LECTURERS

Gosse de Kort
The Netherlands, 1978

Gosse de Kort studied architecture at TU Delft and ArtScience at the Royal Conservatory and Royal Academy, The Hague. His works are situated on the border of architecture and theater. De Kort develops spatiotemporal scenarios by combining elements of the expressive potential of a space with the possibilities of a time-based focus. While his performance work is theatrical in nature, his installations engage the audience as a co-actor to provide them the opportunity to personally explore the given environment or situation in greater detail.

http://www.gossedekort.com

Xandra van der Eijk
The Netherlands, 1985

Xandra van der Eijk completed the Interfaculty ArtScience program in The Hague, where she developed a fascination for analog, tactile work. Constantly driven by the idea of structure, van der Eijk's works embrace the contradiction between emotion/aesthetics and (generated) data-cycles or strict systems. She is a recipient of the Paul Schuitema prize.

http://www.xandravandereijk.com

Baghdad, 830: Birth of the Algorithm

Chapter 6 of
Enfoldment and Infinity:
An Islamic Genealogy of New Media Art
(Cambridge, MA: MIT Press, 2010)

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A first intuition of the common nature of Islamic art and new media art is often that they are visualizations of mathematics—in particular, of geometry. The geometry characteristic of so much Islamic art certainly has an evident parallel with the patterns easily generated by computer programs. More significant, these geometries are the result of algorithmic activity. If an algorithm is a statement of instructions that, when carried out, will bring about a new state or new information, then many art forms can be said to be algorithmic. What is most interesting about artworks that reveal and revel in their algorithmic construction is that they indicate a certain way the image unfolds from the imperceptible: that relationships can be known rationally.

In Islam, this view arises during the early ʻAbbasid caliphate of ninth-century Baghdad, which vigorously promoted intellectual activity. New media artworks that celebrate the way images and actions arise from code and encourage participants to trace these paths are also proponents of rational unfolding. This chapter also considers the subjective states that algorithmic artworks call up and the performative nature of algorithmic art. In the eleventh century, after the ʻAbbasid caliphate took an ideologically conservative turn in what is called the Sunni revival, "rational" artwork becomes increasingly complex, even baroque.[1] In a way described by literary theorist ʻAbd al-Qâhir al-Jurjânî (d. 1078), as we shall see, it simultaneously stimulates and stymies desire to understand its internal relationships. New media too has a neobaroque manifestation that can be seen through the film cycle *Ocean's Eleven* to *Ocean's Thirteen*, works whose outcome is no surprise but whose complex, interlacing plots are satisfyingly fascinating. These films are perfectly comparable to the stratigraphic patterns of Persian carpets from the Seljuk and Safavid periods.

The elective affinity between complex geometrical pattern and computer animation appears most often in computer-graphic design. Spanish digital animator Cristóbal Vila's video *Isfahan* (2005) is a three-dimensional animated flight through an idealized mosque, based loosely on the Imam Mosque in Isfahan. The *muqarnas* structure of the dome is drawn in CGI wireframe, then painted with arabesque designs that look like art nouveau. Painstakingly produced, algorithmically awe-inspiring, and paired with the flute music of Omar Faruk Tekbilek, *Isfahan* indicates the smooth transition from algorithmic aesthetics to mysticism.

Mathematics and the New Rationalism in Early Baghdad

The ʻAbbasid caliph Harûn al-Rashid (reign 786–809) founded the House of Wisdom, or *beit al-hikma*, in the new capital of Baghdad. He and his son Abu Jafar al-Ma'mûn ibn Harûn (reign 813–833) sponsored a massive movement of translations, as well as new works in all fields. Three brothers known as the Banû Mûsâ led a group of translators, themselves for the most part prominent scientists, who assimilated into Arabic learning most of the works deemed important by the end of the ninth century on mathematics, astronomy, medicine, and engineering.[2]

The powerful new mathematics made it possible to calculate planetary motions, keep time in different latitudes, subdivide land, convert currency, and a host of other important acts both concrete and abstract. Geometry, so commonly associated with Islamic art, was the fruit of translations from the Greek; for example, Euclid's *Elements* came into Arabic through the translation of al-Hajjaj ibn Yusuf ibn Matar (786–833) (whence Abelard of Bath would translate it into Latin in the twelfth century). But in fact the greatest mathematical innovations in ninth-century Baghdad involved freeing mathematics from geometry through the development of algebra. The geometrical patterns we enjoy in Islamic art are expressions of algebraic equations, such as the square root of two. The chief librarian of the House of Wisdom was the great Persian mathematician, astronomer, and astrologer Muhammad ibn Musa al-Khwârizmî (780–850). Al-Khwarîzmî introduced Indian (commonly referred to as "Arabic") numerals and the decimal system, an invaluable breakthrough for calculation. He also published a new system for solving polynomial and quadratic equations, *algebra*, in his great work of 830. The word algebra derives from *al-jabr*, or "integration"; *algorithm* is a Latinization of al-Khwârizmî's name. Gerard of Cremona's translation, made in Toledo, the hotbed of translations from Arabic to Latin and other languages in the mid-twelfth century, begins, "Dixit Algorismus" (al-Khwârizmî says) and from there, the word came to mean a sequence of mathematical instructions. Another important mathematical innovator was al-Karajî (c. 953–c. 1029), who introduced polynomial equations that were further developed by Leonardo Fibonacci (1170-1245). (Fibonacci's father, a scribe who worked for Pisan merchants in Bejaia, Algeria, sent his son to that city to study Arabic mathematics. Fibonacci's *Liber Abaci*, which he dedicated to Frederick II of Sicily, introduced the Islamic number system to Europe.)[3] And likely inspired by Indian sources, Islamic mathematicians were developing modern trigonometry as early as the eighth century, which replaced Ptolemy's awkward chord system with the six

trigonometrical ratios (sine, cosine, tangent, and so forth) that we still use today.[4]

Also hard at work in ninth-century Iraq were the *kalâm* rationalist theologians, a relatively indigenous group of thinkers who sought to use reason, and a vigorous style of rational debate, to elucidate the Qur'an: they include Dirar ibn ʻAmr, who lived in Basra in the late eighth century; Abu al-Hudhayl al-ʻAllaf (about 750–840, Baghdad), and his student Abu Yaqub al-Shahham (later ninth century); and Ibrahim al-Nazzam (d. 845). The early *falâsifa*, or philosophers building on the Greek tradition, including Ya'qub ibn Ishaq al-Kindî (d. 866), the Persian Platonist Abu Bakr al-Razî (d. 925), and Abu Nasr Muhammad al-Farabî (d. 950), who hailed from Turkestan and worked in Aleppo, sought to adapt Greek Peripatetic ideas—a stimulating source of rational thought about the world, which arose from a polytheist culture—to monotheistic thought. (This achievement would be invaluable to medieval Christian theologians.) Both *kalâm* theologians and *falâsifa* argued that some of God's attributes can be deduced and that the world unfolds from God in a knowable, rational way. But while the *falâsifa* emphasized that the world is an emanation from God, the *kalâm* theologians argued that it is possible to deduce some of God's actions in the world from statements in the Qur'an.

Geometry, a New Visual Culture

Many scholars have examined how Islamic patterns rely on applied geometry and other kinds of mathematical knowledge.[5] Some writings on geometry in Islamic art, including popular versions published as pattern books, propose an ahistorical, pan-Islamic geometric aesthetics that ignores the wide variety of artistic practices in the Muslim world. But geometric art dates historically to the ninth and tenth centuries and relates to the philosophical and religious thought of the time. Geometry is the organizing principle of the abstract ornament so commonly associated with Islamic art and of *muqarnas*, a three-dimensional unit that can be iterated in many different schemes to articulate an architectural surface such as a dome or niche.[6] Both *muqarnas* and geometric ornament developed during the ʻAbbasid caliphate and Seljuk sultanate, as many art historians, including Gülrü Necipoglu, Yasser Tabbaa, and Alpay Özdural, demonstrate. An example is the tomb of Zumurrud Khatun in Baghdad, built by the ʻAbbasid caliph al-Nasir for his mother in 1193. Nine levels of *muqarnas*, perforated to let in light, spiral up the interior of the tall conical vault. In gazing up at them, you would see a perfect Fibonacci spiral. It is as wondrous and

satisfying as observing the same pattern in the seeds of a sunflower.

Artisans could produce two-dimensional patterns with a ruler, a compass, and basic mathematical knowledge. Historians dispute whether they understood the complexity of the mathematics they were applying.[7] Necipoglu points out that the popular mathematical-mystical writings of the Ikhwân al-Safâ, or Brethren of Purity, were probably read by architects.[8] In another context, Ron Eglash instructively handles the question of mathematical intentionality in *African Fractals: Modern Computing and Indigenous Design*. He argues that fractal patterns—patterns that are recursive, scalable, or self-similar and contain an infinite length within a finite boundary—are typically and culturally African and that they are produced through conscious acts of abstraction, not imitations of nature.[9] He suggests that this ubiquitous aesthetic form responds to the bottom-up, nonstate organization of African societies. Eglash's example suggests that algorithms can be meaningfully and consciously carried out without the need for the practitioners—builders, potters, braiders of hair—to know the abstract form of the algorithm.

