

## 8. History of Computers: From Abacus to Smart-phones

**Aim:** In this lesson, you will learn:

Various devices that have been used for computations in the past.

Major milestones in development of modern day computers

Development of Internet, browser and other Internet based applications, games and Linux.



Jyoti and Tejas have brought things like abacus, some pictures of old computers, a handmade slide rule, a cloth with nice designs, some notes written on sheets of paper. Others are looking on and wondering, how these articles are related to history of computers.

Jyoti: We have gathered history of computers right from 3rd century B.C. It is very interesting to find, what they did when there were no computers  i. Information gathering

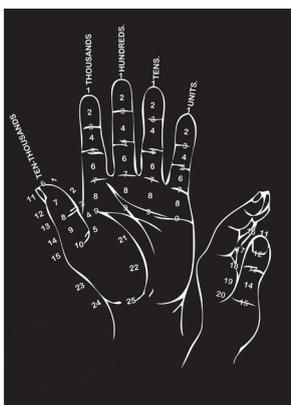
Moz: We have been using the computers for the past 40 years. But the origin of the concepts, algorithms and the developments in computations date back to the very early cultures.

Tejas: In very early days that is in B.C, when there were no computational devices, people used pebbles, bones and the fingers of hands to count and calculate.

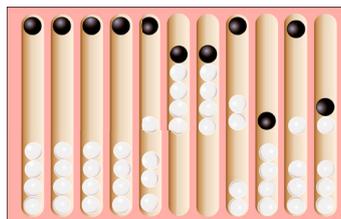
Jyoti: They even used ropes and shapes for some measurements. For example: For assuring a right angle, people used 3-4-5 right triangle shape or a rope with 12 evenly spaced knots, which could be formed into a 3-4-5 right triangle.

### Use of counters to aid calculations: 3<sup>rd</sup> - 6<sup>th</sup> century B.C

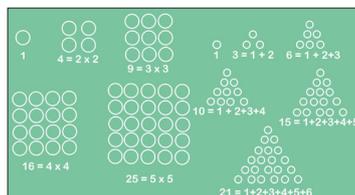
Requirement of simple calculations were done in innovative ways with stones, pebbles and they even used bones. These were called counters. We can find many versions of the abacus now with more complicated calculation abilities.



Calculation using fingers



Abacus – 6<sup>th</sup> century B. C



Computing Squares and sums by arranging counters

Cross Out Multiples of 2												
2	3	<del>4</del>	5	<del>6</del>	7	<del>8</del>	9	<del>10</del>	11	<del>12</del>	13	
<del>14</del>	15	<del>16</del>	<del>17</del>	<del>18</del>	19	<del>20</del>	21	<del>22</del>	<del>23</del>	<del>24</del>	25	
<del>26</del>	27	<del>28</del>	<del>29</del>	<del>30</del>	31	<del>32</del>	<del>33</del>	<del>34</del>	<del>35</del>	<del>36</del>	37	
Cross Out Multiples of 3												
2	3	<del>4</del>	5	<del>6</del>	<del>7</del>	8	9	<del>10</del>	<del>11</del>	<del>12</del>	13	
<del>14</del>	15	<del>16</del>	<del>17</del>	<del>18</del>	19	<del>20</del>	21	<del>22</del>	<del>23</del>	<del>24</del>	25	
<del>26</del>	27	<del>28</del>	<del>29</del>	<del>30</del>	31	<del>32</del>	<del>33</del>	<del>34</del>	<del>35</del>	<del>36</del>	37	
Cross Out Multiples of 5												
2	3	<del>4</del>	5	<del>6</del>	<del>7</del>	<del>8</del>	9	<del>10</del>	<del>11</del>	<del>12</del>	13	
<del>14</del>	15	<del>16</del>	<del>17</del>	<del>18</del>	19	<del>20</del>	21	<del>22</del>	<del>23</del>	<del>24</del>	25	
<del>26</del>	27	<del>28</del>	<del>29</del>	<del>30</del>	31	<del>32</del>	<del>33</del>	<del>34</del>	<del>35</del>	<del>36</del>	37	

Sieve of Eratosthenes: Finding prime numbers in 3<sup>rd</sup> century B.C



i. The first step for gathering information is to list what you know, what you do not know. Next, gather, consolidate, analyse and organise the gathered information.

