**Sessional Assignment**

**Name: Muhammad Daniyal**

**ID NO: 17011**

**Course Title: Introduction to Computer**

**Instructor: DR. Atif Ishtiaq**

Assignment NO 1

What is Big Data explain in detail?

Big Data:Big Data is also data but with a huge size. Big Data is a term used to  
describe a collection of data that is huge in volume and yet growing  
exponentially with time. In short such data is so large and complex that none  
of the traditional data management tools are able to store it or process it  
efficiently.  
Examples of Big Data:  
Following are some the examples of Big Data The New York Stock Exchange generates about one terabyte of new trade data per  
day.

  
Social Media:  
The statistic shows that 500+terabytes of new data get ingested into the  
databases of social media site Facebook, every day. This data is mainly  
generated in terms of photo and video uploads, message exchanges, putting  
comments ETC



A single **Jet engine** can generate **10+terabytes** of data in **30 minutes** of  
flight time. With many thousand flights per day, generation of data reaches up  
to many **Petabytes.**

# 

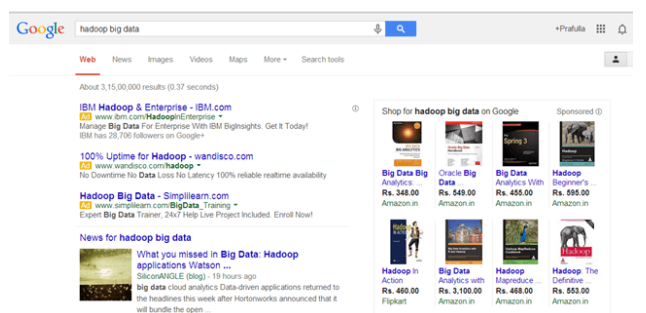
**Types of Big Data:**Big Data' could be found in three forms:  
1. **Structured**2. **UN structured**3. **Semi-structured  
Structured:**Any data that can be stored, accessed and processed in the form of fixed  
format is termed as a 'structured' data. Over the period of time, talent in  
computer science has achieved greater success in developing techniques for  
working with such kind of data (where the format is well known in advance)  
and also deriving value out of it. However, nowadays, we are foreseeing  
issues when a size of such data grows to a huge extent, typical sizes are  
being in the rage of multiple zetta bytes.

Examples of Structured Data:  
 An 'Employee' table in a database is an example of Structured Data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Employee ID** | **Employee Name** | **Gender** | **Department** | **Salary\_In\_lacs** |
| 2365 | Rajesh Kulkarni | Male | Finance | 650000 |
| 3398 | Pratibha Joshi | Female | Admin | 650000 |
| 7465 | Shushil Roy | Male | Admin | 500000 |
| 7500 | Shubhojit Das | Male | Finance | 500000 |
| 7699 | Priya Sane | Female | Finance | 550000 |

**Unstructured:**Any data with unknown form or the structure is classified as unstructured data.  
In addition to the size being huge, un-structured data poses multiple  
challenges in terms of its processing for deriving value out of it. A typical  
example of unstructured data is a heterogeneous data source containing a  
combination of simple text files, images, videos etc. Now day organizations  
have wealth of data available with them but unfortunately, they don't know  
how to derive value out of it since this data is in its raw form or unstructured  
format.

Examples of Un-structured Data  
The output returned by 'Google Search'



**Semi-structured:**Semi-structured data can contain both the forms of data. We can see semi structured data as a structured in form but it is actually not defined with e.g. a  
table definition in relational DBMS. Example of semi-structured data is a data  
represented in an XML file.  
Examples of Semi-structured Data:  
Personal data stored in an XML file-  
<rec><name>Prashant Rao</name><sex>Male</sex><age>35</age></rec>  
<rec><name>Seema R.</name><sex>Female</sex><age>41</age></rec>  
<rec><name>Satish Mane</name><sex>Male</sex><age>29</age></rec>  
<rec><name>Subrato Roy</name><sex>Male</sex><age>26</age></rec>  
<rec><name>Jeremiah J.</name><sex>Male</sex><age>35</age></rec>  
**Characteristics Of Big Data:  
(i)** Volume ***–*** The name Big Data itself is related to a size which is enormous.  
Size of data plays a very crucial role in determining value out of data. Also,  
whether a particular data can actually be considered as a Big Data or not, is  
dependent upon the volume of data. Hence, **'Volume'** is one characteristic  
which needs to be considered while dealing with Big Data.  
**(ii)** Variety ***–*** The next aspect of Big Data is its **variety**.  
Variety refers to heterogeneous sources and the nature of data, both  
structured and unstructured. During earlier days, spreadsheets and databases  
were the only sources of data considered by most of the applications.  
Nowadays, data in the form of emails, photos, videos, monitoring devices,  
PDFs, audio, etc. are also being considered in the analysis applications. This  
variety of unstructured data poses certain issues for storage, mining and  
analyzing data.  
**(iii)** Velocity ***–*** The term **'velocity'** refers to the speed of generation of data.  
How fast the data is generated and processed to meet the demands,  
determines real potential in the data.  
Big Data Velocity deals with the speed at which data flows in from sources like  
business processes, application logs, networks, and social media sites,  
sensors, Mobile devices, etc. The flow of data is massive and continuous.  
**(iv)** Variability ***–*** This refers to the inconsistency which can be shown by the  
data at times, thus hampering the process of being able to handle and  
manage the data effectively.  
**Benefits of Big Data Processing:**Ability to process Big Data brings in multiple benefits, such Businesses can utilize outside intelligence while taking decisions  
Access to social data from search engines and sites like Facebook, twitter are  
enabling organizations to fine tune their business strategies.  
o Improved customer service  
Traditional customer feedback systems are getting replaced by new systems  
designed with Big Data technologies. In these new systems, Big Data and  
natural language processing technologies are being used to read and  
evaluate consumer responses.  
o Early identification of risk to the product/services, if any  
o Better operational efficiency  
Big Data technologies can be used for creating a staging area or landing zone  
for new data before identifying what data should be moved to the data  
warehouse. In addition, such integration of Big Data technologies and data  
warehouse helps an organization to offload infrequently accessed data.  
**Summary:**• Big Data is defined as data that is huge in size. Big data is a term used  
to describe a collection of data that is huge in size and yet growing  
exponentially with time.  
• Examples of Big Data generation includes stock exchanges, social  
media sites, jet engines, etc.  
• Big Data could be 1) Structured, 2) Unstructured, 3) Semi-structured  
• Volume, Variety, Velocity, and Variability are few Characteristics of  
Big Data.  
• Improved customer service, better operational efficiency, Better  
decision making are few advantages of Big Data.

