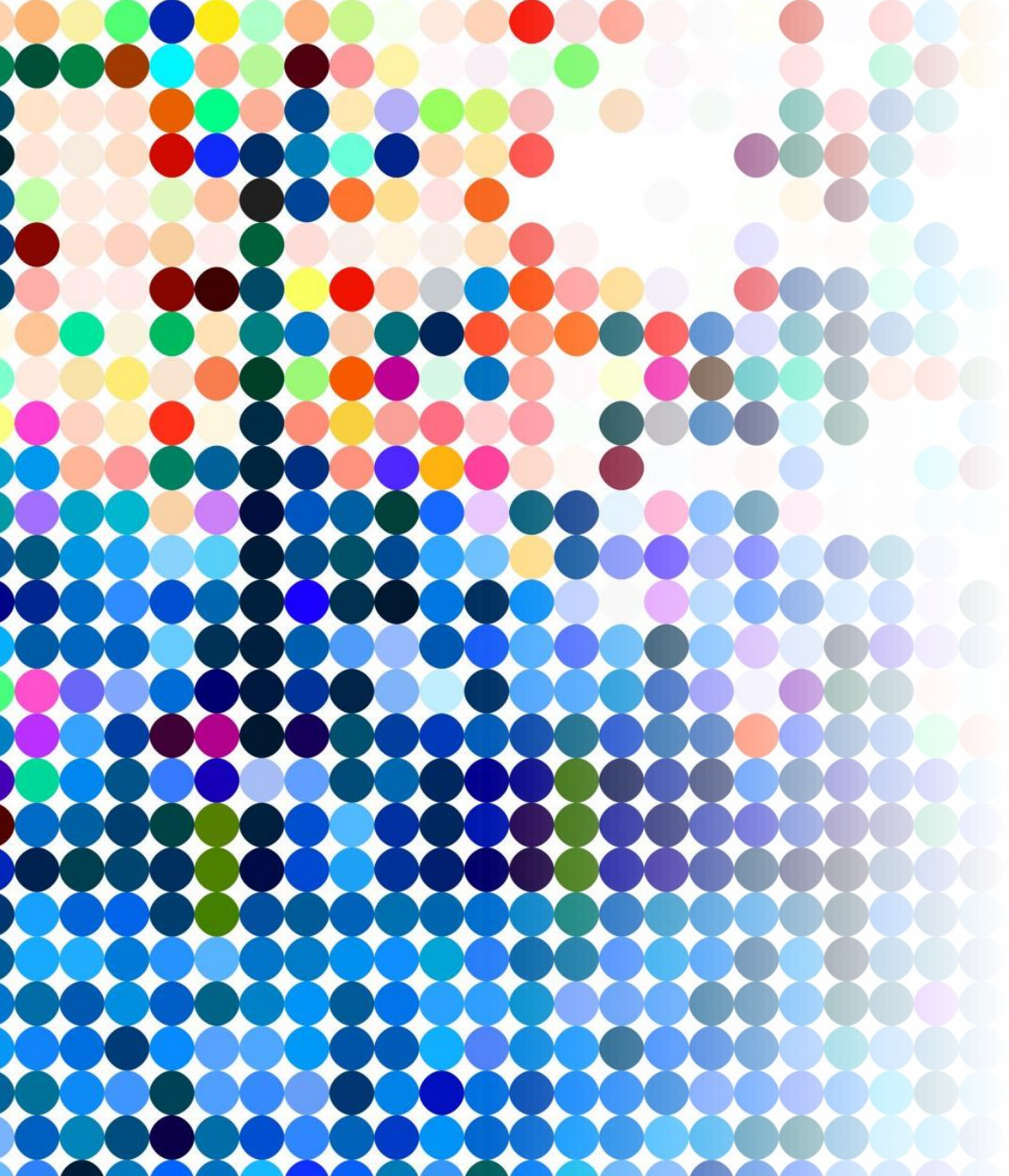


Machine Learning Concepts: Training, Testing, Overfitting, Underfitting, and Regularization

