WEEK 1:

1. **Intro to AI:**
   Objectives:
   1. Clearance of basic terminologies e.g. data science.
   2. We can realize the what Ai can do and what it cannot do.
   3. How to spot the opportunities to apply AI in a company.
   4. What it feels like to do machine learning project (what is needed).
   5. How to hire AI team for work.
   6. We will get to know that what I can do in AI.
2. **Impact of AI in industry:**

   According to a research from Mckinsey Global institute: Till 2030 the value of Ai industry will be $13 Trillion. And it will not be only form software developing companies but other fields will also take part in it. Example oil factories, agricultural organization etc.

3. **ANI vs AGI:**

   These two are the types of artificial intelligence:

   1. **Artificial Narrow intelligence** is the first type. Almost all the work done in AI is done in this aspect. Actually, ANI is technique in which model/robot developed can perform only and only one task. It focuses on single task. Examples:
      - **Smart Speaker:**
        Used in offices or homes we can talk to it and get the result.
      - **Self-driving car:**
        Here question is that self-driving car can do multiple things at time for example
        It can move, detect people, checks location etc. so how it can be an ANI.
        So, answer is that: There is a different model for every function it is performing and every model is doing a specific work.
      - **AI to do web search:**
        Search system that we used there are different companies doing work in the background.
      - **AI Apps in farming or in a factory.**

   2. **Artificial General Intelligent** is second type. Almost there is no progress in this aspect of the AI. Actually, in AGI model/robot developed can perform multiple task at a time.
      EXAMPLE can be a human that we got general intelligence that we can see, touch, smell, talk at same time. Researchers are trying to explore this field.
      This goal to build AI.
      They can do anything a human can do and even more things than human.

For achievements in AGI will take time. It can decades or hundreds of years.

People are fearing from AGI that the robots develop in AGI will dominate the

Humans but as technical person you must know that there is nothing like that.

4. **Machine learning:**

It is defined as:

"Field of study that gives computer the ability to learn without being explicitly programmed."

Machine learning project often result in software that convert A to B or input to output.

There are multiple types machine learning we will start with:

1. **Supervised learning:**

   In this type training data and as well as Data labels are given to machine these labels are for supervision so that machine can understand that data given to it Is for what.

   Model learn to convert input to output or A to B mapping.

   When different inputs will be given to machine it will understand that input is from which category and it will give it output in that category.

   Example:

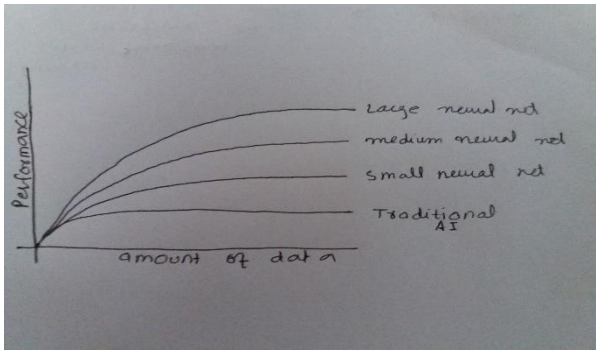
   - If audio clip is given to machine there will be label with it that it is audio and the job is to output the text transcript (also labeled that it is converted in text form), then this is speech recognition.
   - If you want to input English and have it output a different language, Chinese, Spanish, something else, then this is machine translation.
   - All the large online ad platform has a piece of AI that inputs some information about an ad, and some information about you, and tries to predict, will you click on this ad or not? Here Ad + User info is labeled as input output will be click and it is machine translation.
   - If you want to build a self-driving car input will be taken by machine will be image and location of other cars (machine will do learning on that and it will understand that it is input) and output will be position of other cars, so your self-driving car can avoid other cars.
   - In manufacturing, some pictures of new phones and some pics of broken phones are given as input and machine is trained to check that the phone is broken or not (so output will be this). This is VISUAL INSPECTION.

2. **Unsupervised learning:**

   Training data is given to the machine but labels are not given.

5. **Why Now:**

In traditional AI when we build software or model, we provide certain amount of data to the model so performance of that model become fixed or locked means every time model's performance will be same. But in modern AI we have neural network which depends upon amount of data, more the amount of data performance of the model will be greater and if the data is less its performance will be less. When amount of data increases size of neural network also increases so we can conclude that higher the amount of data higher will be performance in neural networks.



6. **What is data:**

Data is thing on which machine learning is based. A developed model work accordingly to data provide to it. In tabular data there are rows and columns. In machine learning these columns are known as the features of the data. **Example 1:**

Size of House (square feet)	Price ($1000)
523	115
645	150
708	210
1034	280
2290	355
2545	440
A (Input)	B (output)

In this example we have total 2 features.

Example 2:

Size of House (square feet)	Number of bedrooms	Price ($1000)
523	1	115
645	1	150
708	2	210
1034	3	280
2290	4	355
2545	4	440
A (Input)		B (output)

In this example we have 3 features in total but 2 features are combined to make the input and one feature is output.

Data is changed business to business. It depends upon what we ant to that. The same example can be like that we give price as input and size of house as output so it can be changed.

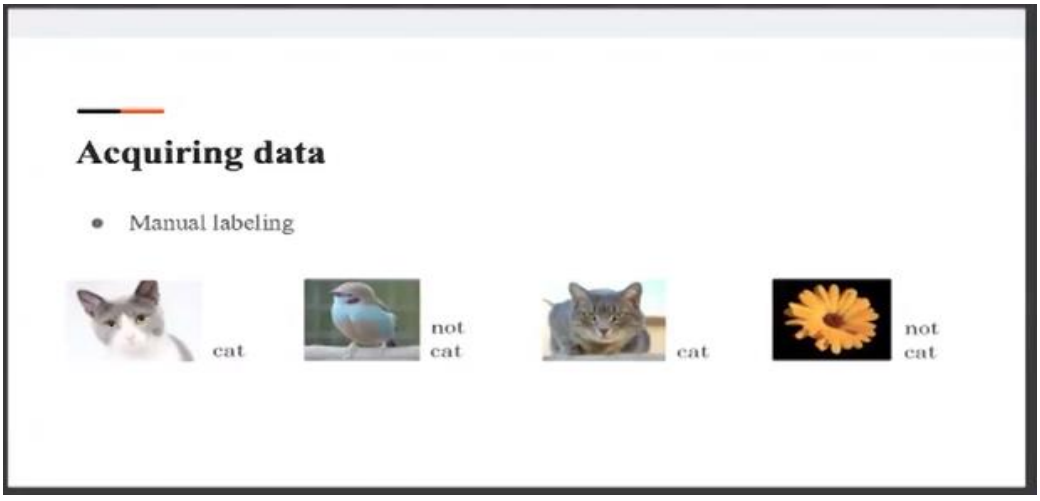
Example: If we go to agent and we tell our budget (input) and he tells us the size of the house and the number of bedrooms.