Assignment NO 2

Explain Artificial Intelligence (AI) in detail?

Artificial intelligence .................................................................................................2  
learning processes.....................................................................................................2  
Reasoning processes. .................................................................................................3  
Self-correction processes. ......................................................................................3  
Advantages and disadvantages of artificial intelligence............................................3  
augmented intelligence vs. artificial intelligence .....................................................4  
Four types of artificial intelligence........................................................................4  
Type 1: Reactive machines. ...................................................................................4  
Type 2: Limited memory. ......................................................................................4  
Type 3: Theory of mind. ........................................................................................5  
Type 4: Self-awareness..........................................................................................5  
Components of AI......................................................................................................5  
Ethical use of artificial intelligence ...........................................................................5  
Explainability and artificial intelligence....................................................................6  
Examples of AI technology .......................................................................................6  
Automation.............................................................................................................6  
Machine learning....................................................................................................6  
Supervised learning................................................................................................6  
Unsupervised learning. ..........................................................................................7  
Reinforcement learning..........................................................................................7  
Machine vision.......................................................................................................7  
Natural language processing..................................................................................7  
Robotics. ................................................................................................................7  
Self-driving cars.....................................................................................................7  
AI applications ...........................................................................................................7  
AI in healthcare......................................................................................................8  
AI in business.........................................................................................................8  
AI in education.......................................................................................................8  
AI in finance...........................................................................................................8  
AI in law.................................................................................................................8  
AI in manufacturing...............................................................................................9  
AI in banking. ........................................................................................................9  
**Artificial intelligence:**Artificial intelligence (AI) is the ability of a machine or computer system to copy  
human intelligence processes, learn from experiences, adapt to new information  
and perform human-like activities. Specific applications of AI include expert  
systems, natural language processing (NLP), speech recognition and machine vision  
AI is a wide field of study -- incorporating various technologies, methods and  
theories -- that focuses on combining large amounts of data with defined rules and  
fast, repetitive processing. This enables the software to advance and improve its  
ability to complete tasks by recognizing patterns and features in the data sets.  
Self-driving cars and computers that play chess are two examples of machines with  
artificial intelligence. In addition, a variety of industries have begun using AI to  
improve their work processes -- such as healthcare, manufacturing, banking and  
retail. In addition, AI is finding multiple beneficial uses in cyber security.  
AI programming focuses on three cognitive skills: learning, reasoning and Self Correction.  
**Learning processes:**  
This aspect focuses on acquiring data and creating rules for how to turn the data  
into actionable information. The rules, which are called algorithms, provide  
computing devices with step-by-step instructions for how to complete a specific  
task  
**Reasoning processes:**This aspect focuses on choosing the right algorithm to reach a desired outcome.  
**Self-correction processes:**This aspect is designed to continually fine-tune algorithms and ensure they  
provide the most accurate results possible.  
**Advantages and disadvantages of Artificial  
Intelligence**Artificial neural networks (ANN) and deep learning technologies are quickly  
evolving, primarily because AI processes large amounts of data much faster and  
makes predictions more accurately than humanly possible. While the huge volume  
of data that's being created on a daily basis would bury a human researcher, AI  
applications that use machine learning can take that data and quickly turn it into  
actionable information.  
As of this writing, the primary disadvantage of using AI is that it is expensive to  
process the large amounts of data that AI programming requires. Other  
disadvantages include its potential to increase unemployment by replacing jobs  
previously held by humans; its lack of creativity because machines can only do  
what they're taught or told; and its inability to completely replicate humans  
AI can be categorized as either weak or strong. Weak AI, also known as narrow  
AI, is an AI system that is designed and trained to complete a specific  
task. Industrial robots and virtual personal assistants, such as Apple's Siri, use  
weak AI.  
Strong AI, also known as artificial general intelligence (AGI), describes  
programming that can replicate human cognitive abilities. When presented with an  
unfamiliar task, a strong AI system can use fuzzy logic to apply knowledge from  
one domain to another and find a solution autonomously. In theory, a strong AI  
program should be able to pass both a Turing test and the Chinese room test --  
which states that a computer cannot be given a mind or consciousness, no matter  
how intelligent it seems.  
**Augmented intelligence vs. artificial  
intelligence**Some industry experts believe that the term artificial intelligence is too closely  
linked to popular culture, and this has caused the general public to have  
improbable expectations about how AI will change the workplace and life in  
general. Some researchers and marketers hope the label augmented intelligence,  
which has a more neutral connotation, will help people understand that most  
implementations of AI will be weak and simply improve products and services.  
The concept of the Singularity and a world where the application of super  
intelligence extends to humans or human problems -- including poverty, disease  
and mortality -- still falls within the realm of science fiction.  
**Four types of artificial intelligence:**Arend Hintze, an assistant professor of integrative biology and computer science  
and engineering at Michigan State University, categorized AI into four types,  
beginning with the intelligent systems that exist today to sentient systems, which  
do not yet exist. His categories are as follows:  
**Type 1: Reactive machines**These AI systems have no memory and are task specific. An example is Deep  
Blue, the IBM chess program that beat Garry Kasparov in the 1990s. Deep Blue  
can identify pieces on the chessboard and make predictions, but because it has no  
memory, it cannot use past experiences to inform future ones.  
**Type 2: Limited memory**These AI systems have memory, so they can use past experiences to inform future  
decisions. Some of the decision-making functions in self-driving cars are designed  
this way.  
**Type 3: Theory of mind**Theory of mind is a psychology term. When applied to AI, it means that the  
system would understand emotions. This type of AI will be able to infer intentions  
and predict behavior when it becomes available.  
**Type 4: Self-awareness:**In this category, AI systems have a sense of self, which gives them consciousness.  
Machines with self-awareness understand their own current state. This type of AI  
does not yet exist.  
**Components of AI:**As the publicity and excitement around artificial intelligence has accelerated,  
vendors have been scrambling to promote how their products and services use AI.  
Often what they refer to as AI is simply one component of AI, such as machine  
learning.  
AI requires a foundation of specialized hardware and software for writing and  
training machine learning algorithms. No one programming language is  
synonymous with AI, but a few, including Python and C, have set themselves  
apart.  
**Ethical use of artificial intelligence:**While AI tools present a range of new functionality for businesses, the use of  
artificial intelligence also raises ethical questions because, for better or worse, an  