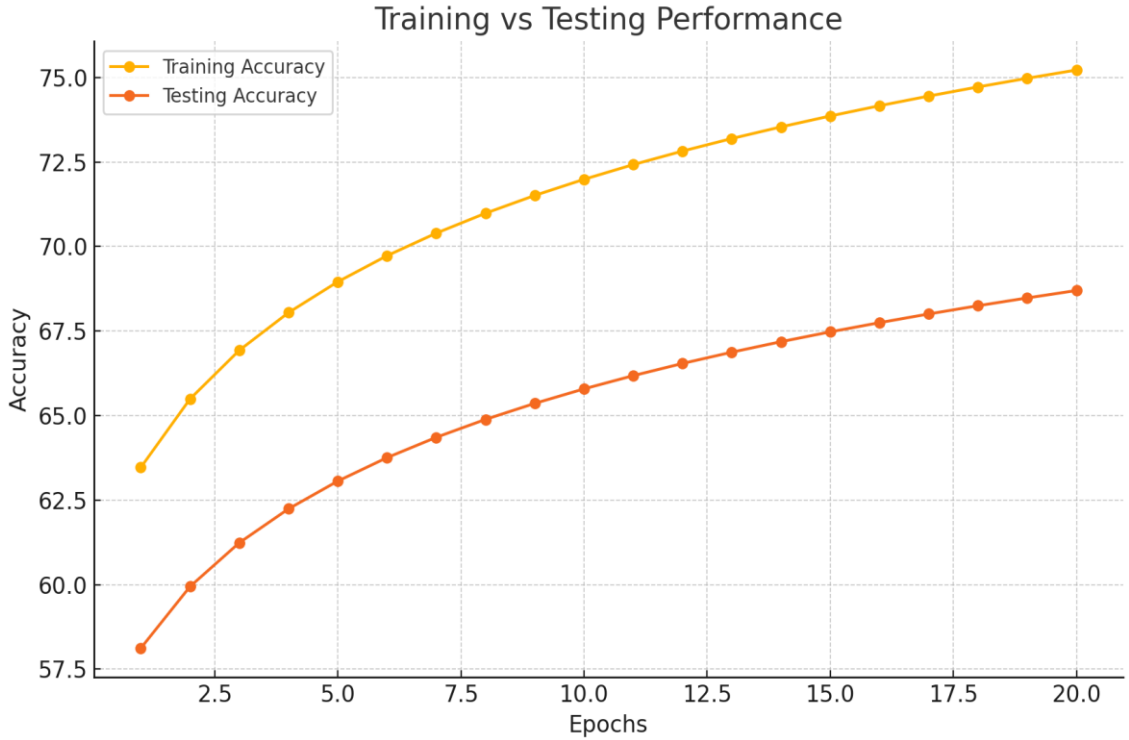
Understanding Core Principles

Training Data

- Training data is the dataset on which a machine learning model is trained.
- Purpose: Helps the model learn patterns and make predictions.
- Process:
  1. Collect data.
  2. Preprocess data (cleaning, normalization).
  3. Train the model using this data.
- Example: Image recognition - training on labeled images.

Testing Data

- Testing data is the dataset used to evaluate the performance of the trained model.
- Purpose: Measures the accuracy and generalization of the model.
- Process:
  1. Split dataset into training and testing sets (e.g., 80-20 split).
  2. Evaluate the model on the testing set.
- Example: Image recognition - testing on unseen labeled images.