Size of House (square feet)	Number of bedrooms	Price ($1000)
523	1	115
645	1	150
708	2	210
1034	3	280
2290	4	355
2545	4	440
B (output)		A (input)

7. **Acquiring Data:**

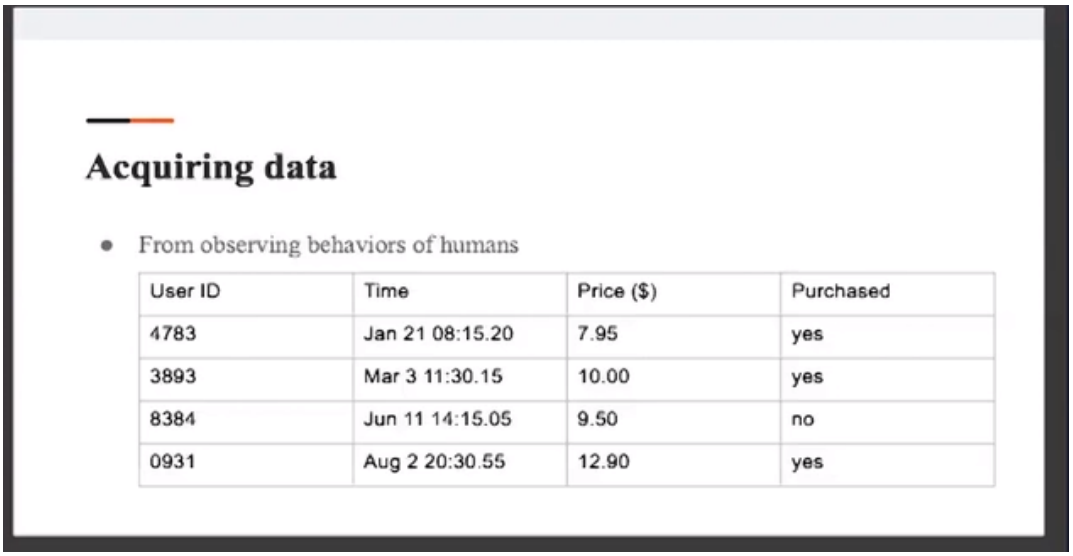
Data Acquiring means that collecting data for the development of the model we want. There are many ways of Acquiring Data some of them are:

- **Manual labeling:**
  Label is actually the output we give with data so that machine can understand that about what data is. So, in manual labeling we provide data with the label.



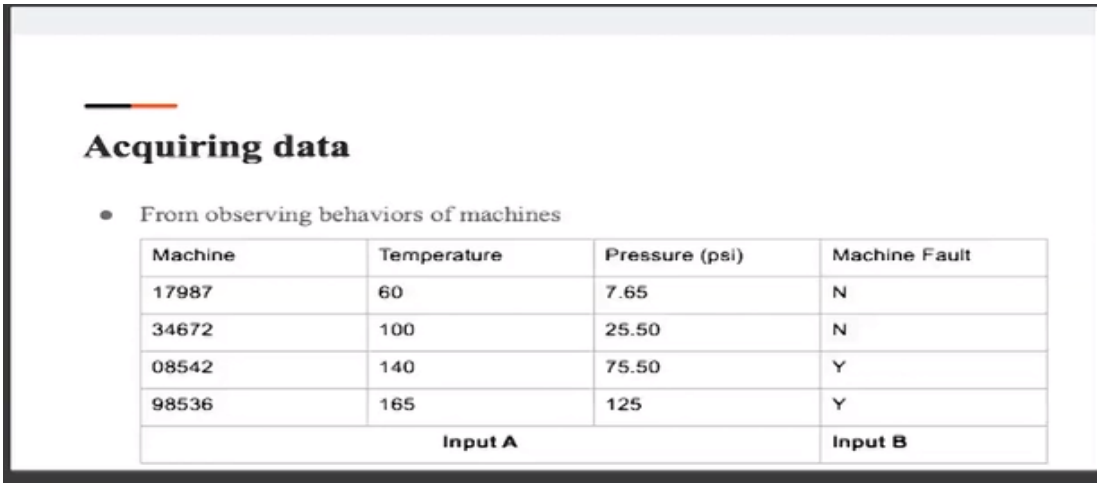
In this picture you can see that is provided inform of image and it is labeled that tells is that either it's a cat or it's not.

- **From human behavior:**
  Data can be acquired by observing the human behavior or activities. Example:



In the above picture data is stored or collected through human behavior in the way that if we visit a website and we purchase something, automatically website is storing out activity. In whole it acquires data through observing our activities.

- **From machine behavior:**
  Not only from the human behavior but data can be acquired by the machine's behavior.
  Example:

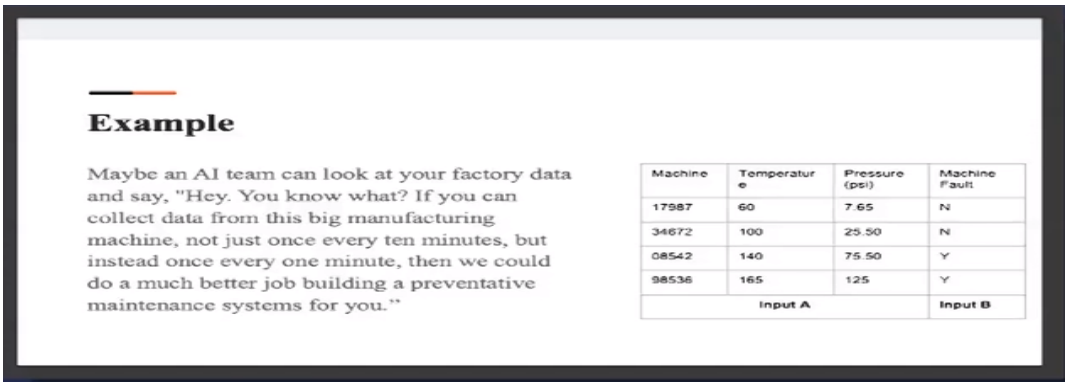


In the above table log of a machine is shown that with these variables how is the performance of machine.

How To collect data?

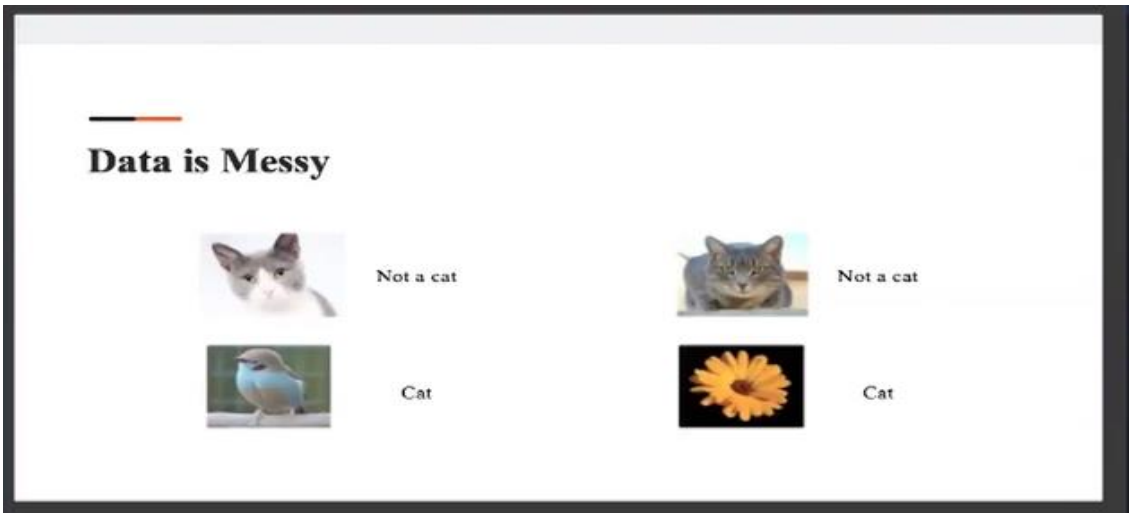
- Download from website if it is available free if it is not free you can partnership with the owner of the data to acquire it.
- If you are doing the project that no one has done and its data is not available then you can hire people and they can collect data for you.

