



- ∞ The real success of the workshop has depended greatly on the work done by IPM staff. Organizing the logistics, keeping the web site current, taking pictures, putting together the newsletter, keeping the computers and the network functional, making sure that the foreign visitors feel at home are just a few of what the staff have been doing. Often they work behind the scenes and many have been here at 7:00 am everyday and others have not left till 1:00 or 2:00 am. The ten who have been directly involved with the workshop were Majid Ashtiani, Nushin Barati, Abbas Eslami, Mohammad Hossein-zadeh Giv, Mandana Mashayekhi, Akbar Mirahmadi, Tanya Parsa, Ali Asghari Rad, Mohsen Rahpeyma, and Nayereh Ramezani. Their pictures were featured in yesterday's Daily News (#4). We thank all of them for a very successful workshop.
- ∞ Yesterday, IPM computers were attacked by a virus. This was the cause of the problem at the beginning of one of the presentations. Go to <http://www.symantec.com> for more information. It describes the virus as: W32.Blaster.Worm is a worm that will exploit the DCOM RPC vulnerability using TCP port 135. It will attempt to download and run a file, msblast.exe.
- ∞ Those who wanted a copy of "External Representations of Block Designs" edited by Peter Cameron et. al. can pick it up at the office.
- ∞ The notes on music in yesterday and today's Daily News are from <http://www.artiniran.com/>. The notes about Iranian music and instruments distributed at the Dinner last night were from <http://www.kereshmeh.com/>.

∞ The final (I promise) news from the Mathematics Genealogy Project (<http://genealogy.math.ndsu.nodak.edu/>):

Richard Brualdi is related to Peter Cameron. E. H. Moore is a common ancestor of both. Richard's lineage goes as follows: Richard Brualdi, Herbert Ryser, Cornelius Everett, Jr., Cyrus MacDuffee, Leonard Dickson, E. H. Moore, H. A. Newton, Michel Chasles, Simeon Poisson, Joseph Lagrange, Leonhard Euler, Johann Bernoulli, Jacob Bernoulli.

The most extensive mathematical family is that of Charles Johnson. The Genealogy project traces his lineage back to the seventeenth century. A number of mathematicians among his ancestors have had two advisors and hence the list of his ancestry includes not only Lagrange, Euler, and the Bernoulli brothers but also Felix Klein, Dirichlet, Fourier, and Carl Gauss. His ancestors (not in order) are: Olga Taussky-Todd, Philipp Furtwängler, C. Felix Klein, Julius Plücker, Rudolf Lipschitz, Gustav Dirichlet, Martin Ohm, Simeon Poisson, Jean-Baptiste Fourier, Joseph Lagrange, Leonhard Euler, Johann Bernoulli, Jacob Bernoulli, Karl von Langsdorf, Christian Gerling, Carl Gauß, Johann Pfaff, Abraham Kaestner, Christian Hausen, Johann Wichmannshausen, and Otto Mencken.



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Workshop on
Combinatorics, Linear Algebra and Graph Coloring





A Brief Note on Persian Classical Music

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Characteristics.

Persian music is rich in structure, comprising of melodic tones combined with colorful rhythms. The music is based on the modal system with each mode rendering a variety of melodic types. In the old time there existed twelve modes. At the time of the Qajar dynasty the old system was changed into the seven *Dastgahs* (scales) and five *Avazes* (sub-scales) and about 400 *Gushehs* (part of a scale).

The Old Twelve-Mode System. The twelve-modal system was derived by combining sequences of subdominants (series of the 4th) with dominants (series of the 5th). In the past, there were seven sub-dominant and thirteen dominant compositional possibilities. (Khaleghi, Nazari-be-Musiqi, p 214). Each sequence of one sub-dominant with one dominant forms a mode. There existed a total of 91 (13 times 7) modes called the circle of 91 of which 12 were tempered and chosen.

The twelve modes are: *Oshaq*, *Nava*, *Bousalikh*, *Rast*, *Eraq*, *Esfahan*, *Zir-afkand*, *Bozorg*, *Zanguleh*, *Rahavi*, *Hosseini*, and *Hejazi*.