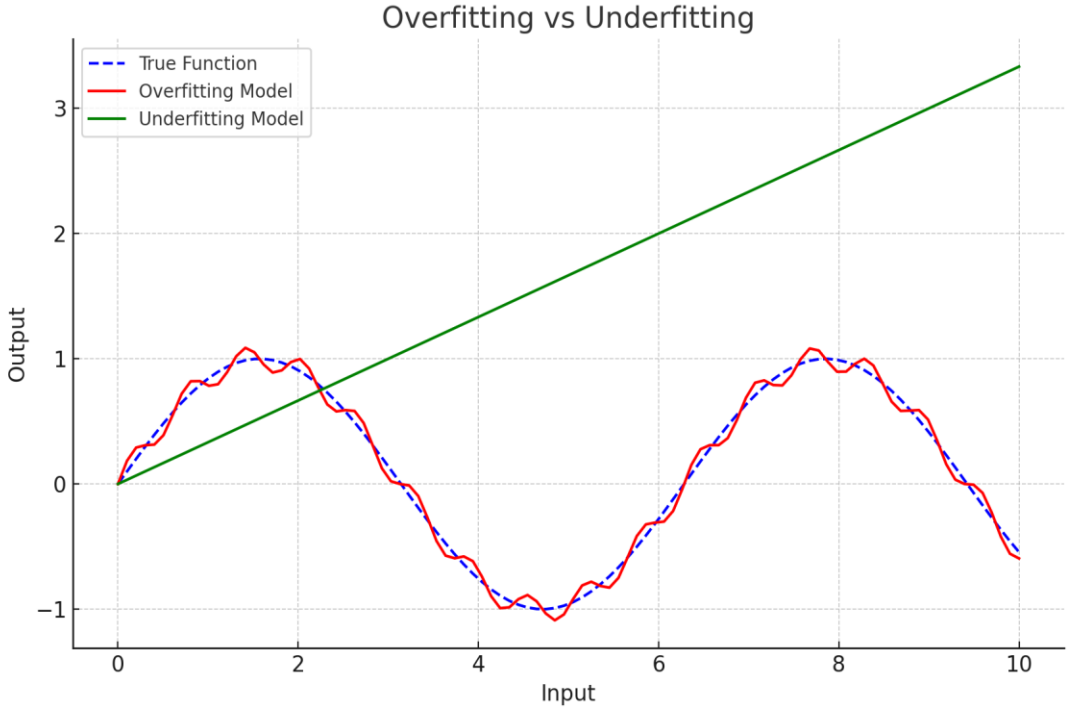

Training vs Testing Performance
Training Accuracy
Testing Accuracy
Accuracy
75.0
72.5
70.0
67.5
65.0
62.5
60.0
57.5
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Epochs

Overfitting

- Overfitting occurs when a model learns not only the underlying patterns but also the noise in training data.
- Symptoms: High accuracy on training data but poor performance on testing data.
- Causes:
  - Too complex model.
  - Insufficient training data.
- Example: A decision tree with too many branches fitting every single data point.

Underfitting

- Underfitting occurs when a model is too simple to capture the underlying patterns in the data.
- Symptoms: Poor performance on both training and testing data.
- Causes:
  - Model is too simple.
  - Insufficient training time.
- Example: A linear regression model applied to non-linear data.

