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**Lecture - 01**

**Breast Cancer Recurrence Prediction Problem as a Machine Learning Problem using Train-Test Split Approach**

**Breast Cancer Project**



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| **بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيْم** |



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| **Human Engineering** |

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| **تصحیح نیت** |

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| |  | | --- | | **حضرت محمد صلی اللہ علیہ وسلم نے فرمایا**  اِنَّمَا الْاَعْمَالُ بِالنِّـیَّاتِ  **ترجمہ:**  **اعمال کا دارومدار نیتوں پر ہے** |  * **اگر دنیا میں کسی نے کوئی کام کیا ہے تو آپ بھی کر سکتے ہیں** * **میں دل سے عمل کی نیت کرتا ہوں کہ** * **میری زندگی کا مقصد ہے خوش رہنا اور خوش رکھنا** * **میری زندگی کا مقصد اللہ کو پانا ہے** * **میری زندگی کا مقصد حضرت محمد صلی اللہ علیہ وسلم سے کامل عشق اور آپ صلی اللہ علیہ وسلم کی کامل اتباع ہے** * **میری زندگی کا مقصد اپنے شعبے میں پوری دنیا میں پہلے نمبر پر آنا ہے** * **میری زندگی کا مقصد مخلوق خدا کی بے لوث خدمت ہے** |

**The Best Method to Learn Anything is**

**DO IT YOURSELF** 😊

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| **زندگی کا مقصد** |

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| * **ہماری زندگی کا مقصد ۔ اللہ کو پانا** * **اللہ کو پانے کا مختصر ترین اورتیز ترین راستہ – مخلوق خدا کی بے لوث خدمت** |

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| **مشاہدہ سے یقین تک کا سفر** |

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| جس شخص نے بھی اللہ کو پایا ہے اس نے مشاہدہ سے یقین تک کا سفر طے کیا ہے  جو شخص مشاہدہ سے یقین کا سفر طے کر لیتا ہے اُس کو اللہ پاك کی رضا نصیب ہو جاتی ہے  مشاہدہ سے یقینتک کا سفر کیسے طے ہو ؟   1. اِس راستے کا مسافر مشاہدہ میں آنے والی ہر مخلوق ( شکل ) کا انکار کرتا چلا جائے 2. اِس شخص کا حال ( کردار) اِس بات کی گواہی دے گا کہ یہ شخص مشاہدہ سے یقین تک کے سفر کا مسافر ہے 3. اِس شخص کا حال ( کردار) ہی تاریخ ہے   حضرت ابراہیم علیہ السلام ہر مخلوق ( شکل) کا انکار فرماتے چلے گئے اور اللہ کو پا گئے ( مشاہدہ سے یقین تك کا سفر طے ہو گیا)  قرآن میں اللہ پاك فرماتے ہیں   |  | | --- | | **آیت مبارکہ**  وَ اِذۡ  قَالَ  اِبۡرٰہِیۡمُ لِاَبِیۡہِ  اٰزَرَ اَتَتَّخِذُ  اَصۡنَامًا  اٰلِہَۃً ۚ اِنِّیۡۤ   اَرٰىکَ وَ قَوۡمَکَ فِیۡ ضَلٰلٍ مُّبِیۡنٍ  کَذٰلِکَ نُرِیۡۤ  اِبۡرٰہِیۡمَ مَلَکُوۡتَ السَّمٰوٰتِ وَ الۡاَرۡضِ وَ لِیَکُوۡنَ مِنَ الۡمُوۡقِنِیۡنَ  فَلَمَّا جَنَّ عَلَیۡہِ الَّیۡلُ  رَاٰ کَوۡکَبًا ۚ قَالَ ہٰذَا  رَبِّیۡ ۚ فَلَمَّاۤ  اَفَلَ  قَالَ لَاۤ  اُحِبُّ  الۡاٰفِلِیۡنَ  فَلَمَّا رَاَ  الۡقَمَرَ بَازِغًا  قَالَ ہٰذَا رَبِّیۡ ۚ فَلَمَّاۤ  اَفَلَ قَالَ  لَئِنۡ  لَّمۡ  یَہۡدِنِیۡ رَبِّیۡ لَاَکُوۡنَنَّ مِنَ  الۡقَوۡمِ  الضَّآلِّیۡنَ  فَلَمَّا رَاَ الشَّمۡسَ بَازِغَۃً  قَالَ ہٰذَا رَبِّیۡ ہٰذَاۤ  اَکۡبَرُ ۚ فَلَمَّاۤ  اَفَلَتۡ قَالَ یٰقَوۡمِ  اِنِّیۡ بَرِیۡٓءٌ  مِّمَّا تُشۡرِکُوۡنَ  اِنِّیۡ وَجَّہۡتُ وَجۡہِیَ لِلَّذِیۡ فَطَرَ السَّمٰوٰتِ وَ الۡاَرۡضَ حَنِیۡفًا وَّ مَاۤ اَنَا مِنَ الۡمُشۡرِکِیۡنَ  وَ حَآجَّہٗ  قَوۡمُہٗ ؕ قَالَ  اَتُحَآجُّوۡٓنِّیۡ  فِی اللّٰہِ وَ قَدۡ ہَدٰىنِ ؕ وَ لَاۤ  اَخَافُ مَا تُشۡرِکُوۡنَ بِہٖۤ  اِلَّاۤ  اَنۡ یَّشَآءَ رَبِّیۡ شَیۡئًا ؕ وَسِعَ رَبِّیۡ کُلَّ شَیۡءٍ عِلۡمًا ؕ اَفَلَا تَتَذَکَّرُوۡنَ  وَ کَیۡفَ اَخَافُ مَاۤ  اَشۡرَکۡتُمۡ وَ لَا  تَخَافُوۡنَ  اَنَّکُمۡ  اَشۡرَکۡتُمۡ بِاللّٰہِ مَا لَمۡ یُنَزِّلۡ بِہٖ عَلَیۡکُمۡ سُلۡطٰنًا ؕ فَاَیُّ الۡفَرِیۡقَیۡنِ  اَحَقُّ  بِالۡاَمۡنِ ۚ اِنۡ  کُنۡتُمۡ  تَعۡلَمُوۡنَ  اَلَّذِیۡنَ اٰمَنُوۡا وَ لَمۡ یَلۡبِسُوۡۤا اِیۡمَانَہُمۡ بِظُلۡمٍ  اُولٰٓئِکَ لَہُمُ الۡاَمۡنُ وَ ہُمۡ مُّہۡتَدُوۡنَ  **ترجمہ**  **اور ( اس وقت کا ذکر سنو ) جب ابراہیم نے اپنے باپ آزر سے کہا تھا کہ :   کیا آپ بتوں کو خدا بنائے بیٹھے ہیں؟ میں دیکھ رہا ہوں کہ آپ اور آپ کی قوم کھلی گمراہی میں مبتلا ہیں ۔**  **اور اسی طرح ہم ابراہیم کو آسمانوں اور زمین کی سلطنت کا نظارہ کراتے تھے ، اور مقصد یہ تھا کہ وہ مکمل یقین رکھنے والوں میں شامل ہوں**  **چنانچہ جب ان پر رات چھائی تو انہوں نے ایک ستارا دیکھا ۔ کہنے لگے : یہ میرا رب ہے**  **پھر جب وہ ڈوب گیا تو انہوں نے کہا : میں ڈوبنے والوں کو پسند نہیں کرتا ۔**  **پھر جب انہوں نے چاند کو چمکتے دیکھا تو کہا کہ : یہ میرا رب ہے ۔ لیکن جب وہ بھی ڈوب گیا تو کہنے لگے : اگر میرا رب مجھے ہدایت نہ دیتا تو میں یقینا گمراہ لوگوں میں شامل ہوجاؤں ۔**  **پھر جب انہوں نے سورج کو چمکتے دیکھا تو کہا : یہ میرا رب ہے ۔ یہ زیادہ بڑا ہے ۔ پھر جب وہ غروب ہوا تو انہوں نے کہا : اے میری قوم ! جن جن چیزوں کو تم اللہ کی خدائی میں شریک قرار دیتے ہو ، میں ان سب سے بیزار ہوں**  **میں نے تو پوری طرح یکسو ہو کر اپنا رخ اس ذات کی طرف کرلیا ہے جس نے آسمانوں اور زمین کو پیدا کیا ہے ، اور میں شرک کرنے والوں میں سے نہیں ہوں ۔**  **اور (پھر یہ ہوا کہ) ان کی قوم نے ان سے حجت شروع کردی ۔ ابراہیم نے (ان سے) کہا : کیا تم مجھ سے اللہ کے بارے میں حجت کرتے ہو جبکہ اس نے مجھے ہدایت دے دی ہے ؟ اور جن چیزوں کو تم اللہ کے ساتھ شریک مانتے ہو ، میں ان سے نہیں ڈرتا ( کہ وہ مجھے کوئی نقصان پہنچا دیں گی ) الا یہ کہ میرا پروردگار ( مجھے ) کچھ ( نقصان پہنچانا ) چاہے ( تو وہ ہر حال میں پہنچے گا ) میرے پروردگار کا علم ہر چیز کا احاطہ کیے ہوئے ہے ۔ کیا تم پھر بھی کوئی نصیحت نہیں مانتے؟**  **اور جن چیزوں کو تم نے اللہ کا شریک بنا رکھا ہے ، میں ان سے کیسے ڈر سکتا ہوں جبکہ تم ان چیزوں کو اللہ کا شریک ماننے سے نہیں ڈرتے جن کے بارے میں اس نے تم پر کوئی دلیل نازل نہیں کی ہے؟ اب اگر تمہارے پاس کوئی علم ہے تو بتاؤ کہ ہم دو فریقوں میں سے کون بے خوف رہنے کا زیادہ مستحق ہے ؟**  **(حقیقت تو یہ ہے کہ) جو لوگ ایمان لے آئے ہیں اور انہوں نے اپنے ایمان کے ساتھ کسی ظلم کا شائبہ بھی آنے نہیں دیا ، امن اور چین تو بس انہی کا حق ہے ، اور وہی ہیں جو صحیح راستے پر پہنچ چکے ہیں ۔**  **Surah**  **Al-Anaam Ayat# 74-82**  **آیت مبارکہ**  اَلَمۡ تَرَ اِلَی الَّذِیۡ حَآجَّ اِبۡرٰہٖمَ فِیۡ رَبِّہٖۤ اَنۡ اٰتٰىہُ اللّٰہُ الۡمُلۡکَ ۘ اِذۡ قَالَ اِبۡرٰہٖمُ رَبِّیَ الَّذِیۡ یُحۡیٖ وَ یُمِیۡتُ ۙ قَالَ اَنَا اُحۡیٖ وَ اُمِیۡتُ ؕ قَالَ اِبۡرٰہٖمُ فَاِنَّ اللّٰہَ یَاۡتِیۡ بِالشَّمۡسِ مِنَ الۡمَشۡرِقِ فَاۡتِ بِہَا مِنَ الۡمَغۡرِبِ فَبُہِتَ الَّذِیۡ کَفَرَ ؕ وَ اللّٰہُ لَا یَہۡدِی الۡقَوۡمَ الظّٰلِمِیۡنَ  **ترجمہ**  **کیا تم نے اس شخص ( کے حال ) پر غور کیا جس کو اللہ نے سلطنت کیا دے دی تھی کہ وہ اپنے پروردگار ( کے وجود ہی ) کے بارے میں ابراہیم سے بحث کرنے لگا؟ جب ابراہیم نے کہا کہ میرا پروردگار وہ ہے جو زندگی بھی دیتا ہے اور موت بھی   تو وہ کہنے لگا کہ :   میں بھی زندگی دیتا ہوں اور موت دیتا ہوں ۔   ابراہیم نے کہا :   اچھا ! اللہ تو سورج کو مشرق سے نکالتا ہے ، تم ذرا اسے مغرب سے تو نکال کر لاؤ ۔   اس پر وہ کافر مبہوت ہو کر رہ گیا ۔ اور اللہ ایسے ظالموں کو ہدایت نہیں دیا کرتا ۔**  **Surah Al-Baqarah Ayat# 258** |   حضرت ابراہیم علیہ السلام کا حال   1. حضرت ابراہیم علیہ السلام کو آگ میں پھینکا جا رہا ہے اور سب سے بڑی نورانی مخلوق (حضرت جبرئیل علیہ السلام ) آپ سے درخواست کر رہے ہیں کہ اِس آگ کو ہم بجھا دیں ؟ آپ علیہ السلام نے اُس حال میں سب سے بڑی نوری مخلوق کا انکار فرما دیا . اور فرمایا **حَسۡبِیَ اللّٰہ** ( اللہ پاك میرے لیے کافی ہے)   قرآن میں اللہ پاك فرماتے ہیں   |  | | --- | | **آیت مبارکہ**  فَاَقۡبَلُوۡۤا اِلَیۡہِ یَزِفُّوۡنَ  قَالَ اَتَعۡبُدُوۡنَ مَا تَنۡحِتُوۡن  وَ اللّٰہُ خَلَقَکُمۡ وَ مَا تَعۡمَلُوۡنَ  قَالُوا ابۡنُوۡا لَہٗ بُنۡیَانًا فَاَلۡقُوۡہُ فِی الۡجَحِیۡمِ  وَ قَالَ اِنِّیۡ ذَاہِبٌ اِلٰی رَبِّیۡ سَیَہۡدِیۡنِ  **ترجمہ**  **اس پر ان کی قوم کے لوگ ان کے پاس دوڑے ہوئے آئے**  **ابراہیم نے کہا :   کیا تم ان ( بتوں ) کو پوجتے ہو جنہیں خود تراشتے ہو؟**  **حالانکہ اللہ نے تمہیں بھی پیدا کیا ہے ، اور جو کچھ تم بناتے ہو ، اس کو بھی ۔**  **ان لوگوں نے کہا : ابراہیم کے لیے ایک عمارت بناؤ ، اور اسے دہکتی ہوئی آگ میں پھینک دو**  **اور ابراہیم نے کہا :   میں اپنے رب کے پاس جارہا ہوں ، وہی میری رہنمائی فرمائے گا ۔**  **Surah Al-** **Saaffaat Ayat# 94-111**  **آیت مبارکہ**  قُلۡنَا یٰنَارُ کُوۡنِیۡ بَرۡدًا وَّ سَلٰمًا عَلٰۤی اِبۡرٰہِیۡمَ  **ترجمہ**  (**چنانچہ انہوں نے ابراہیم کو آگ میں ڈال دیا ، اور ہم نے کہا** ) **اے آگ ٹھندی ہوجا ، اور ابراہیم کے لیے سلامتی بن جا**  **Surah Al-Anbiya Ayat #69** |  1. حضرت ابراہیم علیہ السلام کو اللہ پاك نے حکم فرمایا کہ اپنے بیٹے حضرت اسماعیل علیہ السلام کو اللہ کے راستے میں قربان کر دیں ( یہ بہت ہی مشکل حال ہے ) . آپ علیہ السلام نے ہر حال میں اللہ کی چاہت ( حکم ) کو پورا فرمایا اور اپنے بیٹےکو ذبح کرنے کے لیے چل پڑے   قرآن میں اللہ پاك فرماتے ہیں   |  | | --- | | **آیت مبارکہ**  فَلَمَّا بَلَغَ مَعَہُ  السَّعۡیَ قَالَ یٰبُنَیَّ  اِنِّیۡۤ اَرٰی فِی الۡمَنَامِ اَنِّیۡۤ  اَذۡبَحُکَ فَانۡظُرۡ مَاذَا تَرٰی ؕ قَالَ یٰۤاَبَتِ افۡعَلۡ مَا تُؤۡمَرُ ۫ سَتَجِدُنِیۡۤ  اِنۡ شَآءَ اللّٰہُ مِنَ الصّٰبِرِیۡنَ  **ترجمہ**  **پھر جب وہ لڑکا ابراہیم کے ساتھ چلنے پھرنے کے قابل ہوگیا تو انہوں نے کہا : بیٹے ! میں خواب میں دیکھتا ہوں کہ تمہیں ذبح کر رہا ہوں ، اب سوچ کر بتاؤ ، تمہاری کیا رائے ہے؟ بیٹے نے کہا ابا جان ! آپ وہی کیجیے جس کا آپ کو حکم دیا جارہا ہے ، انشاءاللہ آپ مجھے صبر کرنے والوں میں سے پائیں گے**  **Surah Al-** **Saaffaat Ayat# 102** |  1. حضرت ابراہیم علیہ السلام کو اللہ پاك نے حکم فرمایا کہ اپنے بیٹے اور بیوی کو مکہ چھوڑ آؤ ( جہاں زندگی کے کوئی اسباب نہ تھے ) . حضرت ابراہیم علیہ السلام نے ہر حال میں اللہ کی چاہت ( حکم ) کو پورا فرمایا اور اپنے بیٹے اور بیوی کو مکہ چھوڑ آئے   قرآن میں اللہ پاك فرماتے ہیں   |  | | --- | | **آیت مبارکہ**  **ر**بَّنَاۤ اِنِّیۡۤ اَسۡکَنۡتُ مِنۡ ذُرِّیَّتِیۡ بِوَادٍ غَیۡرِ ذِیۡ زَرۡعٍ عِنۡدَ بَیۡتِکَ الۡمُحَرَّمِ ۙ رَبَّنَا لِیُـقِیۡمُوا الصَّلٰوۃَ فَاجۡعَلۡ اَفۡئِدَۃً مِّنَ النَّاسِ تَہۡوِیۡۤ اِلَیۡہِمۡ وَارۡ زُقۡہُمۡ مِّنَ الثَّمَرٰتِ لَعَلَّہُمۡ یَشۡکُرُوۡنَ  **ترجمہ**  **اے ہمارے پروردگار ! میں نے اپنی کچھ اولاد کو آپ کے حرمت والے گھر کے پاس ایک ایسی وادی میں لا بسایا ہے جس میں کوئی کھیتی نہیں ہوتی ۔ ہمارے پروردگار ! ( یہ میں نے اس لیے کیا ) تاکہ یہ نماز قائم کریں ، لہذا لوگوں کے دلوں میں ان کے لیے کشش پیدا کردیجیے ، اور ان کو پھلوں کا رزق عطا فرمایے ، تاکہ وہ شکر گذار بنیں**  **Surah Al-** **Abraham Ayat# 37** |   حضرت ابراہیم علیہ السلام کا حال ( کردار ) اور تاریخ  حضرت ابراہیم علیہ السلام کا حال ( کردار ) پوری امت مسلمہ کے لیے ( قیامت تک ) نمونہ ہے  قرآن میں اللہ پاك فرماتے ہیں   |  | | --- | | **آیت مبارکہ**  وَ مَنۡ اَحۡسَنُ دِیۡنًا مِّمَّنۡ اَسۡلَمَ  وَجۡہَہٗ لِلّٰہِ وَ ہُوَ مُحۡسِنٌ وَّ اتَّبَعَ مِلَّۃَ اِبۡرٰہِیۡمَ حَنِیۡفًا ؕ وَ اتَّخَذَ اللّٰہُ اِبۡرٰہِیۡمَ خَلِیۡلًا  **ترجمہ**  **اور اس سے بہتر کس کا دین ہوگا جس نے اپنے چہرے ( سمیت سارے وجود ) کو اللہ کے آگے جھکا دیا ہو ، جبکہ وہ نیکی کا خوگر بھی ہو ، اور جس نے سیدھے سچے ابراہیم کے دین کی پیروی کی ہو ۔ اور ( یہ معلوم ہی ہے کہ ) اللہ نے ابراہیم کو اپنا خاص دوست بنا لیا تھا ۔**  **Surah un-Nissa Ayat# 125**  **آیت مبارکہ**  قَدۡ کَانَتۡ لَکُمۡ  اُسۡوَۃٌ  حَسَنَۃٌ  فِیۡۤ اِبۡرٰہِیۡمَ وَ الَّذِیۡنَ مَعَہٗ ۚ ُ  **ترجمہ**  **تمہارے لیے ابراہیم اور ان کے ساتھیوں میں بہترین نمونہ ہے**  **Surah Al-** **Mumtahina Ayat# 4**  **آیت مبارکہ**  قَدۡ کَانَتۡ لَکُمۡ  اُسۡوَۃٌ  حَسَنَۃٌ  فِیۡۤ اِبۡرٰہِیۡمَ وَ الَّذِیۡنَ مَعَہٗ ۚ ُ  **ترجمہ**  **تمہارے لیے ابراہیم اور ان کے ساتھیوں میں بہترین نمونہ ہے ہوئے ہیں**  **Surah Al-** **Mumtahina Ayat# 4**  **آیت مبارکہ**  قُلۡ صَدَقَ اللّٰہُ ۟ فَاتَّبِعُوۡا مِلَّۃَ اِبۡرٰہِیۡمَ حَنِیۡفًا ؕ وَ مَا کَانَ مِنَ الۡمُشۡرِکِیۡنَ  **ترجمہ**  **آپ کہیے کہ اللہ نے سچ کہا ہے ، لہذا تم ابراہیم کے دین کا اتباع کرو جو پوری طرح سیدھے راستے پر تھے ، اور ان لوگوں میں سے نہیں تھے جو اللہ کی خدائی میں کسی کو شریک مانتے ہیں**  **Surah Al-** **Imran Ayat# 95** | |