Similarly, artisans in Muslim societies have carried out complex geometries with a meaningful consciousness, even if they would not recognize a polynomial equation. Geometry is experiential; it is algebra embodied. This is the case for both the artisan producing geometric forms and for the person contemplating them. Carol Bier, attending to the physical activities of artisans working in tile, stucco, textiles, and other media, points out that applying geometrical principles would be materially different in each case. She suggests that artists working with pattern would have assimilated the principles of applied geometry without a symbolic knowledge of geometry or algorithm.[10] It is noteworthy that al-Khwârizmî's algebra expresses equations in prose, not symbolically, so they too imply an engagement that is experiential and not just abstract. Clearly, in this age when mathematics inspired so much respect, builders would have been consulting works like Abu al-Wafâ' al-Buzjânî's (940–998) book on applied geometry, *On What the Artisan Requires of Geometric Constructions*. This book, written by a mathematician-astronomer, was intended to teach artisans the basic principles of geometry that were relevant to architecture.[11] It may well have arisen from the meetings of artisans and geometers Abu al-Wafâ' attended, which gave practitioners access to theoretical knowledge and geometers a chance to apply their knowledge, such as one in which they discussed the problem of "composing a square from three squares," that is, calculating the square root of three.[12] Özdural pictures Abu al-Wafâ's figure proving the Pythagorean theorem. The figure looks just like certain tile patterns, and indeed it became one of the bases

of new visual forms in the tenth century. [figure 6.1]

Mathematics, and the new technologies they enabled, became popular culture throughout the Muslim world in the ninth and tenth centuries. Bier argues that a textile pattern occurring all along the Silk Road, a design of coin-like roundels arranged in a grid, embodies applied mathematics. Replicating al-Khwârizmî's method of teaching algebra by placing coins on a cloth, this pattern demonstrates algebraic problems of addition, subtraction, multiplication, and squares and square roots.[13] Wearers of this luxurious cloth might have enjoyed using it to demonstrate their grasp of the new mathematical knowledge, just as in our times some knowledge of how computers work is valuable cultural capital.

Algorithmic Aesthetics

The rational appreciation of beauty is like admiring an algorithm—and the more complex and ultimately resolved the mental distances traversed, the better it is. Bier's focus on creative process allows her to suggest that "the artistic production of repeated patterns may become deeply meaningful as meditation for the individual pattern maker, who is enmeshed in a process at once unitary and systematic, in which mindlessness and mindfulness become one." The person viewing these patterns may also enter a meditative state.

Early Islamic thought supports the view that Islamic art invites a time-based, contemplative, and subjective response. The *kalâm* theologians and *falâsifa* argued that both perception and inference are sources of knowledge, thus placing their faith in both the perceptible world and the action of the perceiver.[14] This was ultimately a rationalist, though subjective, aesthetics. Like Ibn al-Haytham, the *falâsifa* emphasized the role of the intellect in perception and understanding.[15] As Oliver Leaman puts it, the aesthetics of the *falâsifa* value "art where the representation of the world is clearly perceived as symbolic of a deeper structure which lies behind the appearance [,] but in the sense of being an aspect of the organization of the world, not something behind it."[16]

Among the writings of the great philosopher al-Farabî, who hailed from Turkestan and worked in Aleppo, were works on poetry. His aesthetic theory helps in understanding how someone of his time might have engaged with visual art as well. Poetry relies on associations between images, al-Farabî argued; the listener (or, I would add, the viewer) needs to mentally bridge the image with its object. "The

success of the image or phrase is in direct proportion to the distance between their literal meaning," and aesthetic pleasure arises from the unity achieved over this distance.[17] Similarly, early Islamic poetry pursued the aesthetic strategy of *tibaq*, or antithesis, which implies bringing together opposites in a comparison: the word's etymology implies both "antithetical objects" and "similar objects."[18] You can see how this subjective process mimics the algorithmic process by which such patterns were formed.

The geometric patterns made by repeating, multiplying, and rotating shapes around an axis are the plastic equivalent of *tibaq*. Admiring a geometric (or other complex and symmetrical) form involves mentally comparing things that are similar and things that are opposites. A sense of unity and well-being rewards the contemplation of geometric harmonies.[19] This aesthetic approach is concerned not with individual creativity but with an intuition that gets one in touch with the divine. Both the artist and the viewer or listener partake in the same imaginative faculty. In fact, according to al-Farabî, al-Kindî, and other *falâsifa*, so do prophets and dreamers, bees building honeycombs and spiders spinning webs.[20] This nonhuman quality of thought that is imagination recurs some centuries later in the writings of Charles Sanders Peirce: "Thought is not necessarily connected with a brain. It appears in the work of bees, of crystals, and throughout the purely physical world; and one can no more deny that it is really there, than that the colors, the shapes, etc. of objects are there."[21] Imagination is subjective but impersonal in these theories: they suggest that we humans, like the bees who somehow know to build hexagonal structures, are using our imaginative faculties to get in touch with the divine order.

Necipoglu argues that the growing taste for geometric abstraction in the late tenth and early eleventh-century Islamic world responds to a widely diffused Neoplatonist worldview. The 'Abbasid caliph al-Qadir (reign 991–1031) forbade speculative Mu'tazili and Shi'a teachings and sought a unifying semiotics that would visually crystallize Sunni thought in "algebraically definable, angular geometric shapes."[22] In his commentary on Euclid's *Elements*, translated into Arabic by the tenth century, Proclus emphasized the capacity of geometry to elevate the mind: "Mathematics occupies a middle position between the intelligible and the sense worlds and exhibits within itself many likenesses of divine things and also many paradigms of physical relations."[23] The intermediate position of mathematics elevates the mind of a viewer so inclined. Though he was no Neoplatonist, the great Sunni sociologist Ibn Khaldun (1332–1406) echoed Proclus when he wrote, "Our teachers used to say that one's application to geometry does to the mind what soap does to a garment. It

washes off stains and cleanses it of grease and dirt. The reason for this is that geometry is well arranged and orderly."[24] Sunni revival aesthetics pursued the elevating and mind-cleansing (as Ibn Khaldun suggested) qualities of mathematics in music, poetics, and visual art.

Yet these same aesthetics can lead the mind into mystery. Another influential philosophy in this period, neo-Pythagoreanism, argued that the universe has an objective harmony, and the goal of aesthetics is to discover this harmony.[25] Neo-Pythagorean thought arose in the tenth-century Islamic world and continued to exert its influence well into the European Renaissance. Pythagoras had conceived of the cosmos as the fundamentally arithmetical, perfectly harmonious emanation of God. In the tenth century, the Ikhwân al-Safâ or Brethren of Purity, based in the southern seaport town of Basra, published an encyclopedia that synthesized Gnostic, Neoplatonist, and Pythagorean thought with the new mathematics of al-Farabî and al-Kindî. The Brethren were Isma'ilis, the Shi'a doctrine we explore in chapter 8. Their philosophy would not have met the approval of Sunni orthodoxy, yet their ideas proved popular and influential.[26] The Ikhwân al-Safâ adapted the Pythagorean music of the spheres to argue that a geometric harmony structures the universe. The fundamental relationship structuring the universe is God's unity and the universe's multiplicity to which it gives rise. Listening to music, they wrote, the soul resonates with the harmony of the spheres, which it contains in microcosm.[27]

Algorithmic Performativity

Early theories of geometry suggest that geometric forms unfold in time. The ideas of al-Farabî emphasize that geometric patterns express visually the way unity rationally gives rise to infinity. While Western geometric design principles are based on the repetition of similar forms, the Islamic system, as Lisa Golombek and Donald Wilber point out, is based on "a harmony of parts, whereby all parts were related to a single entity, as the parts of the square, triangle, and pentagon are related to each other."[28] Geometric forms thus unfold from a central form, much as the universe unfolds from God in emanationist thought, giving rise to systems of form through multiplication, division, mirroring, inversion, and multiplication.

The Brethren of Purity, like other Isma'ilis, believed that true knowledge remains in a state of latency until one who is qualified comes to make it manifest. Similarly, algorithmic art forms are characterized by a state of latency. When the

algorithm is carried out, what is latent becomes manifest, for example, as a proliferation of pattern or a musical sequence. In computer media, as in much Islamic art, image is a manifestation of algorithmic activity. However, that algorithm may remain inactive, and the image may remain latent. As such, computer media, like Islamic art, are characteristically performative, in that they bring out image and movement selectively. The state of latency in algorithmic Islamic art invites a high degree of participation on the part of the viewer, much as modernist art would. Latency on the part of the artwork invites activity on the part of the participant.

