's visualize the data we collected.

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Next - Can we visualize how data in any two columns vary jointly?



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Height (in cms)	Weight (in kgs)	Age (in years)
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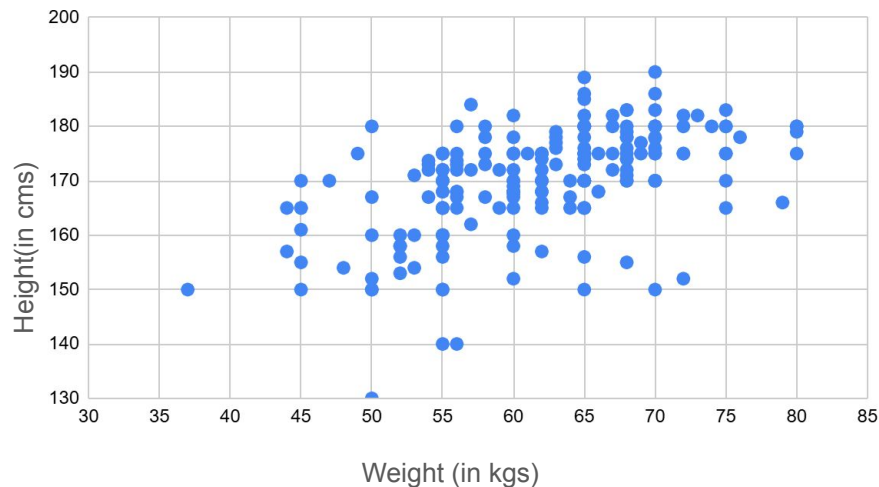
Next - Can we visualize how data in any two columns vary jointly?

# Modelling

Can model the relationship between “weight” and “height”?

- Scatter plot

Weight (in kgs) vs. Height (in cms)

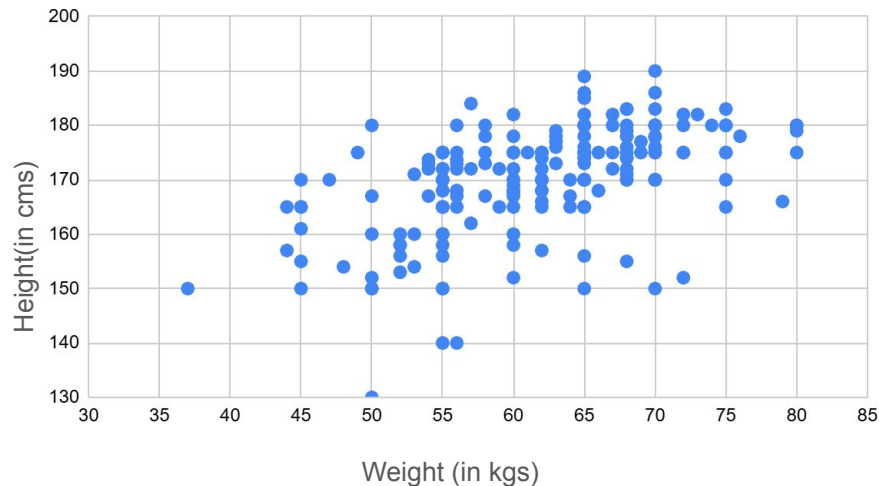


# Modelling

Can model the relationship between “weight” and “height”?

- What can be the model?

Weight (in kgs) vs. Height (in cms)



# Modelling

Can model the relationship between “weight” and “height”?

height =  $f(\text{weight})$  is this possible?

What will be that  $f(\cdot)$  then?

One choice is , let  $f(\cdot)$  be a linear model:

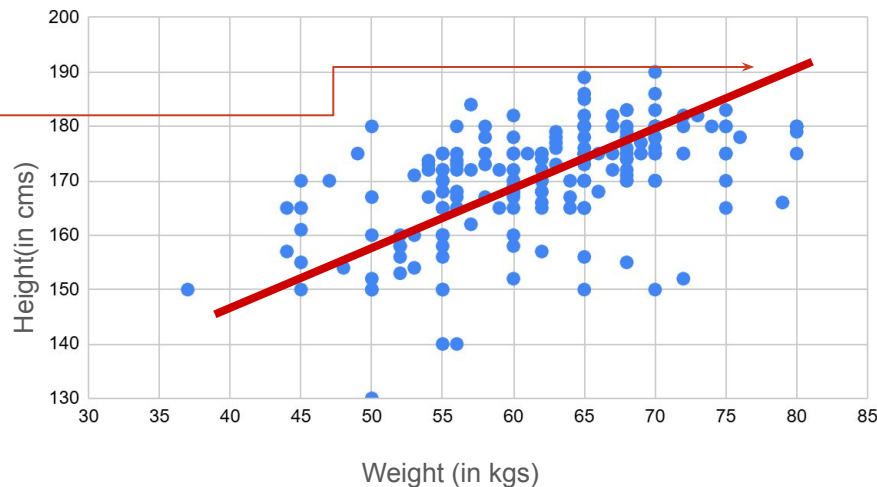
$$f(x) = m x + c$$

where,

$x := \text{weight}$

$f(\cdot) := \text{model}$

Weight (in kgs) vs. Height (in cms)



# Modelling

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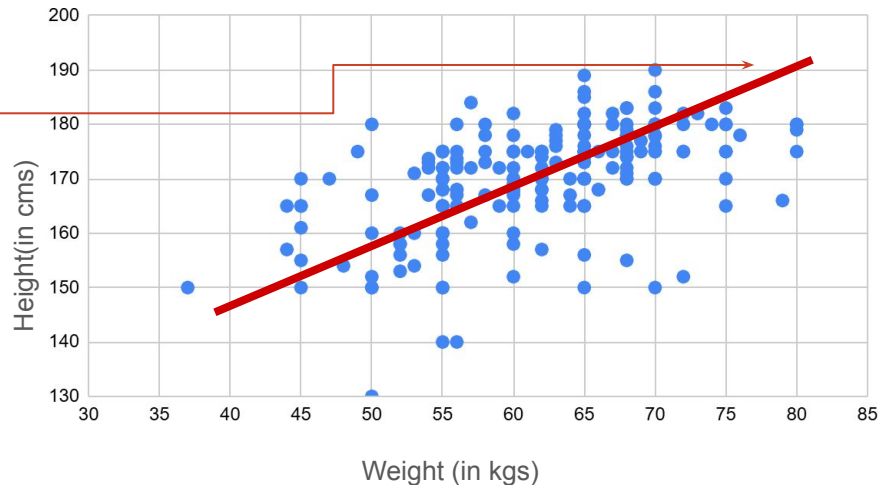
$f(\cdot) := \text{model}$

**How do we find  $m$  and  $c$ ?**

**These are the parameters of our linear model**

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Weight (in kgs) vs. Height (in cms)



# Modelling

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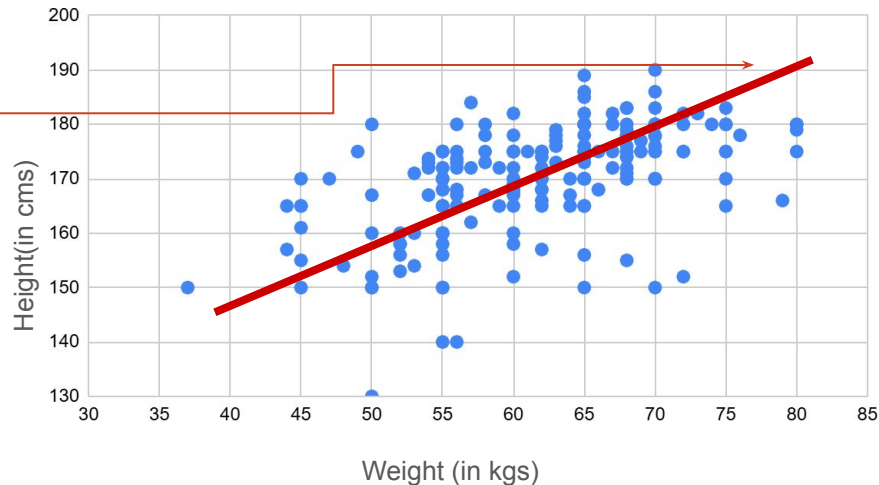
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Weight (in kgs) vs. Height (in cms)



# Modelling

Can model the relationship between “weight” and “height”?