Tejas: Many such algorithms were developed around the world by early mathematicians like Panini, Euclid, Leibniz and others.

Jyoti: Yes. By the middle of 16<sup>th</sup> century explorations of various continents and trading brought in the requirements of precise calculations of sea routes, accounting, etc. Some mechanical devices were also developed to assist in tedious and repetitive calculations like generating calendars of a year, taxing, trading.

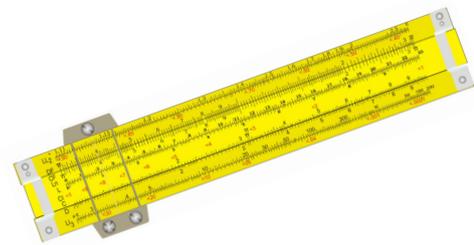
Tejas: The first computers were people. This was a job title given to people who did repetitive calculations for navigational tables, planetary positions and other such requirements.

Jyoti: Mostly women with mathematical proficiency were employed for the job.

**Simple devices to aid human calculations- 16th century**

Explorations of various continents and trading brought in the requirements of precise calculations of sea routes, accounting, planetary positions, and navigational tables- 16<sup>th</sup> century.

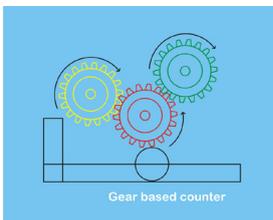
1	1	2	3	4	5	6	7	8	9
2	2	4	6	8	10	12	14	16	18
3	3	6	9	12	15	18	21	24	27
4	4	8	12	16	20	24	28	32	36
5	5	10	15	20	25	30	35	40	45
6	6	12	18	24	30	36	42	48	54
7	7	14	21	28	35	42	49	56	63
8	8	16	24	32	40	48	56	64	72
9	9	18	27	36	45	54	63	72	81



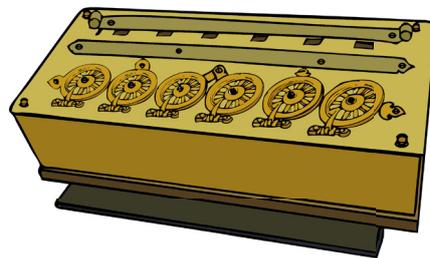
Napier bones- Numbers 0 to 9 were marked on a set of ivory sticks in such a way that the product of any number can be found by placing the sticks side by side.

The Slide rule was used for landing man on the Moon. This was used by NASA engineers in 1960s for Apollo mission also.

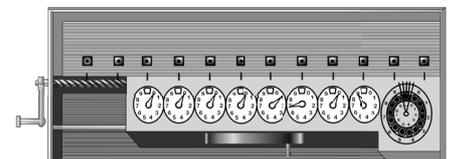
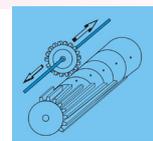
**Devices with gears and flutes for calculations- 16th-17th century**



Schikard's calculating clock with gears



Pascaline built by Pascal for his father who was a tax collector.



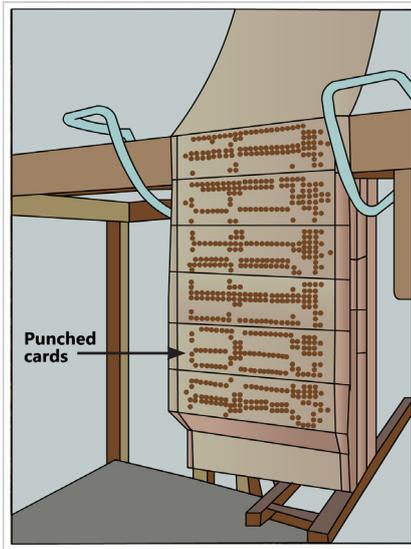
Stepped reckoner by Leibniz using flutes.

Tejas: I am sure they must have needed a lot of calculations, to build pyramids and Taj Mahal, to weave the designs for the beautiful old tapestry that we see in many places and also when they wanted to travel from one place to another.

Moz: Good observations. So they started inventing devices for precise calculations and automation of certain tasks. One of the important automation which is the Jacquard loom is important in the computer history.

## Automation with punched cards 18<sup>th</sup>-19<sup>th</sup> century

Trade, travel, and increase in population (which demanded increase in requirements like clothing, food etc.), led to automation of machinery in 18<sup>th</sup>-19<sup>th</sup> century.