Geometry is experiential on three levels, argues Valérie Gonzalez. Looking up at a geometrically patterned dome invokes geometry kinetically, suggesting movement in space; conceptually, as what Edmund Husserl calls "an object for pure consciousness"; and spiritually. The dome of the Comares Hall at the Alhambra, Gonzalez writes, is "a geometry of the spiritual path from matter to the highest abstract spheres."[29] Gonzalez is rather ahistorical here;[30] but it is interesting that she brings together across history two universalist points of view: Husserl's transcendental phenomenology and the Ikhwân al-Safâ's neo-Pythagoreanism. At least the first of these three experiences would be available to any person standing under this dome. Someone looking up at that pattern might take the opportunity to reflect on the paths of reason that lead to inevitable truths simply by following it with his eyes.

The Ikhwân al-Safâ popularized a powerful and portable way to demonstrate the harmony of the universe, namely the magic square: a square composed of numbers arranged so that the numbers in each row, each column, and the diagonals add up to the same sum. As Schuyler Cammann wrote, they were like miniature diagrams of the universe.[31] Based in the seaport of Basra, the Brethren may have learned about this device from Chinese seafarers.[32] Magic squares were popular in Shi'a-leaning Persia and North Africa from the tenth to the fourteenth centuries. Later they would decorate the talismanic shirts of Ottoman sultans; they are still popular as amulets. The knowledge of how to make magic squares, and the esoteric symbolism of letters used on them, were secrets, which doubtless added to their effectiveness. [figure 6.2]

For the neo-Pythagorean Brethren, music and magic squares focused cosmic forces into crystalline forms with active powers. In our time, science, computer science, and new age religion attempt to do the same. Combinatorial systems, which work through all possible combinations of a set of fundamental units such as numbers or letters, appeal to mysticism in part because of the notion that once all the combinations are exhausted, the universe may collapse back into the fundamental

unity that begat it. The Ikhwân al-Safâ belong in a profound historical lineage of computational devices that have performative, seemingly magical effects. Florian Cramer's deep history of executable code points out that Pythagorean harmonies performed adjustments in the structure of the cosmos; the desktop icons invented in Xerox PARC in the 1970s are images that enact computer commands. Cramer deepens the history of mystical combinatorial systems earlier traced by Janet Zweig, from the ancient Hebrew text Sefer *Yetzirah* and the *I Ching*, through the proto-computational devices invented by the fourteenth-century Catalan monk Ramon Llull and the seventeenth-century Jesuit priest Athanasius Kircher, to the Renaissance allegorical images that condensed operations into emblems. This abstract line of computational magic reaches into the nineteenth century to George Boole and Charles Babbage, the twentieth-century computational art of John Cage, the combinatorial poems of Raymond Queneau, Oulipo, and Gysin and Burroughs. Siegfried Zielinski also explores the roots of computational magic with detail and gusto, and includes discussions of Llull's and Kircher's debt to Islamic science.[33]

Into these histories we must insert the missing link of Islamic Neoplatonism, particularly the mathematical mysticism of the Brethren of Purity. The Brethren's practice of magical computation "anticipates the modeling of culture through software."[34] Thus software that works through condensed images, such as contemporary musical and image programs like MAX-MSP, has a direct lineage in the Brethren's magic squares, equations of a symbolic source code to the operations of the universe.[35]

Tibaq in New Media Art

Algorithmic aesthetics returned to prominence in twentieth-century art. Painting; choreography; music composition, both high and popular; Situationist dérive; conceptual artworks; Fluxus instruction-based art; structuralist filmmaking: many disciplines built artworks around sets of instructions, often specifically mathematical in nature. Moreover, the algorithmicity of the works is the basis of their aesthetics: we admire the way they draw attention to their algorithms in executing them. Scholars now pursue parallels between Islamic art and twentieth-century findings in mathematics, physics, and computer science.[36] This topic was recently popularized in the "discovery" that Iranian and Uzbek tiling predates by five hundred years the Western development of the nonperiodic, quasicrystalline patterns known as Pen-

rose tiles after the mathematical physicist Roger Penrose.[37] Indeed Islamic tilework and carpets grace the covers of many math textbooks—both because mathematical concepts are difficult to illustrate visually and in homage to the heritage of these concepts in the Muslim world.[38]

Contemporary information-based artwork that demonstrates the clarity of its algorithms, relating images to the code that produced them in pleasingly complex ways, is a clear parallel to the "mind-cleansing" geometrical artwork associated with Sunni Islam. Similarly, the quality of elegance in an equation consists in the vast amount of calculation that is invisible, yet implicit, in the final formulation. Elegance is an index of logical depth; a mathematician who knows the codes can appreciate the skill with which they are concealed.

Rational, performative, and rewarding slow and subjective discovery: this describes Marek Walczak and Martin Wattenberg's elegant long-term Web artwork *Apartment* (2001–). *Apartment* translates words typed by the user into the floor plan of an apartment where words construct rooms, often quite amusingly. Engaging with the piece, one gradually learns its algorithm, a program that builds "apartments" according to categories of words. If you type "ooh, aah," these words will float in dreamy spirals in the "bedroom"; typing "wash wash wash" will produce a churning spin cycle; a rash of violent words will be relegated to the "closet"; words not in its dictionary float outside the apartment's walls. At a metalevel the program categorizes the "apartments" according to criteria of content (vision, glamour, and so forth). The more one engages with *Apartment*, the more one comes to understand its algorithm and to play with it through the interface. [figure 6.3]

Apartment's beauty as network art is that it creates a sense of community among apartment builders. A visitor is required to participate, that is, to write something, in order to view the "apartment complexes" that have aggregated. Then she can see her own work of concrete poetry in relation to the constructions of other anonymous participants—her new neighbors. Visitors' original writings, poetic, sad, or silly, become ghosts that the artwork only hints at in its translation. So a visitor feels compelled to write for maximum clarity *and* complexity, submitting to the logic of the algorithm in order to produce the most beautiful and interesting word apartment that will delight or mystify visitors to come. *Apartment* is an example of a new media work whose algorithm holds up to scrutiny and is the basis of a satisfying work of art, because, as al-Farabî said of poetry, it shows that seemingly disparate parts all reflect on a deep and purposeful unity.

Artists in the Muslim world have drawn on traditions of algorithmic repetition,

sometimes in traditional ways, sometimes critically. Two works in the seemingly innocuous medium of wallpaper use repetition to denaturalize cultural and political patterns. Zineb Sedira's *Une Génération de Femmes* (1997) inserts light-colored digital portraits of the women of her family into a traditional repetitive geometric pattern. The work suggests that women have a structural, if nearly invisible, presence in Muslim society. Parastou Forouhar's *Thousand and One Day* (2003) at first glance looks like wallpaper with a regular pattern of beige-colored motifs. But when you approach it, you see that the patterns are in fact scenes of people being tortured. These images are all the more horrific because they are rendered as schematic digital drawings. Their peaceful minimal style calls to mind Persian miniatures—an inheritance, Forouhar says, frowned on by her teachers in Iran, who encouraged an (outdated) Euro-style naturalism.[39] These works critique algorithmic aesthetics by arguing that patterns of information, far from being the manifestation of a divine order, crystallize from histories of violence.

A digital animation by Iraqi-American artist Usama Alshaibi, provocatively titled *Allahu Akbar* (2003), cheekily brings the body into algorithmic performance while remaining aniconic. The title, and the call of "Allahu akbar!" at the beginning, signal a religious context. The image consists of geometrical ornament such as decorates the monuments of the strictest Sunni Islam. But this high-minded image is paired with thumping Arabic-techno dance music that appeals to a very earthly and embodied state: it sings directly to the viewer's hips. The geometric shapes themselves start to shimmy and dance, in synesthetic reciprocity with the music. [figure 6.4]