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| **اللہ پاک نے اپنے ایک حکم سے ساتوں آسمان اور ساتوں زمین بنا دیے**  **اس وقت جو دنیا ہے ساتوں آسمان اور زمین سے فائدہ اٹھانے میں اپنی قوت کو ضائع کر رہی ہے**  **جس اللہ پاک نے بنایا ہے اس پاک ذات سے فائدہ اٹھانے میں نہیں لگی ہوئی**  **اللہ پاک کی ذات سے فائدہ اٹھانا کیا ہے**  **جس وقت وہ اللہ پاک جو چاہتا ہے اس کو ہم نے حضرت محمد صلی اللہ علیہ وسلم کے طریقے سے پورا کرنا ہے**  **سب سے پہلے محنت اس بات پر کرنی پڑے گی**  **اللہ ہے**  **اور اسی کے ہاتھ میں سب کچھ ہے**  **(کسی سے نہیں ہوتا اللہ سے ہوتا ہے)**  **اسے ایک ہے زبان سے کہنا اور ایک ہے دل میں اتارنا**  **ہمارا کام یہ ہے**  **ہرآن ہر گھڑی ہر وقت ہماری یہ سوچ ہو کہ ساری دنیا کے انسان اس بات کو اپنی فکر بنائیں**  **اللہ ہے وہ ہم سے کیا چاہتا ہے**  **اللہ کی چاہت کو ہم نے حضرت محمد صلی اللہ علیہ وسلم کے مبارک طریقے سے پورا کرنا ہے**  **اور ساری دنیا کے انسانوں کو اس کے پورا کرنے پر تیار کرنا ہے** |

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| باتیں کم عمل زیادہ |

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| **حضرت صوفی برکت علی صاحب رح**  **اے نوجوان**  **نہ کہہ نہ لکھ ، نہ کہہ نہ لکھ ، نہ کہہ نہ لکھ**  **بہت کہا جا چکا بہت لکھا جا چکا ،بہت کہا جا چکا بہت لکھا جا چکا ،بہت کہا جا چکا بہت لکھا جا چکا**  **کر کے دکھا ، کر کے دکھا ، کر کے دکھا**  **دنیا تو تیرے** **کئے کو دیکھنا چاہتی ہے** |

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| با ادب با نصیب ، بے ادب بے نصیب |

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| فن   * وہ معلومات جو بغیر **ا**دب کے آتی ہیں . ان كو فنون کہتے ہیں * فنون اجسسام پر محنت کرتے ہیں * جسم مٹی سے بنا ہے ، اِس نے مٹ جانا ہے   علم   * وہ معلومات جو ادب کے راستے سے آتی ہَیں . ان کو علوم کہتے ہَیں * علوم ارواح پر محنت کرتے ہَیں * روح عالم امر سے ہے، اِس لیے کبھی بھی فنا نہیں ہو گی   علم کی حقیقت   * علم کی حقیقت صِرف ایک راستے سے حاصل ہو سکتی ہے ، اور وہ ہے   + ادب * کسی بھی آدمی سے کچھ سیکھنے کے لیے ، آپ کو سب سے پہلے دل سے اُس کا ادب کرنا پَڑے گا   + بغیر ادب کے آپ معلومات تو حاصل کر لیں گے لیکن علم کی حقیقت ( استاد کا فیض ) نہیں ملے گا * جس شخص کو علم کی حقییقت نصیب ہو جاتی ہے ، وہ اللہ کو پا جاتا ہے |

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| **جو کام کریں دل سے کریں** |

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| * **کام کرنا.** * **خوشی خوشی کام کرنا.** * **الله کو ساتھ لے کرخوشی خوشی کام کرنا.** * **آیت :** إِيَّاكَ نَعْبُدُ وإِيَّاكَ نَسْتَعِينُ   **ترجمہ: یا الله ہم تیری ہی عبادت کرتے ہیں. اور تجھ ہی سے مد د مانگتے ہیں** |

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| **نتائج سے بے پروا ہو کر ہمیشہ پاکیزگی کا راستہ اختیار کریں** |

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| **یہ دعا روزانہ پڑھیں**  **دعا:** ٱهْدِنَا ٱلصِّرَٰطَ ٱلْمُسْتَقِيمَ صِرَٰطَ ٱلَّذِينَ أَنْعَمْتَ عَلَيْهِم  **ترجمہ: ہمیں سیدھی راه دکھا ان لوگوں کی راه جن پر تو نے انعام کیا.**  **یا اللہ ہم کچھ نہیں چاہتے ہم وہ چاہتے ہیں جو تو چاہتا ہے**  **(حضرت حاجی عبدالوہاب صاحب رح)** |

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| **دعا ایسی ہو جو اللہ سے فیصلے کروا دے** |

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| * اللَّهُمَّ خِرْ لِيْ وَاخْتَرْ لِي * سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا ۖ   إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ   * رَبِّ اشْرَحْ لِي صَدْرِي وَيَسِّرْ لِي اَمْرِي   وَاحْلُلْ عُقْدَةً مِنْ لِسَانِي يَفْقَهُوا قَوْلِي   * رَّبِّ أَعُوذُ بِكَ مِنْ هَمَزَاتِ الشَّيَاطِينِ ۖ   وَاَعُوْذُبِكَ رَبِّ اَنْ يَّحْضُرُوْنِ |

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| **Commando is a Man of Character** |

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**Five Types of Training**

* **Police**
* **Elite**
* **Rangers**
* **Army**
* **Commando**

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**Main Goal of a Course - Commando Training**

* **Commando**
  + **Commando is a Man of Character and (s)he should Safeguard his Character**

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**Main Qualities of a Commando**

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| * **Live a Balanced and Scheduled Life** * **محنت کبھی نہیں ہارتی.** * **100% Effort with Sincerity** * **دعائیں ہوں تو کھوٹے سکے بھی چل جاتے ہیں.** * **والدین اور اُستاد کی خدمت + ادب** * **Respect and Serve your Parents and Teachers** |

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**Main Qualities of a Commando Cont…**

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| * **Go to bed immediately after عشاء نماز (between 9pm – 10pm)** * **Do اللہ کا ذکر on daily basis (at least 30 minutes)** * قرآن پاک کی تلاوت ہمیشہ تجوید کے ساتھ کریں * **Do brisk walk / running on daily basis (at least 30 minutes)** * **Drink 1-liter milk, eat at least 10 dates and take at least 10 spoons of honey on daily basis** |

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**Main Qualities of a Commando Cont…**

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| * **Commando Passes in Three Big Exams of Life:** * **پیسہ** * **عہدہ** * **عورت ہے تو مرد / مرد ہے تو عورت** |

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**Summary of Qualities in a Commando**

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| **عاجزی** |

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| **Course Focus** |

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| |  | | --- | | * **To Master the Art of Living, mainly get Excellence in two things**   + **Become a Balanced and Characterful Personality**   + **Become an Authority in Machine Learning in the Whole World** | |

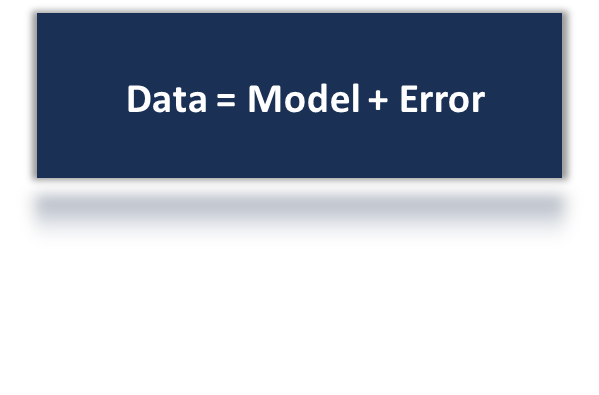
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| **Little Efforts Daily Will Make You the Greatest** |

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**Little Efforts Daily Will Make You the Greatest**

* **To systematically learn and get excellence in any concept / subject**
* **روز کا کام روز کریں**
* **اک مہینے کا کھانا ایک دن میں نہیں کھایا جا سکتا، ایسے ہی ایک مہینے کا کام ایک دن میں نہیں ہو سکتا**
* **Importance of Completing Tasks on Daily Basis**
  + **Main Reasons of Failure in Life**
* **یہ کام کل کریں گے**
* **جو کام کبھی بھی ہو سکتا ہے وہ کبھی نہیں ہوتا**
* **زندگی ایک دن ہے اور وہ ہے آج زندگی میں کل نام کی کوئی چیز نہیں ہے**
* **جو دن آپ کی زندگی سے چلا گیا اب واپس نہیں آئے گا**
* **آج کا کام آج ہی ہوسکتا ہے**
* **جو گزر گیا وہ آنا نہیں ، آنے والے دن کا پتہ نہیں ، آج میدان جما ہے تو اپنے جوہر دکھاؤ**

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| **Machine Learning – Summary** |

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| **Lecture Outline** |

* **Best Teaching and Learning Methodology of the World**
* **Using a Template-based Approach to Systematically Perform a Real-world Task**
* **Lecture Aim**
* **Breast Cancer Prediction Problem**
* **Steps – Treating Breast Cancer Prediction Problem as a Machine Learning Problem using Train-Test Split Approach**
* **Stop Complaining! Stop Criticizing! Let’s Start Contributing**
* **Lecture Summary**

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| **Best Teaching and Learning Methodology of the World** |

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**Best Teaching and Learning Methodology of the World**

* **Question**
  + **What is the best Teaching and Learning Methodology of the world?**
* **Answer**
  + **The best Teaching and Learning Methodology of the world is the one, which**
    - **Allah (اللہ) taught us in The Holy Quran and Hazrat Muhammad S.A.W.W. (حضرت محمد صلی اللہ علیہ وسلم) used to teach His Students i.e. Sahaba Karam R.A. (صحابہ کرام رضی اللہ عنھم اجمعین)**
* **Reason**
  + **The Teaching and Learning Methodology of Hazrat Muhammad S.A.W.W. is the best (till the Day of Judgment) because** 
    - **It produced the best Human Beings of the world till the Day of Judgement**
  + **Hazrat Muhammad S.A.W.W. said**

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| **حدیث مبارکہ**  **حَدَّثَنَا آدَمُ ، حَدَّثَنَا شُعْبَةُ ، حَدَّثَنَا أَبُو جَمْرَةَ ، قَالَ : سَمِعْتُ زَهْدَمَ بْنَ مُضَرِّبٍ ، قَالَ : سَمِعْتُ عِمْرَانَ بْنَ حُصَيْنٍ رَضِيَ اللَّهُ عَنْهُمَا ، قَالَ : قَالَ النَّبِيُّ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ : خَيْرُكُمْ قَرْنِي ، ثُمَّ الَّذِينَ يَلُونَهُمْ ، ثُمَّ الَّذِينَ يَلُونَهُمْ . قَالَ عِمْرَانُ : لَا أَدْرِي ، أَذَكَرَ النَّبِيُّ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ بَعْدُ قَرْنَيْنِ أَوْ ثَلَاثَةً ، قَالَ النَّبِيُّ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ : إِنَّ بَعْدَكُمْ قَوْمًا يَخُونُونَ وَلَا يُؤْتَمَنُونَ ، وَيَشْهَدُونَ وَلَا يُسْتَشْهَدُونَ ، وَيَنْذِرُونَ وَلَا يَفُونَ ، وَيَظْهَرُ فِيهِمُ السِّمَنُ**  **ترجمہ**  **رسول اللہ صلی اللہ علیہ وسلم نے فرمایا تم میں سب سے بہتر میرے زمانہ کے لوگ ( صحابہ ) ہیں۔ پھر وہ لوگ جو ان کے بعد آئیں گے ( تابعین ) پھر وہ لوگ جو اس کے بھی بعد آئیں گے ( تبع تابعین ) عمران نے بیان کیا کہ میں نہیں جانتا آپ صلی اللہ علیہ وسلم نے دو زمانوں کا ( اپنے بعد ) ذکر فرمایا یا تین کا پھر آپ صلی اللہ علیہ وسلم نے فرمایا کہ تمہارے بعد ایسے لوگ پیدا ہوں گے جو چور ہوں گے، جن میں دیانت کا نام نہ ہو گا۔ ان سے گواہی دینے کے لیے نہیں کہا جائے گا۔ لیکن وہ گواہیاں دیتے پھریں گے۔ نذریں مانیں گے لیکن پوری نہیں کریں گے۔ مٹاپا ان میں عام ہو گا۔**  **صحیح بخاری 2651** |

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**Best Teaching Methodology and Learning Methodology of the World Cont…**

* **Question**
  + **In what areas Sahaba Karam R.A. mainly achieved Excellence?**
* **Answer** 
  + **Sahaba Karam R.A. mainly achieved Excellence in three areas**
    1. **Excellence in Friendship (تعلق) and Obedience (اطاعت) of Allah**
    2. **Excellence in Love (عشق) and Obedience (اطاعت) of Hazrat Muhammad S.A.W.W.**
    3. **Excellence in their Field of Work**

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**اللہ سے تعلق**

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| * **حضرت فرماتے تھے**   + **اللہ پاك سے کم سے کم اِتْنا تو تعلق ہو کہ آدمی دعا کے لیے ہاتھ اٹھائے اور کام ہو جائے**   + **آج ہم کہتے ہیں کے میرا فلاں سے اِتْنا تعلق ہے کے میرا نام لیا تو کام ہو جائے گا**     - **کیا ہم نے کبھی یہ کہا کے اللہ پاك سے اِتْنا تعلق ہے کہ دعا کی لیے ہاتھ اٹھائے تو کم ہو جائے جا ؟** * **انسان جب قیامت کے دن اللہ پاك کو دیکھے گا تو اس بات کی حسرت اور تمنا کرے گا کے اتنے پیارے اللہ کو میں نے دنیا میں کیوں نہیں پا لیا** |

* **امیر خُسْرَو (رحمتہ اللہ علیہ) کا شعر ہے**

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| **از لذت دیدار است خسرو چیں تواں گفتن**  **سر دادن جاں دادن نہ دیدا رخ یارے** |

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| * + **لوگوں نے اللہ کو دیکھا نہیں ہے اور اللہ کی محبت میں سَر کٹوا دیئے ( جان دے دی ) . جب اللہ کو دیکھیں گے تو کیا ہو گا (اللہ کو دیکھنے کی خوشی لفظوں میں بیان نہیں ہو سکتی(**   + **اللہ سب کا ہے . وہ مُجھ جیسے گناہ گروں کا بھی ہے . اللہ کی رحمت اور فضل سے کبھی بھی ناامید** **نہیں ہونا چاہے**   + **جو سچے دل سے اللہ پاك کو طلب کرے گا . انشا اللہ ، اللہ پاك اپنے فضل سے اسے اپنا عشق اور تعلق ضرور نصیب فرمائیں گے** |