AI system will reinforce what it has already learned.  
This can be problematic because machine learning algorithms, which underpin  
many of the most advanced AI tools, are only as smart as the data they are given in  
training. Because a human being selects what data is used to train an AI program,  
the potential for machine learning bias is inherent and must be monitored closely.  
Anyone looking to use machine learning as part of real-world, in-production  
systems needs to factor ethics into their AI training processes and strive to avoid  
bias. This is especially true when using AI algorithms that are inherently  
unexplainable in deep learning and generative adversarial network (GAN)  
applications.  
**Explainability and artificial intelligence**:  
The inability to explain AI is a potential stumbling block for industries that operate  
under strict regulatory compliance requirements. For example, financial institutions  
in the United States operate under regulations that require them to explain their  
credit-issuing decisions. When a decision to refuse credit is made by AI  
programming, however, it can be difficult to explain how the decision was arrived  
at because the AI tools used to make such decisions operate by teasing out subtle  
correlations between thousands of variables. When the decision-making  
process cannot be explained, the program may be referred to as black box AI.  
**Examples of AI technology:**AI is incorporated into a variety of different types of technology. Here are seven  
examples:  
**Automation**:  
This makes a system or process function automatically. For example, robotic  
process automation (RPA) can be programmed to perform high-volume, repeatable  
tasks that are normally completed by humans. RPA is different from IT  
automation in that it can adapt to changing circumstances.  
**Machine learning:**This is the science of getting a computer to act without programming. Deep  
learning is a subset of machine learning that, in very simple terms, can be thought  
of as the automation of predictive analytics. There are three types of machine  
learning algorithms:  
**Supervised learning**:  
Data sets are labeled so that patterns can be detected and used to label new data  
sets.  
**Unsupervised learning**:  
Data sets aren't labeled and are sorted according to similarities or differences.  
**Reinforcement learning**:  
Data sets aren't labeled but, after performing an action or several actions, the AI  
system is given feedback.  
**Machine vision:**This is the science of allowing computers to see. This technology captures and  
analyzes visual information using a camera, analog-to-digital  
conversion and digital signal processing. It is often compared to human eyesight,  
but machine vision isn't bound by biology and can be programmed to see through  
walls, for example. It is used in a range of applications from signature  
identification to medical image analysis. Computer vision, which is focused on  
machine-based image processing, is often interchanged with machine vision.  
**Natural language processing:**This is processing of human -- and not computer -- language by a computer  
program. One of the older and best-known examples of NLP is spam detection,  
which looks at the subject line and the text of an email and decides if it's junk.  
Current approaches to NLP are based on machine learning. NLP tasks include text  
translation, sentiment analysis and speech recognition.  
**Robotics:**This field of engineering focuses on the design and manufacturing of robots.  
Robots are often used to perform tasks that are difficult for humans to perform or  
perform consistently. They are used in assembly lines for car production and by  
NASA to move large objects in space. Researchers are also using machine learning  
to build robots that can interact in social settings.  
**Self-driving cars:**These use a combination of computer vision, image recognition and deep learning  
to build automated skill at piloting a vehicle while staying in a given lane and  
avoiding unexpected obstructions, such as pedestrians.  
**AI applications:**Artificial intelligence has made its way into a wide variety of markets. Here are six  
examples:  
**AI in healthcare:**The biggest bets are on improving patient outcomes and reducing costs.  
Companies are applying machine learning to make better and faster diagnoses than  
humans. One of the best-known healthcare technologies is IBM Watson. It  
understands natural language and can respond to questions asked of it. The system  
mines patient data and other available data sources to form a hypothesis, which it  
then presents with a confidence scoring schema. Other AI applications  
include chat bots -- a computer program used online to answer questions and assist  
customers, to help schedule follow-up appointments or aid patients through the  
billing process -- and virtual health assistants that provide basic medical feedback.  
**AI in business:**Robotic process automation is being applied to highly repetitive tasks that humans  
normally perform. Machine learning algorithms are being integrated into analytics  
and customer relationship management (CRM) platforms to uncover information  
on how to better serve customers. Chat bots have been incorporated into websites to  
provide immediate service to customers. Automation of job positions has also  
become a talking point among academics and IT analysts.  
**AI in education:**AI can automate grading, giving educators more time. It can assess students and  
adapt to their needs, helping them work at their own pace. AI tutors can provide  
additional support to students, ensuring they stay on track. AI could change where  
and how students learn, perhaps even replacing some teachers.  
**AI in finance:**AI in personal finance applications, such as Intuit's Mint or TurboTax, is  
disrupting financial institutions. Applications such as these collect personal data  
and provide financial advice. Other programs, such as IBM Watson, have been  
applied to the process of buying a home. Today, artificial  
intelligence software performs much of the trading on Wall Street.  
**AI in law:**The discovery process -- sifting through documents -- in law is often  
overwhelming for humans. Automating this process is a more efficient use of time.  
Startups are also building question-and-answer computer assistants that can sift  
programmed-to-answer questions by examining the taxonomy and ontology  
associated with a database.  
**AI in manufacturing:**This is an area that has been at the forefront of incorporating robots into  
the workflow. Industrial robots used to perform single tasks and were separated  
from human workers, but as the technology advanced that changed.  
**AI in banking:**Banks have been finding good results in using chat bots to make their customers  
aware of additional services and offerings. They are also using AI to improve  
decision-making for making loans, setting credit limits and identifying investment  
opportunities.  
**AI in security:**Artificial intelligence and machine learning in cyber security products are adding  
real value for the security teams looking for ways to identify attacks, malware and  
other threats.  
Organizations today use machine learning in security information and event  
management (SIEM) software and related areas to detect anomalies and identify  
suspicious activities that indicate threats. By analyzing data and using logic to  
identify similarities to known malicious code, AI can provide alerts to new and  
emerging attacks much sooner than human employees and previous technology  
iterations.  
As a result, AI security technology both dramatically lowers the number of false  
positives and gives organizations more time to counteract real threats before  
damage is done. The maturing technology is playing a big role in helping  
organizations fight off Cyber Attacks.  
**AI as a service (AIaaS):**Because hardware, software and staffing costs for AI can be expensive, many  
vendors are including AI components in their standard offerings or providing  
access to artificial intelligence as a service (AIaaS) platforms. AIaaS allows  
individuals and companies to experiment with AI for various business purposes  
and sample multiple platforms before making a commitment.  
Popular AI cloud offerings include the following:  
• Amazon AI  
• IBM Watson Assistant  
• Microsoft Cognitive Services  
• Google AI  
**Cognitive computing and AI:**The terms AI and cognitive computing are sometimes used interchangeably, but,  
generally speaking, the label AI is used in reference to products and services that  
automate tasks, while the label cognitive computing is used in reference to  
products and services that augment human thought processes.  
**Regulation of AI technology:**Despite potential risks, there are currently few regulations governing the use of AI  
tools, and where laws do exist, they typically pertain to AI indirectly. For example,  
United States Fair Lending regulations require financial institutions to explain  
credit decisions to potential customers. This limits the extent to which lenders can  
use deep learning algorithms, which by their nature are opaque and lack  
explainability.  
The European Union's GDPR puts strict limits on how enterprises can use  
consumer data, which impedes the training and functionality of many consumer facing AI applications.  
In 2016, the National Science and Technology Council issued a report examining  
the potential role governmental regulation might play in AI development, but it did  
not recommend specific legislation be considered. Since that time the issue has  
received little attention from lawmakers.