From Algorithmic to Baroque

Historically, "rational" artwork came to be associated with conservative ideology. In the tenth century, the 'Abbasid caliphate in Baghdad weakened and succumbed to an invasion by the Buyids, a Shi'a dynasty from Persia. Then the Great Seljuks overwhelmed Baghdad in 1036 in a wave of colonization that continued almost to Constantinople. The Seljuks, who practiced a strict Sunni Islam, restored the 'Abbasids to power. In the resulting Sunni revival, which lasted until the Mongol invasion of Baghdad in 1258, Sunni theology gained power and the thought of the *kalâm* and *falsafa*, as well as Shi'ism, was suppressed. The new religious constraints in the Sunni world shaped theology and art, with a new emphasis on artifice and extreme

complexity. As Necipoglu argues, geometric art dominated visual culture across the disparate lands that bore allegiance to the ʻAbbasids and their orthodox Sunnism: these included the Seljuks, who ruled many regions from Anatolia to Persia until the Mongol invasion of 1258; the Almoravids, who ruled the Maghreb and Spain from 1056 to 1137; and the Mamluks, an ʻAbbasid shadow caliphate in Cairo from 1260 to 1517.[40] The artwork sponsored by these powers favors geometric interlace patterns (such as that pictured here from fourteenth-century Fez) and *muqarnas*, the "ideological statement of Sunni Islam";[41] these become increasingly complex over time. [figure 6.5] These forms rarely appear in the art of the Isma'ili Shi'a Fatimid caliphate, which, as we will see in chapter 8, preferred less evident visual strategies. Imitating nature is not the source of beauty in Islamic art of this period; it usually is not in computer-based art either. Rather beauty arises from the pleasure of artifice. In their emphasis on artifice, both Sunni revival Islamic art and new media art share qualities of the baroque. It is traditional that Islamic artists do not consider themselves to be creators, for that would be to compete with God. Justification for this view is often based on Qur'an 3:43, where only God or someone enabled by him (Jesus) can make a clay bird and then breathe life into it.[41] Similarly, God alone is a "fashioner," *musawwir* (Qur'an 59:24), though the same word is used for painters.[42] But these passages did not acquire their force until theologians argued that God's world is already perfect and nothing can be added to it. The conservative doctrine of Abu al-Hasan al-Ash'ari (873–935), which came to dominate Sunni Islam, held that the world is finite, created by God out of nothing, and to which nothing can be added. Art, in such a world, consists not of creating something from nothing, but in showing the relationships among existing things in elegant and delightful ways. Originality consists not in invention but in skillful new variations on a theme.[43]

The new Sunni revival thought diminished the importance of reason. Rationality, al-Ash'ari argued with great force, is useful for disciplines like science but will not lead to salvation. This view, maintained in Sunni orthodoxy, is also, as we shall see, an attitude of the European baroque and of certain new media spectacles. In all of these cases, the result for aesthetics is that the artwork favors extremely complex interrelationships that ultimately stymie a rational response.

The literary theorist and theologian ʻAbd al-Qahir al-Jurjânî (d. 1078), who lived his entire life in Gurgan, Iran, wrote texts that were widely influential not only in his time but also in the revival of Arab poetics in the twentieth century.[44] We hear in his writings an elaboration of al-Farabî's argument that the perception of beauty arises from mental operations. Al-Jurjânî's treatise on poetry, *Asrâr al-balaghah*

(The Secrets of Eloquence), proposed a structuralist poetics that, Kamal Abu Deeb argues, are well suited to modern aesthetics. Rather than value morality and truth as do Aristotelian poetics, which were also influential in the Muslim world at this time, al-Jurjânî valued creativity and imagination (*takhyîl*). His criteria point inward to a work of art rather than outward from the work of art to the world: in order to appreciate a poem, a listener must accept the universe of images that the poet establishes. Ibn al-Haytham and the *falsafa* also valued imagination as one of the internal faculties, but al-Jurjânî was the first to raise it to a spiritual level and value individual creation and invention above all else.[45]

This is not creation ex nihilo. What the imagination does is discover hidden affinities between seemingly disparate things, revealing the harmony of God's universe: a sense of unity that brings joy and ease. This is a sublimely delicate process, Al-Jurjânî cautioned: the poet must not bludgeon the listener with an obvious simile. As Abu Deeb puts it, "Intimacy is created in the soul if it is led from hidden or veiled knowledge to clear knowledge, and from the implicit to the explicit."[46] This is as true in reception as it is in creation: the listener uses imagination in order to appreciate the relations that structure the poem.[47] Al-Jurjânî shows a fascination with what is obscured and suddenly revealed:

> Human nature is so created, and human instinctive and innate qualities are such, that when something appears whence it is not usually expected to appear, and when it emerges from a source that is not its usual one, the soul feels deeper fondness of, and greater affection for it. It is as exciting and amazing to reveal the existence of something in a place in which it is not known to belong, as it is to create something which does not exist at all, or whose very existence is not realized.[48]

Al-Jurjânî also argued that in images produced by "all crafts and artistic activities which are associated with subtlety, fineness and skill . . . it is always the case that the more widely different in shape and appearance their parts are and the more perfect the harmony achieved between these parts is, the more fascination the images will possess and the more deserving of praise for their skill their creators will be."[49] Since al-Jurjânî allows that some of these skills pertain to art forms other than poetry, we can apply his theory of creative reception to visual art as well: as an imaginative viewer gazes on a work of art, he gradually discovers subtle affinities among its parts. Aesthetic pleasure results from unexpected unfolding, from the revelation of

hitherto unseen relationships. Creativity in this scheme lies not in creation anew but in a pleasingly subtle translation from information to perceptible image.

Al-Jurjânî's criteria call to mind the voracious yet discriminating consumers of computer games. A good computer game must be satisfyingly complex and reveal relationships embedded in the software from interesting angles, and it must do so with a satisfying rhythm. As Grahame Weinbren says of new media, originality consists in finding interesting paths through a database:[50] a criterion close to al-Jurjânî's. And interestingly, Owen Jones, the design reformer and student of the Alhambra whose 1852 pattern book was so wildly influential, made a statement about the cognitive value of complex harmony that almost exactly echoes al-Jurjânî. One of his propositions for ornament is that it should be based on proportional relationships but that "those proportions will be the most beautiful which it will be most difficult for the eye to detect."[51]

Al-Jurjânî's poetics lead to a sense of divine harmony only if the recipient is willing to pursue a demanding process of mental comparison. His aesthetics emphasize the in-between status of geometry and other forms that mediate between the world of the senses and the world of abstract ideas. Both strains of medieval Islamic thought have the qualities of allegory, in the influential formulation of Walter Benjamin. Indeed Benjamin's ideas seem very much at home with the esoteric strains of Islamic thought, including the Neoplatonist idea that the phenomenal world emanates from the ideal or divine world, but in an obscure way that must be interpreted. (In this second sense, Benjamin's thought is closer to that of Isma'ili Shi'ism and to the synthesis between the two performed by Ibn Sînâ.) In *The Origin of German Tragic Drama*, Benjamin argued that in baroque theater, the "false unity" of individual phenomena must be stripped away in order for them to "partake of the genuine unity of truth."[52] Allegory functions for Benjamin as geometry often did in medieval Islamic art, divesting phenomena of their sensuous qualities in order to reveal their connections to a greater, abstract truth. The common baroque allegories of the skull and the ruin, for example, show the futility of vanity and worldly pursuits. Much more could be explored in this comparison between al-Jurjânî's poetics of algorithmic complexity and Benjamin's allegory.[53] For now I wish simply to emphasize that they both privilege a baroque style of artifice that would, delicately and with difficulty, bring the recipient into confrontation with a divine order—an act that will be exalting or terrifying depending on your point of view.

Another result of the focus on artifice in Islamic art of this period is that the surface of an artwork is independent of its underlying structure. The typically Islamic architectural feature of *muqarnas* becomes, in its later variations, decidedly baroque. While the early *muqarnas* domes are pleasing to look up at because of their rational harmonies, later *muqarnas* domes become very complex, shimmering with facets. A *muqarnas* vault at the Friday Mosque at Isfahan, Iran, presents an undulating surface of stars and fan shapes that are sometimes concave, sometimes convex. [figure 6.6] Often the *muqarnas* units are themselves decorated, so each element in the shimmering surface itself flickers with light and dark, demonstrating, as Tabbaa argues, "that shape, color, and luminosity are accidents which by definition are subject to continuous change according to the will of God."[54] (The next chapter pursues Tabbaa's argument that the *muqarnas* dome reflects an atomistic worldview, a theory not at odds with the characterization of the muqarnas as baroque.) Later Persian *muqarnas* are covered with colorful floral and geometric patterned tiles, further challenging the mind as to what is structure, what is ornament. These *muqarnas* no longer invite a calm contemplation of the orderliness of the universe; instead they delight and baffle. [figure 6.7]

In all these examples, to use the terms of enfolding-unfolding aesthetics, the artwork's perceptible aspect does not evoke the source from which it unfolded. Rather, the baroque "tends to invade space in every direction, to perforate it, to become as one with all its possibilities."[55] A similar model of relations of unfolding appears in Deleuze's *Le Pli: Leibniz et le baroque*. Deleuze characterizes the baroque aesthetics of Leibniz as concerned with a level that is visible and a level that is legible, as in the facade and interior of baroque architecture.[56] Like computer art and Islamic art, in baroque art the visible skin is the expression or unfoldment of a legible level of information. All being is surface, Leibniz and Deleuze propose, without duality: a fabric stretched to infinity. There is no meaning to dig for, for sense is simply the other side or the lining of that surface.[57] This describes computational art, both Islamic and computer based, very well. And yet the Baroque characteristically conceals the fact that there is nothing underneath by making the surface overwhelmingly complex: folding it, for example. Baroque painting is a cloud of distracting, whirling forms, a matrix of points of light, concealing emptiness. Islamic and computer art have in common the baroque quality that the perceptible surface is not a window into depth, as in Renaissance painting and the cinema, but opaque.[58]

