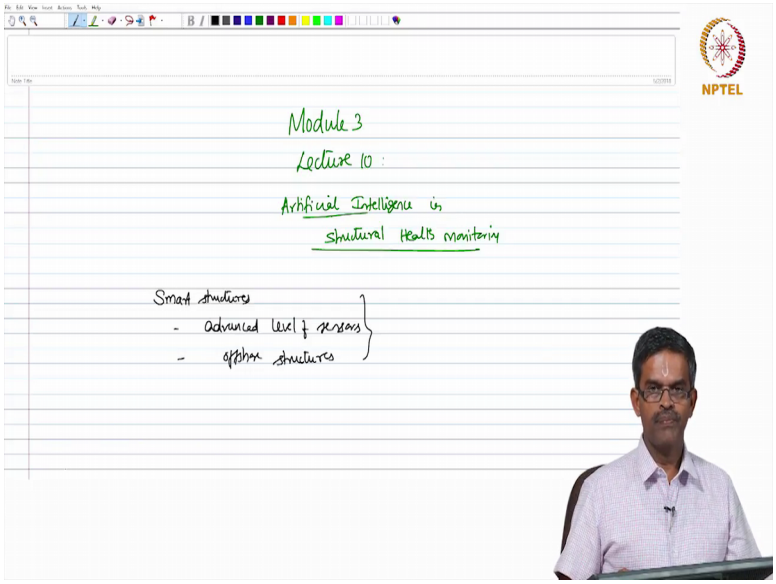
**Structural Health Monitoring (SHM)**
**Prof. Srinivasan Chandrasekaran**
**Department of Ocean Engineering**
**Indian Institute of Technology, Madras**

**Lecture - 61**
**Part - 1: Artificial Intelligence (AI) in structural health monitoring (SHM)**

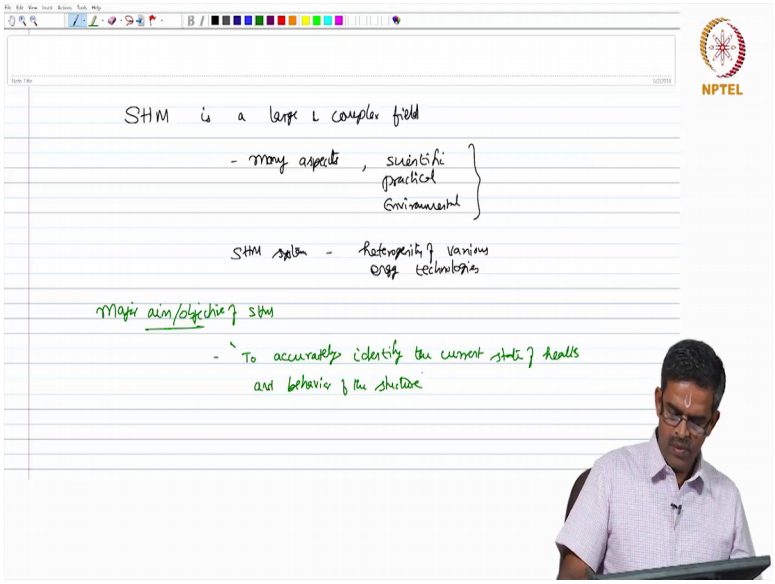
(Refer Slide Time: 00:21)




Friends, welcome to the 10th lecture in module 3. In this lecture we are going to talk about the usefulness of Artificial Intelligence in Structural Health Monitoring.

Friends we have already seen the importance of smart structures, then advanced level of sensors, their applications in offshore structures and so on. Interestingly, artificial intelligence plays a very important role in structural health monitoring in certain issues.

(Refer Slide Time: 01:49)