**Assignment NO 3**

Explain 5G (Fifth Generation) technology in detail?

4/14 5G  
 **5th generation**

Contents  
What is 5G?.................................................................................................................................1  
How does 5G work?........................................................................................................................2  
Spectrum ..................................................................................................................................... 2  
Low-band spectrum .................................................................................................................... 2  
Mid - band spectrum ..................................................................................................................... 2  
High - band spectrum.................................................................................................................... 2  
How fast is 5G?...............................................................................................................................3  
Peak data rate:......................................................................................................................... 3  
Real-world speeds................................................................................................................... 3  
Latency......................................................................................................................... 3  
Efficiency:....................................................................................................................3  
Spectral efficiency .................................................................................................................. 4  
Mobility: ................................................................................................................................. 4  
Connection density.................................................................................................................. 4  
What can 5G do?.......................................................................................................................... 4  
Improve broadband ..................................................................................................................... 4  
Autonomous vehicles.................................................................................................................. 4  
Public safety and infrastructure ..................................................................................................4  
Remote device control ................................................................................................................5  
Health care ..................................................................................................................................5  
IoT............................................................................................................................................... 5  
Where is 5G now? ....................................................................................................................... 5  
Verizon..........................................................................................................................................6  
**What is 5G?**Before we explain how 5G works, it’s probably a good idea to explain what 5G is. There are a  
lot of specifics, which we talk about later in this post, but here’s a quick primer.  
5G is the next generation of mobile broadband that will eventually replace, or at least augment,  
your 4G LTE connection. With 5G, you’ll see exponentially faster download and upload speeds.  
Latency, or the time it takes devices to communicate with wireless networks, will also drastically  
decrease.  
**How does 5G work?**Now that we know what 5G is, it’s a good idea to understand how it works, since it’s different  
from traditional 4G LTE. First, let’s talk spectrum.  
**Spectrum:**Unlike LTE, 5G operates on three different spectrum bands. While this may not seem  
important, it will have a dramatic effect on your everyday use.  
**Low-band spectrum:**can also be described as a sub-1GHz spectrum. It’s the primary band used by carriers in the U.S.  
for LTE, and bandwidth is nearly depleted. While low-band spectrum offers great coverage area  
and wall penetration, there is a big drawback: Peak data speeds will top out around 100Mbps.  
T-Mobile is the key player when it comes to low-band spectrum. The carrier picked up a massive  
amount of 600MHz spectrum at a Federal Communications Commission (FCC) auction in 2017  
and is using it to quickly build out its nationwide 5G network.  
**Mid-band spectrum:**provides faster speeds and lower latency than low-band. It does, however, fail to penetrate  
buildings as effectively as low-band spectrum. Expect peak speeds up to 1Gbps on mid-band  
spectrum.  
Sprint has the majority of unused mid-band spectrum in the U.S. The carrier is using Massive  
MIMO to improve penetration and coverage area on the mid-band. Massive MIMO groups  
multiple antennas onto a single box, and at a single cell tower, to create multiple simultaneous  
beams to different users. Sprint will also use Beam forming to bolster 5G service on the mid band. This sends a single focused signal to every user in the cell, and systems using it to monitor  
each user to make sure they have a consistent signal.  
**High-band spectrum:**is what delivers the highest performance for 5G, but with major weaknesses. It is often referred  
to as mm Wave. High-band spectrum can offer peak speeds up to 10Gbps and has extremely low  
latency. The main drawback of high-band is that it has low coverage area and building  
penetration is poor.  
AT&T, T-Mobile, and Verizon are all rolling out high-band spectrum. 5G coverage for the  
carriers will piggyback off LTE while they work to build out nationwide networks. Since high band spectrum sacrifices building penetration and coverage area for high speed, it will rely on  
many small cells**.** These are low-power base stations that cover small geographic areas and can  
be combined with beam forming to bolster coverage.  
**How fast is 5G?**The International Telecommunication Union (ITU) is a specialized agency at the United Nations  
that develops technical standards for communication technologies, and it sets the rules for radio  
spectrum usage and telecommunications interoperability. In 2012, the ITU created a program  
called “IMT for 2020 and beyond” (IMT-2020) to research and establish minimum requirements  
for 5G. After years of work, the agency created a draft report with 13 minimum requirements for  
5G in 2017. Once the ITU set the minimum requirements for 5G, the 3rd Generation Partnership  