Table 1: Old System of Persian Music, Twelve Modes

<i>Oshaq</i>	C	D	E	F	G	A	bB	C
<i>Nava</i>	C	D	bE	F	G	bA	bB	C
<i>Bousalikh</i>	C	bD	bE	F	bG	bA	bB	C
<i>Rast</i>	C	D	pE	F	G	pA	bB	C
<i>Eraq</i>	C	pD	pE	F	pG	pA	bB	C
<i>Esfahan</i>	C	D	pE	F	G	pA	bB	C
<i>Zirafkand</i>	C	pD	bE	F	pG	bA	B	C
<i>Bozorg</i>	C	pD	pE	F	pG	A	B	C
<i>Zanguleh</i>	C	D	pE	F	pG	pA	bB	C
<i>Rahavi</i>	C	pD	pE	F	pG	bA	bB	C
<i>Hosseini</i>	C	pD	bE	F	pG	bA	bB	C
<i>Hejazi</i>	C	pD	bE	F	pG	pA	bB	C

By looking at the modal structure above one can easily see that there were 18 notes in the Persian classical music with 17 intervals. The musicians used to put a name for each mode some of which are still used today. Moreover, each mode had specific effect on human mind and soul. For instance, it was suggested that low pitch melodies should be played for people with somewhat red skins while high pitch melodies were more suitable for yellow skins. For dark-skin and slim people one should play trios and white and fat people were more apt to the base melodies pitch. [1].

In addition, the musicians proposed a different mode to be played in different points in day or night. Accordingly, Hosseini was played at the end of the day, Rahavi in the morning, Rast at dawn, Bousalik in the afternoon, Oshaq at the sunset, Nava before night prayer, and Hejazi at midnight. Some modes such as Oshaq, Bousalik, and Nava were perceived to create fortitude while Iraq, Esfahan, and Rast to bring up moderation and therefore were played for pleasure. Music therapy was also strongly used to cure various types of illnesses.

Rhythm was of extreme importance among the classicists. Farabi defined rhythm as “.....the division of sounds within times of limited duration.” Safieddin Ormavi had a more elaborated definition:

“Rhythm is the sequence of timings of specific duration that are separated from each other and generate specific Dors (clusters of beats of the same length, e.g., a set of four eighth notes divided by rests). Rhythms were of two types: continuous and discrete. The former was the sets of beats attached to each other with no rest in between. The discrete rhythm was the one in which the beats were separated by rests.

At the time of Qajar dynasty, the twelve modal system was changed into the present Dastgah (scale) convention. There are also melodic types that are called Gushehs, literally meaning corners. Each Gusheh is a combination of tetrachords or pentachords around which a musician is free to improvise. Each scale or mode is divided into a number of Gushehs. Gushehs are the building blocks of the Persian music. A number of Gushehs make a Dastgah (scale) and/or an Avaz (subscale). The combination of Gushehs, Avazes, and Dastgahs form the repertory of the Persian music called Radif.

Radif includes seven Dastgahs (scales): Shur, Segah, Chargah, Homayoon, Mahour, Nava, and Rast-Panjgah and five Avazes (subscales) as Dashti, Abu-ata, Bayat-e Turk (Zand), and Afshari and Isfahan. The former four Avazes are derived from the Shur scale and the latter from Homayoon. When compared to the Western music, Persian music allows more variety in terms of scales and subscales because of the existence of microtones. A Dastgah in Persian music includes 24 chromatic quartertones as opposed to the 12-half-tone music of the West.

Table 2: Present System of Persian Music, Seven Dastgahs

Shur	C	pD	bE	F	G	bA	bB	C
Segah	C	pD	bE	F	pG	(pA,A)	bB	C
Chargah	C	pD	E	F	G	pA	B	C
Homayoon	C	D	(bE,E)	F	G	pA	B	C
Mahour	C	D	E	F	G	A	B	C
Nava	C	pD	bE	F	G	bA	bB	C
Rast	C	D	E	F	G	A	B	C

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