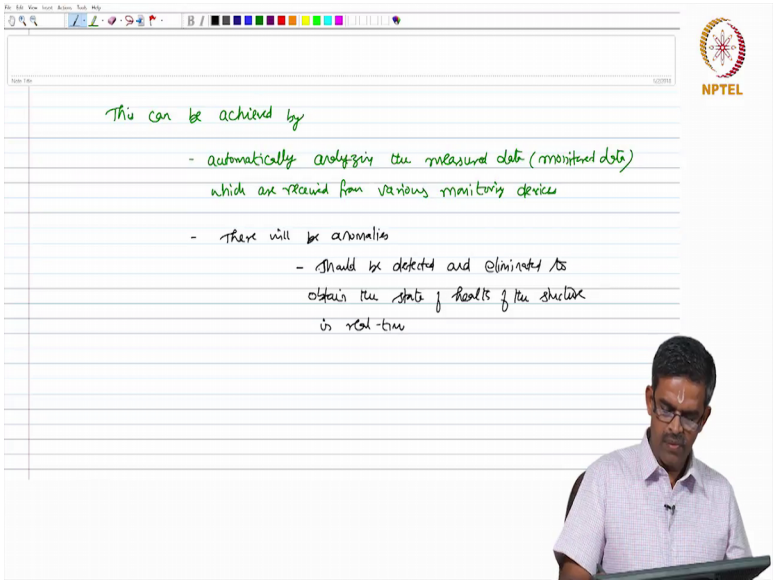



We all do agree that structural health monitoring is a large and complex field. It has got many aspects which are sometimes scientific, which are practical, which are environmental controlled. Structural health monitoring system is actually heterogeneity of various engineering technologies. It is a combination of various technologies heterogeneously.

What is the major aim objective of structural health monitoring? Let us ask this question once again back, we have answered this many number of times in various lectures earlier. But still let us put this question back to us once again to understand the importance and application of advanced level of smart sensing in structural health monitoring.

So, let us put this question back again; what is the major objective. The major objective is to accurately identify the current state of health and behavior of the structure. That is the objective.

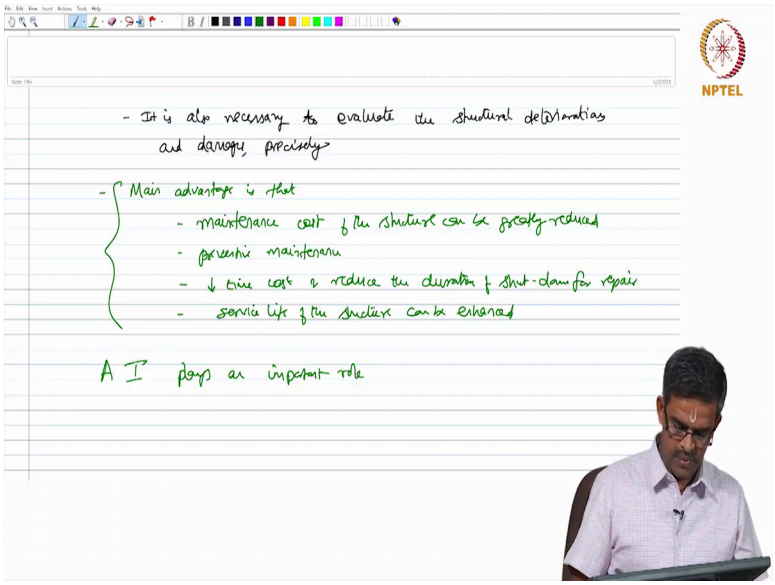
(Refer Slide Time: 03:53)




How this can be generally achieved? This objective can be achieved through many ways by commonly by automatically analyzing; I should say the measured data, but indirectly I am meaning the monitored data; the monitored data which are received from various monitoring devices.

Now, when you receive various measurements from several devices, there will be anomalies these anomalies should be detected, and as far as possible eliminated to obtain the state of health of the structure in real time.

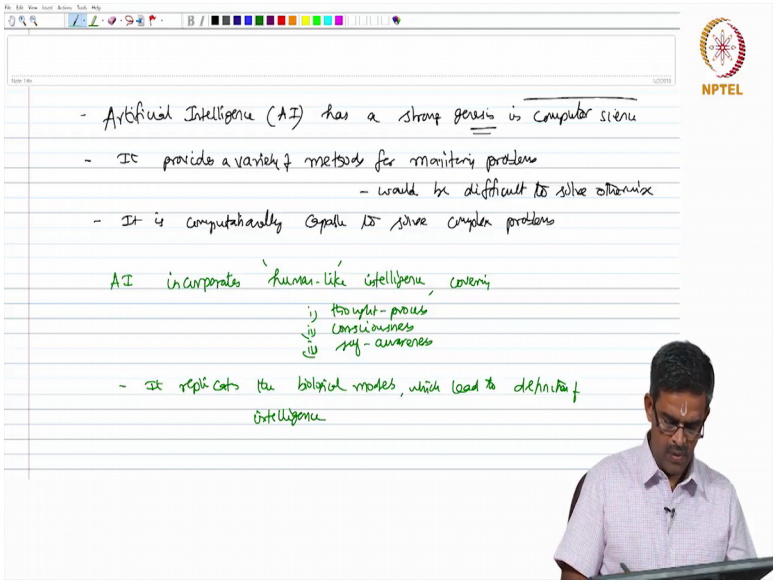
(Refer Slide Time: 05:30)



It is also necessary the structural deteriorations and damages, precisely. The greatest advantage of doing the above is maintenance cost of the structure can be greatly reduced: we can aim towards preventive maintenance, we can avoid downtime cost and reduce the duration of shutdown time for repair, and I can also say the service life of the structure can be also.