Project (3GPP), a collaboration of telecommunications standards organizations, on creating  
standards for 5G, In December 2017, 3GPP completed its non-standalone began work (NSA)  
specifications, and in June 2018 it followed up with its stand-alone specifications (SA).  
Both NSA and SA standards share the same specifications, but NSA uses existing LTE networks  
for rollout while SA will use a next-generation core network. Carriers are starting with the NSA  
specification, which means you will fall back on 4G LTE in a non-5G environment.  
The standards set by 3GPP closely correspond with IMT-2020 performance targets and are  
somewhat complex, but here’s a general rundown:  
**Peak data rate:** 5G will offer significantly faster data speeds. Peak data rates can hit 20Gbps  
downlink and 10Gbps uplink per mobile base station. Mind you, that’s not the speed you’d  
experience with 5G (unless you have a dedicated connection) — it’s the speed shared by all users  
on the cell.  
**Real-world speeds:** While the peak data rates for 5G sound pretty impressive, actual speeds  
won’t be the same. The spec calls for user download speeds of 100Mbps and upload speeds of  
50Mbps.  
**Latency:** Latency, the time it takes data to travel from one point to another, should be at 4  
milliseconds in ideal circumstances, and at 1 millisecond for use cases that demand the utmost  
speed. Think remote surgeries, for instance.  
**Efficiency:** Radio interfaces should be energy efficient when in use, and drop into low-energy  
mode when not in use. Ideally, a radio should be able to switch into a low-energy state within 10  
milliseconds when no longer in use.  
**Spectral efficiency:** Spectral efficiency is “the optimized use of spectrum or bandwidth so  
that the maximum amount of data can be transmitted with the fewest transmission errors.” 5G  
should have a slightly improved spectral efficiency over LTE, coming in at 30bits/Hz downlink,  
and 15 bits/Hz uplink.  
**Mobility:** With 5G, base stations should support movement from 0 to 310 mph. This means the  
base station should work across a range of antenna movements — even on a high-speed train.  
While it’s easily done on LTE networks, such mobility can be a challenge on new millimeter  
wave networks.  
**Connection density:** 5G should be able to support many more connected devices than LTE.  
The standard states 5G should be able to support 1 million connected devices per square  
kilometer. That’s a huge number, which takes into account the slew of devices that will power  
the Internet of Things (IoT).  
**What can 5G do?  
Improve broadband:**The shift to 5G will undoubtedly change the way we interact with technology on a day-to-day  
basis, but it’s also an absolute necessity if we want to continue using mobile broadband. Carriers  
are running out of LTE capacity in many major metropolitan areas. In some cities, users are  
already experiencing slowdowns during busy times of the day. 5G adds huge amounts of  
spectrum in bands that haven’t been used for commercial broadband traffic.  
**Autonomous vehicles:**Expect to see autonomous vehicles rise at the same rate that 5G is deployed across the U.S. In  
the future, your vehicle will communicate with other vehicles on the road, provide  
information to other cars about road conditions, and offer performance information to drivers and  
automakers. If a car brakes quickly up ahead, yours may learn about it immediately and  
preemptively brake as well, preventing a collision. This kind of vehicle-to-vehicle  
communication could ultimately save thousands of lives.  
**Public safety and infrastructure:**5G will allow cities and other municipalities to operate more efficiently. Utility companies will  
be able to easily track usage remotely, sensors can notify public works departments when drains  
flood or streetlights go out, and municipalities will be able to quickly and  
inexpensively install surveillance cameras.  
**Remote device control:**Since 5G has remarkably low latency, remote control of heavy machinery will become a  
reality. While the primary aim is to reduce risk in hazardous environments, it will also allow  
technicians with specialized skills to control machinery from anywhere in the world.  
**Health care:**The ultra-reliable low latency communications (URLLC) component of 5G could fundamentally  
change health care. Since URLLC reduces 5G latency even further than what you’ll see with  
enhanced mobile broadband, a world of new possibilities opens up. Expect to see improvements  
in telemedicine, remote recovery, and physical therapy via AR, precision surgery, and  
even remote surgery in the coming years.  
Remember massive Machine-Type Communications? mMTC will also play a key role in health  
care. Hospitals can create massive sensor networks to monitor patients, physicians can prescribe  
smart pills to track compliance, and insurers can even monitor subscribers to  
determine appropriate treatments and processes.  
**IOT:**One of the most exciting and crucial aspects of 5G is its effect on the Internet of Things. While  
we currently have sensors that can communicate with each other, they tend to require a lot of  
resources and are quickly depleting LTE data capacity.  
With 5G speeds and low latencies, the IOT will be powered by communications among sensors  
and smart devices (here’s MMTC again). Compared to current smart devices on the market,  
MMTC devices will require fewer resources, since huge numbers of these devices can connect  
to a single base station, making them much more efficient.  
**Where is 5G now?**So, when should you expect to see 5G in your neighborhood? Well, it depends on the  
neighborhood you live in. Some neighborhoods already have 5G access — meaning that all you  
need to take advantage of the blazingly fast speeds is a 5G-enabled smartphone. All of the major  
U.S. carriers are working furiously to build out 5G networks, yet deployment across the entire  
country will nonetheless take several years. If you’re interested in seeing if your city has access  
to 5G, check out this guide. It’s also worth noting that each carrier has a different 5G rollout  
strategy. This means your 5G experience may vary greatly depending on your carrier. Here are  
all the details we currently have concerning each carrier’s deployment plans.  
**Verizon:**In its quest to be the first carrier to provide 5G, Verizon began offering pre-standard fixed  
5G in homes in October 2018. Verizon’s fixed 5G service is currently available in portions of  
Houston, Indianapolis, Los Angeles, and Sacramento, California. Since then, however, Verizon  
has also started rolling out its mobile 5G offering — and so far has brought mobile 5G to  
dozens of cities around the country, including New York, Los Angeles, and more.

**Assignment NO 4**

Explain Robotics in detail?