8. **Use and Misuse of data:**
   There are multiple wrong approaches related use of data some are:
   - If AI team wants to build a project for the they hire an IT team to collect data and IT team say that they will collect perfect data with in three years and the will give data to AI after three years it's a wrong approach because if they do mistake in collecting data or hey collected false data then they wasted three years.
     Solution: IT team must show their collected data to AI team on daily or weekly basis so that they can get feedback that they are on right track.



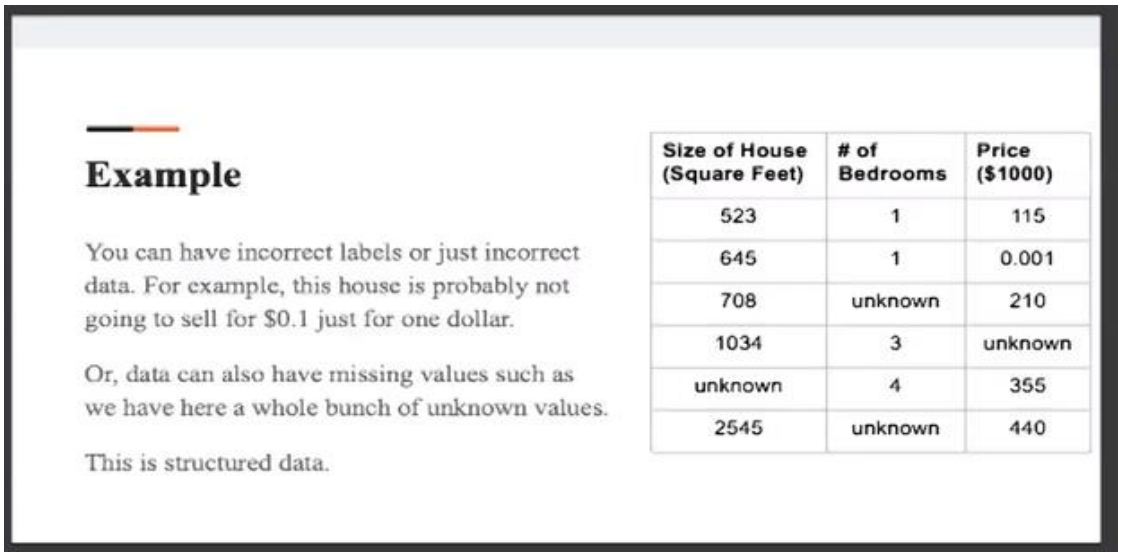
   - Second approach that is wrong in use of data is that, if you have a lot of data and you are sure that AI can make it valuable but its wrong because AI team does not check that either that data is correct or incorrect/valuable or invaluable. So, it can be incorrect.

     In this way data can be **messy**.
     Data can be messy due to 2 reasons:
     1. **Incorrect labels:**
        If data that is collected is labeled incorrectly.



In above picture data is labeled in wrong manner. So, this data is messy it is not giving any sense. It can be due to typing mistake or wrong recording. So, this record is not valuable.

2. **Missing data:**
   Data can be missing in the way that if during survey person who was doing survey did not collect that data or lost the collected data then this is the messy data.

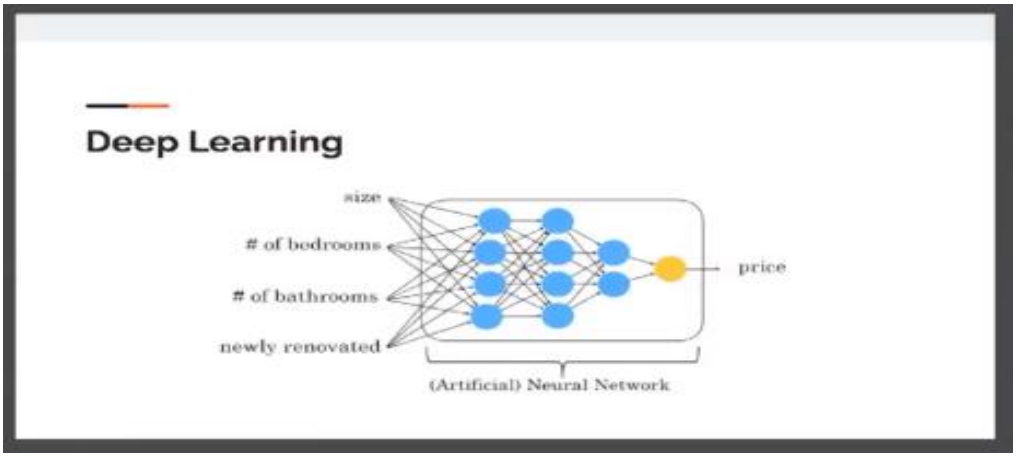


9. **Data Science vs Machine Learning:**
   Data science enables us to understand the data that helps in making decision in the business.
   Or
   The output of data science project is to know the insight/understanding of data that helps to make the business decisions.

On the other hand, output of machine learning is a software that takes input and give output.

Machine learning is defined as:
"Field of study that gives computer the ability to learn without being explicitly programmed."
Example of machine learning is online ad industry in which information about user's interest is given as input and outputs whether user will on ad or not.

10. **Intro into Deep Learning:**



The above picture is **(Artificial) Neural Network.**
It is known as the artificial neural net because it is inspiration of human neurons of brain but **Artificial.** The circles shown in the picture are known **neuron** or **nodes.** These vertical representations of these neurons are known as **layers.** The first layer from left (that have 4 neurons) is **Input layer.** The last layer that has one neuron (yellow one) is known as **Output layer.** The two middle layers are known as the **hidden layers.** All operation is performed in these layers and it is hidden from us. These lines or arrows are called as **Edges.**
You can see that every neuron of every layer is connected to every other neuron of next layer so that is why this network is known as the **dense connected network**.

ALL THE FUNCTIONS BEHIND THE WORKING OF MACHINE LEARNING AND DATA SCIENCE IS DEEP LEARNING.

11. **AI and Related Disciplines:**
    - Machine Learning
    - Deep Learning/Neural Network
    - Data Science
    - Supervised Learning
    - Unsupervised Learning
    - Reinforcement Learning

12. What makes an AI Company?

Following are some points, AI company must have:

- **Strategic Data Acquisition:**
  Data is the most important thing when it comes to machine learning or AI. Company must have strategy of acquiring or collecting data, Company should know that what are the sources of data for them if they start doing projects.
- **Unified Data Warehouse:**
  For AI company it is important that all the data copies of data are present or held in one place or warehouse because AI team needs data frequently it will made difficult for them if data is distributed in different places.
- **Pervasive Automation:**
  AI company should show pervasiveness which means that they must be passionate about automation they must be eager or think on little thing that can be automated.
  As we are now studying AI we must also think about little things and their working in AI if they are converted.
- **New Roles such as MLE:**
  If you make an AI company it is very important to have Machine learning engineers and experts.