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**حضرت محمد صلی اللہ علیہ وسلم سے عشق**

* **Hazrat Muhammad S.A.W.W. said**

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| **حدیث مبارکہ**  حَدَّثَنَا قُتَيْبَةُ بْنُ سَعِيدٍ حَدَّثَنَا يَعْقُوبُ يَعْنِي ابْنَ عَبْدِ الرَّحْمَنِ عَنْ سُهَيْلٍ عَنْ أَبِيهِ عَنْ أَبِي هُرَيْرَةَ أَنَّ رَسُولَ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ قَالَ مِنْ أَشَدِّ أُمَّتِي لِي حُبًّا نَاسٌ يَكُونُونَ بَعْدِي يَوَدُّ أَحَدُهُمْ لَوْ رَآنِي بِأَهْلِهِ وَمَالِهِ  **ترجمہ**  **حضرت ابو ہریرہ رضی اللہ تعالیٰ عنہ سے روایت ہے کہ رسول اللہ صلی اللہ علیہ وسلم نے فرمایا میری امت میں میرے ساتھ سب سے زیادہ محبت کرنے والوں میں وہ لوگ ( بھی ) ہیں جو میرے بعد ہوں گے ، ان میں سے ( ہر ) ایک یہ چاہتا ہوگا کہ کاش! اپنے اہل وعیال اور مال کی قربانی دے کرمجھے دیکھ لے ۔**  **7145 مسلم صحیح** |

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| * **حضرت فرماتے تھے**   + **آج بھی ایسے لوگ دُنیا میں موجود ہیں اور قیامت تک رہیں گے**     - **جن کو حضور صلی اللہ علیہ وسلم سے ایسا عشق ہے کہ وہ ایک بار آپ صلی اللہ علیہ وسلم کو دیکھنے کے لیے اپنا سب کچھ قربان کرنے کو تیار ہیں**     - **لیکن سوال یہ ہے کہ**       * **کیا میں ان خوش نصیبوں میں سے ہوں یانہیں ؟** * **ساری دنیا کی ماؤں سے زیادہ حضرت محمد صلی اللہ علیہ وسلم کو اپنے ایک ایک امتی سے محبت ہے** * **اللہ پاك ہمیں**   + **حضرت محمد صلی اللہ علیہ وسلم سے کامل عشق**   + **آپ صلی اللہ علیہ وسلم کی کامل اتباع**   + **اور آپ صلی اللہ علیہ وسلم پر کثرت سے درود شریف پڑھنے کی توفیق عطا فرمائیں آمین** |

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**Example 01 – Excellence Achieved by Sahaba Karam R.A.**

* **Name of Sahabi R.A.**
  + **Hazrat Umar R.A.**
* **Trait 01 - Excellence in Friendship (تعلق) and Obedience (اطاعت) of Allah**
  + **Hazrat Umar R.A. achieved Excellence in the Friendship (تعلق) and Obedience (اطاعت) of Allah and Allah made him Khalifa.tur.Rasool S.A.W.W (خلیفۃ الرسول صلی اللہ علیہ وسلم)**
  + **Allah ordered the world to obey the commands of Hazrat Umar R.A. (اللہ پاک نے دنیا کو حضرت عمر رضی اللہ تعالی عنہ کے لیے مُسَخَّر کر دیا)**
  + **Earth (زمین) Obeying Hazrat Umar R.A.**

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| **مدینہ میں زلزلہ آیا . حضرت عمر رضی اللہ تعالی عنہ نے زمین پر کوڑا مارا اور فرمایا کہ کیا عمر رضی اللہ تعالی عنہ تم پر انصاف نہیں کرتا . تو کیوں ہلتی ہے . زلزلہ رک گیا** |

* + **Air (ہوا) Obeying Hazrat Umar R.A.**

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| **حضرت سریہ رضی اللہ تعالی عنہ مدینہ سے ہزاروں میل دور جنگ لڑ رہے ہیں . پہاڑ کی طرف سے دشمن آ رہا ہے اور حضرت سریہ رضی اللہ تعالی عنہ کو اُس کا پتہ نہیں ہے . حضرت عمر رضی اللہ تعالی عنہ مدینہ سے خطبہ دیتے ہُوئے فرماتے ہیں ، اے سریہ ( رضی اللہ تعالی عنہ) پہاڑ کی طرف دیکھو . ہوا حضرت عمر رضی اللہ تعالی عنہ کا پیغام حضرت سریہ رضی اللہ تعالی عنہ تک پہنچاتی ہے اور حضرت سریہ رضی اللہ تعالی عنہ کو دشمن کا پتہ چل جاتا ہے** |

* + **Water (پانی) Obeying Hazrat Umar R.A.**

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| **دریاۓ نیل خُشک ہو گیا . مشہور یہ تھا کہ کسی نوجوان لڑکی کو دلہن بنا کر دریا میں ڈالا جائے تو پِھر دریا چلتا ہے . یہ بات حضرت عمر رضی اللہ تعالی عنہ تک پہنچی . آپ رضی اللہ تعالی عنہ نے دریا ۓ نیل کو خط لکھا جس کا مفہوم ہے کہ اللہ پاك کے حکم سے چلتا ہے تو چل ، ورنہ ہمیں تیری ضرورت نہیں ہے حضرت عمر رضی اللہ تعالی عنہ کا خط دریا نیل میں ڈالا گیا اور دریاۓ نیل چل پڑا** |

* + **Fire (آگ) Obeying Hazrat Omar R.A.**

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| **مدینہ کے قریب لاوا نکلنے لگا . حضرت عمر رضی اللہ تعالی عنہ نے اپنے ساتھی کو فرمایا ، جا** **ؤ اور لاوا بند کر آ** **ؤ . وہ ساتھی گئے اور اپنے ہاتھ کے اشارے سے لاوا کو دوباہ زمین میں بند کر دیا** |

* **Trait 02 - Excellence in Love (عشق) and Obedience (اطاعت) of Hazrat Muhammad S.A.W.W.**

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| * **حضرت عمر رضی اللہ تعالی عنہ كو کائنات میں ہر چیز سے زیادہ حضرت محمد صلی اللہ علیہ وسلم سے محبت تھی** * **ایک مرتبہ حضرت عمر رضی اللہ تعالی عنہ کے کرتا مبارک کی آسْتِین لمبی ہو گئی . کسی نے قینچی دی کے فالتو کپڑا کاٹ لیں . حضرت عمر رضی اللہ تعالی عنہ نے فرمایا کہ ایک مرتبہ حضور صلی اللہ علیہ وسلم کے کرتا مبارک کی آسْتِین لمبی ہو گئی تھی آپ صلی اللہ علیہ وسلم نے اپنے کرتےمبارک کی آسْتِین کو چھری سے کاٹا تھا . میں بھی اپنے کرتے کی آسْتِین کو چھری سے کاٹوں گا۔** * **صحابہ کرام رضی اللہ تعالی عنہ دنیا اور آخرت میں کامیاب تھے کیونکہ وہ سنت کو سنت سمجھ کر اختیار کرتے تھے**   + **آج ہم مسلمان دنیا میں پریشان ہیں کیوں کہ ہم سنت کو سنت سمجھ کر چھوڑ دیتے ہَیں** |

* **Trait 03 - Excellence in their Field of Work**
  + **Hazrat Umar R.A. achieved Excellence in his Field of Work**
    - **i.e. Establishing and Running a Very Big State**

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| * **حضرت عمر رضی اللہ تعالی عنہ کا دور خلافت صرف 10 سال ہے . اِس مختصر سے وَقت میں مسلمانوں کی حکومت 22.5 لاکھ مربع میل تک پھیل گئی** * **حضرت عمر رضی اللہ تعالی عنہ . نے اتنے تھوڑے وَقت میں ایسی مثالی حکومت قائم کر دی . جسکی مثال تاریخ انسانی میں نہیں ملتی** * **حضرت عمر رضی اللہ تعالی عنہ کے دور میں اتنی خوشحالی تھی کہ لوگ زکوۃ کے پیسے لے کر ضرورت مند ڈھونڈتے تھے لیکن کوئی زکوۃ لینے والا نہیں ملتا تھا** * **حضرت عمر رضی اللہ تعالی عنہ کے دور میں اتنا امن تھا کہ ایک عورت عراق سے مدینہ تنہا سفر کرتی ہے اور اسے کوئی نظر اٹھا کر بھی نہیں دیکھتا** |

* **Conclusion**
  + **The Teaching and Learning Methodology of Hazrat Muhammad S.A.W.W. produced best Human Beings (i.e. Sahaba Karam R.A.) who performed miracles in every field of life**
  + **If we use the Teaching and Learning Methodology of Hazrat Muhammad S.A.W.W**
    - **We can also produce great Human Beings in very short time**

**SLIDE**

**Example 02 – Excellence Achieved by Sahaba Karam R.A.**

* **Name of Sahabi R.A.**
  + **Hazrat Abdur Rehman Bin Auf R.A**
* **Trait 01 - Excellence in Friendship (تعلق) and Obedience (اطاعت) of Allah**
  + **Hazrat Abdur Rehman Bin Auf R.A. is in Ashra Mubashra Sahaba R.A (صحابہ رضی اللہ تعالی عنہ عشرہ مبشرہ)**
* **Question**
  + **Who are Ashra Mubashra (عشرہ مبشرہ) Sahaba Karam R.A.?**
* **Answer**

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| * **عشرہ مبشرہ رضی اللہ تعالی عنہ وہ 10 صحابہ کرام رضی اللہ تعالی عنہ ہَیں جن کو اللہ پاك نے دنیا میں ہی جنت کی بشارت دےدی تھی** * **عشرہ مبشرہ صحابہ کرام کے نام یہ ہَیں** * **Hazrat Abu Bakar Siddiq (R.A.)**   **( حضرت أبو بكر الصديق رضی اللہ تعالی عنہ)**   * **Hazrat Umar Farooq (R.A.)**   **(حضرت عمر بن الخطاب رضی اللہ تعالی عنہ)**   * **Hazrat Usman Ghani (R.A.)**   **(حضرت عثمان بن عفان رضی اللہ تعالی عنہ)**   * **Hazrat Ali (R.A.)**   **(حضرت علي بن ابو طالب رضی اللہ تعالی عنہ)**   * **Hazrat Talha (R.A.)**   **(حضرت طلحةبن عبيدالله رضی اللہ تعالی عنہ)**   * **Hazrat Zubair ibn-e-Awam (R.A.)**   **(حضرت الزبير بن العوام بن خويلد رضی اللہ تعالی عنہ)**   * **Hazrat Abu Obaidaibn-al-Jarah (R.A.)**   **(حضرت ابوعبیدہ بن جراح رضی اللہ تعالی عنہ ‎)**   * **Hazrat Abdul Rehman Ibn-e-Auf (R.A.)**   **(حضرت عبد الرحمن بن عوف رضی اللہ تعالی عنہ ‎)**   * **Hazrat Saad Ibn-e-Abi Waqas (R.A.)**   **(حضرت سعد بن أبي وقاص رضی اللہ تعالی عنہ)**   * **Hazrat Saeed Ibn-e-Zaid (R.A.)**   **(حضرت سعيد بن زيد رضی اللہ تعالی عنہ)** |

* **Trait 02 - Excellence in Love (عشق) and Obedience (اطاعت) of Hazrat Muhammad S.A.W.W.**

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| * + **حضرت عبد الرحمان بن عوف رضی اللہ تعالی عنہ كو کائنات میں ہر چیز سے زیادہ حضرت محمد صلی اللہ علیہ وسلم سے محبت تھی**   + **حضرت عبد الرحمان بن عوف رضی اللہ تعالی عنہ نے اپنی تجارت business)) 100فیصد حضرت محمد صلی اللہ علیہ وسلم کے مبارک طَریقے کے مطابق کِیا** |

* **Trait 03 - Excellence in the Field of Work**
  + **Hazrat Abdur Rehman Bin Auf R.A achieved Excellence in his Field of Work**
    - **i.e. Business**

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| * + **حضرت عبد الرحمان بن عوف رضی اللہ تعالی عنہ کا جب انتقال ہوا تو 3 ارب سے زیادہ اشرفیاں چھوڑیں** |

* **Conclusion**
  + **The Teaching and Learning Methodology of Hazrat Muhammad S.A.W.W. produced best Human Beings (i.e. Sahaba Karam R.A.) who performed miracles in every field of life**
  + **If we use the Teaching and Learning Methodology of Hazrat Muhammad S.A.W.W**
    - **We can also produce great Human Beings in very short time**

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| **حدیث مبارکہ**  حَدَّثَنَا آدَمُ بْنُ أَبِي إِيَاسٍ , حَدَّثَنَا شُعْبَةُ ، عَنْ الْأَعْمَشِ ، قَالَ : سَمِعْتُ ذَكْوَانَ يُحَدِّثُ ، عَنْ أَبِي سَعِيدٍ الْخُدْرِيِّ رَضِيَ اللَّهُ عَنْهُ , قَالَ : قَالَ النَّبِيُّ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ : لَا تَسُبُّوا أَصْحَابِي فَلَوْ أَنَّ أَحَدَكُمْ أَنْفَقَ مِثْلَ أُحُدٍ ذَهَبًا مَا بَلَغَ مُدَّ أَحَدِهِمْ وَلَا نَصِيفَهُ . تَابَعَهُ جَرِيرٌ , وَعَبْدُ اللَّهِ بْنُ دَاوُدَ , وَأَبُو مُعَاوِيَةَ , وَمُحَاضِرٌ ، عَنْ الْأَعْمَشِ  **ترجمہ**  **نبی کریم صلی اللہ علیہ وسلم نے فرمایا میرے اصحاب کو برا بھلا مت کہو۔ اگر کوئی شخص احد پہاڑ کے برابر بھی سونا ( اللہ کی راہ میں ) خرچ کر ڈالے تو ان کے ایک مد غلہ کے برابر بھی نہیں ہو سکتا اور نہ ان کے آدھے مد کے برابر۔ شعبہ کے ساتھ اس حدیث کو جریر، عبداللہ بن داود، ابومعاویہ اور محاضر نے بھی اعمش سے روایت کیا ہے۔**  **3673 صحیح بخاری** |

**SLIDE**

**Example – Teaching and Learning Methodology of The Holy Quran**

* **Order of Allah**
  + **Allah Gave Order (حکم) that Drinking of Wine (شراب) is Haram (حرام)**
* **Allah systematically gave this Order i.e.**
  + **A Simple to Complex (Step by Step) Approach was used**
* **Step 1: Drinking of Wine is Bad**

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| **آیت مبارکہ**  یٰۤاَیُّہَا الَّذِیۡنَ اٰمَنُوۡۤا اِنَّمَا الۡخَمۡرُ وَ الۡمَیۡسِرُ وَ الۡاَنۡصَابُ وَ الۡاَزۡلَامُ رِجۡسٌ مِّنۡ عَمَلِ الشَّیۡطٰنِ فَاجۡتَنِبُوۡہُ لَعَلَّکُمۡ تُفۡلِحُوۡنَ  **ترجمہ**  **اے ایمان والو ! شراب ، جوا ، بتوں کے تھان اور جوئے کے تیر ، ( ٦٢ ) یہ سب ناپاک شیطانی کام ہیں ، لہذا ان سے بچو ، تاکہ تمہیں فلاح حاصل ہو**  **سُورَةُ المائدہ آیت 90** |

* **Step 2: You should not Drunk Wine at the Time of Namaz**

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| **آیت مبارکہ**    یٰۤاَیُّہَا الَّذِیۡنَ اٰمَنُوۡا لَا تَقۡرَبُوا الصَّلٰوۃَ وَ اَنۡتُمۡ سُکٰرٰی حَتّٰی تَعۡلَمُوۡا مَا تَقُوۡلُوۡنَ وَ لَا جُنُبًا اِلَّا عَابِرِیۡ سَبِیۡلٍ حَتّٰی تَغۡتَسِلُوۡا ؕ  **ترجمہ**  **اے ایمان والو ! جب تم نشے کی حالت میں ہو تو اس وقت تک نماز کے قریب بھی نہ جانا جب تک تم جو کچھ کہہ رہے ہو اسے سمجھنے نہ لگو ، ( ٣٢ )**  **سُورَةُ النسا آیت 43** |

* **Step 3: Drinking of Wine is Haram**

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| **آیت مبارکہ**  یَسۡئَلُوۡنَکَ عَنِ الۡخَمۡرِ وَ الۡمَیۡسِرِؕ قُلۡ فِیۡہِمَاۤ اِثۡمٌ کَبِیۡرٌ وَّ مَنَافِعُ لِلنَّاسِ ۫ وَ اِثۡمُہُمَاۤ اَکۡبَرُ مِنۡ نَّفۡعِہِمَا ؕ  **ترجمہ**  **لوگ آپ سے شراب اور جوئے کے بارے میں پوچھتے ہیں ۔ آپ کہہ دیجیے کہ ان دونوں میں بڑا گناہ بھی ہے ، اور لوگوں کے لیے کچھ فائدے بھی ہیں ، اور ان دونوں کا گناہ ان کے فائدے سے زیادہ بڑھا ہوا ہے**  **سُورَةُ البقرہ آیت 219** |

**SLIDE**

**Example – Teaching and Learning Methodology of The Holy Quran Cont…**

* **Outcome of Template-based Approach used in The Holy Quran for Teaching and Learning**
  + **When Sahaba Karam (R.A.) heard the Third Order of Allah about Wine (i.e. Drinking of Wine Is Haram)**
    - **All the Sahaba Karam (R.A.) immediately obeyed the Order of Allah and stopped drinking Wine**
* **Conclusion**
  + **Following The Holy Quran, if we use a Template-based Approach to systematically learn / perform any Real-world Task as Allah has taught us**
    - **We can make Impossible Possible In Sha Allah 😊**