Jyoti: The Jacquard loom invented by Joseph Marie Jacquard used punched cards to control a sequence of operations. A pattern of the loom's weave could be changed by changing the punched card.

Moz: Why do you think Jacquard looms are important?

Tejas: In Scratch programming, the computer takes the blocks one by one and executes them. The loom too weaves line by line in a sequence the design on the punched card.

Jyoti: In computers we use some input device like keyboard to input data. The punched card is like an input to the loom.

Moz: Yes. You are right. Babbage used the punched card idea, to store data in his analytical machine.

Tejas: Boolean algebra which is extensively used in computers was also developed in 19<sup>th</sup> century by the mathematician George Boole.

Moz: Yes. This is one of the most important concepts in computers. You will be learning about these constructs of programming soon. Note that the 19<sup>th</sup> century contributions of automating and the development of algorithm are of immense value to the development of electronic computers in the next century.

## Mechanical computation machines- 19<sup>th</sup> century

Developments in logic and need for more complicated calculations led to mechanical computation devices which were designed and implemented for varied degree of computations. But, accuracy, speed and precision could not be ensured due to the wear and tear of the mechanical components.

### Mechanical computation machines- Earlier 19<sup>th</sup> century

#### Babbage- The Analytical Machine

The analytical machine was designed but not built. The main parts of his machine were called the "store" and "mill". Punched card store data, which is equivalent to the memory unit in computers. Mill weaves or processes the data to give a result, which is equivalent to the central processing unit in computers. He used conditional processing of data. Example: If block in Scratch.



#### ADA Lovelace- The first programmer

ADA Lovelace, a friend of Babbage wrote the first sequence of instructions for various tasks for the analytical engine. Used programming concept of looping for repetitive actions. Example: repeat block in Scratch. She used subroutines in her programs.



#### Hollerith desk

It consisted of a card reader which sensed the holes in the cards, a gear driven mechanism which could count and a large wall of dial indicators to display the results of the count. For example: a car speedometer is a dial indicator. This was used for U.S census 1890.

Tejas: Early 20<sup>th</sup> century saw many analog computers which were mechanical or electrical or electro mechanical devices.

Jyoti: These were for limited purpose like solving some mathematical equations, decoding messages, or for tables of firing artillery in world war II.

Moz: Yes. These computers were based on binary representation of data and boolean algebra.

### Analog computers- First general purpose computers- first half of 1900-1940

The war time requirements for artillery firing, communication of strategies using complicated codes led to electromechanical computers where magnetic storage and vacuum tubes were first used. Babbage's punched card was used to input data.

#### Mechanical computation machines - 19<sup>th</sup> century

Info

**1936- Alan Turing** regarded to be the father of modern Computer Science provided a formalisation for the concept of algorithm and computations.

**1941- Konrad Zuse** inventor of the program-controlled computer, built the first working computer. This computer was based on magnetic storage.

**1942- Atanasoff-Berry** computer which used vacuum tube, binary numbers, was non programmable.

**1943- Colossus** a secret British computer with limited programmability built using vacuum tubes, was built to break the German wartime codes. It was the first computer to read and decipher the codes using cryptography.

**1944- Harvard Mark I** an electromechanical computer built out of switches, relays, rotating shafts, and clutches had limited programmability. It used punched paper tape instead of the punched cards. It worked for almost 15 years. **Grace Hopper** was the primary programmer. She invented the first high level language called **Flow-Matic** which later developed into COBOL. She also constructed the first compiler. She found the first computer "bug": a dead moth that got into the Mark I and whose wings were blocking the reading of the holes in the paper tape. The word "bug" had been used to describe a defect since at least 1889 but Hopper is credited with coining the word "debugging" to describe the work to eliminate program faults.

Jyoti: Next there was something called the "Stored program architecture" of Von Neumann in 1945. With this architecture rewiring was not required to change a program.

Moz: Yes. The program and data was stored in memory and instructions were processed one after the other.

Tejas: The input was typed on a terminal which looks like a monitor with keyboard in the front or on cards. Each instruction was typed on one card and the deck of cards was read by a card reader and stored in memory.

Moz: Yes. And those who submitted the program had to wait till their program was processed and output printed and given to them.