Baroque Politics and Aesthetics

In "On Totalitarian Interactivity" Lev Manovich recalls his Soviet upbringing to explain his suspicion of the promises of new media:

> For the West, interactivity is a perfect vehicle for the ideas of democracy and equality. For the East, it is another form of manipulation, in which the artist uses advanced technology to impose his/her totalitarian will on the people. . . . Western media artists usually take technology absolutely seriously and despair when it does not work. Post-communist artists, on the other hand, recognize that the nature of technology is that it does not work, will always break down, will never work as it is supposed to.[59]

Computer media too often obfuscate, rather than explicate, the relationship between the perceptible image and the underlying algorithm. Those computer-based works that deemphasize performativity and instead emphasize the viewer's wonder and lack of agency in front of the spectacle may also be characterized as baroque. Artworks of baffling complexity, most commonly the baroque art of late sixteenth- and early seventeenth-century Europe and Latin America, are associated with an absolutist state.[60] Necipoglu and Tabbaa make similar assertions about the art of the Sunni revival, while Sean Cubitt argues that the digital cinema of our age is neobaroque. Hence this parallel requires a discussion of the relationship of politics and aesthetics in three place-times: the Sunni revival of the eleventh century, the Spanish and Italian baroque of the seventeenth century, and the neobaroque spectacles of our age. The baroque parallel is political as much as aesthetic, describing the dazzling and incomprehensible mass art promoted in times of strong state control.

In Islamic caliphates as well as European monarchies, the ideology of divine rule imposed a state with no outside. "In the political realm, the essence of all power is to tend toward the absolute, it is part of its reality never to console itself for not reaching it. Representation (of which power is the effect and which, in turn, allows it and authorizes it) will be the infinite work of a mourning—that of a missing Object, of the Absolute."[61] The visual analog of this impossible representation is literally a *horror vacui*, a fear of the void. A "visual theatricality which strikes the eye and subjugates the gaze"[62] characterizes not only the European baroque buildings but also the spectacles of Sunni revival palaces and mosques. A politics of mystification finds a convenient ally in mysticism—in all the periods being examined here.

Sean Cubitt characterizes digital mass media images as baroque for similar reasons. In Cubitt's analysis, neobaroque cinema is an entirely contemporary phenomenon, reflecting both the database and algorithmic qualities of digital media and contemporary corporate capitalism's tendency toward closure. "In creating a world rather than a narrative, the neobaroque seeks . . . a circumscribed perfection removed from history and thence from dialectical process."[63] Neobaroque films include elaborate conspiracy movies like *The Usual Suspects*, *Strange Days*, and that neobaroque howler *Snake Eyes*, as well as digitally generated blockbusters like the *Lord of the Rings* and *Harry Potter* series.

Cubitt contrasts this spectacular cinema to a cinema that is open to the world, that moves forward causally into a future that is unknown. Its roots are in both the early montage aesthetic of Sergei Eisenstein and the realist aesthetic of André Bazin. In Bazin's realism, deep space and the long take yielded a contact with materiality and an immanent spirituality. Realism permitted exploration of the world in all its mystery and freshness. The neobaroque cinema, according to Cubitt, is a perversion of Bazinian realism: neobaroque movies look full, populated with more activity than the eye can see, giving that promise of infinite variety. But this is only an appearance of worldly infinity: in fact, the neobaroque's visual plenitude is algorithmically generated, in style if not technically—a "Where's Waldo" aesthetic where the dazzled eye can no longer decide what is important. The neobaroque cinema he discusses, like *The Usual Suspects*, *The Matrix*, and *Strange Days*, creates a total world. We appreciate it for its seamlessness, its closed infinity that lacks an outside, its "algorithmic elegance"—not the story but the script, the abstract, linear construction underlying it.

These films are what Manovich calls "database narratives," whose interface allows us to explore and admire the database and the algorithms that organize it.[64] Similarly, Cubitt compares the neobaroque cinema to a computer-graphic wireframe model. We have a beautiful model of the CGI wireframe from that early proponent of the abstract line, William Hogarth, who in 1753 described an object with "its inward contents scoop'd out so nicely, as to have nothing of it left but a thin shell . . . and let us likewise imagine this shell to be made up of very fine threads, closely connected together. . . . The imagination will naturally enter into the vacant space within this shell."[65] In neobaroque cinema, the script is the algorithm giving rise to the narrative, and it is the complexity and subtlety of the script, its symmetries so satisfyingly complex that it can be admired at any angle, that we are invited to admire. A "gotcha" thriller like The *Usual Suspects* or Woody Allen's *Match Point*

(2005) is especially satisfying at the end, when it reveals that all of the film's seemingly random occurrences were complexly interrelated.

Above I discussed Walczak and Wattenberg's *Apartment* as a contemporary parallel to the geometric artworks that encourage rational appreciation, making their algorithmic workings fairly transparent. This is a digital artwork that invites reflection on its medium in modernist style. The aesthetics that Cubitt calls neobaroque are more typical of commercial media—movies, games, and software. These tend to obscure their algorithmic process, either to keep knowledge private (proprietary software) or to emphasize the spectacle, while only hinting provocatively at how it is produced. Indeed, the pleasure of digital cinema and games consists of a kind of toggle effect, whereby the spectator or player alternates between being absorbed in the narrative and enjoying the attraction, in Tom Gunning's term, of the technological means by which it came about. But they are not really interested in empowering the viewer or player to imagine another kind of world, only to remain engrossed in theirs. And so I turn to a series of films that I enjoy immensely, which are characteristically neobaroque and also compare significantly to the carpets of sixteenth-century Persia.

Baroque Fascination in Persian Carpets and Casino Movies

Al-Jurjânî's criteria splendidly describe the caper subgenre of casino films, which depict a world of baffling complexity whose internal relationships are fascinating to comprehend but impossible to master. In the development of casino movies from the original *Ocean's Eleven* (1960) to the genre's masterwork, Martin Scorsese's *Casino* (1995), we observe a gradual shift in focus from human and moral issues to the complex network of relationships between the casino's financial system and the underworld systems interlaced with it. In Steven Soderbergh's neobaroque film cycle *Ocean's Eleven* (2001) to *Ocean's Thirteen* (2007), moral questions and narrative openness drop out in favor of an amoral yet pleasing closed system.

The increasing complexity of caper films reflects an increasing concern with information rather than image or, put another way, with the algorithmic deployment of database information rather than character-driven narrative. Algorithmic qualities have been heightened since the advent of digital editing, but digital editing does not cause the algorithmic aesthetic; rather, it facilitates a language of information that was already in place. I focus on casino movies because their subject is

already numerical, relatively unvarnished by narrative. Las Vegas is a city that wears information, in the form of money, on its surface. As Dave Hickey notes, Las Vegas requires not interpretation but calculation. Hickey sardonically adds that the city frustrates "cultural critics" who are used to digging for information, because in Las Vegas, status and potential are entirely about money.[66]

Like a good neobaroque film, a beautiful Persian carpet appeals to both intellect, in the complexity of its pattern, and senses, in its textures and colors. The carpet "subgenre" I look at here is the spiral-tendril carpet, whose intertwining lines suggest the narrative sequences of a film. There is a lot of similarity, after all, between enjoying a large, beautiful carpet in the company of a group seated on it and going to the movies. Both are collective yet individual pleasures, allowing both distraction and absorption.

In the fourteenth century, carpet weavers for the Seljuks in Anatolia developed a method of layering up to four decorative schemes for a three-dimensional effect.[67] This "stratigraphic" method culminated in late-sixteenth-century carpets produced for the Safavid Persian court. With a complexity that perception cannot manage, the new carpets do not soothe the mind with algorithms so much as pose it tantalizing puzzles, locking it in an elegant wireframe cage. Richard Ettinghausen analyzed this effect in an influential 1979 article, "The Taming of the Horror Vacui in Islamic Art."

Ettinghausen's rather disparaging title requires a digression. The notion of *horror vacui* originates in the "spatial anxiety" that Wilhelm Worringer attributed to the crowded linear patterns of Oriental and Nordic art.[68] A generation of Western art historians reacted with aversion to the proliferation of pattern in much Islamic art. Their reaction reflects Western preferences for a clear distinction between figure and ground—something that is a key element of narrative cinema too, for how can you know who is the protagonist, and what is the point or the moral if there are too many interweaving narratives? Later Ernst Gombrich thoughtfully reversed the Orientalist cliché by terming Islamic overall patterns not *horror vacui*, but *amor infinity*—a love of infinity.[69] Yet as Seyyed Hossain Nasr insists, the infinity revealed in interleaved patterns is in a constant play with the void. "There is an aspect of nothingness or void which lies in the very nature of the whole created order and which is a direct consequence of the fact that, in an absolute sense, only God is real. . . . The arabesque enables the void to enter into the very heart of matter."[70] In short, the fear of complex pattern reflects a fear of the void—a perfectly reasonable fear, to which I will return.