ROBOTICS

Contents  
ROBOTICS.................................................................................................................. 2  
Historical Background .................................................................................................................................. 2  
Types of Robots .................................................................................................................................... 3  
Pre-Programmed Robots.......................................................................................................................... 3  
Humanoid Robots ..................................................................................................................................... 3  
Autonomous Robots ..................................................................................................................................... 3  
Teleoperated Robots ..................................................................................................................................... 4  
Augmenting Robots ..................................................................................................................................... 4  
Uses of Robots ..................................................................................................................................... 4  
Manufacturing............................................................................................................... 4  
Logistics....................................................................................................................... 4  
Home............................................................................................................................ 4  
Travel......................................................................................................................... 4  
Healthcare ..................................................................................................................................... 4  
Robots At Work: The Present Day ..................................................................................................................... 5  
Movement Of Materials..................................................................................................................... 5  
Hazardous Or Remote Duty Robots......................................................................................................................6  
How Robots Work ...................................................................................................................................... 6  
Mechanical Systems ..................................................................................................................................... 6  
Sensory Systems ..................................................................................................................................... 7  
Microcomputer-Driven Robots........................................................................................................................... 7  
Advancements............................................................................................................. 8  
ROBOTICS:  
Robotics is the intersection of science, engineering and technology that produces machines, called robots, that  
substitute for (or replicate) human actions. Pop culture has always been fascinated with robots. R2- D2.  
optimus Prime, WALL-E, These over-exaggerated, humanoid concepts of robots usually seem like a  
caricature of the real thing...or are they more forward thinking than we realize? Robots are gaining intellectual  
and mechanical capabilities that don’t put the possibility of a R2-D2-like machine out of reach in the future.  
As technology progresses, so too does the scope of what is considered robotics. In 2005, 90% of all robots  
could be found assembling cars in automotive factories. These robots consist mainly of mechanical arms  
tasked with welding or screwing on certain parts of a car. Today, we’re seeing an evolved and expanded  
definition of robotics that includes the development, creation and use of bots that explore Earth’s harshest  
conditions, robots that assist law-enforcement and even robots that assist in almost every facet of healthcare.  
While the overall world of robotics is expanding, a robot has some consistent characteristics:  
1. Robots all consist of some sort of mechanical construction. The mechanical aspect of a robot helps it  
complete tasks in the environment for which it’s designed. For example, the Mars 2020 Rover’s  
wheels are individually motorized and made of titanium tubing that help it firmly grip the harsh terrain  
of the red planet.  
2. Robots need electrical components that control and power the machinery. Essentially, an electric  
current (a battery, for example) is needed to power a large majority of robots.  
3. Robots contain at least some level of computer programming. Without a set of code telling it what to  
do, a robot would just be another piece of simple machinery. Inserting a program into a robot gives it  
the ability to know when and how to carry out a task.  
The robotics industry is still relatively young, but has already made amazing strides. From the deepest depths  
of our oceans to the highest heights of outer space, robots can be found performing tasks that humans couldn’t  
dream of achieving.  
Historical Background:  
The idea of a machine that looks and behaves like a human being goes back at least 2,000 years. According  
To Greek mythology, Hephaestus, the god of fire constructed artificial women out of gold. These women were  
able to walk, talk, and even to think.  
By the eighteenth century, scientists and inventors had created an impressive array of mechanical figures that  
looked and acted like humans and other animals. Swiss watchmaker Pierre Jacquet-Droz (1721–1790), and his  
son Henri-Louis (1752–1791), for example, designed and constructed animated dolls, called automata, and  
mechanical birds to help sell watches. One doll was able to play the piano, swaying in time with the music, and  
a young scribe who could write messages of up to 40 characters.  
The modern robot is considered today to have been built by Serb-American physicist, engineer, and  
inventor Nikola Tesla (1856–1943). He constructed a remote-operated boat and showed its abilities at an 1898  
exhibition in New York City. He also built remote vehicles for use in the air and on the ground. One of the first  
companies to build robots was Westinghouse in the 1930s. The company built Electro, which was  
programmed to talk, walk, and move its head and arms. The first electrically operated robot was built  
in England by American-born English neurophysiologist W. Grey Walter (1919–1977).  
Many of these early accomplishments had little practical value. They were built in order to impress or charm  
viewers, or to demonstrate the inventor’s creative and technological skills. That line of research continues  
today. Many modern robots have little function beyond demonstrating what can be done in building machines  
that more and more closely resemble the appearance and function of humans.  
One function for such robots is in advertising. They are used to publicize some particular product or to inform  
the public about the robots themselves. Robots of this kind are most commonly found at conventions,  
conferences, or other large meetings. As one example, a robot named Argon was used in April 1983 to walk a  
dog through a veterinary congress in London, England, promoting the “Pets Are Good People” program.  
Types of Robots:  
Mechanical bots come in all shapes and sizes to efficiently carry out the task for which they are designed.  
From the 0.2 millimeter-long “ robo bee” to the 200 meter-long robotic shipping vessel “vindskip,” robots are  
emerging to carry out tasks that humans simply can’t. Generally, there are five types of robots:  
Pre-Programmed Robots:  
Pre-programmed robots operate in a controlled environment where they do simple, monotonous tasks. An  
example of a pre-programmed robot would be a mechanical arm on an automotive assembly line. The arm  
serves one function — to weld a door on, to insert a certain part into the engine, etc , and it's, job is to  
perform that task longer, faster and more efficiently than a human.  
Humanoid Robots:  
Humanoid robots are robots that look like and/or mimic human behavior. These robots usually perform  
human-like activities (like running, jumping and carrying objects), and are sometimes designed to look like us,  