Jyoti: If they had to change the program, they have to type in another card and insert in the deck of cards.

### Digital computers- 1940 to 1970

Census, elections, research in various fields and many more such advances in every field required increased speed, precision, immediate results. Stored program digital computer architecture was designed with CPU, memory to hold instructions and data around 1946.

These computers were built using vacuum tubes, transistors, integrated circuits which are classified into the first three generations of computers. The classification of generations has been done based on technology, speed, storage, reliability and cost.

### Computation machines- Second half of 19<sup>th</sup> century

Info

#### First generation computers

These computers were named Eniac, Edvac, and Univac. These computers were made of **vaccum tubes** way back in 1945-55. They were huge in size and very costly to maintain.

#### Second generation computers

These computers developed after 1955, had transistors in the place of vaccum tubes. **Trasistors** were more reliable, much cheaper and smaller. This generation had more computing power, were smaller in size, easier to maintain and were more affordable than the previous generation.

#### Third generation computers

These computers developed in the 1960's, used **integrated circuits**. The trasistors were miniaturised and kept on silicon chips called the semiconductors which drastically increased the speed and efficiency of computers.

Jyoti: Microprocessor revolution brought in the explosion of usage of computers in every field.

Tejas: The size of computers started decreasing and the speed started increasing.

Jyoti: The storage space also started increasing.

Tejas: Most importantly the reliability of computers increased and the cost started decreasing.

Moz: Yes. Invention of microprocessors revolutionised the computer development and due to the reduction of cost, by 1990 students could own a personal computer.

### Computers with Microprocessors- 1970 onwards

Use of microprocessors in computers increased reliability, precision and reduced size and cost. This led to uses of computers in offices, colleges, personal use and exploration of computer usage in every field.

### Computation machines- After 1970's

Info

#### Fourth generation computers

These were developed in the 1970's and used **microprocessors** or **chips**. The microprocessors were smaller than a postage stamp and had tremendous computing capabilities.

#### Fifth generation computers

These were developed in 1980's and used the concept of **Artificial intelligence**. The different types of fifth generation computers are Desktop, notebook or laptop, palmtop, server, Mainframe and Super Computer.

- Desktop computers are based on IC's.
- Notebook or laptop computer is same as desktop but can be carried around.
- Palmtop is a miniature version of notebook with limited capabilities.
- Server is a powerful version of desktop capable of catering to various applications in a network environment.
- Mainframe is a powerful version of server and is capable of handling huge applications and data processing.
- Super computer has multiprocessors to perform typical scientific applications that need trillions of information per second while processing.

Jyoti: Computer are also being used in many devices like the phones, household machines like washing machines.

Tejas: These are very small computers which cannot be programmed but are meant to help in the operation of these devices.

Moz: These are called embedded devices.

## Late 20th century - Networking, Smart phones and FOSS

Tejas: We have also collected some information about the history of networking and related technologies that revolutionized many aspects of our daily life like communication, buying tickets, banking, information and much more.

Networking	
Networking	On the evening of October 29, 1969 the first data travelled between two nodes of the ARPANET, a key ancestor of the Internet. The men who symbolically turned the key on the connected world we know today were two young programmers, Charley Kline at UCLA and Bill Duvall at SRI in Northern California, using special equipment made by BBN in Cambridge, Massachusetts.
Internet 	In 1977 Cerf and Kahn successfully linked three networks in a dramatic round-the-world transmission from a cruising van. The Internet was born.
Inventing the Web2 major milestones	1. At the world's biggest physics laboratory, CERN in Switzerland, English programmer and physicist Tim Berners-Lee created "WorldWideWeb" on an advanced NeXT computer in 1990. It featured a server, HTML, URLs, and the first browser. This browser also functioned as an editor, like a word processor connected to the Internet – which reflected his original vision that the Web also incorporate authoring and personal organization tools. 2. The world's first popular browser one of the first graphical web browsers Andreesen's Mosaic (later Netscape)– led to an explosion in web use in 1993, made the World Wide Web system easy to use and more accessible to the average person and sparked the internet boom of the 1990s.
Web browsers 	1994 – Netscape navigator 1995 Microsoft released it's Internet Explorer 1996 Opera focused on mobile phone web browsers and was preinstalled on over 40 million phones. It is also available on embedded systems and Nintendo's In WII games console. 1998 Netscape launched Mozilla foundation to provide a competitive open source web browser which has led to the current firefox. 2003 Apple's safari was released 2009 Google's Chrome
Search engines	Early search engines: 1990 Archie, 1991 Veronica and Jughead 1992 Vlib (Berners and Lee), 1993 Excite (Stanford undergrads), Aliweb (Martijn Korster). Some of the popular search engines: 1994 Altavista, Yahoo, webcrawler; 1996 Google, Hotbot, Ask jeeves; 1998 MSN. Many more came in later. Some of the latest additions are as follows: 2009-2010 Cuil (Managed by previous google employees), Bing (Msn's live search).