**SLIDE**

**Template-based Approach Learned from the Holy Quran**

* **From the example given (from The Holy Quran) in previous Slides, we may extract the following** 
  + **Teaching and Learning Methodology**
* **To systematically learn / perform any Real-world Task** 
  + **Use a Template-based Approach**
* **To Make a Template, use the** 
  + **Divide and Conquer Approach**
* **How Divide and Conquer Approach Works?**
  + **Systematically break a Real-world Task into**
    - **Steps / Sub-steps / Sub-sub-steps**
  + **For each Step / Sub-step / Sub-sub-step, see the** 
    - **Order and Flow i.e.**
      * **Use a Simple to Complex Approach**
    - **Connectivity and Independence i.e.** 
      1. **Each Step / Sub-step / Sub-sub-step must be connected to the previous and next Step / Sub-step / Sub-sub-step**
      2. **Each Step / Sub-step / Sub-sub-step must be independent of every other Step / Sub-step / Sub-sub-step**

**SLIDE**

**Note**

* **In Sha Allah, in the next Slides, I will plan, design and write my Lecture using the**
  + **Template-based Approach which we learned from The Holy Quran**

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| **Using a Template-based Approach to Systematically Perform a Real-world Task** |

**SLIDE**

**Steps – Using a Template-based Approach to Systematically Perform a Real-world Task**

* **To systematically perform any Real-world Task, follow the following steps**
  + **Step 1: Completely and correctly understand the Real-world Task**
    - **Write down two main things**
      * **Given**
      * **Task**
  + **Step 2: Understand the Input and Output of the Real-world Task**
    - **Write down two main things**
      * **Input**
      * **Output**
  + **Step 3: Plan and Design a Template-based Approach to perform the Real-world Task**
    - **Step 3.1: Use Divide and Conquer Approach to break the Real-world Task into**
      * **Steps / Sub-steps / Sub-sub-steps**
    - **Step 3.2: For each Steps / Sub-steps / Sub-sub-steps**
      * **Check the Order and Flow between Steps / Sub-steps / Sub-sub-steps**
      * **Check the Connectivity and Independence between Steps / Sub-steps / Sub-sub-steps**
  + **Step 4: Use a Five Step Process to perform the Real-world Task**
    - **Step 4.1: Plan – in Mind**
    - **Step 4.2: Design – on Paper**
    - **Step 4.3: Execute – at Prototype level**
    - **Step 4.4: Execute – at Full Scale**
    - **Step 4.5: Take Feedback from Users / Audience and Domain Experts to further improve the solution of Real-world Task**
  + **Step 5: Document each and every Step, when performing a Real-world Task**

**SLIDE**

**Importance of Documentation**

* **At university, mainly three types of degree programs are offered**
  + **Undergraduate**
  + **MPhil**
  + **PhD**
* **Let’s see the main outcome of these degree programs**
  + **Outcome of an Undergraduate Degree Programs**
    - **Final Year Project Report** 
      * **i.e. A Written Document**
  + **Outcome of a MPhil Degree Programs**
    - **MPhil Thesis** 
      * **i.e. A Written Document**
  + **Outcome of a PhD Degree Programs**
    - **PhD Thesis** 
      * **i.e. A Written Document**
* **Conclusion**
  + **As can be noted from above discussion, that**
    - **A Written Document is the main outcome of all the major degree programs offered at university level**
  + **This clearly highlights the**
    - **Importance of Documentation**

**SLIDE**

**Importance of Documentation Cont…**

* **The best book of the world i.e. the Holy Quran, is also** 
  + **A Written Document**
* **Question**
  + **How to recite The Holy Quran?**
* **Answer**
  + **Recite with Love (عشق)**
* **Situation 01 - Recitation of the Holy Quran** 
  + **A person is reciting Bismillah (اللہِ بِسمِ) and he recites the complete Bismillah (اللہِ بِسمِ) in one go and then starts reciting other Ayats (آیات) of the Holy Quran**

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| **بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيْم** |

* **Situation 02 - Recitation of The Holy Quran with Love (عشق)**
  + **A person is reciting Bismillah (اللہِ بِسمِ) and he stops at the second word of Bismaillah (اللہِ بِسمِ) i.e. Allah (اللہ)**
  + **He kisses the word Allah (اللہ) and starts crying, saying that**
    - **It is the كلام of my beloved Allah (اللہ)**
  + **He repeats the word Allah (اللہ) again and again with Love**
  + **After reading the complete Bismillah (اللہِ بِسمِ), he asks himself a question**
  + **اللہ ملا کہ نہیں ملا؟**
  + **اِس تلاوت کا مقصد تھا اللہ كو پانا ، تو کیا مجھے اللہ ملا کہ نہیں ملا ؟**
* **Conclusion**
  + **Every night When you go to bed for sleep, ask yourself a question**
  + **میں اِس دنیا میں اللہ کو پانے آیا تھا**
  + **اللہ ملا کہ نہیں ملا؟**
  + **جو اللہ کو اللہ سے مانگے گا ، انشا اللہ وہ اللہ کو پا جائے گا**
  + **یا اللہ ، ہم آپ سے آپ کو مانگتے ہَیں ، ہمیں اپنا عشق اور سچا تعلق عطا فرما آمین!**

**SLIDE**

**Example - Steps (Systematically Performing a Real-world Task)**

* **Consider the following Real-world Task**
* **Real-world Task**
  + **Treating breast cancer problem Machine Learning Problem using Train-Test Split Approach**

**SLIDE**

**Example - Steps (Systematically Performing a Real-world Task) Cont…**

* **Step 1: Completely and correctly understand the Real-world Task**
  + **Given**
    - **Fazal of Allah (اللہ کا فضل)**
    - **Dua (دعا) and Tawajju (توجہ) of Akabir (اکابر)**
    - **Learning Material related to Breast Cancer Prediction Problem using Train-Test Split Approach and Machine Learning**
  + **Task**
    - **Design and develop a self-explanatory and detailed Lecture on**
      * **Treating Breast Cancer Prediction Problem as a Machine Learning Problem using Train-Test Split Approach**

**SLIDE**

**Example – Steps (Systematically Performing a Real-world Task) Cont…**

* **Step 2: Understand the Input and Output of the Real-world Task**
  + **Input**
    - **Fazal of Allah (اللہ کا فضل)**
    - **Dua (دعا) and Tawajju (توجہ) of Akabir (اکابر)**
    - **Learning Material related to Breast Cancer Prediction Problem using Train-Test Split Approach and Machine Learning**
  + **Output**
    - **Lecture - 01 Treating Breast Cancer Prediction Problem as a Machine Learning Problem using Train-Test Split Approach**

**SLIDE**

**Example - Steps (Systematically Performing a Real-world Task) Cont…**

* **Step 3: Plan and Design a Template-based Approach to perform the Real-world Task**
  + **Step 3.1: Use Divide and Conquer Approach to break the Real-world Task into**
    - **Steps / Sub-steps / Sub-sub-steps**
* **Using a Template-based Approach, I have divided the Real-world Task into three main Steps**
  + **Step 1: Breast Cancer Prediction Problem**
  + **Step 2: Steps – Treating Breast Cancer Prediction Problem as a Machine Learning Problem using Train-Test Split Approach**
* **Each main Step is further divided into Sub-steps / Sub-sub-steps**
  + **In Sha Allah, I will show you the Sub-steps / Sub-sub-steps in the next Sections of the Lecture**

**SLIDE**

**Example - Steps (Systematically Performing a Real-world Task) Cont…**

* **Step 4: Use a Five Step Process to perform the Real-world Task**
  + **Step 4.1: Plan – in Mind**
  + **Step 4.2: Design – on Paper**
  + **Step 4.3: Execute – at Prototype level**
  + **Step 4.4: Execute – at Full Scale**
  + **Step 4.5: Take Feedback from Users / Audience and Domain Experts to further improve the solution of Real-world Task**
* **Alhumdulilah, with Fazal of Allah (اللہ کے فضل سے), I have performed the Real-world Task (i.e. Treating Breast Cancer Prediction Problem as a Machine Learning Problem using Train-Test Split Approach) using the above Five Step Process**
* **Note**
  + **I did multiple iterations of first three Steps i.e. Plan, Design and Execute (Prototype Level)**
  + **I completed the fourth Step i.e. Execute (Full Scale)**
  + **In Sha Allah, I will wait for your valuable Feedback to further improve this Lecture**

**SLIDE**

**Example - Steps (Systematically Performing a Real-world Task) Cont…**

* **Step 5: Document each and every Step, when performing a Real-world Task**
* **Alhumdulialh, with Fazal of Allah (اللہ کے فضل سے) I have documented this Lecture and you are reading it 😊**
* **In Sha Allah, I will wait for your valuable Feedback on the quality of Documentation**

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| **Lecture Aim** |

**SLIDE**

**Lecture Aim**

* **The main aim of this Lecture is to demonstrate, how Breast Cancer Prediction Problem can be treated as a Supervised Machine Learning Problem using Train-Test Split Approach**

**SLIDE**

**What Will You Need?**

* **To read, understand, analyze and absorb how Breast Cancer Prediction Problem can be treated as a Supervised Machine Learning Problem using Train-Test Split Approach and become a balanced and characterful personality, you will need:**
  + **Purity in Intention**
    - **Intention (نیت) to read this Lecture should be to**
      * **Get Marifat (معرفت) of Allah (اللہ کو پانا)**
      * **Become a balanced and characterful personality**
      * **Become an authority in the field of Computer Science in the whole world** 
        + **To serve the humanity for Raza of Allah (اللہ کی رضا)**
    - **Learning Material related to Breast Cancer Prediction Problem using Train-Test Split Approach and Machine Learning**
    - **A Laptop / PC with**
      * **A PDF Reader installed on it**

**SLIDE**

**What Will You Learn?**

* **After reading, understanding, documenting and absorbing this Lecture, In Sha Allah, you will learn:**
  + **How to systematically perform any Real-world Task using a Template-based Approach**
  + **How to become a balanced and characterful personality**
  + **Breast Cancer Prediction Problem**
  + **What are the main Steps to treat the Breast Cancer Prediction Problem as a Machine Learning Problem using Train-Test Split Approach**

**SLIDE**

**Best Medicine of the World**

* **The best medicine of the world is**

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| **Love and Respect the Humanity**  **ساری انسانیت سے محبت کریں اور ساری انسانیت کا احترام کریں** |

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| **انسانیت کی سب سے بڑی خیر خواہی** **یہ ہے کہ ساری دنیا کے انسان ہمیشہ کی دوزخ سے بچ کر ہمیشہ کی جنّت میں جانے والے بن جائیں**  **ہمارا ایمان ہے کہ حضرت محمدﷺ الله کے آخری نبی اور رسول ہیں آپ ﷺ کے بعد ( قیامت تک ) کوئی نبی اور رسول نہیں آے گا - اس لئے ختم نبوت کے صدقے یہ ہم سب کی ذمداری ہے**  **کہ خود نیک اعمال (الله کی فرمابرداری ) کرتے ہوے ساری دنیا کے انسانوں کو ایمان اور نیک اعمال (الله کی فرمابرداری ) کی دعوت دیں اور خود گناہوں (الله کی نافرمانی ) سے بچتے ہوے ساری دنیا کے انسانوں کو گناہوں (الله کی نافرمانی ) سے بچنے کی دعوت دیں**  **الله پاک قرآن میں فرماتے ہیں :**  **آیت مبارکہ**  کُنۡتُمۡ خَیۡرَ اُمَّۃٍ اُخۡرِجَتۡ لِلنَّاسِ تَاۡمُرُوۡنَ بِالۡمَعۡرُوۡفِ وَ تَنۡہَوۡنَ عَنِ الۡمُنۡکَرِ وَ تُؤۡمِنُوۡنَ بِاللّٰہِ ؕ وَ لَوۡ اٰمَنَ اَہۡلُ  الۡکِتٰبِ لَکَانَ خَیۡرًا لَّہُمۡ ؕ مِنۡہُمُ الۡمُؤۡمِنُوۡنَ وَ اَکۡثَرُہُمُ الۡفٰسِقُوۡنَ  **ترجمہ**  **مسلمانو ! تم وہ بہترین امت ہو جو لوگوں کے فائدے کے لیے وجود میں لائی گئی ہے ۔ تم نیکی کی تلقین کرتے ہو ، برائی سے روکتے ہو اور اللہ پر ایمان رکھتے ہو ۔ اگر اہل کتاب ایمان لے آتے تو یہ ان کے حق میں کہیں بہتر ہوتا ۔ ان میں سے کچھ تو مومن ہیں ، مگر ان کی اکثریت نافرمان ہے ۔**  **Aal-e-Imran, 110** |

**SLIDE**

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| **محبت**   * **کسی کو پا لینا محبت نہیں ہے کسی کے دل میں جگہ بنا لینا محبت ہے** |

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| **کبھی خاموش بیٹھو گے کبھی کچھ گنگناؤ گے**  **میں اتنا یاد آؤں گا مجھے جتنا بھلاؤ گے**  **کوئی جب پوچھ بیٹھے گا خاموشی کا سبب تم سے**  **بہت سمجھانا چاہو گے مگر سمجھا نہ پاؤ گے**  **کبھی دنیا مکمل بن کے آئے گی نگاہوں میں**  **کبھی میری کمی دنیا کی ہر اک شے میں پاؤ گے**  **کہیں پر بھی رہیں ہم تم محبت تھی محبت ہے**  **تمہیں ہم یاد آئیں گے ہمیں تم یاد آو گے** |

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| **Breast Cancer Prediction Problem** |

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**Breast cancer – Brief Overview**

* **Breast cancer is a disease in which the cells in the breast of a person grow out of control becoming cancerous for the person.**
* **Breast cancer is a very common cancer. It has more than 2.2 million cases every year around the globe. Almost 1 in every 12 women has breast cancer. It is known as the most common cancer. Almost 600k women died from breast cancer last year.**
* **Breast cancer is the most common cancer in the world**

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**Breast Cancer – Main Features**

* **Name of Cancer**
  + **Breast Cancer**
* **Symptoms**
  + **New lump in the breast or underarm (armpit).**
  + **Thickening or swelling of part of the breast.**
  + **Irritation or dimpling of breast skin.**
* **Risk Factors**
* **The risk for breast cancer increases with age; most breast cancers are diagnosed after age 50.**
* **Early menstrual periods before age 12 and starting menopause after age 55 expose women to hormones longer, raising their risk of getting breast cancer.**
* **Women who are not physically active have a higher risk of getting breast cancer.**
* **Studies show that a woman’s risk for breast cancer increases with the more alcohol she drinks.**
* **Statistics of 2020**
* [**https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-019-7330-z#:~:text=The%20total%20projected%20breast%20cancer,and%202025%20relative%20to%202015.**](https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-019-7330-z#:~:text=The%20total%20projected%20breast%20cancer,and%202025%20relative%20to%202015.)
* **Ways of treatment**
  + **Can be treated in several ways depending upon the kind of breast cancer and how far it has spread:**
    - **Surgery**
    - **Chemotherapy**
    - **Hormonal Therapy**
    - **Biological Therapy**
    - **Radiation Therapy**

**SLIDE**

**Lecture Focus**

* **The main focus of this Lecture is developing a**
  + **Predictive System which can automatically predict whether a person has breast cancer recurring or not.**

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**Breast Cancer Detection Prediction System**

* **Real-world World**
  + **Breast Cancer Detection**
* **Treated as**
  + **Supervised Machine Learning Problem**
* **Note** 
  + **Breast Cancer Prediction Problem is treated as a**
    - **Binary Classification Problem because the** 
      * **The main aim is to distinguish between Two Classes**
        + **Class 01 = Recurrence Event**
        + **Class 02 = No Recurrence Event**
* **Goal**
  + **Learn an Input-Output Function**
    - **i.e. Learn from Input to predict the Output**

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**Breast Cancer Detection Prediction System – Task**

* **Given**
  + **A Person medical information related to breast cancer. (Represented as Set of Attributes)**
* **Task**
  + **Automatically Predict whether the person has Breast Cancer Recurrence or Not**

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**Breast Cancer Detection Prediction System – Input and Output**

* **Input** 
  + **A Person medical information related to breast cancer.**
* **Output**
  + **Breast cancer:** **Recurrence / No Recurrence**

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**Note**

* **In Original breast cancer Dataset, a Person is represented with many Attributes**
* **Breast cancer Dataset**
  + **URL:** [**Breast cancer dataset**](https://archive.ics.uci.edu/ml/machine-learning-databases/breast-cancer/)
* **For simplicity and to explain things more clearly**
  + **In this Lecture, we have represented a Person with 8 Attributes**

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**Breast Cancer Detection Prediction** **System – Input Attributes**

* **In this Lecture, Input is represented with the following Eight Attributes**
* **Attribute 01 – Age**
  + **Possible Value 01 = 10 - 19**
  + **Possible Value 02 = 20 - 29**
  + **Possible Value 03 = 30 - 39**
  + **Possible Value 04 = 40 - 49**
  + **Possible Value 05 = 50 - 59**
  + **Possible Value 06 = 60 - 69**
  + **Possible Value 07 = 70 - 79**
  + **Possible Value 08 = 80 - 89**
  + **Possible Value 09 = 90 - 99**
* **Attribute 02 – Menopause**
  + **Possible Value 01 = lt40**
  + **Possible Value 02 = ge40**
  + **Possible Value 03 = premeno**
* **Attribute 03 – Tumor Size**
  + **Possible Value 01 = 0 - 4**
  + **Possible Value 02 = 5 - 9**
  + **Possible Value 03 = 10 - 14**
  + **Possible Value 04 = 15 - 19**
  + **Possible Value 05 = 20 - 24**
  + **Possible Value 06 = 25 - 29**
  + **Possible Value 07 = 30 - 34**
  + **Possible Value 08 = 35 - 39**
  + **Possible Value 09 = 40 - 44**
  + **Possible Value 10 = 45 - 49**
  + **Possible Value 11 = 50 - 54**
  + **Possible Value 18 = 55 - 59**
* **Attribute 04 – Node-Caps**
  + **Possible Value 01 = Yes**
  + **Possible Value 02 = No**
* **Attribute 05 – deg-malig**
  + **Possible Value 01 = 1**
  + **Possible Value 02 = 2**
  + **Possible Value 03 = 3**
* **Attribute 06 – Breast-Quad**
  + **Possible Value 01 = left-low**
  + **Possible Value 02 = left-up**
  + **Possible Value 03 = right-low**
  + **Possible Value 04 = right-up**
  + **Possible Value 05 = central**
* **Attribute 07 – Irradiate**
  + **Possible Value 01 = Yes**
  + **Possible Value 02 = No**
* **Attribute 08 – Breast** 
  + **Possible Value 01 = left**
  + **Possible Value 02 = right**