even having human faces and expressions. Two of the most prominent examples of humanoid robots  
are Hanson Robotics’ Sophia (in the video above) and Boston Dynamics’ Atlas.  
Autonomous Robots:  
Autonomous robots operate independently of human operators. These robots are usually designed to carry out  
tasks in open environments that do not require human supervision. An example of an autonomous robot would  
be the Roomba vacuum cleaner, which uses sensors to roam throughout a home freely.  
Tele operated Robots:  
Tele operated robots are mechanical bots controlled by humans. These robots usually work in extreme  
geographical conditions, weather, circumstances, etc. Examples of Tele operated robots are the human controlled submarines used to fix underwater pipe leaks during the BP oil spill or drones used to detect  
landmines on a battlefield.  
Augmenting Robots:  
Augmenting robots either enhance current human capabilities or replace the capabilities a human may have  
lost. Some examples of augmenting robots are robotic prosthetic limbs or exoskeletons used to lift hefty  
weights.  
Uses of Robots  
Manufacturing:  
The manufacturing industry is probably the oldest and most well-known user of robots. These robots and (robots that work alongside humans) work to efficiently test and assemble products, like cars and industrial  
equipment. It’s estimated that there are more than three million industrial robots in use right now.  
Logistics  
Shipping, handling and quality control robots are becoming a must-have for most retailers and logistics  
companies. Because we now expect our packages arriving at blazing speeds, logistics companies employ  
robots in warehouses, and even on the road, to help maximize time efficiency. Right now, there are robots  
taking your items off the shelves, transporting them across the warehouse floor and packaging them.  
Additionally, a rise in last-mile robots (robots that will autonomously deliver your package to your door)  
ensure that you’ll have a face-to-metal-face encounter with a logistics bot in the near future.  
Home  
It’s not science fiction anymore. Robots can be seen all over our homes, helping with chores, reminding us of  
our schedules and even entertaining our kids. The most well-known example of home robots is the  
autonomous vacuum cleaner Roomba. Additionally, robots have now evolved to do everything from  
autonomously mowing grass to cleaning pools.  
Travel  
Is there anything more science fiction-like than autonomous vehicles? These self-driving cars are no longer  
just imagination. A combination of data science and robotics, self-driving vehicles are taking the world by  
storm. Automakers, like Tesla, Ford, Waymo, Volkswagen and BMW are all working on the next wave of  
travel that will let us sit back, relax and enjoy the ride. Rideshare companies Uber and Lyft are also developing  
autonomous rideshare vehicles that don’t require humans to operate the vehicle.  
Healthcare:  
Robots have made enormous strides in the healthcare industry. These mechanical marvels have use in just  
about every aspect of healthcare, from robot-assisted surgeries to bots that help humans recover from injury in  
physical therapy. Examples of robots at work in healthcare are Toyota’s healthcare assistants, which help  
people regain the ability to walk, and “TUG,” a robot designed to autonomously stroll throughout a  
hospital and deliver everything from medicines to clean linens.  
Robots At Work: The Present Day:  
Robots have come to play a widespread and crucial role in many industrial operations today. These robots are  
almost always without human features — rather than the Jacquet-Droz doll-like style. The work that robots do  
can be classified into three major categories: in the assembly and finishing of products; in the movement of  
materials and objects; and in the performance of work in environmentally difficult or hazardous situations.  
The most common single application of robots is in welding. About one-fourth of all robots used by industry  
have this function. In a typical operation, two pieces of metal will be moved within the welding robot’s field  
and the robot will apply the heat needed to create the weld. Welding robots can have a variety of appearances,  
but they tend to consist of one large arm that can rotate in various directions. At the end of the arm is a welding  
gun that actually performs the weld.  
Closely related types of work now done by robots include cutting, grinding, polishing, drilling, sanding,  
painting, spraying, and otherwise treating the surface of a product. As with welding, activities of this kind are  
usually performed by one-armed robots that hang from the ceiling, project outward from a platform, or reach  
into a product from some other angle.  
There are some obvious advantages for using a robot to perform tasks such as these. They are often boring,  
difficult, and sometimes dangerous tasks that have to be repeated over and over again in exactly the same way.  
Why should a human be employed to do such repetitive work, robotics engineers ask, when a machine can do  
the same task just as efficiently?  
That argument can be used for many of the other industrial operations in which robots have replaced humans.  
Another example of such operations is the assembly of individual parts into some final product, as in the  
assembly of automobile parts in the manufacture of a car. At one time, only a crew of humans, each of whom  
had his or her own specific responsibility, could have done this kind of assembly: moving a body section into  
position, welding it into place, installing and tightening bolts, turning the body for the next operation, and so  
forth. In many assembly plants today, the assembly line of humans has been replaced by an assembly line of  
robots that does the same job, but more safely and more efficiently than was the case with the human team.  
Mechanical robots have been successfully built to evolve the automobile assembly. Such an robotic system  
would eliminate most or all the human element. Its replacement would consist of automatic controls that  
guarantee a level of accuracy and quality that is beyond human skills. Advanced computerization has resulted  
in assembly lines that are completely run by computers controlling numerous types of industrial robots. Such  
robots perform repetitive, elementary tasks, but also are increasingly able to regulate or adjust their own  
performance to changing situations.  
Movement of Materials:  
Many industrial operations involve the lifting and moving of large, heavy objects over and over again. For  
example, a particular process may require the transfer of steel ingots onto a conveyor belt and then, at some  
later point, the removal of shaped pieces of steel made from those ingots. One way to perform these operations  
is with heavy machinery operated by human workers. But another method that is more efficient and safer is to  
substitute robots for the human and his or her machine.  
Another type of heavy-duty robot is an exoskeleton, that is, a metallic contraption that surrounds a human  
worker. The human can step inside the exoskeleton, placing his or her arms and legs into the corresponding  
limbs of the exoskeleton. By operating the exoskeleton’s controls, the human can magnify his or her strength  
many times, picking up and handling objects that would otherwise be much too heavy for the operator’s own  
capacity.  
Mobile robots are used for many heavy-duty operations. The robots operate on a system of wheels or legs, on a  
track, or with some other system of locomotion. They pick up a material or an object in one location and move  
it to a different location. The robots need not be designed to handle very large loads only. As an example, some  
office buildings contain tracks along which mobile robots can travel delivering mail to various locations within  
the building.  
As another example of robots in everyday usage, automated guided vehicles (AGVs) are used in medical  
facilities, such as hospitals, to move materials such as medicines and supplies from one location to another  
with the use of markers. Some AGVs are laser-guided and do not even need markers to guide them.  
Consumers not are seeing advertisements for vacuum cleaners and lawn mowers that are robots. The  
RoboMower® from the company Friendly Robotics, is advertised to cut grass automatically without the use of  
human effort, gasoline, oil and harmful environmental emissions.  
Hazardous Or Remote Duty Robots:  
A common application of robots is for use in places that humans can go only at risk to their own health or  