In the fifteenth century, geometric carpets in Persia gave way to a new set of designs. The new patterns abandoned the Seljuk geometric style that emphasized the physical knot matrix of the carpet. They were full of flowers and curling vines that radiated from a central medallion, because at this time, carpets were being designed by painters, who based their design on illuminated manuscripts. In and out of the interlacing vines drift peonies, clouds, birds, and other motifs that traveled from the Far East after the *pax Mongolica*. [figure 6.8] Soon enough bands of romping animals, hunters, and garden scenes would populate the Persian carpets. Scholars with a functionalist bent bemoan this development. Kurt Erdmann considered the painting-based innovations to violate the internal norms of carpet design as an "outside intervention" that interrupted "the true and characteristic evolution of the carpet."[71] The Seljuk, Turkish Ushak, and Mongol carpets frankly displayed their underlying matrix; we might compare them to new media works that emphasize their digital materiality. The new Persian carpets, to extend the comparison, are like the shimmering illusions that digital media such as CGI special-effects films produce when they disavow their pixel basis. (And the strange-looking Caucasian carpets are like bootleg software—low-resolution compressions that imitate Persian designs but become more and more geometric, revealing the machinery behind the illusion as bootlegs tend to do.)

By the sixteenth century, carpets' complex patterns were designed by painters of illustrated manuscripts. The stratigraphic method culminates in up to four overlapping patterns in late-sixteenth-century Persian carpets. Ettinghausen diagrammatically separates the four levels of pattern; his analysis is simultaneously an aesthetic response:

> It is striking to see in a reconstruction on the drafting board how two of these systems interlock with each other to fill the space more densely; it becomes astonishing to see three of them overlap each other. It is truly remarkable when we see four forming the ground pattern on which the large medallion is placed. However, the design is now so intricate that the eye can no longer follow the patterns, but perceives the whole as a lacy ground cover, like the combination of many plants and vines, forming a highly varied herbaceous border in a garden.[72]

Early twentieth-century German scholars and curators seem to have been especially keen to master and comprehend the mind-boggling patterns of these carpets, just

as their prominence and price were rising in the West.[73] Siegfried Troll drew several diagrams of spiral-tendril carpets, published in 1926 in an important early book on carpets, Sarre-Trenkwald's *Old Oriental Carpets*. Troll's drawings, such as one of a carpet made in Isfahan during the reign of Shah Safi,[74] valiantly reproduce the overlaid effect of spiraling tendrils of various thicknesses by reducing them to a linear black-and-white design. [figure 6.9] They emphasize the carpets' symmetry around one or two axes to a much greater extent than the carpets themselves do. One can only sympathize with Troll's effort to come to terms with these visually overwhelming carpets by emphasizing their algorithmicity at the expense of their haptic qualities.

Carpets made after Seljuk times, including those made under the Shi'a regime of the Safavids, suggest a baroque elaboration of the algorithmic aesthetics of the earlier period. In a direct historical baroque connection, floral Persian and Mughal carpets were popular imports to Italy in the sixteenth century.[75] Their complex designs complemented European baroque interiors and surely facilitated their owners' pleasurable contemplation of the void.

Again, in baroque aesthetics, as in those of al-Jurjânî, the goal is known in advance. It is how the work arrives at it, developing elaborate variations on a known theme, enriching the relationship between parts, that is worthy of admiration. "As we reach the end of a film like *Snake Eyes*," Cubitt writes, "we should survey the whole plot as if it were a knot garden, a spatial orchestration of events whose specific attraction is its elaboration of narrative premise into pattern, its reorganization of time as space."[76]

"Knot garden," as Cubitt surely intended, perfectly describes the beauty of Persian carpets, especially the spiral-tendril or vine-scroll carpets produced during Safavid rule (1501–1732).[77] Writing about some carpets from this period, Erdmann, former carpet curator at the Pergamonmuseum in Berlin, makes a fascinating comment on the combination of "infinite" patterning and a finite surface.[78] He observes that while the pattern could extend in all directions beyond the carpet's borders, the tendrils instead curl in on themselves and the arabesque grows internally, becoming thicker and denser. It is not an extensive infinity but an intensive infinity; as though the pattern on the carpet, already bafflingly dense at some points, might grow into another dimension, fractally.

Scorsese's *Casino* (1995) marks the beginning of the algorithmic aesthetic in casino films. It happens to be an early example of virtuosic digital editing, with editor Thelma Schoonmaker taking advantage of the new medium's capacity for paral-

lel editing, flashbacks, and other kinds of nonlinear temporality, as well as shaving microseconds off shots. But *Casino* is also a great narrative film precisely because it witnesses the demise of the character-driven gangster film, and the world of individual narrative causality that produced it, to be eclipsed by a corporate economy of information and financial management. *Casino*'s most lovingly detailed plot is about how money travels: from the gamblers to the counters to the Kansas City gangsters. The main character of this gangster film, Ace Rothstein, is an accountant. His pride in his work drives the film: managing his casino, he is like a computer executing an algorithm. *Casino* is, as reviewer Richard Alleva notes, "the most intricate yet lucid of diagrams"[79]: it is a film about information in a world of information. [figures 6.10, 6.11]

In the *Ocean*'s films, a handsome and talented group of thieves, daredevils, and technicians gather around their leader, Danny Ocean, to carry out wondrously complex heists, which are so elegant and morally either neutral or justified that it misses the point to call them crimes. The narrative is never propelled by the question of whether the team will succeed, only how they will succeed. An algorithmic script establishes the thousand details all of which must fall into place. Our heroes' temporary setbacks are like the weaver's practice of incorporating mistakes into the carpet "because only God is perfect."

In *Ocean's Thirteen* (2007) the group intends to ruin the fortunes of a thoroughly despicable and punningly named casino mogul, Willy Bank—Al Pacino in a cracking fake tan—who himself ruined the group's beloved colleague Reuben Tishkoff and caused him to have a heart attack; they must carry out the act in time to save Reuben's life. Numerous separate subplots weave together with such deft timing that at points, the screen subdivides, all the better to let the audience marvel at the interweaving of simultaneous action. Here too the Safavid carpet analogy is exact, for it is the interweaving of motifs and their figure-ground reversal that delight the eye and challenge the mind. [figures 6.12, 6.13]

The ensemble cast performs deftly, with grace and modesty, lending themselves to the whole like colorful strands of silk and wool woven into a carpet. The extremely mobile camera, typical of the neobaroque cinema, sweeps across the surface of the action. In the scenes on the vast casino floor simmering with activity, the mobile camera behaves exactly like one's eyes do when surveying a large, complex carpet: we follow one strand, then another, contemplating now the whole, optically, and now the detail, haptically. *Ocean's Thirteen* does not indulge in the digitally aided mobile camera as much as do earlier neobaroque films like *Strange Days* and

Snake Eyes, however; beautifully timed edits also demand that we shift our attention. Editing allows what was ground to become figure, presses what was figure into the background, and emphasizes another relationship among the interleaving patterns.

For example, there is a scene in *Ocean's Thirteen* in which it seems the jig is up because Banks is about to be alerted to the thirteen criminals' identities by an FBI file downloading on his computer. He must be distracted and the files neutralized at the same time—this is the premise for the pattern. Achieving this begins by having two pretty girls (on the request of Ocean's colleague Saul Bloom) walk sexily past the stunt motorcyclist who is going to perform at the casino's grand opening that night and suggestively into his trailer. He follows, and in moments his red, white, and blue costume is passed out the window. In the next scene, Don Cheadle's character, Basher Tarr, enters Bank's office dressed as the daredevil. Fast-talking and fascinating, the American flag decals on his teeth gleaming, Basher compels Bank's attention with a stream of distracting yarns. Meanwhile, the other thread in the pattern comes into play: as the FBI photos of the accomplices download on Bank's computer, the film cuts to the computer geek colleagues, Virgil and Turk Malloy, altering the photographs and searching new names. Though this must be done in seconds, Virgil and Turk play with giving their colleagues weird features and ridiculous names, and Basher's image is altered last. It is a dazzling intertwining of exuberantly ornamental narrative strands.