$$f(x) = m x + c$$

**Finding  $m$  and  $c$  is also called the learning problem.**

Data points

x	y
$x_1$	$y_1$
$x_2$	$y_2$
$x_3$	$y_3$
.	.
.	.
.	.
$x_N$	$y_N$

Step 1: Start with random choice of  $m$  and  $c$

Step 2: Define error

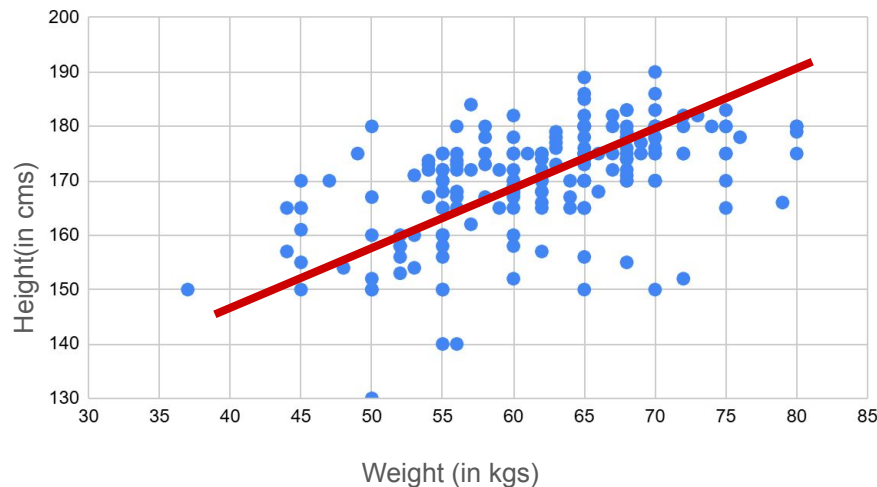
$$e_i = f(x_i) - y_i = ax_i - y_i$$

Step 3: Collect this error for all data points

Step 4: Update  $m$  and  $c$  such that the collected error is minimized

Neeraj Sharma (Neeks), IIT Guwahati, India | M2025

Weight (in kgs) vs. Height (in cms)



# Modelling

Can model the relationship between “weight” and “height”?

$$f(x) = m x + c$$

**Finding  $m$  and  $c$  is also called the learning problem.**

Step 1: Start with random choice of  $m$  and  $c$

Step 2: Define error

**Design a learning algorithm to estimate  $m$  and  $c$**

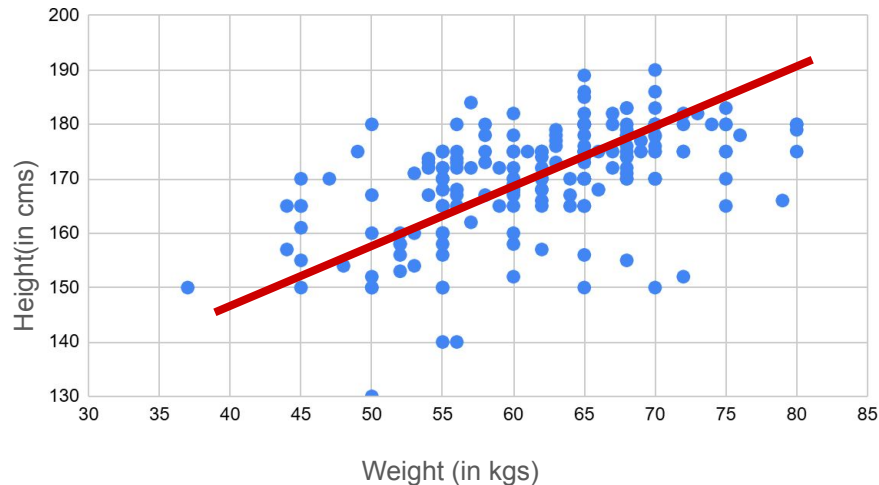
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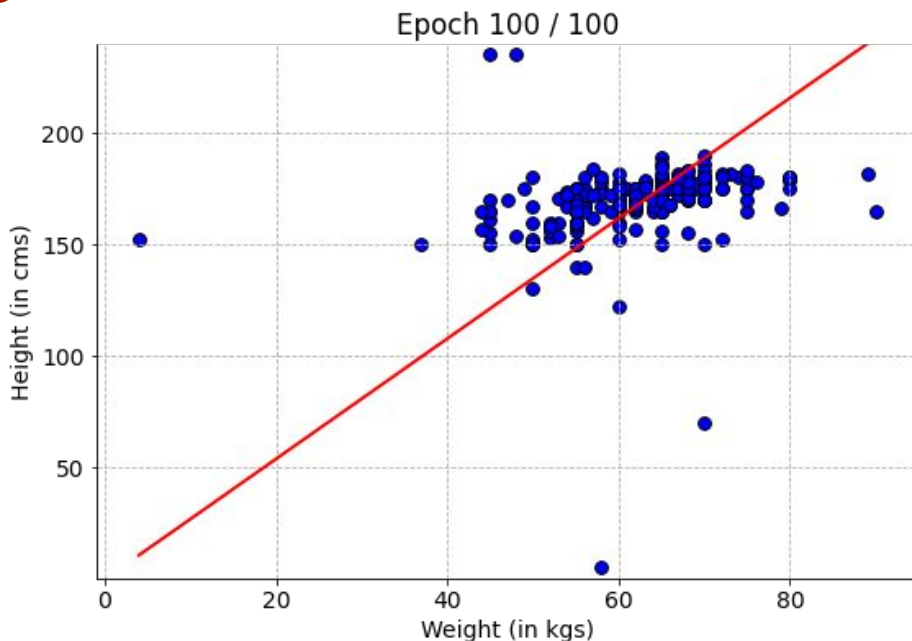
Weight (in kgs) vs. Height (in cms)