So, if any company comes to you and offers you their services then you must check their criteria or ability on these 4 points.

AI Transformation:

If you have formed the AI company now you have to do following things to actually transform company to AI company.

1. **Execute Pilot/small projects to Gain Momentum:**
   Company must do project with the small-scale projects that are simple to gain momentum because they are new in this field. They must be popular software house before but now they are in different field. If they started doing large project and failed in the beginning, they must become demotivated.
2. **Build an in-house AI team:**
   Company must train their employees about AI so that they must know what their company is doing and they must perform their best in their aspect.
3. **Provide Broad AI Training:**
   Broad training concept means that with model developers and data science related employees AI training, People from other domains like business and sales must be trained so that they know about the execution.
4. **Develop an AI strategy:**
   AI company must have a strategy that what kind of projects they are going to do. They must consider their expertise in taking project. For Example

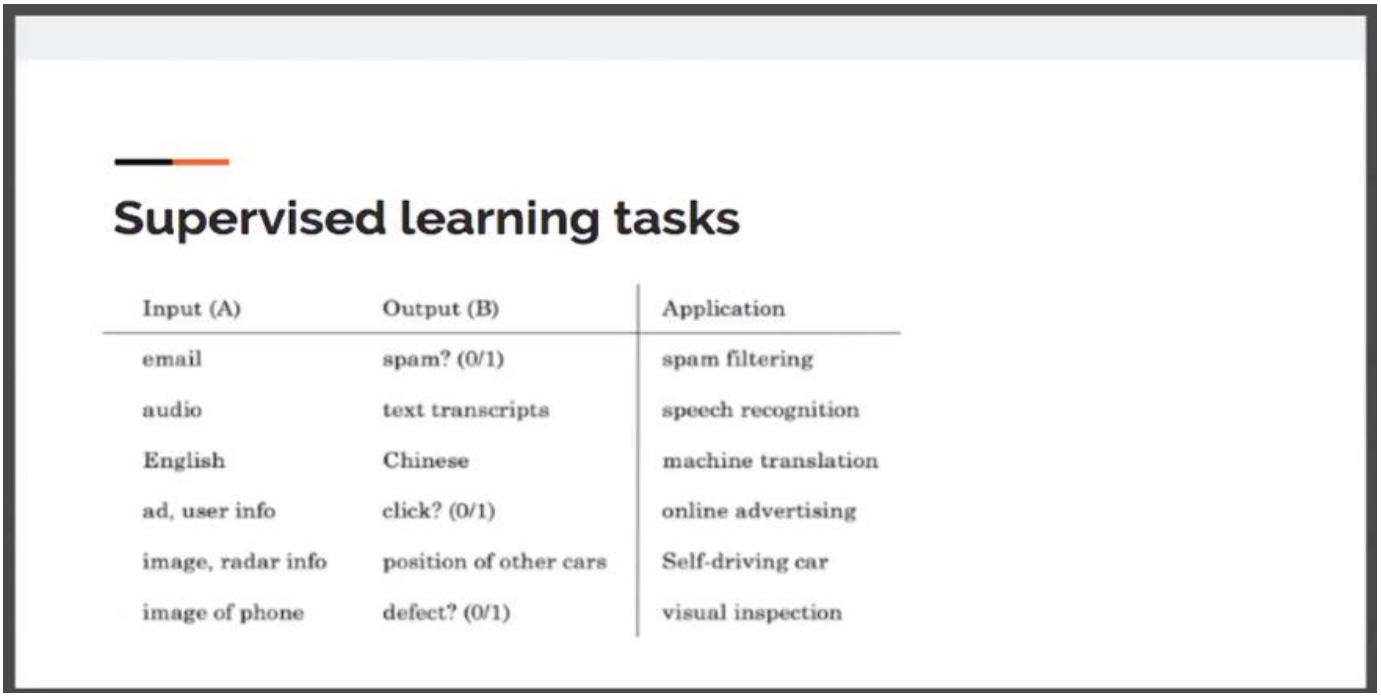
If they have the expertise to build self-driving cars, they must take these kinds of projects.

5. **Develop internal and external communication:**
   When AI company is formed it is important that all the internal and external employees, stack holders must know about this.

Deciding about New Projects:

- **Technical Diligence:**
  It comprises of two things:
  - Is it a feasible project?
    If project is possible company should check about the feasibility. It means that checking resources, checking that project they are making is worth according to that place and circumstances.
  - Can AI do that:
    If we have decided the project now, we must think that can we do it in AI or not.
- Start doing the project that you can do in seconds of thoughts it must be very simple but when it will be automated with supervised learning and whole app will come it will be very useful.

13. Examples Supervised Learning:



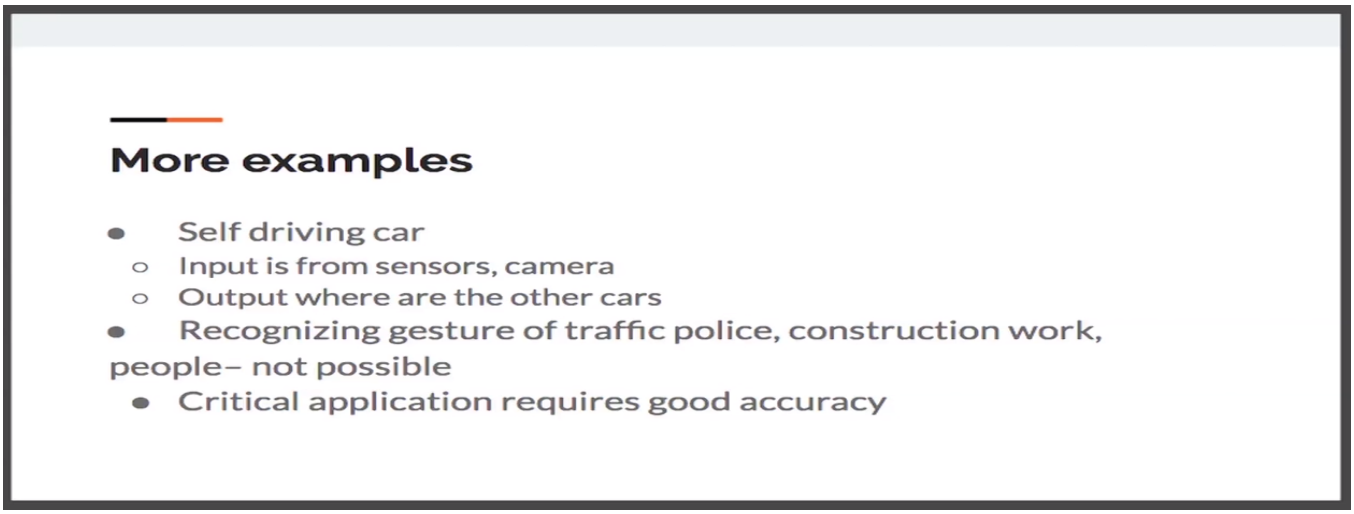
14. **Limitations of Machine Learning:**

Most of companies that related to AI have a company head who Is not related with AI so he always forces his employees to do every work using AI even it is not possible in AI.