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**Breast Cancer Detection Prediction** **System – Output Attributes**

* **In Breast Cancer Dataset, there is One Output Attribute**
  + **Attribute 01 – Breast Cancer**
    - **Possible Value 01 = Recurrence Event**
    - **Possible Value 02 = No Recurrence Event**

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**Breast Cancer Detection Prediction** **System – Summary (Input and Output)**

* **The following Table summarizes the Input and Output Attributes for Breast Cancer Dataset**

|  |  |  |  |
| --- | --- | --- | --- |
| **Attribute No.** | **Attribute Names** | **Possible Values** | **Data Types** |
| **1** | **Age** | **10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99** | **Categorical** |
| **2** | **Menopause** | **lt40, ge40, premeno** | **Categorical** |
| **3** | **Tumor-Size** | **0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 45-49, 50-54, 55-59** | **Categorical** |
| **4** | **Node-Caps** | **yes, no** | **Categorical** |
| **5** | **Deg-Malig** | **1, 2, 3** | **Categorical** |
| **6** | **Breast-Quad** | **left-low, left-up, right-low, right-up, central** | **Categorical** |
| **7** | **Breast Cancer** | **recurrence-events, no-recurrence-events** | **Categorical** |

**Table 01: Attributes of Dataset**

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**Horrrrrrrraaaaaaayyyyyyyyyyyy! 🚩**

* **Alhamdulillah, we have understood the Breast Cancer Prediction Problem in detail**
* **In Sha Allah, in the next section, I will try to present the** 
  + **Steps – Breast Cancer Prediction Problem as a Supervised Machine Learning Problem**
* **Note**
  + **Always celebrate your achievements**
* **Remember**
  + **There are no such things as**
    - **Big Achievement**
    - **Small Achievement**
    - **Achievement is Achievement**

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| **Its Story Time** |

**Story No 01**

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| **Steps – Treating Breast Cancer Prediction Problem as a Supervised Machine Learning Problem** **using Train-Test Split Approach** |

**SLIDE**

**Breast Cancer Prediction Problem**

* **Task**
  + **Develop a Breast Cancer Detection Prediction System to Predict whether a person has breast cancer recurring or not**
* **Input**
* **Eight Attributes**

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| 1. **Age** 2. **Menopause** 3. **Tumor-Size** 4. **Node-Caps** 5. **Deg-malig** 6. **Breast** 7. **Breast-Quad** 8. **Irradiate** |

* **Output**
  + **One Attribute**

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| 1. **Recurrence** |

* **Treated as a**
  + **Supervised Machine Learning Problem**
* **Goal**
  + **Learn an Input-Output Function**
    - **i.e. Learn from Input to predict the Output**

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**Breast Cancer Detection Prediction System is a Classification Problem**

* **Breast Cancer Detection Prediction System is a Classification Problem because** 
  + **Output is Categorical**

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**Breast Cancer Prediction Problem – Input and Output**

* **Input**
  + **Categorical**
* **Output**
  + **Categorical**

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**Project Focus**

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| **Breast Cancer Detection Prediction System** |

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**Steps – Treating Breast Cancer Prediction Problem as a Classification Problem**

* **In Sha Allah (انشاء اللہ), I will follow the following steps to treat the Breast Cancer Prediction Problem as a Classification Problem** 
  + **Step 1: Decide the Learning Settings**
  + **Step 2: Obtain Sample Data**
  + **Step 3: Understand and Pre-process Sample Data**
  + **Step 4: Represent Sample Data in Machine Understandable Format**
  + **Step 5: Select Suitable Machine Learning Algorithms**
  + **Step 6: Split Sample Data into Training Data and Testing Data**
  + **Step 7: Select Suitable Evaluation Measure(s)**
  + **Step 8: Execute First Two Phases of Machine Learning Cycle**
    - **Training Phase**
    - **Testing Phase**
  + **Step 9: Analyze Results**

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| **If (Results are Good)**  **Then**  **Move to the Next Step**  **Else**  **Go to Step 1** |

* + **Step 10: Execute 3rd and 4th Phases of Machine Learning Cycle**
    - **Application Phase**
    - **Feedback Phase**
  + **Step 11: Based on Feedback**
    - **Go to Step 1 and Repeat all the Steps**

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| **Step 1: Decide the Learning Setting** |

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**Step 1: Decide the Learning Setting**

* **In Sha Allah (انشاء اللہ), I will treat the Breast Cancer Detection Prediction Problem as a** 
  + **Supervised Machine Learning Problem**
* **Since Output is Categorical, it will be treated as a**
  + **Classification Problem**

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| **Step 2: Obtain Sample Data** |

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**Step 2: Obtain Sample Data**

* **Since I am Treating Breast Cancer Prediction Problem as a Supervised Machine Learning Problem, I will need**
  + **Annotated Data**
* **For more accurate learning, I need**
  1. **Large amount of Annotated Data**
  2. **High-quality Annotated Data**
  3. **Balanced Data**
* **Note**
  + **For simplicity, In Sha Allah (انشاء اللہ) I will use a toy Corpus / Dataset of 100 instances**

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**Step 2: Obtain Sample Data Cont…**

* **Two Main Choices to Obtain Data**
  1. **Use an Existing Corpus**
  2. **Develop Your Corpus**
* **The Dataset to use is a subset of Breast cancer dataset from University Medical Centre, Institute of Oncology, Ljubljana, Yugoslavia**
  + **Corpus / Dataset** 
    - **Link:** [**Breast cancer dataset**](https://archive.ics.uci.edu/ml/machine-learning-databases/breast-cancer/)
* **Paper Reference:**
  + - **Matjaz Zwitter & Milan Soklic (physicians) Institute of Oncology University Medical Center Ljubljana, Yugoslavia**
    - **Donors: Ming Tan and Jeff Schlimmer (Jeffrey.Schlimmer@a.gp.cs.cmu.edu)**

**Date: 11 July 1988**

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**Obtain Sample Data Cont…**

* **Total Instances in Sample Data = 100**
  + **Survived = 50**
  + **Not Survived = 50**

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**Sample Data**

* **We obtained a Sample Data of 100 instances**
  + **See sample-data.csv File in Supporting Material**
* **The following Table shows the Sample Data**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. of Instances** | **Input** | | | | | | | | **Output** |
| **Age** | **Menopause** | **Tumor Size** | **Node-caps** | **Deg-malig** | **Breast** | **Breast-quad** | **Irradiate** | **Recurrence** |
| **x1** | **50-59** | **premeno** | **15-19** | **no** | **2** | **left** | **left\_low** | **no** | **recurrence-events** |
| **x2** | **50-59** | **ge40** | **25-29** | **yes** | **3** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x3** | **50-59** | **ge40** | **35-39** | **no** | **2** | **left** | **left\_low** | **no** | **recurrence-events** |
| **x4** | **50-59** | **ge40** | **35-39** | **no** | **3** | **left** | **left\_low** | **no** | **no-recurrence-events** |
| **x5** | **30-39** | **premeno** | **0-4** | **no** | **2** | **right** | **central** | **no** | **recurrence-events** |
| **x6** | **30-39** | **lt40** | **15-19** | **no** | **3** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x7** | **50-59** | **premeno** | **25-29** | **no** | **2** | **left** | **right\_up** | **no** | **recurrence-events** |
| **x8** | **50-59** | **ge40** | **25-29** | **yes** | **3** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x9** | **40-49** | **premeno** | **35-39** | **no** | **1** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x10** | **50-59** | **ge40** | **30-34** | **no** | **1** | **right** | **central** | **no** | **no-recurrence-events** |
| **x11** | **50-59** | **ge40** | **20-24** | **no** | **2** | **right** | **central** | **no** | **recurrence-events** |
| **x12** | **40-49** | **premeno** | **25-29** | **no** | **3** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x13** | **50-59** | **premeno** | **25-29** | **no** | **1** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x14** | **60-69** | **ge40** | **10-14** | **no** | **2** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x15** | **40-49** | **ge40** | **20-24** | **no** | **2** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x16** | **60-69** | **ge40** | **25-29** | **no** | **1** | **right** | **left\_low** | **yes** | **no-recurrence-events** |
| **x17** | **40-49** | **premeno** | **15-19** | **no** | **2** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x18** | **40-49** | **premeno** | **20-24** | **no** | **2** | **right** | **left\_low** | **no** | **no-recurrence-events** |
| **x19** | **30-39** | **premeno** | **15-19** | **no** | **1** | **right** | **left\_low** | **no** | **recurrence-events** |
| **x20** | **50-59** | **premeno** | **10-14** | **no** | **2** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x21** | **30-39** | **premeno** | **30-34** | **no** | **1** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x22** | **30-39** | **premeno** | **20-24** | **yes** | **2** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x23** | **60-69** | **ge40** | **20-24** | **no** | **3** | **right** | **left\_low** | **no** | **recurrence-events** |
| **x24** | **60-69** | **ge40** | **30-34** | **yes** | **2** | **right** | **right\_up** | **no** | **no-recurrence-events** |
| **x25** | **40-49** | **ge40** | **20-24** | **no** | **3** | **right** | **left\_low** | **yes** | **recurrence-events** |
| **x26** | **50-59** | **premeno** | **25-29** | **yes** | **2** | **left** | **left\_low** | **yes** | **no-recurrence-events** |
| **x27** | **50-59** | **premeno** | **30-34** | **no** | **3** | **right** | **left\_up** | **yes** | **recurrence-events** |
| **x28** | **40-49** | **ge40** | **25-29** | **no** | **2** | **left** | **left\_low** | **no** | **no-recurrence-events** |
| **x29** | **60-69** | **ge40** | **45-49** | **no** | **1** | **right** | **right\_up** | **yes** | **recurrence-events** |
| **x30** | **50-59** | **premeno** | **25-29** | **no** | **2** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x31** | **40-49** | **premeno** | **30-34** | **no** | **2** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x32** | **40-49** | **premeno** | **35-39** | **yes** | **3** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x33** | **70-79** | **ge40** | **15-19** | **no** | **1** | **left** | **left\_low** | **yes** | **recurrence-events** |
| **x34** | **40-49** | **premeno** | **25-29** | **no** | **1** | **right** | **left\_low** | **yes** | **no-recurrence-events** |
| **x35** | **50-59** | **premeno** | **25-29** | **yes** | **3** | **left** | **left\_low** | **yes** | **recurrence-events** |
| **x36** | **50-59** | **ge40** | **30-34** | **no** | **3** | **left** | **left\_low** | **yes** | **no-recurrence-events** |
| **x37** | **40-49** | **premeno** | **25-29** | **no** | **2** | **right** | **left\_low** | **no** | **recurrence-events** |
| **x38** | **50-59** | **ge40** | **25-29** | **no** | **1** | **left** | **right\_low** | **no** | **no-recurrence-events** |
| **x39** | **40-49** | **premeno** | **20-24** | **yes** | **2** | **right** | **right\_up** | **yes** | **recurrence-events** |
| **x40** | **40-49** | **premeno** | **10-14** | **no** | **2** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x41** | **40-49** | **premeno** | **15-19** | **yes** | **3** | **left** | **left\_low** | **no** | **recurrence-events** |
| **x42** | **40-49** | **premeno** | **15-19** | **no** | **3** | **right** | **right\_low** | **yes** | **no-recurrence-events** |
| **x43** | **50-59** | **ge40** | **20-24** | **yes** | **3** | **right** | **right\_up** | **no** | **recurrence-events** |
| **x44** | **50-59** | **ge40** | **30-34** | **yes** | **2** | **left** | **left\_low** | **no** | **no-recurrence-events** |
| **x45** | **30-39** | **premeno** | **30-34** | **no** | **2** | **right** | **left\_up** | **yes** | **recurrence-events** |
| **x46** | **50-59** | **premeno** | **50-54** | **yes** | **2** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x47** | **50-59** | **ge40** | **30-34** | **yes** | **3** | **left** | **right\_low** | **yes** | **recurrence-events** |
| **x48** | **50-59** | **premeno** | **10-14** | **no** | **1** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x49** | **30-39** | **premeno** | **20-24** | **yes** | **2** | **left** | **left\_low** | **no** | **recurrence-events** |
| **x50** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x51** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x52** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x53** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x54** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x55** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x56** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x57** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x58** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x59** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x60** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x61** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x62** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x63** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x64** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x65** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x66** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x67** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x68** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x69** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x70** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x71** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x72** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x73** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x74** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x75** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x76** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x77** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x78** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x79** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x80** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x81** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x82** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x83** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x84** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x85** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x86** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x87** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x88** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x89** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x90** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x91** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x92** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x93** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x94** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x95** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x96** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x97** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x98** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x99** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x100** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |

|  |
| --- |
| **Step 03: Understand and Pre-process Data** |

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**Step 3: Understand and Pre-process Sample Data**

* **Understanding Data**
  + **The Sample Data contains Nine Attributes** 
    - **Age**
    - **Menopause**
    - **Tumor-size**
    - **Node-caps**
    - **Deg-malig**
    - **Breast**
    - **Breast-quad**
    - **Irradiate**
    - **Recurrence**
  + **Separating Input from Output**
    - **Input comprises of Eight Attributes** 
      * **Age**
      * **Menopause**
      * **Tumor-size**
      * **Node-caps**
      * **Deg-malig**
      * **Breast**
      * **Breast-quad**
      * **Irradiate**
    - **The Output comprises of a Single Attribute**
      * **Recurrence**
* **Pre-processing Data**
  + **Corpus is already pre-processed**
    - **Therefore, no pre-processing is needed 😊**

**SLIDE**

**Note**

|  |
| --- |
| * **To be successful in life, try to spend most of your time with people**   + **Who are clean from two main diseases?** * **مولانا عبدالرحمن اشرفی رح فرماتے تھے کہ،**   + **قرآن پاک کا خلاصہ 2 باتیں ہیں: (1) بدکلامی اور (2) بد گمانی**     - **بد کلامی سے جسمانی بیماریاں پیدا ہوتی ہیں**     - **بد گمانی سے روحانی بیماریاں پیدا ہوتی ہیں** * **ان دونوں ( بد کلامی اور بد گمانی) کا خلاصہ ہے**   + **عاجزی** * **استاد محترم فرماتے ہیں کہ،**   + **اللہ پاک عاجزی پر ملتے ہیں** |

|  |
| --- |
| **Step 04: Represent Data in Machine Understandable Format** |

**SLIDE**

**Step 4: Represent Sample Data in Machine Understandable Format**

* **Feature-based Classification Algorithms (implemented in Scikit-learn) can understand data in**
  + **Attribute-Value Pair**
    - **Values of Attributes / Features must be Numeric**
* **Problem**
  + **Our Sample Data is not in Attribute-Value Pair form**
    - **We need to transform our Sample Data into Machine Understandable Format**
* **Solution**
  + **There are many approaches to transform Sample Data into Machine Understandable Format**

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**Feature Extraction**

* **Features are already extracted**
  + **Therefore, we will skip the Feature Extraction Step 😊**

**SLIDE**

**Important Note**

* **In this Lecture, we are using Scikit-learn implementation of the Support Vector Classifier Machine Learning Algorithm**
* **Scikit-learn can only understand Data in Numerical Representation**
  + **Therefore, we will need to Convert the Categorical Values to Numerical Values**

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**Transforming Sample Data in Machine Understandable Format**

* **In our Sample Data**
  + **Input is Categorical**
  + **Output is Categorical**

**Considering Input (Age, Menopause, Tumor-size, Node-caps, Deg-malig, Breast, Breast-quad, Irradiate ) and Output (Recurrence), we will need to**

* **Transform Input (Categorical) into Numerical Representation**
* **Transform Output (Categorical) into Numerical Representation**

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**Converting Output into Numerical Representation**

* **A Two-Step Process**
  + **Step 01: Define an Encoding Scheme**
  + **Step 02: Use Encoding Scheme defined in Step 01, to convert Categorical Output Values to Numerical Output Values for all instances in the Sample Data**

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**Converting Output into Numerical Representation Cont…**

* **Step 01: Define an Encoding Scheme**
* **Encoding Scheme for Recurrence Attribute**
  + **No = 0**
  + **Yes = 1**