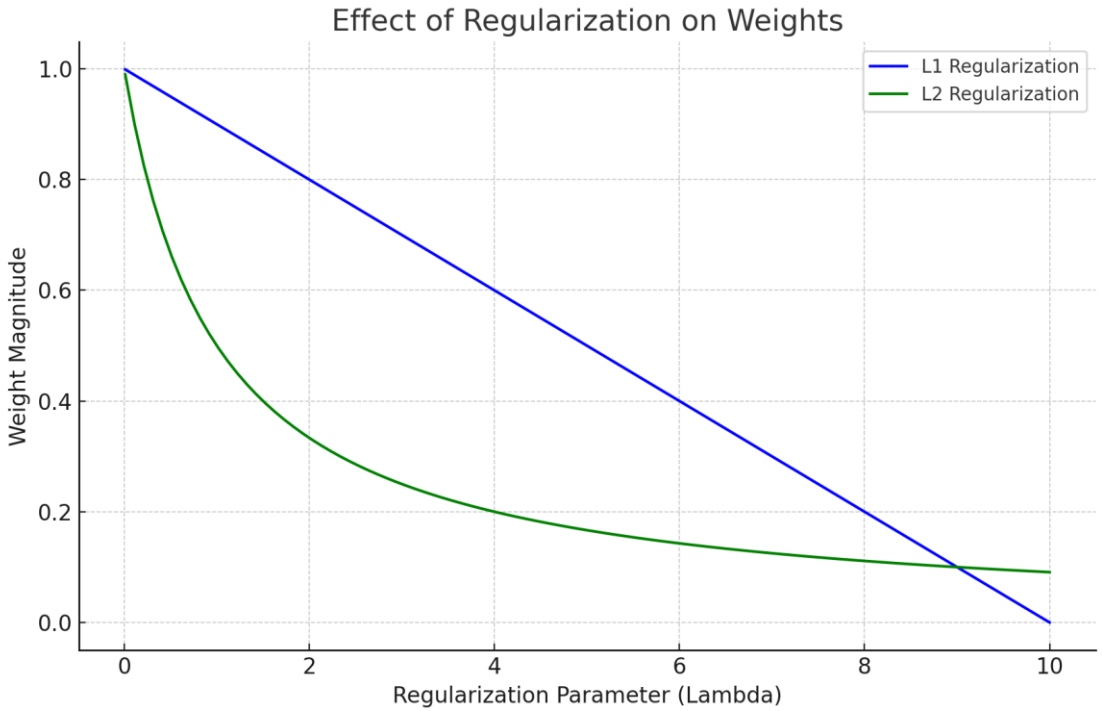

Overfitting vs Underfitting
True Function
Overfitting Model
Underfitting Model
Output
Input
3
2
1
0
−1
0
2
4
6
8
10

Regularization

- Utilize regularization to improve model performance.
- Regularization techniques are used to prevent overfitting by adding a penalty to the loss function.
- Types:
  - L1 Regularization (Lasso): Adds the absolute value of coefficients as penalty.
  - L2 Regularization (Ridge): Adds the squared value of coefficients as penalty.
- Process:
  1. Apply regularization during model training.
  2. Adjust regularization parameter to balance bias and variance.
- Example: Logistic regression with L2 regularization to prevent overfitting.

Regularization Techniques

- L1 Regularization: Encourages sparsity (many zero coefficients).
- L2 Regularization: Distributes error across all terms.
- Elastic Net: Combines L1 and L2 regularization.
- Dropout (in neural networks): Randomly drops neurons during training to prevent co-adaptation.
- Example: Regularization applied to neural network training.


Effect of Regularization on Weights
L1 Regularization
L2 Regularization
Weight Magnitude
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
Regularization Parameter (Lambda)

Comparing Overfitting and Underfitting

- Overfitting:
  - Complex model.
  - High variance.
  - Low bias.
  - Poor generalization.
- Underfitting:
  - Simple model.
  - Low variance.
  - High bias.
  - Poor generalization.

RESULT OF MPhil Microbiology (1ST SEMESTER) (Spring 2024)

Serial Number	Name	Father's Name	PI			PII			PIII			PIV		
			Research Planning and Scientific Writing Dr. Azam Hayat			Microbial Diagnostic Dr. Aneela Rehman			Advances in Applied Microbiology Dr. Qismat Shakeela			Tumor Immunology and Immunotherapeutic Dr. Ayub Jadoon		
			Obtained Marks	NG	GP	Obtained Marks	NG	GP	Obtained Marks	NG	GP	Obtained Marks	NG	GP
			100			100			100			100		
			60			60			60			60		
			3			3			3			3		
1	**Umeema Arif**	Muhammad Arif	**60**	2.0	6.0	**56**	1.6	4.8	**50**	1.0	3.0		0.0	0.0
2	**Amina Asghar Swati**	Ali Asghar	**18**	0.0	0.0	**23**	0.0	0.0	**38**	0.0	0.0		0.0	0.0
3	**Mahnoor Waseem**	Waseem Khan	**74**	3.4	10.2	**72**	3.2	9.6	**69**	2.9	8.7		0.0	0.0
4	**Numra Sharatfat**	Sharafat	**48**	0.0	0.0	**40**	0.0	0.0	**58**	1.8	5.4		0.0	0.0
5	**Qurratul Ain**	Abdul Jalil	**48**	0.0	0.0	**37**	0.0	0.0	**43**	0.0	0.0		0.0	0.0
6	**Amina Tariq**	Tariq Javed	**60**	2.0	6.0	**70**	3.0	9.0	**68**	2.8	8.4		0.0	0.0
7	**Sadia Khan**	Mattiulah	**66**	2.6	7.8	**71**	3.1	9.3	**54**	1.4	4.2		0.0	0.0
8	**Sana Rafique**	Muhammad Rafique	**66**	2.6	7.8	**60**	2.0	6.0	**62**	2.2	6.6		0.0	0.0
9	**Zahid fazal Chand**	Missing		0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0
10	**Zainab Afzal**	Muhammad Afzal	**67**	2.7	8.1	**67**	2.7	8.1	**65**	2.5	7.5		0.0	0.0