Technical Diligence Rules:

- You are learning a simple concept (This point means that the project you want to make must be simple.
- You must have large training data about the project.

Following are some example that explain the limitation of machine learning accordingly this era:



Explanation of Example:

So, first thing in picture **self-driving car** is possible with AI which will take input from sensor and camera and give output where are the other cars. But 3rd thing which is Recognizing gesture of traffic police, construction workers- It is not possible because some gesture are similar and it also required a lot of training data because there are multiple gesture. **But remember that it is not possible till now we don't know about the future it can be possible in future.** Critical application requires good accuracy. Applications related to health, diseases or applications for Aeroplan flight, missile flight must have 100% accuracy otherwise the model is of no use.

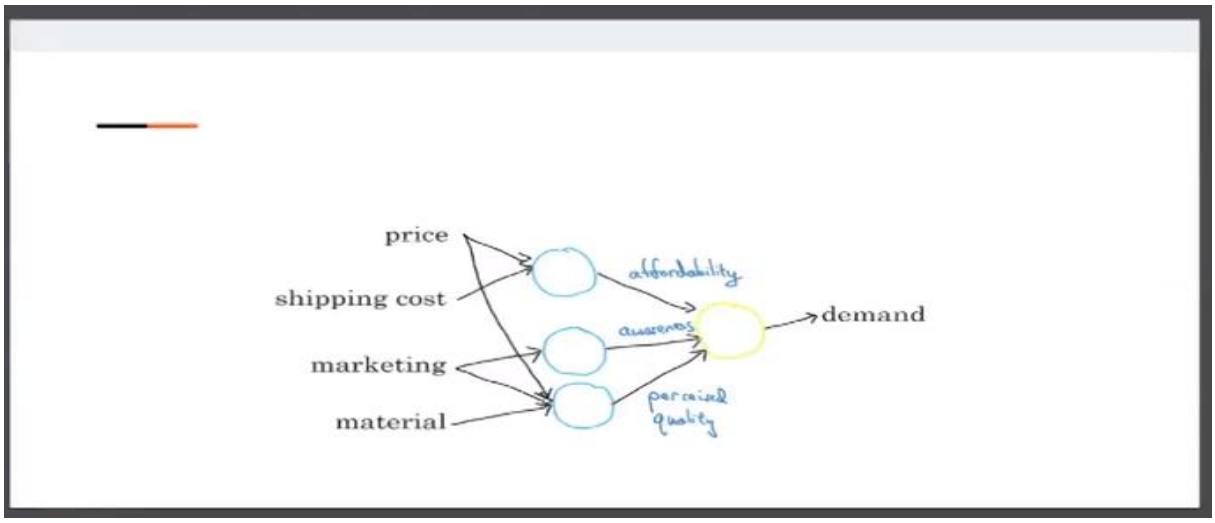
Strengths and Weakness of Machine Learning:

- Works when,
  - Learning a simple concept or developing simple concept in machine learning.
  - Lots of data available.
- Doesn't work when,
  - Learning a complex concept or developing complex concept in machine learning.

- Asked to work on new type of data such as X-ray images in different conditions and angles when model is trained on any other data so the result will not be the same when data is different.

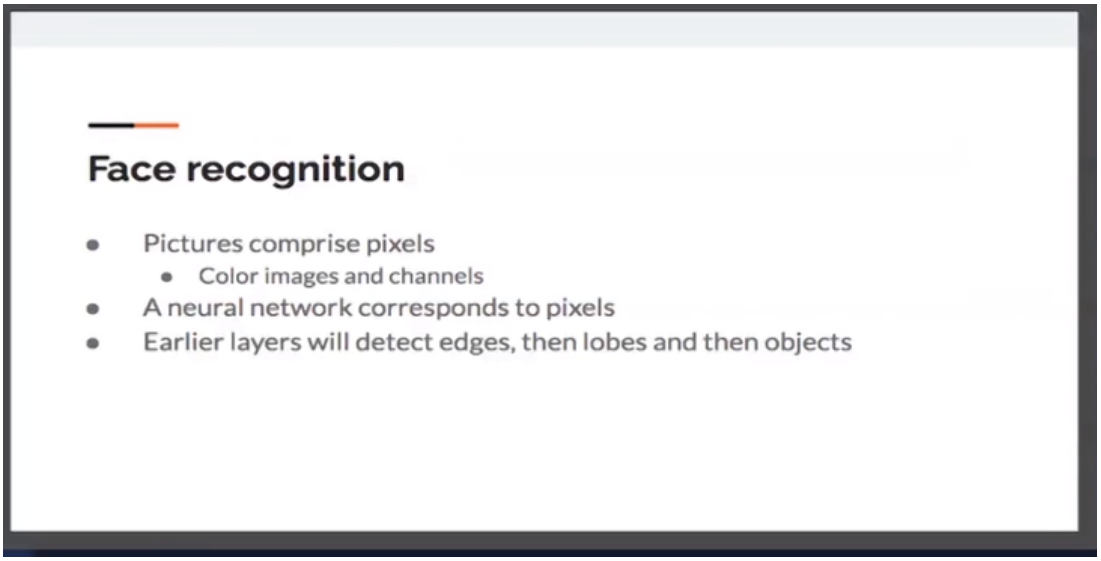
15. Machine Learning Examples:

Example 1:

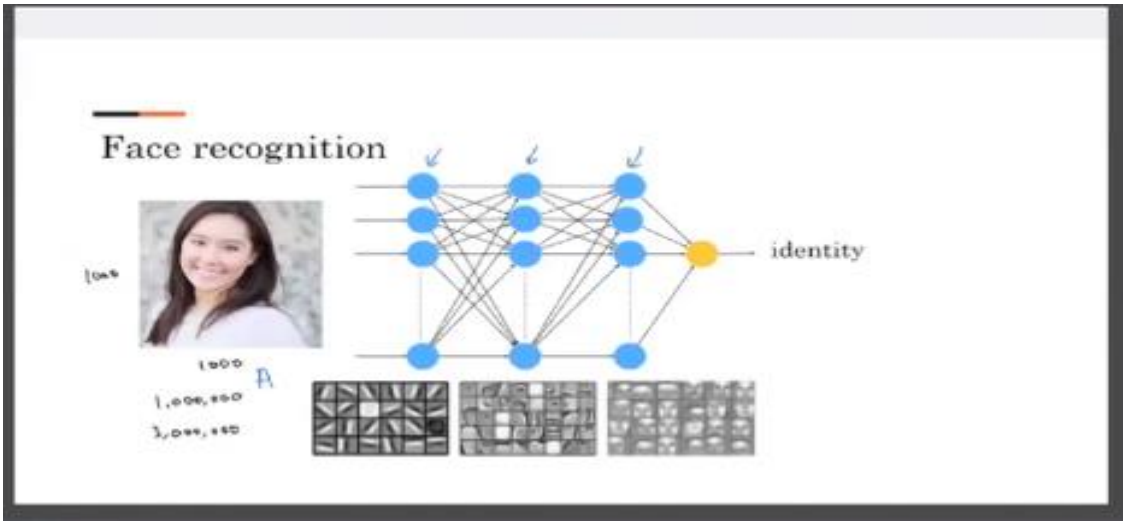


This is the neural network which is taking price, shipping cost, marketing, material as input and performing the functions affordability, awareness etc. But these functions perform cannot be seen these are hidden. In this case we just imagine that these functions can be taking place in hidden layer.