**SLIDE**

**Converting Output into Numerical Representation Cont…**

* **Step 02: Use Encoding Scheme defined in Step 01, to convert Categorical Output Values to Numerical Output Values for all instances in the Sample Data**
* **The Table below shows Sample Data after Encoding Categorical Output Values to Numerical Output Values**
  + **See sample-data-encoded-output.csv File in Supporting Material**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. of Instances** | **Input** | | | | | | | | **Output** |
| **Age** | **Menopause** | **Tumor Size** | **Node-caps** | **Deg-malig** | **Breast** | **Breast-quad** | **Irradiate** | **Recurrence** |
| **x1** | **50-59** | **premeno** | **15-19** | **no** | **2** | **left** | **left\_low** | **no** | **1** |
| **x2** | **50-59** | **ge40** | **25-29** | **yes** | **3** | **right** | **left\_up** | **no** | **0** |
| **x3** | **50-59** | **ge40** | **35-39** | **no** | **2** | **left** | **left\_low** | **no** | **1** |
| **x4** | **50-59** | **ge40** | **35-39** | **no** | **3** | **left** | **left\_low** | **no** | **0** |
| **x5** | **30-39** | **premeno** | **0-4** | **no** | **2** | **right** | **central** | **no** | **1** |
| **x6** | **30-39** | **lt40** | **15-19** | **no** | **3** | **right** | **left\_up** | **no** | **0** |
| **x7** | **50-59** | **premeno** | **25-29** | **no** | **2** | **left** | **right\_up** | **no** | **1** |
| **x8** | **50-59** | **ge40** | **25-29** | **yes** | **3** | **right** | **left\_up** | **no** | **0** |
| **x9** | **40-49** | **premeno** | **35-39** | **no** | **1** | **right** | **left\_up** | **no** | **1** |
| **x10** | **50-59** | **ge40** | **30-34** | **no** | **1** | **right** | **central** | **no** | **0** |
| **x11** | **50-59** | **ge40** | **20-24** | **no** | **2** | **right** | **central** | **no** | **1** |
| **x12** | **40-49** | **premeno** | **25-29** | **no** | **3** | **right** | **left\_up** | **yes** | **0** |
| **x13** | **50-59** | **premeno** | **25-29** | **no** | **1** | **right** | **left\_up** | **no** | **1** |
| **x14** | **60-69** | **ge40** | **10-14** | **no** | **2** | **right** | **left\_up** | **yes** | **0** |
| **x15** | **40-49** | **ge40** | **20-24** | **no** | **2** | **right** | **left\_up** | **no** | **1** |
| **x16** | **60-69** | **ge40** | **25-29** | **no** | **1** | **right** | **left\_low** | **yes** | **0** |
| **x17** | **40-49** | **premeno** | **15-19** | **no** | **2** | **left** | **left\_up** | **no** | **1** |
| **x18** | **40-49** | **premeno** | **20-24** | **no** | **2** | **right** | **left\_low** | **no** | **0** |
| **x19** | **30-39** | **premeno** | **15-19** | **no** | **1** | **right** | **left\_low** | **no** | **1** |
| **x20** | **50-59** | **premeno** | **10-14** | **no** | **2** | **right** | **left\_up** | **no** | **0** |
| **x21** | **30-39** | **premeno** | **30-34** | **no** | **1** | **right** | **left\_up** | **no** | **1** |
| **x22** | **30-39** | **premeno** | **20-24** | **yes** | **2** | **right** | **left\_up** | **yes** | **0** |
| **x23** | **60-69** | **ge40** | **20-24** | **no** | **3** | **right** | **left\_low** | **no** | **1** |
| **x24** | **60-69** | **ge40** | **30-34** | **yes** | **2** | **right** | **right\_up** | **no** | **0** |
| **x25** | **40-49** | **ge40** | **20-24** | **no** | **3** | **right** | **left\_low** | **yes** | **1** |
| **x26** | **50-59** | **premeno** | **25-29** | **yes** | **2** | **left** | **left\_low** | **yes** | **0** |
| **x27** | **50-59** | **premeno** | **30-34** | **no** | **3** | **right** | **left\_up** | **yes** | **1** |
| **x28** | **40-49** | **ge40** | **25-29** | **no** | **2** | **left** | **left\_low** | **no** | **0** |
| **x29** | **60-69** | **ge40** | **45-49** | **no** | **1** | **right** | **right\_up** | **yes** | **1** |
| **x30** | **50-59** | **premeno** | **25-29** | **no** | **2** | **right** | **left\_up** | **yes** | **0** |
| **x31** | **40-49** | **premeno** | **30-34** | **no** | **2** | **right** | **left\_up** | **no** | **1** |
| **x32** | **40-49** | **premeno** | **35-39** | **yes** | **3** | **right** | **left\_up** | **yes** | **0** |
| **x33** | **70-79** | **ge40** | **15-19** | **no** | **1** | **left** | **left\_low** | **yes** | **1** |
| **x34** | **40-49** | **premeno** | **25-29** | **no** | **1** | **right** | **left\_low** | **yes** | **0** |
| **x35** | **50-59** | **premeno** | **25-29** | **yes** | **3** | **left** | **left\_low** | **yes** | **1** |
| **x36** | **50-59** | **ge40** | **30-34** | **no** | **3** | **left** | **left\_low** | **yes** | **0** |
| **x37** | **40-49** | **premeno** | **25-29** | **no** | **2** | **right** | **left\_low** | **no** | **1** |
| **x38** | **50-59** | **ge40** | **25-29** | **no** | **1** | **left** | **right\_low** | **no** | **0** |
| **x39** | **40-49** | **premeno** | **20-24** | **yes** | **2** | **right** | **right\_up** | **yes** | **1** |
| **x40** | **40-49** | **premeno** | **10-14** | **no** | **2** | **right** | **left\_up** | **no** | **0** |
| **x41** | **40-49** | **premeno** | **15-19** | **yes** | **3** | **left** | **left\_low** | **no** | **1** |
| **x42** | **40-49** | **premeno** | **15-19** | **no** | **3** | **right** | **right\_low** | **yes** | **0** |
| **x43** | **50-59** | **ge40** | **20-24** | **yes** | **3** | **right** | **right\_up** | **no** | **1** |
| **x44** | **50-59** | **ge40** | **30-34** | **yes** | **2** | **left** | **left\_low** | **no** | **0** |
| **x45** | **30-39** | **premeno** | **30-34** | **no** | **2** | **right** | **left\_up** | **yes** | **1** |
| **x46** | **50-59** | **premeno** | **50-54** | **yes** | **2** | **right** | **left\_up** | **yes** | **0** |
| **x47** | **50-59** | **ge40** | **30-34** | **yes** | **3** | **left** | **right\_low** | **yes** | **1** |
| **x48** | **50-59** | **premeno** | **10-14** | **no** | **1** | **right** | **left\_up** | **no** | **0** |
| **x49** | **30-39** | **premeno** | **20-24** | **yes** | **2** | **left** | **left\_low** | **no** | **1** |
| **x50** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x51** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x52** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x53** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x54** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x55** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x56** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x57** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x58** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x59** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x60** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x61** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x62** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x63** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x64** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x65** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x66** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x67** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x68** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x69** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x70** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x71** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x72** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x73** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x74** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x75** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x76** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x77** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x78** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x79** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x80** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x81** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x82** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x83** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x84** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x85** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x86** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x87** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x88** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x89** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x90** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x91** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x92** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x93** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x94** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x95** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x96** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x97** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x98** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |
| **x99** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **1** |
| **x100** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **0** |

**SLIDE**

**Note**

* **Alhamdulillah (الحمدللہ), Output is transformed into Numerical Representation**
* **In Sha Allah (انشاء اللہ), in the next Slides, I will try to explain how to transform Input into Numerical Representation**

**SLIDE**

**Converting Input into Numerical Representation**

* **Step 01: Define an Encoding Scheme**
* **Step 02: Use Encoding Scheme defined in Step 01, to convert Categorical Input Values to Numerical Input Values for all instances in the Sample Data**

**SLIDE**

**Converting Input into Numerical Representation Cont…**

**Step 01: Define an Encoding Scheme**

* **Encoding Scheme for Age Attribute**
  + **0 = 10 - 19**
  + **1 = 20 - 29**
  + **2 = 30 - 39**
  + **3 = 40 - 49**
  + **4 = 50 - 59**
  + **5 = 60 - 69**
  + **6 = 70 - 79**
  + **7 = 80 - 89**
  + **8 = 90 - 99**
* **Encoding Scheme for Menopause Attribute**
  + **0 = lt40**
  + **1 =  ge40**
  + **2 =  premeno**
* **Encoding Scheme for tumor size Attribute**
  + **0 = 0 - 4**
  + **1 = 5 - 9**
  + **2 = 10 - 14**
  + **3 = 15 - 19**
  + **4 = 20 - 24**
  + **5 = 25 - 29**
  + **6 = 30 - 34**
  + **7 = 35 - 39**
  + **8 = 40 - 44**
  + **9 = 45 - 49**
  + **10 = 50 - 54**
  + **11 = 55 - 59**
* **Attribute 04 – Node-Caps**
  + **0 = Yes**
  + **1 = No**
* **Attribute 05 – deg-malig**
  + **0 = 1**
  + **1 = 2**
  + **2 = 3**
* **Attribute 06 – Breast-Quad**
  + **0 = left-low**
  + **1 = left-up**
  + **2 = right-low**
  + **3 = right-up**
  + **4 = central**
* **Attribute 07 – Irradiate**
  + **0 = Yes**
  + **1 = No**
* **Attribute 08 – Breast**
  + **0 = left**
  + **1 = right**

**SLIDE**

**Converting Input into Numerical Representation Cont…**

* **Step 02: Use Encoding Scheme defined in Step 01, to convert Categorical Input Values to Numerical Input Values for all instances in the Sample Data**
* **The Table below shows Sample Data after Encoding Categorical Input Values to Numerical Input Values**
  + **See sample-data-encoded.csv File in Supporting Material**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. of Instances** | **Input** | | | | | | | | **Output** |
| **Age** | **Menopause** | **Tumor Size** | **Node-caps** | **Deg-malig** | **Breast** | **Breast-quad** | **Irradiate** | **Recurrence** |
| **x1** | **4** | **2** | **2** | **0** | **1** | **0** | **1** | **0** | **1** |
| **x2** | **4** | **0** | **4** | **1** | **2** | **1** | **2** | **0** | **0** |
| **x3** | **4** | **0** | **6** | **0** | **1** | **0** | **1** | **0** | **1** |
| **x4** | **4** | **0** | **6** | **0** | **2** | **0** | **1** | **0** | **0** |
| **x5** | **2** | **2** | **0** | **0** | **1** | **1** | **0** | **0** | **1** |
| **x6** | **2** | **1** | **2** | **0** | **2** | **1** | **2** | **0** | **0** |
| **x7** | **4** | **2** | **4** | **0** | **1** | **0** | **4** | **0** | **1** |
| **x8** | **4** | **0** | **4** | **1** | **2** | **1** | **2** | **0** | **0** |
| **x9** | **3** | **2** | **6** | **0** | **0** | **1** | **2** | **0** | **1** |
| **x10** | **4** | **0** | **5** | **0** | **0** | **1** | **0** | **0** | **0** |
| **x11** | **4** | **0** | **3** | **0** | **1** | **1** | **0** | **0** | **1** |
| **x12** | **3** | **2** | **4** | **0** | **2** | **1** | **2** | **1** | **0** |
| **x13** | **4** | **2** | **4** | **0** | **0** | **1** | **2** | **0** | **1** |
| **x14** | **5** | **0** | **1** | **0** | **1** | **1** | **2** | **1** | **0** |
| **x15** | **3** | **0** | **3** | **0** | **1** | **1** | **2** | **0** | **1** |
| **x16** | **5** | **0** | **4** | **0** | **0** | **1** | **1** | **1** | **0** |
| **x17** | **3** | **2** | **2** | **0** | **1** | **0** | **2** | **0** | **1** |
| **x18** | **3** | **2** | **3** | **0** | **1** | **1** | **1** | **0** | **0** |
| **x19** | **2** | **2** | **2** | **0** | **0** | **1** | **1** | **0** | **1** |
| **x20** | **4** | **2** | **1** | **0** | **1** | **1** | **2** | **0** | **0** |
| **x21** | **2** | **2** | **5** | **0** | **0** | **1** | **2** | **0** | **1** |
| **x22** | **2** | **2** | **3** | **1** | **1** | **1** | **2** | **1** | **0** |
| **x23** | **5** | **0** | **3** | **0** | **2** | **1** | **1** | **0** | **1** |
| **x24** | **5** | **0** | **5** | **1** | **1** | **1** | **4** | **0** | **0** |
| **x25** | **3** | **0** | **3** | **0** | **2** | **1** | **1** | **1** | **1** |
| **x26** | **4** | **2** | **4** | **1** | **1** | **0** | **1** | **1** | **0** |
| **x27** | **4** | **2** | **5** | **0** | **2** | **1** | **2** | **1** | **1** |
| **x28** | **3** | **0** | **4** | **0** | **1** | **0** | **1** | **0** | **0** |
| **x29** | **5** | **0** | **8** | **0** | **0** | **1** | **4** | **1** | **1** |
| **x30** | **4** | **2** | **4** | **0** | **1** | **1** | **2** | **1** | **0** |
| **x31** | **3** | **2** | **5** | **0** | **1** | **1** | **2** | **0** | **1** |
| **x32** | **3** | **2** | **6** | **1** | **2** | **1** | **2** | **1** | **0** |
| **x33** | **6** | **0** | **2** | **0** | **0** | **0** | **1** | **1** | **1** |
| **x34** | **3** | **2** | **4** | **0** | **0** | **1** | **1** | **1** | **0** |
| **x35** | **4** | **2** | **4** | **1** | **2** | **0** | **1** | **1** | **1** |
| **x36** | **4** | **0** | **5** | **0** | **2** | **0** | **1** | **1** | **0** |
| **x37** | **3** | **2** | **4** | **0** | **1** | **1** | **1** | **0** | **1** |
| **x38** | **4** | **0** | **4** | **0** | **0** | **0** | **3** | **0** | **0** |
| **x39** | **3** | **2** | **3** | **1** | **1** | **1** | **4** | **1** | **1** |
| **x40** | **3** | **2** | **1** | **0** | **1** | **1** | **2** | **0** | **0** |
| **x41** | **3** | **2** | **2** | **1** | **2** | **0** | **1** | **0** | **1** |
| **x42** | **3** | **2** | **2** | **0** | **2** | **1** | **3** | **1** | **0** |
| **x43** | **4** | **0** | **3** | **1** | **2** | **1** | **4** | **0** | **1** |
| **x44** | **4** | **0** | **5** | **1** | **1** | **0** | **1** | **0** | **0** |
| **x45** | **2** | **2** | **5** | **0** | **1** | **1** | **2** | **1** | **1** |
| **x46** | **4** | **2** | **10** | **1** | **1** | **1** | **2** | **1** | **0** |
| **x47** | **4** | **0** | **5** | **1** | **2** | **0** | **3** | **1** | **1** |
| **x48** | **4** | **2** | **1** | **0** | **0** | **1** | **2** | **0** | **0** |
| **x49** | **2** | **2** | **3** | **1** | **1** | **0** | **1** | **0** | **1** |
| **x50** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x51** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x52** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x53** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x54** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x55** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x56** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x57** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x58** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x59** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x60** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x61** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x62** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x63** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x64** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x65** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x66** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x67** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x68** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x69** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x70** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x71** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x72** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x73** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x74** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x75** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x76** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x77** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x78** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x79** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x80** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x81** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x82** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x83** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x84** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x85** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x86** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x87** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x88** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x89** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x90** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x91** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x92** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x93** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x94** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x95** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x96** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x97** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x98** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x99** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x100** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |

**SLIDE**

**Hoooooooorrrrrrrrrraaaaaaaaayyyyyyyyyyy! 🚩**

* **Alhamdulillah (الحمدللہ), both Input and Output are transformed into Numerical Representation**

