**Primitive Data Types**

**There are 8 primitive data types supported by Java**

**Primitive data types are predefined by the language and named by a keyword.**

**Byte**

* The byte data type is an 8-bit signed two’s complement integer.
* It has a maximum value of -128 and a maximum value of 127.
* The byte data type can be useful for saving memory in large arrays, where the memory savings actually matters.
* They can also be used in place of int where their limits help to clarify your code: the fact that a variable’s range is limited can serve as a form of documentation.

**Short**

* The short data type is a 16-bit signed two’s complement integer.
* It has a minimum value of -32,768 and a maximum value of 32,767
* As with byte, the same guidelines apply: you can use a short to save memory in large arrays, in situations where the memory savings actually matters.

**Int**

* The int data type is a 32-but signed two’s complement integer.
* It has a minimum value of -2,147,483,648 and a maximum value of 2,147,483,647
* For integral values, this data type is generally the default choice unless there is a reason (like the above) to choose something else.
* This data type will most likely be large enough for the numbers your program will use, but if you need wider range of values, use long instead.

**Long**

* The long data type is a 64-bit signed two’s complement integer.
* It has the minimum value of -9,223,372,036,854,775,808 and a maximum value of -9,223,372,036,854,775,807
* Use this data type when you need a range of values wider than those provide by int.

**Float**

* The float data type is a single-precision 32-bit floating point.
* As with the recommendations for byte and short, use a float (instead of double) if you need to save memory in large arrays of floating point numbers.
* This data type should never be used for precise values, such as currency.

**Double**

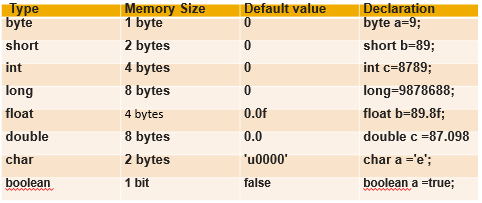
* The double data type is a double-precision 64-bit floating point.
* For decimal values, this data type is generally the default choice.
* As with float, this data type should never be used for precise values, such as currency

**Boolean**

* The Boolean data type has only two possible values: true and false.
* Use this data type for simple flags that track true/false conditions.
* This data type represents one bit of information, but its “size” isn’t something that’s precisely defined.

**Char**

* The char data type is a single 16-bit Unicode character.



**Complex data types**

These are non-primitive data types

* String
* Record
* Table
* 1-dimensional
* 2-dimensional

**String**

* String s a class built into the java language defined in the jave.lang package. It represents character strings.



* Strings are immutable, that is, they cannot be modified once they are created. Whenever it looks as if a string object was modified actually a new string was created.

**Records**

* A record is essentially a Java object that has instance variables only, but no instance methods.
* The data items in a record are called the fields of the record. Each item is referred to using a field name or in Java, the names of the instance variables. The distinguishing characteristics of a record are that the data items in the record are referred to by name and that different field in a record are allowed to be of different types.

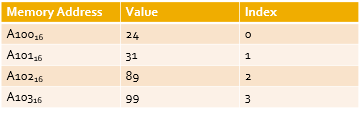
**Arrays in Java**

* An array is a collection of elements where each element is the same type
  + Element type can be primitive or Object
  + Each element is a single value
* Individual array elements are accessed via an index.
* Array index numbering start at 0.

See powerpoint point for creating array

**Mapping arrays to memory**

* Assuming our grades array starts at address A10016 and each address represents 2 bytes of storage, the array would be mapped to memory as shown below:



* In order to perform this mapping, we need to know the start address, the size of the data type being stored and the addressable nature of the computer system (number of bytes associated with each unique address). Fortunately, in practice, the system performs this mapping for us and as programmers we only need to know the array variable’s name and range of indexes.

**Memory Requirements**

* A user-defined type will need at least the sum of the memory for each of the attributes within the complex type. There may well be additional requirements dependent on the contract used.
* The amount of memory required for a table is dependent on the size requirement for each record and the number of records that need to be stored.

**XML**

* XML was designed to transport and store data.
* HTML was designed to display data

**What is XML**

* XML stands for Extensible Markup Language
* XML is a markup language much like HTML
* XML was designed to carry data, not to display data
* XML tags are not predefined. You must define your own tags
* XML is designed to be self-descriptive

**The difference between XML and HTML**

* XML is not a replacement for HTML
* XML and HTML were designed with different goals:
  + XML was designed to transport and store data, with focus on what data is.
  + HTML was designed to display data, with focus on what data looks
* HTML is about displaying information, while XML is about carrying the information
* XML is a complement to HTML

**XML is Used to Create New Internet Languages**

* A lot of new Internet Languages are created with XML
* Here are some examples:
  + XHTML the latest version of HTML
  + WSDL for describing available web services
  + WAP and WML as markup languages for handheld devices
  + RSS Languages for news feeds
  + RDF and owl for describing resources and ontology
  + SMIL for describing multimedia for the web

**Entity References**

* Some characters have a special meaning in XML.
* If you place a character like “<” inside an XML element, it will generate an error because the parser interprets it as the start of a new element.