Strikingly, most of the effects of this digital-era heist film are entirely analog, depending on human ingenuity, manual dexterity, and the specific qualities of materials. The heist genre is challenged in the computer age, since so many of its stock tricks now have digital approximations. But in *Ocean's Thirteen* computers are smart only insofar as smart humans operate them. Bank's artificial intelligence surveillance system is no match for the team's collective, emotional, hands-on ingenuity. The film celebrates analog processes and lovingly rendered material objects, including special dice altered in their manufacture in Mexico, "Nuff Said" brand special dominos, and the many daring and dexterous acts involved in stealing necklaces and making sure the hotel reviewer has a disastrous stay. In sum, *Ocean's Thirteen* is an algorithmic film about the superiority of human ingenuity over cold digital technology.

Of course many reviewers do not agree that algorithmic aesthetics add up to a good movie. Andrew O'Hehir in *Sight and Sound* notes that seven subplots of *Ocean's Eleven* (not *Thirteen*) are meshed with "enviable dexterity and flashily brilliant edits," but complains that it has "lost two of the caper movie's essential ingredients: an asymmetrical balance of power and ingenious simplicity."[80] This criticism recalls

Kurt Erdmann criticizing the overly virtuosic weaving of Persian carpets.[81] When the movie, like the carpet, is no longer true to the best properties of its medium, and instead baroquely exaggerates and distorts them, perhaps a certain inner coherence is sacrificed. But other critics welcome the exchange of narrative for baroque style, as does Manohla Dargis, who writes that *Ocean's Thirteen* "pushes at the limits of conventional narrative filmmaking, forcing your attention away from the story's logical bricks and mortar toward its fields of dancing colors and a style that is its content."[82]

The new casino movies, the caper genre more broadly, and the newly pervasive multiplot narratives show that the contemporary cinema is becoming ever more like Persian carpets in that its pleasures are not narrative but algorithmic and sensuous. In their baroque fascination, they point our attention, if not to God or to the void, then at least to the information-based economy that is their outer limit. Often in this book I suggest, through the concept of lame infinity, that in digital media, the "universe" is flattened, via algorithmic repetition, to a field of articulated sameness. The exceptions, like *Ocean's Thirteen*, are those works that augment the algorithmic space with humanity, mystery, and what Bernard Berenson called "tactile values."[83]

The seductive, ultimately baffling patterns of Safavid carpets show that at a certain point, the rational approach to the divine is rebuffed. Algorithmic patterns may initially appeal to reason, but ultimately they compel a mystical response. Arabesque and other kinds of pattern cajole our gaze to seek and search for what is beyond them, at the risk of perishing in the attempt, as a flame attracts a moth—a metaphor from the great Sufi philosopher Ibn al-'Arabi to describe the soul's attraction to God. As we saw above, mysticism reveals that the notion of *horror vacui* so commonly attributed to Islamic art is exactly the opposite: a love of the infinite. Abdelkebir Khatibi and Mohammed Sijelmassi—echoing the reasoning of the Shi'a thinker Abu Ya'qûb al-Sijistânî that God, being beyond comprehension, is both not a thing and not *not* a thing[84]—romantically put it this way:

> The superabundance of the sacred is such that it contains its own void. Muslim art moves onwards in a secret, veiled anguish which harbours in itself a mystical experience. Hence the arabesque, which expresses this anguish in decorative form. It holds the balance of line and color to a point where they begin to waver and vibrate in an interlaced tracery. . . . This tracery holds the superabundance in check yet marks a secret desire to lose itself.[85]

This beautiful aesthetics of mystical abandon has a less beautiful counterpart in political quietism. Mysticism offers a refuge from a political world beyond the individual's knowledge and control. A domesticated strain of Sufism, or Islamic mysticism, was often a useful ideological accompaniment to conservative state religion in the Muslim world, including the later 'Abbasid caliphate, the Safavid dynasty, and the Ottoman empire.

In the baroque and the neobaroque, the theological and political implications of an unfathomable void meet and intertwine. A fragmentary world of signs concealing a fundamental emptiness: this is Benjamin's influential definition of allegory, an intuition that arises from a sense of the world's impermanence. "The form such an experience of the world takes is fragmentary and enigmatic; in it the world ceases to be purely physical and becomes an aggregation of signs."[86] These signs open not onto the fullness of experience, as symbols do in romantic thought, but onto the lack of fullness in the world. Benjamin's conception of allegory, as an elaborate sign system covering a fundamental emptiness, aligns closely with Islamic mystical conceptions of the universe as a void—though in the case of mysticism, the void itself conceals the blinding and inconceivable fullness that is God. As Ian Almond points out, many of Benjamin's writings have a Neoplatonist flavor, in that they suggest that our disparate, fragmentary experience expresses a unity that is beyond our grasp. Hence Benjamin's careful attention to allegories such as modern ruins and children's toys; he seeks in them some connection to a larger whole, conceived as social and material, not divine.[87] Benjamin seemed confident that the perceptible world unfolds from the imperceptible; but he seems to have doubted that the imperceptible source could be divined, or even existed.

These thoughts bring us back to an algorithmic aesthetics by which the infinite unfolds from an unknowable One. In Benjamin's efforts to describe the distance between translation and original, the distance between them is marked by folds. The translated, manifest, or accessible meaning is like loose clothing on an inaccessible source: "the language of the translation envelops its content like a royal robe with ample folds."[88] As so often occurs in his thought, Benjamin hesitates between a transcendental and an immanent understanding of the world. We may benefit from this hesitancy, to claim the transcendental beauty of baroque mysticism, while attempting to locate its unfathomable void in the divine and maddening complexity that is *this* world. Whether elegant or baffling, algorithmic aesthetics invite us to admire the universe, crystallized in human thought and the work of human hands.

Notes

1 Necipoglu uses this term in T*he Topkapi Scroll: Geometry and Ornament in Islamic Architecture* (Santa Monica, CA: Getty Center for the History of Art and Architecture in the Humanities, 1995), and Yasser Tabbaa does so in *The Transformation of Islamic Art during the Sunni Revival* (Seattle: University of Washington Press, 2001). The Sunni revival consolidated Sunni Islam as the official doctrine of the 'Abbasid caliphate, in reaction against the Shi'a caliphate in Egypt and other threats.

2 Donald R. Hill, "Science and Technology in Ninth-Century Baghdad," in *Science in Western and Eastern Civilization in Carolingian Times*, ed. P. L. Butzer and D. Lohrmann (Basel: Birkhäuser Verlag, 1993), 487. An excellent detailed guide to Islamic mathematics is J. Len Berggren, Episodes in the *Mathematics of Medieval Islam* (New York: Springer-Verlag, 1986).

3 See Roshdi Rashed, "Fibonacci et le prolongement latin des mathématiques arabes," *Bollettino di Storia delle Scienze Matematiche,* 23:2 (December 2003): 55–73; and Roshdi Rashed, "Fibonacci et les mathématiques arabes," *Micrologus*, 2 (1994): 145-160.

4. Hill, "Science and Technology in Ninth-Century Baghdad," 490.

5. These include Sergei Chmelnizkij, M. S. Bulatov, Alpay Özdural, Gülrü Necipoglu, Carol Bier, Kevin Crichlow, Samer Akkach, Brian Wichmann, and John Rigby.

6. Yasser Tabbaa, "The Muqarnas Dome: Its Origin and Meaning," *Muqarnas*, 3 (1985): 61–74.

7 Reviewing *The Topkapi Scroll,* historian of science George Saliba criticized Necipoglu for assuming too much mathematical knowledge on the part of the artist, in "Artisans and Mathematics in Medieval Islam," *Journal of the American Oriental Society*, 119:4 (1999): 637–645.

8 See Necipoglu, *The Topkapi Scroll*, chap. 8.

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18 Ibid., 82.

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21 Charles Sanders Peirce, *Collected Writings* (4.551), quoted in Vincent M. Colapietro, *Peirce's Approach to the Self: A Semiotic Perspective on Human Subjectivity* (Albany, NY: SUNY Press, 1989), 18.

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23 Proclus, *A Commentary on the First Book of Euclid's Elements*, trans. Glenn R. Morrow (Princeton, NJ: Princeton University Press, 1970), quoted in Necipoglu, *The Topkapi Scroll*, 191.

24 Ibn Khaldun, *The Muqqadimah: An Introduction to History*, vol. 2, trans. Franz Rosenthal (Princeton, NJ: Princeton University Press, 1967), quoted in Necipoglu, T*he Topkapi Scroll*, 104.

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27 Doris Behrens-Abouseif, B*eauty in Arabic Culture* (Princeton, NJ: Markus-Wiener Publishers, 1999), 27; Necipoglu, *The Topkapi Scroll*, 188.

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29 Valérie Gonzalez, "The Geometries of the Alhambra," in *Beauty and Islam* (London: I. B. Tauris, 2001), 86–92.

30 As Leaman points out in *Islamic Aesthetics*, 138.

31 Schuyler Cammann, "Islamic and Indian Magic Squares. Part I," *History of Religions*, 8:3 (1969), 183.

32 Cammann in ibid. points out that different combinations of numbers were popular in Chinese, Hindu, and Islamic magic squares, reflecting cultural preferences.