**SLIDE**

**Recap – Original Sample Data**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. of Instances** | **Input** | | | | | | | | **Output** |
| **Age** | **Menopause** | **Tumor Size** | **Node-caps** | **Deg-malig** | **Breast** | **Breast-quad** | **Irradiate** | **Recurrence** |
| **x1** | **50-59** | **premeno** | **15-19** | **no** | **2** | **left** | **left\_low** | **no** | **recurrence-events** |
| **x2** | **50-59** | **ge40** | **25-29** | **yes** | **3** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x3** | **50-59** | **ge40** | **35-39** | **no** | **2** | **left** | **left\_low** | **no** | **recurrence-events** |
| **x4** | **50-59** | **ge40** | **35-39** | **no** | **3** | **left** | **left\_low** | **no** | **no-recurrence-events** |
| **x5** | **30-39** | **premeno** | **0-4** | **no** | **2** | **right** | **central** | **no** | **recurrence-events** |
| **x6** | **30-39** | **lt40** | **15-19** | **no** | **3** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x7** | **50-59** | **premeno** | **25-29** | **no** | **2** | **left** | **right\_up** | **no** | **recurrence-events** |
| **x8** | **50-59** | **ge40** | **25-29** | **yes** | **3** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x9** | **40-49** | **premeno** | **35-39** | **no** | **1** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x10** | **50-59** | **ge40** | **30-34** | **no** | **1** | **right** | **central** | **no** | **no-recurrence-events** |
| **x11** | **50-59** | **ge40** | **20-24** | **no** | **2** | **right** | **central** | **no** | **recurrence-events** |
| **x12** | **40-49** | **premeno** | **25-29** | **no** | **3** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x13** | **50-59** | **premeno** | **25-29** | **no** | **1** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x14** | **60-69** | **ge40** | **10-14** | **no** | **2** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x15** | **40-49** | **ge40** | **20-24** | **no** | **2** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x16** | **60-69** | **ge40** | **25-29** | **no** | **1** | **right** | **left\_low** | **yes** | **no-recurrence-events** |
| **x17** | **40-49** | **premeno** | **15-19** | **no** | **2** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x18** | **40-49** | **premeno** | **20-24** | **no** | **2** | **right** | **left\_low** | **no** | **no-recurrence-events** |
| **x19** | **30-39** | **premeno** | **15-19** | **no** | **1** | **right** | **left\_low** | **no** | **recurrence-events** |
| **x20** | **50-59** | **premeno** | **10-14** | **no** | **2** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x21** | **30-39** | **premeno** | **30-34** | **no** | **1** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x22** | **30-39** | **premeno** | **20-24** | **yes** | **2** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x23** | **60-69** | **ge40** | **20-24** | **no** | **3** | **right** | **left\_low** | **no** | **recurrence-events** |
| **x24** | **60-69** | **ge40** | **30-34** | **yes** | **2** | **right** | **right\_up** | **no** | **no-recurrence-events** |
| **x25** | **40-49** | **ge40** | **20-24** | **no** | **3** | **right** | **left\_low** | **yes** | **recurrence-events** |
| **x26** | **50-59** | **premeno** | **25-29** | **yes** | **2** | **left** | **left\_low** | **yes** | **no-recurrence-events** |
| **x27** | **50-59** | **premeno** | **30-34** | **no** | **3** | **right** | **left\_up** | **yes** | **recurrence-events** |
| **x28** | **40-49** | **ge40** | **25-29** | **no** | **2** | **left** | **left\_low** | **no** | **no-recurrence-events** |
| **x29** | **60-69** | **ge40** | **45-49** | **no** | **1** | **right** | **right\_up** | **yes** | **recurrence-events** |
| **x30** | **50-59** | **premeno** | **25-29** | **no** | **2** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x31** | **40-49** | **premeno** | **30-34** | **no** | **2** | **right** | **left\_up** | **no** | **recurrence-events** |
| **x32** | **40-49** | **premeno** | **35-39** | **yes** | **3** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x33** | **70-79** | **ge40** | **15-19** | **no** | **1** | **left** | **left\_low** | **yes** | **recurrence-events** |
| **x34** | **40-49** | **premeno** | **25-29** | **no** | **1** | **right** | **left\_low** | **yes** | **no-recurrence-events** |
| **x35** | **50-59** | **premeno** | **25-29** | **yes** | **3** | **left** | **left\_low** | **yes** | **recurrence-events** |
| **x36** | **50-59** | **ge40** | **30-34** | **no** | **3** | **left** | **left\_low** | **yes** | **no-recurrence-events** |
| **x37** | **40-49** | **premeno** | **25-29** | **no** | **2** | **right** | **left\_low** | **no** | **recurrence-events** |
| **x38** | **50-59** | **ge40** | **25-29** | **no** | **1** | **left** | **right\_low** | **no** | **no-recurrence-events** |
| **x39** | **40-49** | **premeno** | **20-24** | **yes** | **2** | **right** | **right\_up** | **yes** | **recurrence-events** |
| **x40** | **40-49** | **premeno** | **10-14** | **no** | **2** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x41** | **40-49** | **premeno** | **15-19** | **yes** | **3** | **left** | **left\_low** | **no** | **recurrence-events** |
| **x42** | **40-49** | **premeno** | **15-19** | **no** | **3** | **right** | **right\_low** | **yes** | **no-recurrence-events** |
| **x43** | **50-59** | **ge40** | **20-24** | **yes** | **3** | **right** | **right\_up** | **no** | **recurrence-events** |
| **x44** | **50-59** | **ge40** | **30-34** | **yes** | **2** | **left** | **left\_low** | **no** | **no-recurrence-events** |
| **x45** | **30-39** | **premeno** | **30-34** | **no** | **2** | **right** | **left\_up** | **yes** | **recurrence-events** |
| **x46** | **50-59** | **premeno** | **50-54** | **yes** | **2** | **right** | **left\_up** | **yes** | **no-recurrence-events** |
| **x47** | **50-59** | **ge40** | **30-34** | **yes** | **3** | **left** | **right\_low** | **yes** | **recurrence-events** |
| **x48** | **50-59** | **premeno** | **10-14** | **no** | **1** | **right** | **left\_up** | **no** | **no-recurrence-events** |
| **x49** | **30-39** | **premeno** | **20-24** | **yes** | **2** | **left** | **left\_low** | **no** | **recurrence-events** |
| **x50** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x51** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x52** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x53** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x54** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x55** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x56** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x57** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x58** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x59** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x60** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x61** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x62** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x63** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x64** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x65** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x66** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x67** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x68** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x69** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x70** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x71** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x72** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x73** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x74** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x75** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x76** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x77** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x78** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x79** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x80** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x81** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x82** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x83** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x84** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x85** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x86** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x87** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x88** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x89** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x90** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x91** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x92** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x93** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x94** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x95** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x96** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x97** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x98** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |
| **x99** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** |
| **x100** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** |

**SLIDE**

**Recap - Sample Data in Numerical Representation**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. of Instances** | **Input** | | | | | | | | **Output** |
| **Age** | **Menopause** | **Tumor Size** | **Node-caps** | **Deg-malig** | **Breast** | **Breast-quad** | **Irradiate** | **Recurrence** |
| **x1** | **4** | **2** | **2** | **0** | **1** | **0** | **1** | **0** | **1** |
| **x2** | **4** | **0** | **4** | **1** | **2** | **1** | **2** | **0** | **0** |
| **x3** | **4** | **0** | **6** | **0** | **1** | **0** | **1** | **0** | **1** |
| **x4** | **4** | **0** | **6** | **0** | **2** | **0** | **1** | **0** | **0** |
| **x5** | **2** | **2** | **0** | **0** | **1** | **1** | **0** | **0** | **1** |
| **x6** | **2** | **1** | **2** | **0** | **2** | **1** | **2** | **0** | **0** |
| **x7** | **4** | **2** | **4** | **0** | **1** | **0** | **4** | **0** | **1** |
| **x8** | **4** | **0** | **4** | **1** | **2** | **1** | **2** | **0** | **0** |
| **x9** | **3** | **2** | **6** | **0** | **0** | **1** | **2** | **0** | **1** |
| **x10** | **4** | **0** | **5** | **0** | **0** | **1** | **0** | **0** | **0** |
| **x11** | **4** | **0** | **3** | **0** | **1** | **1** | **0** | **0** | **1** |
| **x12** | **3** | **2** | **4** | **0** | **2** | **1** | **2** | **1** | **0** |
| **x13** | **4** | **2** | **4** | **0** | **0** | **1** | **2** | **0** | **1** |
| **x14** | **5** | **0** | **1** | **0** | **1** | **1** | **2** | **1** | **0** |
| **x15** | **3** | **0** | **3** | **0** | **1** | **1** | **2** | **0** | **1** |
| **x16** | **5** | **0** | **4** | **0** | **0** | **1** | **1** | **1** | **0** |
| **x17** | **3** | **2** | **2** | **0** | **1** | **0** | **2** | **0** | **1** |
| **x18** | **3** | **2** | **3** | **0** | **1** | **1** | **1** | **0** | **0** |
| **x19** | **2** | **2** | **2** | **0** | **0** | **1** | **1** | **0** | **1** |
| **x20** | **4** | **2** | **1** | **0** | **1** | **1** | **2** | **0** | **0** |
| **x21** | **2** | **2** | **5** | **0** | **0** | **1** | **2** | **0** | **1** |
| **x22** | **2** | **2** | **3** | **1** | **1** | **1** | **2** | **1** | **0** |
| **x23** | **5** | **0** | **3** | **0** | **2** | **1** | **1** | **0** | **1** |
| **x24** | **5** | **0** | **5** | **1** | **1** | **1** | **4** | **0** | **0** |
| **x25** | **3** | **0** | **3** | **0** | **2** | **1** | **1** | **1** | **1** |
| **x26** | **4** | **2** | **4** | **1** | **1** | **0** | **1** | **1** | **0** |
| **x27** | **4** | **2** | **5** | **0** | **2** | **1** | **2** | **1** | **1** |
| **x28** | **3** | **0** | **4** | **0** | **1** | **0** | **1** | **0** | **0** |
| **x29** | **5** | **0** | **8** | **0** | **0** | **1** | **4** | **1** | **1** |
| **x30** | **4** | **2** | **4** | **0** | **1** | **1** | **2** | **1** | **0** |
| **x31** | **3** | **2** | **5** | **0** | **1** | **1** | **2** | **0** | **1** |
| **x32** | **3** | **2** | **6** | **1** | **2** | **1** | **2** | **1** | **0** |
| **x33** | **6** | **0** | **2** | **0** | **0** | **0** | **1** | **1** | **1** |
| **x34** | **3** | **2** | **4** | **0** | **0** | **1** | **1** | **1** | **0** |
| **x35** | **4** | **2** | **4** | **1** | **2** | **0** | **1** | **1** | **1** |
| **x36** | **4** | **0** | **5** | **0** | **2** | **0** | **1** | **1** | **0** |
| **x37** | **3** | **2** | **4** | **0** | **1** | **1** | **1** | **0** | **1** |
| **x38** | **4** | **0** | **4** | **0** | **0** | **0** | **3** | **0** | **0** |
| **x39** | **3** | **2** | **3** | **1** | **1** | **1** | **4** | **1** | **1** |
| **x40** | **3** | **2** | **1** | **0** | **1** | **1** | **2** | **0** | **0** |
| **x41** | **3** | **2** | **2** | **1** | **2** | **0** | **1** | **0** | **1** |
| **x42** | **3** | **2** | **2** | **0** | **2** | **1** | **3** | **1** | **0** |
| **x43** | **4** | **0** | **3** | **1** | **2** | **1** | **4** | **0** | **1** |
| **x44** | **4** | **0** | **5** | **1** | **1** | **0** | **1** | **0** | **0** |
| **x45** | **2** | **2** | **5** | **0** | **1** | **1** | **2** | **1** | **1** |
| **x46** | **4** | **2** | **10** | **1** | **1** | **1** | **2** | **1** | **0** |
| **x47** | **4** | **0** | **5** | **1** | **2** | **0** | **3** | **1** | **1** |
| **x48** | **4** | **2** | **1** | **0** | **0** | **1** | **2** | **0** | **0** |
| **x49** | **2** | **2** | **3** | **1** | **1** | **0** | **1** | **0** | **1** |
| **x50** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x51** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x52** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x53** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x54** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x55** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x56** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x57** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x58** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x59** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x60** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x61** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x62** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x63** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x64** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x65** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x66** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x67** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x68** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x69** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x70** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x71** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x72** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x73** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x74** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x75** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x76** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x77** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x78** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x79** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x80** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x81** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x82** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x83** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x84** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x85** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x86** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x87** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x88** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x89** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x90** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x91** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x92** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x93** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x94** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x95** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x96** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x97** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x98** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x99** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x100** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |

|  |
| --- |
| **Step 05: Select Suitable Machine Learning Algorithms** |

**SLIDE**

**Step 05: Select Suitable Machine Learning Algorithms**

* **Previous students have shown that Good Starting Points for Classification Problems are**
  + **Random Forest Classifier**
  + **Support Vector Classifier**
  + **Naïve Bayes**
  + **Gradient Boosting Classifier**

**SLIDE**

**Lecture Focus**

* **In Sha Allah, in this Lecture, we will use**

|  |
| --- |
| **Support Vector Classifier** |

|  |
| --- |
| **Hadith** |

**Hadith No 01**

**Reference: Book Name: Muntakhab Ahadith, Page Number: 384**

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| --- |
|  |

**Hadith No 02**

**Reference: Book Name: Muntakhab Ahadith, Page Number: 384**

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| --- |
|  |

**Hadith No 03**

**Reference: Book Name: Muntakhab Ahadith, Page Number: 385**

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|  |

**Hadith No 04**

**Reference: Book Name: Muntakhab Ahadith, Page Number: 385**

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| **Step 06: Split Sample Data into Training Data and Testing Data** |

**SLIDE**

**Step 6: Split Sample Data into Training and Testing**

* **We Split the Sample Data using**
  + **Train-Test Split Ratio of**
    - **80% - 20%**
* **Training Data** 
  + **Total Instances = 80**
    - **Recurrence-events = 40**
    - **No-recurrence-events = 40**
* **Testing Data** 
  + **Total Instances = 20**
    - **Recurrence-events = 10**
    - **No-Recurrence-events = 10**

**SLIDE**

**Training Data**

* **The following Table shows the Training Data**
  + **See training-data-encoded.csv File in Supporting Material**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. of Instances** | **Input** | | | | | | | | **Output** |
| **Age** | **Menopause** | **Tumor Size** | **Node-caps** | **Deg-malig** | **Breast** | **Breast-quad** | **Irradiate** | **Recurrence** |
| **x1** | **4** | **2** | **2** | **0** | **1** | **0** | **1** | **0** | **1** |
| **x2** | **4** | **0** | **4** | **1** | **2** | **1** | **2** | **0** | **0** |
| **x3** | **4** | **0** | **6** | **0** | **1** | **0** | **1** | **0** | **1** |
| **x4** | **4** | **0** | **6** | **0** | **2** | **0** | **1** | **0** | **0** |
| **x5** | **2** | **2** | **0** | **0** | **1** | **1** | **0** | **0** | **1** |
| **x6** | **2** | **1** | **2** | **0** | **2** | **1** | **2** | **0** | **0** |
| **x7** | **4** | **2** | **4** | **0** | **1** | **0** | **4** | **0** | **1** |
| **x8** | **4** | **0** | **4** | **1** | **2** | **1** | **2** | **0** | **0** |
| **x9** | **3** | **2** | **6** | **0** | **0** | **1** | **2** | **0** | **1** |
| **x10** | **4** | **0** | **5** | **0** | **0** | **1** | **0** | **0** | **0** |
| **x11** | **4** | **0** | **3** | **0** | **1** | **1** | **0** | **0** | **1** |
| **x12** | **3** | **2** | **4** | **0** | **2** | **1** | **2** | **1** | **0** |
| **x13** | **4** | **2** | **4** | **0** | **0** | **1** | **2** | **0** | **1** |
| **x14** | **5** | **0** | **1** | **0** | **1** | **1** | **2** | **1** | **0** |
| **x15** | **3** | **0** | **3** | **0** | **1** | **1** | **2** | **0** | **1** |
| **x16** | **5** | **0** | **4** | **0** | **0** | **1** | **1** | **1** | **0** |
| **x17** | **3** | **2** | **2** | **0** | **1** | **0** | **2** | **0** | **1** |
| **x18** | **3** | **2** | **3** | **0** | **1** | **1** | **1** | **0** | **0** |
| **x19** | **2** | **2** | **2** | **0** | **0** | **1** | **1** | **0** | **1** |
| **x20** | **4** | **2** | **1** | **0** | **1** | **1** | **2** | **0** | **0** |
| **x21** | **2** | **2** | **5** | **0** | **0** | **1** | **2** | **0** | **1** |
| **x22** | **2** | **2** | **3** | **1** | **1** | **1** | **2** | **1** | **0** |
| **x23** | **5** | **0** | **3** | **0** | **2** | **1** | **1** | **0** | **1** |
| **x24** | **5** | **0** | **5** | **1** | **1** | **1** | **4** | **0** | **0** |
| **x25** | **3** | **0** | **3** | **0** | **2** | **1** | **1** | **1** | **1** |
| **x26** | **4** | **2** | **4** | **1** | **1** | **0** | **1** | **1** | **0** |
| **x27** | **4** | **2** | **5** | **0** | **2** | **1** | **2** | **1** | **1** |
| **x28** | **3** | **0** | **4** | **0** | **1** | **0** | **1** | **0** | **0** |
| **x29** | **5** | **0** | **8** | **0** | **0** | **1** | **4** | **1** | **1** |
| **x30** | **4** | **2** | **4** | **0** | **1** | **1** | **2** | **1** | **0** |
| **x31** | **3** | **2** | **5** | **0** | **1** | **1** | **2** | **0** | **1** |
| **x32** | **3** | **2** | **6** | **1** | **2** | **1** | **2** | **1** | **0** |
| **x33** | **6** | **0** | **2** | **0** | **0** | **0** | **1** | **1** | **1** |
| **x34** | **3** | **2** | **4** | **0** | **0** | **1** | **1** | **1** | **0** |
| **x35** | **4** | **2** | **4** | **1** | **2** | **0** | **1** | **1** | **1** |
| **x36** | **4** | **0** | **5** | **0** | **2** | **0** | **1** | **1** | **0** |
| **x37** | **3** | **2** | **4** | **0** | **1** | **1** | **1** | **0** | **1** |
| **x38** | **4** | **0** | **4** | **0** | **0** | **0** | **3** | **0** | **0** |
| **x39** | **3** | **2** | **3** | **1** | **1** | **1** | **4** | **1** | **1** |
| **x40** | **3** | **2** | **1** | **0** | **1** | **1** | **2** | **0** | **0** |
| **x41** | **3** | **2** | **2** | **1** | **2** | **0** | **1** | **0** | **1** |
| **x42** | **3** | **2** | **2** | **0** | **2** | **1** | **3** | **1** | **0** |
| **x43** | **4** | **0** | **3** | **1** | **2** | **1** | **4** | **0** | **1** |
| **x44** | **4** | **0** | **5** | **1** | **1** | **0** | **1** | **0** | **0** |
| **x45** | **2** | **2** | **5** | **0** | **1** | **1** | **2** | **1** | **1** |
| **x46** | **4** | **2** | **10** | **1** | **1** | **1** | **2** | **1** | **0** |
| **x47** | **4** | **0** | **5** | **1** | **2** | **0** | **3** | **1** | **1** |
| **x48** | **4** | **2** | **1** | **0** | **0** | **1** | **2** | **0** | **0** |
| **x49** | **2** | **2** | **3** | **1** | **1** | **0** | **1** | **0** | **1** |
| **x50** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x51** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x52** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x53** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x54** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x55** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x56** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x57** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x58** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x59** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x60** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x61** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x62** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x63** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x64** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x65** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x66** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x67** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x68** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x69** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x70** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x71** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x72** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x73** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x74** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x75** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x76** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x77** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x78** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x79** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x80** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |

**SLIDE**

**Testing Data**

* **The following Table shows the Testing Data**
  + **See testing-data-encoded.csv File in Supporting Material**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. of Instances** | **Input** | | | | | | | | **Output** |
| **Age** | **Menopause** | **Tumor Size** | **Node-caps** | **Deg-malig** | **Breast** | **Breast-quad** | **Irradiate** | **Recurrence** |
| **x1** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x2** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x3** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x4** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x5** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x6** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x7** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x8** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x9** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x10** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x11** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x12** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x13** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x14** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x15** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x16** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x17** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x18** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |
| **x19** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** |
| **x20** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** |

|  |
| --- |
| **Step 07: Select Suitable Evaluation Measure(s)** |

**SLIDE**

**Step 07: Select Suitable Evaluation Measure(s)**

* **I will use the Accuracy Evaluation Measure to evaluate the performance of the Model**
* **Accuracy**
  + **Accuracy is defined as the proportion of correctly classified Test Instances**

|  |
| --- |
|  |

* **Note**
  + **Error = 1 - Accuracy**

|  |
| --- |
| **Step 08: Execute First Two Phases of Machine Learning Cycle** |

**SLIDE**

**Step 8: Execute First Two Phases of Machine Learning Cycle**

* **Recall the Equation**

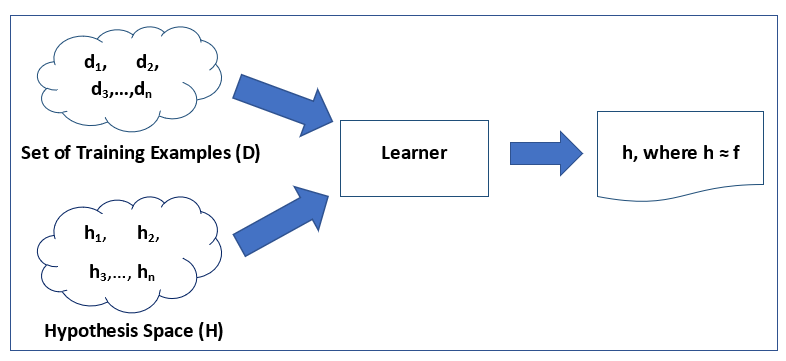
|  |
| --- |
|  |

* **Training Phase**
  + **Use Training Data to build the Model**
* **Testing Phase**
  + **Use Testing Data to evaluate the performance of the Model**
* **Note that we aim to**
  + **Learn an Input-Output Function**