So, to do this artificial intelligence plays a very important role. Let us see how.

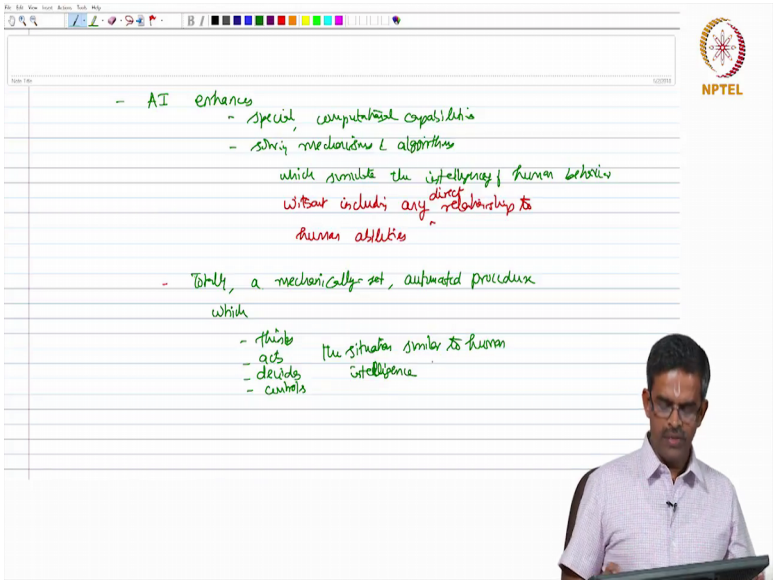
(Refer Slide Time: 07:05)




Referred simply as AI has a strong genesis in computer science; a variety of methods for monitoring problems which would be otherwise difficult to solve. This is possible because it has got some genesis from the computer science background.

It is computationally capable to solve complex problems, human like intelligence; that is what is called artificial human like intelligence covering a similar thought process, consciousness, self awareness, and it replicates the biological models which lead to the definition of intelligence.

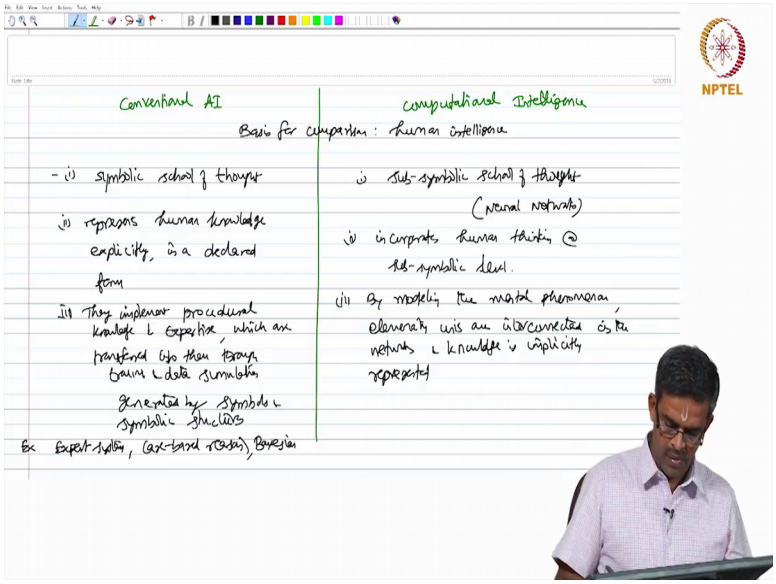
(Refer Slide Time: 09:17)




The second advantage is artificial intelligence enhances special, computational capabilities solving mechanisms as an algorithms actually simulate the intelligency of human behavior. Without including, that is very very important without including any relationship to human abilities: I should say direct relationship.

So, this is completely totally mechanically set automated procedure which things acts, decides, and controls the situation similar to human intelligence. That is artificial intelligence. Let us now compare the conventional artificial intelligence computational intelligence.