Note; Errors and omission (if any), are subject to subsequent rectification.

RESULT OF MPhil Microbiology (1ST SEMESTER) (Fall 2023)

Serial Number	Name	Father's Name	PI			PIII			PIV					
			Advances in Molecular Genetics Dr. Ibrar Khan			Proteomics and Genomics Dr. Gul Habib			Advances in Antimicrobial Chemotherpy Dr. Qismat Shakeela			Molecular Mechanism of Pathogenesis. Dr. Ayub Jadoon		
			Obtained Marks	NG	GP	Obtained Marks	NG	GP	Obtained Marks	NG	GP	Obtained Marks	NG	GP
			100			100			100			100		
			60			60			60			60		
			3			3			3			3		
1	**Abiha zahid Khan**	Zahid Hafeez Khan	**60**	2.0	6.0	**50**	1.0	3.0	**62**	2.2	6.6		0.0	0.0
2	**Afeefa**	Muhammad Masood	**81**	4.0	12.0	**88**	4.0	12.0	**80**	4.0	12.0		0.0	0.0
3	**Afzaal Nazir**	Muhammad Nazir Awan	**65**	2.5	7.5	**63**	2.3	6.9	**66**	2.6	7.8		0.0	0.0
4	**Aimen Sherbaz**	Sherbaz	**75**	3.5	10.5	**70**	3.0	9.0	**80**	4.0	12.0		0.0	0.0
5	**Anum Iqbal**	Muhammad Iqbal	**60**	2.0	6.0	**33**	0.0	0.0	**64**	2.4	7.2		0.0	0.0
6	**Ayesha Waqar**	Waqar Jadoon	**82**	4.0	12.0	**83**	4.0	12.0	**80**	4.0	12.0		0.0	0.0
7	**Eiman Bibi**	Niaz Ahmed	**81**	4.0	12.0	**85**	4.0	12.0	**80**	4.0	12.0		0.0	0.0
8	**Hadia Riaz**	Riaz Muhammad Khan	**80**	4.0	12.0	**84**	4.0	12.0	**75**	3.5	10.5		0.0	0.0
9	**Ihsan Ullah Khan**	Rehmat Ullah	**45**	0.0	0.0	**24**	0.0	0.0	**36**	0.0	0.0		0.0	0.0
10	**Iza Shafaqat**	Shafaqat Saeed	**83**	4.0	12.0	**87**	4.0	12.0	**80**	4.0	12.0		0.0	0.0
11	**Jawad Khan**	Jaffar Khan	**80**	4.0	12.0	**82**	4.0	12.0	**75**	3.5	10.5		0.0	0.0
12	**Kinza Khalid**	Abdul Khalid	**74**	3.4	10.2	**72**	3.2	9.6	**75**	3.5	10.5		0.0	0.0
13	**Misbah Bashir**	Muhammad Bashir	**67**	2.7	8.1	**61**	2.1	6.3	**66**	2.6	7.8		0.0	0.0
14	**Muhammad Azhar**	Muhammad Nazir	**60**	2.0	6.0	**37**	0.0	0.0	**75**	3.5	10.5		0.0	0.0
15	**Muqadas Hameed**	Abdul Hameed	**71**	3.1	9.3	**69**	2.9	8.7	**76**	3.6	10.8		0.0	0.0
16	**Samra Javed**	Muhammad Javed	**80**	4.0	12.0	**81**	4.0	12.0	**75**	3.5	10.5		0.0	0.0
17	**Sania**	Sed Arif Hussain Shah	**82**	4.0	12.0	**84**	4.0	12.0	**80**	4.0	12.0		0.0	0.0
18	**Sara Nisar**	Nisar Khan	**80**	4.0	12.0	**85**	4.0	12.0	**80**	4.0	12.0		0.0	0.0
19	**Yashfa Riaz**	Muhammad Riaz	**85**	4.0	12.0	**90**	4.0	12.0	**80**	4.0	12.0		0.0	0.0
20	**Ali Hamza**	Muhammad Arshad	**60**	2.0	6.0	**55**	1.5	4.5	**61**	2.1	6.3		0.0	0.0