Example 2:

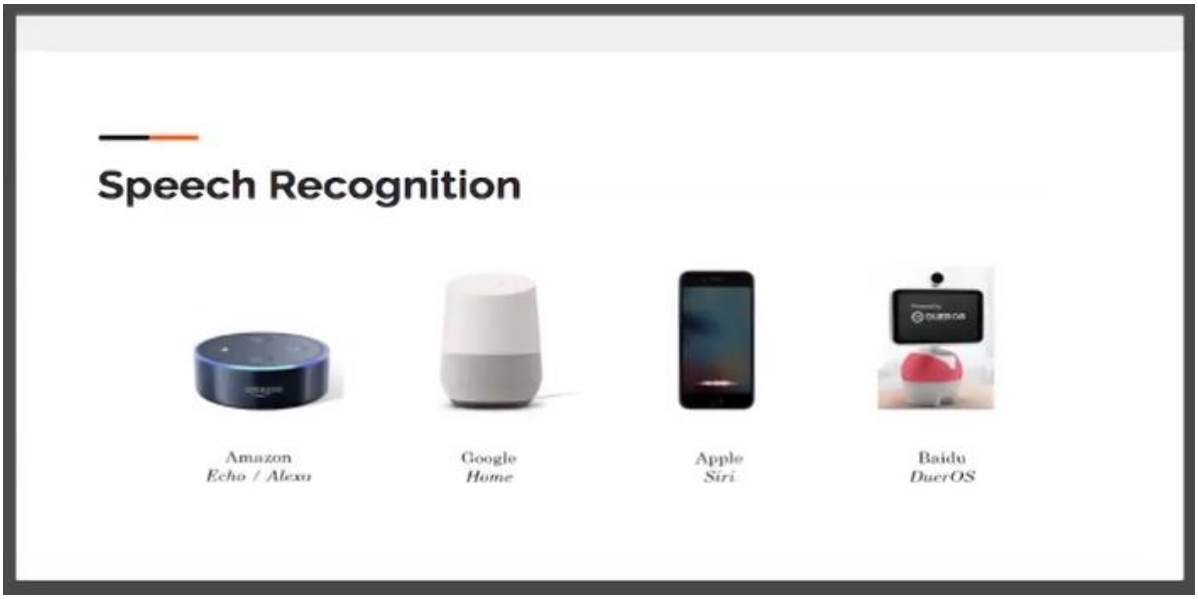


In the application of face recognition main thing is image processing. Image is comprised of a lot of pixels. Pixel is smallest part of a image, these pixels are comprised of RGB colors. Every pixel i has value from 0 to 255. If all values of 3 colors is 255 it will be a dark black spot and if these values become 0 it gives whit sharp spot. Whole image is converted to numbers form and then it is manipulated. In the starting layers of neural network edges are formed and the object is identified in the ending layers.

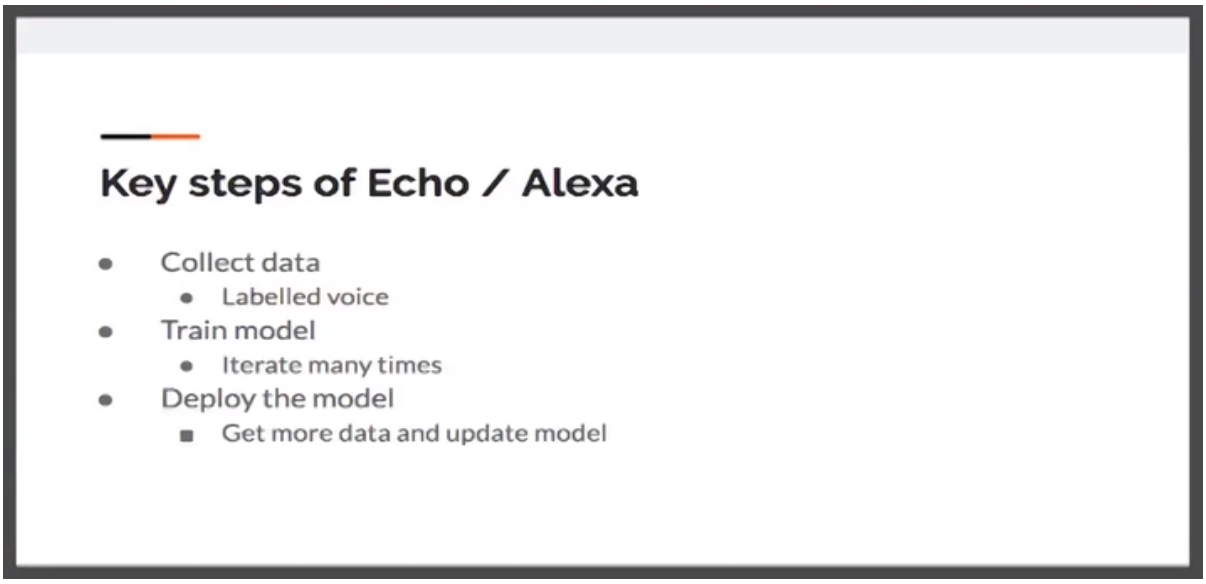


As we can see how it detect the image 1000x1000 pixels. The number of layers can be more. It depends upon the pixels. If we increase neurons and layers processing speed will also increase and we will have new values.

Another example is speech recognition projects:

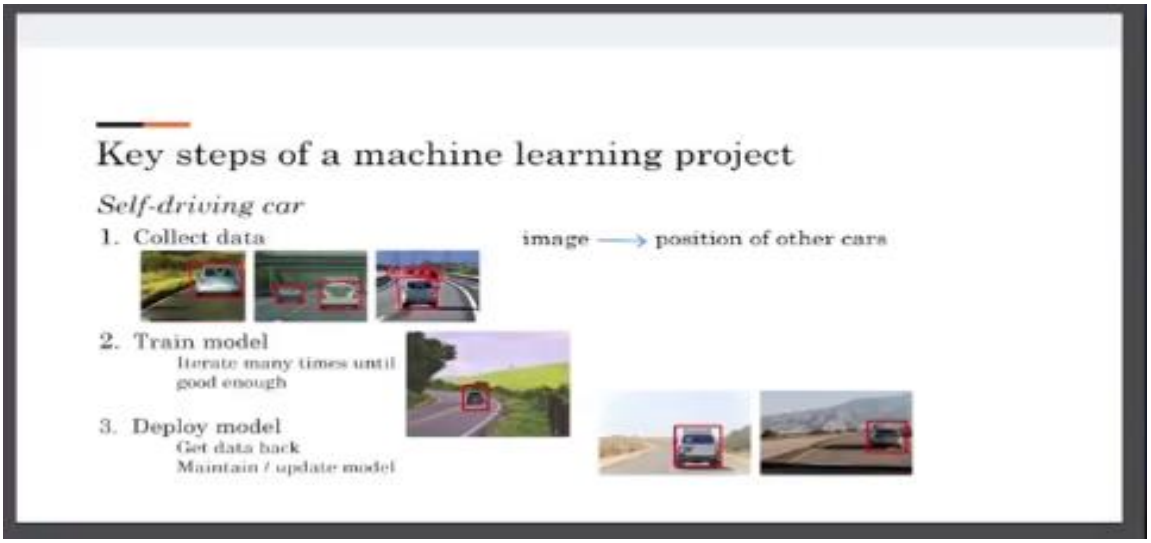


One of speech recognition project is Alexa. Following are some steps involved in developing it:

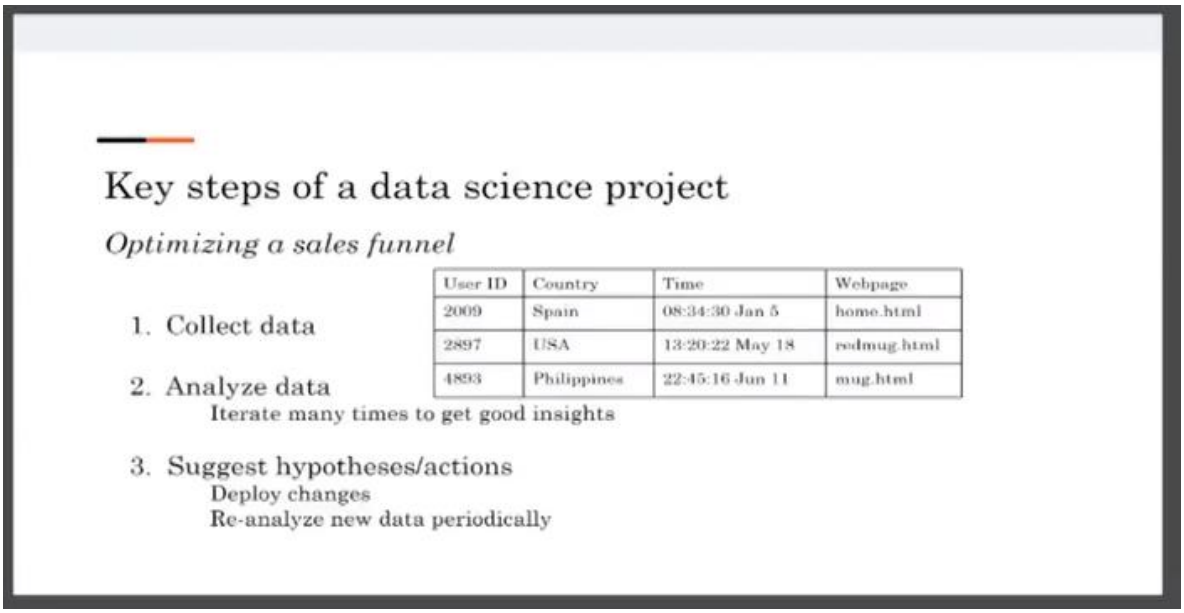


Another very good example of machine learning is self-driving cars:

It involves following steps:



16. Data Science Example:



In the above picture data is collected from an ecommerce website where customer visited. IN second step data will be analyzed. In last step changes must be deploy on the bases of result of data analysis as data science project gives insight of data on which decision can be made.

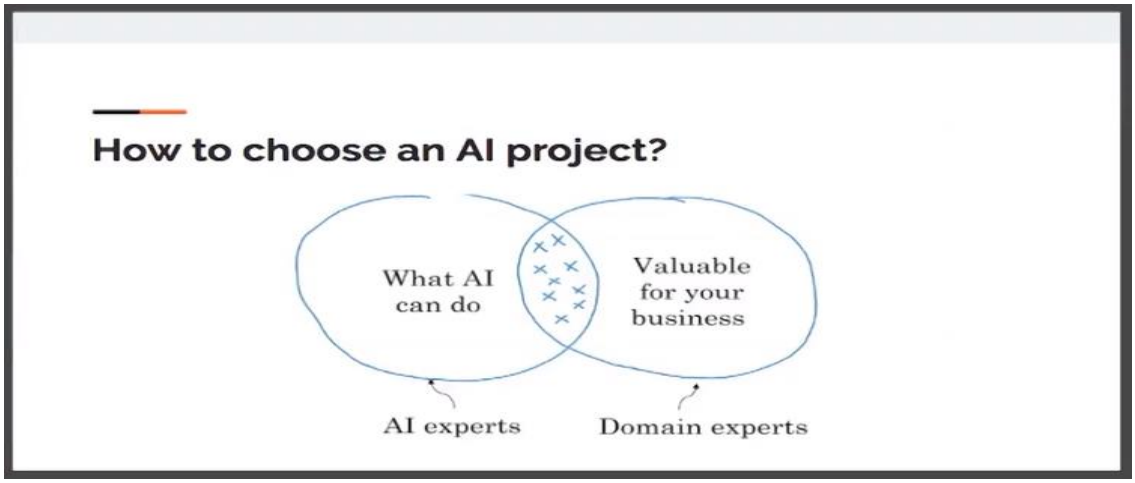
17. **Machine Learning Changing Job Function:**
    Here we will talk about the change in the function in a specific job and we are not talking about the replacement of the particular job. Job will be there but only the style of doing will be changed with machine learning. Following are some jobs, machine learning can change their function.

- **Sales:**
    - Identifying Sales opportunities.
    - Prioritizing
      A package will be sold to customer according to his priorities (What he likes as his data will be there). So, it will save time and things will not be offered to those who are not interested in it.
- **Manufacturing line manager:**
  It will change the function of person who manage the manufacturing site that include manufactured items (checking that it has a defect or not) and also who take care of machine.
    - Optimizing Manufacturing
      It can be check that whether this machine is working good and till how much time it is going to work well and in what circumstances it will be out of order.
    - Machine Learning can spot defects.
      So, it will be so easy to detect the defective item.
- **Recruiting:**
  It is very difficult to select one required person from thousands. It is difficult and time consuming to check the thousands of CVs of candidates. So, machine learning will help us in recruiting our desired person. In this CVs will be classified in our priority.

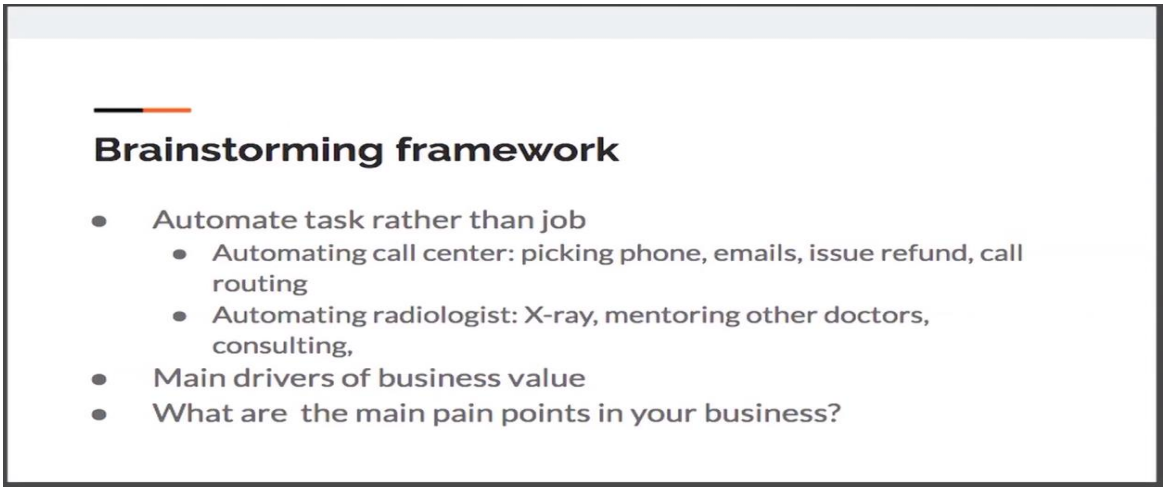
- Identify How People Prefer Recruitment
- Spot Good Candidates

18. Working with an AI Team:

An AI company have AI experts as well as business experts. Business domain experts give the project that are more profitable and suitable for them and AI experts do their work and check that what Project AI can do and What can not do as we discussed earlier AI can not do everything. The case can be like that, project AI team is offering or want to made is profitable for the business, it will be checked by the business experts. So, project will be chosen that satisfies both of the domains.