## Services on internet

Info

<b>Email</b>	<b>1972</b> Ray Tomlinson who worked as an ARPANET contractor is credited with inventing email in 1972. He picked the @ symbol from the computer keyboard to denote sending messages from one computer to another (name-of-the-user@name-of-the-computer). Current count of email users internationally is more than 600 million.
<b>Video conferencing</b>	<b>1990</b> Ericsson company initiated video conferencing services which was adopted initially by business firms all over the world.
<b>CHAT</b>	<b>1988</b> Internet Relay Chat was introduced and it did not take long to become popular. Soon, other varieties of chat like voice and video chat evolved.
<b>E-Commerce</b>	<b>1960</b> E-commerce services (buying and selling of products) evolved from the development of EDI or Electronic Data Exchange technology.

Jyoti: The other most important part of the computer technology is Open source. It is interesting to note that professionals and hobbyists improve on the Open source operating systems, applications and information. We too can contribute content on internet.

## Linux (Open source operating system):

Info

Torvald released his Linux operating system in 1994. A global community of professionals and hobbyists has continually improved it. Academicians, corporations, businesses, governments and many more users have adopted it. Later on many flavors of linux evolved a few of which are Suse, Fedora, Ubuntu, android for mobiles.

Tejas: Games on computers also has interesting history.

## Games

Info

<b>1952: Tic-Tac-Toe</b>	Donald Davies a computer researcher designed a machine to play Naughts and crosses or Tic-Tac-Toe. Davies later became an important pioneer in artificial intelligence (AI) which is used in designing games.
<b>1958: Tennis for Two</b>	William Higinbotham created the first video game called "Tennis for Two," which was created and played on a Brookhaven National Laboratory oscilloscope.
<b>1962: SpaceWar</b>	Steve Russell invented the first computer game SpaceWar on a MIT PDP-1 Mainframe computer. Interactive personal computing started after this invention as it ignited interest in programming on college campuses, pushed the limits of technology

Tejas: Currently (2011) we have very advanced smart phones which have many features available on a computer. For example we can browse internet, check email, play games. Smart phones of today date back to 1992.

## Smart phones

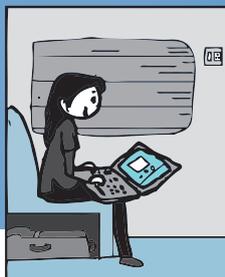
Info

**1992:** The first smartphone IBM Simon was designed in 1992 and released in 1993. It also contained a calendar, address book, world clock, calculator, note pad, e-mail client, the ability to send and receive faxes and games. It had no physical buttons, instead customers used a touchscreen to select telephone numbers with a finger or create facsimiles and memos with an optional stylus. Text was entered with a unique on-screen “predictive” (as one types the words are predicted and select the word) keyboard.

Moz: Good. You have covered the history of computers from Abacus to Smartphones.

Jyoti: We enjoyed reading about the history of computers and collecting important information for the presentation.

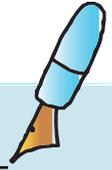
Moz: History teaches you not only how things were made but also how you can innovate and invent. Chin Chinaki...



## Learning Outcome

At the end of the lesson, you will be able to:

- List major milestones in the development of modern day computers and Internet.
- List names of person responsible for development of computer and related technologies



1. Given are some of the devices used for calculation. Can you arrange them in sequence of which appeared first?

Palmtop	Abacus	Eniac
Pebbles	Napier bones	Punched card reader
Desktop	Laptop	PascalTejasne

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2. Explain the factors which resulted in the inventions of devices like Napier bones, slide rule in the 16th century.

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3. Pick the right options.