This will generate an XML error:

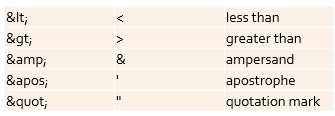
<message>if salary < 1000 then</message>

To avoid this error, replace the "<" character with an **entity reference**:

<message>if salary &lt; 1000 then</message>

**Entity References in XML**

* There are 5 predefined entity references in XML:
* **Note:** Only the characters “<” and “&” are strictly illegal in XML. The greater than characters are legal, but it is a good habit to replace it.



**XML Naming Rules**

* Names can contain letter, numbers, and other characters
* Names cannot start with a number or punctuation character
* Names cannot start with the letters xml (or XML, or Xml, etc)
* Names cannot contain spaces
* Any name can be used, no words are reserved

**What is sound?**

* Sound is a continuous wave that travels through the air
* It will not travel through a vacuum.
* The wave is made up of pressure differences
* Sound is detected by measuring the pressure level at a location.
* Sound is a wave phenomenon like light
* Sound waves have normal wave properties:
  + Reflection - sound wave reflecting off a surface
  + Reflection – is the bending of waves when they enter a medium
  + Diffraction – uses the edges of a barrier as a secondary sound source that sends waves in a direction

**Sound wave properties**

* The length of one complete wave is called the wavelength, and the number of completed waves that pass a fixed point in a fixed unit of time is the frequency of the wave.
* Amplitude – The measure of how powerful sound waves are in terms of pressure.

**Why Digitize**

* Microphones, video camera produce analogue signals
* To store audio or video data into a computer, we must digitize it by converting it into a stream or numbers
* Digitization means conversation to a steam of numbers and preferably these numbers should be integers for efficiency

**Analog vs Digital Signals**

* A continuously recorded sine wave signal usually recorded on a magnetic medium.

Picture3

* A waveform switches between two voltage levels representing the two states of a Boolean value (0 and 1)

Picture4

**Digitisation**

* Building digital liberties begins with creating digital content and collections
* Creating a digital object by converting a source object in analogue form
* What is a digital object?
  + Digital objects are individual entities in a digital collection
  + Any object which can be digitised can be a digital object

**Digitisation Process**

* Identification of the items for the collection
* Selection of the ‘kind’ if content
* Choice of formats
* Choice of hardware
* Choice of software
* Selection of medium
* Storage and archiving
* Management

**What is sampling?**

* A sample is a measurement of the pressure at a point in time
* In sampling the signal is measured in a series of instants
* Sampling is used to digitize analogue sound waves

**Sampling Rate**

* Sampling rate defines the number of samples per second taken from an analog signal to makes a digital signal
* Sampling rate determines the sound frequency range which can be represented in the digital waveform
  + High sampling rate preserves sound quality
  + Low sampling rate saves disk space but reduces quality sound

**Sampling Rate for Sound**

* 1000 samples per second is called a kilohertz (KHz)
* 8000 samples per second captures the essential characteristics of human voice.
  + This is the standard for telephone transmission.
* 44,100 samples per second captures CD quality sound
* DVD uses a sampling rate of up to 192,000 samples per second

**Bit Depth**

* Bit depth describes the numbers of bits per sample
* Bit depth directly corresponds to the resolution or each sample in a set of digital audio data
* Common sampling includes:
  + 8 bit depth (in CDs)
  + 16 bit depth (in DVDs)

**Digital Audio Quality**

* For a given sound wave, the quality of the digitized sound data is determined by
  + The sampling rate
  + The number of bits per sample

**Size of Digital Video Files**

* Size of Digital Video File dependent upon:
  + Window size
  + Frame rate
  + Number of colours
  + Compression Ratio
  + Audio file size
* File size= (*window size)* x (*frame* rate) x (*number of colours)* x (*compression ratio)* + (*audio file)*

**Window Size**

* Standard video is 640 x 480 pixels
* Most web video is smaller

**Frame rate**

* Broadcast video is 29.97 (30) fps
* Most web video is slower (15 fps)

**Number of Colours**

* Broadcast video is 24 bit (millions of colors, just like scanners)
* Some web video uses fewer colors
* Some compression schemes limit color choices

**Compression**

* Most digital video uses some type of compression
* Compression can be hardware or software based
* Compression schemes can be classified as special or temporal (or both)
* A CODEC is used to compress a media file, eliminating redundant data
* A CODEC is also used to decompress the file and play it on an end user’s computer