(Refer Slide Time: 11:25)

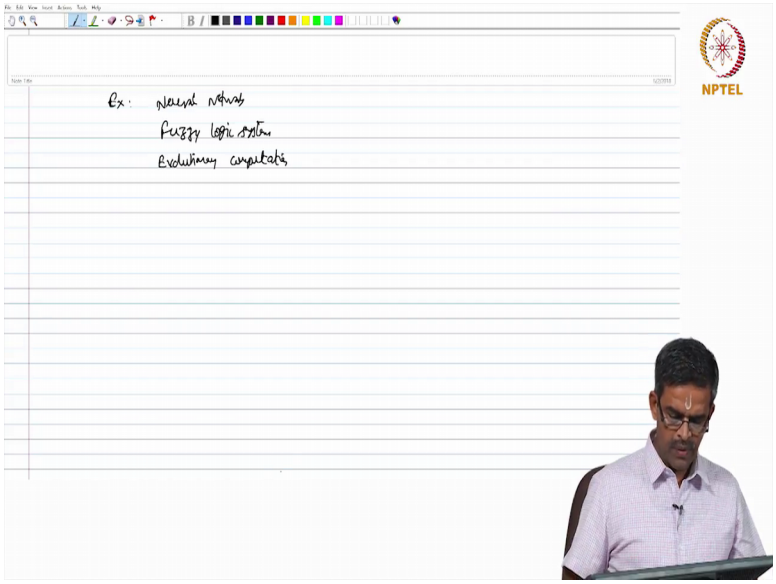



Let us compare: the basis for comparison is going to be human intelligence. I am going to compare both of them with respect to human intelligence, ok.

Conventional AI has two options: one, a symbolic school of thought, the other one is called sub-symbolic school of thought which includes neural networks also. Conventional artificial intelligence represents human knowledge explicitly in a declared form so, they implement procedural knowledge and expertise which are transferred into them through training and data simulation generated by symbols and symbolic structures.

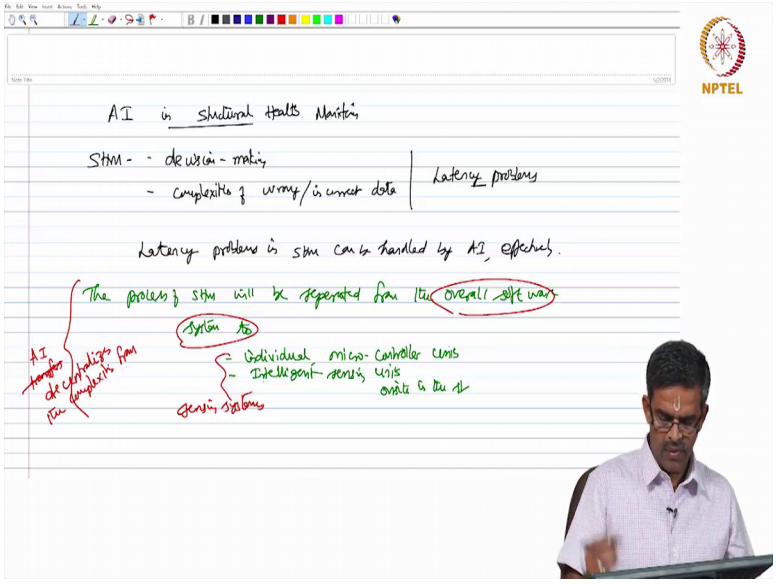
Examples could be: expert systems, case based reasoning, Bayesian network; these are examples. This incorporates human thinking at sub symbolic level. By modeling the mental phenomena elementary units are interconnected in the network and knowledge is implicitly represented.

(Refer Slide Time: 15:44)




Examples could be: neural networks for C logic systems and evolutionary computation.