I. Which one is not true about the fifth generation computers?

- These are cheaper.
- They are compact.
- They are reliable.
- They use transistors.

II. Which are the features of embedded devices?

- They are used in phones and washing machines.
- They can control multiple devices.
- They are small.
- User can do programming with them.

- a. Both i & ii    b. Both i & iii    c. Both ii & iv    d. Both iii & iv

4. List some advantages of fifth generation computers compared to the other generation computers.

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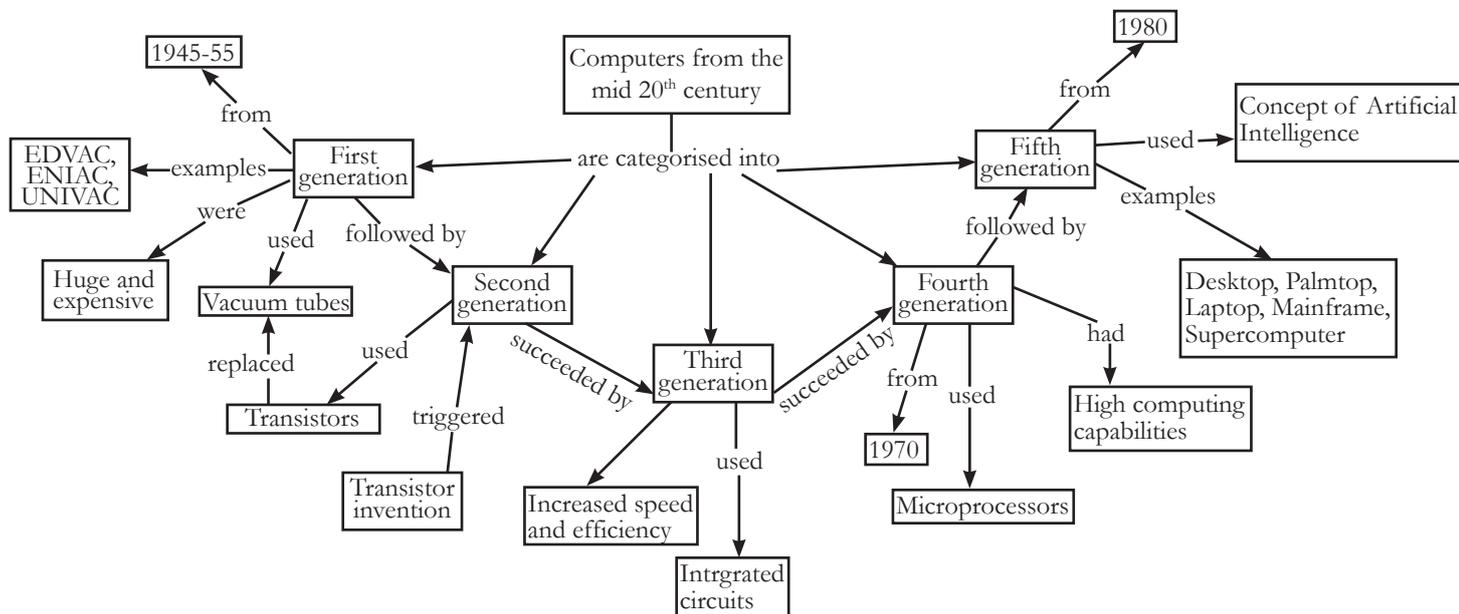
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5. Here is a picture which tells about the history of computers from mid twentieth century. Study the picture and answer the following questions.



a. From the figure can you tell which was the technology used in the first, second, third, fourth and fifth generation computers?

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b. Name two first generation computers.

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c. Which invention resulted in the evolution of Second generation computer?

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d. Give some examples of fifth generation computers.

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6. The recall icon in this lesson indicates a few places where concepts from previous levels are being applied.

a. Identify one more connect box in the lesson and justify your answer.