Brainstorming Framework:



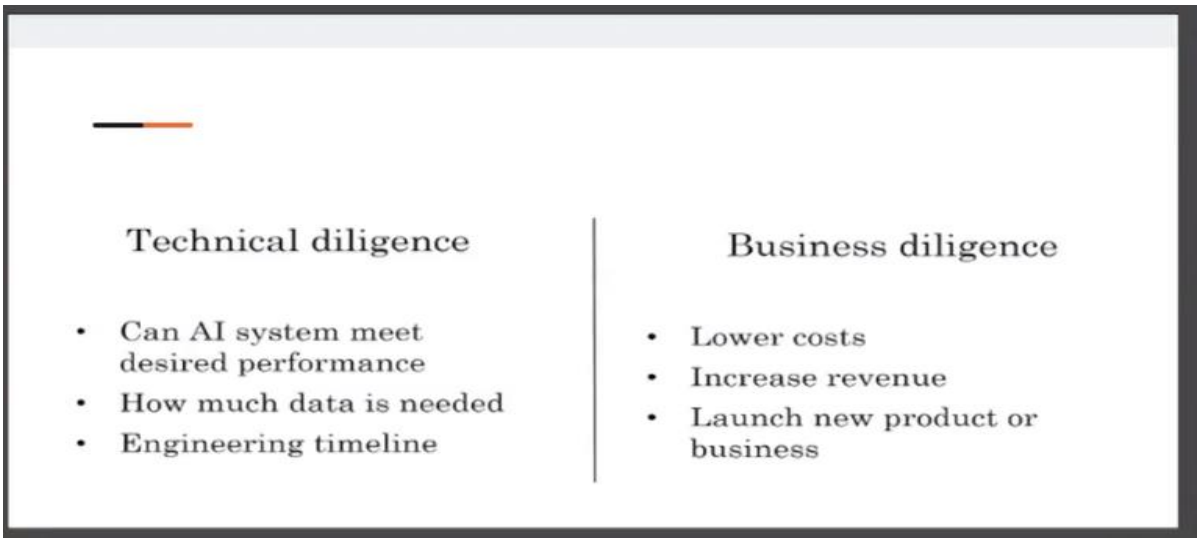
It is very important thing it means that instead Automating job we should automate the task for example Developing a project that helps doctor to diagnose problem/disease with more accuracy is better instead of developing a project that replace the job of the doctor.

Brainstorming of main drivers of business (business experts) is necessary because we have to convince them to chose AI for their project by showing them success of other company and other things so that they can invest in it.

Is It Always Necessary to have Big (more) Data?

- **No,** it is not always necessary to have big data.
- Having more data is good.
- But with small datasets you can make progress.
- 10, 100 or 1000 data points can be good to start the data must be keep adding when project will proceed further.

Technical Diligence vs Business Diligence:



- Engineering timeline means how much time it will take to be developed. Is that time being feasible? Engineering time will contain all domain time example data collecting time, data refining time etc.
- Lower cost means that it will be checked that does it makes the product price low or not?
- Increase revenue means does it will increase profit?
- Does this project will help us to make and launch new products.

We talked about technical diligence and business diligence but there is **Ethical diligence** too, that is being considered while making a project. IT means that in this we check that what kind of impact it will give to society. Is this going to make society better?

Build vs Buy:

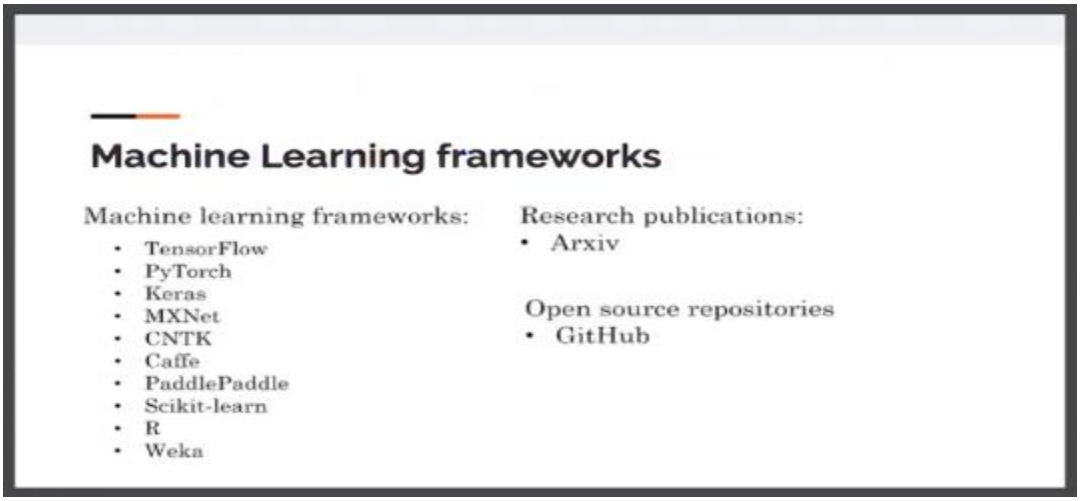
- Machine Learning projects can be developed in house or outsourced.
- Data Science project are generally developed inhouse.
- **Buy industry standards, only build specialized projects.**

It means that don't make the products that are popular in industry just buy them and make the projects according to your specialization even they are simple.

How to work with AI team:

- Specify your acceptance criteria:
  Acceptance Criteria means that how much accurate your model must be for it approval by you or the authorities. It can be 95% or 96% whatever. But don't expect 100% accuracy because different things can happen like wrong data entrance, Insufficient data, Limitations of ML. But can be improved to a huge extent without mistake.
- There are three types accuracies that are specified:
  1. Training accuracy
  2. Validation Accuracy
  3. Test Dataset Accuracy

19. Machine Learning Tools:



In the above picture there are many frameworks of machine learning the most used framework is **TensorFlow (**Developed by Google**).** We will study this framework and Keras frame work too.

CPU vs GPU:

- **Central Processing Unit**. It is slower than the GPU. But it is very cheap and it is now very common in the industry. It can also do machine learning work but slower than GPU.
- **Graphic Processing Unit**. It is 1000 times faster than CPU. It is expensive than the CPU system. It is recommended one in machine learning as we have to process a lot of data in it.
  We use cloud Services for the GPU base system use. Which can be purchased also there are some free too.