**SLIDE**

**General Settings - Learning Input-Output Function**

* **Recall – Our goal is to** 
  + **Learn an Input-Output Function**



**SLIDE**

**Training Phase**

**Training Phase**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | **2** | **2** | **0** | **1** | **0** | **1** | **0** | **1** |
| **4** | **0** | **4** | **1** | **2** | **1** | **2** | **0** | **0** |
| **4** | **0** | **6** | **0** | **1** | **0** | **1** | **0** | **1** |
| **4** | **0** | **6** | **0** | **2** | **0** | **1** | **0** | **0** |
| **2** | **2** | **0** | **0** | **1** | **1** | **0** | **0** | **1** |
| **2** | **1** | **2** | **0** | **2** | **1** | **2** | **0** | **0** |
| **4** | **2** | **4** | **0** | **1** | **0** | **4** | **0** | **1** |
| **4** | **0** | **4** | **1** | **2** | **1** | **2** | **0** | **0** |
| **3** | **2** | **6** | **0** | **0** | **1** | **2** | **0** | **1** |
| **4** | **0** | **5** | **0** | **0** | **1** | **0** | **0** | **0** |

**Set of Training Examples ( D )**

**Hypothesis Space (H)**

**h, Where h ≈ f**

**Learner**

**h1, h2,**

**h3,….., hn**

**SLIDE**

**Testing Phase**

* **Apply Model on the Testing Data**

**Testing Phase**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** |
| **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** |
| **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** |
| **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** |
| **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** |

**Set of Testing Examples ( D )**

**Predictions**

**Model (h)**

**SLIDE**

**Testing Phase Cont…**

* **The following Table shows the Predictions Returned by the Model (h)**
* **See model-predictions.csv File in Supporting Material**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. of Instances** | **Input** | | | | | | | | **Output** | |
| **Age** | **Menopause** | **Tumor Size** | **Node-caps** | **Deg-malig** | **Breast** | **Breast-quad** | **Irradiate** | **Recurrence** | **Predictions** |
| **x1** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x2** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |
| **x3** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x4** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |
| **x5** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x6** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |
| **x7** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x8** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |
| **x9** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x10** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |
| **x11** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x12** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |
| **x13** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x14** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |
| **x15** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x16** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |
| **x17** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x18** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |
| **x19** | **3** | **2** | **4** | **0** | **2** | **0** | **2** | **0** | **1** | **1** |
| **x20** | **4** | **0** | **2** | **1** | **1** | **0** | **0** | **1** | **0** | **0** |

**SLIDE**

**Testing Phase, Continue**

* **Calculating Accuracy** 
  + **To calculate Accuracy, we will compare** 
    - **Actual Values with Predicted Values**
* **Note**
  + **To explain calculations more clearly, I have converted Numerical Predicted Values to Categorical Predicted Values**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. of Instances** | **Input** | | | | | | | | **Output** | | |
| **Age** | **Menopause** | **Tumor Size** | **Node-caps** | **Deg-malig** | **Breast** | **Breast-quad** | **Irradiate** | **Actual Values** | **Predicted Values** | **Score** |
| **x1** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x2** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
| **x3** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x4** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
| **x5** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x6** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
| **x7** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x8** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
| **x9** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x10** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
| **x11** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x12** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
| **x13** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x14** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
| **x15** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x16** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
| **x17** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x18** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
| **x19** | **40-49** | **premeno** | **25-29** | **no** | **3** | **left** | **left\_up** | **no** | **recurrence-events** | **recurrence-events** | **1** |
| **x20** | **50-59** | **ge40** | **15-19** | **yes** | **2** | **left** | **central** | **yes** | **no-recurrence-events** | **no-recurrence-events** | **1** |
|  | | | | | | | | | | | |

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| **Step 09: Analyze Results** |

**SLIDE**

**Step 9: Analyze Results**

* **The assumption for this Example**
  + **Here, I am assuming that the Model** 
    - **performed well on large Test Data and we can apply it in the real-world 😊**

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| **Step 10: Execute 3rd and 4th Phases of Machine Learning Cycle** |

**SLIDE**

**Step 10: Execute 3rd and 4th Phases of Machine Learning Cycle**

* **Application Phase**
  + **Model is deployed in Real-world to make predictions on Real-time Data**
* **Steps – Make Predictions on Real-time Data**
  + **Step 1: Take Input from User**
  + **Step 2: Convert User Input into Feature Vector** 
    - **The same as Feature Vectors of Sample Data**
  + **Step 3: Apply Model on the Feature Vector of the unseen instance**
  + **Step 4: Return Prediction to the User**

**SLIDE**

**Example – Making Predictions on Real-time Data**

* **Step 1: Take Input from User**
  + **User Input**

|  |
| --- |
| **Please enter your Age: 50-59** |
| **Please enter Menopause: premeno** |
| **Please enter Tumor Size: 15-19** |
| **Please enter Node Caps: no** |
| **Please enter Deg-malig: 2** |
| **Please enter Breast: left** |
| **Please enter your Breast-quad: left\_low** |
| **Please enter Irradiate: no** |

* **Step 2: Convert User Input into Feature Vector** 
  + **Feature Vector**

|  |
| --- |
| **< 50-59, premeno, 15-19, no, 2, left, left\_low, no >** |

* **Feature Vector after Label Encoding**
  + **Exactly same as Label Encoded Feature Vectors of Sample Data**
  + **Label Encoded Feature Vector** 
    - **< 4, 2, 2, 0, 1, 0, 1, 0 >**
* **Step 3: Apply Model on the Label Encoded Feature Vector of unseen instance**
  + **Model (h) is applied on < 4, 2, 2, 0, 1, 0, 1, 0 >**
* **Step 4: Return Prediction to the User**
  + **1 (Recurrence-Events)**

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**Application Phase**

**Application Phase**

**Prediction**

**Model (h)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | **2** | **2** | **0** | **1** | **0** | **1** | **0** |

**SLIDE**

**Feedback Phase**

* **A Two-Step Process**
* **Step 1: After some time, take Feedback from** 
  + **Domain Experts and Users on deployed Breast Cancer Prediction System**
* **Step 2: Make a List of Possible Improvements based on Feedback receive**

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| **Step 11: Improve Breast Cancer Prediction System based on Feedback** |

**SLIDE**

**Step 11: Improve Breast Cancer Prediction System based on Feedback**

* **Go to Step 1 and improve the Breast Cancer Prediction System based on** 
  + **List of Possible Improvements made in Step 10**

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| **TODO and Your Turn** |

**SLIDE**

**TODO**

* **Task**
  + **Consider the Heart Disease Classification Problem. The main aim is to predict whether a patient has Heart Disease or Not (i.e. Binary Classification Problem)?**
  + **Heart Disease Dataset Link**
    - **URL:**

[**https://www.kaggle.com/cdabakoglu/heart-disease-classifications-machine-learning/data**](https://www.kaggle.com/cdabakoglu/heart-disease-classifications-machine-learning/data)

* + **For simplicity, I have taken a sample of 100 instances from the Original Heart Disease Dataset**
    - **See heart-disease-sample-data.csv File in Supporting Material**
* **Note**
  + **Your answer should be**
    - **Well Justified**
* **Question**
  + **Write down the Input and Output of the Heart Disease Classification Problem?**
  + **Follow the Steps mentioned in this Lecture and show**
    - **How will you treat the Heart Disease Classification Problem as a Supervised Machine Learning Problem using Train-Test Split Approach?**

**SLIDE**

**Your Turn**

* **Task**
  + **Select a Problem (similar to the one given in TODO) and answer the questions given below**
* **Note**
  + **Your answer should be**
    - **Well Justified**
* **Questions**
  + **Write Input and Output for the selected Machine Learning Problem?**
  + **Follow the Steps mentioned in this Lecture and show** 
    - **How will you treat** **the selected Machine Learning Problem as a Supervised Machine Learning Problem using Train-Test Split Approach?**

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| **It’s Poetry Time** |

**Ghazal No 01**

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| میں خیال ہوں کسی اور کا مجھے سوچتا کوئی اور ہے  سر آئینہ مرا عکس ہے پس آئینہ کوئی اور ہے  میں کسی کے دست طلب میں ہوں تو کسی کے حرف دعا میں ہوں  میں نصیب ہوں کسی اور کا مجھے مانگتا کوئی اور ہے  عجب اعتبار و بے اعتباری کے درمیان ہے زندگی  میں قریب ہوں کسی اور کے مجھے جانتا کوئی اور ہے  مری روشنی ترے خد و خال سے مختلف تو نہیں مگر  تو قریب آ تجھے دیکھ لوں تو وہی ہے یا کوئی اور ہے  تجھے دشمنوں کی خبر نہ تھی مجھے دوستوں کا پتا نہیں  تری داستاں کوئی اور تھی مرا واقعہ کوئی اور ہے  وہی منصفوں کی روایتیں وہی فیصلوں کی عبارتیں  مرا جرم تو کوئی اور تھا پہ مری سزا کوئی اور ہے  کبھی لوٹ آئیں تو پوچھنا نہیں دیکھنا انہیں غور سے  جنہیں راستے میں خبر ہوئی کہ یہ راستہ کوئی اور ہے  جو مری ریاضت نیم شب کو سلیمؔ صبح نہ مل سکی  تو پھر اس کے معنی تو یہ ہوئے کہ یہاں خدا کوئی اور ہے  سلیم کوثر |

**Ghazal No 02**

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| ملتی ہے خوئے یار سے نار التہاب میں  کافر ہوں گر نہ ملتی ہو راحت عذاب میں  کب سے ہوں کیا بتاؤں جہان خراب میں  شب ہائے ہجر کو بھی رکھوں گر حساب میں  تا پھر نہ انتظار میں نیند آئے عمر بھر  آنے کا عہد کر گئے آئے جو خواب میں  قاصد کے آتے آتے خط اک اور لکھ رکھوں  میں جانتا ہوں جو وہ لکھیں گے جواب میں  مجھ تک کب ان کی بزم میں آتا تھا دور جام  ساقی نے کچھ ملا نہ دیا ہو شراب میں  جو منکر وفا ہو فریب اس پہ کیا چلے  کیوں بد گماں ہوں دوست سے دشمن کے باب میں  میں مضطرب ہوں وصل میں خوف رقیب سے  ڈالا ہے تم کو وہم نے کس پیچ و تاب میں  میں اور حظ وصل خدا ساز بات ہے  جاں نذر دینی بھول گیا اضطراب میں  ہے تیوری چڑھی ہوئی اندر نقاب کے  ہے اک شکن پڑی ہوئی طرف نقاب میں  لاکھوں لگاؤ ایک چرانا نگاہ کا  لاکھوں بناؤ ایک بگڑنا عتاب میں  وہ نالہ دل میں خس کے برابر جگہ نہ پائے  جس نالہ سے شگاف پڑے آفتاب میں  وہ سحر مدعا طلبی میں نہ کام آئے  جس سحر سے سفینہ رواں ہو سراب میں  غالبؔ چھٹی شراب پر اب بھی کبھی کبھی  پیتا ہوں روز ابر و شب ماہتاب میں  مرزا اسد اللہ خان غالب |

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| **Stop Complaining! Stop Criticizing! Let’s Start Contributing** |

**SLIDE**

**A True Story**

* **Here I am writing a true story of one of my Respected Teachers**

**(Prof. Dr. Yaseen Iqbal**

**Department of Physics, University of Peshawar, Pakistan)**

**SLIDE**

**Story**

* **In 1996, I was a Ph.D. student at the University of Sheffield, England. One day, I was having a walk with my friends. We saw an Old Lady picking up French Fries (potato chips) from the Foot Path. One of my friends said to the Old Lady**
  + **Mam! Why are you picking these? It is a crowded place and you may get hurt.**
* **Old Lady replied**
  + **Gentleman! This is MY Country. If it is dirty. I feel dirty.**
* **Remember** 
  + **There is nothing like**
    - **Big Contribution or**
    - **Small Contribution**
  + **Contribution is Contribution 😊**
* **Let’s Strat Contributing from Today**
  + **To make this Beautiful World, more Beautiful 😊**

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| **Its Inspirational Quotes Time** |

**Quote No 01**

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| عِلم تمہیں راہ دکھاتا ہے اور عمل تمہیں مقصد تک پہنچا دیتا ہے  حضرت علی رضی اللہ تعالی عنہ |

**Quote No 02**

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| The Desire to Know your own Soul will end all other Desires  رومی |

**Quote No 03**

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| برائی ڈھونڈنے کا شوق ہے تو آئینے کا استعمال کیجئے دوربین نہیں۰۰۰ |

**Quote No 04**

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| دکھ بول كے دسیا تے كے دسیا |

**Quote No 05**

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| اپنی آواز کی بجائے اپنے دلائل كو بلند کیجئے  پھول بَادَل كے گرجنے سے نہیں برسنے سے اگتے ہیں  رومی |

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| **Lecture Summary** |

**SLIDE**

**Lecture Summary**

* **To systematically perform any Real-world Task using a Template-based Approach, follow the following steps**
  + **Step 1: Completely and correctly understand the Real-world Task**
    - **Write down two main things**
      * **Given**
      * **Task**
  + **Step 2: Understand the Input and Output of the Real-world Task**
    - **Write down two main things**
      * **Input**
      * **Output**
  + **Step 3: Plan and Design a Template-based Approach to perform the Real-world Task**
    - **Step 3.1: Use the Divide and Conquer Approach to break the Real-world Task into**
      * **Steps / Sub-steps / Sub-sub-steps**
    - **Step 3.2: For each Steps / Sub-steps / Sub-sub-steps**
      * **Check the Order and Flow between Steps / Sub-steps / Sub-sub-steps**
      * **Check the Connectivity and Independence between Steps / Sub-steps / Sub-sub-steps**
  + **Step 4: Use a Five-Step Process to perform the Real-world Task**
    - **Step 4.1: Plan – in Mind**
    - **Step 4.2: Design – on Paper**
    - **Step 4.3: Execute – at Prototype level**
    - **Step 4.4: Execute – at Full Scale**
    - **Step 4.5: Take Feedback from Users / Audience and Domain Expert to further improve the solution of Real-world Task**
  + **Step 5: Document each Step, when performing a Real-world Task**
* **Breast Cancer Prediction System – Task**
  + **Given**
    - **A Person medical information related to breast cancer. (Represented as Set of Attributes)**
  + **Task**
    - **Automatically predict whether the Person have recurrence of Breast Cancer or Not**
* **Breast Cancer Prediction System – Input and Output**
  + **Input** 
    - **A Person medical information related to breast cancer.**
  + **Output**
    - **Recurrence / Non-Recurrence**
* **The Problem of Breast Cancer Prediction is treated as a**
  + **Supervised Machine Learning Task**
* **The main goal of Breast Cancer Prediction System is to**
  + **Learn an Input-Output Function** 
    - **i.e. Learn from Input to predict the Output**
* **Learning Input-Output Function – General Settings** 
  + **Input to Learner**
    - **Set of Training Examples (D)**
    - **Set of Hypothesis (a.k.a. Hypothesis Space (H))**
  + **Job of Learner**
    - **The main job of a Learner is to search the Hypothesis Space (H) using the Set of Training Examples (D) to find out a Hypothesis (h) from Hypothesis Space (H), which best fits the Set of Training Examples (D)**
  + **Output of Learner**
    - **A Learner outputs a Hypothesis (h) from Hypothesis Space (H), which best fits the Set of Training Examples (D)**
* **Steps to treat the Breast Cancer Prediction System Problem as a Classification Problem** 
  + **Step 01: Decide the Learning Settings**
  + **Step 02: Obtain Sample Data**
  + **Step 03: Understand and Pre-process Sample Data**
  + **Step 04: Represent Sample Data in Machine Understandable Format**
  + **Step 05: Select Suitable Machine Learning Algorithms**
  + **Step 06: Split Sample Data into Training Data and Testing Data**
  + **Step 07: Select Suitable Evaluation Measure(s)**
  + **Step 08: Execute First Two Phases of Machine Learning Cycle**
    - **Training Phase**
    - **Testing Phase**
  + **Step 09: Analyze Results**

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| **If (Results are Good )**  **Then**  **Move to the Next Step**  **Else**  **Go to Step 01** |

* + **Step 10: Execute 3rd and 4th Phases of Machine Learning Cycle**
    - **Application Phase**
    - **Feedback Phase**
  + **Step 11: Based on Feedback**
    - **Go to Step 01 and Repeat all the Steps**
* **Alhamdulillah, in this Lecture we systematically learned (using a Template-based Approach) how to**
  + **Use the Best Teaching and Learning Methodology of the World to systematically perform any Real-world Task using a Template-based Approach**
  + **Breast Cancer Prediction Problem**
  + **Steps – Breast Cancer Prediction Problem as a Supervised Machine Learning Problem**
  + **Start Contributing from Today 😊**

|  |
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| **جزاك اللهُ خيرًا** |