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## ACTIVITY

Level VII | Lesson 8

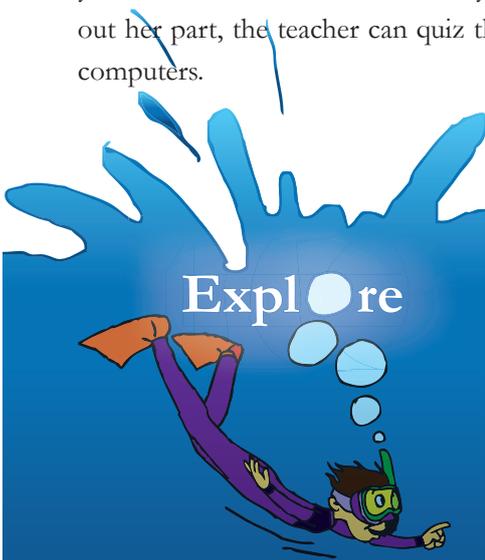
1. Select one of the following set of URLs and read the information on the website. Write three questions that test the knowledge of information you have just read here.
  - <http://www.csc.liv.ac.uk/~ped/teachadmin/histsci/htmlform/lect1.html>
  - <http://www.computersciencelab.com/ComputerHistory/History.htm>
  - <http://www.merchantos.com/articles/informational/the-history-of-the-computer/>
  - <http://www.computerhistory.org/timeline/?category=cmptr>
  - <http://www.hitmill.com/computers/computerhx1.html>
  - <http://www.inmagine.com/searchterms/abacus.html>
  - <http://www.fotosearch.com/photos-images/slide-rule.html>
  - [http://en.wikipedia.org/wiki/Stepped\\_Reckoner](http://en.wikipedia.org/wiki/Stepped_Reckoner)
  - [http://en.wikipedia.org/wiki/Jacquard\\_loom](http://en.wikipedia.org/wiki/Jacquard_loom)
2. Prepare a table of the information about developments in the field of computer over the period of time. Arrange the list chronologically as per the year in which it was developed. Include all the details about the invention such as the developer, purpose of use. Exchange it with your partner to find out if your table matches.
3. Find images of the machines that were invented prior to the present day personal computers. Prepare a collage using the same.
4. Select one of the following and write a short note on the history of its development.
  - Cell phone
  - Television
  - Internet
  - Email
  - Social networking

The following questions would help you:

When was it invented and by whom? For what purpose was it invented? Is the purpose for which it is used today different from what it was initially designed for? Can you include pictures that depict the different stages of its developments?

### Group activity

5. Students act out as computers of different period of time. One student acts as humans called computers, one as abacus and so on. This way cover all the historical developments included in the lesson such as Pascal's calculator, Napier bones, slide rules, analytic machine, punched card, Hollerith disk upto the present day embedded computers in cell phones and PDA. Now act out a skit where you share with the class details about when you were invented, who invented you and for what purpose you were used. After each character has acted out her part, the teacher can quiz the class on the details of the different machines that form the history of computers.



1. Find out when the first super computer was made in India. What was it called? For what purpose was it used?

- The objective of this lesson is to inform the students about the milestones that led to the development of modern day computers. The rationale is that students are able to appreciate the efforts that have been made in the past to make the present day convenience available to them.
- You can begin with a virtual tour to the computer history museum (url:insert from further reading) to take the students through the major developments. You can highlight that simultaneous developments have occurred in different locations, so it is possible that more than one person may be given a credit for a particular development.
- Summarize the major developments, year and person responsible for development by referring the info boxes of the lesson. You can use the Web quest strategy to allow students to collect information about major development and gather information from selected urls. (See activity 1). This will maintain the interest level of students and motivate them to learn on their own. Ask students to do worksheet question 5 in the class. Students already know how to read the concept map. If required, help them read it and answer the worksheet questions. You can give worksheet questions 1 to 4 as homework.
- Present generation of students have been born in an era where Internet connectivity is taken for granted. Encourage students to imagine what would be the difference in absence of these technologies. Inform them about the factors that led to the development of Internet and related technology. Summarize by saying that history teaches us not only about how things were made but also the process of innovation and invention.
- Students enjoy playing computer games, but are seldom aware of the history of its development. Refer the info box on games to tell them about its history. Now encourage students to find out about history of their favourite games.
- Most students would have seen and/or used Smart phone and may be aware of its functionalities. You can demonstrate a simulation of a smart phone to the class and tell them about the history of its development.
- Summarize the lesson and ask the students to do activity 5 (group activity) to reinforce learning of the topic.

#### Further Reading:

<http://www.computerhistory.org/>

<http://www.cbi.umn.edu/hostedpublications/Tomash/index.htm>

<http://www.computersciencelab.com/ComputerHistory/History.htm>