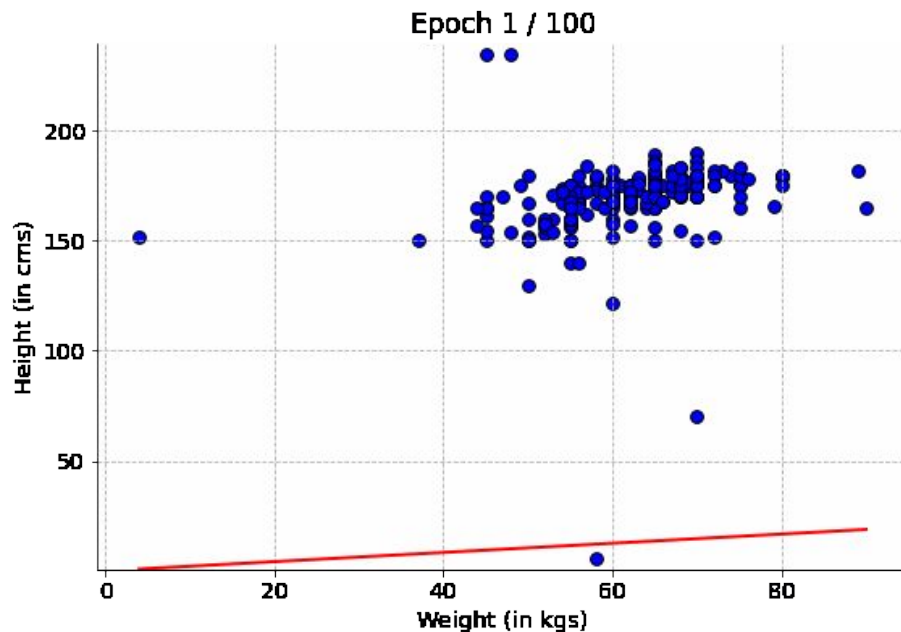


Model thus obtained using  
**Gradient Descent learning algorithm**

$$\text{height} = f(\text{weight}) = 2.7 \text{ weight} + .05$$



# Gradient Descent learning in action ... below is a gif animation (may not show in pdf)



# Experiment Summary

## What We Learned from the Experiment

**Data is Everywhere** – Even our quick guesses became a usable dataset.

**Messiness is the Norm** – Real-world data has noise, biases, and outliers.

**Patterns Emerge** – Despite noise, trends like the height–weight relationship can be captured.

**Modeling is About Parameters** – In our case, learning meant finding the slope and intercept that best fit the data.

**Humans vs. Machines** – Humans provided subjective estimates; machines formalize these into consistent predictions.

# Is This Intelligence? Is this AI?

## Food for thought

- **For Humans**

- Estimating height, weight, and age from a face — is this a learned skill?
- Does it involve perception, prior knowledge, and reasoning?
- Does accuracy matter in calling it “intelligent”?

- **For Machines**

- If a model took in the same image and gave estimates — would that be AI?
- Would it be *less* AI or *more* AI



# Predicting height from face, relevant?

**Recovering a person's height from a single image is important for:**

- **virtual garment fitting**  
Example, think about Amazon/Myntra shopping experience
- **autonomous driving**  
Example, predicting height of pedestrians from occluded images will be extremely useful
- **surveillance**  
Example, in forensics

**An active R&D topic:**

## **What Face and Body Shapes Can Tell Us About Height**

Semih Günel<sup>1</sup>, Helge Rhodin<sup>1,2</sup>, Pascal Fua<sup>1</sup>

<sup>1</sup>Computer Vision Lab, EPFL, Lausanne, Switzerland

<sup>2</sup>UBC, Vancouver, Canada

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Thank you