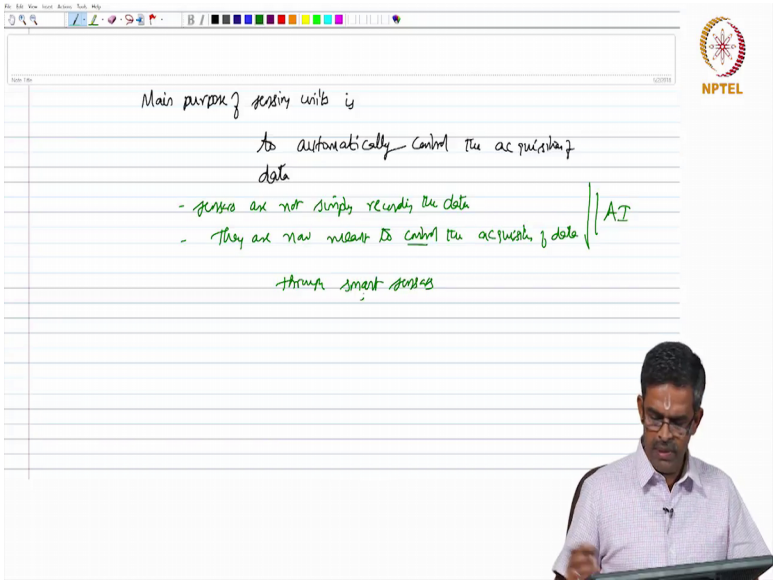
(Refer Slide Time: 16:06)




Let us see; what is the role of artificial intelligence in structural health monitoring, how this can be useful in structural health monitoring. Now, structural health monitoring has certain levels of decision making: it also has complexities of wrong or I should say incorrect data we call them as latency problems. The latency problems, in artificial intelligence sorry in structural health monitoring can be handled by artificial intelligence effectively.

So, how do you do that? The process of SHM, the overall software system to individual, microcontroller units, intelligent sensors, which are located on site in the structure; so, friends interestingly artificial intelligence transverse or decentralizes the complexities from software system to sensing systems.

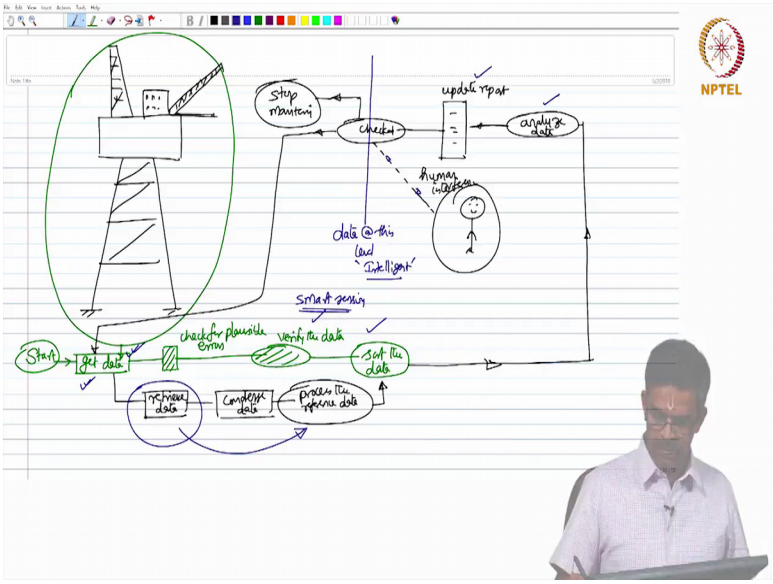
(Refer Slide Time: 18:33)




Now the main purpose of sensing system is: to automatically control the acquisition of data.

Friends, please realize the importance here sensors are not simply recording the data, they are now meant to control the acquisition of data. There is a shift here right that shift is because of AI. How do you do that? Through smart sensors; this can be expressed graphically. I have a platform.

(Refer Slide Time: 19:44)




So, an offshore platform which I want to monitor this, say I want to monitor. Now, I start monitoring get the data from the system, then check the system for plausible errors, verify the system or verify the data. Then sort the data as per the demand of the system. Alternatively, one can also retrieve the data on request. Then condense the data, then process the reference data what is asked not the entire data, and then feed it back to the sorting data.

Now, take it back to analysis stage you can analyze the data then once analysis complete then update the report in the computer. Once the report is updated the report is checked generally at this stage you involve human interference. So, there is a involvement of human interference of checking the data. Once the data is checked you can again continue to procure the data and do the monitoring or alternatively you can stop monitoring.

So, look at the algorithm here where artificial intelligence can play a very important role. Accumulating data is a general task which every sensor can do, , but verification of data sorting the data retrieving the data which is required for presence is all are done only by smart sensing.

Further, it also analyzes and updates and also enters the data which is given by the feedback of human interference and make it intelligent. So, here my data accumulated to

this level. The data accumulated at this level is intelligent enough compared to the data acquired at this level.

So, that is the modification in the SHM process when you start deploying smart sensors or otherwise artificial intelligence into the scheme.