33 Florian Cramer, *Words Made Flesh: Code, Culture, Imagination* (Rotterdam: Piet Zwart Institute, 2005); Janet Zweig, "Ars Combinatoria: Mystical Systems, Procedural Art, and the Computer," *Art Journal* 56:3 (Autumn 1997): 20-29; Siegfried Zielinski, *Deep Time of the Media: Toward an Archaeology of Hearing and Seeing by Technical Means*, trans. Gloria Custance (Cambridge, MA: MIT Press, 2006).

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38 Such as Eric Gosset, *Discrete Mathematics with Proofs*, first edition (Englewood Cliffs, NJ: Prentice Hall, 2003), as Greg Farrell kindly told me.

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42 Michael Barry, *Figurative Art in Medieval Islam and the Riddle of Bihzâd of Herat* (Paris: Flammarion, 2004), 229; Oleg Grabar, *The Formation of Islamic Art*, rev. ed. (New Haven, CT: Yale University Press, 1987), 81.

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44 Kamal Abu Deeb, A*l-Jurjani's Theory of Poetic Imagery* (Warminster: Aris and Phillips, 1979), 1.

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46 Ibid., 277.

47 Ibid., 269, 281.

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49 Ibid., quoted in Abu Deeb, Al-Jurjani's *Theory of Poetic Imagery*, 282. By "image" al-Jurjânî implies not a figurative image but a poetic image, such as a metaphor.

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53 For example, Coleridge's "mechanic form" has been compared to both; see Bainard Cowan, "Walter Benjamin's Theory of Allegory," *New German Critique*, 22 (Winter 1981): 117; and Abu Deeb compares Coleridge's and Al-Jurjânî's poetics in *Al-Jurjani's Theory of Poetic Imagery* , 299–302.

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55 Henri Focillon, *The Life of Forms in Art* [1934], trans. George Kubler (New York: Zone Books, 1992), 58.

56 Deleuze, *Le Pli: Leibniz et le Baroque* (Paris: Minuit, 1988), 43–44.

57 Deleuze, *Le Pli*, 38, and *Cinema 2: The Time-Image*, trans. Hugh Tomlinson and Robert Galeta (Minneapolis: University of Minnesota Press, 1989), 265–267.

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69 E. H. Gombrich, *The Sense of Order: A Study in the Psychology of Decorative Art* (Ithaca, NY: Cornell University Press, 1979), 80
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72 Richard Ettinghausen, "The Taming of the Horror Vacui in Islamic Art," in *Proceedings of the American Philosophical Society*, February 20, 1979, 18.
73 David Sylvester, "The Eastern Carpet in the Western World from the 15th to the 20th Century," in *The Eastern Carpet in the Western World from the 15th to the 17th Century*, ed. Donald King and David Sylvester (London: Arts Council of Great Britain, 1983), 14.
74 The shah presented this carpet to Peter the Great, who in turn gave it to Leopold I of Austria.
75 Leonard M. Helfgott, T*ies That Bind: A Social History of the Iranian Carpet* (Washington, DC: Smithsonian, 1994), 58.
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77 Friedrich Spuhler, *Oriental Carpets in the Museum of Islamic Art*, Berlin, trans. Robert Pinner (London: Faber and Faber, 1988), 74.
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81 Erdmann, *Oriental Carpets*, 32.
82 Manohla Dargis, "They Always Come Out Ahead; Bet on It," *New York Times*, June 8, 2007.
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84 Paul E. Walker, *Early Philosophical Shi'ism: The Ismaʿīlī Neoplatonism of Abu Yaʿqūb al-Sijistānī* (Cambridge: Cambridge University Press, 1993), 78.
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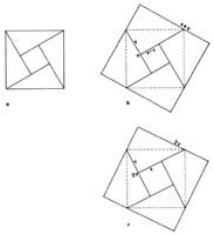
87 Ian Almond, "Different Fragments, Different Vases: A Neoplatonic Commentary on Benjamin's 'The Task of the Translator,'" *Heythrop Journal*, 43:2 (April 2002): 185–198.
88 Walter Benjamin, "The Task of the Translator," in *Illuminations: Essays and Reflections*, ed. Hannah Arendt (New York: Schocken, 1968), 75. This metaphor has a long Neoplatonist genealogy, Ian Almond points out, including Ibn Al 'Arabi and the thirteenth-century Dominican Meister Eckhart. "For the medieval exegete," Almond points out, "interpretation *was* translation—not simply Arabic into Persian or Greek or Latin, but the translation of the hidden, divine language (*batin*, 'inner meaning') into the comprehensible language of men (*zahir*, 'outer meaning')." Almond, 191.

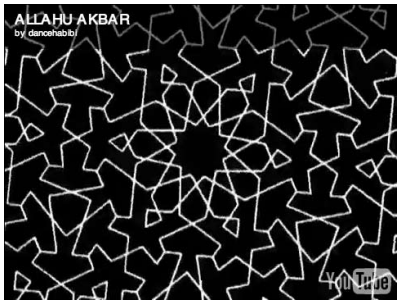
Figures



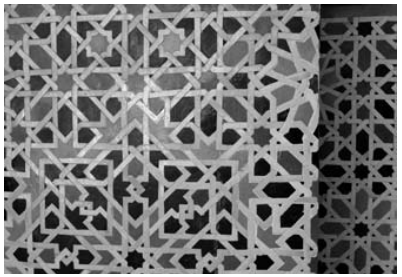
6.1 Abu 'l-Wafâ's figure proving the Pythagorean theorem; b) The ornamental pattern of Abu 'l-Wafâ's proof, general; c) The ornamental pattern of Abu 'l-Wafâ's proof, the ratio of 1:2. From Alpay Özdural, "Omar Khayyam, Mathematicians, and 'Conversazione' with Architects," 1995.

6.2 Author portrait, the Ikhwan al-Safa or Brethren of Purity (1287). Süleymaniye Library, Istanbul.

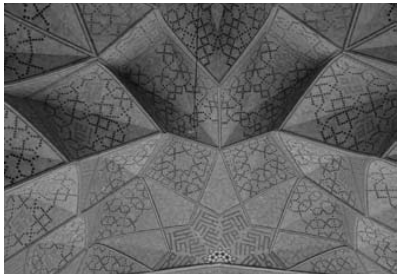
6.3 Screen grab from Marek Walczak and Martin Wattenberg, *Apartment* (2001-).



6.4 Frame from *Allahu Akbar* (2003) by Usama Alshaibi.



6.5 Detail of tilework, Bou 'Inania Madrasa (1350-1355), Fez. Photo by Laura Marks.



6.6 Detail of muqarnas vault, south iwan (12th C) of Friday Mosque, Isfahan. Photo by Laura Marks.

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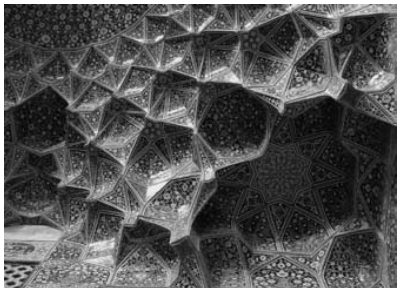
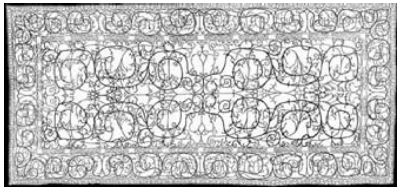
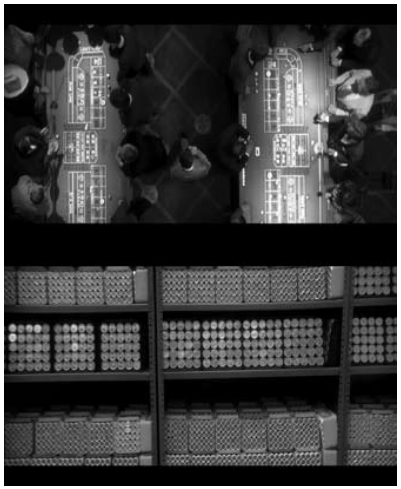


6.7 Detail of muqarnas vault, entrance of Sheikh Lutfallah Mosque (1619), Isfahan. Photo by Laura Marks.

6.8 Persian carpet, sixteenth century, lent by Czartoryski Musuem, Krakau. From the catalogue *Meisterwerke Muhammedanischer Kunst*, Munich, 1910, vol. 1.



6.9 Siegfried Troll, diagram of spiral-tendril carpet made in Isfahan during the reign of Shah Safi. From Sarre-Trenkwald, *Old Oriental Carpets*, 1926 and 1929.



6.10, 6.11 Algorithmic fascination in *Casino* (Martin Scorsese, 1995)

6.12, 6.13 Interwoven narrative strands in *Ocean's Thirteen* (Steven Soderbergh, 2007)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