safety or that humans cannot go at all. Industries where nuclear materials are used often make use of robots so  
that human workers are not exposed to the dangerous effects of radioactive materials. In one type of machine,  
a worker sits in a chair and places his or her hands and arms into a pair of sleeves. The controls within the  
sleeves are connected to a robot arm that can reach into a protected area where radioactive materials are kept.  
The worker can operate the robot arm and hand to perform many delicate operations that would otherwise have  
to be carried out by a human worker.  
Robots have also been useful in space research. In 1975, for example, two space probes, code-named Viking 1  
and Viking 2, landed on the planetMars. These probes were two of the most complex and sophisticated robots  
ever built at that time. Their job was to analyze the planet’s surface. In order to accomplish this task, the  
probes were equipped with a long arm that was able to operate across a 120° radius, digging into the ground  
and taking out samples of Martian soil. The samples were then transported to one of three chemical  
laboratories within the robot, where they underwent automated chemical analysis. The results of these analyses  
were then transmitted by automatic telemetry to receiving stations on the Earth.  
How Robots Work:  
In order for a robot to imitate the actions of a human being, it has to be able to perform three fundamental  
tasks. First, it must be conscious of the world around it, just as humans obtain information about the world  
from five senses. Second, the robot must somehow be programmed to know what to do. One way for it to get  
that knowledge is to have a human prepare a set of instructions that are then implanted into the robot’s brain  
(central processing center). Alternatively, it must be able to analyze and interpret data it has received from its  
senses and then make a decision based on that data as to how it should react. Third, the robot must be able to  
act on the instructions or data it has received.  
Not all robots have all of these functions. For example, some of the earliest ‘for fun’ robots like the Jacquet -Droz doll and scribe knew what to do because of the instructions that had been programmed into them by their  
inventors. The inventors also gave their toys the mechanical means with which to carry out their instructions:  
arms, fingers, torsos, eyes, and other body parts that were able to move in specific ways.  
Mechanical Systems:  
The human-like movements that a robot makes as it works can be accomplished with a relatively small number  
of mechanical systems. One of those systems is known as the rectangular or Cartesian coordinate system. This  
system consists of a set of components that can move in any one of three directions, all at right angles to each  
other.  
Think of a three-dimensional system in which an x-axis and a y-axis define a flat plane. Perpendicular to that  
plane is a third axis, the z-axis. A rule can be made to travel along the x-axis, along the y-axis, or along the zaxis. Overall, the ruler has the ability to move in three different directions, back and forth along the xand yaxes and up and down along the z-axis. A system of this type is said to have three degrees of freedom because  
it has the ability to move in three distinct directions.  
Another type of mechanical system is the cylindrical coordinate system. This system consists of a cylinder  
with a solid column through the middle of it. The cylinder can move up and down on the column (one degree  
of freedom), and an arm attached to the outside of the cylinder can rotate around the central column (a second  
degree of freedom). Finally, the arm can be constructed so that it will slide in and out of its housing attached to  
the cylinder (a third degree of freedom).  
A third type of mechanical system is the spherical coordinate system. To understand this system, imagine a  
rectangular box-shaped component attached to a base. The box can rotate on its own axis (one degree of  
freedom) or tilt up or down on its axis (a second degree of freedom). An arm attached to the box may also be  
able to extend or retract, giving it a third degree of freedom.  
Many robots have more than three degrees of freedom because they consist of two or more simple systems  
combined with each other. For example, a typical industrial robot might have one large arm constructed on a  
Cartesian coordinate system. At the end of the arm, there might then be a wrist-type component with the same  
or a different mechanical system. Attached to the wrist might then be a hand with fingers, each with a  
mechanical system of its own. Combinations of mechanical systems like this one make it possible for an  
industrial robot to perform a variety of complex maneuvers not entirely different from those of a human arm,  
wrist, hand, and finger.  
Sensory Systems:  
The component of modern robots that was most commonly missing from their early predecessors was the  
ability to collect data from the outside world. Humans accomplish this task, of course, by means of hands,  
eyes, ears, noses, and tongues. With some important exceptions, robots usually do not need to have the ability  
to hear, smell, or taste things in the world around them, but they are often required to be able to see an object  
or to feel it.  
The simplest optical system used in robots is a photoelectric cell. A photoelectric cell converts light-energy  
into electrical energy. It allows a robot to determine yes/no situations in its field of vision, such as whether a  
particular piece of equipment is present or not. Suppose, for example, that a robot looks at a place on the table  
in front of it where a tool is supposed to be. If the tool is present, light will be reflected off it and sent to the  
robot’s photoelectric cell. There, the light waves will be converted to an electrical current that is transmitted to  
the robot’s computer-brain.  
More complex robot video systems make use of television cameras. The images collected by the cameras are  
sent to the robot’s brain, where they are processed for understanding. One means of processing is to compare  
the image received by the television camera with other images stored in the robot’s computer-brain.  
The human sense of touch can be replicated in a robot by means of tactile sensors. One kind of tactile sensor is  
nothing more than a simple switch that goes from one position to another when the robot’s fingers come into  
contact with a solid object. When a finger comes into contact with an object, the switch may close, allowing an  
electrical current to flow to the brain. A more sophisticated sense of touch can be provided by combining a  
group of tactile sensors at various positions on the robot’s hand. This arrangement allows the robot to estimate  
the shape, size, and contours of an object being examined.  
Microcomputer-Driven Robots:  
Probably the most important development in the history of robotics has been the evolution of the  
microcomputer. The microcomputer makes it possible to store enormous amounts of information as well as  
huge processing programs into the brain of a robot. With the aid of a microcomputer, a robot can not only be  
provided with far more basic programming than had been possible before, but it can also be provided with the  
programming needed to help the robot teach itself, that is, to learn. For example, some computers designed to  
carry out repetitious tasks have developed the ability to learn from previous mistakes and, therefore, to work  
more efficiently in the future.  
Advancements:  
Robots are increasing used in hazardous conditions, such as bomb disposal robots that are used in the military.  
The iRobot Pack bot is an explosive ordinance disposal (EOD) robot that is used when explosives are involved.  
Onboard the Pack bot are cameras, laser pointers, sensors, and other equipment that can sense explosive  
materials. When identified as such, the robot is able to defuse the explosive so soldiers are not placed in  
danger. As of November 2006, hundreds of Pack Bots had been deployed by the United States military in  
the countries of Afghanistan and Iraq.  
Other robots are being designed and constructed for more mundane efforts. Robots are being developed to  
provide companionship to people (social robots) such as robotic pets. Sony’s AIBO pet dog is designed with a  
variety of preprogrammed behaviors. However, based on human interactions, the robot can learn other new  
behaviors. The dog is programmed to play with its pink ball, however, by petting the dog’s head repeatedly,  
for example, it will begin to like such activity.