Note; Errors and omission (if any), are subject to subsequent rectification.

RESULT OF MPhil Microbiology (2ND SEMESTER) (Spring 2024)

Serial Number	Name	PI			PII			PIII			PIV		
		Research Methodology Dr. Azam Hayat			Microbial Diagnostic Dr. Aneela Rehman			Advances in Applied Microbiology Dr. Qismat Shakeela			Tumor Immunology and Immunotherapeutic Dr. Ayub Jadoon		
		Obtained Mark	NG	GP	Obtained Mark	NG	GP	Obtained Mark	NG	GP	Obtained Mark	NG	GP
		100			100			100			100		
		60			60			60			60		
		3			3			3			3		
1	Abiha zahid Khan	66	2.6	7.8	60	2.0	6.0	60	2.0	6.0		0.0	0.0
2	Afeefa	82	4.0	12.0	80	4.0	12.0	76	3.6	10.8		0.0	0.0
3	Afzaal Nazir	60	2.0	6.0	64	2.4	7.2	60	2.0	6.0		0.0	0.0
4	Aimen Sherbaz	12	0.0	0.0	19	0.0	0.0	24	0.0	0.0		0.0	0.0
5	Annam Iqbal	46	0.0	0.0	52	1.2	3.6	52	1.2	3.6		0.0	0.0
6	Ayesha Waqar	65	2.5	7.5	72	3.2	9.6	69	2.9	8.7		0.0	0.0
7	Eiman Bibi	70	3.0	9.0	65	2.5	7.5	65	2.5	7.5		0.0	0.0
8	Hadia Riaz	71	3.1	9.3	67	2.7	8.1	68	2.8	8.4		0.0	0.0
9	Ihsan Ullah Khan	22	0.0	0.0	16	0.0	0.0	36	0.0	0.0		0.0	0.0
10	Iza Shafaqat	80	4.0	12.0	81	4.0	12.0	75	3.5	10.5		0.0	0.0
11	Jawad Khan	70	3.0	9.0	74	3.4	10.2	66	2.6	7.8		0.0	0.0
12	Kinza Khalid	65	2.5	7.5	63	2.3	6.9	60	2.0	6.0		0.0	0.0
13	Misbah Bashir	68	2.8	8.4	61	2.1	6.3	48	0.0	0.0		0.0	0.0
14	Muhammad Azhar	37	0.0	0.0	39	0.0	0.0	53	1.3	3.9		0.0	0.0
15	Muqadas Hameed	72	3.2	9.6	67	2.7	8.1	45	0.0	0.0		0.0	0.0
16	Samra Javed	70	3.0	9.0	68	2.8	8.4	65	2.5	7.5		0.0	0.0
17	Sania	67	2.7	8.1	66	2.6	7.8	60	2.0	6.0		0.0	0.0
18	Sara Nisar	66	2.6	7.8	61	2.1	6.3	66	2.6	7.8		0.0	0.0
19	Yashfa Riaz	75	3.5	10.5	75	3.5	10.5	70	3.0	9.0		0.0	0.0
20	Ali Hamza	60	2.0	6.0	55	1.5	4.5	62	2.2	6.6		0.0	0.0

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